附錄三　程式碼

GraphAlgorithm.java

```
package emnet.algorithm;

import java.util.Vector;
import emnet.graph.Graph;
import emnet.graph.Node;
import emnet.graph.Edge;
import java.util.Iterator;
import emnet.thread.Center;
import emnet.thread.Roamer;
import emnet.thread.Detourist;
import emnet.thread.DetourManager;


public class GraphAlgorithm {
    public GraphAlgorithm() {
        try {
            jbInit();
        }
        catch (Exception ex) {
            ex.printStackTrace();
        }
    }

    public static Graph copyGraph(Graph oldGraph){
        Vector oldNodeSet,oldEdgeSet;

        oldNodeSet=oldGraph.getNodeSet();
        oldEdgeSet=oldGraph.getEdgeSet();

        return copyGraph(oldNodeSet,oldEdgeSet);
    }

    public static Graph copyGraph(Vector oldNodeSet,Vector oldEdgeSet){
        Vector newNodeSet=new Vector(),newEdgeSet=new Vector();

        for(int i=0;i<oldNodeSet.size();i++){

            // new node setting:
            // 1. check label
```

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```
                // 2. check supply/demand
                // 3. check visit
                Node tempOldNode=(Node)oldNodeSet.elementAt(i);
                Node tempNewNode=new Node(i);

                if(tempOldNode.isSupply()){
                    tempNewNode.setSupply();
                }else if(tempOldNode.isDemand()){
                    tempNewNode.setDemand();
                }

                if(tempOldNode.isVisited()){
                    tempNewNode.visit();
                }

                newNodeSet.addElement(tempNewNode);
            }

            for(int i=0;i<oldEdgeSet.size();i++){

                // new edge setting:
                // 1. check label
                // 2. check n1/n2
                // 3. set weight
                // 4. set previous node
                // 5. check fast
                // 6. check detour
                // 7. check visit
                Edge tempOldEdge=(Edge)oldEdgeSet.elementAt(i);
                int n1=tempOldEdge.getN1Label(),n2=tempOldEdge.getN2Label();
                double weight=tempOldEdge.getWeight();
                Edge tempNewEdge=new
Edge(i,(Node)newNodeSet.elementAt(n1),(Node)newNodeSet.elementAt(n2),weight);

                if(tempOldEdge.isFastEdge()){
                    tempNewEdge.setFastEdge();
                }

                if(tempOldEdge.isDetourEdge()){
                    tempNewEdge.setDetourEdge();
                }
```

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```
            if(tempOldEdge.isVisited()){
                tempNewEdge.visit();
            }

            newEdgeSet.addElement(tempNewEdge);
        }
        return new Graph(newNodeSet,newEdgeSet);
    }

    public static Graph getSubtreeWithCertainNode(Graph tree,Node certainNode,Edge ruinedEdge){

        Vector nodeSet=new Vector(),edgeSet=new Vector();
        Vector currAdjacentNodes,currIncidentEdges;
        Node currNode=certainNode;

        int maxLabel=0;
        Vector tempTreeNodeSet=tree.getNodeSet();
        Node tempTreeNode;
        for(int i=0;i<tempTreeNodeSet.size();i++){
            tempTreeNode=(Node)tempTreeNodeSet.elementAt(i);
            if(tempTreeNode.getLabel()>maxLabel)
                maxLabel=tempTreeNode.getLabel();
        }

        Vector preNodes=new Vector(maxLabel+1);
        for(int i=0;i<(maxLabel+1);i++)
            preNodes.addElement(null);

        boolean finish=false;

        do{
            currAdjacentNodes=tree.adjacentNodeSet(currNode);
            currIncidentEdges=tree.incidentEdgeSet(currNode);

            if(currIncidentEdges.contains(ruinedEdge)){
                currIncidentEdges.removeElement(ruinedEdge);
                currAdjacentNodes.removeElement(ruinedEdge.theOtherNode(currNode));
            }

            Iterator itrAdjacentNodes=currAdjacentNodes.iterator();

            if(!nodeSet.contains(currNode))
```

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```
                nodeSet.addElement(currNode);

            int i=0;
            currNodeAssign:
            do{
                if(itrAdjacentNodes.hasNext()){
                    Node tempNode=(Node)itrAdjacentNodes.next();

                    if(!nodeSet.contains(tempNode)){
                        preNodes.setElementAt(currNode,tempNode.getLabel());
                        currNode=tempNode;
                        break currNodeAssign;
                    }else{
                        i++;
                        if(i==currAdjacentNodes.size()){
                            if(currNode==certainNode){
                                finish=true;
                                break currNodeAssign;
                            }
                            Edge
tempEdge=tree.getEdge(currNode,(Node)preNodes.elementAt(currNode.getLabel()));
                            if(!edgeSet.contains(tempEdge)){
                                edgeSet.addElement(tempEdge);
                            }
                            currNode=(Node)preNodes.elementAt(currNode.getLabel());
                        }
                    }
                }else{
                    finish=true;
                    //break currNodeAssign;
                }
            }while(itrAdjacentNodes.hasNext());
        }while(!finish);
        return new Graph(nodeSet,edgeSet);
    }

    public static Vector getAdjacentNodes(Graph graph,Node currNode){
        return graph.adjacentNodeSet(currNode);
    }

    public static Vector getIncidnetEdges(Graph graph,Node currNode){
        return graph.incidentEdgeSet(currNode);
```

```
    }


    public static Graph getSubtreeWithoutSupply(Graph tree,Edge ruinedEdge){
        Graph subtreeWithoutSupply=null;
        Graph subtreeN1=getSubtreeWithCertainNode(tree,ruinedEdge.getN1(),ruinedEdge);
        Graph subtreeN2=getSubtreeWithCertainNode(tree,ruinedEdge.getN2(),ruinedEdge);
        Vector subtreeNodeSetN1=subtreeN1.getNodeSet();
        Node tempNode;
        for(int i=0;i<subtreeNodeSetN1.size();i++){
            tempNode=(Node)subtreeNodeSetN1.elementAt(i);
            if(tempNode.isSupply())
                subtreeWithoutSupply=subtreeN2;
        }
        if(subtreeWithoutSupply!=subtreeN2)
            subtreeWithoutSupply=subtreeN1;
        return subtreeWithoutSupply;
    }

    public static Graph getSubtreeWithSupply(Graph tree,Edge ruinedEdge){
        Graph subtreeWithSupply=null;
        Graph subtreeN1=getSubtreeWithCertainNode(tree,ruinedEdge.getN1(),ruinedEdge);
        Graph subtreeN2=getSubtreeWithCertainNode(tree,ruinedEdge.getN2(),ruinedEdge);
        Vector subtreeNodeSetN1=subtreeN1.getNodeSet();
        Node tempNode;
        for(int i=0;i<subtreeNodeSetN1.size();i++){
            tempNode=(Node)subtreeNodeSetN1.elementAt(i);
            if(tempNode.isSupply())
                subtreeWithSupply=subtreeN1;
        }
        if(subtreeWithSupply!=subtreeN1)
            subtreeWithSupply=subtreeN2;
        return subtreeWithSupply;
    }


    private void jbInit() throws Exception {
    }

    public static Vector getIncidentEdgeSet(Roamer roamer,Vector nodeSet){
        Center center=roamer.getCenter();
        Graph graph=center.getGraph();
```

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```
        Edge myEdge=center.getMyEdge(roamer);
        Vector visitorSequence;

        Vector edgeSet=new Vector();
        Edge tempEdge;
        Node n1,n2;
        for(int i=0;i<nodeSet.size();i++){
            Vector tempEdgeSet=graph.incidentEdgeSet((Node)nodeSet.elementAt(i));
            for(int j=0;j<tempEdgeSet.size();j++){
                if(!edgeSet.contains(tempEdgeSet.elementAt(j))){
                    edgeSet.addElement(tempEdgeSet.elementAt(j));

                    tempEdge=(Edge)tempEdgeSet.elementAt(j);
                    n1=tempEdge.getN1();
                    n2=tempEdge.getN2();
                    //remove edges included in the routeEdgeSet
                    if(nodeSet.contains(n1) && nodeSet.contains(n2))
                        edgeSet.removeElement(tempEdge);
                    //remove dummyEdges
                    if(n1==center.getDummyNode() || n2==center.getDummyNode())
                        edgeSet.removeElement(tempEdge);
                    //remove visited edge
                    if(nodeSet.contains(n1)){
                        visitorSequence=center.getVisitorSequence(n2);
                        if(visitorSequence.contains(roamer))
                            edgeSet.removeElement(tempEdge);
                    }else if(nodeSet.contains(n2)){
                        visitorSequence=center.getVisitorSequence(n1);
                        if(visitorSequence.contains(roamer))
                            edgeSet.removeElement(tempEdge);
                    }
                }
            }
        }
        if(edgeSet.contains(myEdge))
            edgeSet.removeElement(myEdge);

        return edgeSet;
    }

    public static Vector getIncidentEdges(Detourist detourist,Vector nodeSet){
        Graph usableGraph=detourist.getUsableGraph();
```

GraphAlgorithm.java

```
        DetourManager dmr=detourist.getDetourManager();
        Center center=dmr.getCenter();
        Edge myEdge=dmr.getMyEdge(detourist);

        Vector incidentEdges=new Vector();
        Edge tempEdge;
        Node n1,n2;

        for(int i=0;i<nodeSet.size();i++){
            Vector tempEdgeSet=usableGraph.incidentEdgeSet((Node)nodeSet.elementAt(i));
            for(int j=0;j<tempEdgeSet.size();j++){
                tempEdge=(Edge)tempEdgeSet.elementAt(j);
                if(!incidentEdges.contains(tempEdge))
                    incidentEdges.addElement(tempEdge);

                n1=tempEdge.getN1();
                n2=tempEdge.getN2();
                if(nodeSet.contains(n1) && nodeSet.contains(n2))
                    incidentEdges.removeElement(tempEdge);
                if(n1==center.getDummyNode() || n2==center.getDummyNode())
                    incidentEdges.removeElement(tempEdge);
            }
        }
        if(incidentEdges.contains(myEdge))
            incidentEdges.removeElement(myEdge);

        return incidentEdges;
    }

    public static Vector getInterfaceNodes(Graph subject,Graph environment){
        Vector interfaceNodes=new Vector();
        Vector environmentEdgeSet=environment.getEdgeSet();

        Edge tempEdge;
        Node n1,n2;

        for(int i=0;i<environmentEdgeSet.size();i++){
            tempEdge=(Edge)environmentEdgeSet.elementAt(i);
            n1=tempEdge.getN1();
            n2=tempEdge.getN2();

            if(subject.hasNode(n1) && !subject.hasNode(n2)){
```

GraphAlgorithm.java

```
                if(!interfaceNodes.contains(n1))
                    interfaceNodes.addElement(n1);
            }
            if(subject.hasNode(n2) && !subject.hasNode(n1)){
                if(!interfaceNodes.contains(n2))
                    interfaceNodes.addElement(n2);
            }
        }
        return interfaceNodes;
    }


    public static double networkCost(Graph graph){
        Vector edgeSet=graph.getEdgeSet();
        Edge edge;
        double networkCost=0.0;
        for(int i=0;i<edgeSet.size();i++){
            edge=(Edge)edgeSet.elementAt(i);
            networkCost=networkCost+edge.getWeight();
        }
        return networkCost;
    }

    public static double pathCost(Vector edgeSet){
        double pathkCost=0.0;
        Edge edge;
        for(int i=0;i<edgeSet.size();i++){
            edge=(Edge)edgeSet.elementAt(i);
            pathkCost=pathkCost+edge.getWeight();
        }
        return pathkCost;
    }

    public static Vector intersection(Vector set0,Vector set1){
        Vector intersection=new Vector();
        Object temp;
        for(int i=0;i<set0.size();i++){
            temp=set0.elementAt(i);
            if(set1.contains(temp))
                intersection.addElement(temp);
        }
        return intersection;
```

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```
}

public static Vector union(Vector set0,Vector set1){
    Vector union=new Vector();
    Object temp;
    for(int i=0;i<set0.size();i++){
        temp=set0.elementAt(i);
        union.addElement(temp);
    }
    for(int i=0;i<set1.size();i++){
        temp=set1.elementAt(i);
        if(!union.contains(temp))
            union.addElement(temp);
    }
    return union;
}

//detour
public static double getMergeCost(Detourist detourist,Node node){

    Center center=detourist.getDetourManager().getCenter();
    double mergeCost=0.0;

    Graph downstream=detourist.getDownstream();
    Vector downstreamDemandNodeSet=downstream.getDemandNodeSet();

    Graph mergeNodeToSupplyPath=getPathToSupply(node,center);
    Vector mergeNodeToSupplyEdgeSet=mergeNodeToSupplyPath.getEdgeSet();

    Vector tempEdgeSetUnion=new Vector(),tempEdgeSetIntersection=new Vector();

    Node tempDemand;
    Graph tempDemandToSupplyPath;
    Vector tempDemandToSupplyEdgeSet;
    for(int i=0;i<downstreamDemandNodeSet.size();i++){
        tempDemand=(Node)downstreamDemandNodeSet.elementAt(i);

        tempDemandToSupplyPath=getPathToSupply(tempDemand,center);
        tempDemandToSupplyEdgeSet=tempDemandToSupplyPath.getEdgeSet();

        tempEdgeSetUnion=union(mergeNodeToSupplyEdgeSet,tempDemandToSupplyEdgeSet);
```

GraphAlgorithm.java

```
tempEdgeSetIntersection=intersection(mergeNodeToSupplyEdgeSet,tempDemandToSupplyEdgeSet);

                mergeCost=mergeCost+pathCost(tempEdgeSetUnion)-pathCost(tempEdgeSetIntersection);
            }
            return mergeCost;
        }

        public static Graph getPathToSupply(Node node,Center center){
            Vector nodeSet=new Vector();
            Vector edgeSet=new Vector();

            Node currNode=node;
            Edge preEdge;
            while(currNode!=center.getDummyNode()){
                preEdge=center.getPreEdge(currNode);

                if(center.getPreNode(currNode)!=center.getDummyNode()){
                    if(!nodeSet.contains(currNode))
                        nodeSet.addElement(currNode);
                    if(!edgeSet.contains(preEdge))
                        edgeSet.addElement(preEdge);
                }else{
                    if(!nodeSet.contains(currNode))
                        nodeSet.addElement(currNode);
                }
                currNode=preEdge.theOtherNode(currNode);
            }
            return new Graph(nodeSet,edgeSet);
        }
}
```

Graph.java

```
package emnet.graph;

import java.util.Vector;

public class Graph {
	private Vector nodeSet,edgeSet;
	int supplyNodeNum,demandNodeNum;

	public Graph(Vector nodeSet, Vector edgeSet){
		this.nodeSet=nodeSet;
		this.edgeSet=edgeSet;
	}

	public Vector getNodeSet(){
		return this.nodeSet;
	}

	public Vector getEdgeSet(){
		return this.edgeSet;
	}

	//incident edges of node n
	public Vector incidentEdgeSet(Node node){
		Vector incidentEdgeSet=new Vector();
		for(int i=0;i<this.edgeSet.size();i++){
			Edge tempEdge=(Edge)edgeSet.elementAt(i);
			if(tempEdge.getN1()==node || tempEdge.getN2()==node){
				if(!incidentEdgeSet.contains(tempEdge)){
					incidentEdgeSet.addElement(tempEdge);
				}
			}
		}
		return incidentEdgeSet;
	}

	//adjacent nodes of node n
	public Vector adjacentNodeSet(Node n){
		Vector adjacentNodeSet=new Vector();
		for(int i=0;i<this.edgeSet.size();i++){
			Edge tempEdge=(Edge)edgeSet.elementAt(i);
			if(tempEdge.getN1()==n && !adjacentNodeSet.contains(tempEdge.getN2())){
```

Graph.java

```
                adjacentNodeSet.addElement(tempEdge.getN2());
            }else if(tempEdge.getN2()==n && !adjacentNodeSet.contains(tempEdge.getN1())){
                adjacentNodeSet.addElement(tempEdge.getN1());
            }
        }
        return adjacentNodeSet;
    }

    public Vector getSupplyNodeSet(){
        Vector supplyNodeSet=new Vector();
        for(int i=0;i<this.nodeSet.size();i++){
            Node tempNode=(Node)nodeSet.elementAt(i);
            if(tempNode.isSupply())
                supplyNodeSet.addElement(tempNode);
        }
        return supplyNodeSet;
    }

    public int getSupplyNodeNum(){
        return getSupplyNodeSet().size();
    }

    public Vector getDemandNodeSet(){
        Vector demandNodeSet=new Vector();
        for(int i=0;i<this.nodeSet.size();i++){
            Node tempNode=(Node)nodeSet.elementAt(i);
            if(tempNode.isDemand())
                demandNodeSet.addElement(tempNode);
        }
        return demandNodeSet;
    }

    public int getDemandNodeNum(){
        return getDemandNodeSet().size();
    }

    public Edge getEdge(Node n1,Node n2){
        Edge edge;
        for(int i=0;i<edgeSet.size();i++){
            edge=(Edge)edgeSet.elementAt(i);
            if(edge.getN1()==n1){
                if(edge.theOtherNode(edge.getN1())==n2)
```

Graph.java

```
                return edge;
            }else if(edge.getN1()==n2){
                if(edge.theOtherNode(edge.getN1())==n1)
                    return edge;
            }
        }
        System.out.println("error: no edge can be returned!");
        return null;
    }

    public void addNode(Node node){
        if(!nodeSet.contains(node))
            this.nodeSet.addElement(node);
    }

    public void addEdge(Edge edge){
        if(!edgeSet.contains(edge))
            this.edgeSet.addElement(edge);
    }

    public boolean hasNode(Node node){
        if(nodeSet.contains(node)){
            return true;
        }else{
            return false;
        }
    }

    public boolean hasEdge(Edge edge){
        if(edgeSet.contains(edge)){
            return true;
        }else{
            return false;
        }
    }

    public void removeNode(Node node){
        if(nodeSet.contains(node)){
            Vector incidentEdges=this.incidentEdgeSet(node);
            Edge tempIncidentEdge;
            for(int i=0;i<incidentEdges.size();i++){
                tempIncidentEdge=(Edge)incidentEdges.elementAt(i);
```

Graph.java

```
                    if(edgeSet.contains(tempIncidentEdge))
                        edgeSet.removeElement(tempIncidentEdge);
                }
                nodeSet.removeElement(node);
            }
        }

        public void removeEdge(Edge edge){
            if(edgeSet.contains(edge))
                edgeSet.removeElement(edge);
        }
    }
```

Node.java

```
package emnet.graph;

public class Node{
	private int label;
	private double x,y;
	private boolean demand,supply,merge,access,source,dummy;
	private boolean visit,occupy;

	public Node(int label){
		this.label=label;
		this.demand=false;
		this.supply=false;
		this.merge=false;
		this.access=false;
		this.source=false;
		this.dummy=false;
		this.visit=false;
		this.occupy=false;
	}

	public Node(int label,double x,double y){
		this(label);
		setX(x);
		setY(y);
	}

	public void setDemand(){
		this.demand=true;
	}

	public void setSupply(){
		this.supply=true;
	}

	public void setNeutral(){
		this.supply=false;
		this.demand=false;
	}

	public void setMerge(){
		this.merge=true;
```

Node.java

```
}

public void setAccess(){
    this.access=true;
}

public void setSource(){
    this.source=true;
}

public void setDummy(){
    this.dummy=true;
}

public synchronized void visit(){
    this.visit=true;
}

public synchronized void occupy(){
    this.occupy=true;
}

public synchronized void unOccupied(){
    this.occupy=false;
}

public synchronized void leave(){
    this.occupy=false;
}

public boolean isOccupied(){
    return this.occupy;
}

public boolean isDemand(){
    return this.demand;
}

public boolean isSupply(){
    return this.supply;
}
```

Node.java

```
	public boolean isMerge(){
		return this.merge;
	}

	public boolean isAccess(){
		return this.access;
	}

	public boolean isSource(){
		return this.source;
	}

	public boolean isDummy(){
		return this.dummy;
	}

	public boolean isVisited(){
		return this.visit;
	}

	public int getLabel(){
		return label;
	}

	public void setX(double x){
		this.x=x;
	}

	public void setY(double y){
		this.y=y;
	}

	public double getX(){
		return this.x;
	}

	public double getY(){
		return this.y;
	}
}
```

Edge.java

```
package emnet.graph;

public class Edge {
	private int label;
	private double weight;
	private Node n1,n2;
	private boolean fastEdge,detourEdge,testEdge,detourTestEdge,dummyEdge,maTestEdge,maEdge;
	private boolean visit;

	public Edge(int label,Node n1,Node n2){
		this.label=label;
		this.weight=0.0;
		this.n1=n1;
		this.n2=n2;
		this.fastEdge=false;
		this.detourEdge=false;
		this.testEdge=false;
		this.detourTestEdge=false;
		this.dummyEdge=false;
		this.maTestEdge=false;
		this.maEdge=false;
		this.visit=false;
	}

	public Edge(int label,Node n1,Node n2,double weight){
		this(label,n1,n2);
		this.weight=weight;
	}

	public synchronized void setFastEdge(){
		this.fastEdge=true;
	}

	public boolean isFastEdge(){
		return this.fastEdge;
	}

	public synchronized void setDetourEdge(){
		this.detourEdge=true;
	}
```

Edge.java

