Shyam Nandan Rai

E-Mail | Website | Github | Google scholar

Education

Politecnico di Torino, Turin **GPA**: 102/110
PhD in Artificial Intelligence *Nov. 2021 - Aug. 2025 (expected)*

- **Thesis (expected):** From pixels to masks: Toward open-set segmentation

International Institute of Information Technology, Hyderabad **GPA**: 8.83/10
M.S. by Research in Computer Science and Engineering *Aug. 2017 – Dec. 2020*

- **Thesis:** Computer Vision for Atmospheric Turbulence

Indian Institute of Information Technology, Sri City **GPA**: 8.71/10
B.Tech (Hons.) in Electronics and Communication Engineering *Aug. 2013 – May 2017*

- **Thesis:** Cartoon Image Understanding

Research Experience

Politecnico di Torino Turin, Italy
Graduate Researcher *Nov. 2021 - Present*

- **Visual And Multimodal Applied Learning Laboratory (VANDAL)**
  *Advised by Professors **Barbara Caputo** and **Carlo Masone**.*

  - Developed Mask2Anomaly - a universal mask-transformer for anomaly segmentation, open-set semantic segmentation and open-set panoptic segmentation. *[ICCV'23, T-PAMI'24]*

  - Proposed an adapter architecture designed for anomaly segmentation models having training parameter efficiency. *(work under submission)*

Technical University of Munich | Helmholtz Munich Munich, Germany
Collaborating Graduate Researcher *April 2024 - October 2024*

- **Explainable Machine Learning Lab (EML)**
  *Advised by Professor **Zeynep Akata**.*

  - Proposed video anomaly segmentation for urban road scenes. We leveraged foundational models: SAM2 and CLIP to address it in zero-shot and supervised settings. *(work under submission)*

International Institute of Information Technology - Hyderabad Hyderabad, India
Research Fellow *Aug. 2017 - Aug. 2021*

- **Center for Visual Information Technology (CVIT)**
  *Advised by Professors **C. V. Jawahar**, **Chetan Arora** and **Vineeth N Balasubramanian**.*

  - Proposed a framework that addresses the problem of detecting objects in real world scenarios for road scenes. *[IROS'22, NurIPSw'21]*

  - Developed image restoration models for adverse weather such as rain and atmospheric turbulence. These models were employed to improve computer vision tasks such as semantic segmentation and object detection critical for autonomous navigation systems. *[WACV'22, T-IP'22, WACV'20, BMVC'20, NCVPRIPG'19]*

Indian Institute of Information Technology, Sri City Sri City, India
Undergraduate researcher *Jan. 2016 - April 2017*

- *Advised by Professors **C. V. Jawahar** and **Anand Mishra**.*

  - Worked on the problem of cartoon image understanding and collating related dataset.*[ECCVw'16]*

Work Experience

MLL Lab-IIITH & Talentsprint Oct. 2018 – July 2021
AI/ML Mentor

- Mentoring of industrial professionals during the lab sessions on the concepts of machine learning & deep learning.

RTC, Robert Bosch, Bangalore, India May 2016 – July 2016
Computer Vision Intern

- Benchmarking of person detection and tracking algorithm.
- Implementation of KLT tracker on PNNL and Pizza sequences.

Publications and Patents

♣: **Equal contribution** | ♠: **In advising capacity.**

Open-Set Segmentation

- **Mask2Anomaly: Mask Transformer for Universal Open-set Segmentation**.[Paper]
  Shyam Nandan Rai, Fabio Cermelli, Barbara Caputo, Carlo Masone.
  IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI), 2024.

- **Unmasking Anomalies in Road-Scene Segmentation.**[**Oral**][Paper][Code]
  Shyam Nandan Rai, Fabio Cermelli, Dario Fontanel, Carlo Masone, Barbara Caputo.
  International Conference on Computer Vision (ICCV), 2023.

Intent Prediction

- **Early Anticipation of Driving Maneuvers**.[Project Page]
  Abdul Wasi, Shankar Gangisetty, **Shyam Nandan Rai**♠, C. V. Jawahar.
  European Conference on Computer Vision (ECCV), 2024.

Open-World Detection

- **New Objects on the Road? No Problem, We'll Learn Them Too**.[Paper]
  Deepak Kumar Singh♣ **Shyam Nandan Rai**♣,♠, K. J. Joseph, Rohit Saluja, V. N. Balasubramanian, Chetan Arora, Anbumani Subramanian, C. V. Jawahar.
  International Conference on Intelligent Robots and Systems (IROS), 2022.

- **ORDER: Open World Object Detection on Road Scenes**.[Paper]
  Deepak Kumar Singh♣ **Shyam Nandan Rai**♣,♠, K J Joseph, Rohit Saluja, V. N. Balasubramanian, Chetan Arora, Anbumani Subramanian, C. V. Jawahar.
  Machine Learning for Autonomous Driving, NurIPSw 2021.

Image Restoration and Generation

- **Removing Atmospheric Turbulence via Deep Adversarial Learning**.[Paper][Code]
  Shyam Nandan Rai, C. V. Jawahar.
  IEEE Transactions on Image Processing (T-IP), 2022.

- **System and method for generating derained image using self-supervised learning model**.
  C.V. Jawahar, Rohit Saluja, Chetan Arora, V. N. Balasubramanian, **Shyam Nandan Rai**.
  US Patent App. US18/138.060, 2023.

