

# Patrick Yu

Computer Science PhD Student @ Paul G. Allen School of Computer Science & Engineering, University of Washington.  
Research interests: Computational Biology and Bioinformatics, Machine/Deep Learning, Meta-Learning, Computer Vision.

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## EDUCATION

### University of Washington, Seattle, WA — *PhD in Computer Science*

Expected: September 2023 - June 2028

### University of Illinois at Urbana-Champaign, Champaign, IL — *BS in Computer Science*

August 2020 - May 2023

GPA: 4.0/4.0

#### Relevant Courses:

CS 582 (Machine Learning in Bioinformatics); STAT 530 (Bioinformatics); CS 442 (Trustworthy Machine Learning); CS 598 LTL (Learning to learn); ECE 490 (Optimization); CS 497 (CS Team Project: *Machine Learning for Video and Audio Compression*); CS 397 (Independent Study: *Impact of Task Diversity on the Performance of Meta-Learned Models*); CS 446 (Machine Learning); CS 543 (Computer Vision)

## WORK/RESEARCH EXPERIENCE

### Meta-Learning Research Internship (REU) at the Koyejo Lab, Stanford University

Palo Alto, CA

October 2021 - Present

- Advised by Professor Sanmi Koyejo and doctoral student Brando Miranda
- Goal: Identify the types tasks through which popular meta-learning methods (e.g. MAML) yield the largest magnitude of performance gain, relative to traditional supervised learning
- Proposed that a dataset may benefit from meta-learning if it has a high *task diversity* - that is, there is a large variation in the tasks' representations
- Generated synthetic Gaussian benchmarks and devised a novel Hellinger-based diversity metric
- Discovered that supervised-learners and meta-learners perform equivalently when benchmarked under low-diversity Gaussian benchmarks; currently working on high-diversity benchmarks

### Bioinformatics Research Internship at Klarman Cell Observatory, Broad Institute of MIT and Harvard

Cambridge, MA

August 2020 - Present

- Developed computational tools to analyze gene-expression-based markers of pancreatic cancer initiation (such as acinar-ductal metaplasia) as well as hallmark features of tumor-nerve crosstalk from histopathology (such as perineural invasion)
- Collaborated with Broad Institute researchers (under Professor William Hwang, Andrew Aguirre and doctoral student Jimmy Guo) to understand associations between PNI severity/pattern with patient survival, through computer vision-aided quantitation of nerve-tumor interactions
- Constructed a computational analysis pipeline to filter and identify safe, robustly expressed gene targets for the treatment of pancreatic cancer
- Applied Python and R-based differential expression libraries (such as DESeq and MAST) towards single-cell and bulk RNA-seq datasets to unveil gene expression signatures that characterize both tumor and cellular subtypes
- Analyzed large volumes of omics datasets through statistical tests, regression models, and differential expression analyses to understand the factors that differentiate basal versus classical cell types and drive the epithelial-to-mesenchymal transition (EMT) process in pancreatic cancer

## **Research Intern at Duke University Center for Computational Evolutionary Intelligence Laboratory**

Durham, NC

July 2018 - August 2019

- Conducted research at Duke's CEI under Dr. Yiran Chen on privacy-preserving federated learning and neural architecture search/optimization
- Formulated and implemented a novel algorithm: LEASGD (Leader-Follower Elastic Averaging Stochastic Gradient Descent) - which speeds up decentralized training under differentially-private constraints
- Developed memory-optimized methods of scheduling the feed-forward computation in a neural network using greedy variants of the Breadth-First Search traversal algorithm
- Devised multiple ways of utilizing Bayesian Optimization to efficiently search for an optimally-performing neural architecture under memory and time constraints

## **USA Computing Olympiad Competition Instructor at SpringLight Education Institute**

Cupertino, CA

June 2019-August 2020

- Taught weekly USA Computing Olympiad preparation courses at a local college preparatory academy
- Structured the courses to emphasize students' skill development of debugging, algorithmic thinking, and code optimization
- Strengthened students' algorithmic thinking skills through a blend of mock contests and interactive puzzles like *Project Euler* and *PythonChallenge*
- Prepared students for the Bronze, Silver, and Gold levels in the upcoming USA Computing Olympiad

## **PUBLICATIONS / MANUSCRIPTS**

- Brando Miranda, Patrick Yu, Yu-Xiong Wang, and Sanmi Koyejo. "The Curse of Low Task Diversity: On the Failure of Transfer Learning to Outperform MAML and Their Empirical Equivalence." **NeurIPS Workshop on Meta-Learning (2022). (Selected as one of four 15-minute contributed talks)**
- William L. Hwang, [...], Patrick Yu et al. "Single-nucleus and spatial whole transcriptome profiling of pancreatic cancer reveals multicellular communities and enrichment of a neural-like progenitor phenotype after

neoadjuvant treatment.” **Nature Genetics** (2022).