```
public boolean isDetourEdge(){
    return this.detourEdge;
}

public synchronized void setTestEdge(){
    this.testEdge=true;
}

public boolean isTestEdge(){
    return this.testEdge;
}

public synchronized void setDetourTestEdge(boolean detourTestEdge){
    this.detourTestEdge=detourTestEdge;
}

public boolean isDetourTestEdge(){
    return detourTestEdge;
}

public synchronized void setDummyEdge(){
    this.dummyEdge=true;
}

public boolean isDummyEdge(){
    return dummyEdge;
}

public synchronized void setMATestEdge(boolean maTestEdge){
    this.maTestEdge=maTestEdge;
}

public boolean isMATestEdge(){
    return maTestEdge;
}

public synchronized void setMAEdge(){
    this.maEdge=true;
}

public boolean isMAEdge(){
    return maEdge;
```

Edge.java

```
}

public synchronized void setNeutralEdge(){
    this.fastEdge=false;
    this.detourEdge=false;
    this.maEdge=false;
    this.testEdge=false;
    this.detourTestEdge=false;
    this.maTestEdge=false;
}

public void setWeight(double weight){
    this.weight=weight;
}

public double getWeight(){
    return this.weight;
}

public Node getN1(){
    return this.n1;
}

public Node getN2(){
    return this.n2;
}

public Node theOtherNode(Node n){
    if(n==this.n1){
        return this.n2;
    }else if(n==this.n2){
        return this.n1;
    }
    return null;
}

public synchronized void visit(){
    this.visit=true;
}

public boolean isVisited(){
    return this.visit;
```

Edge.java

```
        }

        public int getN1Label(){
            return n1.getLabel();
        }

        public int getN2Label(){
            return n2.getLabel();
        }

        public int getLabel(){
            return this.label;
        }
}
```

Map.java

```
package emnet.gui;

import emnet.graph.Graph;
import emnet.graph.Node;
import emnet.graph.Edge;
import javax.swing.JPanel;
import java.awt.BorderLayout;
import java.awt.Dimension;
import java.util.Vector;
import java.awt.Graphics;
import java.awt.Color;
import java.awt.event.MouseEvent;
import java.awt.event.MouseAdapter;
import emnet.Frame;
import java.text.DecimalFormat;
import java.awt.Font;

public class Map extends javax.swing.JPanel{
    Frame frame;
    JPanel map=new JPanel();
    Graph graph;
    boolean dataIn;
    boolean supply,demand,neutral;
    DecimalFormat myFormatter=new DecimalFormat("###,###.#");

    public Map(){
        init();
    }

    public void init(){
        this.setLayout(new BorderLayout());
        this.setSize(new Dimension(600,400));
        this.setPreferredSize(new Dimension(600,400));
        this.add(map,BorderLayout.CENTER);
        this.dataIn=false;

        this.addMouseListener(new Map_MouseAdapter(this));
    }

    public void paint(Graphics g){
        if(dataIn){
```

Map.java

```
                drawNodes(graph,g);
                drawEdges(graph,g);
                frame.setSeperator(graph);
            }else{
                g.drawString("n/a",this.getWidth()/2,this.getHeight()/2);
            }
        }

        public void setGraph(Graph graph){
            this.graph=graph;
            this.dataIn=true;
            this.repaint();
        }

        public Graph getGraph(){
            return this.graph;
        }
        public void sentFrame(Frame frame){
            this.frame=frame;
        }

        public Map getMap(){
            return this;
        }

        private void drawNodes(Graph graph,Graphics g){
            double ratio=scaledRatio(graph);
            double newOX=newOX(graph);
            double newOY=newOY(graph);
            int l=12,m=10,s=8;

            g.setFont(new Font(null,Font.PLAIN,12));

            Vector nodeSet=graph.getNodeSet();
            Node node;
            for(int i=0;i<nodeSet.size();i++){
                node=(Node)nodeSet.elementAt(i);

                if(node.isSupply()){
                    g.setColor(Color.RED);
                    g.drawOval(new Double((node.getX()-newOX)*ratio).intValue()-l/2,new
Double((node.getY()-newOY)*ratio).intValue()-l/2,l,l);
```

Map.java

```
                }else if(node.isDemand()){
                    g.setColor(Color.BLUE);
                    g.drawRect(new Double((node.getX()-newOX)*ratio).intValue()-m/2,new
Double((node.getY()-newOY)*ratio).intValue()-m/2,m,m);
                }else{
                    g.setColor(Color.LIGHT_GRAY);
                }
                g.drawString(""+node.getLabel(),new Double((node.getX()-newOX)*ratio).intValue(),new
Double((node.getY()-newOY)*ratio).intValue());

                if(node.isAccess() && node.isMerge()){
                    g.setColor(Color.DARK_GRAY);
                    g.drawString("A & M",new Double((node.getX()-newOX)*ratio).intValue(),new
Double((node.getY()-newOY)*ratio).intValue()+20);
                }else if(node.isAccess()){
                    g.setColor(Color.DARK_GRAY);
                    g.drawString("A",new Double((node.getX()-newOX)*ratio).intValue(),new
Double((node.getY()-newOY)*ratio).intValue()+20);
                }else if(node.isMerge()){
                    g.setColor(Color.DARK_GRAY);
                    g.drawString("M",new Double((node.getX()-newOX)*ratio).intValue(),new
Double((node.getY()-newOY)*ratio).intValue()+20);
                }

                if(node.isSource()){
                    g.setColor(Color.DARK_GRAY);
                    g.drawString("$rc",new Double((node.getX()-newOX)*ratio).intValue(),new
Double((node.getY()-newOY)*ratio).intValue()+20);
                }
            }
        }

        private void drawEdges(Graph graph,Graphics g){
            double ratio=scaledRatio(graph);
            double newOX=newOX(graph);
            double newOY=newOY(graph);

            Vector edgeSet=graph.getEdgeSet();
            Edge edge;

            g.setFont(new Font(null,Font.PLAIN,10));
```

Map.java

```
            for(int i=0;i<edgeSet.size();i++){
                edge=(Edge)edgeSet.elementAt(i);
                Node n1=edge.getN1(),n2=edge.getN2();
                int n1x=new Double((n1.getX()-newOX)*ratio).intValue();
                int n1y=new Double((n1.getY()-newOY)*ratio).intValue();
                int n2x=new Double((n2.getX()-newOX)*ratio).intValue();
                int n2y=new Double((n2.getY()-newOY)*ratio).intValue();

                if(edge.isFastEdge()){
                    g.setColor(Color.BLACK);
                }else if(edge.isDetourEdge()){
                    g.setColor(Color.ORANGE);
                }else if(edge.isMAEdge()){
                    g.setColor(Color.GREEN);
                }else if(edge.isTestEdge()){
                    g.setColor(Color.MAGENTA);
                }else if(edge.isDetourTestEdge()){
                    g.setColor(Color.CYAN);
                }else if(edge.isMATestEdge()){
                    g.setColor(Color.MAGENTA);
                }else{
                    g.setColor(Color.LIGHT_GRAY);
                }

                if(!edge.isDummyEdge()){
                    Double weight;
                    if(edge.isMAEdge()){
                        g.setFont(new Font(null,Font.BOLD,11));
                        g.drawLine(n1x,n1y,n2x,n2y);
                        weight=new Double(edge.getWeight());
                        g.drawString(""+edge.getLabel()+":"+myFormatter.format(weight)+" @B",new
Double((n1x+n2x)/2).intValue(),new Double((n1y+n2y)/2).intValue());
                        g.setFont(new Font(null,Font.PLAIN,10));
                    }else{
                        g.drawLine(n1x,n1y,n2x,n2y);
                        weight=new Double(edge.getWeight());
                        g.drawString(""+edge.getLabel()+":"+myFormatter.format(weight),new
Double((n1x+n2x)/2).intValue(),new Double((n1y+n2y)/2).intValue());
                    }
                }
            }
        }
```

Map.java

```
private double scaledRatio(Graph graph){
    Vector nodeSet=graph.getNodeSet();
    double maxX=0.0,maxY=0.0;
    double newOX=newOX(graph),newOY=newOY(graph);
    Node node;
    for(int i=0;i<nodeSet.size();i++){
        node=(Node)nodeSet.elementAt(i);
        if((node.getX()-newOX)>maxX){
            maxX=node.getX()-newOX;
        }else if((node.getY()-newOY)>maxY){
            maxY=node.getY()-newOY;
        }
    }
    return Math.min(map.getWidth()/maxX,map.getHeight()/maxY);
}

private double newOX(Graph graph){
    Vector nodeSet=graph.getNodeSet();
    Node node=(Node)nodeSet.elementAt(0);
    double minX=node.getX();
    for(int i=1;i<nodeSet.size();i++){
        node=(Node)nodeSet.elementAt(i);
        if(node.getX()<minX){
            minX=node.getX();
        }
    }
    return minX;
}

private double newOY(Graph graph){
    Vector nodeSet=graph.getNodeSet();
    Node node=(Node)nodeSet.elementAt(0);
    double minY=node.getY();
    for(int i=1;i<nodeSet.size();i++){
        node=(Node)nodeSet.elementAt(i);
        if(node.getY()<minY){
            minY=node.getY();
        }
    }
    return minY;
}
```

Map.java

```
    public void nodeSetting(boolean supply,boolean demand,boolean neutral){
        this.supply=supply;
        this.demand=demand;
        this.neutral=neutral;
    }

    void mouse_clicked_actionPerformed(MouseEvent e){
        double ratio=scaledRatio(graph);
        double newOX=newOX(graph),newOY=newOY(graph);
        Vector nodeSet=graph.getNodeSet();
        Node node;
        int err=10;
        for(int i=0;i<nodeSet.size();i++){
            node=(Node)nodeSet.elementAt(i);
            int x=new Double((node.getX()-newOX)*ratio).intValue();
            int y=new Double((node.getY()-newOY)*ratio).intValue();
            if(Math.abs(e.getX()-x)<err && Math.abs(e.getY()-y)<err){
                if(supply){
                    node.setNeutral();
                    node.setSupply();
                }
                if(demand){
                    node.setNeutral();
                    node.setDemand();
                }
                if(neutral){
                    node.setNeutral();
                }
            }
        }
    }
}

class Map_MouseAdapter extends MouseAdapter{
    Map adaptee;

    Map_MouseAdapter(Map adaptee){
        this.adaptee=adaptee;
    }

    public void mouseClicked(MouseEvent e){
```

Map.java

```
            this.adaptee.mouse_clicked_actionPerformed(e);
        }
    }
```

IOGraph.java

```
package emnet.io;

import emnet.graph.Graph;
import emnet.graph.Node;
import emnet.graph.Edge;
import java.util.Vector;
import java.io.File;
import java.io.FileReader;
import java.io.IOException;
import java.io.BufferedReader;
import java.util.StringTokenizer;

public class IOGraph {

    private Graph g;

    public IOGraph(String dirName,String nodeFile,String edgeFile) throws IOException {
        File inputNodeFile=new File(dirName,nodeFile);
        File inputEdgeFile=new File(dirName,edgeFile);
        Vector nodeSet=new Vector();
        Vector edgeSet=new Vector();
        g=new Graph(nodeSet,edgeSet);

        //read node.txt
        FileReader nodeIn=new FileReader(inputNodeFile);
        BufferedReader buffNodeIn=new BufferedReader(nodeIn);

        String strLine;
        Node node;
        while((strLine=buffNodeIn.readLine())!=null){
            //delimiter of Tab is "\t"
            StringTokenizer strToken=new StringTokenizer(strLine,"\t",false);

            String[] nodeAttr=new String[3];
            for(int i=0;i<3;i++){
                nodeAttr[i]=strToken.nextToken();
            }
            node=new
Node(Integer.parseInt(nodeAttr[0]),Double.parseDouble(nodeAttr[1]),Double.parseDouble(nodeAttr[2]));
            nodeSet.addElement(node);
        }
```

IOGraph.java

```
            buffNodeIn.close();
            nodeIn.close();

            //read edge.txt
            FileReader edgeIn=new FileReader(inputEdgeFile);
            BufferedReader buffEdgeIn=new BufferedReader(edgeIn);

            Edge edge;
            while((strLine=buffEdgeIn.readLine())!=null){
                //delimiter of Tab is "\t"
                StringTokenizer strToken=new StringTokenizer(strLine,"\t",false);

                String[] edgeAttr=new String[3];
                for(int i=0;i<3;i++){
                    edgeAttr[i]=strToken.nextToken();
                }

                Node n1=(Node)nodeSet.elementAt(Integer.parseInt(edgeAttr[1]));
                Node n2=(Node)nodeSet.elementAt(Integer.parseInt(edgeAttr[2]));
                double
weight=Math.sqrt((n1.getX()-n2.getX())*(n1.getX()-n2.getX())+(n1.getY()-n2.getY())*(n1.getY()-n2.getY()));
                edge=new Edge(Integer.parseInt(edgeAttr[0]),n1,n2,weight);
                edgeSet.addElement(edge);
            }
            buffEdgeIn.close();
            edgeIn.close();
        }

        public Graph getGraph(){
            return this.g;
        }

}
```

Center.java

```
package emnet.thread;

import java.util.Vector;
import emnet.graph.Graph;
import emnet.graph.Node;
import emnet.graph.Edge;
import emnet.Frame;
import emnet.algorithm.GraphAlgorithm;

public class Center extends Thread{
	//Center
	Graph graph;
	Frame frame;
	boolean finish,available,detourCenterFinish,maCenterFinish;
	Node dummyNode;

	//nodeCenter
	int nodeNum;
	Object[][] nodeCenter;

	//roamerCenter
	int roamerNum;
	Object[][] roamerCenter;

	//fastCenter
	Object[][] fastCenter;

	//detourCenter
	int edgeNum,detourManagerNum;
	Object[][] detourCenter;

	//MutualAssistanceCenter
	Graph emnet;
	int maManagerNum;
	Object[][] maCenter;

	public Center(Graph graph,Frame frame){
		//Center
		this.graph=graph;
		this.frame=frame;
		finish=false;
```

Center.java

```
available=true;

//nodeCenter
//nodeCenter[node][0]: occupy(Boolean)
//nodeCenter[node][1]: distance(Double)
//nodeCenter[node][2]: preNode(Node)
//nodeCenter[node][3]: preEdge(Edge)
//nodeCenter[node][4]: visitorSequence(Vector)
//nodeCenter[node][5]: supply(Node)
//nodeCenter[node][6]: detourDist(Double)???

nodeNum=this.graph.getNodeSet().size();
nodeCenter=new Object[(nodeNum+1)][6];
dummyNode=new Node(nodeNum,0.0,0.0);

for(int i=0;i<(nodeNum+1);i++){
    nodeCenter[i][0]=new Boolean(false);
    nodeCenter[i][1]=new Double(0.0);
    nodeCenter[i][2]=null;
    nodeCenter[i][3]=null;
    nodeCenter[i][4]=new Vector();
    nodeCenter[i][5]=null;
}

//roamerCenter
//roamerCenter[roamer][0]: myNode(Node)
//roamerCenter[roamer][1]: myEdge(Edge)
//roamerCenter[roamer][2]: currNode(Node)
//roamerCenter[roamer][3]: routeSet(Graph)
roamerNum=graph.getSupplyNodeSet().size();
roamerCenter=new Object[roamerNum][4];
for(int i=0;i<roamerNum;i++){
    roamerCenter[i][0]=dummyNode;
    roamerCenter[i][1]=null;
    roamerCenter[i][2]=null;
    roamerCenter[i][3]=null;
}

//fastCenter
//fastCenter[demand][0]: fastPath(Graph)
//fastCenter[demand][1]: supply(Node)
//fastCenter[demand][2]: fastPathLength(Double)
```

Center.java

```
fastCenter=new Object[nodeNum][3];
for(int i=0;i<nodeNum;i++){
    fastCenter[i][0]=null;
    fastCenter[i][1]=null;
    fastCenter[i][2]=null;
}

//detourCenter
//detourCenter[edge][0]: downstream(Graph)
//detourCenter[edge][1]: upstream(Graph)
//detourCenter[edge][2]: mergeNode(Node)
//detourCenter[edge][3]: accessNode(Node)
//detourCenter[edge][4]: detourPath(Graph)
//detourCenter[edge][5]: systematicDetourCost(Double)
//detourCenter[edge][6]: mergeCost(Vector)
edgeNum=graph.getEdgeSet().size();
detourManagerNum=graph.getSupplyNodeSet().size();
detourCenter=new Object[edgeNum][7];
for(int i=0;i<edgeNum;i++){
    detourCenter[i][0]=null;
    detourCenter[i][1]=null;
    detourCenter[i][2]=null;
    detourCenter[i][3]=null;
    detourCenter[i][4]=null;
    detourCenter[i][5]=new Double(0.0);
    detourCenter[i][6]=new Vector(nodeNum);
}

//mutualAssistantCenter
//maCenter[supply][0]: fastTree(Graph)
//maCenter[supply][1]: territory(Graph) 2ECON
//maCenter[supply][2]: source(Node)
//maCenter[supply][3]: icpSet(Vector)
//maCenter[supply][4]: maPath(Graph)
//maCenter[supply][5]: within territory supply-demand ratio(Double)
//maCenter[supply][6]: mutual assistant supply-demand ratio(Double)
//maCenter[supply][7]: maCost > source to supply
maManagerNum=graph.getSupplyNodeNum();
maCenter=new Object[nodeNum][8];
for(int i=0;i<nodeNum;i++){
    maCenter[i][0]=null;
    maCenter[i][1]=null;
```

Center.java

```
                maCenter[i][2]=null;
                maCenter[i][3]=new Vector();
                maCenter[i][4]=null;
                maCenter[i][5]=new Vector();
                maCenter[i][6]=new Double(0.0);
                maCenter[i][7]=new Double(0.0);
        }
    }

    public void run(){
        startRoamerCenter();
        startFastCenter();
        startDetourCenter();
        startMutualAssistanceCenter();
        startOutputReport();
    }

    //center method
    void startRoamerCenter(){
        //roamerCenter
        //send roamers to find fast paths (Shortest Path Forest, SPF)
        sendRoamer();

        Vector nodeSet=graph.getNodeSet();
        int demandNodeNum=graph.getDemandNodeNum();
        do{
            int totalTimes=0;
            watching:
                for(int i=0;i<nodeNum;i++){
                Node tempNode=(Node)nodeSet.elementAt(i);
                //finish condition is focused on demand nodes only
                if(tempNode.isDemand()){
                    if(getVisitorNum(tempNode)==roamerNum){
                        totalTimes=totalTimes+roamerNum;
                        if(totalTimes==(demandNodeNum*roamerNum))
                            finish=true;
                    }
                    else{
                        finish=false;
                        break watching;
                    }
                }
```

Center.java

```
                }
            }while(!finish);
            //roamer center finished!
        }

        void startFastCenter(){
            //fastCenter
            //fastCenter[demand][0]: fastPath(Graph)
            //fastCenter[demand][1]: supply(Node)
            //fastCenter[demand][2]: fastPathLength(Double)

            //finding fast paths from demand nodes to the dummyNode
            try{
                sleep(1);
            }catch(InterruptedException ex){
                //fast center cannot sleep!
            }

            Vector demandNodeSet=graph.getDemandNodeSet();
            Node tempDemand,tempNode;
            Edge tempPreEdge,tempEdge;
            double length;
            Vector tempFastNodeSet,tempFastEdgeSet;

            for(int i=0;i<demandNodeSet.size();i++){
                tempDemand=(Node)demandNodeSet.elementAt(i);
                tempNode=tempDemand;

                tempFastNodeSet=new Vector();
                tempFastEdgeSet=new Vector();

                find:
                while(tempNode!=dummyNode){
                    tempPreEdge=(Edge)getPreEdge(tempNode);
                    if(tempNode.isSupply()){
                        fastCenter[tempDemand.getLabel()][1]=tempNode;
                        if(!tempFastNodeSet.contains(tempNode))
                            tempFastNodeSet.addElement(tempNode);

                        //node of fast route belong to the same supply
                        Node tempNode2;
                        for(int j=0;j<tempFastNodeSet.size();j++){
```

Center.java

```
                    tempNode2=(Node)tempFastNodeSet.elementAt(j);
                    nodeCenter[tempNode2.getLabel()][5]=tempNode;
                }
                break find;
            }else{
                if(!tempFastNodeSet.contains(tempNode))
                    tempFastNodeSet.addElement(tempNode);
                if(!tempFastEdgeSet.contains(tempPreEdge))
                    tempFastEdgeSet.addElement(tempPreEdge);
                tempPreEdge.setFastEdge();
            }
            tempNode=tempPreEdge.theOtherNode(tempNode);
        }

        fastCenter[tempDemand.getLabel()][0]=new Graph(tempFastNodeSet,tempFastEdgeSet);
        length=0.0;
        for(int j=0;j<tempFastEdgeSet.size();j++){
            tempEdge=(Edge)tempFastEdgeSet.elementAt(j);
            length=length+tempEdge.getWeight();
        }
        fastCenter[tempDemand.getLabel()][2]=new Double(length);
    }

    //maCenter[supply][0]: fastTree(Graph)
    Vector fastTreeSupplyNodeSet=graph.getSupplyNodeSet();
    Node tempFastTreeSupply;
    Vector fastTreeDemandNodeSet=graph.getDemandNodeSet();
    Node tempFastTreeDemand;

    Graph tempFastPath;
    Vector tempFastPathNodeSet;
    Node tempFastPathNode;
    Vector tempFastPathEdgeSet;
    Edge tempFastPathEdge;

    Vector tempFastTreeNodeSet;
    Vector tempFastTreeEdgeSet;

    for(int i=0;i<fastTreeSupplyNodeSet.size();i++){
        tempFastTreeNodeSet=new Vector();
        tempFastTreeEdgeSet=new Vector();
```

Center.java

```
                tempFastTreeSupply=(Node)fastTreeSupplyNodeSet.elementAt(i);
                if(!tempFastTreeNodeSet.contains(tempFastTreeSupply))
                    tempFastTreeNodeSet.addElement(tempFastTreeSupply);

                for(int j=0;j<fastTreeDemandNodeSet.size();j++){
                    tempFastTreeDemand=(Node)fastTreeDemandNodeSet.elementAt(j);

                    //fast paths with different demands of the same supply
                    if(fastCenter[tempFastTreeDemand.getLabel()][1]==tempFastTreeSupply){
                        tempFastPath=(Graph)fastCenter[tempFastTreeDemand.getLabel()][0];
                        tempFastPathEdgeSet=tempFastPath.getEdgeSet();
                        for(int k=0;k<tempFastPathEdgeSet.size();k++){
                            tempFastPathEdge=(Edge)tempFastPathEdgeSet.elementAt(k);
                            if(!tempFastTreeEdgeSet.contains(tempFastPathEdge)){
                                tempFastTreeEdgeSet.addElement(tempFastPathEdge);
                            }
                        }

