

# Philip M. Carr

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## Education

**California Institute of Technology (Caltech)**

**Graduated 2020**

Major: BS, Computer Science

GPA: 3.6

**Thomas Jefferson High School for Science and Technology (TJHSST)**

**Graduated 2016**

Newsweek's Number 1 Ranked High School in the U.S. in 2016

## Personal Statement

I am passionate about pursuing a career in software engineering/development. I am especially interested in computer graphics and machine learning. Throughout my years at Caltech, I immersed myself in diverse projects including: Developing data analysis software to perform more efficient research into T Tauri stars; implementing machine learning models to classify variable young stars; implementing illustrative rendering of 3d triangle-mesh models; and animating time-dependent 2-dimensional functions on a 2d-triangle mesh plane. I further performed research at the Mitsubishi Electric Advanced Technology Research and Development Center on the feasibility of using a D-wave quantum computer algorithm to accelerate training supervised machine learning models. From my extensive experience over the years in computer science, I am confident that I will be an excellent fit for any available position relevant to my skill set.

## Computer Science Fields of Interest

Graphics, Animation, and Simulation

Artificial Intelligence and Machine Learning

**Programming Languages:** C/C++ (with OpenGL, GLSL, CUDA), Python/Anaconda/Jupyter, OCaml, Haskell, Java, x86-64 Assembly

## Selected Classes Taken

### Computer Graphics, Animation, and Simulation:

CS 171: **Computer Graphics Laboratory** (C++), CS 174: **Computer Graphics Projects** (C++), CS 178: **Numerical Algorithms and their Implementation** (Python), CS 179: **GPU Programming** (CUDA), CS 90: **Reading in Computer Science** (Graphics Papers), Ph 20 and Ph 22: **Computational Physics** (Python)

### Machine Learning:

CS 156a: **Learning Systems** (Jupyter Notebooks), CS 155: **Machine Learning & Data Mining** (Jupyter Notebooks)

### Computer Systems:

CS 24: **Introduction to Computing Systems** (C, x86-64 Assembly), CS 115: **Functional Programming** (Haskell)

## Project/Research Experience

**LeetCode/HackerRank Practice and Independent Computer Science Study**

**Fall 2021 – Present**

**Consolidating Academic Research and Updating Class Projects on GitHub**

**Fall 2020 – Summer 2021**

### Projects in Computer Science Class

**Class/Project Mentor: Dr. Alan Barr**

**October 2, 2019 – June 12, 2020**

**Project Title:** Illustrative Rendering and 2D Heightmap Animation Program

### Project Description:

- Developed a program (in C++) that renders 3D triangle mesh models (.obj files) in the art style of the video game Team Fortress 2 as detailed by Mitchell, J., Francke, M., and Eng, D. 2007. This program utilizes a variety of techniques such as texture-mapped diffuse lighting and rim lighting.
- Additionally, animates a 2-dimensional heightmap (triangle mesh sheet oriented along the xy-plane) with any given time-dependent function of 2 variables (e.g.  $h = f(t; x, y)$ ).

### Mitsubishi Electric Advanced Technology Research and Development Center – Hyogo, Japan

**Coordinated with the Caltech Japan Internship Program**

**Project Mentors: Dr. Kenzo Makino, Dr. Hiroaki Murakami**

**July 1, 2019 – September 8, 2019**

**Project Title:** Research and development to speed up machine learning by using a quantum computer

### Project Description:

- Developed a software pipeline (in Python) to investigate the feasibility of using the D-Wave quantum computer to accelerate the pre-training process (QPU-based pre-training) of a deep neural network. This system compares the performances of the fully trained (pre-training followed by post-training) deep-neural network models using QPU-based pre-training against equivalent models pre-trained using the traditional CPU-based method.

- Experimental procedure replicated that of Adachi & Henderson 2015, which found that QPU-based pre-training results in higher deep neural network accuracy with fewer pre-training iterations than does the CPU-based pre-training, although results of this project differed from Adachi & Henderson 2015 (possibly due to replication error).

