

Joseph Matthew Rich

Physician-scientist in training specializing in multimodal biomedical AI spanning radiology, genomics, and clinical data



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Google Scholar: scholar.google.com/citations?user=vtDtrHoAAAAJ

Education

MD/PhD Candidate, USC-Caltech MD-PhD Program Candidate (PhD4) 2021–2029 (Projected)
PhD Candidate, California Institute of Technology, Computational Biology 2023–2027 (Projected)
Lab: Dr. Lior Pachter
Dissertation Title (working): Computational Methods and Machine Learning for Radiogenomics
MD Candidate, Keck School of Medicine of the University of Southern California 2021–2023, 2027–2029
Step 1: Pass (First Attempt)

Bachelor of Science, University of California, Los Angeles 2016–2020
Field of Study: Molecular, Cell and Developmental Biology (Major); Biomedical Research (Minor)
GPA: 3.99/4.0 (Summa Cum Laude)
MCAT: 524/528 (100th Percentile)
Honors: Highest Departmental Honors, Chancellor's Service Award, Alumni Scholars Club

Professional Objectives

I am a physician-scientist in training in the USC-Caltech MD/PhD program specializing in multimodal biomedical AI with expertise spanning radiology, genomics, and clinical data. I am completing my PhD in Computational Biology under Dr. Lior Pachter, where my work bridges radiomics and bioinformatics through theory, AI interpretability, multimodal modeling, variant detection, software development, and data analysis. I aim to complete medical training in radiology and practice as a physician-scientist leading research in medical data science and precision medicine.

Research Experience

California Institute of Technology, Department of Biology and Biological Engineering Sept 2023–present
Advisor: Dr. Lior Pachter, PhD

- Developing an information theoretic view of radiogenomics (*Skills: deep learning, information theory, linear algebra, multimodal modeling, PyTorch*)
- Developing a contrastive learning model for radiogenomics data (*Skills: contrastive and self-supervised learning, deep learning, multimodal modeling, PyTorch*)
- Developing a suite of tools for AI interpretability with respect to semantically meaningful subspaces applied to radiology AI (*Skills: explainable AI, representation learning, deep learning, radiology AI*)
- Conducting statistical analysis on prospective clinical trial data for CAR T cell immunotherapy in stage IV breast cancer patients at the City of Hope (*Skills: biostatistics, clinical-trial analysis, Python*)
- Extending an AI model for single-cell gene expression at spatial resolution, GHIST, by incorporating variant information (*Skills: deep learning, spatial transcriptomics, model development, PyTorch*)
- Maintaining gget, a popular bioinformatics package developed in the Pachter lab for convenient querying of bioinformatics resources (*Skills: GraphQL, HTML, REST APIs, Python*)
- Created a standardized pipeline for processing computed tomography data for machine learning, with applications to TCGA and CPTAC imaging — <https://doi.org/10.64898/2026.06.15.26354651> (*Skills: computed tomography, data processing, machine learning, radiomics*)
- Co-developed CellSweep, a tool for removing noisy counts from scRNA-seq data by applying the expectation-maximization algorithm to estimate noise from empty droplets and cell type profiles — <https://doi.org/10.64898/2026.03.04.709349> (*Skills: software development, expectation-maximization, single-cell RNA-seq, Python, statistical modeling*)
- Developed wompwomp, an algorithm and software package for improving visualization of alluvial plots with Hamiltonian path solvers. Available on [CRAN](https://cran.r-project.org/web/packages/wompwomp/index.html) — <https://doi.org/10.48550/arXiv.2509.03761> (*Skills: algorithm design, combinatorial optimization (Hamiltonian paths), data structures (Fenwick trees), data visualization, software development, Python*)

- Created varseek, a pipeline to identify and analyze the cancer-driving mutations in RNA sequencing data by expanding two popular bioinformatics packages from the lab, gget and kallisto-bustools — <https://doi.org/10.1101/2025.09.03.674039> (Skills: software development, cancer genomics, variant calling, k-mer pseudoalignment, bioinformatics, Python)
- Created fastQpick, a tool for sampling fastQ files (sequencing read files) with or without replacement — <https://doi.org/10.64898/2026.06.23.734068> (Skills: data structures, bioinformatics, bootstrapping, Python)
- Applied statistical techniques to compare the inherent variance between Seurat and Scanpy, two commonly used packages in single-cell RNA sequencing analysis — <https://doi.org/10.1101/2024.04.04.588111> (Skills: statistical analysis, reproducibility, software development, Docker, CI/CD, Python, R, data visualization)
- Created vignettes for the spatial transcriptomics geospatial analysis package Voyager — <https://voyagerpy.readthedocs.io/en/latest/technologies.html> (Skills: R, spatial transcriptomics, data visualization, technical writing)

Children's Hospital Los Angeles (CHLA), Department of Radiology

Sept 2023–present

Advisor: Dr. Patricia Acharya, MD

- Performed a retrospective clinical study regarding the impact of time to treatment on outcomes of ileocolic intussusception (Skills: clinical research, retrospective study design, biostatistics)
- Conducted statistical analysis on reporting rate of ovarian torsion in the emergency department (Skills: clinical research, biostatistics)