                        tempFastPathNodeSet=tempFastPath.getNodeSet();
                        for(int k=0;k<tempFastPathNodeSet.size();k++){
                            tempFastPathNode=(Node)tempFastPathNodeSet.elementAt(k);
                            if(!tempFastTreeNodeSet.contains(tempFastPathNode)){
                                tempFastTreeNodeSet.addElement(tempFastPathNode);
                            }
                        }
                    }
                }
                maCenter[tempFastTreeSupply.getLabel()][0]=new
Graph(tempFastTreeNodeSet,tempFastTreeEdgeSet);

                //maCenter[supply][5]: within territory supply-demand ratio(Double)
                if(getFastTree(tempFastTreeSupply).getDemandNodeNum()!=0){

this.setTerritorySDR(tempFastTreeSupply,1.0/getFastTree(tempFastTreeSupply).getDemandNodeNum());
                }else{
                    this.setTerritorySDR(tempFastTreeSupply,1.0);
                }

            }

            //fast center finished!
            //finalization
```

Center.java

```
        Vector edgeSet=graph.getEdgeSet();
        Edge clearEdge;
        for(int i=0;i<edgeSet.size();i++){
            clearEdge=(Edge)edgeSet.elementAt(i);
            if(!clearEdge.isFastEdge())
                clearEdge.setNeutralEdge();
        }
    }

    void startDetourCenter(){
        //detourCenter
        try{
            sleep(1);
        }catch(InterruptedException ex){
            //detour center cannot sleep!
        }

        detourCenterFinish=false;
        Vector supplyNodeSet=graph.getSupplyNodeSet();

        Node tempSupply;
        for(int i=0;i<supplyNodeSet.size();i++){
            tempSupply=(Node)supplyNodeSet.elementAt(i);
            new DetourManager(i,this,tempSupply).start();
        }

        while(!detourCenterFinish){
            //detour center waiting for detour managers finish their jobs
        }
        //detour center finished!
    }

    void startMutualAssistanceCenter(){
        try{
            sleep(1);
        }catch(InterruptedException ex){
            //mutual assistance center cannot sleep!
        }

        //where are supply nodes:
        Vector nodeSet=graph.getNodeSet();
        Node tempNode;
```

Center.java

```
for(int i=0;i<nodeSet.size();i++){
    tempNode=(Node)nodeSet.elementAt(i);
}

//initialization
Vector edgeSet=graph.getEdgeSet();
Edge tempEdge;
for(int i=0;i<edgeSet.size();i++){
    tempEdge=(Edge)edgeSet.elementAt(i);
    if(!tempEdge.isFastEdge() && !tempEdge.isDetourEdge())
        tempEdge.setNeutralEdge();
}

maCenterFinish=false;
Vector supplyNodeSet=graph.getSupplyNodeSet();

Node tempSupply;
for(int i=0;i<supplyNodeSet.size();i++){
    tempSupply=(Node)supplyNodeSet.elementAt(i);
    new MAManager(i,this,tempSupply).start();
}

while(!maCenterFinish){
    //ma center waiting for detour managers finish their jobs
}

//emnet
Vector emnetNodeSet=new Vector();
Vector emnetEdgeSet=new Vector();

Graph tempTerritory;
Vector tempTerritoryNodeSet;
Vector tempTerritoryEdgeSet;

Graph tempMAPath;
Vector tempMAPathNodeSet;
Vector tempMAPathEdgeSet;

for(int i=0;i<supplyNodeSet.size();i++){
    tempSupply=(Node)supplyNodeSet.elementAt(i);

    tempTerritory=this.getTerritory(tempSupply);
```

Center.java

```
            tempTerritoryNodeSet=tempTerritory.getNodeSet();
            tempTerritoryEdgeSet=tempTerritory.getEdgeSet();

            emnetNodeSet=GraphAlgorithm.union(emnetNodeSet,tempTerritoryNodeSet);
            emnetEdgeSet=GraphAlgorithm.union(emnetEdgeSet,tempTerritoryEdgeSet);

            tempMAPath=this.getMAPath(tempSupply);
            tempMAPathNodeSet=tempMAPath.getNodeSet();
            tempMAPathEdgeSet=tempMAPath.getEdgeSet();

            emnetNodeSet=GraphAlgorithm.union(emnetNodeSet,tempMAPathNodeSet);
            emnetEdgeSet=GraphAlgorithm.union(emnetEdgeSet,tempMAPathEdgeSet);
        }
        emnet=new Graph(emnetNodeSet,emnetEdgeSet);

        //ma center finished!
        //finalization
        for(int i=0;i<edgeSet.size();i++){
            tempEdge=(Edge)edgeSet.elementAt(i);
            if(!tempEdge.isFastEdge() && !tempEdge.isDetourEdge() && !tempEdge.isMAEdge())
                tempEdge.setNeutralEdge();
        }
        //ma center closed!
    }

    void startOutputReport(){
        //maCenter[supply][6]: mutual assistant supply-demand ratio(Double)
        double ld=0.0;
        Vector supplyNodeSet=graph.getSupplyNodeSet();
        Node tempSupply;
        Vector tempFastTreeEdgeSet;
        Edge tempRuinedEdge;
        for(int i=0;i<supplyNodeSet.size();i++){
            tempSupply=(Node)supplyNodeSet.elementAt(i);
            tempFastTreeEdgeSet=this.getFastTree(tempSupply).getEdgeSet();
            for(int j=0;j<tempFastTreeEdgeSet.size();j++){
                tempRuinedEdge=(Edge)tempFastTreeEdgeSet.elementAt(j);
                if(this.getSystematicDetourCost(tempRuinedEdge)>ld)
                    ld=this.getSystematicDetourCost(tempRuinedEdge);
            }
        }
        frame.setLD(ld);
```

Center.java

```
        double mac=0.0;
        for(int i=0;i<supplyNodeSet.size();i++){
            tempSupply=(Node)supplyNodeSet.elementAt(i);
            mac=mac+this.getMACost(tempSupply);
        }
        frame.setAMAC(mac/supplyNodeSet.size());
        frame.setNC(GraphAlgorithm.networkCost(emnet));

        double fastCost=0.0;
        double maxFastCost=0.0;
        Vector demandNodeSet=graph.getDemandNodeSet();
        Node tempDemand;
        for(int i=0;i<demandNodeSet.size();i++){
            tempDemand=(Node)demandNodeSet.elementAt(i);

            if(getFastCost(tempDemand)>maxFastCost)
                maxFastCost=getFastCost(tempDemand);

            fastCost=fastCost+this.getFastCost(tempDemand);
        }
        frame.setATC(fastCost/demandNodeSet.size());
        frame.setMTC(maxFastCost);
    }

    //center field:
    public synchronized Graph getGraph(){
        return this.graph;
    }

    public synchronized boolean isFinished(){
        return this.finish;
    }

    void sendRoamer(){
        Node supply;
        for(int i=0;i<this.graph.getSupplyNodeSet().size();i++){
            supply=(Node)this.graph.getSupplyNodeSet().elementAt(i);
            roamerCenter[i][0]=supply;
            new Roamer(i,supply,this).start();
        }
    }
```

Center.java

```
public Node getDummyNode(){
    return this.dummyNode;
}

public synchronized void takeKey(Roamer roamer){
    if(!finish){
        while(!available){
            try{
                //roamer is waiting to take!
                wait(1);
            }catch(InterruptedException e){
                //takeKey: cannot wait!
            }
        }
        //roamer took the key!
        available=false;
    }else{
        available=false;
        //roamer took the key, but center is finished!
    }
}

public synchronized void putKey(Roamer roamer){
    if(!finish){
        while(available){
            try{
                //roamer is waiting to put...
                wait(1);
            }catch(InterruptedException e){
                //putKey: cannot wait!
            }
        }
        //roamer put the key!
        available=true;
    }else{
        //roamer put the key & center is already finished!
        available=true;
    }
}

//detour manager take key
```

Center.java

```
public synchronized void takeKey(DetourManager dmr){
    if(!detourCenterFinish){
        while(!available){
            try{
                //dmr is waiting to take!
                wait(1);
            }catch(InterruptedException e){
                //takeKey: cannot wait!
            }
        }
        //dmr took the key!
        available=false;
    }else{
        available=false;
        //dmr took the key, but detour center is finished!
    }
}

public synchronized void putKey(DetourManager dmr){
    if(!detourCenterFinish){
        while(available){
            try{
                //dmr is waiting to put...
                wait(1);
            }catch(InterruptedException e){
                //putKey: cannot wait!
            }
        }
        //dmr put the key!
        available=true;
    }else{
        //dmr put the key! detour center is already finished!
        available=true;
    }
}

//ma manager take key
public synchronized void takeKey(MAManager maMr){
    if(!maCenterFinish){
        while(!available){
            try{
                //maMr is waiting to take!
```

Center.java

```
                    wait(1);
                }catch(InterruptedException e){
                    //takeKey: cannot wait!
                }
            }
            //maMr took the key!
            available=false;
        }else{
            available=false;
            //maMr took the key but maCenter is already finished!
        }
    }

    public synchronized void putKey(MAManager maMr){
        if(!maCenterFinish){
            while(available){
                try{
                    //maMr is waiting to put...
                    wait(1);
                }catch(InterruptedException e){
                    //putKey: cannot wait!
                }
            }
            //maMr put the key!
            available=true;
        }else{
            //maMr put the key! and maCenter already finished!
            available=true;
        }
    }

    public void updateDetourCondition(){
        detourManagerNum--;
        if(detourManagerNum==0)
            detourCenterFinish=true;
    }

    public void updateMACondition(){
        maManagerNum--;
        if(maManagerNum==0)
            maCenterFinish=true;
    }
```

Center.java

```
//nodeCenter method:
//nodeCenter[node][0]: occupy(Boolean)
public synchronized void setOccupy(Node node,boolean occupy){
    nodeCenter[node.getLabel()][0]=new Boolean(occupy);
    notifyAll();
}

//nodeCenter[node][1]: distance(Double)
public synchronized void setDistance(Node node,double distance){
    nodeCenter[node.getLabel()][1]=new Double(distance);
}

public synchronized double getDistance(Node node){
    Double distance=(Double)nodeCenter[node.getLabel()][1];
    return distance.doubleValue();
}

//nodeCenter[node][2]: preNode(Node)
public synchronized void setPreNode(Node node,Node preNode){
    nodeCenter[node.getLabel()][2]=preNode;
}

public synchronized Node getPreNode(Node node){
    Node preNode=(Node)nodeCenter[node.getLabel()][2];
    return preNode;
}

//nodeCenter[node][3]: preEdge(Edge)
public synchronized void setPreEdge(Node node,Edge preEdge){
    nodeCenter[node.getLabel()][3]=preEdge;
}

public synchronized Edge getPreEdge(Node node){
    Edge preEdge=(Edge)nodeCenter[node.getLabel()][3];
    return preEdge;
}

//nodeCenter[node][4]: visitorSequence(Vector)
public synchronized void addViditor(Node node,Roamer roamer){
    Vector visitorSequence=(Vector)nodeCenter[node.getLabel()][4];
    if(!visitorSequence.contains(roamer))
```

Center.java

```
            visitorSequence.addElement(roamer);
        nodeCenter[node.getLabel()][4]=visitorSequence;
    }

    public synchronized Vector getVisitorSequence(Node node){
        Vector visitorSequence=(Vector)nodeCenter[node.getLabel()][4];
        return visitorSequence;
    }

    public synchronized int getVisitorNum(Node node){
        Vector visitorSequence=(Vector)nodeCenter[node.getLabel()][4];
        int visitorNum=visitorSequence.size();
        return visitorNum;
    }

    public synchronized Roamer lastVisitor(Node node){
        Vector visitorSequence=(Vector)nodeCenter[node.getLabel()][4];
        Roamer lastVisitor=(Roamer)visitorSequence.lastElement();
        return lastVisitor;
    }

    //nodeCenter[node][5]: supply(Node)
    public Node getSupply(Node node){
        return (Node)nodeCenter[node.getLabel()][5];
    }

    //roamerCenter method:
    //roamerCenter[roamer][0]: myNode(Node)
    public synchronized void setMyNode(Roamer roamer,Node myNode){
        roamerCenter[roamer.getID()][0]=myNode;
    }

    public synchronized Node getMyNode(Roamer roamer){
        Node myNode=(Node)roamerCenter[roamer.getID()][0];
        return myNode;
    }

    //roamerCenter[roamer][1]: myEdge(Edge)
    public synchronized void setMyEdge(Roamer roamer,Edge myEdge){
        roamerCenter[roamer.getID()][1]=myEdge;
    }
```

Center.java

```
public synchronized Edge getMyEdge(Roamer roamer){
    Edge myEdge=(Edge)roamerCenter[roamer.getID()][1];
    return myEdge;
}

//roamerCenter[roamer][2]: currNode(Node)
public synchronized void setCurrNode(Roamer roamer,Node currNode){
    roamerCenter[roamer.getID()][2]=currNode;
}

public synchronized Node getCurrNode(Roamer roamer){
    Node currNode=(Node)roamerCenter[roamer.getID()][2];
    return currNode;
}

//roamerCenter[roamer][3]: routeSet(Graph)
public synchronized void setRouteSet(Roamer roamer,Graph routeSet){
    roamerCenter[roamer.getID()][3]=routeSet;
}

public synchronized void setRouteSet(Roamer roamer,Vector routeNodeSet,Vector routeEdgeSet){
    roamerCenter[roamer.getID()][3]=new Graph(routeNodeSet,routeEdgeSet);
}

public synchronized Graph getRouteSet(Roamer roamer){
    Graph routeSet=(Graph)roamerCenter[roamer.getID()][3];
    return routeSet;
}

public synchronized Vector getRouteNodeSet(Roamer roamer){
    Graph routeSet=(Graph)roamerCenter[roamer.getID()][3];
    Vector routeNodeSet=routeSet.getNodeSet();
    return routeNodeSet;
}

public synchronized Vector getRouteEdgeSet(Roamer roamer){
    Graph routeSet=(Graph)roamerCenter[roamer.getID()][3];
    Vector routeEdgeSet=routeSet.getEdgeSet();
    return routeEdgeSet;
}

public synchronized void addEdge(Roamer roamer,Edge edge){
```

Center.java

```
        Graph routeSet=this.getRouteSet(roamer);
        Vector routeNodeSet=routeSet.getNodeSet();
        Vector routeEdgeSet=routeSet.getEdgeSet();
        if(!routeEdgeSet.contains(edge))
            routeEdgeSet.addElement(edge);
        this.setRouteSet(roamer,routeNodeSet,routeEdgeSet);
    }

    public synchronized void addNode(Roamer roamer,Node node){
        Graph routeSet=this.getRouteSet(roamer);
        Vector routeNodeSet=routeSet.getNodeSet();
        Vector routeEdgeSet=routeSet.getEdgeSet();
        if(!routeNodeSet.contains(node))
            routeNodeSet.addElement(node);
        this.setRouteSet(roamer,routeNodeSet,routeEdgeSet);
    }

    public synchronized void removeEdge(Roamer roamer,Edge edge){
        Graph routeSet=this.getRouteSet(roamer);
        Vector routeNodeSet=routeSet.getNodeSet();
        Vector routeEdgeSet=routeSet.getEdgeSet();
        if(routeEdgeSet.contains(edge)){
            routeEdgeSet.removeElement(edge);
        }
        this.setRouteSet(roamer,routeNodeSet,routeEdgeSet);
    }

    public synchronized void removeSubtree(Roamer roamer,Graph subtree){
        Graph routeSet=(Graph)this.roamerCenter[roamer.getID()][3];
        Vector tempNodeSet1=routeSet.getNodeSet();
        Vector tempEdgeSet1=routeSet.getEdgeSet();
        Vector tempNodeSet2=subtree.getNodeSet();
        Vector tempEdgeSet2=subtree.getEdgeSet();

        Node tempNode;
        for(int i=0;i<tempNodeSet2.size();i++){
            tempNode=(Node)tempNodeSet2.elementAt(i);
            boolean nodeExist=tempNodeSet1.removeElement(tempNode);
        }

        Edge tempEdge;
        for(int i=0;i<tempEdgeSet2.size();i++){
```

Center.java

```
            tempEdge=(Edge)tempEdgeSet2.elementAt(i);
            boolean edgeExist=tempEdgeSet1.removeElement(tempEdge);
        }
    }

    public synchronized void addSubtree(Roamer roamer,Graph subtree){
        Graph visitedRouteSet=(Graph)this.roamerCenter[roamer.getID()][3];
        Vector tempNodeSet1=visitedRouteSet.getNodeSet();
        Vector tempEdgeSet1=visitedRouteSet.getEdgeSet();
        Vector tempNodeSet2=subtree.getNodeSet();
        Vector tempEdgeSet2=subtree.getEdgeSet();
        Node tempNode;
        for(int i=0;i<tempNodeSet2.size();i++){
            tempNode=(Node)tempNodeSet2.elementAt(i);
            if(tempNodeSet1.contains(tempNode)){
            }else{
                tempNodeSet1.addElement(tempNode);
            }
        }

        Edge tempEdge;
        for(int i=0;i<tempEdgeSet2.size();i++){
            tempEdge=(Edge)tempEdgeSet2.elementAt(i);
            if(tempEdgeSet1.contains(tempEdge)){
            }else{
                tempEdgeSet1.addElement(tempEdge);
            }
        }
    }

    //fastCenter
    //fastCenter[demand][0]: fastPath(Graph)
    //fastCenter[demand][1]: supply(Node)
    //fastCenter[demand][2]: fastPathLength(Double)
    public double getFastCost(Node demand){
        Double fastCost=(Double)fastCenter[demand.getLabel()][2];
        return fastCost.doubleValue();
    }

    //detourCenter[edge][0]: downstream(Graph)
    public void setDownstream(Edge ruinedEdge,Graph downstream){
        detourCenter[ruinedEdge.getLabel()][0]=downstream;
```

Center.java

```
    }

    public Graph getDownstream(Edge ruinedEdge){
        return (Graph)detourCenter[ruinedEdge.getLabel()][0];
    }

    //detourCenter[edge][1]: upstream(Graph)
    public void setUpstream(Edge ruinedEdge,Graph upstream){
        detourCenter[ruinedEdge.getLabel()][1]=upstream;
    }

    public Graph getUpstream(Edge ruinedEdge){
        return (Graph)detourCenter[ruinedEdge.getLabel()][1];
    }

    //detourCenter[edge][2]: mergeNode(Node)
    public void setMergeNode(Edge ruinedEdge,Node mergeNode){
        detourCenter[ruinedEdge.getLabel()][2]=mergeNode;
    }

    public Node getMergeNode(Edge ruinedEdge){
        return (Node)detourCenter[ruinedEdge.getLabel()][2];
    }

    //detourCenter[edge][3]: accessNode(Node)
    public void setAccessNode(Edge ruinedEdge,Node accessNode){
        detourCenter[ruinedEdge.getLabel()][3]=accessNode;
    }

    public Node getAccessNode(Edge ruinedEdge){
        return (Node)detourCenter[ruinedEdge.getLabel()][3];
    }

    //detourCenter[edge][4]: detourPath(Graph)
    public void setDetourPath(Edge ruinedEdge,Graph detourPath){
        detourCenter[ruinedEdge.getLabel()][4]=detourPath;
    }

    public Graph getDetourPath(Edge ruinedEdge){
        return (Graph)detourCenter[ruinedEdge.getLabel()][4];
    }
```

Center.java

```
//detourCenter[edge][5]: systematicDetourCost(Double)
public void setSystematicDetourCost(Edge ruinedEdge,double sdc){
    detourCenter[ruinedEdge.getLabel()][5]=new Double(sdc);
}

public double getSystematicDetourCost(Edge ruinedEdge){
    Double tempDouble=(Double)detourCenter[ruinedEdge.getLabel()][5];
    return tempDouble.doubleValue();
}

//detourCenter[edge][6]: mergeCost(Vector)
public void setMergeCost(Edge ruinedEdge,double cost){
    detourCenter[ruinedEdge.getLabel()][6]=new Double(cost);
}

public double getMergeCost(Edge ruinedEdge){
    Double mergeCost=(Double)detourCenter[ruinedEdge.getLabel()][6];
    return mergeCost.doubleValue();
}

//maCenter
//maCenter[supply][0]: fastTree(Graph)
public Graph getFastTree(Node supply){
    return (Graph)maCenter[supply.getLabel()][0];
}

//maCenter[supply][1]: territory(Graph) 2ECON
public synchronized void setTerritory(Node supply,Graph territory){
    maCenter[supply.getLabel()][1]=territory;
}

public Graph getTerritory(Node supply){
    return (Graph)maCenter[supply.getLabel()][1];
}

//maCenter[supply][2]: source(Node)
public synchronized void setSource(Node supply,Node source){
    maCenter[supply.getLabel()][2]=source;
}

public Node getSource(Node supply){
    return (Node)maCenter[supply.getLabel()][2];
```

Center.java

```
}

//maCenter[supply][3]: icpSet(Vector)
public synchronized void setICPSet(Node supply,Vector icpSet){
    maCenter[supply.getLabel()][3]=icpSet;
}

public Vector getICPSet(Node supply){
    return (Vector)maCenter[supply.getLabel()][3];
}

public int getICPNum(Node supply){
    Vector icpSet=(Vector)maCenter[supply.getLabel()][3];
    return icpSet.size();
}

//maCenter[supply][4]: maPath(Graph)
public synchronized void setMAPath(Node supply,Graph maPath){
    maCenter[supply.getLabel()][4]=maPath;
}

public Graph getMAPath(Node supply){
    return (Graph)maCenter[supply.getLabel()][4];
}

//maCenter[supply][5]: within territory supply-demand ratio(Double)
public synchronized void setTerritorySDR(Node supply,double territorySDR){
    maCenter[supply.getLabel()][5]=new Double(territorySDR);
}

public double getTerritorySDR(Node supply){
    Double territorySDR=(Double)maCenter[supply.getLabel()][5];
    return territorySDR.doubleValue();
}

//maCenter[supply][6]: mutual assistant supply-demand ratio(Double)
public synchronized void setMAsdr(Node supply,double maSDR){
    maCenter[supply.getLabel()][6]=new Double(maSDR);
}

public double getMAsdr(Node supply){
    Double maSDR=(Double)maCenter[supply.getLabel()][6];
```

Center.java