#### **Caltech Summer Undergraduate Research Fellowship**

**Project Mentor: Dr. Lynne Hillenbrand**

**July 16, 2018 - September 21, 2018**

**Project Title:** Application of Supervised Machine Learning to Classification of Variable Young Stars

#### **Project Description:**

- Developed software in Python with Jupyter Notebooks to implement the application of supervised machine learning models to the classification of variable young stars using labelled data derived from light curves of different variability types.
- Developed programs to read in the labelled light curve data, extract features from the data, train and optimize a variety of classifiers on the data (using scikit-learn) and evaluate the classification accuracy of each model. The most accurate model was the random forest algorithm with an average classification accuracy of  $75 \pm 5\%$  and a balanced accuracy of  $75 \pm 6\%$ .

#### **Caltech Summer Undergraduate Research Fellowship**

**Project Mentor: Dr. Lynne Hillenbrand**

**July 10, 2017 - September 15, 2017**

**Project Title:** Development of a T Tauri star spectral analysis infrastructure

#### **Project Description:**

- Developed software in Python in a Jupyter Notebook to perform data analysis methods on the spectra of T Tauri (young) stars. Designed data analysis infrastructure to study both properties of stars (spectrum plotting, stellar chemical composition, radial velocity, etc.) and interactions between a star and its circumstellar disk (disk accretion veiling, emission line profiles, and velocity spectrum plotting).

#### **Caltech Freshman Summer Research Institute**

**Project Mentor: Dr. Adric Riedel**

**July 10, 2016 - August 13, 2016**

#### **Project Description:**

- Helped retrieve data of Young Stellar Objects (YSOs) from various research papers and populate the Caltech YSOC database with the retrieved data. Determined the relative ages of several star-forming regions (using a color-color plot distinguishing infrared excess stars from non-infrared excess stars) using the data in the database (Python used for the data analysis).

#### **Summer Science Program 2015 (SSP)**

**Hosted by University of Colorado Boulder**

**Sponsored by Caltech and MIT**

**June 28, 2015 - August 5, 2015**

#### **Project Description:**

- On a team of three people, selected a near-earth asteroid (2005 JF21) to observe and measure throughout the course of the program, using ground-based optical telescopes. Wrote software to determine the size, shape, and orientation of the asteroid's orbit around the Sun using Python, with determined orbital elements of the asteroid submitted to the Minor Planet Center of the International Astronomical Union.

### **Honors and Awards**

**USA Astronomy and Astrophysics Olympiad Grades 11, 12**  
National Astronomy Olympiad (NAO) Semifinalist 2015, 2016

#### **Science Olympiad Grades 7, 8, 11**

**2<sup>nd</sup> Place Astronomy, 5<sup>th</sup> Place Geologic Mapping**  
**1<sup>st</sup> Place Team Trophy 2015**

*Virginia Science Olympiad Division C Regional Tournament*  
*Marshall HS, Falls Church, Virginia*

**1<sup>st</sup> Place Reach for the Stars, 1<sup>st</sup> Place Meteorology**  
**1<sup>st</sup> Place Team 2012**

*Virginia Science Olympiad State Finals*  
*Westfield High School, Chantilly, Virginia*

**Member of 8<sup>th</sup> Place Team National Finals 2012**  
*University of Central Florida, Orlando, Florida*

**2<sup>nd</sup> Place Reach for the Stars, 2<sup>nd</sup> Place Water Quality, 3<sup>rd</sup> Place Meteorology**  
**2012**

*Virginia Science Olympiad Regional Finals*  
*Kilmer MS, Vienna, Virginia*

**1<sup>st</sup> Place Meteorology, 2<sup>nd</sup> Place Reach for the Stars 2012**

*Virginia Science Olympiad Division B Invitational Tournament*  
*Fairfax HS, Fairfax, Virginia*

#### **Botball Robotics Grade 11, 12-Dead Robot Society, Botball Robotics Team Awards**

**1<sup>st</sup> Place Overall**

**1<sup>st</sup> Place Double Elimination**

**Overall Judges Choice Trophy**

*2016 Greater DC Regional Botball Tournament*  
*Rockville, Maryland*

**2<sup>nd</sup> Place Overall**

**1<sup>st</sup> Place Head to Head**

**Overall Judges Choice Trophy**

*2015 Greater DC Botball Tournament*  
*Alexandria, Virginia*

**2<sup>nd</sup> Place Alliance Match Team Trophy**

**Spirit of Botball Team Trophy**

**Youth Advisory Council People's Choice Award**

*2014 International Botball Tournament*  
*Los Angeles, California*