

# Vibhas Kumar Vats

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## Education

### Indiana University

Bloomington, IN

Ph.D. in Computer Science | GPA 4.0/4.0

2021 – 2026 (expected)

### Indiana University

Bloomington, IN

Master of Science in Data Science (with thesis) | GPA: 3.97/4.0

2019 - 2021

Master's thesis: [Response-Based Knowledge Distillation](#) (paper)

### National Institute of Technology (NIT) Patna

Bihar, India

Bachelor of Technology in Electrical Engineering | CGPA: 8.77/10.0

2011 - 2015

## Research Experience

### Graduate Research Assistant, Indiana University Computer Vision lab

Multi-View Stereo (MVS) and 3D Reconstruction

Aug 2021 – Present

- Designed and executed MVS algorithm that enforce multi-view geometric consistency in end-to-end learning process
- Exploring integration of geometric constraints in deep learning-based MVS frameworks
- Datasets: DTU, Tanks & Temples, BlendedMVS, ETH3D

Deep Learning (DL) - Case Based Reasoning (CBR) Integration:

June 2022 – Present

- Developed an algorithm to examine the impact of DL features on CBR models
- Exploring methods to integration feedback from a CBR model in training a DL model
- Exploring hybrid system leveraging knowledge-engineered and network learned feature in concert
- Significant contribution in writing DL-CBR integration survey paper
- Datasets: AWA2, Mini-ImageNet

EngageAI Institute Project

Jan 2023 – Present

- Exploring AI technologies to enhance student engagement in classroom
- Exploring continuous tracking of objects in a video
- Dataset: EgoTracks (Ego4D)

Roof-area Segmentation and Orientation Detection

Aug 2022 – Feb 2023

- Designed a RANSAC algorithm to detect orientation and plane area of roof in 3D point clouds
- Improved roof segmentation and orientation detection using satellite images

**Master's Thesis** on "Response-based Knowledge Distillation"

Aug 2020 – May 2021

- Analyze the knowledge distillation process under varying conditions of networks
- Proposed the soft-label hypothesis to explain the behavior of distillation process
- Proposed methods for pre-training teacher models to retain increased similarity information in soft-labels
- A condensed version of the thesis was published at AAAI-2022 workshop

**External Research Fellow**, NIT Patna (Electrical Engineering Lab).

July 2018 – June 2019

Project title: "Sustainable Smart Grid Framework for Energy Management System Incorporating Available Renewable Resources." funded by the Science & Engineering Research Board, Government of India.

- Successfully conceptualized and implemented a model to mitigate the Communication-link failure in smart meter-based load forecasting system using various classification methods.
- Programmed and implemented an electrical load forecasting system with one year of data using polynomial regression model.
- Presented paper at 4th IEEE International Conference on Computing Communication and Automation (2018).

## Publications

- **V. K. Vats**, S. Joshi, D. Crandall, Md. Reza, S. Jung, "GC-MVSNet: Multi-View, Multi-Scale, Geometrically-Consistent Multi-View Stereo", Accepted – WACV-2024 ([pdf](#))
- C. Wang, Md. Reza, **V. K. Vats**, Y. Ju, N. Thakurdesai, Y. Wang, D. Crandall, S. Jung, "Deep Learning-Based 3D Reconstruction from Multiple Images: A Survey", Under review, Neurocomputing.
- Z. Wilkerson, **V. K. Vats**, K. Acharya, D. Leake, D. Crandall, "Examining the Impact of Network Architecture on Extracted Feature Quality for Case-Based Reasoning" ICCBR-2023 ([pdf](#))
- **V. K. Vats** and David Crandall, "Controlling the Quality of Distillation in Response-Based Network Compression", Association for the Advancement of Artificial Intelligence (AAAI – 22) workshop ([pdf](#))
- **V. K. Vats**, M. De, S. Rai and S. De, "Mitigating Effect of Communication Link Failure in Smart Meter based Load Forecasting", Springer, 4<sup>th</sup> International Conference on Nanoelectronics, Circuits & Communication Systems 2018.
- **V. K. Vats**, M. De, S. Rai and D. Bharti, "Very Short-Term, Short-Term and Mid-Term Load Forecasting for Residential Academic Institute: A Case Study", IEEE Xplore, 4<sup>th</sup> IEEE International Conference on Computing Communication and Automation 2018.