```
            return maSDR.doubleValue();
        }

        //maCenter[supply][7]: maCost > source to supply
        //including maPath cost & merge cost with respect to territory demandNum
        public synchronized void setMACost(Node supply,double maCost){
            maCenter[supply.getLabel()][7]=new Double(maCost);
        }

        public double getMACost(Node supply){
            Double maCost=(Double)maCenter[supply.getLabel()][7];
            return maCost.doubleValue();
        }
}
```

Detourist.java

```
package emnet.thread;

import emnet.graph.Node;
import emnet.graph.Graph;
import java.util.Vector;
import emnet.graph.Edge;
import emnet.algorithm.GraphAlgorithm;

public class Detourist extends Thread{
    int id;
    Node start,supply,access;
    DetourManager dmr;
    Center center;

    Node currNode,preNode,myNode;
    Edge preEdge,myEdge,currRuinedEdge;
    Graph usableGraph,downstream,upstream,bridge,routeSet,detourPath;
    Vector routeNodeSet,routeEdgeSet,upstreamNodeSet;

    int downstreamDemandNum;
    double mergeCost,systematicDetourCost;

    boolean detouristFinish;



    public Detourist(int id,Node start,DetourManager dmr){
        super(""+id);
        this.id=id;
        this.start=start;
        this.dmr=dmr;
        center=dmr.getCenter();
        supply=dmr.getSupply();

        int edgeNum=dmr.getGraph().getEdgeSet().size();
        Node dummyNode=this.center.getDummyNode();
        dummyNode.setDummy();
        Edge dummyEdge=new Edge(edgeNum,start,dummyNode,0.0);
        dummyEdge.setDummyEdge();

        dmr.getGraph().addNode(dummyNode);
```

Detourist.java

```
        dmr.getGraph().addEdge(dummyEdge);

        Vector routeNodeSet=new Vector();
        routeNodeSet.addElement(dummyNode);
        Vector routeEdgeSet=new Vector();
        routeEdgeSet.addElement(dummyEdge);
        dmr.setRouteSet(this,routeNodeSet,routeEdgeSet);

        dmr.setMyNode(this,dummyNode);
        dmr.setMyEdge(this,dummyEdge);
        dmr.setCurrNode(this,start);

        Vector nodeSet=dmr.getGraph().getNodeSet();
        Vector edgeSet=dmr.getGraph().getEdgeSet();
        Vector usableEdgeSet=new Vector();
        Edge tempEdge;
        for(int i=0;i<edgeSet.size();i++){
            tempEdge=(Edge)edgeSet.elementAt(i);
            if(tempEdge!=dmr.getCurrRuinedEdge())
                usableEdgeSet.addElement(tempEdge);
        }
        usableGraph=new Graph(nodeSet,usableEdgeSet);

        downstream=dmr.getCurrDownstream();
        upstream=dmr.getCurrUpstream();
        upstreamNodeSet=upstream.getNodeSet();

        currRuinedEdge=dmr.getCurrRuinedEdge();
        downstreamDemandNum=dmr.getDownstreamDemandNum();
        mergeCost=GraphAlgorithm.getMergeCost(this,start);
        systematicDetourCost=0.0;

        dmr.setCurrDetourCost(this,dmr.getMyNode(this),mergeCost);
        dmr.setPreNode(this,start,dummyNode);
        dmr.setPreEdge(this,start,dummyEdge);

        detouristFinish=false;
    }

    public int getID(){
        return id;
    }
```

Detourist.java

```
public Graph getUsableGraph(){
    return usableGraph;
}

public Graph getDownstream(){
    return downstream;
}

public Graph getUpstream(){
    return upstream;
}

public DetourManager getDetourManager(){
    return dmr;
}

public Center getCenter(){
    return center;
}

public Node getMergeNode(){
    return start;
}

public Node getAccessNode(){
    return access;
}

public Edge getRuinedEdge(){
    return currRuinedEdge;
}

public double getMergeCost(){
    return mergeCost;
}

public double getSystematicDetourCost(){
    return systematicDetourCost;
}

public Graph getDetourPath(){
```

Detourist.java

```
            return detourPath;
        }

        public void run(){

            dmr.takeKey(this);

            //::map init::
            Vector edgeSet=center.getGraph().getEdgeSet();
            Edge tempEdge;
            for(int i=0;i<edgeSet.size();i++){
                tempEdge=(Edge)edgeSet.elementAt(i);
                if(!tempEdge.isFastEdge() && !tempEdge.isDetourEdge() && !tempEdge.isMAEdge())
                    tempEdge.setNeutralEdge();
            }
            //::map init::

            detouring:
            while(!detouristFinish){
                if(dmr.getCurrNode(this)==supply){
                    double
sdc=dmr.getCurrDetourCost(this,dmr.getMyNode(this))+dmr.getMyEdge(this).getWeight()*downstreamDemandNum;
                    dmr.setCurrDetourCost(this,dmr.getCurrNode(this),sdc);

                    dmr.addNode(this,supply);
                    dmr.addEdge(this,dmr.getMyEdge(this));

                    dmr.setPreNode(this,supply,dmr.getMyNode(this));
                    dmr.setPreEdge(this,supply,dmr.getMyEdge(this));

                    dmr.updatMinSDC(this,dmr.getCurrDetourCost(this,dmr.getSupply()));

                    dmr.getMyEdge(this).setDetourTestEdge(true);

                    break detouring;
                }else if(dmr.getMinSDC(this)!=0.0 &&
dmr.getMinSDC(this)<dmr.getCurrDetourCost(this,dmr.getMyNode(this))){
                    //some detourist has already found a shorter detour path
                    break detouring;
                }else{
                    dmr.addNode(this,dmr.getCurrNode(this));
                    dmr.addEdge(this,dmr.getMyEdge(this));
```

Detourist.java

```
                dmr.setPreNode(this,dmr.getCurrNode(this),dmr.getMyNode(this));
                dmr.setPreEdge(this,dmr.getCurrNode(this),dmr.getMyEdge(this));

                double
sdc=dmr.getCurrDetourCost(this,dmr.getMyNode(this))+dmr.getMyEdge(this).getWeight()*downstreamDemandNum;
                dmr.setCurrDetourCost(this,dmr.getCurrNode(this),sdc);

                dmr.getMyEdge(this).setDetourTestEdge(true);
                dmr.setMyNode(this,dmr.getCurrNode(this));

                //find currEdge & currNode, assign new myNode
                dijkstra(null);

                try{
                    sleep(1);
                }catch(InterruptedException ex){
                }

            }

        }

        //set access node
        Vector detourPathNodeSet=new Vector(),detourPathEdgeSet=new Vector();
        Node tempCurrNode=dmr.getSupply();
        detourPathNodeSet.addElement(tempCurrNode);

        Edge tempPreEdge;
        Node n1,n2;
        do{
            tempPreEdge=dmr.getPreEdge(this,tempCurrNode);

            if(!detourPathEdgeSet.contains(tempPreEdge))
                detourPathEdgeSet.addElement(tempPreEdge);

            n1=tempPreEdge.getN1();
            n2=tempPreEdge.getN2();

            if(!detourPathNodeSet.contains(n1))
                detourPathNodeSet.addElement(n1);
            if(!detourPathNodeSet.contains(n2))
```

Detourist.java

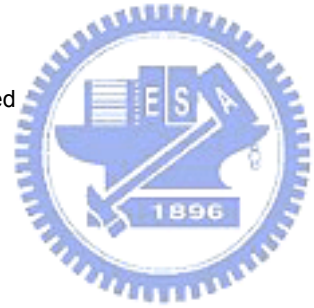
```
                detourPathNodeSet.addElement(n2);

            if(upstreamNodeSet.contains(n1) && !upstreamNodeSet.contains(n2)){
                access=n1;
            }else if(upstreamNodeSet.contains(n2) && !upstreamNodeSet.contains(n1)){
                access=n2;
            }else{
                access=null;
            }

            tempCurrNode=dmr.getPreNode(this,tempCurrNode);
        }while(tempCurrNode!=start);

        if(!detourPathNodeSet.contains(start))
            detourPathNodeSet.addElement(start);

        //set detourPath
        detourPath=new Graph(detourPathNodeSet,detourPathEdgeSet);

        //set sdc
        systematicDetourCost=dmr.getCurrDetourCost(this,supply);
        dmr.setSystematicDetourCost(this,systematicDetourCost);

        dmr.updateCurrRuinedEdgeFinish();
        dmr.updateDetourCenter(this);

        dmr.putKey(this);
    }

    void dijkstra(Edge canceledEdge){

        //find out the best incident edge
        //define new myEdge & currNode
        Vector tempRouteNodeSet=(Vector)dmr.getRouteNodeSet(this);

        Vector incidentEdgeSet=GraphAlgorithm.getIncidentEdges(this,tempRouteNodeSet);
        Vector exclusiveIncidentEdgeSet=new Vector();
        for(int i=0;i<incidentEdgeSet.size();i++){
            if(!dmr.getRouteEdgeSet(this).contains(incidentEdgeSet.elementAt(i))){
                exclusiveIncidentEdgeSet.addElement(incidentEdgeSet.elementAt(i));
            }
        }
```

Detourist.java

```
        Edge tempEdge;
        Node n1,n2;

        if(exclusiveIncidentEdgeSet.size()>1){
            tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(0);
            dmr.setMyEdge(this,tempEdge);
            n1=tempEdge.getN1();
            n2=tempEdge.getN2();
            if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                dmr.setMyNode(this,n1);
                dmr.setCurrNode(this,n2);
            }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                dmr.setMyNode(this,n2);
                dmr.setCurrNode(this,n1);
            }else{
                //dijkstra error 1: not incident edge! check GraphAlgorithm.getIncidentEdgeSet()
            }

            double
min=dmr.getCurrDetourCost(this,dmr.getMyNode(this))+dmr.getMyEdge(this).getWeight()*downstreamDemandNum;

            for(int i=1;i<exclusiveIncidentEdgeSet.size();i++){
                tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(i);
                n1=tempEdge.getN1();
                n2=tempEdge.getN2();
                if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                    if((dmr.getCurrDetourCost(this,n1)+tempEdge.getWeight()*downstreamDemandNum)<min){
                        min=dmr.getCurrDetourCost(this,n1)+tempEdge.getWeight()*downstreamDemandNum;
                        dmr.setMyEdge(this,tempEdge);
                        dmr.setMyNode(this,n1);
                        dmr.setCurrNode(this,n2);
                    }
                }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                    if((dmr.getCurrDetourCost(this,n2)+tempEdge.getWeight()*downstreamDemandNum)<min){
                        min=dmr.getCurrDetourCost(this,n2)+tempEdge.getWeight()*downstreamDemandNum;
                        dmr.setMyEdge(this,tempEdge);
                        dmr.setMyNode(this,n2);
                        dmr.setCurrNode(this,n1);
                    }
                }else{
                    //dijkstra error 2: incident edge error!
```

Detourist.java

```
                    }
                }

            }else if(exclusiveIncidentEdgeSet.size()==1){
                tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(0);
                dmr.setMyEdge(this,tempEdge);
                n1=tempEdge.getN1();
                n2=tempEdge.getN2();
                if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                    dmr.setMyNode(this,n1);
                    dmr.setCurrNode(this,n2);
                }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                    dmr.setMyNode(this,n2);
                    dmr.setCurrNode(this,n1);
                }else{
                    //dijkstra error 3: not incident edge! check GraphAlgorithm.getIncidentEdgeSet()
                }
            }else{
                detouristFinish=true;
                //renders all nodes visited
            }
        }
}
```



DetourManager.java

```
package emnet.thread;

import emnet.graph.Node;
import emnet.graph.Graph;
import java.util.Vector;
import emnet.graph.Edge;
import emnet.algorithm.GraphAlgorithm;

public class DetourManager extends Thread{

    int id;
    Center center;
    Node supply;
    Graph graph,fastTree,territory;
    Vector edgeSet,nodeSet,fastTreeEdgeSet,fastTreeNodeSet,detourists,territoryNodeSet,territoryEdgeSet;
    int detouristNum,downstreamDemandNum;

    //nodeDept
    //nodeDept[detourist][node][0]: currDetourDist
    //nodeDept[detourist][node][1]: preNode
    //nodeDept[detourist][node][2]: preEdge
    Object[][][] nodeDept;

    //detourDept
    //detourDept[detourist][0]: myNode(Node)
    //detourDept[detourist][1]: myEdge(Edge)
    //detourDept[detourist][2]: currNode(Node)
    //detourDept[detourist][3]: routeSet(Graph)
    //detourDept[detourist][4]: detourLength(Double)
    //deoutrDept[detourist][5]: bridge(Graph)
    Object[][] detourDept;

    //sdcDept
    //sdcDept[ruinedEdge][0]: minSDC
    Object[][] sdcDept;

    Edge currRuinedEdge;
    Graph currUpstream,currDownstream;
    Vector currDownstreamNodeSet;

    boolean currRuinedEdgeFinish,available;
```

DetourManager.java

```
    //one manager controls one territory
    public DetourManager(int id,Center center,Node supply){
        this.id=id;
        this.center=center;
        this.supply=supply;

        graph=center.getGraph();
        edgeSet=graph.getEdgeSet();
        nodeSet=graph.getNodeSet();

        fastTree=center.getFastTree(supply);
        fastTreeEdgeSet=fastTree.getEdgeSet();
        fastTreeNodeSet=fastTree.getNodeSet();

//          detouristNum=fastTreeNodeSet.size();

        nodeDept=new Object[fastTreeNodeSet.size()][nodeSet.size()][3];
        detourDept=new Object[fastTreeNodeSet.size()][6];

        if(fastTreeEdgeSet.size()!=0){
            Edge tempFastTreeEdge=(Edge)fastTreeEdgeSet.elementAt(0);
            int maxEdgeLabel=tempFastTreeEdge.getLabel();
            for(int j=1;j<fastTreeEdgeSet.size();j++){
                tempFastTreeEdge=(Edge)fastTreeEdgeSet.elementAt(j);
                if(tempFastTreeEdge.getLabel()>maxEdgeLabel)
                    maxEdgeLabel=tempFastTreeEdge.getLabel();
            }
            sdcDept=new Object[maxEdgeLabel+1][1];
        }
    }

    public void run(){

        if(fastTreeEdgeSet==null){
            center.updateDetourCondition();
            destroy();
        }
        center.takeKey(this);

        for(int i=0;i<fastTreeEdgeSet.size();i++){
```

DetourManager.java

```
//initialization
currRuinedEdgeFinish=false;
available=true;

for(int j=0;j<fastTreeNodeSet.size();j++){
    Node tempNode;
    for(int k=0;j<fastTreeNodeSet.size();j++){
        tempNode=(Node)fastTreeNodeSet.elementAt(j);
        nodeDept[j][tempNode.getLabel()][0]=new Double(0.0);
    }
}

for(int j=0;j<detouristNum;j++){
    detourDept[j][0]=null;
    detourDept[j][1]=null;
    detourDept[j][2]=null;
    detourDept[j][3]=null;
    detourDept[j][4]=new Double(0.0);
    detourDept[j][5]=null;
}

Edge tempFastTreeEdge;
for(int j=0;j<fastTreeEdgeSet.size();j++){
    tempFastTreeEdge=(Edge)fastTreeEdgeSet.elementAt(j);
    sdcDept[tempFastTreeEdge.getLabel()][0]=new Double(0.0);
}

currRuinedEdge=(Edge)fastTreeEdgeSet.elementAt(i);
currUpstream=GraphAlgorithm.getSubtreeWithSupply(fastTree,currRuinedEdge);
currDownstream=GraphAlgorithm.getSubtreeWithoutSupply(fastTree,currRuinedEdge);
currDownstreamNodeSet=currDownstream.getNodeSet();
detouristNum=currDownstreamNodeSet.size();

Node tempNode;
downstreamDemandNum=0;
for(int k=0;k<currDownstreamNodeSet.size();k++){
    tempNode=(Node)currDownstreamNodeSet.elementAt(k);
    if(tempNode.isDemand())
        downstreamDemandNum++;
}

//one detourist tests from one node when one currRuinedEdge is simulated
```

DetourManager.java

```
        Detourist tempDetourist;
        detourists=new Vector();
        for(int j=0;j<currDownstreamNodeSet.size();j++){
            tempNode=(Node)currDownstreamNodeSet.elementAt(j);
            tempDetourist=new Detourist(j,tempNode,this);
            detourists.addElement(tempDetourist);
            tempDetourist.start();
        }

        //dmr waiting the currRuinedEdge finish
        while(!currRuinedEdgeFinish){
        }

        //currRuinedEdge finish: all situations simulated
        //set detour edges on the shortest detour route
        Detourist bestDetourist=(Detourist)detourists.elementAt(0);
        Detourist tempDetourist1;
        double minSDC=bestDetourist.getSystematicDetourCost();
        for(int j=1;j<detourists.size();j++){
            tempDetourist1=(Detourist)detourists.elementAt(j);
            if(tempDetourist1.getSystematicDetourCost()<minSDC){
                minSDC=tempDetourist1.getSystematicDetourCost();
                bestDetourist=tempDetourist1;
            }
        }

        Vector bestDetourPathEdgeSet=bestDetourist.getDetourPath().getEdgeSet();
        Edge tempEdge1;
        for(int j=0;j<bestDetourPathEdgeSet.size();j++){
            tempEdge1=(Edge)bestDetourPathEdgeSet.elementAt(j);
            tempEdge1.setDetourEdge();
        }
    }

    //::maCenter[supply][1]: territory(Graph) 2ECON::
    Graph territory=fastTree;
    Edge tempRuinedEdge;
    Graph tempDetourPath;
    Vector tempDetourPathNodeSet,tempDetourPathEdgeSet;
    Node tempDetourPathNode;
    Edge tempDetourPathEdge;
    for(int i=0;i<fastTreeEdgeSet.size();i++){
```

DetourManager.java

```
                tempRuinedEdge=(Edge)fastTreeEdgeSet.elementAt(i);
                tempDetourPath=center.getDetourPath(tempRuinedEdge);
                if(tempDetourPath!=null){
                    tempDetourPathNodeSet=tempDetourPath.getNodeSet();
                    tempDetourPathEdgeSet=tempDetourPath.getEdgeSet();
                    if(tempDetourPathNodeSet!=null){
                        for(int j=0;j<tempDetourPathNodeSet.size();j++){
                            tempDetourPathNode=(Node)tempDetourPathNodeSet.elementAt(j);
                            if(!territory.hasNode(tempDetourPathNode))
                                territory.addNode(tempDetourPathNode);
                        }
                    }
                    if(tempDetourPathEdgeSet!=null){
                        for(int j=0;j<tempDetourPathEdgeSet.size();j++){
                            tempDetourPathEdge=(Edge)tempDetourPathEdgeSet.elementAt(j);
                            if(!territory.hasEdge(tempDetourPathEdge))
                                territory.addEdge(tempDetourPathEdge);
                        }
                    }
                }else{
                    //tempDetourPath is null!
                }
            }

            center.setTerritory(supply,territory);
            //::maCenter[supply][1]: territory(Graph) 2ECON::

            center.updateDetourCondition();
            center.putKey(this);
        }

        //detourDept method:
        public synchronized void takeKey(Detourist detourist){
            if(!currRuinedEdgeFinish){
                while(!available){
                    try{
                        wait(1);
                    }catch(InterruptedException e){
                        //takeKey: cannot wait!
                    }
                }
                available=false;
```

DetourManager.java

```
        }else{
            available=false;
        }
    }

    public synchronized void putKey(Detourist detourist){
        if(!isCurrRuinedEdgeFinish()){
            while(available){
                try{
                    wait(1);
                }catch(InterruptedException e){
                    //putKey: cannot wait!
                }
            }
            available=true;
        }else{
            available=true;
        }
    }

    public synchronized boolean isFinished(){
        return currRuinedEdgeFinish;
    }

    void sendDetourist(Graph downstream){
        Vector fastTreeNodeSet=downstream.getNodeSet();
        Node tempNode;
        for(int i=0;i<fastTreeNodeSet.size();i++){
            tempNode=(Node)fastTreeNodeSet.elementAt(i);
            new Detourist(i,tempNode,this).start();
        }
    }

    public synchronized void setCurrRuinedEdgeFinish(boolean currRuinedEdgeFinish){
        this.currRuinedEdgeFinish=currRuinedEdgeFinish;
    }

    public Edge getCurrRuinedEdge(){
        return currRuinedEdge;
    }

    public Graph getCurrUpstream(){
```

DetourManager.java

```
        return currUpstream;
    }

    public Graph getCurrDownstream(){
        return currDownstream;
    }

    public Graph getGraph(){
        return center.getGraph();
    }

    public void setPreNode(Detourist detourist,Node node,Node preNode){
        nodeDept[detourist.getID()][node.getLabel()][1]=preNode;
    }

    public Node getPreNode(Detourist detourist,Node node){
        return (Node)nodeDept[detourist.getID()][node.getLabel()][1];
    }

    public void setPreEdge(Detourist detourist,Node node,Edge preEdge){
        nodeDept[detourist.getID()][node.getLabel()][2]=preEdge;
    }

    public Edge getPreEdge(Detourist detourist,Node node){
        return (Edge)nodeDept[detourist.getID()][node.getLabel()][2];
    }

    public int getDownstreamDemandNum(){
        return downstreamDemandNum;
    }

    public Center getCenter(){
        return center;
    }

    public Node getSupply(){
        return supply;
    }

    public int getID(){
        return id;
    }
```

DetourManager.java

```
public synchronized void updateCurrRuinedEdgeFinish(){
    detouristNum--;
    if(detouristNum==0){
        currRuinedEdgeFinish=true;
    }else{
        currRuinedEdgeFinish=false;
    }
}

public synchronized boolean isCurrRuinedEdgeFinish(){
    return currRuinedEdgeFinish;
}

public synchronized void updateDetourCenter(Detourist detourist){
    Center center=detourist.getCenter();
    DetourManager dmr=detourist.getDetourManager();
    Edge ruinedEdge=detourist.getRuinedEdge();

