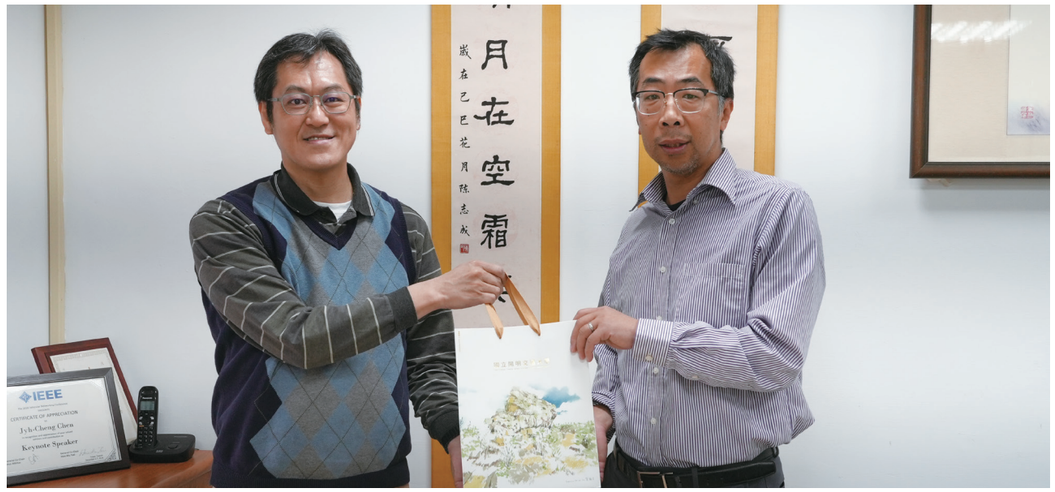
德州奧斯丁大學 Chen Yu 教授演講
Learning in Humans and Machines: Two Sides of the Same Coin or Not

文／孔啟熙 研究助理



Chen Yu 教授在羅徹斯特大學 (University of Rochester) 獲得博士學位，目前德州奧斯丁 (The University of Texas at Austin) 心理系教授以及在該校的神經科學系中的感知系統中心的教授。

Chen 曾獲得了認知科學 (Cognitive science) 中的 馬爾獎 (David Marr)。Chen 首先介紹了自己的背景，為何一個受電腦科學訓練的學者會轉向往人類發展研究。受啟發於電腦之父 Alan Turing 的圖靈測試即是模仿人類的運算、也曾是心理學背景 Jeff Hinton 透過人類神經傳遞方式而設計了神經網路。也包含幾年前的對於 Alpha GO 的觀察，電腦很擅長預測下一步棋該如何走但卻很難做出對應的下棋動作，而這樣的動作對於人類來說卻是輕而易舉。受到這些啟發，Chen Yu 教授便投入在研究人類與電腦在學習上的關係，以及是否能透過人類學習的方式來教會電腦學習。

電腦和人類在學習上的幾個最大的差別是：人類只需要少量的經驗就可以學習一個任務，而在學的過程是不斷的用全身感知環境並與環境互動，相反的，電腦需要大量的靜態訓練集資料，且只透過模型及演算法 (類比於大腦) 被動的學習。因此電腦在學習的方式上還有很大的進步空間，而我們討論能不能透過人類的智能發展得到啟發。

為了更好的捕捉到人類發展學習的特徵，Chen 的實驗室建立了一個模擬居家的空間，裡頭設置了許多相機及感應器，並蒐集大量家長與小孩在互動以及摸索玩具的過程。在測試之後也大量標記物體、人體動作支架、以及重建 3D 環境。這些蒐集到的資料便可以用 AI 的技術加以分析得到人類學習的特徵集結論，也能更進一步的將其結論帶回到機器學習領域，探討是否能幫助電腦學習。