California Institute of Technology, Department of Computing and Mathematical Sciences

May–Sept 2023

Advisor: Dr. Anima Anandkumar, PhD (Caltech); Dr. Andrew Hung, MD (Cedars-Sinai Medical Center)

- Trained machine learning algorithms to predict surgical outcomes based on contextualized gesture sequences (Skills: machine learning, sequence modeling, surgical data science, Python)
- Wrote review papers on pathomics and genomics of renal cell carcinoma, and on different approaches to studying the nerve-sparing step of radical prostatectomy (Skills: literature review, scientific writing, pathomics, genomics)

Children's Hospital Los Angeles (CHLA), Department of Radiology

Feb 2023–present

Advisor: Dr. Amit Sura, MD, MBA

- Studying the compliance of radiologist recommendations in clinical settings and how it affects patient outcomes
- Researched how varying definitions of chronic lung disease of prematurity are used by radiologists at CHLA – doi: <https://doi.org/10.1186/s40748-024-00178-4> (Skills: clinical research, inter-rater agreement analysis, biostatistics)
- Compared the incidence and types of injuries detected by skeletal surveys in suspected child physical abuse cases before versus during the COVID-19 pandemic at a large academic children's hospital — <https://doi.org/10.1002/pdi3.2526> (Skills: clinical research, biostatistics (chi-squared / Fisher's exact))

Keck School of Medicine of USC, Department of Radiology

June 2022–present

Advisors: Dr. Vinay Duddalwar, MD; Dr. Assad Oberai, PhD

- Developing agentic radiology AI (Skills: agentic AI, AWS, HIPAA-compliant deployment, machine learning)
- Evaluated the cost-effectiveness of AI-based radiology analysis against each other and standard of care — <https://doi.org/10.1097/UPJ.0000000000001031> (Skills: cost-effectiveness analysis, machine learning, Markov microsimulation)
- Compared and quantified the external validity of single-institution vs. multi-institution convolutional neural networks in kidney mass segmentation — <https://doi.org/10.1016/j.ejrai.2025.100035> (Skills: deep learning, image segmentation, CNNs, external validation, medical imaging)
- Assessed the clinical utility of imputed images with conditional generative adversarial networks on four-phase computed tomography renal masses — <https://doi.org/10.1371/journal.pdig.0000970> (Skills: generative adversarial networks, deep learning, medical imaging, PyTorch)
- Applied deep learning image segmentation algorithms to analyze bone metastases of prostate cancer carcinoma, comparing the performance of multiple packages and algorithms including nnUNet and Residual Attention Unet — <https://doi.org/10.1016/j.ejrai.2025.100005> (Skills: deep learning, image segmentation, nnUNet, medical imaging)
- Benchmarked segmentation foundation models (SAM, SAM2, and SAM-Med2D) against a supervised nnUNetv2 baseline for segmenting osseous metastatic prostate cancer lesions on CT, and developed a prompt-guided integration strategy — <https://doi.org/10.1016/j.ejrai.2025.100058> (Skills: foundation models (SAM/SAM2), zero-shot segmentation, deep-learning benchmarking, medical imaging)

- Co-authored a scoping review of radiomics, machine learning, and deep learning methods applied to imaging of prostate cancer bone metastases — <https://doi.org/10.1002/ird3.99> (*Skills: scoping review, radiomics, scientific writing*)
- Conducted a literature review to identify genomic markers that differentiate metastatic from primary clear cell renal cell carcinoma - <https://doi.org/10.3390/cancers15204934> (*Skills: systematic review, cancer genomics, scientific writing*)
- Led a literature review that compares performance of machine learning-based image segmentation algorithms for cancerous lesions of the bone — <https://doi.org/10.3389/fradi.2023.1241651> (*Skills: systematic review, meta-analysis, scientific writing*)
- Wrote two case reports on extremely rare urological endocrine tumors with an emphasis on imaging findings — <https://doi.org/10.1159/000533835>, <https://doi.org/10.1159/000534060> (*Skills: radiology, clinical case writing*)

California Institute of Technology, Department of Bioengineering

Nov 2021–Aug 2022

Advisor: Dr. Richard Murray, PhD

- Created a computational model of cells in a gut tube environment using Vivarium, a Pythonic computational biology software (*Skills: computational modeling, Python, dynamical systems, mathematical biology*)
- Designed processes and implemented mathematical models to capture cellular behaviors including adhesion, bond formation, and chemotaxis (*Skills: mathematical modeling, simulation, Python*)