    //detourCenter[edge][0]: downstream(Graph)
    //detourCenter[edge][1]: upstream(Graph)
    //detourCenter[edge][2]: mergeNode(Node)
    //detourCenter[edge][3]: accessNode(Node)
    //detourCenter[edge][4]: detourPath(Graph)
    //detourCenter[edge][5]: systematicDetourCost(Double)
    //detourCenter[edge][6]: mergeCost(Vector)

    //maCenter[supply][1]: territory(Graph) 2ECON

    double detouristDetourLength=dmr.getSystematicDetourCost(detourist);
    double centerDetourLengthRecord=center.getSystematicDetourCost(detourist.getRuinedEdge());
    if(centerDetourLengthRecord==0.0 || detouristDetourLength<centerDetourLengthRecord){

        center.setDownstream(ruinedEdge,detourist.getDownstream());
        center.setUpstream(ruinedEdge,detourist.getUpstream());
        center.setMergeNode(ruinedEdge,detourist.getMergeNode());
        center.setAccessNode(ruinedEdge,detourist.getAccessNode());
        center.setDetourPath(ruinedEdge,detourist.getDetourPath());
        center.setSystematicDetourCost(ruinedEdge,detouristDetourLength);
        center.setMergeCost(ruinedEdge,detourist.getMergeCost());

        //detouristDetourLength is smaller than center record
```

DetourManager.java

```
        }else{
            //detouristDetourLength is larger than center record
        }
    }

    //detourDept method:
    //detourDept[detourist][0]: myNode(Node)
    public synchronized void setMyNode(Detourist detourist,Node myNode){
        detourDept[detourist.getID()][0]=myNode;
    }

    public synchronized Node getMyNode(Detourist detourist){
        Node myNode=(Node)detourDept[detourist.getID()][0];
        return myNode;
    }

    //detourDept[detourist][1]: myEdge(Edge)
    public synchronized void setMyEdge(Detourist detourist,Edge myEdge){
        detourDept[detourist.getID()][1]=myEdge;
    }

    public synchronized Edge getMyEdge(Detourist detourist){
        Edge myEdge=(Edge)detourDept[detourist.getID()][1];
        return myEdge;
    }

    //detourDept[detourist][2]: currNode(Node)
    public synchronized void setCurrNode(Detourist detourist,Node currNode){
        detourDept[detourist.getID()][2]=currNode;
    }

    public synchronized Node getCurrNode(Detourist detourist){
        Node currNode=(Node)detourDept[detourist.getID()][2];
        return currNode;
    }

    //detourDept[detourist][3]: routeSet(Graph)
    public synchronized void setRouteSet(Detourist detourist,Graph routeSet){
        detourDept[detourist.getID()][3]=routeSet;
    }

    public synchronized void setRouteSet(Detourist detourist,Vector routeNodeSet,Vector routeEdgeSet){
```

DetourManager.java

```
        detourDept[detourist.getID()][3]=new Graph(routeNodeSet,routeEdgeSet);
    }

    public synchronized Graph getRouteSet(Detourist detourist){
        Graph routeSet=(Graph)detourDept[detourist.getID()][3];
        return routeSet;
    }

    public synchronized Vector getRouteNodeSet(Detourist detourist){
        Graph routeSet=(Graph)detourDept[detourist.getID()][3];
        Vector routeNodeSet=routeSet.getNodeSet();
        return routeNodeSet;
    }

    public synchronized Vector getRouteEdgeSet(Detourist detourist){
        Graph routeSet=(Graph)detourDept[detourist.getID()][3];
        Vector routeEdgeSet=routeSet.getEdgeSet();
        return routeEdgeSet;
    }

    public synchronized void addEdge(Detourist detourist,Edge edge){
        Graph routeSet=this.getRouteSet(detourist);
        Vector routeNodeSet=routeSet.getNodeSet();
        Vector routeEdgeSet=routeSet.getEdgeSet();
        if(!routeEdgeSet.contains(edge))
            routeEdgeSet.addElement(edge);
        this.setRouteSet(detourist,routeNodeSet,routeEdgeSet);
    }

    public synchronized void addNode(Detourist detourist,Node node){
        Graph routeSet=this.getRouteSet(detourist);
        Vector routeNodeSet=routeSet.getNodeSet();
        Vector routeEdgeSet=routeSet.getEdgeSet();
        if(!routeNodeSet.contains(node))
            routeNodeSet.addElement(node);
        this.setRouteSet(detourist,routeNodeSet,routeEdgeSet);
    }

    public synchronized void removeEdge(Detourist detourist,Edge edge){
        Graph routeSet=this.getRouteSet(detourist);
        Vector routeNodeSet=routeSet.getNodeSet();
        Vector routeEdgeSet=routeSet.getEdgeSet();
```

DetourManager.java

```
        if(routeEdgeSet.contains(edge)){
            routeEdgeSet.removeElement(edge);
        }
        this.setRouteSet(detourist,routeNodeSet,routeEdgeSet);
    }

    public synchronized void removeSubtree(Detourist detourist,Graph subtree){
        Graph routeSet=(Graph)this.detourDept[detourist.getID()][3];
        Vector tempNodeSet1=routeSet.getNodeSet();
        Vector tempEdgeSet1=routeSet.getEdgeSet();
        Vector tempNodeSet2=subtree.getNodeSet();
        Vector tempEdgeSet2=subtree.getEdgeSet();

        Node tempNode;
        for(int i=0;i<tempNodeSet2.size();i++){
            tempNode=(Node)tempNodeSet2.elementAt(i);
            boolean nodeExist=tempNodeSet1.removeElement(tempNode);
        }

        Edge tempEdge;
        for(int i=0;i<tempEdgeSet2.size();i++){
            tempEdge=(Edge)tempEdgeSet2.elementAt(i);
            boolean edgeExist=tempEdgeSet1.removeElement(tempEdge);
        }
    }

    public synchronized void addSubtree(Detourist detourist,Graph subtree){

        Graph visitedRouteSet=(Graph)this.detourDept[detourist.getID()][3];
        Vector tempNodeSet1=visitedRouteSet.getNodeSet();
        Vector tempEdgeSet1=visitedRouteSet.getEdgeSet();
        Vector tempNodeSet2=subtree.getNodeSet();
        Vector tempEdgeSet2=subtree.getEdgeSet();

        Node tempNode;
        for(int i=0;i<tempNodeSet2.size();i++){
            tempNode=(Node)tempNodeSet2.elementAt(i);
            if(tempNodeSet1.contains(tempNode)){
            }else{
                tempNodeSet1.addElement(tempNode);
            }
        }
```

DetourManager.java

```
        Edge tempEdge;
        for(int i=0;i<tempEdgeSet2.size();i++){
            tempEdge=(Edge)tempEdgeSet2.elementAt(i);
            if(tempEdgeSet1.contains(tempEdge)){
            }else{
                tempEdgeSet1.addElement(tempEdge);
            }
        }
    }

    //detourDept[detourist][4]: detourLength(Double)
    public void setSystematicDetourCost(Detourist detourist, double sdc){
        detourDept[detourist.getID()][4]=new Double(sdc);
    }

    public double getSystematicDetourCost(Detourist detourist){
        Double sdc=(Double)detourDept[detourist.getID()][4];
        return sdc.doubleValue();
    }


    public void setCurrDetourCost(Detourist detourist,Node node,double sdc){
        nodeDept[detourist.getID()][node.getLabel()][0]=new Double(sdc);
    }

    public double getCurrDetourCost(Detourist detourist,Node node){
        Double tempDouble=(Double)nodeDept[detourist.getID()][node.getLabel()][0];
        return tempDouble.doubleValue();
    }

    //detourCenter:
    public synchronized void updateMinSDC(double sdc){
        double currSDC=center.getSystematicDetourCost(currRuinedEdge);
        if(currSDC==0.0 || sdc<currSDC)
            center.setSystematicDetourCost(currRuinedEdge,sdc);
    }

    public synchronized double getMinSDC(){
        return center.getSystematicDetourCost(currRuinedEdge);
    }
```

DetourManager.java

```
	//deoutrDept[detourist][5]: bridge(Graph)
	//sdcDept
	//sdcDept[ruinedEdge][0]: minSDC
	public synchronized void updatMinSDC(Detourist detourist,double sdc){
		Edge ruinedEdge=detourist.getRuinedEdge();
		DetourManager dmr=detourist.getDetourManager();
		double currSDC=dmr.getMinSDC(detourist);
		if(sdc<currSDC)
			sdcDept[ruinedEdge.getLabel()][0]=new Double(sdc);
	}

	public synchronized double getMinSDC(Detourist detourist){
		Edge ruinedEdge=detourist.getRuinedEdge();
		Double minSDC=(Double)sdcDept[ruinedEdge.getLabel()][0];
		return minSDC.doubleValue();
	}
}
```

Helper.java

```
package emnet.thread;

import java.util.Vector;
import emnet.graph.Node;
import emnet.graph.Graph;
import emnet.graph.Edge;

public class Helper extends Thread{
	int id;
	MAManager maMr;
	Node start,source;

	Node currNode,preNode,myNode;
	Edge preEdge,myEdge;

	Graph maPath;

	//maCost = mergeCost + demandNum * bridgeLength(maPath)
	double maCost;

	//for merge cost
	//walkerCenter[node][]:
	//nodeDept
	//nodeDept[node][0]: currCost
	//nodeDept[node][1]: preNode
	//nodeDept[node][2]: preEdge
	Object[][] nodeDept;

	//walkerDept
	//walkerDept[0]: myNode(Node)
	//walkerDept[1]: myEdge(Edge)
	//walkerDept[2]: currNode(Node)
	//walkerDept[3]: routeSet(Graph)
	Object[] walkerDept;

	boolean helperFinish,longer,exclusiveIsZero;

	public Helper(int id,Node start,MAManager maMr){

		this.id=id;
		this.start=start;
```

```
        this.maMr=maMr;
        this.source=null;

        //nodeDept
        nodeDept=new Object[maMr.getGraph().getNodeSet().size()][3];

        //walkerDept
        walkerDept=new Object[4];

        Node dummyNode=maMr.getCenter().getDummyNode();
        dummyNode.setDummy();
        int edgeNum=maMr.getGraph().getEdgeSet().size();
        Edge dummyEdge=new Edge(edgeNum,start,dummyNode,0.0);
        dummyEdge.setDummyEdge();

        maMr.getGraph().addNode(dummyNode);
        maMr.getGraph().addEdge(dummyEdge);

        //helper init, set to maMr
        Vector routeNodeSet=new Vector();
        routeNodeSet.addElement(dummyNode);
        Vector routeEdgeSet=new Vector();
        routeEdgeSet.addElement(dummyEdge);

        maMr.setRouteSet(this,routeNodeSet,routeEdgeSet);
        maMr.setMyNode(this,dummyNode);
        maMr.setMyEdge(this,dummyEdge);
        maMr.setCurrNode(this,start);

        double mergeCost=getECONMergeCost(start);

        maMr.setCurrMACost(this,maMr.getMyNode(this),mergeCost);
        maMr.setPreNode(this,start,dummyNode);
        maMr.setPreEdge(this,start,dummyEdge);
        maCost=0.0;
        helperFinish=false;
        longer=false;
        exclusiveIsZero=false;
    }

    public int getID(){
        return id;
```

```
}

public Node getStart(){
    return start;
}

public MAManager getMAManger(){
    return maMr;
}

public double getMACost(){
    return maCost;
}

public Graph getMAPath(){
    return maPath;
}

public Node getSource(){
    return source;
}

public void run(){
    maMr.takeKey(this);

    //::map init::
    Vector edgeSet=maMr.getCenter().getGraph().getEdgeSet();
    Edge tempEdge;
    for(int i=0;i<edgeSet.size();i++){
        tempEdge=(Edge)edgeSet.elementAt(i);
        if(!tempEdge.isFastEdge() && !tempEdge.isDetourEdge() && !tempEdge.isMAEdge())
            tempEdge.setNeutralEdge();
    }
    //::map init::

    maHelping:
    while(!helperFinish){

        if(maMr.getCurrNode(this).isSupply() && maMr.getCurrNode(this)!=maMr.getSupply()){

            source=maMr.getCurrNode(this);
```

Helper.java

```
                double
currMACost=maMr.getCurrMACost(this,maMr.getMyNode(this))+maMr.getMyEdge(this).getWeight()*maMr.getDemanNum();
                maMr.setCurrMACost(this,maMr.getCurrNode(this),currMACost);

                maMr.addNode(this,maMr.getCurrNode(this));
                maMr.addEdge(this,maMr.getMyEdge(this));

                maMr.setPreNode(this,maMr.getCurrNode(this),maMr.getMyNode(this));
                maMr.setPreEdge(this,maMr.getCurrNode(this),maMr.getMyEdge(this));

                maMr.updateMinMACost(maMr.getCurrMACost(this,maMr.getCurrNode(this)));

                maMr.getMyEdge(this).setMATestEdge(true);

                break maHelping;
            }else if(maMr.getMinMACost()!=0.0 &&
maMr.getMinMACost()<maMr.getCurrMACost(this,maMr.getMyNode(this))){
                //some detourist has already found a shorter detour path
                longer=true;
                break maHelping;
            }else{
                maMr.addNode(this,maMr.getCurrNode(this));
                maMr.addEdge(this,maMr.getMyEdge(this));

                maMr.setPreNode(this,maMr.getCurrNode(this),maMr.getMyNode(this));
                maMr.setPreEdge(this,maMr.getCurrNode(this),maMr.getMyEdge(this));

                double
currMACost=maMr.getCurrMACost(this,maMr.getMyNode(this))+maMr.getMyEdge(this).getWeight()*maMr.getDemanNum();
                maMr.setCurrMACost(this,maMr.getCurrNode(this),currMACost);

                maMr.getMyEdge(this).setMATestEdge(true);
                maMr.setMyNode(this,maMr.getCurrNode(this));

                //find currEdge & currNode, assign new myNode
                dijkstra();

                try{
                    sleep(1);
                }catch(InterruptedException ex){
                    System.out.println("maMr "+maMr.getID()+", helper "+getID()+" cannot sleep: "+ex);
                }
```

Helper.java

```
            }
        }

        //helper finished!
        //maPath setting:
        if(!longer && !exclusiveIsZero){
            Vector maPathNodeSet=new Vector();
            Vector maPathEdgeSet=new Vector();

            Node tempCurrNode=maMr.getCurrNode(this);
            Edge tempPreEdge;

            maPathSetting:
            do{
                if(!maPathNodeSet.contains(tempCurrNode))
                    maPathNodeSet.addElement(tempCurrNode);

                tempPreEdge=maMr.getPreEdge(this,tempCurrNode);

                //tempPreEdge!=null
                if(!tempPreEdge.isDummyEdge()){
                    if(!maPathEdgeSet.contains(tempPreEdge))
                        maPathEdgeSet.addElement(tempPreEdge);

                    tempCurrNode=maMr.getPreNode(this,tempCurrNode);
                }else{
                    break maPathSetting;
                }

            }while(tempCurrNode!=start);

            if(!maPathNodeSet.contains(start))
                maPathNodeSet.addElement(start);

            maPath=new Graph(maPathNodeSet,maPathEdgeSet);

            //update mutual assistant path to center
            //maCost setting:
            maCost=maMr.getCurrMACost(this,maMr.getCurrNode(this));
        }
        maMr.updateMAFinish();
        maMr.putKey(this);
```

Helper.java

```
    }

    void dijkstra(){
        //find out the best incident edge
        //define new myEdge & currNode
        Graph tempRouteSet=(Graph)maMr.getRouteSet(this);
        Vector tempRouteNodeSet=(Vector)tempRouteSet.getNodeSet();

        Vector incidentEdgeSet=getIncidentEdgeSet(maMr.getUsableGraph(),tempRouteNodeSet);

        Vector exclusiveIncidentEdgeSet=new Vector();
        for(int i=0;i<incidentEdgeSet.size();i++){
            if(!maMr.getRouteEdgeSet(this).contains(incidentEdgeSet.elementAt(i))){
                exclusiveIncidentEdgeSet.addElement(incidentEdgeSet.elementAt(i));
            }
        }

        Edge tempEdge;
        Node n1,n2;

        if(exclusiveIncidentEdgeSet.size()>1){
            tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(0);
            maMr.setMyEdge(this,tempEdge);
            n1=tempEdge.getN1();
            n2=tempEdge.getN2();
            if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                maMr.setMyNode(this,n1);
                maMr.setCurrNode(this,n2);
            }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                maMr.setMyNode(this,n2);
                maMr.setCurrNode(this,n1);
            }else{
                //dijkstra error 1: not incident edge! check GraphAlgorithm.getIncidentEdgeSet()
            }
            double
min=maMr.getCurrMACost(this,maMr.getMyNode(this))+maMr.getMyEdge(this).getWeight()*maMr.getDemanNum();
            for(int i=1;i<exclusiveIncidentEdgeSet.size();i++){
                tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(i);
                n1=tempEdge.getN1();
                n2=tempEdge.getN2();
                if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                    if(maMr.getCurrMACost(this,n1)+tempEdge.getWeight()*maMr.getDemanNum()<min){
```

Helper.java

```
                        min=maMr.getCurrMACost(this,n1)+tempEdge.getWeight()*maMr.getDemanNum();
                        maMr.setMyEdge(this,tempEdge);
                        maMr.setMyNode(this,n1);
                        maMr.setCurrNode(this,n2);
                    }
                }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                    if(maMr.getCurrMACost(this,n2)+tempEdge.getWeight()*maMr.getDemanNum()<min){
                        min=maMr.getCurrMACost(this,n2)+tempEdge.getWeight()*maMr.getDemanNum();
                        maMr.setMyEdge(this,tempEdge);
                        maMr.setMyNode(this,n2);
                        maMr.setCurrNode(this,n1);
                    }
                }else{
                    //dijkstra error 2: incident edge error!"
                }
            }
        }else if(exclusiveIncidentEdgeSet.size()==1){
            tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(0);
            maMr.setMyEdge(this,tempEdge);
            n1=tempEdge.getN1();
            n2=tempEdge.getN2();
            if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                maMr.setMyNode(this,n1);
                maMr.setCurrNode(this,n2);
            }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                maMr.setMyNode(this,n2);
                maMr.setCurrNode(this,n1);
            }else{
                //dijkstra error 3: not incident edge! check GraphAlgorithm.getIncidentEdgeSet()
            }
        }else{
            exclusiveIsZero=true;
            helperFinish=true;
            //renders all nodes visited
        }

    }

    double getECONMergeCost(Node node){
        Walker walker=new Walker(this,node);
        walker.start();
```

Helper.java

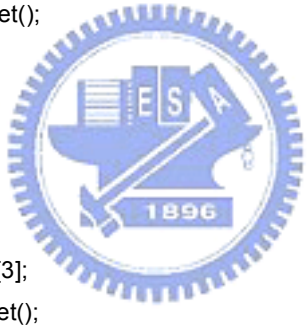
```
        while(!walker.isFinish()){
            //wait for walker to calculate merge cost
        }
        return walker.getTerritoryMergeCost();
    }

    Vector getIncidentEdgeSet(Graph usableGraph,Vector routeNodeSet){
        Edge myEdge=maMr.getMyEdge(this);

        Vector incidentEdges=new Vector();
        Edge tempEdge;
        Node n1,n2;

        for(int i=0;i<routeNodeSet.size();i++){
            Vector tempEdgeSet=usableGraph.incidentEdgeSet((Node)routeNodeSet.elementAt(i));
            for(int j=0;j<tempEdgeSet.size();j++){
                tempEdge=(Edge)tempEdgeSet.elementAt(j);
                if(!incidentEdges.contains(tempEdge))
                    incidentEdges.addElement(tempEdge);

                n1=tempEdge.getN1();
                n2=tempEdge.getN2();
                if(routeNodeSet.contains(n1) && routeNodeSet.contains(n2))
                    incidentEdges.removeElement(tempEdge);
                if(n1==maMr.getCenter().getDummyNode() || n2==maMr.getCenter().getDummyNode())
                    incidentEdges.removeElement(tempEdge);
            }
        }
        if(incidentEdges.contains(myEdge))
            incidentEdges.removeElement(myEdge);

        return incidentEdges;
    }

    //walker methods:
    //nodeDept[node][0]: currCost
    public void setCurrCost(Node node,double cost){
        nodeDept[node.getLabel()][0]=new Double(cost);
    }

    public double getCurrCost(Node node){
        Double tempDouble=(Double)nodeDept[node.getLabel()][0];
```

Helper.java

```
        return tempDouble.doubleValue();
    }

    //nodeDept[node][1]: preNode
    public void setPreNode(Node node,Node preNode){
        nodeDept[node.getLabel()][1]=preNode;
    }

    public Node getPreNode(Node node){
        return (Node)nodeDept[node.getLabel()][1];
    }

    //nodeDept[node][2]: preEdge
    public void setPreEdge(Node node,Edge preEdge){
        nodeDept[node.getLabel()][2]=preEdge;
    }

    public Edge getPreEdge(Node node){
        return (Edge)nodeDept[node.getLabel()][2];
    }

    //walkerDept[0]: myNode(Node)
    public void setMyNode(Node node){
        walkerDept[0]=node;
    }

    public Node getMyNode(){
        return (Node)walkerDept[0];
    }

    //walkerDept[1]: myEdge(Edge)
    public void setMyEdge(Edge edge){
        walkerDept[1]=edge;
    }

    public Edge getMyEdge(){
        return (Edge)walkerDept[1];
    }

    //walkerDept[2]: currNode(Node)
    public void setCurrNode(Node node){
        walkerDept[2]=node;
```

Helper.java

```
    }

    public Node getCurrNode(){
        return (Node)walkerDept[2];
    }

    //walkerDept[3]: routeSet(Graph)
    public void setRouteSet(Vector nodeSet,Vector edgeSet){
        walkerDept[3]=new Graph(nodeSet,edgeSet);
    }

    public Graph getRouteSet(){
        return (Graph)walkerDept[3];
    }

    public void addNode(Node node){
        Graph routeSet=(Graph)walkerDept[3];
        Vector nodeSet=routeSet.getNodeSet();
        if(!nodeSet.contains(node))
            nodeSet.addElement(node);
    }

    public void addEdge(Edge edge){
        Graph routeSet=(Graph)walkerDept[3];
        Vector edgeSet=routeSet.getEdgeSet();
        if(!edgeSet.contains(edge))
            edgeSet.addElement(edge);
    }

