

SAPTARSHI BISWAS

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AREAS OF EXPERTISE AND INTEREST

- Machine/Deep Learning
- Metaheuristic Algorithms
- Learning Optimization
- Cryptography
- Theory of Computation
- Complexity Theory
- Information Theory
- Quantum Computing
- Molecular Programming
- Analog Computing
- Dynamical Systems
- Molecular Memory

EDUCATION

Doctor of Philosophy

Computer Science

Master of Science

Computer Science

GPA: 3.95 out of 4.00

Major Professor: **Jack Lutz, Ph.D.**

Courses: Theory of Computation, Machine Learning, Design and Analysis of Algorithm, Fundamentals of Quantum Computing, Quantum Information and Complex, Molecular Programming of Nanoscale Devices and Processes, Analysis I (Math), Real Analysis I (Math), Numerical Analysis I (Math)

Bachelor of Technology

Computer Science and Engineering

GPA: 8.87 out of 10.00

Advisor: **Subhrapratim Nath, Ph.D.**

Jan 2021-Present

Iowa State University, Ames, IA

May 2024-May 2025

Iowa State University, Ames, IA

Aug 2016-Sep 2020

Meghnad Saha Institute of Technology, Kolkata, India

RESEARCH EXPERIENCE

Graduate Research Assistant

Department of Computer Science, Iowa State University, Ames, IA

Summer 2021-Summer 2025

Research Assistant of Dr. Jack Lutz and Dr. Hongyang Gao

- Investigate the significance of theoretical computational models that are stronger than Turing Machines in complexity analysis of computable real functions
- Explore the computational power of theoretical parallel computing models in contrast to analog computing models, namely, General Purpose Analog Computer
- Study computability and complexity of computing real numbers and functions
- Investigate the computability of real functions using Oracle Pointer Machines
- Explore effects of learning rate optimization on Meta-Learning models

Graduate Student Contributor

Ames National Laboratory, Ames, IA

Fall 2024-Present

Student Researcher advised by Dr. Prashant Singh

- Investigating the theoretical significance of clustering approaches in magnetocaloric materials.
- Understanding the relevance and importance of machine learning algorithms in magnetocalorimetry.
- Exploring methodologies both theoretically and practically to establish reliable machine learning practices in magnetocalorimetry.
- Exploring presentation and data visualization techniques to make research findings accessible and engaging for a wider and diverse audience.

Undergraduate Student Researcher

Computer Science & Engineering, Meghnad Saha Institute of Technology, Kolkata, India

Spring 2018-Summer 2020

Undergraduate student researcher of Dr. Subhpratik Nath and Mr. Indrajit Das

- Developing Meta-heuristic framework for Rectilinear Steiner Minimal Tree ([Link](#))
- Studying the importance of Meta-heuristic Algorithms in the sphere of VLSI Global routing
- Implementing the Pigeon-Inspired Optimization and Gradient-based Particle Swarm Optimization algorithm to construct an approximated optimal solution of the Rectilinear Steiner Minimal Tree problem
- Investigating the data storage capability of Nucleic Acids with non-standard nucleotides
- Developing a technology named Extended Nucleic Acid Memory
- Constructing the mathematical structure of an encryption/decryption algorithm named Varibox encryption algorithm
- Contributing to a survey regarding Eye Movement Based Authentication (EMBA)

Collaboration

Fall 2020-Present

Department of Computer Science, Iowa State University, Ames, IA

Collaboration with Ames National Laboratory, Department of Mathematics (Iowa State University), Jadavpur University, Meghnad Saha Institute of Technology, and Kalyani, Government Engineering College