University of California, Los Angeles, Department of Chemistry and Biochemistry

Aug 2018–Mar 2021

Advisor: Dr. Margot Quinlan, PhD

- Investigated the role of the Wasp-Homology 2C Domain of the actin-nucleating protein Spire in conjunction with the formin Cappuccino, two cytoskeleton-regulating proteins essential for oogenesis
- Investigated the elongation activity of Cappuccino I706A, a widely used mutant of Cappuccino that was designed to be nonfunctional
- Employed total internal reflection fluorescence (TIRF) microscopy, pyrene-actin kinetic assays, and protein expressions and purifications
- Established a microfluidics system to enhance TIRF microscopy assays
- Produced 6 quarterly 15+ page papers for class credit, an abstract for the Biomedical Research Minor, 3 posters (and one with a Dean's Prize for my presentation), and a highest honors thesis

University of California, Los Angeles, Department of Molecular and Medical Pharmacology

Nov 2017–July 2018

Advisor: Dr. Harley Kornblum, MD, PhD

- Analyzed the effect of the Let7 microRNA (miRNA) on Glioblastoma Multiforme proliferation
- Studied how best to effectively study and kill Isocitrate Dehydrogenase (IDH) mutant tumors, a mutation present in over 10% of Glioblastomas
- Employed cell culture, miRNA transfection, quantitative polymerase chain reaction (qPCR), immunohistochemistry, and Western Blots

Projects

Math to English (github.com/josephrich98/math-to-english)

July 2026

- Built a Python package and CLI that convert LaTeX math embedded in text into plain English so text-to-speech engines can dictate equations the way they are read aloud
- Implemented math, physics, and chemistry vocabulary modes covering relations, fractions, roots, powers, accents, vectors/derivatives, and chemistry notation (`\ce{}`, `\pu{}`)
- *Skills: Python package development, CLI design, LaTeX parsing, text-to-speech accessibility, regular expressions*

PaperPush (github.com/pachterlab/paperpush)

July 2026

- Built PaperPush, a Python package and CLI that automates manuscript submission to journals, conferences, and preprint servers by programmatically filling out venue submission portals
- Implemented browser automation with Playwright alongside LLM-assisted autofill and pre-submission validation, exposed as Claude skills and an AGENTS.md agent interface
- *Skills: Python package development, Playwright browser automation, HTML, Web development, JavaScript, CLI design, LLM/agent integration, PyPI packaging*

- Designed and deployed a curated database platform that aggregates academic conference dates and submission deadlines, with both AI-driven and Boolean search and filtering by field, format, cost, and deadline
- Implemented dynamic iCalendar/.ics feeds and Google Calendar integration that automatically refresh to reflect active search parameters, alongside CSV export and customizable columns
- Built a no-authentication architecture prioritizing accessibility and ease of use
- *Skills: AWS full-stack web development (S3 + CloudFront frontend, Lambda + Magnum backend, IAM protection, RDS database, EventBridge Scheduler updates), Next.js, Vercel, iCalendar/.ics feeds, Google Calendar API, REST APIs, UX design*

- Designed and deployed a web application and Python package for searching the NCBI Gene Expression Omnibus (GEO) database across over 2.5 billion samples using PubMed-style boolean query syntax
- Implemented boolean (AND/OR/NOT) and field-scoped queries (e.g., assay, tissue, and sample count) with customizable sorting, filtering, and CSV export
- Integrated the NCBI GEO API to enable efficient discovery of transcriptomic datasets for meta-analysis and comparative studies
- *Skills: AWS full-stack web development (Vercel frontend, , Lambda + Magnum backend, IAM protection, RDS database, EventBridge Scheduler updates), Next.js, Python, REST APIs, NCBI GEO API integration, bioinformatics, genomics*

- Designed and deployed a production website using Jekyll, Vercel, Docker, GitHub Actions, and giscus.
- Published technical articles on machine learning, genomics, radiology AI, and software engineering.
- Integrated custom domain management, discussion forums, and reproducible development environments.
- *Skills: web development, Jekyll, Vercel, Docker, GitHub Actions, CI/CD, containerization, DNS and domain management, technical writing, science communication*