}
```



MAManager.java

```
package emnet.thread;

import java.util.Vector;
import emnet.graph.Node;
import emnet.graph.Graph;
import emnet.graph.Edge;
import emnet.algorithm.GraphAlgorithm;

public class MAManager extends Thread{

    int id;
    Center center;

    Node supply;
    Graph territory,usableGraph;
    Vector icp,helpers,usableGraphNodeSet,usableGraphEdgeSet,interfaceNodes;
    int demandNum,helperNum;

    //nodeDept
    //nodeDept[helper][node][0]: currMACost
    //nodeDept[helper][node][1]: preNode
    //nodeDept[helper][node][2]: preEdge
    Object[][][] nodeDept;

    //maDept
    //maDept[helper][0]: myNode(Node)
    //maDept[helper][1]: myEdge(Edge)
    //maDept[helper][2]: currNode(Node)
    //maDept[helper][3]: routeSet(Graph)
    Object[][] maDept;

    //maCost
    double minMACost;

    boolean available,maFinish;

    public MAManager(int id,Center center,Node supply){
        this.id=id;
        this.center=center;
        this.supply=supply;
```

```
territory=center.getTerritory(supply);


if(territory.getDemandNodeSet().size()!=0){
    demandNum=territory.getDemandNodeSet().size();

    Vector territoryNodeSet=territory.getNodeSet();

    //icp init, usableGraph init
    Graph graph=center.getGraph();
    Vector graphEdgeSet=graph.getEdgeSet();

    usableGraphNodeSet=new Vector();
    usableGraphEdgeSet=new Vector();
    icp=new Vector();

    Edge tempEdge;
    Node n1,n2;
    for(int i=0;i<graphEdgeSet.size();i++){
        tempEdge=(Edge)graphEdgeSet.elementAt(i);
        n1=tempEdge.getN1();
        n2=tempEdge.getN2();

        if(!territoryNodeSet.contains(n1) && !territoryNodeSet.contains(n2)){
            if(!usableGraphEdgeSet.contains(tempEdge))
                usableGraphEdgeSet.addElement(tempEdge);
            if(!usableGraphNodeSet.contains(n1))
                usableGraphNodeSet.addElement(n1);
            if(!usableGraphNodeSet.contains(n2))
                usableGraphNodeSet.addElement(n2);
        }

        if(territoryNodeSet.contains(n1) && !territoryNodeSet.contains(n2)){
            if(!usableGraphEdgeSet.contains(tempEdge))
                usableGraphEdgeSet.addElement(tempEdge);
            if(!usableGraphNodeSet.contains(n1))
                usableGraphNodeSet.addElement(n1);
            if(!usableGraphNodeSet.contains(n2))
                usableGraphNodeSet.addElement(n2);
            if(!tempEdge.isDummyEdge()){
                if(!icp.contains(n1))
                    icp.addElement(n1);
```

```
                }
            }

            if(!territoryNodeSet.contains(n1) && territoryNodeSet.contains(n2)){
                if(!usableGraphEdgeSet.contains(tempEdge))
                    usableGraphEdgeSet.addElement(tempEdge);
                if(!usableGraphNodeSet.contains(n1))
                    usableGraphNodeSet.addElement(n1);
                if(!usableGraphNodeSet.contains(n2))
                    usableGraphNodeSet.addElement(n2);
                if(!tempEdge.isDummyEdge()){
                    if(!icp.contains(n2))
                        icp.addElement(n2);
                }
            }

            //while territory is not convex
            if(!territory.hasEdge(tempEdge) && !usableGraphEdgeSet.contains(tempEdge)){
                usableGraphEdgeSet.addElement(tempEdge);
                if(!usableGraphNodeSet.contains(n1))
                    usableGraphNodeSet.addElement(n1);
                if(!usableGraphNodeSet.contains(n2))
                    usableGraphNodeSet.addElement(n2);
                if(!tempEdge.isDummyEdge()){
                    if(!icp.contains(n1))
                        icp.addElement(n1);
                    if(!icp.contains(n2))
                        icp.addElement(n2);
                }
            }
        }
        usableGraph=new Graph(usableGraphNodeSet,usableGraphEdgeSet);
        interfaceNodes=GraphAlgorithm.getInterfaceNodes(territory,graph);
        helperNum=icp.size();
        nodeDept=new Object[icp.size()][graph.getNodeSet().size()][3];
        for(int i=0;i<icp.size();i++){
            for(int j=0;j<graph.getNodeSet().size();j++){
                nodeDept[i][j][0]=new Double(0.0);
            }
        }
        maDept=new Object[icp.size()][4];
        minMACost=0.0;
```

MAManager.java

```
                available=true;
                maFinish=false;
            }else{
                maFinish=true;
            }

        }

        public void run(){
            center.takeKey(this);

            //map init
            Vector edgeSet=center.getGraph().getEdgeSet();
            Edge tempEdge;
            for(int i=0;i<edgeSet.size();i++){
                tempEdge=(Edge)edgeSet.elementAt(i);
                if(!tempEdge.isFastEdge() && !tempEdge.isDetourEdge() && !tempEdge.isMAEdge())
                    tempEdge.setNeutralEdge();
            }

            if(territory.getDemandNodeSet().size()!=0){
                helpers=new Vector();
                Node tempNode;
                Helper tempHelper;
                for(int i=0;i<icp.size();i++){
                    tempNode=(Node)icp.elementAt(i);
                    tempHelper=new Helper(i,tempNode,this);
                    helpers.addElement(tempHelper);
                    tempHelper.start();
                }

                while(!maFinish){
                    //watching
                }

                //finding supply source finished: all situations simulated
                //set ma edges on the shortest ma route
                //find a subject helper
                Helper bestHelper=(Helper)helpers.elementAt(0);
                for(int j=1;j<helpers.size();j++){
                    if(bestHelper.getMACost()==0.0)
                        bestHelper=(Helper)helpers.elementAt(j);
```

```
        }

        //find a competitor helper
        Helper tempHelper1;
        double minMACost=bestHelper.getMACost();
        for(int j=1;j<helpers.size();j++){
            tempHelper1=(Helper)helpers.elementAt(j);
            if(tempHelper1.getMACost()!=0.0 && tempHelper1.getMACost()<minMACost){
                minMACost=tempHelper1.getMACost();
                bestHelper=tempHelper1;
            }
        }

        updateMACenter(bestHelper);

        Vector bestMAPathEdgeSet=bestHelper.getMAPath().getEdgeSet();
        if(bestMAPathEdgeSet.size()>0){
            Edge tempEdge1;
            Node n1,n2;
            Node source=bestHelper.getSource();
            Graph sourceTerritory=center.getTerritory(source);
            for(int j=0;j<bestMAPathEdgeSet.size();j++){
                tempEdge1=(Edge)bestMAPathEdgeSet.elementAt(j);
                tempEdge1.setMAEdge();

                n1=tempEdge1.getN1();
                n2=tempEdge1.getN2();
                if(territory.hasNode(n1) && !territory.hasNode(n2))
                    n1.setMerge();
                if(territory.hasNode(n2) && !territory.hasNode(n1))
                    n2.setMerge();
                if(sourceTerritory.hasNode(n1) && !sourceTerritory.hasNode(n2))
                    n1.setAccess();
                if(sourceTerritory.hasNode(n2) && !sourceTerritory.hasNode(n1))
                    n2.setAccess();

                if(j==(bestMAPathEdgeSet.size()-1)){
                    if(territory.hasNode(n1) && sourceTerritory.hasNode(n1)){
                        n1.setAccess();
                        n1.setMerge();
                    }
                    if(territory.hasNode(n2) && sourceTerritory.hasNode(n2)){
```

MAManager.java

```
                                n2.setAccess();
                                n2.setMerge();
                            }
                        }
                    }
                }else{
                    bestHelper.getSource().setSource();
                }
            }else{
                //demandNum=0

                //mutualAssistantCenter
                //maCenter[supply][2]: source(Node)
                //maCenter[supply][3]: icpSet(Vector)
                //maCenter[supply][4]: maPath(Graph)
                //maCenter[supply][7]: maCost > source to supply
                center.setSource(supply,supply);
                center.setICPSet(supply,territory.getNodeSet());
                center.setMAPath(supply,territory);
                center.setMACost(supply,0.0);
            }

            //ma manager finish its job!
            center.updateMACondition();
            center.putKey(this);
        }

        public int getID(){
            return id;
        }

        public Center getCenter(){
            return center;
        }

        public Node getSupply(){
            return supply;
        }

        public Graph getGraph(){
            return center.getGraph();
        }
```

MAManager.java

```
public Graph getUsableGraph(){
	return usableGraph;
}

public Graph getTerritory(){
	return territory;
}

public int getDemanNum(){
	return demandNum;
}

public int getICP(){
	return interfaceNodes.size();
}

public synchronized void updateMinMACost(double currMACost){
	if(minMACost==0.0 || currMACost<minMACost)
		minMACost=currMACost;
}

public double getMinMACost(){
	return minMACost;
}

public void updateMAFinish(){
	helperNum--;
	if(helperNum==0){
		maFinish=true;
	}
}

public synchronized void takeKey(Helper helper){
	if(!maFinish){
		while(!available){
			try{
				wait(1);
			}catch(InterruptedException e){
				//takeKey: cannot wait!
			}
		}
```

MAManager.java

```
            available=false;
        }else{
            available=false;
            //helper took the key, but center is finished!
        }
    }

    public synchronized void putKey(Helper helper){
        if(!maFinish){
            while(available){
                try{
                    //helper is waiting to put...
                    wait(1);
                }catch(InterruptedException e){
                    //putKey: cannot wait!
                }
            }
            //helper put the key!
            available=true;
        }else{
            //helper put the key, maFinish=true!
            available=true;
        }
    }

    //nodeDept
    //nodeDept[helper][node][0]: currMACost
    public void setCurrMACost(Helper helper,Node node,double maCost){
        nodeDept[helper.getID()][node.getLabel()][0]=new Double(maCost);
    }

    public double getCurrMACost(Helper helper,Node node){
        Double maCost=(Double)nodeDept[helper.getID()][node.getLabel()][0];
        return maCost.doubleValue();
    }

    //nodeDept[helper][node][1]: preNode
    public void setPreNode(Helper helper,Node node,Node preNode){
        nodeDept[helper.getID()][node.getLabel()][1]=preNode;
    }

    public Node getPreNode(Helper helper,Node node){
```

MAManager.java

```
        return (Node)nodeDept[helper.getID()][node.getLabel()][1];
    }

    //nodeDept[helper][node][2]: preEdge
    public void setPreEdge(Helper helper,Node node,Edge preEdge){
        nodeDept[helper.getID()][node.getLabel()][2]=preEdge;
    }

    public Edge getPreEdge(Helper helper,Node node){
        return (Edge)nodeDept[helper.getID()][node.getLabel()][2];
    }

    //maDept
    //maDept[helper][0]: myNode(Node)
    public void setMyNode(Helper helper,Node myNode){
        maDept[helper.getID()][0]=myNode;
    }

    public Node getMyNode(Helper helper){
        return (Node)maDept[helper.getID()][0];
    }

    //maDept[helper][1]: myEdge(Edge)
    public void setMyEdge(Helper helper,Edge myEdge){
        maDept[helper.getID()][1]=myEdge;
    }

    public Edge getMyEdge(Helper helper){
        return (Edge)maDept[helper.getID()][1];
    }

    //maDept[helper][2]: currNode(Node)
    public void setCurrNode(Helper helper,Node currNode){
        maDept[helper.getID()][2]=currNode;
    }

    public Node getCurrNode(Helper helper){
        return (Node)maDept[helper.getID()][2];
    }

    //maDept[helper][3]: routeSet(Graph)
    public void setRouteSet(Helper helper,Vector routeNodeSet,Vector routeEdgeSet){
```

```
        maDept[helper.getID()][3]=new Graph(routeNodeSet,routeEdgeSet);
    }

    public Graph getRouteSet(Helper helper){
        return (Graph)maDept[helper.getID()][3];
    }

    public Vector getRouteEdgeSet(Helper helper){
        Graph routeSet=getRouteSet(helper);
        return routeSet.getEdgeSet();
    }

    public synchronized void addEdge(Helper helper,Edge edge){
        Graph routeSet=this.getRouteSet(helper);
        Vector routeNodeSet=routeSet.getNodeSet();
        Vector routeEdgeSet=routeSet.getEdgeSet();
        if(!routeEdgeSet.contains(edge))
            routeEdgeSet.addElement(edge);
        this.setRouteSet(helper,routeNodeSet,routeEdgeSet);
    }

    public synchronized void addNode(Helper helper,Node node){
        Graph routeSet=this.getRouteSet(helper);
        Vector routeNodeSet=routeSet.getNodeSet();
        Vector routeEdgeSet=routeSet.getEdgeSet();
        if(!routeNodeSet.contains(node))
            routeNodeSet.addElement(node);
        this.setRouteSet(helper,routeNodeSet,routeEdgeSet);
    }

    public synchronized void updateMACenter(Helper helper){
        //mutualAssistantCenter
        //maCenter[supply][2]: source(Node)
        //maCenter[supply][3]: icpSet(Vector)
        //maCenter[supply][4]: maPath(Graph)
        //maCenter[supply][7]: maCost > source to supply

        MAManager maMr=helper.getMAManger();
        Center center=maMr.getCenter();
        Node supply=maMr.getSupply();

        center.setSource(supply,helper.getSource());
```

MAManager.java

```
            center.setICPSet(supply,interfaceNodes);
            center.setMAPath(supply,helper.getMAPath());
            center.setMACost(supply,helper.getMACost());
        }
    }
```

Roamer.java

```
package emnet.thread;

import emnet.graph.Node;
import emnet.graph.Edge;
import java.util.Vector;
import emnet.algorithm.GraphAlgorithm;
import emnet.graph.Graph;

public class Roamer extends Thread{
    Node supply;
    int id;
    Center center;
    boolean roamerFinish;

    Node currNode,preNode,myNode;
    Edge preEdge,myEdge;
    Graph graph,routeSet;
    Vector routeNodeSet,routeEdgeSet;

    public Roamer(int id,Node supply,Center center){
        super(""+id);
        this.id=id;
        this.supply=supply;
        this.center=center;
        roamerFinish=false;
        graph=center.getGraph();
        int nodeNum=graph.getNodeSet().size();
        int edgeNum=graph.getEdgeSet().size();

        //roamerCenter init
        //roamerCenter[roamer][0]: myNode(Node)
        //roamerCenter[roamer][1]: myEdge(Edge)
        //roamerCenter[roamer][2]: currNode(Node)
        //roamerCenter[roamer][3]: routeSet(Graph)

        Node dummyNode=this.center.getDummyNode();
        dummyNode.setDummy();
        Edge dummyEdge=new Edge(edgeNum,supply,dummyNode,0.0);
        dummyEdge.setDummyEdge();

        this.graph.addNode(dummyNode);
```

Roamer.java

```
        this.graph.addEdge(dummyEdge);

        Vector routeNodeSet=new Vector();
        routeNodeSet.addElement(dummyNode);
        Vector routeEdgeSet=new Vector();
        routeEdgeSet.addElement(dummyEdge);
        this.center.setRouteSet(this,routeNodeSet,routeEdgeSet);

        this.center.setMyNode(this,dummyNode);
        this.center.setMyEdge(this,dummyEdge);
        this.center.setCurrNode(this,supply);

        //nodeCenter init
        //nodeCenter[node][0]: occupy(Boolean)
        //nodeCenter[node][1]: distance(Double)
        //nodeCenter[node][2]: preNode(Node)
        //nodeCenter[node][3]: preEdge(Edge)
        //nodeCenter[node][4]: visitorSequence(Vector)

        this.center.setDistance(supply,0.0);
        this.center.setPreNode(supply,dummyNode);
        this.center.setPreEdge(supply,dummyEdge);
        this.center.addViditor(supply,this);
    }

    public int getID(){
        return this.id;
    }

    public Node getSupply(){
        return this.supply;
    }

    public Center getCenter(){
        return this.center;
    }

    public void run(){

        roaming:
        while(!center.isFinished() && !roamerFinish){
            //take the key to have the right to run
```

Roamer.java

```
center.takeKey(this);

if(center.isFinished()){
    center.putKey(this);
    break roaming;
}

//test currNode is visited or not
if(!center.getCurrNode(this).isVisited()){
    //currNode is not visited
    center.getCurrNode(this).visit();
    updateVisitorSequence(0,this,center.getCurrNode(this));

    //update myEdge, myNode, currNode, preNode
    //update currNode distance by myNode & myEdge
    //update routeSet (myNode, myEdge)
    //set fast edge
    center.addNode(this,center.getCurrNode(this));
    center.addEdge(this,center.getMyEdge(this));

    center.setPreNode(center.getCurrNode(this),center.getMyNode(this));
    center.setPreEdge(center.getCurrNode(this),center.getMyEdge(this));
    double distance=center.getDistance(center.getMyNode(this))+center.getMyEdge(this).getWeight();
    center.setDistance(center.getCurrNode(this),distance);
    center.getMyEdge(this).setTestEdge();
    center.setMyNode(this,center.getCurrNode(this));

    dijkstra();
}else{
    //currNode is visited
    //Comparison: change to new location to find myEdge to find currNode, and update to myNode
    Vector visitorSequence=center.getVisitorSequence(center.getCurrNode(this));
    if(!visitorSequence.contains(this)){
        //comparison
        double currDistance=center.getDistance(center.getCurrNode(this));
        double myDistance=center.getDistance(center.getMyNode(this));
        if(myDistance+center.getMyEdge(this).getWeight()<currDistance){
            //closer! subtree finding!
            //1. find out who the last roamer is
            Roamer lastRoamer=center.lastVisitor(center.getCurrNode(this));

            //2. update visitor sequence [finish condition]
```

Roamer.java

```
                updateVisitorSequence(1,this,center.getCurrNode(this));

                //3. find out where the last roamer is now
                Node lastRoamerLocation=center.getCurrNode(lastRoamer);

                //4. remove last roamer's subtree
                Graph lastRoamerRouteSet=center.getRouteSet(lastRoamer);
                Graph
subtree=GraphAlgorithm.getSubtreeWithCertainNode(lastRoamerRouteSet,center.getCurrNode(this),center.getPreEd
ge(center.getCurrNode(this)));

                center.removeSubtree(lastRoamer,subtree);
                center.removeEdge(lastRoamer,center.getPreEdge(center.getCurrNode(this)));
                center.getPreEdge(center.getCurrNode(this)).setNeutralEdge();

                //5. add myEdge and the subtree to current roamer's RouteSet
                center.setPreEdge(center.getCurrNode(this),center.getMyEdge(this));
                center.setPreNode(center.getCurrNode(this),center.getMyNode(this));
                center.addSubtree(this,subtree);
                center.addEdge(this,center.getMyEdge(this));
                center.getMyEdge(this).setTestEdge();

                //6. relocate last roamer's place to preNode to prevent missing, relocate current roamer
using dijkstra
                center.setCurrNode(lastRoamer,center.getPreNode(center.getCurrNode(this)));

                //7. update the distance in the subtree
                Vector subtreeNodeSet=subtree.getNodeSet();
                Node tempNode;
                double saving;
                for(int i=0;i<subtreeNodeSet.size();i++){
                    tempNode=(Node)subtreeNodeSet.elementAt(i);

saving=center.getDistance(center.getCurrNode(this))-(center.getDistance(center.getMyNode(this))+center.getMyEdg
e(this).getWeight());
                    center.setDistance(tempNode,center.getDistance(tempNode)-saving);
                }

                dijkstra();
            }else{
                //not closer, remove myEdge from routeEdgeSet, find new myEdge
                //update visitor sequence: downstream subree
```

```
                        updateVisitorSequence(1,this,center.getCurrNode(this));
                        center.removeEdge(this,center.getMyEdge(this));

                        dijkstra();
                    }
                }else{
                    //I visited this node before
                    dijkstra();
                }
            }
            center.putKey(this);

            try{
                sleep(1);
            }catch(InterruptedException ex){
                //roamer cannot sleep
            }

        }
        //roamer finished his job!
    }

    void dijkstra(){
        //find out the best incident edge
        //define new myEdge & currNode
        Graph tempRouteSet=(Graph)center.getRouteSet(this);
        Vector tempRouteNodeSet=(Vector)tempRouteSet.getNodeSet();

        Vector incidentEdgeSet=GraphAlgorithm.getIncidentEdgeSet(this,tempRouteNodeSet);
        Vector exclusiveIncidentEdgeSet=new Vector();
        for(int i=0;i<incidentEdgeSet.size();i++){
            if(!center.getRouteEdgeSet(this).contains(incidentEdgeSet.elementAt(i))){
                exclusiveIncidentEdgeSet.addElement(incidentEdgeSet.elementAt(i));
            }
        }

        Edge tempEdge;
        Node n1,n2;
        if(exclusiveIncidentEdgeSet.size()>1){
            tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(0);
            center.setMyEdge(this,tempEdge);
            n1=tempEdge.getN1();
```

Roamer.java

```
            n2=tempEdge.getN2();
            if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                center.setMyNode(this,n1);
                center.setCurrNode(this,n2);
            }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                center.setMyNode(this,n2);
                center.setCurrNode(this,n1);
            }else{
                //dijkstra error 1: not incident edge! check GraphAlgorithm.getIncidentEdgeSet()
            }

            double min=center.getDistance(center.getMyNode(this))+center.getMyEdge(this).getWeight();
            for(int i=1;i<exclusiveIncidentEdgeSet.size();i++){
                tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(i);
                n1=tempEdge.getN1();
                n2=tempEdge.getN2();
                if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                    if(center.getDistance(n1)+tempEdge.getWeight()<min){
                        min=center.getDistance(n1)+tempEdge.getWeight();
                        center.setMyEdge(this,tempEdge);
                        center.setMyNode(this,n1);
                        center.setCurrNode(this,n2);
                    }
                }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                    if(center.getDistance(n2)+tempEdge.getWeight()<min){
                        min=center.getDistance(n2)+tempEdge.getWeight();
                        center.setMyEdge(this,tempEdge);
                        center.setMyNode(this,n2);
                        center.setCurrNode(this,n1);
                    }
                }else{
                    //dijkstra error 2: incident edge error!
                }
            }
        }else if(exclusiveIncidentEdgeSet.size()==1){
            tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(0);
            center.setMyEdge(this,tempEdge);
            n1=tempEdge.getN1();
            n2=tempEdge.getN2();
            if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                center.setMyNode(this,n1);
                center.setCurrNode(this,n2);
```

Roamer.java

