

When I was 14, I fell in love with visual arts. I greedily consumed the great works of cinema, TV series, storytelling video games and VR shorts. I believed visual art was the best way to reach to our insides and bring us together. Then, I entered Pomona College as a film studies major. I am grateful for the freedom I had in here in exploring my interest. As I delved deeper into the field, I gradually realized the importance of technology on the development of visual art. As I saw the visual effects in movies like *The Curious Case of Benjamin Button* and *Avengers*, I was attracted by how graphics technology could be waived into storytelling. I realized that technology and art are related rather than separated. Thus, I wished to explore new ways to enrich storytelling and interactions with graphic technologies.

My exploration in academics was not smooth. I first looked into computer graphics, but there was not much research opportunity in my college, so I switched my studies to computer vision. I self-taught the contents with Jeff Heaton's Keras lectures, Stanford CS231 Convolutional Neural Networks and CS330 Meta Learning. I also took math courses that were helpful to my understanding of neural networks, such as probability, advanced linear algebra, differential equations and math of big data.

In order to gain a deeper understanding in the subject, I started my first research in facial recognition with professor Weiqing Gu at Harvey Mudd College. I proposed to use a joint network combining the prediction of face shape recognition and CNN recognition on extracted areas. To accelerate the progress, I registered the project in a college-wise machine learning club and recruited three students through the organization. As the group leader, I led the research direction, held group discussions and distributed research works. Based on what I learned, we implemented the distance recognition with Gaussian model clustering. Although it did not reach to an ideal result, I learned to read the papers, set the research goal, do presentations and academic writings. I was more determined to go on doing research in computer science after this experience.

Another thing I learned was that researchers must track academic result in their respective field in order to relevantly contributed. Earlier this year, in Vincent Sitzmann's twitter, I read about the exciting work of NeRF: Representing Scenes as Neural Radiance Fields for View Synthesis. I was impressed by the high-quality renderings from the trained model, as well as the elegance of this pipeline. Nonetheless, the training on each scene took 1-2 days on a high-end GPU, which would be too long for interactive 3D graphics or training on a full video. I thought of accelerating the training with meta-learning, so I began to look for relevant articles. As I saw MetaSDF, which applied a Model-Agnostic Meta-Learning (MAML) model to a neural rendering function for computer-generated scenes, I confirmed my idea that first-order meta-learning methods could have great effects on accelerating the training of neural rendering tasks. After I implemented MAML-NeRF, it performed only slightly better than a blank model, and became worse as the iteration increased. Rather than giving up, I continued looking for other meta-learning methods. I soon discovered Reptile, another optimization-based meta-learning algorithm. Since this method could have many more inner steps, I was able to make Reptile-NeRF treat each scene as an inner task, and thus shuffle the rays to decrease the variance of inner training data. Unfortunately, on December 3rd, the original NeRF team published their work *Learned Initializations for Optimizing Coordinate-Based Neural Representations*. They used the exact same method as mine, and were able to achieve a good result with a much larger dataset. I

was scooped, so I ended the project. Though I failed to publish my work, I experienced the whole process of research. This was also my first time writing the final paper as the first author. Learning from the best, I carefully read through NeRF and MetaSDF quite a few times to learn their writing structures. For details, I received help from my research partner, a PhD student at Princeton University. I also learned to alleviate my frustrations at each obstacle and come back with fresh energy. Furthermore, this project made me wonder if a wiser choice of the rendering function could also improve the training efficiency. I was thus inspired to start my math thesis project - a survey on rendering functions for neural rendering on view synthesis. I plan to explore further in neural rendering.

Previous experience gave me a solid understanding on computer vision and computer graphics. In August, I began a project in augmented reality with professor Misha Sra at. It was a great opportunity to work with an active researcher in the field and further develop my research skills. Apart from learning the AR implementations, I also learned about designing experiments that involved human participants. Our goal was to investigate the effect of location-based memory in AR language learning. We let our participants walk around an outdoor area holding a smartphone, through which they would see word tags in the foreign language attached to the real objects. Designing the first user study in my life was quite challenging, so I went through every detail in relevant studies and learned the HCI study principles behind them. In this way, I finished experiment setup and testing metrics. I discussed a lot of details with prof Sra on how to display the words in the most comfortable way and how to control time spent on the walking procedure. Eventually, I successfully designed a pipeline that could demonstrate the effectiveness of AR learning in fair comparison, and implemented an Android AR app with cloud anchors to give participants a comfortable user interface. The actual experiment is postponed due to COVID, but we have all the details set at this point. We plan to conduct the user study in a college in late January, and then publish the paper in February. Before this project, I had no experience with Android development, but I learned everything in a short time and was able to finish the app for experiment by myself. I am grateful for prof Sra as she guided me through the design of experiments, writing interview questions and analyzing users' reviews. This HCI research experience is invaluable to my career.

At this point, my research spans from machine learning to graphical display to human computer interaction. I am proud of having experience in all these fields. In the future, I wish to lay a solid foundation by gaining more knowledge in these areas and focus my research on visual HCI. I like CMU because it respects students' interests in research. Every program includes a final project, in which students can collaborate with professors in respective fields. For the three areas I wish to study further - computer graphics, machine learning and HCI, CMU is top-ranked in all of them. The courses offered in CMU are both rigorous and practical. I can have a well-rounded knowledge in machine learning with the core courses such as *Advanced ML*, *Convex Optimization* and *Reinforcement Learning*; I can also gain a deep understanding in graphics from the electives such as *Computer Graphics*, *Computer Game Programming*. These classes will give me valuable skills and insights in visual HCI. With the knowledge, I hope I will be able to work with professors such as *Ken Holstein*, *Yaser Sheikh*, *Matthew O'Toole* and *Keenan Crane* as I finish the degree. In all, I believe I will thrive in CMU.