OMB No. 0925-0001 and 0925-0002 (Rev. 10/2021 Approved Through 01/31/2026)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Gopalakrishnan, Vanathi

eRA COMMONS USER NAME (credential, e.g., agency login): VANATHI

POSITION TITLE: Associate Professor of Biomedical Informatics (tenured), Bioengineering, Clinical and Translational Science

EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)

| INSTITUTION AND LOCATION | DEGREE(if applicable) | Completion DateMM/YYYY | FIELD OF STUDY |
| --- | --- | --- | --- |
| BMS College of Engineering, Bangalore, India | B.E. | 1988 | Computer Engineering |
| University of Pittsburgh, Pittsburgh, PA | M.S. | 1991 | Computer Science |
| University of Pittsburgh, Pittsburgh, PA | Ph.D. | 1999 | Computer Science |

**A. Personal Statement**

Dr. Vanathi Gopalakrishnan is a tenured Associate Professor in the Department of Biomedical Informatics within the School of Medicine at the University of Pittsburgh (UPitt). She has joint appointments in Bioengineering, Clinical and Translational Science. Vanathi obtained her Master’s and Doctorate degrees in Computer Science from the University of Pittsburgh. She is a distinguished alumna of the BMS College of Engineering in Bengaluru, India, where she obtained her Bachelor’s degree in Engineering and Technology. She recently served as the elected Director of the Intelligent Systems Program, an exceptional multidisciplinary graduate degree program in applied Artificial Intelligence (AI) in the School of Computing and Information.

Dr. Gopalakrishnan collaborates extensively with real-world scientists and clinicians to develop and test hybrid AI algorithms to reduce the burden of disease and increase equity of care via efficient biomedical knowledge discovery. Vanathi directs the PRoBE laboratory for Pattern Recognition from Biomedical Evidence, with a primary focus on biomarker discovery from multimodal biomedical data using novel technologies that allow incorporation of prior knowledge. She creates novel model scoring algorithms using Bayesian statistics and hybrid rule learners in collaboration with world-class scientists. Her lab has applied award-winning methods such as Bayesian Rule Learning and Transfer Learning of classification rules to biomarker discovery, prediction and monitoring of diverse diseases including cardiovascular and neurodegenerative diseases. Multiple types of ‘omics’ data obtained from genomics, proteomics, metabolomics and microbiome profiling have been analyzed, leading to insights regarding biomarkers and molecular mechanisms that underlie chronic disease. Biomarkers for early detection of lung and esophageal cancers have been validated across institutional studies. Dr. Gopalakrishnan was a co-leader of the Bioinformatics and Biostatistics core as part of the NCI-funded Lung SPORE project. She also was the principal investigator on a Pittsburgh Health Data Alliance funded project called CADidME, for Coronary Artery Disease intelligent detection via Metabolomic Expression, which examined differentially expressed metabolic markers for detecting cardiovascular adverse events.

Vanathi’s current research includes investigating hypotheses about drug treatment outcomes in chronic disease using large scale networks of electronic health records and discovering actionable women’s health related risk trends. This project directly aligns with her ongoing efforts to develop inclusive cardiometabolic health risk prediction tools. She is currently engaged as a Longitudinal Educator in the direct training of medical students during their first two years of study. This engagement within a top-ranked medical school provides her with access to medical case studies and physicians across all major subspecialities in multimodal biomedicine for patient management and care. Given Dr. Gopalakrishnan’s decades of experience in predictive health data analytics, she will use this project to explore the use of Digital Twin technology to improve multimodal health forecasting to reduce inequities in health care access. This project will enable her to work with top AI scientists within CMU to create a novel infrastructure for multimodal knowledge integration, complementing her ongoing collaboration as a co-investigator on:

1U24 TR004111-01 (Reis & Visweswaran); NIH/NCATS

08/01/2022- 05/31/2027

ENACT: Translating Health Informatics Tools to Research and Clinical Decision Making

My recent relevant publications include:

A1 **Mani G**, Chen F, Cross S, Kalil T, **Gopalakrishnan V,** Rossi F, Stanley K. Artificial Intelligence’s Grand Challenges: Past, Present, and Future. AI Magazine. 2021 April; 42(1):61-75.

