

# Nishchal Sapkota

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## Education

### University of Notre Dame (UND)

*Ph.D. in Computer Science and Engineering*

*M.S. in Computer Science and Engineering*

*Research Areas: Computer Vision, Self-supervised Learning, Data-efficient Deep Learning Models, AI for Healthcare*

Notre Dame, IN

05/2026

08/2024

### The University of Southern Mississippi (USM)

*B.S. in Computer Science | B.S. in Mathematics – Honors, summa cum laude (GPA: 3.91)*

*Thesis: Probabilistic Analysis of Revenues in Online Games*

Hattiesburg, MS

08/2020

## Experiences

### Mayo Clinic

*Computational Pathology and AI Intern*

Rochester, MN

01/2025 – 05/2025, 08/2025 – 12/2025

- Developed pathology image foundation models by training generalist self-supervised image encoders at varying model and data scales, designed for disease type-agnostic downstream applications, beating SOTA pathology foundation models.
- Contributed to extending the vision encoder by integrating patient diagnosis reports with whole-slide pathology images for advanced multimodal diagnostics and personalized care.
- Assisted in building predictive healthcare models from large-scale clinical and non-clinical data and deploying them through scalable MLOps pipelines with cross-functional teams.

### IBM

*Senior Data Science & AI PhD Intern*

Research Triangle Park – Durham, NC

05/2025 – 08/2025

- Modeled user decision paths from web clickstream sequence data using linear (N-gram Markov) and non-linear (Transformer/Mamba) models to identify high-intent users with greater precision.
- Built session-level predictive models for conversion outcomes, enabling real-time agentic AI marketing interventions to recover up to 10,000 lost conversion opportunities.
- Collaborated cross-functionally to convert model insights into strategies, boosting campaign performance and engagement.

### The University of Notre Dame

*Graduate Researcher*

Notre Dame, IN

08/2020 – Present

- Currently working on surgical video segmentation using agglomerative foundation models to advance AI-assisted surgery .
- Developed 3 self-supervised learning models achieving state-of-the-art segmentation performances. [4][5][6]
- Built transformer-based data-efficient 3D segmentation models with upto 11% performance improvement. [1][2][3]
- Developed 3 novel methods leveraging foundation models for medical image and cancer survival analysis. [10][12][13]
- Proposed multimodal learning frameworks and shape-aware segmentation methods using implicit neural representations by handling label ambiguity and improving data efficiency by 30%. [7][8][11][12]
- Collaborated with multiple biology labs, hospitals, and anthropology departments to address medical and biological research challenges using AI-powered tools, resulting in several publications. [2][3][9][11][14]
- Mentored 1 high school and 4 undergraduate students, resulting in ML research publications and industry placements.

### The University of Southern Mississippi

*Undergraduate Researcher*

Hattiesburg, MS

08/2017 – 05/2020

- Introduced a novel dynamic food chain model for three species and analyzed its long-term behavior. [16]
- Analyzed online games using Markov Chain to maximize revenues for both players and the providers. [15]
- Predicted chemical compound toxicity using in-vitro computational methods and feature engineering.

## Technical Skills

**Programming:** Python, R, C++, Bash, MATLAB, SQL

**ML Packages:** Pytorch, Numpy, Scikit-Learn, Keras, SciPy, OpenCV, Pandas, Tensorflow, Matplotlib, WandB, NLTK

**Tools:** Jupyter, LaTeX, FIJI, Microsoft 365, Adobe Illustrator, Training and Fine-tuning AI models on GPU, Docker, REST API

**Concepts:** Machine Learning, Computer Vision, CNN, LSTM, GAN, Transformers, VLM, Auto Encoders, Foundation Models, Self-supervised Learning, Generative AI, Multimodal Learning, Transfer Learning, INR, Diffusion Models, Time Series Forecasting, Mathematical Modeling, Distributed Training, Model Quantization, Temporal Modeling for Video, Low-latency Inference

**Math Concepts:** Data Analysis, Numerical Methods, Real Analysis, Modern Algebra, Number Theory, Statistics

## Scholarships, Grants, Honors, and Achievements

2024 IEEE International Symposium on Biomedical Imaging (ISBI2024) <b>Travel grant</b> (\$800)	ISBI 2024
Graduate School <b>Professional Development Fund</b> (\$1,250) and <b>Conference Presentation Grant</b> (\$450)	UND 2024
CSE Select <b>Fellowship</b> Award ( <i>1/40 incoming Ph.D students; yearly stipend worth \$40,000</i> )	UND 2020-2025
Wright W. and Annie R. Cross <b>Endowment</b> (\$10,500) and Danny R. Carter Endowed <b>Scholarship</b> (\$4,000)	USM 2017-2020
<b>First Place</b> , Mathematics Comprehensive Exam (MFT)	USM 2019
<b>Second Runner Up</b> : Best Undergraduate Paper	MAA Meeting 2019
Eagle SPUR <b>grant</b> for Undergraduate Research (\$2,000) and Honors Keystone <b>Scholarship</b> (\$2,000)	USM 2019
<b>Finalist</b> , Integration Bee	MAA Meeting 2018
Nominated for College of Science and Technology's <b>Outstanding Sophomore Award</b>	USM 2017
Burner Science & Tech. <b>Scholarship</b> (\$800), Wallace C. & Lynn L. Pye Endowed <b>Scholarship</b> (\$800)	USM 2017