Publications

1. **Rich J**, Pachter L. fastQpick: scalable bootstrap and subsampling of FASTQ reads. bioRxiv. 2026 June 24. <https://doi.org/10.64898/2026.06.23.734068>
2. **Rich J**, Kang R, Jin D, Subramanian S, Duddalwar V, Pachter L. TCIA Radiology Image Processing for AI and Radiomics. medRxiv. 2026 June 24. <https://doi.org/10.64898/2026.06.15.26354651>
3. **Rich JM**, Bajakian T, Gala T, Aminy M, Forsyth E, Raff E, et al. Comparative effectiveness and cost-effectiveness of an artificial intelligence workflow for small renal mass diagnosis on computed tomography. Urology Practice. 2026 June 3. <https://doi.org/10.1097/UPJ.0000000000001031>
4. **Rich JM**, Moses L, Einarsson PH, Luebbert L, Boeshaghi AS, Antonsson S, et al. *The impact of package selection and versioning on single-cell RNA-seq analysis*. Cell Systems. 2026 March 27. <https://doi.org/10.1016/j.cels.2026.101560>
5. Caskey M*, **Rich J***, Weber R, Mortazavi A, Pachter L, Hallgrimsdottir I. Single-Cell Genomics Decontamination with CellSweep. bioRxiv. 2026 March 6. <https://doi.org/10.64898/2026.03.04.709349>
6. Pawan SJ, Malewar S, Buren IV, Smith I, **Rich J**, Prajwal R, et al. Analyzing foundation models for segmentation of osseous metastatic lesions in prostate cancer on CT scans. European Journal of Radiology Artificial Intelligence, Volume 5, 100058. 2025 November 21. <https://doi.org/10.1016/j.ejrai.2025.100058>
7. **Rich J**, Oakes C, Pachter L. Optimizing alluvial plots. arXiv; 2025 Sept 3. <https://doi.org/10.48550/arXiv.2509.03761>
8. **Rich JM**, Luebbert L, Sullivan DK, Rosa R, Pachter L. *Reference-based variant detection with varseek*. bioRxiv. 2025 Sept 3. <https://doi.org/10.1101/2025.09.03.674039>
9. **Rich J**, Le J, Raad R, Tejura T, Rastegarpour A, Gill I, et al. Image Imputation with conditional generative adversarial networks captures clinically relevant imaging features on computed tomography. PLOS Digital Health. 2025 Aug 13. <https://doi.org/10.1371/journal.pdig.0000970>
10. Raman AG, Fisher D, **Rich JM**, Weight C, Heller N, Desai M, et al. Evaluation of nnU-Net for kidney tumor segmentation on a large external patient cohort. European Journal of Radiology Artificial Intelligence. 2025 July 15. <https://doi.org/10.1016/j.ejrai.2025.100035>

11. Vincent R. Li, Trevor A. Pickering, Karen Kay Imagawa, **Joseph M. Rich**, Amit S. Sura. *An Analysis of Child Abuse Detected by Skeletal Surveys Before and During the COVID-19 Pandemic*. Pediatric Discovery. 3 March 2025. <https://doi.org/10.1002/pdi3.2526>
12. Lambda Moses, Alik Huseynov, **Joseph M Rich**, Lior Pachter. *Geospatially informed representation of spatial genomics data with SpatialFeatureExperiment*. bioRxiv. 27 February 2025. <https://doi.org/10.1101/2025.02.24.640007>
13. S. J. Pawan*, **Joseph Rich***, Shreyas Malewar, Daksh Patel, Matt Muellner, et al. *Deep learning-based detection and segmentation of osseous metastatic prostate cancer lesions on computed tomography*. European Journal of Radiology Artificial Intelligence. 6 February 2025. <https://doi.org/10.1016/j.ejrai.2025.100005>
14. S. J. Pawan, **Joseph Rich**, Jonathan Le, Ethan Yi, Timothy Triche, Amir Goldkorn, Vinay Duddalwar. *Artificial Intelligence and Radiomics Applied to Prostate Cancer Bone Metastasis Imaging: A Review*. IRADIOLOGY. 2024 Sept 26. <https://doi.org/10.1002/ird3.99>
15. **Rich JM**, Lin LJ, Le JL, Abe JRC, Sura A. *Assessing the agreement of chronic lung disease of prematurity diagnosis between radiologists and clinical criteria*. Matern health, Neonatology and perinatology. 2024 Apr 5;10(1):8.
16. **Joseph M. Rich**, Vinay A. Duddalwar, Manju Aron, Ramon Ter-Oganesyan, Peter Hu, Shefali Chopra, Phillip M. Cheng. *Localized Multifocal Retroperitoneal Ganglioneuroma with an Infiltrative Appearance on Imaging: A Case Report*. Case Reports in Oncology. 2023
17. Komal A. Dani*, **Joseph M. Rich***, Sean S. Kumar, Harmony Cen, Vinay A. Duddalwar and Anshika D'Souza. *Comprehensive Systematic Review of Biomarkers in Metastatic Renal Cell Carcinoma: Predictors, Prognostics, and Therapeutic Monitoring*. Cancers 2023.
18. **Joseph M. Rich**, Vinay Duddalwar, Phillip M. Cheng, Manju Aron, Siamak Daneshmand. *Feminizing Adrenocortical Tumor with Multiple Recurrences: A Case Report*. Case Reports in Oncology. 2023
19. **Rich JM**, Bhardwaj LN, Shah A, Gangal K, Rapaka MS, Oberai AA, et al. *Deep learning image segmentation approaches for malignant bone lesions: a systematic review and meta-analysis*. Front Radiol. 2023 Aug 8;3:1241651.
20. Knudsen, J. E., **Rich, J. M.**, & Ma, R. (2023). *Artificial Intelligence in Pathomics and Genomics of Renal Cell Carcinoma*. Urologic Clinics of North America. <https://doi.org/10.1016/j.ucl.2023.06.002>
21. **Rich JM**, Bradley AO, Quinlan ME, *A Widely-Used Negative Control Formin Mutant Retains Some Actin Polymerization Activity*, UCLA Molecular, Cell and Developmental Biology Honors Thesis (Highest Honors) 2020

* co-first authorship

Patents

1. Detecting mutational signatures with k-mer-based pseudoalignment. **Joseph Rich**, Lior Pachter, Laura Luebbert, Delaney Sullivan. CIT-9205-P. Filed 9/3/24. Provisional Patent Application.