- Devising a performance-aware Neural Network training model named Deep Greedy Network and explored its significance for medical classification problems like the prediction of COVID-19 from X-Ray images and tracing malarial parasites from microscopic images
- Contributing to a survey focused on the significance of deep learning in the sphere of automated identifying cardiac diseases through studying ECG signals
- Studying in constructing optimization techniques for training neural networks with convex or non-convex spatial search space
- Designing an approach named Hybrid Heuristics in the sphere of AI
- Constructing an adaptive learning rate of deep learning models while training without any overhead of initialization, cross-validation, or predefined scheduler

PUBLICATIONS

Book Chapter (Count: 1)

22. Dey, S., Pal, R., and **Biswas, S.**, “Deep Learning Algorithms for Efficient Analysis of ECG Signals to Detect Heart Disorders,” Biomedical Engineering. *IntechOpen*, Dec. 21, 2022. DOI: 10.5772/intechopen.103075

Journal Papers (Count: 7)

21. Nachnani, A., Li-Caldwell, K., **Biswas, S.**, Sharma, P., Ouyang, G., and Singh, P., “Interpretable machine learning-guided design of Fe-based soft magnetic alloys,” *Physics Review Materials*, vol. 9, no. 8, pp. 1-13, 2025. DOI: 10.1103/w6m3-ymsf
20. **Biswas, S.**, Dey, S. and Nath, S., “Learning Rate Tuner with Relative Adaptation (LRT-RA): Road to Sustainable Computing,” *AppliedMath*, vol. 5, no. 8, 2025. DOI: <https://doi.org/10.3390/appliedmath5010008>
19. **Biswas, S.**, Dey, S., Nath, P. and Nath, S., “Cipher constrained encoding for constraint optimization in extended nucleic acid memory,” *Computational Biology and Chemistry*, vol. 99, 2022. DOI: 10.1016/j.compbiolchem.2022.107696

18. Karmakar, T., **Biswas, S.**, Das, I., Nath, S., “Varibox Encryption Algorithm: The New Generation of Hybrid Security Measure for the Era of Quantum Computation,” *Journal of Discrete Mathematical Sciences & Cryptography*, pp. 479-505, 2022. DOI: 10.1080/09720529.2021.1968573
17. Dey, S., Nath, P., **Biswas, S.**, Nath, S. and Ganguly, A., “Malaria detection through Digital Microscopic Imaging using Deep Greedy Network with Transfer learning,” *Journal of Medical Imaging*, vol. 8, no.5, 2021. DOI: 10.1117/1.jmi.8.5.054502
16. **Biswas, S.**, Nath, S., Dey, S. and Majumdar, U., “Tangent-Cut Optimizer on Gradient Descent: An Approach towards Hybrid Heuristics,” *Artificial Intelligence Review*, vol. 55, no. 2, pp. 1121-1147, 2021. DOI: 10.1007/s10462-021-09984-0
15. **Biswas, S.**, Nath, S., Sing, J. K. and Sarkar, S. K., “Extended Nucleic Acid Memory as the Future of Data Storage Technology,” *International Journal of Nano and Biomaterials*, vol. 9, no. 1/2, pp. 2-17, 2020. DOI: 10.1504/IJNBM.2020.107412

Conference Papers (Count: 7)