- Jimmy A Guo, [...], Patrick Yu et al. “Systematic dissection of transcriptional states in pancreatic cancer.” **Cancer Research** (2022).
- Jimmy A Guo, [...], Patrick Yu et al. “Integrative genomic characterization of therapeutic targets for pancreatic cancer.” **Cancer Research** (2022).
- Daniel Zhao, Daniel Y. Kim, Peter Chen, Patrick Yu, Stephanie W. Cheng, Cindy Zhao, Jimmy A. Guo, and Yun R. Li. “Pan-cancer survival classification with clinicopathologic and targeted gene expression features.” **Cancer Informatics** (2021).
- Hsin-Pai Cheng, Patrick Yu, Haojing Hu, Syed Zawad, Feng Yan, Shiyu Li, Hai Li, and Yiran Chen. “Towards Decentralized Deep Learning with Differential Privacy.” **International Conference on Cloud Computing** (2019).
- Hsin-Pai Cheng, Patrick Yu, Haojing Hu, Feng Yan, Shiyu Li, Hai Li, and Yiran Chen. “LEASGD: an Efficient and Privacy-Preserving Decentralized Algorithm for Distributed Learning.” **NeurIPS Workshop on Privacy Preserving Machine Learning** (2018).

## CONFERENCE PRESENTATIONS

- “Integrative Genomic Characterization of Therapeutic Targets for Pancreatic Cancer” – oral presentation at **2021 Sigma Xi Annual Meeting and Student Research Conference**
- “Pan-Cancer Survival Classification with Clinicopathologic and Targeted Gene Expression Features” – oral presentations at **AACR Undergraduate Student Caucus and Poster Competition** and at **2021 University of Illinois Undergraduate Research Symposium (Outstanding Project Award)**
- “Towards Decentralized Deep Learning with Differential Privacy” – poster session at the **2019 International Conference on Cloud Computing (San Diego)**
- “LEASGD: an Efficient and Privacy-Preserving Decentralized Algorithm for Distributed Learning.” – poster session and spotlight talk at **2018 NeurIPS Workshop on Privacy Preserving Machine Learning**

## AWARDS

- **Yunni & Maxine Pao Memorial Engineering Scholarship** (April 2022) – Awarded to five outstanding students in the CS and ECE departments in the University of Illinois
- **2022-2023 University of Illinois ISUR Scholar** for the project titled “Impact of Task Diversity on the Performance of Meta-Learned Models”
- **James N. Snyder ICCP Memorial Award** (April 2022) – Awarded to two Illinois sophomores or juniors in 2022 with a strong interests in the development and automation of software
- **Outstanding Project Award in the 2021 University of Illinois Undergraduate Research Symposium (URS)** for the project titled “Pan-Cancer Survival Classification with Clinicopathologic and Targeted Gene Expression Features”
- **Conference Travel Grant Award Recipient** (October 2021) from Office of Undergraduate Research for my presentation at the Sigma Xi Student Research Conference for the project titled “Integrative Genomic Characterization of Therapeutic Targets for Pancreatic Cancer”
- **Illinois Engineering Achievement Award** (October 2021) and **Engineering Visionary Award** (September 2021) – from the Grainger College of Engineering
- **USA Computing Olympiad Platinum Contestant** (2017-2020)

- AIME Qualifier (2020)
- Perfect Score on the AP Computer Science A exam. One of “193 students amounting to 0.295% of all students” who took the 2018 AP Computer Science A
- Honorable Mention at the California State Science Fair (2016) for the project “A Novel Approach to Image Recognition with Leaves”

## TECHNICAL SKILLS

### Programming Languages

Python, C, C++, Java, R, HTML, JavaScript, Assembly (MIPS)

### Software Libraries of Interest

Learn2Learn, Tensorflow, OpenCV, PyTorch, Caffe, Pandas, Numpy, Scikit-Learn, OpenWSI, DESeq2, Seurat, MAST, biomaRt, Matplotlib/Seaborn

## PROFESSIONAL MEMBERSHIPS

American Association of Cancer Research (Student Member)

## PAST PROJECTS

### Never Get Lost: An App to Keep You Back on Track (2018)

- Developed an app to help lost hikers determine the shortest off-road/off-trail escape route from their current location to the nearest population center or road
- Weighed cost-benefit analysis of factors such as steepness of terrain, private property, population density, and bodies of water to calculate the optimal escape route

### A Novel Approach to Image Recognition with Leaves (2016)

- Devised a geometric-based computer vision algorithm to recognize unique leaf species corresponding to various leaf samples, using metrics such as area of Convex Hull and centroid-to-edge lengths
- Achieved greater than 85% accuracy across diverse groups of leaf samples

### Developing Efficient Algorithms for Self-Navigating Vehicles (2015)

- Constructed an Arduino-based maze-solving robot and consolidated various algorithms (random, wall-follower, and Pledge algorithm) to propose an enhanced loop-evading algorithm