

南加州大學 孫紹華先生演講 Program-Guided Framework for Interpreting and Acquiring Complex Skills with Learning Robots

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孫紹華先生於南加州大學攻讀博士學位，也同時於南加州大學資訊科學系擔任 Annenberg Fellow，目前在 Joseph J. Lim 教授所指導的 Cognitive Learning for Vision and Robotics Lab (CLVR)。研究的領域甚廣，其中涵蓋深度學習、機器人學習、強化學習、meta-learning、program synthesis 和電腦視覺。

孫紹華先生先於 NeurIPS Taipei Meetup 分享了自己機器人學習領域的相關研究成果，並應邀蒞臨資訊學院演講。主題是 Program-Guided Framework for Interpreting and Acquiring Complex Skills with Learning Robots，本次演講探討機器人學習結合傳統的強化學習所會面臨的問題，透過討論不同專案的相關理論基礎及研究成果，將這些專案整合，並提出一套完整的機器人學習框架。

隨著現今人工智慧和機器學習的技術逐漸普及，電腦能做到辨識圖片或影像，也能理解聲音或自然語言，甚至在一些複雜的棋類遊戲打敗人類。然而，在真實世界中，訓練一個機器人去完成我們預期的任務，並進一步讓它自行去學習新的技能，是一件困難且具有挑戰性的工作。常見的問題主要會包含以下四種，第一，傳統的強化學習能幫助機器人學習一個策略來完成我們設定的目標，然而使用者卻無法輕易地去理解這個策略背後的執行原理，第二，在不重新學習的情況下，機器人無法將簡單的策略套用到相關且規模

較龐大的任務，第三，強化學習往往僅能處理一些時效性較短的任務，第四，電腦無法善用經驗，透過整合一些學到的簡易技能，去完成一項複雜的任務。因此，孫紹華先生的目標是設計一個可解釋、可概括、分層和模組化的機器人學習框架。

這次講座孫先生分享了他許多他的團隊在機器人學習領域的研究與成果。我們在學習機器學習的過程中，往往都會在一些簡易且可控的環境去實作我們的演算法，然而，真實環境卻不會像訓練環境這麼理想，當環境有些微的變化，機器人就需重新去學習對應的策略，這是很不方便且耗成本的。因此，這個完整的機器人學習框架確實能有效地去幫助機器人學習，將整個策略程式化後，可以讓使用者更加清楚整個策略的流程，甚至可以透過簡易的編程去改善整個策略，這不論在機器人學習或是使用者回饋都很有幫助。這些研究讓機器人有辦法勝任長期且複雜的工作，奠定了未來機器人學習領域的基石。

會後，孫先生也憑藉著自己多年的研究和投稿眾多國際會議論文的經驗，和我們分享論文該如何準備和撰寫。我們往往對研究有一套不錯的想法，然而，該如何呈現與表達才是論文是否被接受的關鍵。平時除了廣泛地閱讀其他人的論文外，我們也需要花費一些時間在查閱審查者的評論，以了解論文審查的重點。除此之外，針對每個研究階段，我們都應該具備隨時能夠演講的能力，可以明確地向其他人傳達自己想做什麼，在講解自己的研究時，除了可以獲得別人的回饋以外，也能幫助自己重整思緒，確定自己接下的研究方向。不論是在學期間的研究或是未來工作上的專案，都能使自己不會無所適從，面對問題也都能迎刃而解。

最後，很感謝這次能聆聽孫紹華先生的演講，並能與孫先生經驗交流，除了對於機器學習在現實世界的運用有更加一層的認識以外，對於研究的進行和論文的撰寫也有明確的想法。

The Speech of Mr. Shao-Hua Sun Program-Guided Framework for Interpreting and Acquiring Complex Skills with Learning Robots

Shao-Hua Sun is the Ph.D. candidate and the Annenberg Fellow in the Department of Computer Science at the University of Southern California (USC) as well as a member of the Cognitive Learning for Vision and Robotics Lab (CLVR), advised by Professor Joseph J. Lim. His research interests span over the fields of deep learning, robot learning, reinforcement learning, meta-learning, program synthesis, and computer vision.

Mr. Sun was invited to give a speech at the College of Computer Science at NYCU after he shared his research results in the field of robot learning at the NeurIPS Taipei Meetup. The topic of his speech was "Program-Guided Framework for Interpreting and Acquiring Complex Skills with Learning Robots", in which he discussed the problems raised by robot learning combined with traditional reinforcement learning. While surveying the theoretical bases and research results of different projects, he leveraged the merits of these projects and proposed a complete robot learning framework.

Recent development in artificial intelligence and machine learning has remarkably advanced machines' capability to analyze images and videos, comprehend natural languages and speech, and even outperform professional players in complex board games. However, it still remains a challenge to build intelligent robots that can execute tasks we expected and autonomously acquire novel skills. Most problems fall into four main categories: First, traditional reinforcement learning enables robots to learn its optimal behavioral strategy in order to achieve the desired goal. But the execution principle behind the strategy is obscure to users. Second, robots cannot apply basic policies to related and large tasks without retraining. Third, reinforcement learning is usually able to handle tasks within a short period of time. Fourth, computers are lack of the ability to make good use of experience or combine existing fundamental skills to complete a sophisticated task. Therefore, the goal of Sun's research is to develop a robot learning framework which is interpretable, generalizable, hierarchical, and modularized.

Mr. Sun shared a number of his team's researches

and achievements in the field of robot learning during the speech. While studying machine learning, we usually implement algorithms in a simplified and well-controlled environment. However, the real world is far from ideal as laboratory environments. Any slight change in the environment would force the robot to adapt itself and relearn the updated strategies at hand, which is inconvenient and resource-consuming. On top of that, this complete robot learning framework can help robots learn skills effectively. After programming a complete strategy, users would better understand the process of the strategy, and may even improve the strategy through the low-code development, which is of great help to both robot learning and user feedback. These studies do equip robots with the ability to perform long-run and complex tasks to lay the solid foundation of robot learning in the future.

After the speech, Mr. Sun chatted with us about how to prepare and write papers on the basis of his experience in conducting research and submitting papers to many international conferences for many years. We usually have good ideas for our research; however, the clear expression of our concept in the article would be the key aspect regarding whether the papers get accepted or rejected. Apart from reading research papers extensively, we need to spend some time on checking the reviewers' comments to realize the focus of paper review. In addition, for each stage in research, we should prepare ourselves to give a speech at any time, and communicate our ideas and opinions clearly. When describing our research, we will not only receive feedback but also reorganize our thoughts, thereby determining the following research direction. No matter whether the project is for school or for a future career, we will not stray far from the goal and work out the solution well whatever problem happens to us.

Finally, I would like to express my thankfulness to Mr. Shao-Hua Sun for his speech, and for the exchange of experience with him. In addition to having a better understanding of the application of machine learning in the real world, I have gained a clear idea how to conduct research and compose papers.