14. **Biswas, S.**, “Computability of Real Functions with Oracle Pointer Machines implies Real-Time simulation of Chemical Reaction Networks,” *2025 Computability in Europe (CiE 2025), Lecture Notes in Computer Science, Springer*, Lisbon, Portugal, 2025. DOI: 10.1007/978-3-031-95908-0_13
13. **Biswas, S.**, Ghosh, T. and Nath, S., “Selective Run-Length Encoding on Extended Nucleic Acid Memory,” *2022 IEEE VLSI Device Circuit and System (VLSI DCS)*, Kolkata, India, pp. 148-153, 2022. DOI: 10.1109/VLSIDCS53788.2022.9811440
12. Dey, S., **Biswas, S.**, S. Nandi, S. Nath, and I. Das, “Deep Greedy Network: A Tool for Medical Diagnosis on Exiguous Dataset of COVID-19,” *IEEE International Conference for Convergence in Engineering (ICCE)*, Kolkata, India, pp. 340-344, 2020. DOI: 10.1109/ICCE50343.2020.9290715
11. Nath, S., Gupta, S., **Biswas, S.**, Banerjee, R., Sing, J. K. and Sarkar, S. K., “GPSO Hybrid Algorithm for Rectilinear Steiner Tree Optimization,” *IEEE VLSI Device Circuit and System (VLSI DCS)*, Kolkata, India, pp. 365-369, 2020. DOI: 10.1109/VLSIDCS47293.2020.9179861
10. Das, I., Singh, S., Das, R., **Biswas, S.**, Roy, S. and Gupta, S., “Design and Implementation on EMBA Authentication models,” *IEEE VLSI Device Circuit and System (VLSI DCS)*, pp. 283-288, 2020. DOI: 10.1109/VLSIDCS47293.2020.9179890
9. Nath, S., Bandyopadhyay, R., **Biswas, S.**, Sing, J. K. and Sarkar, S. K., “A New Global Routing Optimization Algorithm based on Pigeon Inspired Optimization,” *IEEE Calcutta Conference (CALCON)*, pp. 184-188, 2020. DOI: 10.1109/CALCON49167.2020.9106507
8. **Biswas, S.**, Nath, S., Sing, J. K. and Sarkar, S. K., “Storing Digital Data in Nucleic Acid Memory with Extended Genetic Alphabet,” *2019 Devices for Integrated Circuit (DevIC)*, Kalyani, India, pp. 236-239, 2019. DOI: 10.1109/DEVIC.2019.8783912

Thesis and Dissertations (Count: 1)

7. **Biswas, S.**, Oracle Pointer Machines (Order No. 31998837), (2025). Available from Dissertations & Theses @ Iowa State University; ProQuest Dissertations & Theses Global. (3225638753).
<https://www.proquest.com/dissertations-theses/oracle-pointer-machines/docview/3225638753/se-2>

Papers Under Review (Count: 1)

6. **Biswas, S.**, Biswas, A., Mudryk, Y., and Singh, P., “MagnoCluster: Physics-Informed Unsupervised Learning Framework for Material Classification”.

Preprint (Count: 5)

5. **Biswas, S.**, Lathrop, J. I. and Parshad, R. D., RevCRN: Reversible Analog Computation using Chemical Reaction Networks, *arXiv*, 2026. Preprint. URL: <https://arxiv.org/abs/2608.11362>
4. Verma, U., Goyal, K., **Biswas, S.**, Lathrop, J. I., and Parshad, R. D., An Investigation of Additional Food Models with Generalized Functional Response, *arXiv*, 2026. Preprint. DOI: <https://doi.org/10.48550/arXiv.2606.26340>
3. **Biswas, S.**, Biswas, A., Mudryk, Y. and Singh, P., MagnoCluster: A Physics-Informed Unsupervised Learning Framework for Interpretable Classification of Magnetocaloric Materials, *SSRN*, 2026. Preprint. DOI: <http://dx.doi.org/10.2139/ssrn.6828600>
2. Nachnani, A., Li-Caldwell, K. K., **Biswas, S.**, Sharma, P., Ouyang, G. and Singh, P., Interpretable machine learning-guided design of Fe-based soft magnetic alloys, *arXiv*, 2025. Preprint. URL: <https://arxiv.org/abs/2504.19787>
1. **Biswas, S.** and Dey, S., Relative Learning Rate Adaptation on Loss Feedback. *TechRxiv*, 2023. Preprint. DOI: [10.36227/techrxiv.21980120.v1](https://doi.org/10.36227/techrxiv.21980120.v1)

TEACHING EXPERIENCE

Graduate Teaching Assistant

Spring 2021 - Spring 2023, Fall 2025-Spring 2026

Department of Computer Science, Iowa State University, Ames, IA

COM S 531, COM S 5310: Theory of Computation (Dr. Jack Lutz): Served as a solo TA