A2 **Gopalakrishnan V**, Balasubramanian J, Kip K, Reis S. Towards learning clinically relevant explainable models via Bayesian Rule Learning with utilities. [Print]. Porto, Portugal: Proceedings of the 12th International Workshop on Knowledge Representation for Health Care (KR4HC 2021); 2021 June. 14 pages (41-54).

A3 **Gopalakrishnan V.** Global Chronic Disease Burden Can Be Reduced by Taking Care of Our Mitochondria. Open Access Biostatistics & Bioinformatics. 2024;3(5):1-4. doi: 10.31031/OABB.2024.03.000573

A4 Samayamuthu, M.J., Kravchenko, O., Lo-Ciganic, W.H., Sadhu, E.M., Yang, S., Visweswaran, S., **Gopalakrishnan, V**. Trends in Postpartum Hemorrhage Prevalence and Comorbidity Burden: Insights from the ENACT Network Aggregated Electronic Health Record Data. Under Review at npj Digital Medicine (2023 Impact Factor =12.4). Preprint located on Research Square: DOI: https://doi.org/10.21203/rs.3.rs-5041092/v1 (September 25, 2024).

**B. Positions, Scientific Appointments, and Honors**

7/2024 – present Longitudinal Educator, School of Medicine, UPitt

2/2019 – present Associate Professor of Clinical and Translational Science, UPitt

9/2019 – 8/2022 Director of the Intelligent Systems Program, School of Computing and Information, UPitt.

2/2018 – present Associate Professor of Bioengineering, Swanson School of Engineering, UPitt.

2/2017 - present Co-Director of the Bioengineering, Biotechnology and Innovation (BBI) Area

of Concentration for Medical Curriculum within the School of Medicine, UPitt.

6/2012 - 6/2014 Director (& mentor) of the Computer Science, Biology and Biomedical Informatics (CoSBBI)

Summer Program for High School Students (rising Juniors and Seniors) for the first two years of this University of Pittsburgh Cancer Institute’s innovative program.

12/2011 – present Associate Professor (tenured) of Biomedical Informatics, School of Medicine, UPitt

7/2006 – 11/2011 Assistant Professor of Computational Biology, UPitt (joint appointment)

8/2002 – 11/2011 Assistant Professor of Intelligent Systems, UPitt (secondary appointment)

7/2006 – 11/2011 Assistant Professor, Department of Biomedical Informatics, UPitt (tenure-track)

8/2002 – 6/2006 Assistant Professor, Department of Medicine (SMI), UPitt (tenure-track)

7/2000 – 7/2002 Visiting Assistant Professor, Department of Medicine, Section of Medical Informatics (SMI), University of Pittsburgh, Pittsburgh, PA

7/2000 – 7/2002 Visiting Assistant Professor of Intelligent Systems, University of Pittsburgh (UPitt)

Spring 2000 Part-Time Faculty, Intelligent Systems Program, University of Pittsburgh. Introduced and taught a new Graduate level core course called Introduction to Bioinformatics.

1996 – 1998 Co-founder of Intelligent Systems, M.D., Inc., Florida, USA. (now NASDAQ:ICAD)

1989 – 1997 Research Assistant, Intelligent Systems Laboratory, University of Pittsburgh, Pittsburgh, PA.

Summer 1991 Software Engineer, Systems Modeling Corporation, Sewickley, PA.

1988 – 1989 Systems Executive, Wipro Information Technology Limited, Bangalore, India.