Abstracts, Posters, and Presentations

1. Nola Vu, **Joseph Rich**, Amit Sura. *Assessment of Radiology Recommendation Adherence on Pediatric Ultrasound Reporting*. The Society for Pediatric Radiology Conference 2026.
2. Caskey M, **Rich J**, Weber R, Mortazavi A, Pachter L, Hallgrimsdottir I. *Single-Cell Genomics Decontamination with CellSweep*. Biology of Genomes, Cold Spring Harbor Laboratories. 2026 May 5.
3. **Joseph Rich**, Laura Luebbert, Delaney Sullivan, Reginaldo Rosa, Lior Pachter. *Reference-based variant detection with varseek*. Cold Spring Harbor Laboratory Single Cell Analyses Conference. 2025 November 12.
4. **Joseph Rich**, Conrad Oakes, Lior Pachter. *Alluvial plot optimization with wompwomp*. Cold Spring Harbor Laboratory Single Cell Analyses Conference. 2025 November 12.
5. **Joseph Rich**, Laura Luebbert, Delaney Sullivan, Reginaldo Rosa, Lior Pachter. *Efficient and accurate variant detection applied to cancer transcriptomics with varseek*. American Physician Scientist Association (APSA) West Regional Conference. 2025 March 29.
6. Jonathan Le, **Joseph Rich**, Ragheb Raad, Tapas Tejura, Ali Rastegarpour, et al. *Image Imputation with Conditional Generative Adversarial Networks Captures Clinically Relevant Features on Computed Tomography* (poster presentation). Keck School of Medicine Medical Student Research Forum 2025.
7. **Joseph Rich**, Laura Luebbert, Delaney Sullivan, Reginaldo Rosa, Lior Pachter. *Efficient and accurate detection of cancer mutations in bulk and single-cell RNA-seq data*. California Institute of Technology Merkin Institute Symposium. 2025 February 6.
8. **Joseph Rich**, Laura Luebbert, Delaney Sullivan, Reginaldo Rosa, Lior Pachter. *Efficient and accurate detection of cancer mutations in bulk and single-cell RNA-seq data* (poster presentation). California Institute of Technology graduate student recruitment. 2025 January 24.

9. **Joseph Rich**, Laura Luebbert, Delaney Sullivan, Reginaldo Rosa, Lior Pachter. *Efficient and accurate detection of cancer mutations in bulk and single-cell RNA-seq data* (oral presentation). City of Hope Graduate Student Symposium. 2024 August 30.
10. **Joseph Rich**, Lambda Moses, Lior Pachter. *The impact of package selection and versioning on single-cell RNA-seq analysis*. BioConductor Conference 2024. 2024 July 24.
11. Lambda Moses, Alik Huseynov, **Joseph Rich**, Lior Pachter. *Exploratory spatial data analysis from single molecules to multiple samples*. BioConductor Conference 2024. 2024 July 24.
12. **Joseph Rich**, Jonathan Le, Ragheb Raad, Tapas Tejura, Ali Rastergarpour, Inderbir Gill, et al. *Image imputation with conditional generative adversarial networks captures clinically relevant imaging features on computed tomography*. Co-Clinical Imaging Research Resource Program Conference 2024. 2024 May 20.
13. Runzhuo Ma, Jiayun Wang, **Joseph Rich**, Sherry L. Huang, Maxwell X. Otiato, Istabraq Dalieh, et al. *Contextualized Surgical Gestures in Nerve-Spare Reveal Heterogeneity in Techniques and Predicts Erectile Function Recovery*. The Journal of Urology. 2024 May 3.
14. **Joseph Rich**, Jonathan Le, Ragheb Raad, Tapas Tejura, Ali Rastergarpour, et al. *Image imputation with conditional generative adversarial networks captures clinically relevant imaging features on computed tomography*. UCLA CVIB-USC collaboratory conference. 2024 April 16.
15. Shreyas Malewar, S. J. Pawan, **Joseph Rich**, Daksh Patel, Darryl Hwang, et al. *AI for Prostate Cancer Bone metastases*. UCLA CVIB-USC collaboratory conference. 2024 April 16.
16. Alex G. Raman, David Fisher, **Joseph Rich**, Assad Oberai, Mihir Desai, Inderbir Gill, Vinay Duddalwar. *Evaluation of nnUNet for Kidney Tumor Segmentation on a Large External Patient Cohort*. UCLA CVIB-USC collaboratory conference. 2024 April 16.
17. **Joseph Matthew Rich**, Lydia Jing Lin, Jonathan Luan Le, Justin Ryan Ching Abe, Amit Sura. *Assessing the Agreement of Chronic Lung Disease of Prematurity Diagnosis between Radiologists and Clinical Criteria*. The Society for Pediatric Radiology Conference 2024.
18. Krish Gangal, **Joseph Rich**, Steven Cen, Vinay Duddalwar. *Segment Anything Model on Prostate Cancer Bone Metastases*. Bridge UnderGrad Science (BUGS) Summer Research Program 2023.
19. **Joseph M. Rich**, Alex G. Raman, Vinay A. Duddalwar, Assad A. Oberai. *Image Segmentation with Deep Learning of Prostate Cancer Bone Metastases on Computed Tomography*. International Conference on Machine Learning and Applications 2023.
20. Alex G. Raman, David Fisher, **Joseph M. Rich**, Erum Mushtaq, Assad A. Oberai, Vinay Duddalwar. *Evaluation of the State-of-the-Art Model in Kidney Tumor Segmentation on a Large Independent Patient Cohort*. International Conference on Machine Learning and Applications 2023
21. **Joseph M. Rich**, Vinay A. Duddalwar, Assad A. Oberai. *Deep Learning Based Image Segmentation of Prostate Cancer Bone Metastases with nnUNet*. Keck School of Medicine Medical Student Research Forum 2023.
22. **Joseph M. Rich**, Vinay A. Duddalwar, Assad A. Oberai. *Deep Learning Based Image Segmentation of Prostate Cancer Bone Metastases with nnUNet*. UCLA Center for Computer Vision and Imaging Biomarkers Workshop 2023.
23. **Rich JM**, Bradley AO, Quinlan ME, *A Negative Control Formin Mutant Retains Some Actin Polymerization Activity*, Biomedical Research Minor Spring Publication 2020
24. **Rich JM**, Bradley AO, Quinlan ME, *A Negative Control Formin Mutant Retains Some Actin Polymerization Activity*, Undergraduate Research Center Poster Day 2020
25. **Rich JM**, Bradley AO, Quinlan ME, *The Synergy of the Actin-Nucleating Proteins Spire and Cappuccino In Vitro*, Molecular, Cell and Developmental Biology Poster Day 2019
26. **Rich JM**, Bradley AO, Quinlan ME, *The Synergy of the Actin-Nucleating Proteins Spire and Cappuccino In Vitro*, Undergraduate Research Center Poster Day 2019