## Work Experience

**Course Development and Instructor** – Computer Vision (CSCI-B 657), Indiana University

Spring 22 and 23

- Designed and co-taught DL discussion section with my advisor, [Prof. David J. Crandall](#)
- Lead the discussion of seminal papers in DL covering development of CNNs, Vision-Transformers and MLP models
- Received Associate Instructor of the year award, 2021-2022 for my distinguished contribution in this course

#### **Associate Instructor**, Indiana University

- Computer Vision (Spring22 and 23), Elements of Artificial Intelligence (Fall20, Spring21)
- Held weekly office hours on Zoom to work one-on-one with graduate students and working professionals.

#### **Senior Manager**, Tata Motors Ltd. Pantnagar.

*Aug 2015 – Aug 2017*

- Analyzed and optimized the maintenance frequency of Generator yard equipment using past breakdown and maintenance data.
- Overhauled and systematized power transformer oil filtration frequency of 36 units of transformer, individually, by predicting oil characteristics threshold value against number of operation hours of each transformer using eight years of past records.

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### Skills and Certifications

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**Languages & Tools:** Python(advanced), SQL, R, Rstudio, PostgreSQL, C – (intermediate)

**Frameworks & Libraries:** Pytorch(advanced), TensorFlow(advanced), Keras, NumPy, Pillow, Scikit-learn.

**Certifications:** “Machine Learning” and “Deep Learning” specialization by Prof. Andrew Ng on Coursera,

- “TensorFlow in practice” by Laurence Moroney from Google.
- “Statistical Learning” by Prof. Hastie and Prof. Tibshirani on Stanford online

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### Minor Projects

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#### **Zero-shot learning (ZSL) and outlier detection using C2C-Siamese network (C2C-SN)**

*Jan 2020 – May 2020*

- Used Siamese network to learn the similarities and differences between two classes with 13 hand-engineered features for 10 classes.
- Successfully detected outlier classes with accuracy of about **72%** and confidence threshold value of **0.999** on MNIST dataset.
- Assessed the potential of doing ZSL by feeding the features learned from C2C-SN and its semantic embedding into Fully connected layer and doing nearest neighbor search. The set up did not prove to perform up to its theoretical understanding.
- Tech Stack: Python, PyTorch, TensorFlow, NumPy, Pandas, Siamese networks. Model accuracy: **72%**

#### **Exploratory analysis of Pima-Indian (women) diabetes dataset**

*March 2020 – May 2020*

- Analysis of eight medical parameters to explore and establish the cause of rise in diabetic patients in the Pima Indian community.
- Used Generalized Linear Model to train and then find the efficacy of model (78%) to predict diabetic women in Pima Indian community.
- Tech Stack: R, RStudio, Ggplot2, Tidyverse. Model accuracy: **78%**

#### **Optical Music Recognition (OMR) and text annotation**

*Feb 2020 – March 2020*

- Implemented 2D convolution from scratch with separable kernels on scanned (greyscale images) musical notes.
- Detected the musical notes by using hamming distance and also through template matching score using edge maps (Sobel operator).
- Used Hough transformation to detect the staff lines and draw bounding box around symbols and tagged text with it.
- Tech stack: Python, NumPy, Pillow.

#### **Study on sentiment Analysis methods**

*Dec 2020*

- Implemented Naïve Bayes, Logistic regression, Recurrent Neural Networks (RNN) from scratch.
- Fine-tuned Google’s BERT sequence classification model on sentiment140 dataset.
- Tech Stack: TensorFlow, Huggingface, Python, NumPy. Model accuracy: **86%**

**Transfer Learning:** Neural style transfer (TensorFlow), Car detection with YOLO (TensorFlow), Face recognition (TensorFlow).

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### Awards and Honors

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- Associate Instructor of the year award- 2021-2022, Indiana University Bloomington
- Best Graduate National Institute of Technology Patna, batch of 2015.
- Honored by Tata Sustainability group for distinctive work in CSR under Pro-engage program in 2016-17.
- Awarded under eNoble program for valuable contribution as CSR volunteer in 2016-17.
- Team member, winner of national level Golden Peacock Environment Management Award 2016 in the manufacturing sector.
- Coordinator, CSR cluster of Graduate Engineer Trainee club of Tata Motors, Pantnagar.