**Honors**

2020 Distinguished Alumni Honor, B.M. S. College of Engineering, Computer Science & Engineering Dept.

2018 Pitt Innovator Award (for Coronary Artery Disease intelligent detection via Metabolomic Expression)

2015 AMIA TBI Marco Ramoni Distinguished Paper Award: Co-author and Senior Author **(see C3d)**

2011 AMIA Translational Bioinformatics (TBI) Distinguished Paper Award: Co-and Senior Author (**see C2b**)

2006 Pitt Innovator Award (for licensing RL-Wrap: Wrapper-based Rule Learning)

1994 W.M. Keck Fellowship in Computational Biology

1988 Best TraineeAward, Wipro Information Technology Limited, Bangalore, India.

**C. Contributions to Science**

* 1. Novel computational frameworks for enabling macromolecular crystallization: The art of growing a good X-ray diffractible quality crystal of a protein or other macromolecule can be infused with scientific theory to enable bench scientists to better understand how protein nucleation and growth take place. My first contribution to interdisciplinary science began with my doctoral dissertation work which produced novel insights into the process of macromolecular crystallization via the development and assessment of computational models. This pioneering research in a niche area of bioinformatics was published in important conferences and journals (see 1a – 1d), and led to new research by other groups and robotic companies to improve the science of macromolecular crystallization to provide better monitoring tools and experimental design conditions.
1. Hennessy, D., **Gopalakrishnan, V**., Buchanan, B.G., Subramanian, D., Rosenberg, J.M. Induction of Rules for Biological Macromolecule Crystallization, In: Proceedings of the Second International Conference on Intelligent Systems for Molecular Biology (1994) 179-187.
2. **Gopalakrishnan, V.**, Buchanan, B.G., Rosenberg, J.M. Intelligent Aids for Parallel Experiment Planning and Macromolecular Crystallization. In: Proceedings of the Eight International Conference on Intelligent Systems for Molecular Biology (2000) 171-180.
3. **Gopalakrishnan, V.**, Buchanan, B.G., Rosenberg, J.M. A Simple Simulator of Protein Crystallization, Journal of Applied Crystallography 35(6) (2002) 727-733.
4. **Gopalakrishnan, V.**, Livingston, G., Hennessy, D., Buchanan, B., Rosenberg, J.M. Machine-Learning Techniques for Macromolecular Crystallization Data, Acta Crystallogr D Biol Crystallogr 60 (2004)1705-1716.
5. Development of novel rule learning methodologies for predictive modeling and classifier construction from both data and prior knowledge: Over the past two decades, I have collaborated with world-renowned faculty at the University of Pittsburgh to develop and test hybrid machine learning methods that combine the strengths of Bayesian network learning with symbolic rule-based inference to provide clinicians and bench scientists with predictive models that are parsimonious, easily interpretable, and accurately capture uncertainty. My laboratory has produced many innovative methods for modeling biomedical data that include new and efficient methods for discretizing continuous valued data (c), and transfer learning of classification rules between two related datasets (b). Moreover, we use ontologies and literature mining methods to capture prior knowledge and use them as input to our classification algorithms.
	1. **Gopalakrishnan, V.**, Lustgarten, J. L., Visweswaran, S., Cooper, G.F. Bayesian Rule Learning for Biomedical Data Mining. Bioinformatics. 26(5) (2010) 668-675. PMID: 20080512; PMCID: PMC2852212.
	2. Ganchev, P., Malehorn, D., Bigbee, W. L., **Gopalakrishnan, V**. Transfer Learning of Classification Rules for Biomarker Discovery and Verification from Molecular Profiling Studies. J Biomed Inform. 2011 Dec;44 Suppl 1:S17-23. Epub 2011 May 6. (*Won a Distinguished Paper Award at the AMIA TBI Summit on Translational Bioinformatics in 2011*). PMID: 21571094 PMCID: PMC3706089.
	3. Lustgarten, J. L., Visweswaran, S., **Gopalakrishnan, V**., Cooper, G. F. Application of an efficient Bayesian discretization method to biomedical data. BMC Bioinformatics. 2011;12:309. PubMed PMID: 21798039; PMCID: PMC3162539.
	4. Balasubramanian JB, Boes RD, **Gopalakrishnan V**. A novel approach to modeling multifactorial diseases using Ensemble Bayesian Rule Classifiers. J Biomed Inform. 2020 Jul;107:103455. doi: 10.1016/j.jbi.2020.103455. Epub 2020 Jun 1. PMID: 32497685.