演講中，Chen 透過三個層面來介紹人類學習中有哪些觀察是能夠引進機器學習的：（一）感知智能：第一人稱視覺是透過的動作得來的。人類的注意力可以分為兩種：從下而上 (Bottom up)，透過刺激轉移注意力以及從上而下 (Top down)，根據人類意圖而主動去注意感興趣的物體。而這兩種機制是獨立、互相競爭、且互相協助的系統。（二）認知智能：人類如何透過少量經驗學習。人是如何選擇經驗來學習，該選擇注意哪裡以及如何透過選擇的資料來學習進而有效率的學習。和機器學習最大的差別是人類除了會選擇正確的資訊也會選擇錯誤的資訊並加以矯正。（三）社交智能：人類如何透過身體動作完成日常多模態的互動。和目前機器學習最大的差別是人類會透過不同的感官不斷找尋更好的注意力去完成任務。

Chen 介紹許多認知發展心理學與電腦科學的結合，如何使用機器學習來幫助尋找人類的學習特徵，從人類學習上觀察到有趣的結論又該如何引進回機器學習的設計。其兩者應是緊密相合且互利互惠，未來仍有許多尚待探討的議題。

Speech by Dr. Chen Yu:
Learning in Humans and Machines: Two Sides of the Same Coin or Not

Professor Chen Yu earned his doctoral degree at the University of Rochester. Currently, he is a professor in both the Department of Psychology and the Center for Perceptual Systems at The University of Texas at Austin.

Dr. Yu has been awarded the Marr Prize in Cognitive Science. During his presentation, he shared his academic background and explained why he shifted from computer science to human development research. Notably, he mentioned that Alan Turing, the pioneer of computers, developed the Turing test to simulate human computation, while Jeff Hinton, who was initially rooted in psychology, developed neural networks inspired by human neural transmission. A few years ago, he scrutinized AlphaGo and found that computers excel at predicting upcoming moves in a game but struggle with executing corresponding physical actions, which humans can do effortlessly. Dr. Yu was motivated by these insights and investigated the relationship between humans and computers in learning, and explored the possibility of teaching computers through human learning methodologies.

The primary distinction in the learning process between computers and humans lies in the fact that humans can become skilled at a task with little experience. They learn through continuous perception and interaction with their environment. In contrast, computers necessitate extensive static training datasets and passively learn through models and algorithms, resembling the functioning of the human brain. Therefore, there is still room for improvement in computer learning. People are discussing whether we can learn from how humans evolved intelligence to enhance computer learning.

Dr. Yu's research team has established a simulated domestic environment with multiple cameras and sensors to better capture the features of human development and learning. They have extensively collected data on parent-child interactions and toy exploration. After the experiments, the team annotated objects and human body movements and reconstructed 3D environments. The gathered data can now be analyzed using AI to conclude human learning characteristics. These insights can be further used for machine learning to improve computer-based learning.

During the speech, Dr. Yu discussed three perspectives on how to integrate insights from human learning into machine learning: 1. Perceptual Intelligence: The acquisition of first-person vision is linked to movement. Human attention can be categorized into two forms. The first form is known as bottom-up, where attention responds to stimuli. The second form is top-down, where attention is actively directed to objects of interest based on human intent. These two mechanisms operate as independent, competitive, and collaborative systems. 2. Cognitive Intelligence: Human learning with limited experiences involves selecting which experiences to prioritize for learning, where to focus attention, and how to learn from chosen data effectively. The primary distinction from machine learning lies in humans' ability to identify and select accurate information and recognize and rectify inaccurate information. 3. Social Intelligence: Investigating how humans engage in daily multimodal interactions through body movements. A significant difference between humans and current machine learning is that humans utilize various senses to improve their attention when accomplishing tasks.

Dr. Yu delivers a presentation that explores the integration of cognitive developmental psychology and computer science. This integration can help us understand human learning characteristics by utilizing machine learning. Additionally, it is remarkable how the interesting discoveries obtained from observing human learning can be incorporated into the framework of machine learning design. The interdependent relationship between these two fields is closely interwoven, providing reciprocal benefits, and there are many unexplored topics to be investigated in the future.