- **FLUID: Few-Shot Self-Supervised Image Deraining**. [Paper]
  Shyam Nandan Rai, Rohit Saluja, V. N. Balasubramanian, Chetan Arora, Anbumani Subramanian, C. V. Jawahar.
  Winter Conference on Applications of Computer Vision (WACV), 2022.

- **Spatial Feedback Learning to Improve Semantic Segmentation in Hot Weather**.[Paper][Code]
  Shyam Nandan Rai, V. N. Balasubramanian, Anbumani Subramanian, C. V. Jawahar.
  The British Machine Vision Conference (BMVC), 2020.

- **Munich to Dubai: How far is it for Semantic Segmentation?**.[Project Page][Paper]
  Shyam Nandan Rai, V. N. Balasubramanian, Anbumani Subramanian, C. V. Jawahar.
  Winter Conference on Applications of Computer Vision (WACV), 2020.

- **Learning To Generate Atmospheric Turbulent Images**.[Paper]
  Shyam Nandan Rai, C. V. Jawahar.
  National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), 2019.

Model Compression

- **Towards Efficient Semantic Segmentation Compression via Meta Pruning**.[Paper]
  Ashutosh Mishra♣, **Shyam Nandan Rai**♣,♠, Girish Varma, and C. V. Jawahar.
  International Conference on Computer Vision and Image Processing (CVIP), 2023.

Image Understanding

- **IIITCFW: A Benchmark Database of Cartoon Faces in the Wild.**[**Oral**][Project Page][Paper]
  Ashutosh Mishra, **Shyam Nandan Rai**, Anand Mishra, C. V. Jawahar.
  Workshop on visual analysis and sketch (ECCVw), 2016.

CV/ML Projects

Model-Contrastive Proximal Federated Learning [Project Page] Spring'22
- Benchmarked FedAvg, federated learning algorithms: FedGKT, FedProx, and MOON in ID and non-IID setting.
- Proposed Model-Contrastive Proximal Federated Learning, an extension of MOON where, we add a proximal term that acts as regulariser enforcing the local model to be close to the global model.

LRR Network for Semantic Segmentation [Project Page] Spring'18
- Implemented a multi-scale architecture leveraging a laplacian pyramid to improve semantic segmentation performance.
- Outperforms traditional fully convolutional networks in achieving better results.

Relationship between Music & Personality [Report] Monsoon'18
- We find a strong correlation between personality of an individual and their music preferences.
- Leveraging this relationship, we predict the personality of person by his/her preferred genre and recommend personalised music.

Reading Comprehension via Siamese CNN [Project Page] Monsoon'17
- Reading comprehension was posed as a sentence classification task with two classes: entailment and contradiction.
- Instead of sequential models, CNN models were utilized for classification extending it to a siamese variation using contrastive loss.

Cross-domain Gender Identification from Facial Images [Project Page] Monsoon'17
- We utilized PCA for dimensionality reduction followed by KNN, Logistic Regression, and SVM as feature classifiers.
- Extended the method to cross-domain gender identification between the real face and its cartoon and caricature modalities.

Detecting misalignment in CAD models [Project Page] Monsoon'17
- Developed an interactive computer vision application using Qt and Opencv, to detect misalignment in CAD Images.
- Internally the application uses RANSAC along with the handcrafted thresholding techniques.

Personal Projects
- Pytorch tutorial for Multi Agent Diverse GAN. [Project Page]
- Implementation of Twin Auxiliary Classifier GAN. [Project Page]
- Image quality assessment. [Project Page]

Academic Activities and Achievements

Achievements:
→ Dean's List - Monsoon '15
→ Dean's Research Award - Spring '17
→ *ELLIS PhD Mobility Grants (2024)* for research visit at EML lab with Zeynep Akata.
→ Uncertainty Estimation for Semantic Segmentation Challenge, 2023, Top-7 among 74 teams [Link]
→ Received PhD grants for the National PhD program in AI & Industry 4.0 from ST microelectronics.

Academic Service:
Talks and Tutorial:
→ Tutorials on GANs at CV/ML Summer School, 2019, IIIT-H.
→ Talk on Unmasking Anomalies in Road-Scene Segmentation at Scania.
→ Presented *Uncertainty Calibrated Mask2Former* at UNCV Workshop.
→ DISI Seminar on Unmasking Anomalies in Road-Scene Segmentation at the University of Trento [Link].

Organizing Committee:
→ Organized Rider Intend Prediction challenge at ICPR 2024 [Link].
→ Summer School on Computer Vision and Machine Learning 2018, 2019, IIIT Hyderabad.

Reviewer: *CVPR:* 2024, *ECCV:* 2024, *ICRA:* 2025, *IROS:* 2024, *PRL:* 2025, *BMVC:* 2020/2021, *WACV:* 2021.
Teaching Assistance: Deep Learning'20, Machine learning and Deep learning'23, Advance Machine Learning'24.

Mentoring

IIIT-H: Deepak Kumar Singh (MS), Abdul Wasi (Research Assistant).
Politecnico di Torino: Gianluca Guzzetta (MS), Nicholas Berado†(MS), Alessandro† (PhD).
† - In progress.

ML Framework

Deep Learning: PyTorch, Keras and Matconvnet
Small Experiments: OpenCV, SciPy, and Scikit-Learn
Languages: Python, MATLAB, and Lua
Development: Qt