PROMOTION RECOMMENDATION
THE UNIVERSITY OF MICHIGAN
MEDICAL SCHOOL
DEPARTMENT OF COMPUTATIONAL MEDICINE AND BIOINFORMATICS
DEPARTMENT OF RADIATION ONCOLOGY
SCHOOL OF PUBLIC HEALTH
DEPARTMENT OF BIOSTATISTICS

Arvind U.K. Rao, Ph.D., associate professor of computational medicine and bioinformatics, with tenure, Department of Computational Medicine and Bioinformatics, ssociate professor of radiation oncology, without tenure, Department of Radiation Oncology, Medical School, and associate professor of biostatistics, without tenure, Department of Biostatistics, School of Public Health, is recommended for promotion to professor of computational medicine and bioinformatics, with tenure, Department of Computational Medicine and Bioinformatics, professor of radiation oncology, without tenure, Department of Radiation Oncology, Medical School, and professor of biostatistics, without tenure, Department of Biostatistics, School of Public Health.

Academic Degrees:
Ph.D.	2008	University of Michigan, Ann Arbor, MI
A.M.	2007	University of Michigan, Ann Arbor, MI
M.S.E.	2003	University of Texas, Austin, TX
B.E.	2001	R.V. College of Engineering, Bangalore University, Bangalore, Karnataka, India

Professional Record:
2019 – present	Associate Professor (without tenure), Department of Biostatistics, University of Michigan
2018 – present	Associate Professor (with tenure), Department of Computational Medicine and Bioinformatics, University of Michigan
2018 – present	Associate Professor (without tenure), Department of Radiation Oncology, University of Michigan
2011 – 2018	Assistant Professor, Department of Bioinformatics and Computational Biology, University of Texas MD Andersen Cancer Center, Houston, TX

Summary of Evaluation:
Teaching: Dr. Rao is a dedicated teacher and mentor. His teaching activities involve mentoring research trainees, teaching graduate level courses, and giving lectures at institutional, national, and international workshops. His learners include post-doctoral fellows, graduate students, undergraduate students, high school students, and research staff. His trainees have successfully gone on to faculty and research scientist positions in industry and academic institutes such as Boston University and New York University. He has served on numerous preliminary exam and dissertation committees of which he was the chair or co-chair of four. Dr. Rao has served as the director and primary instructor of Image Processing and Advanced Machine Learning for Cancer Bioinformatics (BIOINF590), a graduate level course, since 2019. He has given lectures in other

University of Michigan graduate and undergraduate courses as well as at national and international workshops such as Discovery on Target and Drug Discovery Chemistry conferences. These courses focused on teaching working professionals from the pharmaceutical industry. Overall, Dr. Rao's classroom instruction and his research mentorship have demonstrated a dedication to excellence in teaching at the University of Michigan.

Research: Dr. Rao is a computational biologist with expertise in the areas of biomedical image informatics and Artificial Intelligence methodology for medicine. His work focuses on developing methodologies to analyze and interpret spatial multi-modal omics datasets to improve our understanding of disease biology and inform clinical decision-making. He has had great success in acquiring continuous funding from federal and many other agencies. His current funding includes more than 15 grants mostly from the National Institutes of Health (NIH), and the National Science Foundation (NSF), with a few from private funding sources. Dr. Rao's research has made significant contributions to multiple fields leading to 155 peer-reviewed publications in high impact journals such as *Neuroscience Informatics*, *Nature Communications*, and *JCI Insight*. Dr. Rao has been an invited speaker on 26 occasions nationally and internationally including in Canada, Lisbon, Mumbai, and the Netherlands. Additionally, he provided a keynote address at the Single Cell Conference. He has filed two patents and has three active invention disclosures. Dr. Rao has received national recognition for his research as a fellow of the American Informatics Association and as an invited participant in an NSF-sponsored workshop on Artificial Intelligence (AI) and Data Science. Institutionally, he was named a Precision Health Investigator and received the "Valuing Our Own Award" from Michigan Medicine.

Recent and Significant Publications:
Ravikumar V, Xu T, Al-Holou WN, Fattahi S, Rao A, "Efficient Inference of Spatially-Varying Gaussian Markov Random Fields With Applications in Gene Regulatory Networks," *IEEE/ACM Trans Comput Biol Bioinform*. 2023 Sep-Oct;20(5):2920-2932. doi: 10.1109/TCBB.2023.3282028. Epub 2023 Oct 9. PMID: 37276119; PMCID: PMC10623339.

Krishnan SN, Barua S, Frankel TL, Rao A, "Towards the characterization of the tumor microenvironment through dictionary learning-based interpretable classification of multiplexed immunofluorescence images," *Phys Med Biol*. 68(1)12/2022. PM36541756.