Responsibilities Served:

- Assisted in teaching weekly classes to over 100 graduate students from various departments
- Graded students' assignments and exams
- Held in-person weekly office hours
- Maintained course web pages and class electronic announcements
- Used course management systems (E.g., Canvas and Gradescope) to enhance students' engagement
- Provided ongoing support to students as they complete their Scribe Notes

COM S 4020/5990: UG Senior Design/MS Capstone Project (Dr. Simanta Mitra): Served as a TA

Responsibilities Served:

- Managed 9 project groups consisting of over 36 students
- Mentored 6 Undergraduate groups in their senior design projects
- Mentored 3 MS groups in their Capstone projects
- Managed the discussion forum on Discord and responded to students' discussions and queries
- Held in-person weekly office hours/discussion/mentoring sessions (2-4 hours a week)
- Provided step-by-step feedback on project assessment and planning

COM S 106: Introduction to Web Programming (Dr. Susan Chang): Served as a head TA

Responsibilities Served:

- Assisted in teaching weekly classes to over 150 undergraduate students from various departments
- Graded students' coding assignments
- Held online weekly office hours (4 hours a week)
- Managed the discussion forum and responded to students' discussions and queries
- Used course management system, namely, Canvas, to enhance student engagement
- Provided step-by-step walk-through tutorial for coding assignments to students
- Assisted in developing course materials
- Actively engaged in developing course contents like tutorial videos for students

Guest Lecture

Apr 20, 22, 24, 2026

Department of Computer Science, Iowa State University, Ames, IA

COM S 5330: Computational Models of Nanoscale Self-Assembly (Spring 2026)

Guest Lecture

Nov 12, 17, 2025

Department of Computer Science, Iowa State University, Ames, IA
COM S 5310: Theory of Computation (Fall 2025)

Guest Lecture

Feb 16, 2024

Department of Computer Science, Iowa State University, Ames, IA
COM S 633: Advanced Topics in Computational Randomness (Spring 2024)

Guest Lecture

Feb 12, 2024

Department of Computer Science, Iowa State University, Ames, IA
COM S 531: Theory of Computation (Spring 2024)

Guest Lecture

Jan 23, 2023

Department of Computer Science, Iowa State University, Ames, IA
COM S 531: Theory of Computation (Spring 2023)

INDUSTRY AND OTHER ACADEMIC EXPERIENCES

Graduate Assistantship - Ames Lab Research Intern

Sep 1-Sep 30 2024

Ames National Laboratory, Ames, IA

Responsibilities

- Focus on developing AI/ML models for the research project.
- Aim to unveil patterns in the magnetocaloric response of materials.
- Analyze the relationship between materials' chemical compositions and their magnetocaloric response.
- Explore a wide range of material compositions and temperatures.
- Identify promising materials that exhibit desirable magnetocaloric properties.

Decision Scientist Intern

Sep 1-Jan 19 2024, May 19 2025-Jan 16, May 18-July 31 2026

SoilSerdem, Ames, IA

Responsibilities

- Collected, pre-processed, and managed spatial and non-spatial environmental datasets from diverse sources to ensure data quality and readiness for analysis.
- Designed, implemented, and validated supervised and unsupervised models to extract patterns and insights for predictive environmental modeling.
- Developed software applications applying machine learning and data science methods to agronomic and geospatial problems.
- Analyzed 11-spectral band remote sensing imagery (*Landsat-8/9*) and performed **Digital Terrain Analysis** using **Digital Elevation Models**.
- Integrated external data sources, including the **NASA Weather API**, soil surveys, and water sensor data, to model soil moisture and nutrient dynamics.
- Collaborated with agronomists, soil scientists, and remote sensing specialists in a cross-disciplinary R&D team and prepared technical reports and visualizations.

