

# Harihara Maharna

PhD Student at University of Notre Dame, IN, USA

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## Summary

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I am a PhD student in Applied and Computational Mathematics in the Department of Applied and Computational Mathematics and Statistics (ACMS) at the University of Notre Dame, IN, USA. I am enthusiastic about learning numerical methods for solving differential equations and developing efficient computational techniques for complex mathematical problems.

## Education

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<b>PhD in Applied and Computational Mathematics</b>	GPA-4.0/4.0
Department of Applied and Computational Mathematics and Statistics (ACMS), University of Notre Dame, Notre Dame, IN, USA	2024-current
• Advisor: Dr. Zhiliang Xu	
<b>MSc in Mathematics</b>	CGPA-8.45/10 ( <a href="#">grade cards</a> )
School of Mathematics, IISER Thiruvananthapuram, Kerala, India	2022-2024
<b>BSc in Mathematics</b>	CGPA 9.09/10 ( <a href="#">grade sheet</a> )
Department of Mathematics, M. P. C. Autonomous College, Odisha, India	2019-2022

## Projects and Internships

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<b>Graduate Research Assistant</b> , University of Notre Dame, Notre Dame, IN	June 2025-current
Topic: Deep Learning for Multiscale Models	
Advisor: Dr. Zhiliang Xu, Professor, ACMS Department	
• Architected and implemented an <b>Energetic Variational Deep Neural Network</b> (EVNN) solver in <b>PyTorch</b> to model <b>Cahn–Hilliard phase-separation dynamics</b> .	
• Ensured model <b>stability and physical consistency</b> by enforcing <b>energy conservation laws</b> directly within the neural network architecture, resulting in more <b>robust and reliable simulations</b> .	
• Scaling this EVNN framework to model complex, coupled <b>Cahn–Hilliard–Navier–Stokes</b> systems to improve training stability for <b>high-dimensional fluid dynamics</b> .	
<b>Master's Research Project</b> , IISER Thiruvananthapuram, Kerala	Jan-May 2024
Project: An Asymptotic-Preserving and Energy-Stable Scheme for the Euler System ( <a href="#">Publication</a> )	
Guide: Dr. K. R. Arun, School of Mathematics	
• Developed a <b>semi-implicit finite-volume scheme</b> for barotropic Euler equations with a congestion pressure law, ensuring <b>positivity of density</b> and <b>energy stability</b> at the discrete level.	
• Proved <b>entropy stability</b> and <b>asymptotic-preserving properties</b> , ensuring reliability in stiff regimes.	

<b>Summer Project</b>	Summer 2023
Topic: Differential Equations.	
Guide: Dr. Anupam Pal Choudhury, School of Mathematics, NISER Bhubaneswar, India	
• Investigated <b>scalar conservation laws</b> with applications to traffic flow modeling and shockwave dynamics.	
• Analyzed weak solutions, Rankine–Hugoniot conditions, and entropy criteria to understand discontinuities in flow behavior.	

## Fellowships and Scholastic Achievements

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- Departmental Award for highest score in Applied Mathematics qualifying examination, USD 500, ACMS Department, University of Notre Dame, 2025
- NBHM Master's Fellowship, INR 168,000 (over two years), National Board for Higher Mathematics ([NBHM](#)), 2023–2024
- Valedictorian in BSc Mathematics (2019–2022 batch), Maharaja Purna Chandra (MPC) Autonomous College, Odisha, India

## Work Experience

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### Teaching Assistant, University of Notre Dame

Aug 2024 – Present

- Provided instructional support for advanced courses in Applied Mathematics, Statistics, and Data Science; managed grading, held office hours, and delivered lectures when needed.

#### Fall 24

- Probability and Statistics for Data Science (DS 60505)
- Introduction to Numerical Analysis (ACMS 20350)

#### Spring 25

- Scientific Programming (ACMS 40210)
- Numerical Analysis (ACMS 40390)

#### Fall 25

- Nonlinear Dynamical Systems (ACMS 60630, ACMS 40630)
- Numerical Analysis I (ACMS 60690)
- Probability and Statistics for Data Science (DS 60505)

## Online Education Support

- Chegg Subject Matter Expert in Calculus.

Feb 2022- July 2023

## Workshops

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### Scientific Machine Learning: Theory, Algorithm, and Applications Workshop

Purdue University, IN, USA

September 27–28, 2025

Lightning Talk: “*Energetic Variational Neural Network Discretization of the Cahn-Hilliard Equation*”

### Mathematics Training and Talent Search Programme (MTTS) Level-1

IISER Thiruvananthapuram, India

Summer 2022

- In this 4-week summer school, I attended various lectures in analysis and algebra.

### Mathematics Training and Talent Search Programme (MTTS) Level-O (Online)

Summer 2021

### Online Foundation Course in Mathematics (OFCM) (Online)

October 2020

## Technical skills

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- **Programming Languages:** PYTHON, MATLAB, C++, R.
- **Python Libraries:** PyTorch, NGsolve, SimVascular, NumPy, SciPy, Pandas, Matplotlib.
- **Tools:** L<sup>A</sup>T<sub>E</sub>X, Git, Jupyter Notebooks.

## Publications

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1. K. Arun, A. Krishnamurthy, and H. Maharna. An asymptotic preserving and energy stable scheme for the euler system with congestion constraint. *Applied Mathematics and Computation, Applied Mathematics and Computation*, vol. 495, p. 129306, 2025. <https://doi.org/10.1016/j.amc.2025.129306>

## References

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- Dr. Zhiliang Xu, *Professor, Department of Applied and Computational Mathematics and Statistics, University of Notre Dame, IN, USA.*  
Email address: [zhiliangxu@nd.edu](mailto:zhiliangxu@nd.edu). Connection: PhD advisor.
- Dr. K. R. Arun, *Associate Professor, School of Mathematics, Indian Institute of Science Education and Research, Thiruvananthapuram, India.*  
Email address: [arun@iisertvm.ac.in](mailto:arun@iisertvm.ac.in). Connection: Master's project guide.