```
            }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                center.setMyNode(this,n2);
                center.setCurrNode(this,n1);
            }else{
                //dijkstra error 3: not incident edge! check GraphAlgorithm.getIncidentEdgeSet()
            }
        }else{
            roamerFinish=true;
            //renders all nodes visited
            Vector nodeSet=graph.getNodeSet();
            Node tempNode;
            for(int i=0;i<nodeSet.size();i++){
                tempNode=(Node)nodeSet.elementAt(i);
                center.addViditor(tempNode,this);
            }
        }
    }

    void updateVisitorSequence(int sort,Roamer roamer,Node currNode){
        //roamer to be updated....
        //selection choice:
        //case 0: currNode is never visited
        //case 1: currNode is visited

        Vector myVisitorSequence=center.getVisitorSequence(center.getMyNode(this));
        Graph routeSet,subtree;
        Edge preEdge;
        Vector subtreeNodeSet,tempSubtreeNodeVisitorSequence;
        Node tempSubtreeNode,tempPreNode;
        Roamer lastRoamer,tempRoamer;

        switch(sort){
            case 0:
                //case 0: currNode is never visited
                center.addViditor(currNode,roamer);
                break;

            case 1:
                //case 1: currNode is visited
                //add visiotrs to downstream: subtree
                //subtree of currNode
                lastRoamer=center.lastVisitor(currNode);
```

Roamer.java

```
                routeSet=center.getRouteSet(lastRoamer);
                preEdge=center.getPreEdge(currNode);
                tempPreNode=center.getPreNode(currNode);
                subtree=GraphAlgorithm.getSubtreeWithCertainNode(routeSet,currNode,preEdge);
                subtreeNodeSet=subtree.getNodeSet();

                for(int i=0;i<myVisitorSequence.size();i++){
                    tempRoamer=(Roamer)myVisitorSequence.elementAt(i);
                    for(int j=0;j<subtreeNodeSet.size();j++){
                        tempSubtreeNode=(Node)subtreeNodeSet.elementAt(j);
                        tempSubtreeNodeVisitorSequence=center.getVisitorSequence(tempSubtreeNode);
                        if(!tempSubtreeNodeVisitorSequence.contains(tempRoamer))
                            center.addViditor(tempSubtreeNode,tempRoamer);
                    }
                }
                break;
            }
            //update visitorSequence finish!
        }
    }
```

Walker.java

```
package emnet.thread;

import emnet.graph.Graph;
import emnet.graph.Node;
import emnet.graph.Edge;
import java.util.Vector;

public class Walker extends Thread{
    double territoryMergeCost;

    Helper helper;
    MAManager maMr;
    Graph territory;
    int demandNum;

    boolean finish;

    public Walker(Helper helper,Node start){
        territoryMergeCost=0.0;

        this.helper=helper;
        maMr=helper.getMAManger();
        territory=maMr.getTerritory();
        demandNum=territory.getDemandNodeNum();

        int edgeNum=maMr.getCenter().getGraph().getEdgeSet().size();
        Node dummyNode=maMr.getCenter().getDummyNode();
        dummyNode.setDummy();
        Edge dummyEdge=new Edge(edgeNum,start,dummyNode,0.0);
        dummyEdge.setDummyEdge();

        maMr.getGraph().addNode(dummyNode);
        maMr.getGraph().addEdge(dummyEdge);

        //helper init, set to maMr
        Vector routeNodeSet=new Vector();
        routeNodeSet.addElement(dummyNode);
        Vector routeEdgeSet=new Vector();
        routeEdgeSet.addElement(dummyEdge);

        helper.setRouteSet(routeNodeSet,routeEdgeSet);
```

Walker.java

```
        helper.setMyNode(dummyNode);
        helper.setMyEdge(dummyEdge);
        helper.setCurrNode(start);

        helper.setCurrCost(helper.getMyNode(),0.0);

        helper.setPreNode(start,dummyNode);
        helper.setPreEdge(start,dummyEdge);

        finish=false;
    }

    public double getTerritoryMergeCost(){
        return territoryMergeCost;
    }

    public void run(){

        walking:
        while(!finish){
            if(helper.getCurrNode().isDemand()){

                updateFinish();

                helper.addNode(helper.getCurrNode());
                helper.addEdge(helper.getMyEdge());

                helper.setPreNode(helper.getCurrNode(),helper.getMyNode());
                helper.setPreEdge(helper.getCurrNode(),helper.getMyEdge());

                double currCost=helper.getCurrCost(helper.getMyNode())+helper.getMyEdge().getWeight();
                helper.setCurrCost(helper.getCurrNode(),currCost);

                territoryMergeCost=territoryMergeCost+currCost;

                if(!finish){
                    helper.setMyNode(helper.getCurrNode());
                    dijkstra();
                }else{
                    break walking;
                }
            }else{
```

Walker.java

```
                helper.addNode(helper.getCurrNode());
                helper.addEdge(helper.getMyEdge());

                helper.setPreNode(helper.getCurrNode(),helper.getMyNode());
                helper.setPreEdge(helper.getCurrNode(),helper.getMyEdge());

                double currCost=helper.getCurrCost(helper.getMyNode())+helper.getMyEdge().getWeight();
                helper.setCurrCost(helper.getCurrNode(),currCost);

                helper.setMyNode(helper.getCurrNode());
                dijkstra();
            }
        }
    }

    void updateFinish(){
        demandNum--;

        if(demandNum==0)
            finish=true;
    }

    public boolean isFinish(){
        return finish;
    }

    void dijkstra(){
        Graph tempRouteSet=(Graph)helper.getRouteSet();
        Vector tempRouteNodeSet=(Vector)tempRouteSet.getNodeSet();
        Vector incidentEdgeSet=getIncidentEdgeSet(territory,tempRouteNodeSet);
        Vector exclusiveIncidentEdgeSet=new Vector();
        for(int i=0;i<incidentEdgeSet.size();i++){
            if(!helper.getRouteSet().hasEdge((Edge)incidentEdgeSet.elementAt(i))){
                exclusiveIncidentEdgeSet.addElement(incidentEdgeSet.elementAt(i));
            }
        }

        Edge tempEdge;
        Node n1,n2;
        if(exclusiveIncidentEdgeSet.size()>1){
            tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(0);
            helper.setMyEdge(tempEdge);
```

Walker.java

```
            n1=tempEdge.getN1();
            n2=tempEdge.getN2();
            if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                helper.setMyNode(n1);
                helper.setCurrNode(n2);
            }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                helper.setMyNode(n2);
                helper.setCurrNode(n1);
            }
            double min=helper.getCurrCost(helper.getMyNode())+helper.getMyEdge().getWeight();
            for(int i=1;i<exclusiveIncidentEdgeSet.size();i++){
                tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(i);
                n1=tempEdge.getN1();
                n2=tempEdge.getN2();
                if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                    if(helper.getCurrCost(n1)+tempEdge.getWeight()<min){
                        min=helper.getCurrCost(n1)+tempEdge.getWeight();
                        helper.setMyEdge(tempEdge);
                        helper.setMyNode(n1);
                        helper.setCurrNode(n2);
                    }
                }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                    if(helper.getCurrCost(n2)+tempEdge.getWeight()<min){
                        min=helper.getCurrCost(n2)+tempEdge.getWeight();
                        helper.setMyEdge(tempEdge);
                        helper.setMyNode(n2);
                        helper.setCurrNode(n1);
                    }
                }
            }
        }else if(exclusiveIncidentEdgeSet.size()==1){
            tempEdge=(Edge)exclusiveIncidentEdgeSet.elementAt(0);
            helper.setMyEdge(tempEdge);
            n1=tempEdge.getN1();
            n2=tempEdge.getN2();
            if(tempRouteNodeSet.contains(n1) && !tempRouteNodeSet.contains(n2)){
                helper.setMyNode(n1);
                helper.setCurrNode(n2);
            }else if(tempRouteNodeSet.contains(n2) && !tempRouteNodeSet.contains(n1)){
                helper.setMyNode(n2);
                helper.setCurrNode(n1);
            }
```

Walker.java

```
            }else{
                finish=true;
                //renders all nodes visited
            }
        }

        Vector getIncidentEdgeSet(Graph usableGraph,Vector routeNodeSet){
            Edge myEdge=helper.getMyEdge();

            Vector incidentEdges=new Vector();
            Edge tempEdge;
            Node n1,n2;

            for(int i=0;i<routeNodeSet.size();i++){
                Vector tempEdgeSet=usableGraph.incidentEdgeSet((Node)routeNodeSet.elementAt(i));
                for(int j=0;j<tempEdgeSet.size();j++){
                    tempEdge=(Edge)tempEdgeSet.elementAt(j);
                    if(!incidentEdges.contains(tempEdge))
                        incidentEdges.addElement(tempEdge);

                    n1=tempEdge.getN1();
                    n2=tempEdge.getN2();
                    if(routeNodeSet.contains(n1) && routeNodeSet.contains(n2))
                        incidentEdges.removeElement(tempEdge);
                    if(n1==maMr.getCenter().getDummyNode() || n2==maMr.getCenter().getDummyNode())
                        incidentEdges.removeElement(tempEdge);
                }
            }
            if(incidentEdges.contains(myEdge))
                incidentEdges.removeElement(myEdge);

            return incidentEdges;
        }
    }
```

App.java

```
package emnet;

import java.awt.Toolkit;
import javax.swing.SwingUtilities;
import javax.swing.UIManager;
import java.awt.Dimension;

public class App {
  boolean packFrame = false;

  /**
   * Construct and show the application.
   */
  public App() {
    Frame frame = new Frame();
    // Validate frames that have preset sizes
    // Pack frames that have useful preferred size info, e.g. from their layout
    if (packFrame) {
      frame.pack();
    }
    else {
      frame.validate();
    }

    // Center the window
    Dimension screenSize = Toolkit.getDefaultToolkit().getScreenSize();
    Dimension frameSize = frame.getSize();
    if (frameSize.height > screenSize.height) {
      frameSize.height = screenSize.height;
    }
    if (frameSize.width > screenSize.width) {
      frameSize.width = screenSize.width;
    }
    frame.setLocation( (screenSize.width - frameSize.width) / 2,
                       (screenSize.height - frameSize.height) / 2);
    frame.setVisible(true);
  }

  /**
   * Application entry point.
   *
```

App.java

```
     * @param args String[]
     */
    public static void main(String[] args) {
        SwingUtilities.invokeLater(new Runnable() {
            public void run() {
                try {
                    UIManager.setLookAndFeel(UIManager.getSystemLookAndFeelClassName());
                }
                catch (Exception exception) {
                    exception.printStackTrace();
                }

                //read in node & edge data
                //add to table
                //picture the map
                //frame.add table & map
                //set supply & demand nodes
                //response in map
                //after press "start" button, new ant & antCommunicationCenter
                //show fast routes, detour routes, mutual assistant routes
                //show evaluation indices
                //input expert acceptable time
                //illustrate radar digram and standardized evaluation value

                new App();
            }
        });
    }
}
```

Frame_AboutBox.java

```
package emnet;

import java.awt.*;
import java.awt.event.*;
import javax.swing.*;

public class Frame_AboutBox
      extends JDialog implements ActionListener {
  JPanel panel1 = new JPanel();
  JPanel panel2 = new JPanel();
  JPanel insetsPanel1 = new JPanel();
  JPanel insetsPanel2 = new JPanel();
  JPanel insetsPanel3 = new JPanel();
  JButton button1 = new JButton();
  JLabel imageLabel = new JLabel();
  JLabel label1 = new JLabel();
  JLabel label2 = new JLabel();
  JLabel label3 = new JLabel();
  JLabel label4 = new JLabel();
  ImageIcon image1 = new ImageIcon();
  BorderLayout borderLayout1 = new BorderLayout();
  BorderLayout borderLayout2 = new BorderLayout();
  FlowLayout flowLayout1 = new FlowLayout();
  GridLayout gridLayout1 = new GridLayout();
  String product = "Earthquake Mitigation Network Design";
  String version = "version 1.0, percy.itt.nctu.tw";
  String copyright = "Copyright (c) 2006";
  String comments = "Decision Making Tool for Network Design";

  public Frame_AboutBox(Frame parent) {
    super(parent);
    try {
      setDefaultCloseOperation(DISPOSE_ON_CLOSE);
      jbInit();
    }
    catch (Exception exception) {
      exception.printStackTrace();
    }
  }

  public Frame_AboutBox() {
```

Frame_AboutBox.java

```
    this(null);
  }

  /**
   * Component initialization.
   *
   * @throws java.lang.Exception
   */
  private void jbInit() throws Exception {
    image1 = new ImageIcon(emnet.Frame.class.getResource("about.png"));
    imageLabel.setIcon(image1);
    setTitle("About");
    panel1.setLayout(borderLayout1);
    panel2.setLayout(borderLayout2);
    insetsPanel1.setLayout(flowLayout1);
    insetsPanel2.setLayout(flowLayout1);
    insetsPanel2.setBorder(BorderFactory.createEmptyBorder(10, 10, 10, 10));
    gridLayout1.setRows(4);
    gridLayout1.setColumns(1);
    label1.setText(product);
    label2.setText(version);
    label3.setText(copyright);
    label4.setText(comments);
    insetsPanel3.setLayout(gridLayout1);
    insetsPanel3.setBorder(BorderFactory.createEmptyBorder(10, 60, 10, 10));
    button1.setText("OK");
    button1.addActionListener(this);
    insetsPanel2.add(imageLabel, null);
    panel2.add(insetsPanel2, BorderLayout.WEST);
    getContentPane().add(panel1, null);
    insetsPanel3.add(label1, null);
    insetsPanel3.add(label2, null);
    insetsPanel3.add(label3, null);
    insetsPanel3.add(label4, null);
    panel2.add(insetsPanel3, BorderLayout.CENTER);
    insetsPanel1.add(button1, null);
    panel1.add(insetsPanel1, BorderLayout.SOUTH);
    panel1.add(panel2, BorderLayout.NORTH);
    setResizable(true);
  }

  /**
```

Frame_AboutBox.java

```
     * Close the dialog on a button event.
     *
     * @param actionEvent ActionEvent
     */
    public void actionPerformed(ActionEvent actionEvent) {
      if (actionEvent.getSource() == button1) {
        dispose();
      }
    }
}
```

Frame_TermBox.java

```
package emnet;

import javax.swing.JDialog;
import java.awt.GridLayout;
import javax.swing.JLabel;
import java.awt.Dimension;

public class Frame_TermBox extends JDialog{

    JLabel
        label_eva=new JLabel("    E: Overall Evaluation"),
        label_ld=new JLabel("    LD: Longest Detour Cost"),
        label_amac=new JLabel("    AMAC: Average Mutal Assistance Cost"),
        label_nc=new JLabel("    NC: Network Cost"),
        label_atc=new JLabel("    ATC: Average Travel Cost"),
        label_mtc=new JLabel("    MTC: Maximum Travel Cost");

    public Frame_TermBox(Frame parent){
        super(parent);
        try {
          setDefaultCloseOperation(DISPOSE_ON_CLOSE);
          jbInit();
        }
        catch (Exception exception) {
          exception.printStackTrace();
        }
    }

    void jbInit(){
        Dimension d=new Dimension(250,25);
        this.setTitle("Terminology");
        this.getContentPane().setLayout(new GridLayout(6,1,5,5));
        label_eva.setPreferredSize(d);
        label_ld.setPreferredSize(d);
        label_amac.setPreferredSize(d);
        label_nc.setPreferredSize(d);
        label_atc.setPreferredSize(d);
        label_mtc.setPreferredSize(d);

        this.getContentPane().add(label_atc);
        this.getContentPane().add(label_mtc);
```

```
            this.getContentPane().add(label_ld);
            this.getContentPane().add(label_amac);
            this.getContentPane().add(label_nc);
            this.getContentPane().add(label_eva);

            this.setResizable(false);
        }
}
```

Frame.java

```
package emnet;

import java.awt.*;
import java.awt.event.*;
import javax.swing.JFrame;
import javax.swing.JPanel;
import javax.swing.JMenuBar;
import javax.swing.JMenu;
import javax.swing.JMenuItem;
import javax.swing.JLabel;

import emnet.gui.Map;
import emnet.graph.Graph;
import java.util.Vector;
import java.io.IOException;
import emnet.io.IOGraph;
import javax.swing.JTextField;
import javax.swing.JButton;
import javax.swing.SwingConstants;
import javax.swing.JTabbedPane;
import javax.swing.JRadioButton;
import javax.swing.ButtonGroup;
import javax.swing.JSplitPane;
import javax.swing.table.DefaultTableModel;
import javax.swing.JTable;
import javax.swing.JScrollPane;
import emnet.graph.Node;
import emnet.graph.Edge;
import emnet.thread.Center;
import java.text.DecimalFormat;

public class Frame
    extends JFrame {
  JPanel contentPane;
  BorderLayout borderLayout1 = new BorderLayout();
  JMenuBar jMenuBar1 = new JMenuBar();
  JMenu jMenuFile = new JMenu();
  JMenuItem jMenuFileExit = new JMenuItem();
  JMenu jMenuHelp = new JMenu();
  JMenuItem jMenuHelpAbout = new JMenuItem();
  JMenuItem jMenuHelpTerm=new JMenuItem();
```

Frame.java

```
JPanel panel_gridbag=new JPanel(new GridLayout(4,1,2,2));
JPanel panel_setting=new JPanel(new BorderLayout());

JLabel label_dir=new JLabel("common dir: ");
JTextField txt_dir=new JTextField();
JLabel label_node=new JLabel("node file: ");
JTextField txt_node=new JTextField();
JLabel label_edge=new JLabel("edge file: ");
JTextField txt_edge=new JTextField();
JLabel label_dataIn=new JLabel("2econ?");

DefaultTableModel nodeTableModel,edgeTableModel;
JTable
    nodeTable=new JTable(nodeTableModel),
    edgeTable=new JTable(edgeTableModel);

JLabel seperator=new JLabel("[ no graph ]",SwingConstants.CENTER);

JRadioButton radio_supply=new JRadioButton("supply");
JRadioButton radio_demand=new JRadioButton("demand");
JRadioButton radio_neutral=new JRadioButton("neutral");
ButtonGroup radioGroup=new ButtonGroup();
JButton button_run=new JButton("run");

JTextField
    txt_atc_low=new JTextField(),txt_mtc_low=new JTextField(),
    txt_ld_low=new JTextField(),txt_amac_low=new JTextField(),
    txt_nc_low=new JTextField(),

    txt_atc_up=new JTextField(),txt_mtc_up=new JTextField(),
    txt_ld_up=new JTextField(),txt_amac_up=new JTextField(),
    txt_nc_up=new JTextField();

JLabel
    atc_output=new JLabel("0.0       "),mtc_output=new JLabel("0.0       "),
    ld_output=new JLabel("0.0       "),amac_output=new JLabel("0.0       "),
    nc_output=new JLabel("0.0       "),e_output=new JLabel("[ pls fill \"expert\" tab ]    ");

JLabel save_dir=new JLabel();

Map map=new Map();
```

Frame.java

```
    Graph graph;
    Center center;
    DecimalFormat myFormatter=new DecimalFormat("###,###.##");

    public Frame() {
      try {
        setDefaultCloseOperation(EXIT_ON_CLOSE);
        jbInit();
      }
      catch (Exception exception) {
        exception.printStackTrace();
      }
    }

    //Component initialization
    private void jbInit() throws Exception {
      contentPane = (JPanel) getContentPane();
      contentPane.setLayout(borderLayout1);
      setSize(new Dimension(600, 700));
      setTitle(":: EMNet 2006 :: ");
      jMenuFile.setText("File");
      jMenuFileExit.setText("Exit");
      jMenuFileExit.addActionListener(new Frame_jMenuFileExit_ActionAdapter(this));
      jMenuHelp.setText("Help");
      jMenuHelpAbout.setText("About");
      jMenuHelpAbout.addActionListener(new Frame_jMenuHelpAbout_ActionAdapter(this));
      jMenuHelpTerm.setText("Term");
      jMenuHelpTerm.addActionListener(new Frame_jMenuHelpTerm_ActionAdapter(this));
      jMenuBar1.add(jMenuFile);
      jMenuFile.add(jMenuFileExit);
      jMenuBar1.add(jMenuHelp);
      jMenuHelp.add(jMenuHelpAbout);
      jMenuHelp.add(jMenuHelpTerm);
      setJMenuBar(jMenuBar1);

      Dimension big=new Dimension(146,20),big2=new Dimension(185,20),med=new
Dimension(100,20),small=new Dimension(65,20),xs=new Dimension(30,20);

      JPanel panel_bottom=new JPanel(new BorderLayout());
      JPanel panel_left=new JPanel(new BorderLayout());

      panel_gridbag.setPreferredSize(new Dimension(275,120));
```

Frame.java

```
label_dir.setHorizontalAlignment(SwingConstants.RIGHT);
label_dir.setPreferredSize(med);
txt_dir.setPreferredSize(big2);
txt_dir.setText("/Users/percyhou/Desktop/graphFiles");
JPanel gridBag1=new JPanel(new GridBagLayout());
gridBag1.add(label_dir);
gridBag1.add(txt_dir);

label_node.setHorizontalAlignment(SwingConstants.RIGHT);
label_node.setPreferredSize(med);
txt_node.setPreferredSize(big2);
txt_node.setText("node_grid.txt");
JPanel gridBag2=new JPanel(new GridBagLayout());
gridBag2.add(label_node);
gridBag2.add(txt_node);

label_edge.setHorizontalAlignment(SwingConstants.RIGHT);
label_edge.setPreferredSize(med);
txt_edge.setPreferredSize(big2);
txt_edge.setText("edge_grid.txt");
JPanel gridBag3=new JPanel(new GridBagLayout());
gridBag3.add(label_edge);
gridBag3.add(txt_edge);

label_dataIn.setHorizontalAlignment(SwingConstants.RIGHT);
label_dataIn.setPreferredSize(med);
JButton button_import=new JButton("import");
button_import.addActionListener(new Frame_button_import_ActionAdapter(this));