Grants, Fellowships, Honors, and Scholarships

Beckman Institute Neuro Mini-Grant

June 2026

- \$4,400 mini-grant for developing AI latent space interpretability with applications to neurodegenerative disease

SURF Research Mentor

June 2026

- Mentored Caltech undergraduate David Jin who received a SURF fellowship for helping develop a radiogenomics contrastive learning model over the summer.
- \$8,110 awarded to David Jin

Merkin Spark Grant

Oct 2025

- \$10,000 grant awarded by the Merkin Institute for Translational Research of Caltech for my project entitled *Efficient and accurate variant detection applied to cancer transcriptomics with varseek*

AI West Med Conference Grant

Feb 2024

- \$5,000 one-year research grant awarded by the Keck School of Medicine of USC for my project entitled *Image Imputation with Conditional Generative Adversarial Networks Captures Clinically Relevant Imaging Features on Computed Tomography*

RSNA Research Medical Student Grant

June 2023

- \$6,000 one-year research grant awarded by the Radiological Society of North America (RSNA) for my project entitled *Deep Learning Image Segmentation of Prostate Cancer Bone Metastases*

Best Presentation Award, ICMLA Conference 2023

Apr 2023

- Awarded for presenting the best presentation at the conference for the project entitled *Evaluation of the State-of-the-Art Model in Kidney Tumor Segmentation on a Large Independent Patient Cohort*.

Summa Cum Laude

June 2020

- Awarded for achieving a GPA in the top 5% of the graduating class (>3.93 GPA)

MCDB Highest Departmental Honors

June 2020

- Awarded for my top academic achievement and MCDB research culminating in an Honors Thesis

Chancellor's Service Award

June 2020

- Awarded to students after a rigorous review process who demonstrated the "most significant contributions in leadership and service to UCLA and the community"

Science Dean's Prize

May 2020

- Awarded to 6 presenters in the Chemistry and Biochemistry Department for excellence in presentation and high research potential at the Undergraduate Research Center Poster Day in Spring 2020

EMT-B Certification

Apr–July 2018

- Graduated from the UCLA EMT Program, which required 230 hours of didactic and skills training over 11 weeks.
- Passed the NREMT on July 7th, 2018

Biomedical Research Minor

Dec 2017

- Admitted into the Biomedical Research Minor for my previous academic achievements, promise to conduct high quality research while at UCLA, and top performance in the prerequisite class Biomedical Research 5HA (~12% acceptance rate)

Leadership Development Program (LDP) Scholarship

Aug 2017

- \$1,000 award given to 2 Alumni Scholars who demonstrated exemplary leadership and participation in LDP

Dean's List (every quarter)

Sept 2016–June 2020

- Awarded for achieving a 3.7+ GPA and 12 units per quarter

UCLA Harry M. Warner Alumni Scholarship

June 2016

- \$6,000 merit-based scholarship and membership to the Alumni Scholars Club
- Awarded to top ~1% of the incoming UCLA class based on academic, extracurricular, and leadership pursuits