Data Science Intern

May 16-Aug 25 2024

SoilSerdem, Ames, IA

Responsibilities

- Validated environmental data models by analyzing spatial and non-spatial datasets to uncover patterns and actionable insights.
- Applied supervised and unsupervised learning methods to enhance model accuracy and interpretability.

- Designed, developed, and maintained software applications leveraging data science and machine learning techniques.
- Queried, managed, and optimized databases containing large-scale environmental and geospatial information.
- Produced comprehensive reports and visualizations summarizing model performance and research outcomes.
- Contributed to interdisciplinary research initiatives, collaborating with cross-functional teams and leading independent project components.

SERVICES

Community and Leadership

● Vice President <i>IEEE HKN, Nu Chapter, Iowa State University, Ames, Iowa, USA</i>	Apr 2026 – Present
● Lifetime Member <i>IEEE HKN (Eta Kappa Nu) Honourary Society, USA</i>	Dec 2025 – Present
● Scorekeeper <i>Iowa Regional High School Science Bowl, Ames, Iowa, USA</i>	7 Mar 2026
● Scorekeeper <i>Iowa Regional Middle School Science Bowl, Ames, Iowa, USA</i>	21 Feb 2026
● Judge <i>State Science and Technology Fair of Iowa (SSTFI), Ames, Iowa, USA</i>	Mar 2024, 2025
● Member <i>International Society for Nanoscale Science, Computation and Engineering (ISNSCE), USA</i>	Jun 2026 – Present
● Member <i>IEEE, IEEE Computer Society, India and USA</i>	Aug 2019 – Present
● Member <i>ACM, India and USA</i>	Nov 2018 – Present
● Chair <i>MSIT IEEE Computer Society Student Branch Chapter, Kolkata, India</i>	Aug 2019 – Jul 2020
● Chair <i>MSIT ACM Student Chapter, Kolkata, India</i>	Nov 2018 – Jul 2019

Reviewer Positions Served

Journals (Year(number of articles reviewed))

15. *IEEE Transaction on Artificial Intelligence*, IEEE (**2026 (1)**)
14. *SoftwareX*, Elsevier (**2026 (1)**)
13. *Journal of Engineering Research*, Elsevier (**2026 (1)**)
12. *Archives of Computational Methods in Engineering*, Springer Nature (**2026 (1)**)
11. *International Journal of Data Science and Analytics*, Springer Nature (**2025 (1)**)
10. *Computational Biology and Chemistry*, Elsevier (**2025 (1)**)
9. *Cluster Computing*, Springer Nature (**2025 (1)**)
8. *Signal, Image and Video Processing*, Springer Nature (**2025 (1)**)
7. *Discover Applied Sciences*, Springer Nature (**2025 (3)**)
6. *Machine Vision and Applications*, Springer Nature (**2024 (1)**)
5. *Scientific Reports*, Nature (**2023 (1)**, **2024 (2)**, **2025 (3)**)
4. *Knowledge and Information Systems*, Springer Nature (**2022 (1)**, **2023 (2)**)
3. *Current Computer-Aided Drug Design*, Bentham Science (**2023 (2)**)

2. *Artificial Intelligence Review*, Springer Nature (**2020 (1), 2023 (2), 2024 (2), 2025 (3)**)
1. *Applied Artificial Intelligence*, Taylor & Francis Group (**2021 (1), 2024 (1)**)

Conferences (Year)

5. 2025 Devices for Integrated Circuit (DevIC 2025)(**2025**)
4. 3rd IEEE Electron Device Kolkata Conference 2024 (EDKCON 2024)(**2024**)
3. 5th International Conference on Devices for Integrated Circuit (DevIC 2023)(**2023**)
2. 3rd IEEE Conference on VLSI Device, Circuit and System (IEEE VLSI DCS 2022)(**2022**)
1. 2nd IEEE Electron Device Kolkata Conference 2022 (EDKCON 2022)(**2022**)

