

Michael Painter

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9 years of machine-learning experience across *reinforcement learning*, *computer vision*, *image generation*, *natural language processing*, and experience with parallel/distributed systems. Authored the first *open-source, parallelised C++ implementation* of *trial-based heuristic tree search*. Applied Research Scientist at Amazon Robotics and PhD student at the University of Oxford, with research focusing on *Sequential Decision Making*, *Reinforcement Learning*, and *Monte Carlo Tree Search*.

EDUCATION

Oxford University, Oxford Robotics Institute DPhil Engineering Science (Robotics/Machine Learning) - Supervisors: Nick Hawes & Bruno Lacerda	Oct 2018 – Jan 2020 + Jan 2022 – Current
<ul style="list-style-type: none">Developed THTS++ library: first open-source parallelised implementation of Trial-Based Heuristic Tree Search in C++Published papers on state-of-the-art methods for Monte Carlo Tree Search at NeurIPS and ICAPSCo-authored the <i>Risk-Aware Probabilistic Planning fOr Robot Teams</i> library used internally by GOALS research groupTeaching: masters project supervision and teaching assistant for robotics and software engineering courses	
Stanford University MS Computer Science (AI Specialisation)	Sep 2016 – Jun 2018
<ul style="list-style-type: none">Main courses: AI, Machine Learning, Reinforcement Learning, Robotics, Computer Vision, NLP with Deep Learning, Randomised Algorithms, Optimisation and Algorithmic Paradigms, Data Mining, Principles of Computer SystemsTeaching assistant for Probability, Reinforcement Learning and Principles of Computer Systems coursesResearch project using Variational Autoencoders for sequential image generation in the Ermon group (SAIL)	
Cambridge University, Churchill College BA (Hons) Computer Science	Oct 2013 – Jun 2016
<ul style="list-style-type: none">Main courses: Algorithms, AI, Computer Vision, Concurrent/Distributed Systems, Networks, Probability, Linear Algebra, Information Theory, Databases, Security, Computer Systems Modelling, Unix, Computer Architecture and Design	

WORK EXPERIENCE

Applied Research Scientist — Amazon (Berlin) Amazon Robotics, Team Veritas	Jun 2025 – Current
<ul style="list-style-type: none">Adapting <i>Monte Carlo Tree Search</i> into a sound graph-based variant (MCGS) to avoid duplicated computationsFor a <i>Large Language Model</i> trained on <i>PDDL</i> problems, MCGS improves plan lengths (40% closer to optimal) over sampling from the model alone, and integrates into an <i>AlphaZero</i>-style reinforcement learning loop for <i>fine-tuning</i>Technologies used: Python, S3, AWSBatch, HuggingFace	
Software Engineer Intern — Google (Mountain View, US) Display Ads Predictions Team	Jul 2019 – Oct 2019
<ul style="list-style-type: none">Developed <i>Generalised Linear Mixed Models</i> to predict <i>click-through rate</i> (CTR) and <i>conversion rate</i> (CVR)Fitted models using <i>variational inference</i> on <i>billions of data points</i> to improve training efficiency and remove bias from gradient updates; built the training algorithm such that it could <i>distributed</i> to exploit <i>data parallelism</i> and <i>model sparsity</i>Technologies used: Python, TensorFlow, Google Borg	
Applied Scientist Intern — Microsoft (Bellevue, US) Deep Neural Networks (DNN) Frameworks Team	Jul 2018 – Sep 2018
<ul style="list-style-type: none">Trained <i>Generative Adversarial Networks</i> (GANs) to predict 3D human pose estimates from one RGB imageUsed image <i>data augmentation</i> techniques to improve model robustness to “in the wild” imagesIncorporated <i>depth estimation networks</i> to produce global 3D pose predictions, used by <i>Kinect for Azure</i>Technologies used: Python, PyTorch, Horovod, NumPy, SciPy, ONNX	
Software Development Engineer Intern — Amazon (Sunnyvale, US) Alexa Domains, Lab126	Jun 2017 – Sep 2017
<ul style="list-style-type: none">Improved delivery of alarms by removing the necessity of sound files to be stored on devicesTechnologies used: Java, AWS services such as S3, DynamoDB, EC2	

SELECTED PROJECTS

THTS++	Oct 2022 – Ongoing
<ul style="list-style-type: none">First open-source parallelised implementation of <i>Trial-Based Heuristic Tree Search</i> in C++, a modular library which generalises <i>Monte Carlo Tree Search</i> methods such as <i>Upper Confidence bound applied to Trees</i> (UCT)Enables multi-threaded tree-search and includes implementation of UCT and algorithms described in projects below(Ongoing) Implementing support for use as a Python package using <i>PyBind11</i> and the <i>Python/C API</i>Technologies used: C++, GTest, PyBind11, Python/C API, Valgrind (+Callgrind), gdb	
Simplex Maps For Multi-Objective Monte Carlo Tree Search	Aug 2023 – Dec 2024
<ul style="list-style-type: none">Developed <i>simplex map</i> data structure to overcome scalability issues in prior multi-objective plannersIntegrating the data structure with the algorithms developed in <i>MCTS with Boltzmann Exploration</i>	