JPanel panel_import=new JPanel(new BorderLayout());
panel_import.add(label_dataIn,BorderLayout.WEST);
panel_import.add(button_import,BorderLayout.EAST);

panel_gridbag.add(gridBag1);
panel_gridbag.add(gridBag2);
panel_gridbag.add(gridBag3);
panel_gridbag.add(panel_import);

panel_left.add(panel_gridbag,BorderLayout.NORTH);

JTabbedPane jtabbedPane=new JTabbedPane();
```

Frame.java

```
jtabbedPane.setPreferredSize(new Dimension(300,300));
JScrollPane tab_node=new JScrollPane(nodeTable);
JScrollPane tab_edge=new JScrollPane(edgeTable);
jtabbedPane.add(tab_node,"node");
jtabbedPane.add(tab_edge,"edge");

panel_left.add(jtabbedPane,BorderLayout.CENTER);
panel_bottom.add(panel_left,BorderLayout.WEST);

JPanel panel_right=new JPanel(new BorderLayout());

//radio buttons: supply, demand, neutral
panel_setting.setPreferredSize(new Dimension(300,120));

radio_supply.addActionListener(new Frame_radio_ActionAdapter(this));
radio_demand.addActionListener(new Frame_radio_ActionAdapter(this));
radio_neutral.addActionListener(new Frame_radio_ActionAdapter(this));
button_run.addActionListener(new Frame_button_run_ActionAdapter(this));

JPanel panel_radio=new JPanel(new GridBagLayout());
radioGroup.add(radio_supply);
radioGroup.add(radio_demand);
radioGroup.add(radio_neutral);
panel_radio.add(radio_supply);
panel_radio.add(radio_demand);
panel_radio.add(radio_neutral);
panel_radio.add(button_run);

panel_setting.add(panel_radio,BorderLayout.NORTH);

//expert bounds
JTabbedPane jtabbedPane_right=new JTabbedPane();
jtabbedPane_right.setPreferredSize(new Dimension(300,200));
JPanel tab_index=new JPanel(new BorderLayout());
JPanel panel_index=new JPanel(new GridLayout(9,1,2,2));
JPanel tab_result=new JPanel(new GridLayout(9,1,2,2));
tab_index.add(panel_index,BorderLayout.NORTH);
jtabbedPane_right.add(tab_result,"result");
jtabbedPane_right.add(tab_index,"expert");

JPanel panel_expert0=new JPanel(new BorderLayout());
JPanel panel_expert1=new JPanel(new GridBagLayout());
```

Frame.java

```
JPanel panel_expert2=new JPanel(new GridBagLayout());
JPanel panel_expert3=new JPanel(new GridBagLayout());
JPanel panel_expert4=new JPanel(new GridBagLayout());
JPanel panel_expert5=new JPanel(new GridBagLayout());
JPanel panel_expert6=new JPanel(new BorderLayout());

JLabel
    label_mtc=new JLabel(" MTC: ",SwingConstants.RIGHT),
    label_atc=new JLabel(" ATC: ",SwingConstants.RIGHT),
    label_ld=new JLabel(" LD: ",SwingConstants.RIGHT),
    label_amac=new JLabel(" AMAC: ",SwingConstants.RIGHT),
    label_nc=new JLabel(" NC: ",SwingConstants.RIGHT);

JLabel
    label_atc_unit=new JLabel(" m",SwingConstants.LEFT),
    label_mtc_unit=new JLabel(" m",SwingConstants.LEFT),
    label_ld_unit=new JLabel(" m",SwingConstants.LEFT),
    label_amac_unit=new JLabel(" m",SwingConstants.LEFT),
    label_nc_unit=new JLabel(" m",SwingConstants.LEFT);

label_atc.setPreferredSize(small);
label_mtc.setPreferredSize(small);
label_ld.setPreferredSize(small);
label_amac.setPreferredSize(small);
label_nc.setPreferredSize(small);

txt_atc_low.setPreferredSize(small);
txt_mtc_low.setPreferredSize(small);
txt_ld_low.setPreferredSize(small);
txt_amac_low.setPreferredSize(small);
txt_nc_low.setPreferredSize(small);

txt_atc_up.setPreferredSize(small);
txt_mtc_up.setPreferredSize(small);
txt_ld_up.setPreferredSize(small);
txt_amac_up.setPreferredSize(small);
txt_nc_up.setPreferredSize(small);

label_atc_unit.setPreferredSize(xs);
label_mtc_unit.setPreferredSize(xs);
label_ld_unit.setPreferredSize(xs);
label_amac_unit.setPreferredSize(xs);
```

Frame.java

```
label_nc_unit.setPreferredSize(xs);

JButton button_set=new JButton("set");
button_set.addActionListener(new Frame_button_set_ActionAdapter(this));

panel_expert0.add(new JLabel(" acceptable range:"),BorderLayout.WEST);

panel_expert1.add(label_atc);
panel_expert1.add(txt_atc_low);
panel_expert1.add(new JLabel(" ~ "));
panel_expert1.add(txt_atc_up);

panel_expert2.add(label_mtc);
panel_expert2.add(txt_mtc_low);
panel_expert2.add(new JLabel(" ~ "));
panel_expert2.add(txt_mtc_up);

panel_expert3.add(label_ld);
panel_expert3.add(txt_ld_low);
panel_expert3.add(new JLabel(" ~ "));
panel_expert3.add(txt_ld_up);

panel_expert4.add(label_amac);
panel_expert4.add(txt_amac_low);
panel_expert4.add(new JLabel(" ~ "));
panel_expert4.add(txt_amac_up);

panel_expert5.add(label_nc);
panel_expert5.add(txt_nc_low);
panel_expert5.add(new JLabel(" ~ "));
panel_expert5.add(txt_nc_up);

panel_expert6.add(button_set,BorderLayout.EAST);

panel_index.add(panel_expert0);
panel_index.add(panel_expert1);
panel_index.add(panel_expert2);
panel_index.add(panel_expert3);
panel_index.add(panel_expert4);
panel_index.add(panel_expert5);
panel_index.add(panel_expert6);
```

Frame.java

```
        JTextField txtField=new JTextField("[indices]",15);
        txtField.setBackground(Color.WHITE);
        txtField.setEditable(false);

        JPanel panel_output0=new JPanel(new GridBagLayout());
        JPanel panel_output3=new JPanel(new GridBagLayout());
//      JPanel panel_output29=new JPanel(new GridBagLayout());
        JPanel panel_output4=new JPanel(new GridBagLayout());
//      JPanel panel_output49=new JPanel(new GridBagLayout());
        JPanel panel_output5=new JPanel(new GridBagLayout());
        JPanel panel_output1=new JPanel(new GridBagLayout());
        JPanel panel_output2=new JPanel(new GridBagLayout());
        JPanel panel_output6=new JPanel(new BorderLayout());

        JLabel
            label_atc1=new JLabel(" ATC: ",SwingConstants.RIGHT),
            label_mtc1=new JLabel(" MTC: ",SwingConstants.RIGHT),
            label_ld1=new JLabel(" LD: ",SwingConstants.RIGHT),
            label_amac1=new JLabel(" AMAC: ",SwingConstants.RIGHT),
            label_nc1=new JLabel(" NC: ",SwingConstants.RIGHT),
            label_e=new JLabel(" E: ",SwingConstants.RIGHT);

        JLabel
            label_atc_unit1=new JLabel(" ",SwingConstants.LEFT),
            label_mtc_unit1=new JLabel(" ",SwingConstants.LEFT),
            label_ld_unit1=new JLabel(" ",SwingConstants.LEFT),
            label_amac_unit1=new JLabel(" ",SwingConstants.LEFT),
            label_nc_unit1=new JLabel(" ",SwingConstants.LEFT),
            label_e_unit1=new JLabel();

        label_atc1.setPreferredSize(small);
        label_mtc1.setPreferredSize(small);
        label_ld1.setPreferredSize(small);
        label_amac1.setPreferredSize(small);
        label_nc1.setPreferredSize(small);
        label_e.setPreferredSize(small);

        atc_output.setPreferredSize(big);
        mtc_output.setPreferredSize(big);
        ld_output.setPreferredSize(big);
        amac_output.setPreferredSize(big);
        nc_output.setPreferredSize(big);
```

```
e_output.setPreferredSize(big);

atc_output.setHorizontalAlignment(SwingConstants.RIGHT);
mtc_output.setHorizontalAlignment(SwingConstants.RIGHT);
ld_output.setHorizontalAlignment(SwingConstants.RIGHT);
amac_output.setHorizontalAlignment(SwingConstants.RIGHT);
nc_output.setHorizontalAlignment(SwingConstants.RIGHT);
e_output.setHorizontalAlignment(SwingConstants.RIGHT);

label_atc_unit1.setPreferredSize(xs);
label_mtc_unit1.setPreferredSize(xs);
label_ld_unit1.setPreferredSize(xs);
label_amac_unit1.setPreferredSize(xs);
label_nc_unit1.setPreferredSize(xs);
label_e_unit1.setPreferredSize(xs);

panel_output0.add(label_e);
panel_output0.add(e_output);
panel_output0.add(label_e_unit1);

panel_output1.add(label_atc1);
panel_output1.add(atc_output);
panel_output1.add(label_atc_unit1);

panel_output2.add(label_mtc1);
panel_output2.add(mtc_output);
panel_output2.add(label_mtc_unit1);

panel_output3.add(label_ld1);
panel_output3.add(ld_output);
panel_output3.add(label_ld_unit1);

panel_output4.add(label_amac1);
panel_output4.add(amac_output);
panel_output4.add(label_amac_unit1);

panel_output5.add(label_nc1);
panel_output5.add(nc_output);
panel_output5.add(label_nc_unit1);

save_dir.setPreferredSize(new Dimension(200,20));
JButton button_save=new JButton("save");
```

Frame.java

```
//      button_save.addActionListener(this);

        panel_output6.add(save_dir,BorderLayout.WEST);
        panel_output6.add(button_save,BorderLayout.EAST);

        tab_result.add(panel_output1);
        tab_result.add(panel_output2);
        tab_result.add(panel_output3);
        tab_result.add(panel_output4);
        tab_result.add(panel_output5);
        tab_result.add(panel_output0);
        tab_result.add(panel_output6);

        panel_setting.add(jtabbedPane_right,BorderLayout.CENTER);
        panel_right.add(panel_setting,BorderLayout.EAST);
        panel_bottom.add(panel_right,BorderLayout.CENTER);
        panel_bottom.add(seperator,BorderLayout.NORTH);

        map.sentFrame(this);

        JSplitPane sp=new JSplitPane(JSplitPane.VERTICAL_SPLIT,map,panel_bottom);
        sp.setDividerSize(8);
        sp.setDividerLocation(270);
        sp.setResizeWeight(0.5);
        sp.setContinuousLayout(true);
        sp.setOneTouchExpandable(true);
        contentPane.add(sp,BorderLayout.CENTER);
    }

    public void setATC(double atc){
        atc_output.setText(myFormatter.format(atc)+"        ");
        txt_atc_low.setText(myFormatter.format(atc*0.8));
        txt_atc_up.setText(myFormatter.format(atc*1.2));
    }

    public void setMTC(double mtc){
        mtc_output.setText(myFormatter.format(mtc)+"        ");
        txt_mtc_low.setText(myFormatter.format(mtc*0.8));
        txt_mtc_up.setText(myFormatter.format(mtc*1.2));
    }

    public void setLD(double ld){
```

Frame.java

```
        ld_output.setText(myFormatter.format(ld)+"        ");
        txt_ld_low.setText(myFormatter.format(ld*0.8));
        txt_ld_up.setText(myFormatter.format(ld*1.2));
    }

    public void setAMAC(double amac){
        amac_output.setText(myFormatter.format(amac)+"        ");
        txt_amac_low.setText(myFormatter.format(amac*0.8));
        txt_amac_up.setText(myFormatter.format(amac*1.2));
    }

    public void setNC(double nc){
        nc_output.setText(myFormatter.format(nc)+"        ");
        txt_nc_low.setText(myFormatter.format(nc*0.8));
        txt_nc_up.setText(myFormatter.format(nc*1.2));
    }

    public void setE(double e){
        e_output.setText(myFormatter.format(e)+"        ");
    }

    void jMenuFileExit_actionPerformed(ActionEvent actionEvent) {
       System.exit(0);
    }

    void jMenuHelpAbout_actionPerformed(ActionEvent actionEvent) {
       Frame_AboutBox dlg = new Frame_AboutBox(this);
       Dimension dlgSize = dlg.getPreferredSize();
       Dimension frmSize = getSize();
       Point loc = getLocation();
       dlg.setLocation( (frmSize.width - dlgSize.width) / 2 + loc.x,
                        (frmSize.height - dlgSize.height) / 2 + loc.y);
       dlg.setModal(true);
       dlg.pack();
       dlg.show();
    }

    void jMenuHelpTerm_actionPerformed(ActionEvent actionEvent) {
       Frame_TermBox dlg = new Frame_TermBox(this);
       Dimension dlgSize = dlg.getPreferredSize();
       Dimension frmSize = getSize();
       Point loc = getLocation();
```

Frame.java

```
    dlg.setLocation( (frmSize.width - dlgSize.width) / 2 + loc.x,
                     (frmSize.height - dlgSize.height) / 2 + loc.y);
    dlg.setModal(true);
    dlg.pack();
    dlg.show();
}

void button_import_actionPerformed(ActionEvent actionEvent){

    setATC(0.0);
    setMTC(0.0);
    setLD(0.0);
    setAMAC(0.0);
    setNC(0.0);
    setE(0.0);

    //read in files: node.txt & edge.txt, assign to field argument
    try {
        IOGraph ioGraph=new IOGraph(txt_dir.getText(),txt_node.getText(),txt_edge.getText());
        this.graph=ioGraph.getGraph();
        Vector nodeSet=graph.getNodeSet();
        Vector edgeSet=graph.getEdgeSet();

        Node tempNode;
        boolean econ=true;
        for(int i=0;i<nodeSet.size();i++){
            tempNode=(Node)nodeSet.elementAt(i);
            if(graph.incidentEdgeSet(tempNode).size()<2){
                econ=false;
            }
        }

        if(econ){
            label_dataIn.setText("2econ!");
        }else{
            label_dataIn.setText("not 2econ!");
        }
    }
    catch (IOException ex) {
        System.out.println("Data Read-In Problem!");
        ex.printStackTrace();
    }
```

Frame.java

```
        save_dir.setText("dir: "+txt_dir.getText());

        map.setGraph(graph);
        this.seperator.setText("[ graph components: "+graph.getNodeSet().size()+" nodes,
"+graph.getEdgeSet().size()+" edges ]");

        this.fleshTable(graph);
        this.repaint();
    }

    void radio_actionPerformed(ActionEvent actionEvent){
        map.nodeSetting(radio_supply.isSelected(),radio_demand.isSelected(),radio_neutral.isSelected());
        this.repaint();
    }

    void button_run_actionPerformed(ActionEvent actionEvent){
        center=new Center(graph,this);
        center.start();

        this.repaint();
    }

    void button_set_actionPerformed(ActionEvent actionEvent){
        double e=1.0;

        double atc=new Double(atc_output.getText()).doubleValue();
        double low_atc=new Double(txt_atc_low.getText()).doubleValue();
        double up_atc=new Double(txt_atc_up.getText()).doubleValue();
        double std_atc=standardN(atc,low_atc,up_atc);

        double mtc=new Double(mtc_output.getText()).doubleValue();
        double low_mtc=new Double(txt_mtc_low.getText()).doubleValue();
        double up_mtc=new Double(txt_mtc_up.getText()).doubleValue();
        double std_mtc=standardN(mtc,low_mtc,up_mtc);

        double amac=new Double(amac_output.getText()).doubleValue();
        double low_amac=new Double(txt_amac_low.getText()).doubleValue();
        double up_amac=new Double(txt_amac_up.getText()).doubleValue();
        double std_amac=standardN(amac,low_amac,up_amac);

        double ld=new Double(ld_output.getText()).doubleValue();
```

Frame.java

```
        double low_ld=new Double(txt_ld_low.getText()).doubleValue();
        double up_ld=new Double(txt_ld_up.getText()).doubleValue();
        double std_ld=standardN(ld,low_ld,up_ld);

        double nc=new Double(nc_output.getText()).doubleValue();
        double low_nc=new Double(txt_nc_low.getText()).doubleValue();
        double up_nc=new Double(txt_nc_up.getText()).doubleValue();
        double std_nc=standardP(nc,low_nc,up_nc);

        e=(1.0/3.0)*((std_atc + std_mtc)/2.0 + (std_ld + std_amac)/2.0 + std_nc);

        this.setE(e);
    }

    //positive
    double standardP(double x,double low,double up){
        if(up<=x){
            return 1.0;
        }else if(low<=x && x<up){
            return (x-low)/(up-low);
        }else{
            return 0.0;
        }
    }

    //negative
    double standardN(double x,double low,double up){
        if(x<low){
            return 1.0;
        }else if(low<=x && x<up){
            return (low-x)/(low-up);
        }else{
            return 0.0;
        }
    }


    public void setSeperator(Graph graph){

        int nodeNum=0,edgeNum=0;
        Vector nodeSet=graph.getNodeSet();
        Vector edgeSet=graph.getEdgeSet();
```

Frame.java

```
        Node tempNode;
        for(int i=0;i<nodeSet.size();i++){
            tempNode=(Node)nodeSet.elementAt(i);
            if(!tempNode.isDummy())
                nodeNum++;
        }

        Edge tempEdge;
        for(int i=0;i<edgeSet.size();i++){
            tempEdge=(Edge)edgeSet.elementAt(i);
            if(!tempEdge.isDummyEdge())
                edgeNum++;
        }

        seperator.setText("[ graph components: "+nodeNum+" nodes, "+edgeNum+" edges   |   supply
"+graph.getSupplyNodeNum()+" , demand "+graph.getDemandNodeNum()+" ]");
        this.repaint();
    }

    public Map getMap(){
        return this.map;
    }

    void fleshTable(Graph graph){
        Vector nodeSet=graph.getNodeSet(),edgeSet=graph.getEdgeSet();
        Object nodeData[]=new Object[3];
        DefaultTableModel nodeTableModel=new DefaultTableModel();
        nodeTableModel.addColumn("label");
        nodeTableModel.addColumn("x");
        nodeTableModel.addColumn("y");
        for(int i=0;i<nodeSet.size();i++){
            Node node=(Node)nodeSet.elementAt(i);
            nodeData[0]=""+node.getLabel();
            nodeData[1]=""+node.getX();
            nodeData[2]=""+node.getY();
            nodeTableModel.addRow(nodeData);
        }
        this.nodeTable.setModel(nodeTableModel);

        Object edgeData[]=new Object[3];
        DefaultTableModel edgeTableModel=new DefaultTableModel();
        edgeTableModel.addColumn("label");
```

Frame.java

```
            edgeTableModel.addColumn("n1");
            edgeTableModel.addColumn("n2");
            for(int i=0;i<edgeSet.size();i++){
                Edge edge=(Edge)edgeSet.elementAt(i);
                edgeData[0]=""+edge.getLabel();
                edgeData[1]=""+edge.getN1().getLabel();
                edgeData[2]=""+edge.getN2().getLabel();
                edgeTableModel.addRow(edgeData);
            }
            this.edgeTable.setModel(edgeTableModel);
    }

}

class Frame_jMenuFileExit_ActionAdapter
        implements ActionListener {
    Frame adaptee;

    Frame_jMenuFileExit_ActionAdapter(Frame adaptee) {
        this.adaptee = adaptee;
    }

    public void actionPerformed(ActionEvent actionEvent) {
        adaptee.jMenuFileExit_actionPerformed(actionEvent);
    }
}

class Frame_jMenuHelpAbout_ActionAdapter
        implements ActionListener {
    Frame adaptee;

    Frame_jMenuHelpAbout_ActionAdapter(Frame adaptee) {
        this.adaptee = adaptee;
    }

    public void actionPerformed(ActionEvent actionEvent) {
        adaptee.jMenuHelpAbout_actionPerformed(actionEvent);
    }

}

class Frame_jMenuHelpTerm_ActionAdapter
```

Frame.java

```
    implements ActionListener {
  Frame adaptee;

  Frame_jMenuHelpTerm_ActionAdapter(Frame adaptee) {
    this.adaptee = adaptee;
  }

  public void actionPerformed(ActionEvent actionEvent) {
    adaptee.jMenuHelpTerm_actionPerformed(actionEvent);
  }

}


class Frame_button_import_ActionAdapter implements ActionListener{
    Frame adaptee;
    Frame_button_import_ActionAdapter(Frame adaptee){
        this.adaptee=adaptee;
    }

    public void actionPerformed(ActionEvent actionEvent){
        adaptee.button_import_actionPerformed(actionEvent);
    }
}

class Frame_radio_ActionAdapter implements ActionListener{
    Frame adaptee;
    Frame_radio_ActionAdapter(Frame adaptee){
        this.adaptee=adaptee;
    }

    public void actionPerformed(ActionEvent actionEvent){
        adaptee.radio_actionPerformed(actionEvent);
    }
}

class Frame_button_run_ActionAdapter implements ActionListener{
    Frame adaptee;
    Frame_button_run_ActionAdapter(Frame adaptee){
        this.adaptee=adaptee;
    }
```

Frame.java

```
        public void actionPerformed(ActionEvent actionEvent){
            adaptee.button_run_actionPerformed(actionEvent);
        }
    }

    class Frame_button_set_ActionAdapter implements ActionListener{
        Frame adaptee;
        Frame_button_set_ActionAdapter(Frame adaptee){
            this.adaptee=adaptee;
        }

        public void actionPerformed(ActionEvent actionEvent){
            adaptee.button_set_actionPerformed(actionEvent);
        }
    }
```

個人簡歷

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A. 期刊論文

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