Teaching and Mentorship

Teaching Assistant, Bi 1C: Biology Through the Algorithmic Lens

Jan–Mar 2026

- Course topics spanned applications of mathematics and computer science in biology including machine learning, phylogenetic tree construction, information theory, and dimensionality reduction
- Assisted Professor Pachter in responding to student inquiries, holding office hours, grading weekly problem sets, and grading final presentations in which students designed and implemented custom research projects

- Graduate Student Mentor, Pachter Lab** June 2024–present
- David Jin (Undergraduate and SURF fellow, Caltech, Jan 2026–present): Worked on encoder pretraining methods and self-supervised learning techniques for our radiogenomics contrastive learning model. Received a SURF fellowship for this work (\$8,110 for Summer 2026)
 - Derbhla Duffy (Undergraduate, University of Glasgow, June 2025–Sept 2025): Applied our variant detection tool *varseek* to novel datasets for cell type identification
 - Ashrith Valluri (High school student, June–Aug 2025): Created a database of variants associated with environmental health outcomes that was used for variant screening in population genomics datasets
 - Samuel Wagenaar (High school student, June–Aug 2024): Developed multiple *gget* modules (cbio, opentargets, bgee) and an efficient genome alignment tool
- Private MCAT and Interview Coach** Aug 2021–present
- Provide MCAT and graduate school interview preparation services through Wyzant
 - Assisted students in getting into their top choice programs including Stanford medical school, UC Irvine medical school, UC San Diego Medical School, and Kaiser Permanente Medical School
- Mentor, UCLA Alumni Mentor Program** Oct 2020–present
- Act as a mentor for UCLA undergraduates interested in careers in medicine and science
 - Discuss career and education options with students, review résumés and CV’s, conduct mock interviews
- MCAT Master Tutor, MedSchoolCoach** Apr 2020–Nov 2025
- Over 750 hours of tutoring experience with over 30 students
 - Provided pre-med students with personalized instruction to create lesson plans for the MCAT, review content, and go through practice problems
 - Underwent rigorous training that tested my MCAT knowledge in all four sections and pedagogical techniques
 - Promoted to Master Tutor for accumulating 300 tutoring hours with top client ratings
- Leadership**
- Committee Lead, Children’s Hospital of Los Angeles Radiology AI Committee** June 2026–present
- Created quarterly presentations to summarize advances in radiology AI and applications to pediatric radiology
- Treasurer, Science and Engineering Policy at Caltech (SEPAC)** Dec 2025–present
- SEPAC is a student-run organization dedicated to increasing involvement of the Caltech community in science policy
 - Organize speaker panels, poster sessions, and social events related to science policy
- President, Medical Computer Science Student Interest Group** Jan 2022–Jan 2023
- Neurology Student Interest Group
Pathology Student Interest Group
Radiology Student Interest Group
- Organized lunch talks with guest speakers to inform students about the field or the speaker’s specific work
 - Served as the main contact point for student inquiries regarding the specialty/field including research and shadowing opportunities
 - Led teams of board members in organizing events and opportunities
- Student Interviewer, Keck School of Medicine** Oct 2021–present
- Individually interview and assess MD and MD/PhD applicants for admission to the Keck School of Medicine
- Founder and Editor-in-Chief, Medical Literature Society (MLS)** Sept 2017–Sept 2021
- Founded and led MLS, an online publication in which students wrote articles on medicine and science
 - Managed 50+ columnists and 7 other board members
 - Designed and maintained the website, organized meetings, and marketed the group on campus and social media
 - Oversaw the publication of 60+ articles

Community Service

Volunteer MCAT Tutor, Premed Peers

June 2026–present

- Premed Peers is a 501(c)(3) nonprofit dedicated to providing free tutoring and advising to underserved premeds
- I volunteer as an MCAT tutor and application volunteer

Volunteer, Cancer Support Community Greater San Gabriel Valley

Sept 2024–present

- Cancer Support Community provides free support groups, communities, and resources for patients and loved ones suffering from cancer
- Over 42 affiliates across the country and internationally
- Assist with setup of monthly physician-led talks discussing psychosocial methods for managing cancer

Volunteer, Keck School of Medicine Interdisciplinary Community Outreach Team (Student-Run Clinic) May 2023–present

- Volunteer at free clinics and health fairs for underinsured populations
- Conduct history and physical exams, provide nutrition and chronic disease counseling, take vitals, check wounds

Blog Posts (joseph-rich.com)

- Genomics Is Not NLP: A Field Guide for ML Scientists. June 3, 2026
- Radiology AI Is Not Computer Vision: A Field Guide for ML Scientists. June 2, 2026
- How This Blog Is Built: A Reproducible Pipeline for Science Writing. June 1, 2026

Relevant Coursework

Graduate School, Caltech

- Biology 250C – Topics in Systems Neuroscience (A)
- Biology 183 – Introduction to Computational Biology and Bioinformatics (A-)
- Biology 250A – Topics in Molecular and Cellular Biology (A-)
- Biology 252 – Responsible Conduct of Research (P)

Medical School, USC

Pre-clinical (all first-attempt passes)