Invited Talk

4. Iowa Colloquium on Information, Complexity, and Logic Summer Research Conference, Drake University, Des Moines, IA, USA.
Topic: Real-Time Simulation of Chemical Reaction Networks with Oracle Pointer Machines Date: 3-4 Jun, 2025
3. Department of Computer Science, Drake University, Des Moines, IA, USA
Topic: Extended Nucleic Acid Memory
Date: September 2023
2. World Gene Convention 2023, BIT Congress, Sapporo, Japan
Topic: Extended Nucleic Acid Memory
Date: Jan 2023
1. Laboratory of Molecular Programming, Department of Computer Science, Iowa State University, Ames, IA, USA
Topic: Extended Nucleic Acid Memory
Date: Aug 2022

Member of Conference Committee

- (*Scholarly Contributor*) International Conference on Emerging Trends in Cyber Security & Digital Protection (ICETCSDP-2026)
- (*Committee Member*) 3rd IEEE Conference on VLSI Device, Circuit, and System (IEEE VLSI DCS 2022)

HONORS, AWARDS, AND CERTIFICATIONS

- ⇒ **Elected as Lifetime Member of Honorary Society of IEEE HKN (Eta Kappa Nu)**, Iowa State University of Science and Technology (Dec 2025)
- ⇒ **Preparing Future Faculty Associate**, Iowa State University of Science and Technology (May 2024)
- ⇒ **ISU Center for Communication Excellence Ambassador** (Apr 2024)
- ⇒ **Center for the Integration of Research, Teaching, and Learning (CIRTL) Associate Level Certificate**, Iowa State University (Jan 2024)
- ⇒ **Certificate in Quantum Computing Fundamentals**, LinkedIn Learning (Nov 2025)
- ⇒ **Certificate in Programming Foundations: Design Pattern**, LinkedIn Learning (Dec 2024)
- ⇒ **Certificate with Honours in Comparing Genes, Proteins, and Genomes (Bioinformatics III)**, UC San Diego (Oct 2020)
- ⇒ **Certificate with Honours in Finding Hidden Messages in DNA (Bioinformatics I)**, UC San Diego (Sep 2020)

- ⇒ **Certificate with Honours in Genomic Data Science and Clustering (Bioinformatics V)**, UC San Diego (Aug 2020)
- ⇒ **Certificate with Honours in Genome Sequencing (Bioinformatics II)**, UC San Diego (Jul 2020)
- ⇒ **Certificate in Deep Learning Specialization**, Deeplearning.ai (Feb. 2019)
- ⇒ **Certificate in Programming, Data Structure and Algorithms using Python and secured Top 1% National Rank with Gold+Elite Certification**, NPTEL, Indian Institute of Technology (IIT), Madras (May, 2018)
- ⇒ **Certificate in Machine Learning**, Stanford Online (Feb. 2018)

Online Media Highlights

- D. Bradley, Extending nucleic acid memory (NAM), *Inderscience; phys.org*:
<https://phys.org/news/2020-05-nucleic-acid-memory-nam.html>

SKILLS

Programming Languages: Python 3 (*proficient*), C (*advanced*), Java, C++, MATLAB, HTML, CSS, JavaScript, jQuery, SQL

Libraries: Numpy, Matplotlib, PyTorch, Seaborn, Pandas, Scikit-learn, SHAP, XGBoost, Qiskit (beginner)

Software Designing: Object Oriented Programming (advanced), Database Management System (intermediate), Design Pattern (beginner)

Production tools: GitHub, Visual Studio Code, Cursor, LaTeX

GIS Tools and Libraries: GDAL, Grass, SAGA, rasterio, shapely, QGIS, Geopandas, Geo Database, Remote Sensing, Digital Elevation Model, Digital Terrain Analysis

Instruction Tools: Canvas, Gradescope, Microsoft Suite, Google Classroom