

# Nishchal Sapkota

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## Education

<b>University of Notre Dame (UND)</b> <i>Ph.D. in Computer Science and Engineering</i> <i>M.S. in Computer Science and Engineering</i> <i>Research Areas: Deep Learning, Computer Vision, Mathematical Modeling, NLP, AI for Healthcare</i>	Notre Dame, IN 05/2026 08/2024
<b>The University of Southern Mississippi (USM)</b> <i>B.S. with Honors (GPA: 3.91), summa cum laude</i> <i>Dual Major: Computer Science and Mathematics   Thesis: Probabilistic Analysis of Revenues in Online Games</i>	Hattiesburg, MS 08/2020

## Experiences

<b>The University of Notre Dame</b> <i>Graduate Researcher   Python, PyTorch, TensorFlow, Bash, Matlab</i>	Notre Dame, IN 08/2020 – Present
<ul style="list-style-type: none"><li>• Currently developing a diffusion-based super-resolution framework for unpaired infrared photothermal heterodyne images, aimed at overcoming the Abbe diffraction limit and mitigating scanning-resultant background artifacts.</li><li>• Proposed different novel methods leveraging <u>foundation models</u> (based on SAM and GPT) for medical image classification [6] and cancer survival outcome prediction. [2][5]</li><li>• Developed data efficient encoder-agnostic <u>universal 3D segmentation models</u> that improved performance on out-of-distribution datasets by up to 11%, with less than a 2% increase in model complexity. [1] [3] [8]</li><li>• Proposed a <u>multimodal learning</u> framework for automated sperm analysis handling label ambiguity [4] and a shape-aware segmentation method using <u>implicit neural representations</u> improving data efficiency by 30%. [7]</li><li>• Developed 3 <u>self-supervised learning models</u> achieving state-of-the-art segmentation performances. [9][10] [11]</li><li>• Mentored one high school student and three undergraduate students on machine learning projects, leading to several publications and successful placements in the industry.</li><li>• Collaborated with multiple biology labs, hospitals, and anthropology departments to address medical and biological research challenges using AI-powered tools, resulting in several publications. [1] [4] [8]</li></ul>	
<b>The University of Southern Mississippi</b> <i>Undergraduate Researcher   Python, R, Matlab</i>	Hattiesburg, MS 08/2017 – 05/2020
<ul style="list-style-type: none"><li>• Introduced a novel <u>dynamic food chain model</u> for three species and analyzed its long-term behavior. [12]</li><li>• Analyzed online games using Markov Chain to maximum revenues for both players and the providers. [13]</li><li>• Predicted chemical compound toxicity using in-vitro computational methods and feature engineering.</li></ul>	

## Projects

<b>Nenglish: A Language Translator App</b>   <i>React Native, Google Cloud Vision, AutoML Translation.</i>
<ul style="list-style-type: none"><li>• Developed a mobile application that detects the contents from public signboards written in over 105 languages and translates to the user's choice of language.</li></ul>
<b>Bitcoin Price Prediction</b>   <i>LSTM, AR, ARIMA</i>
<ul style="list-style-type: none"><li>• Developed a hybrid mathematical modeling and deep learning-based time series forecasting model to predict bitcoin prices with up to 91% accuracy.</li></ul>
<b>Our Safe Neighborhood</b> – <i>CalHacks 6.0 @ UC Berkeley   Google Cloud NLP, NLTK, React, JavaScript, Flask</i>
<ul style="list-style-type: none"><li>• Built a web application that scraps through the local news article and classifies the cities in the neighborhood as safe or unsafe by identifying the crime's location, type, and severity.</li></ul>

## 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 Office Suite, Adobe Illustrator, Git, AWS, Training and Fine-tuning AI models on GPU  
**Concepts:** Artificial Intelligence, Machine Learning, Computer Vision, Neural Networks, CNN, LSTM, RNN, GAN, Transformers, NLP, LLM, Auto Encoders, Foundation Models, Self-supervised Learning, Generative AI, Multimodal Learning, Transfer Learning, INR, Diffusion Models, Time Series Forecasting, Mathematical Modeling, EDA  
**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)	UND 2024
GSG <b>Conference Presentation Grant</b> (\$450)	UND 2024
CSE Select <b>Fellowship</b> Award (1/40 incoming Ph.D students; yearly stipend worth \$40, 000)	UND 2020-2025
Wright W. and Annie Rea Cross <b>Endowment</b> (\$10, 500)	USM 2017-2020
Danny R. Carter Endowed <b>Scholarship</b> (\$4, 000)	USM 2017, 2019
<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> , Drapeau Center for Undergraduate Research (\$2, 000)	USM 2019
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 – 05/2023
<ul style="list-style-type: none"><li>• <b>Complexity and Algorithms</b> (CSE 60111): Graded submissions, prepared answer keys and held office hours</li><li>• <b>Mobile Application Design</b> (CSE 40333): Graded submissions and prepared lecture slides</li><li>• <b>Discrete Mathematics</b> (CSE 20110): Graded submissions 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