## Teaching Experiences

<b>The University of Notre Dame</b>	Notre Dame, IN
<i>Graduate Teaching Assistant</i>	08/2020 - 12/2025
<ul style="list-style-type: none"><li>• <b>Design &amp; Analysis of Algorithms; Complexity &amp; Algorithms; Mobile App. Design; Discrete Mathematics</b></li><li>• Prepared lecture slides, graded submissions, created answer keys, and held office hours.</li></ul>	
<i>STEM Project Leader   Warrior-Scholar Project</i>	06/2023, 06/2024
<ul style="list-style-type: none"><li>• <b>Medical Image Analysis</b>: Designed and conducted a Bootcamp to prepare veterans for undergraduate research.</li><li>• <b>Introduction to Data Science</b>: Conducted a Bootcamp to prepare veterans for undergraduate coding classes.</li></ul>	

## Publications

### Transformer-Based Segmentation Architectures

- [1] [When Swin Transformer Meets KANs: An Improved Transformer Architecture for Medical Image Segmentation](#) – *arXiv*, 2025
- [2] [Universal Conditional Networks for Cartilage Segmentation with Sparsely Annotated Data](#) – *Nature Scientific Reports*, 2025
- [3] [ConUNETR: A Conditional Transformer Network for 3D Micro-CT Embryonic Cartilage Segmentation](#) – *ISBI*, 2024

### Self-supervised Learning

- [4] [A Point in the Right Direction: Vector Prediction for Spatially-aware Self-supervised Volumetric Rep. Learning](#) – *ISBI*, 2023
- [5] [Keep Your Friends Close & Enemies Farther: Debiasing Contrastive Learning with Spatial Priors in 3D Images](#) – *BIBM*, 2022
- [6] [Unsupervised Feature Clustering Improves Contrastive Representation Learning for Medical Image Segmentation](#) – *BIBM*, 2022

### Implicit Neural Representations (INRs)

- [7] [Sperm Head Morphology Classification with Implicit Neural Representations](#) – *Under Review*, 2025
- [8] [SwIPE: Efficient and Robust Medical Image Segmentation with Implicit Patch Embeddings](#) – *MICCAI*, 2023

### Medical Image Analysis & Computational Pathology

- [9] [H-CNN-ViT: A Hierarchical Gated Attention Multi-Branch Model for Bladder Cancer Recurrence Prediction](#) – *BIBM*, 2025
- [10] [IHCSurv: Effective Immunohistochemistry Priors for Cancer Survival Analysis in Gigapixel Multi-stain WSIs](#) – *MICCAI*, 2024
- [11] [SHMC-Net: A Mask-guided Feature Fusion Network for Sperm Head Morphology Classification](#) – *ISBI*, 2024
- [12] [Path-GPTOmics: A Balanced Multi-modal Learning Framework for Survival Outcome Prediction](#) – *ISBI*, 2024
- [13] [Boosting Medical Image Classification with Segmentation Foundation Model](#) – *ISBI*, 2024
- [14] [Embryonic Cranial Cartilage Defects in the Fgfr<sup>3Y367C/+</sup> Mouse Model of Achondroplasia](#) – *Anatomical Record*, 2023

### Applied Statistics & Mathematical Modeling

- [15] [Probabilistic Analysis of Revenues in Online Games](#) – *University of Southern Mississippi*, 2020
- [16] [Hunting Co-operation in the Middle Predator in Three Species Food Chain Model](#) – *MAA Proceedings*, 2020

## Students Mentored

- **Haoyan Shi** (Undergraduate Intern, 2025) – *Published author, applying to graduate programs*
- **Zihao Zhao** (Undergraduate Intern, 2024) – *Currently a PhD student at Rutgers*
- **Maria Jose Gomez** (High School Intern, 2024) – *Published author, applying to undergraduate programs*
- **Sirui Li** (Undergraduate Intern, 2023) – *Currently a PhD student at UCLA*
- **Santiago Rodriguez** (Undergraduate Intern, 2023) – *Now a Software Engineer at Apple*