- Biochemistry and genetics
- Immunology
- Pathology
- Infectious Disease
- Hematology
- Cardiovascular System
- Pulmonary System
- Renal system
- Gastrointestinal System

- Reproductive System
- Neural System
- Musculoskeletal System
- Dermatology
- Endocrinology

Clinical

- Pediatrics — inpatient and outpatient (High Pass)
- General and laparoscopic surgery (High Pass)
- Surgical Subspecialty research elective — Urology

Undergraduate, UCLA

- Biomedical Research 5HA – Biomedical Research Concepts and Strategies (A+)
- Biomedical Research 5HB – Biomedical Research Skills and Concepts (A)
- Biomedical Research 193H – Journal Club: Current Topics in Biomedical Research (A)
- Biomedical Research 194H – Research Group Seminars: Data Presentation in Biomedical Research (A)
- Biomedical Research 199 (x3) – Directed Biomedical Research (A)
- Biostatistics 100A – Introduction to Biostatistics (A)
- Chemistry 14A – Atomic and Molecular Structure, Equilibria, Acids, and Bases (A+)
- Chemistry 14B – Thermodynamics, Electrochemistry, and Kinetics (A+)
- Chemistry 14BL – General and Organic Chemistry Laboratory I (A)
- Chemistry 14C – Structure of Organic Molecules (A+)
- Chemistry 14CL – General and Organic Chemistry Laboratory II (A)
- Chemistry 14D – Organic Reactions & Pharmaceuticals (A+)
- Chemistry 153A – Biochemistry: Introduction to Structure, Enzymes and Metabolism (A)
- Computer Science XL 31 – Introduction to Computer Science I (A)
- Life Science 1 – Evolution, Ecology, and Biodiversity (A+)
- Life Science 2 – Cells, Tissues, and Organs (A)
- Life Science 3 – Molecular Biology (A)
- Life Science 4 – Genetics (A)
- Life Science 15 – Life: Concepts and Issues (A)
- Life Science 23L – Introduction to Laboratory and Scientific Methodology (A)
- Life Science 192A – Introduction to Collaborative Learning Theory and Practice (A)
- Math 3C – Linear Algebra and Differential Equations for the Life Sciences (A+)

- MCDB 60 – Biomedical Ethics (A)
- MCDB 138 – Developmental Biology (A+)
- MCDB 144 – Molecular Biology of Cellular Processes (A+)
- MCDB 160 – Principles of Light Microscopy (A)
- MCDB 165A – Biology of Cells (A+)
- MCDB 191 – Cardiovascular Development & Disease (A+)
- MCDB 191 – Mechanisms of Plant Development (A)
- MCDB 198A-C – Honors Research in MCDB (A)
- Nursing C155 – Globalization, Social Justice, and Human Rights (A+)
- Physics 5A – Mechanics and Energy (A+)
- Physics 5B – Thermodynamics, Fluids, Waves, Light, and Optics (A+)
- Physics 5C – Electricity, Magnetism, Modern Physics (A)
- Spanish 3 – Elementary Spanish (A)
- Stats 10 – Introduction to Statistical Reasoning (A+)

Self-Study

- Multivariable Calculus
- Linear Algebra
- Differential Equations
- Discrete Mathematics
- Abstract Linear Algebra
- Real Analysis
- Complex Analysis
- Convex Optimization
- Information Theory
- Probability
- Mathematical Statistics
- Generalized Linear Models
- Bayesian Statistics
- Logic
- Data Structures and Algorithms
- Algorithms
- Automata Theory
- Programming Languages
- AWS Cloud Computing
- Machine Learning
- Deep Learning
- Computer Vision

Professional Organizations

- American College of Radiology
- American Society of Clinical Oncology
- Radiological Society of North America
- American Physician Scientist Association
- Bioinformatics.org

Skills and Interests

Languages: Python (Expert), R (Expert), Bash (Expert), LaTeX (Expert), SQL (Intermediate), HTML (Basic), C++ (Basic), Lean (Basic)

Machine Learning and Data Science: PyTorch, Numpy, Pandas, LangChain, Scikit-learn, Pyradiomics, Tidyverse

Data Visualization Libraries: Matplotlib, Seaborn, Tensorboard, Wandb, OpenCV, ggplot2

Research Tools: VSCode, Jupyter, Conda, Overleaf, Beamer, Zotero

Software Development: GitHub, CI/CD (GitHub Actions), REST APIs, PyPi, CRAN

Cloud and Infrastructure: AWS (EC2, S3, Lambda, RDS), Google Cloud Platform, Docker, Linux, SSH

Databases: PostgreSQL, SQLite

Deployment and Web Development: Vercel, Next.js, FastAPI, WordPress

Lab techniques: Spatial transcriptomics, RNA-sequencing, TIRF microscopy, protein expression + purification, kinetic assays, qPCR, western blot, microfluidics

Hobbies: Basketball, jazz/ragtime piano, hiking, weight-lifting, cooking, audiobooks (technology, psychology, classics), ballroom dancing