- [1] **Nishchal Sapkota**, Yejia Zhang, Susan M M Perrine, Yuhang Hsi, Sirui Li, Meng Wu, Greg Holmes, Abdul Abdulai, Ethylin Jabs, Joan T. Richtsmeier, and Danny Z Chen. UniCoN: Universal conditional networks for multi-age embryonic cartilage segmentation with sparsely annotated data. *Submitted to Nature Scientific Reports*, 2024
- [2] Yejia Zhang, Hanqing Chao, Zhongwei Qiu, **Nishchal Sapkota**, Pengfei Gu, Danny Z Chen, Ke Yan, Dakai Jin, and Le Lu. IHCSurv: effective immunohistochemistry priors for multi-stain cancer survival analysis in gigapixel whole slide images. *MICCAI*, 2024
- [3] **Nishchal Sapkota**, Yejia Zhang, Susan M M Perrine, Yuhang Hsi, Sirui Li, Meng Wu, Greg Holmes, Abdul Abdulai, Ethylin Jabs, Joan T. Richtsmeier, and Danny Z Chen. ConUNETR: A conditional transformer network for 3D Micro-CT embryonic cartilage segmentation. *IEEE ISBI*, 2024
- [4] **Nishchal Sapkota**, Yejia Zhang, Sirui Li, Peixian Liang, Zhuo Zhao, and Danny Z Chen. SHMC-Net: A mask-guided feature fusion network for sperm head morphology classification. *IEEE ISBI*, 2024
- [5] Hongxiao Wang, Yang Yang, Zhuo Zhao, Pengfei Gu, **Nishchal Sapkota**, and Danny Z Chen. Path-GPTOmic: A balanced multi-modal learning framework for survival outcome prediction. *IEEE ISBI*, 2024
- [6] Pengfei Gu, Zihan Zhao, Hongxiao Wang, Yaopeng Peng, Yizhe Zhang, **Nishchal Sapkota**, and Danny Z Chen. Boosting medical image classification with segmentation foundation model. *IEEE ISBI*, 2024
- [7] Yejia Zhang, Pengfei Gu, **Nishchal Sapkota**, Yaopeng Peng, Hao Zheng, and Danny Z Chen. Swipe: Efficient and robust medical image segmentation with implicit patch embeddings. *MICCAI*, 2023
- [8] Susan M Motch Perrine, **Nishchal Sapkota**, Kazuhiko Kawasaki, Yejia Zhang, Danny Z Chen, Mizuho Kawasaki, Emily Durham, Yann Heuze, Laurence Legeai-Mallet, and Joan T Richtsmeier. Embryonic cranial cartilage defects in the fgfr3y367c/+ mouse model of achondroplasia. *Anatomical Record*, 2023
- [9] Yejia Zhang, Pengfei Gu, **Nishchal Sapkota**, Hao Zheng, Peixian Liang, and Danny Z Chen. A point in the right direction: Vector prediction for spatially-aware self-supervised volumetric representation learning. *IEEE ISBI*, 2022
- [10] Yejia Zhang, **Nishchal Sapkota**, Pengfei Gu, Y. Peng, Hao Zheng, and Danny Z Chen. Keep your friends close & enemies farther: Debiasing contrastive learning with spatial priors in 3d radiology images. In *IEEE BIBM*, 2022
- [11] Yejia Zhang, Xinrong Hu, **Nishchal Sapkota**, Yiyu Shi, and Danny Z Chen. Unsupervised feature clustering improves contrastive representation learning for medical image segmentation. In *IEEE BIBM*, 2022
- [12] **Nishchal Sapkota**, R Bhatta, P Dabney, and Z Xie. Hunting co-operation in the middle predator in three species food chain model. *Proceedings of the LA-MS Section of the Mathematical Association of America (MAA)*, 2020
- [13] **Nishchal Sapkota** and Bernd SW Schröder. Probabilistic analysis of revenues in online games. *University of Southern Mississippi*, 2020