- Improved scalability with respect to size and number of objectives on baseline environments
- Technologies used: C++, BayesOpt, CLP, qhull, THTS++, MO-Gymnasium

Using Tree Search To Integrate Skills From Multiple Agents

Jun 2023 – Sep 2023

- Training RL agents with *policy gradient* methods to perform specific skills in *Rocket League*
- Using *AlphaZero*-style algorithms for *policy improvement* to integrate knowledge from multiple agents into a single one
- Technologies used: Python, PyTorch, RL Gym, RLBot

MCTS with Boltzmann Exploration (NeurIPS2023)

Jan 2022 – May 2023

- Developed two *Monte Carlo Tree Search* (MCTS) algorithms using *Boltzmann search policies*
- Proved *exponential convergence bounds* for the performance of both algorithms using *simple regret*
- Used the *Alias method* for faster sampling and improving the *asymptotic complexity* of the algorithms
- Technologies used: C++, KataGo, THTS++

Convex Hull Monte-Carlo Tree Search (ICAPS2020)

Apr 2019 – Jan 2020

- Adapted *Monte Carlo Tree Search* for multi-objective planning using *convex hull backups*
- Novel analysis of *sample based multi-objective planning* algorithms using *contextual regret*
- Improved scalability over prior works, demonstrated with *Generalised Deep Sea Treasure* environments
- Technologies used: Python, NumPy, SciPy

Sequential Variational Autoencoders — SAIL/Ermon Group

Jan 2018 – Jun 2018

- Work on applying *Variational Autoencoders* (VAEs) sequentially to generate “sharper” images
- Developed novel objective functions and used multiple VAE architectures to improve image quality
- Technologies used: Python, TensorFlow, NumPy

Efficient Architecture Search — Stanford CS231N Project

Apr 2018 – Jun 2018

- Implemented novel *network preserving transformations* for *Convolutional Neural Networks*
- Demonstrated networks can be trained using fewer floating-point operations by first training a smaller network and using the transformations to increase the number of model parameter
- Used the transformations with *neuroevolution* and parameter sharing in an *efficient architecture search*
- Technologies used: Python, PyTorch, NumPy

BiDAF for Reading Comprehension — Stanford CS224N Project

Jan 2017 – Mar 2017

- Implemented the *Bidirectional Attention Flow* model for the *SQuAD reading comprehension task*
- Explored various modifications to the model, such as using *stacked BiLSTMs* and *Quasi-RNNs*
- Technologies used: Python, TensorFlow, NumPy

TEACHING

University of Oxford — Teaching Assistant & Project Supervisor

Oct 2018 – Apr 2023

- Teaching assistant for the *Autonomous Robotics* course in the *AIMS CDT* program (new course in 2020)
- Developed and ran a day’s worth of course material, including lecture material, coding practicals on planning
- Lab demonstrations (office hours) for Engineering Science course on Software Engineering
- Supervised a Fourth Year Project titled: *Learning How Best to Recover from Failures*

Stanford University — Course Assistant

Jan 2017 – Jun 2018

- Courses: *Probability, Reinforcement Learning* and *Computer Systems* (Concurrent & Distributed Systems)
- Duties included: holding office hours and labs, writing questions for assignments and exams, organizing lecture note creation (Reinforcement Learning), grading and code reviewing

PUBLIC SPEAKING

Research Updates, Oxford University

Oct 2018 – May 2025

- Presented research updates and led reading-group discussions for *Oxford Robotics Institute* and *GOALS* research group

Conference Presentations

- NeurIPS2023: Poster presentation on *MCTS with Boltzmann Exploration*
- ICAPS2020: Poster and 15-minute oral presentations on *Convex Hull Monte Carlo Tree Search*

Churchill Computer Science Talk Series, Cambridge University

Oct 2014, Mar 2016

- *Don’t like the sound of your voice? You can do something about that!* - 30-minute talk covering *auto-tune*
- *An Introduction to Computerised Tomographic Imaging* - 30-minute talk covering *tomographic imaging*,

MISCELLANEOUS

Languages: Python, C/C++, Java, Cython, Matlab, SQL, Javascript, HTML

Packages: PyTorch, NumPy, SciPy, TensorFlow, PyBind11, GTest, Git, SKLearn, Microsoft Azure, AWS

Activities/Interests: Keen hiker; Ex-competitive track and field athlete; Picking up skills, such as juggling, slacklining and cocktail making; Getting lost in a novel; Struggling to find shoes that fit