Krishnan SN, Mohammed S, Frankel TL, Rao A, "GaWRDenMap: a quantitative framework to study the local variation in cell-cell interactions in pancreatic disease subtypes," *Scientific Reports*. 12(1)01/2022. PM35260589.

Mohammed S, Ravikumar V, Warner E, Patel SH, Bakas S, Rao A, Jain R, "Quantifying T2-FLAIR Mismatch Using Geographically Weighted Regression and Predicting Molecular Status in Lower-Grade Gliomas," *AJNR Am J Neuroradiol*. 43(1): 33-39, 01/2022. PM34764084.

Chekouo T, Mohammed S, Rao A, "A Bayesian 2D functional linear model for gray-level co-occurrence matrices in texture analysis of lower grade gliomas," *Neuroimage Clin*. 28: 102437, 01/2020. PM33035963.

Service: Dr. Rao performs extensive service contributions. He is very active at the national and international levels. He has served on the Program Committee for the annual Institute of Electrical and Electronics Engineers (IEEE) International Conference and as the chair or co-chair on several

national committees including IEEE Bioimaging and Signal Processing Technical Committee, International Indian Statistical Association Outreach Committee, and the American Statistical Association Committee on Applied Statistics. He has also served as an ad hoc reviewer on 13 grant review study sections for national and international funding agencies such as NIH, NSF, and the Natural Sciences and Engineering Research Council of Canada. Dr. Rao is an ad hoc reviewer for twenty-two journals and is on the editorial boards of three journals including *IEEE Transactions in Computational Biology and Bioinformatics*. He has served on several departmental and institutional committees, including the Department of Computational Medicine and Bioinformatics Ph.D. Admissions committee and the University of Michigan Curriculum Policy Committee. Notably, he serves as the associate director of bioinformatics for the Rogel Cancer Center.

External Reviewers:
Reviewer A: "Dr. Rao has a remarkable funding record, with support from 23 different grants. This includes 3 grants as major PI (a $200k grant for computational pathology of lupus nephritis; a $249k grant on spatiotemporal Markov random fields; and a $1.2 million grant on image analysis in lower grade gliomas). This level of support is very strong, as a typical active PI will have in the range of 2-5 grants."

Reviewer B: "He has published 182 journal articles and 24 peer-reviewed conference publications. Since his last promotion in 2018, he published 131 journal articles. He has received 38,310 citations, an h-index of 62, and an i10index of 126 (Google Scholar). I would rank Dr. Rao's research and scholarship at the top relative to others with similar backgrounds and stages in their career."

Reviewer C: "In addition to his outstanding contributions in research, it's worth mentioning the caliber of students and trainees that have blossomed under Dr. Rao's mentorship. They have not only been pivotal contributors to the aforementioned research projects but have also found esteemed positions in academic and industry settings, attributing to Dr. Rao's exemplary leadership and guidance."
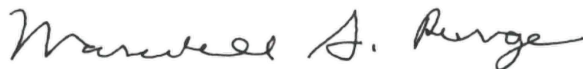
Reviewer D: "Dr. Rao has been active on the professional side serving as associate editor for multiple journals and involved in organizing conferences and workshops. Dr. Rao has also regularly served on federal grant review panels. His involvement in various services activities including grant reviews, conference organizations and associate editorships clearly shows that his peers value his expertise."

Reviewer E: "The impact of Dr. Rao's work has demonstrable importance relative to the advancement of the state of the health and life sciences, as well as growth of fundamental biomedical informatics and data science knowledge and practice. Dr. Rao is recognized throughout the national and international scientific community as a thought leader, and he is in high demand as a collaborator, advisor, mentor, speaker, and peer-reviewer as a result of this profile."

Reviewer F: "Arvind continues to address foundational challenges to ML, such as problems of data bias, uncertainty quantification, and auditing of AI solutions (in radiology and pathology

image informatics) in healthcare. His work has resulted in over 180 peer-reviewed papers in journals and conference venues, which is an impressive record for someone at this stage of their career."

Summary of Recommendations: Dr. Rao is a global leader in the fields of Biomedical Image Informatics and Spatial Biology, Artificial Intelligence (AI) methods for Medicine, and Precision Medicine, who has made significant contributions to the field. He is an excellent teacher and mentor, has an excellent funding record, and is a leader who contributes both in external and internal service. We are pleased to recommend Arvind U.K. Rao, Ph.D. for promotion to professor of computational medicine and bioinformatics, with tenure, Department of Computational Medicine and Bioinformatics, professor of radiation oncology, without tenure, Department of Radiation Oncology, Medical School, and professor of biostatistics, without tenure, Department of Biostatistics, School of Public Health.

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Marschall S. Runge, M.D., Ph.D.
Executive Vice President for Medical Affairs
Dean, Medical School

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F. DuBois Bowman, Ph.D.
Dean, School of Public Health

May 2024