6. Application of our methods to biomarker discovery and validation from omic data: I have been collaborating locally, regionally and nationally with several research groups to apply our novel predictive modeling methods to discover and validate biomarkers for early detection and monitoring of various diseases including Amyotrophic Lateral Sclerosis, Ulcerative Colitis and Cancers of the Lung, Breast and Esophagus. Four representative publications are given below:
7. Ranganathan, S., Williams, E., Ganchev, P., **Gopalakrishnan, V.,** Lacomis, D., Urbinelli, L., Newhall, K., Cudkowicz, M. E., Brown, R. H., Jr., Bowser, R. Proteomic profiling of cerebrospinal fluid identifies biomarkers for amyotrophic lateral sclerosis. J Neurochem. 2005;95(5):1461-71. PubMed PMID: 16313519; PMCID: PMC1540444.
8. Ryberg, H., An, J., Darko, S., Lustgarten, J. L., Jaffa, M., **Gopalakrishnan, V.**, Lacomis, D., Cudkowicz, M., Bowser, R. Discovery and verification of amyotrophic lateral sclerosis biomarkers by proteomics. Muscle Nerve. 2010;42(1):104-11. PubMed PMID: 20583124; PMCID: PMC2975276.
9. Zaidi, A.H, **Gopalakrishnan, V**., Kasi, P. M., Zeng, X., Malhotra, U., Balasubramanian, J., Visweswaran, S., Sun, M., Flint, M. S., Davison, J. M., Hood, B. L., Conrads, T. P., Bergman, J.J., Bigbee, W. L., Jobe, B. A. Evaluation of a 4-protein serum biomarker panel – biglycan, annexin-A6, myeloperoxidase and protein S100-A9 (B-AMP©) – for the detection of esophageal adenocarcinoma. Cancer. 2014 Aug 5. PMID: 25100294. PMCID: PMC4441619 (Impact Factor = 5.201).
10. Lopez Pineda, A., **Gopalakrishnan, V**. Novel Application of Junction Trees to the Interpretation of Epigenetic Differences among Lung Cancer Subtypes. *Winner of the 2015 Marco Ramoni Distinguished Paper Award in Translational Bioinformatics.* AMIA Jt Summits Transl Sci Proc. 2015 Mar 23;2015:31-5. eCollection 2015. San Francisco, CA, USA. PMID: 2630622 PMCID:PMC4525224.
11. Mining big imaging data sets for clinically relevant information and image-derived markers related to injuries and diseases of brain and heart. I am highly interested in research that involves combining omic-biomarkers and imaging-derived markers to increase the precision for disease detection, monitoring and treatment. Towards that end, my laboratory has been developing novel methods to extract image-derived markers from fMRI data, brain tumor diffusion MR data, and cardiac imaging data.
12. Menon, P. G., Morris, L., Staines, M., Lima, J., Lee, D. C., **Gopalakrishnan, V**. Novel MRI-derived quantitative biomarker for cardiac function applied to classifying ischemic cardiomyopathy within a Bayesian rule learning framework. Proceedings of the SPIE 9034, Medical Imaging 2014: Image Processing, 90341L (21 March 2014) pp: 90341L-90341L-6. PMCID: PMC4440803.
13. **Gopalakrishnan, V**., Menon, P.G., Madan, S. cMRI-BED: A novel informatics framework for cardiac MRI biomarker extraction and discovery applied to pediatric cardiomyopathy classification. Biomed Eng Online. 2015;14 Suppl 2:S7. Epub 2015 Aug 13. PMCID: PMC4547147.
14. Liu Y, **Gopalakrishnan V**. An Overview and Evaluation of Recent Machine Learning Imputation Methods Using Cardiac Imaging Data. Data (Basel). 2017. Mar;2(1). doi: 10.3390/data2010008. Epub 2017 Jan 25. PMCID: PMC5325161.
15. Training next generation of scientists. The UPCI runs a highly selective program in the summer to train high school students in laboratory and computational work. Students whom I mentored have won best poster awards, and gone on to present in national conferences. A sample publication in the Journal of Pathology Informatics illustrates this service to science, while also bringing out novel contributions made by these students and their research mentors.
16. Dutta-Moscato, J., **Gopalakrishnan, V**., Lotze, M. T., Becich, M.J. Creating a Pipeline of Talent for Informatics: STEM Initiative for High School Students in Computer Science, Biology and Biomedical Informatics (CoSBBI). Journal of Pathology Informatics. 2014; Editorial in J Pathol Inform 2014;5:12. PMID: 24860688. PMCID: PMC4030307.
17. Firdous, A., **Gopalakrishnan, V.**, Vo, N., & Sowa, G. Challenges and opportunities for omics-based precision medicine in chronic low back pain. European Spine Journal. 2022 Dec 24:1-15. PMID: 36565345

## Complete List of Published Work in MyBibliography:

https://www.ncbi.nlm.nih.gov/myncbi/browse/collection/41925325/