Jishnu Mukhoti

DPhil(PhD) Candidate in Torr Vision Group & OATML, University of Oxford
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Research Interests & Experience

1. Uncertainty quantification, calibration and robustness of neural networks with applications in computer vision
2. Multi-modal foundation models

Education

University of Oxford **Oct. 2019 - Present**
DPhil(PhD) in Engineering Science (Focusing on Machine Learning) *Oxford, UK*
- Supervised by Prof. Philip Torr in Torr Vision Group (TVG) and Prof. Yarin Gal in Oxford Applied & Theoretical Machine Learning (OATML) Group.
- Fully funded by a Research Studentship from the Department of Engineering Science, University of Oxford.

University of Oxford **Oct. 2017 - Sept. 2018**
MSc in Computer Science (Focusing on Machine Learning) *Oxford, UK*
- Supervised by Prof. Yarin Gal in Oxford Applied & Theoretical Machine Learning (OATML) Group.
- Graduated with distinction.

Jadavpur University **June 2012 - May 2016**
BE (Bachelor of Engineering) in Computer Science & Engineering *Oxford, UK*
- University Topper & Gold Medalist, First Class with Honours

Featured Research Projects

Robust Open-World Computer Vision with Multi-modal Foundation Models (Ongoing)
Meta AI (FAIR) & Torr Vision Group *New York City, USA*
- Designed a compatibility function for contrastive loss to achieve token level alignment between multi-modal encoders.
- Models trained using the new loss are able to transfer in a zero-shot manner to different computer vision tasks including image classification, semantic and reference segmentation in an open-vocabulary setting without requiring any segmentation annotations.
- Our models also show higher robustness to spurious correlations in the training set, resulting in higher robustness to distribution shift.
- A paper on this is currently in progress.

Raising the Bar on OoD Evaluation
Meta AI (FAIR) & Torr Vision Group *Oxford, UK*
- Defined different types of OoD using the concepts of semantic and perceptual similarity to in-distribution samples.
- Developed a method of generating the different types of OoD from the training distribution using a GAN based generative model.
- The generated OoD provide a significantly stronger benchmark compared to conventional OoD evaluation benchmarks.
- Paper: **Raising the Bar on the Evaluation of OoD Detection** (in submission)

Deep Deterministic Uncertainty (DDU)
OATML & Torr Vision Group *Oxford, UK*
- Developed a way of quantifying epistemic and aleatoric uncertainty reliably from deterministic models.
- DDU beats state-of-the-art deep ensembles in OoD detection with a single deterministic model.
- Paper: **Deterministic Neural Networks with Inductive Biases Capture Epistemic and Aleatoric Uncertainty** (arxiv:2102.11582)
- Code: `github.com/omegafragger/DDU`

Focal Calibration
Oxford Research Group, FiveAI & Torr Vision Group *Oxford, UK*
- Analysed NLL overfitting as the primary cause of miscalibration in deep neural networks.
- Studied properties of an alternative loss function, focal loss, which can be used to train well-calibrated neural networks as compared to the cross-entropy objective.
- Paper: **Calibrating Deep Neural Networks using Focal Loss** (`arxiv:2002.09437`), published in NeurIPS, 2020.
- Paper: **On using Focal Loss for Neural Network Calibration**, received spotlight in ICML 2020, UDL Workshop.
- Code: `github.com/torrvision/focal_calibration`
- Blog: `torrvision.com/focal_calibration`

Publications

1. Jishnu Mukhoti, Tsung-Yu Lin, Borchun Chen, Ashish Shah, Philip Torr, Puneet Dokania, Ser-Nam Lim, *Raising the Bar on the Evaluation of OoD Detection*, arXiv:2209.11960.

1. Jishnu Mukhoti*, Andreas Kirsch*, Joost van Amersfoort, Philip Torr, Yarin Gal, *Deterministic Neural Networks with Appropriate Inductive Biases Capture Epistemic and Aleatoric Uncertainty*, arXiv:2102.11582.

2. Jishnu Mukhoti*, Viveka Kulharia*, Amartya Sanyal, Stuart Golodetz, Philip Torr, Puneet Dokania, *Calibrating Deep Neural Networks using Focal Loss*, in Advances in Neural Information Processing Systems (NeurIPS), 2020.

3. Jishnu Mukhoti, Joost van Amersfoort, Philip Torr, Yarin Gal, *Deep Deterministic Uncertainty for Semantic Segmentation*, ICML 2021 Workshop on Uncertainty & Robustness in Deep Learning (UDL).

4. Andreas Kirsch, **Jishnu Mukhoti**, Joost van Amersfoort, Philip Torr, Yarin Gal, *On Pitfalls in OoD Detection: Entropy Considered Harmful*, ICML 2021 Workshop on Uncertainty & Robustness in Deep Learning (UDL).

5. Jishnu Mukhoti*, Viveka Kulharia*, Amartya Sanyal, Stuart Golodetz, Philip Torr, Puneet Dokania, *On using Focal Loss for Neural Network Calibration*, in ICML 2020 Workshop on Uncertainty & Robustness in Deep Learning (UDL).

6. Jishnu Mukhoti, Yarin Gal, *Evaluating Bayesian Deep Learning Methods for Semantic Segmentation*, arXiv:1811.12709.

7. Jishnu Mukhoti, Pontus Stenetorp, Yarin Gal, *On the Importance of Strong Baselines in Bayesian Deep Learning*, in NeurIPS 2018 Workshop on Bayesian Deep Learning.

8. Jishnu Mukhoti, Puneet Dokania, Philip Torr, Yarin Gal, *On Batch Normalisation for Approximate Bayesian Inference* in the 3rd Symposium on Advances in Approximate Bayesian Inference, 2021.

9. Diptendu Bhattacharya, **Jishnu Mukhoti**, Amit Konar, *Learning Regularity in an Economic Time-Series for Structure Prediction*, in Elsevier, Applied Soft Computing, 2019.

10. Jishnu Mukhoti, Pratyusha Rakshit, Diptendu Bhattacharya, Amit Konar, Atulya Nagar, *Knowledge Extraction from a Time-Series using Segmentation, Fuzzy Matching and Predictor Graphs*, in IEEE Conference on Fuzzy Systems (FUZZ-IEEE), 2016.

11. Jishnu Mukhoti, Sukanya Dutta, Ram Sarkar, *Handwritten Digit Classification in Bangla and Hindi using Deep Learning*, in Taylor & Francis, Applied Artificial Intelligence, 2020.

Industrial Experience

Meta AI Research **Jun 2022 - Sept 2022**

Research Scientist Intern *New York City, USA*

- Designed a compatibility function for contrastive loss to achieve token level alignment between pre-trained image and text encoders with the transformer architecture.
- The resulting models are able to transfer in a zero-shot setting to different computer vision tasks and are also more robust to spurious correlations in image classification training sets, thereby being robust to distribution shift.

Meta AI Research **Jun 2021 - Sept 2021**

Research Scientist Intern *Remote*

- Designed a generative model to learn different types of OoD from a given training set.
- The proposed models were used to generate significantly stronger reliable benchmarks for evaluating OoD detection compared to current benchmarks like ImageNet-C/A/R etc for shift and ImageNet-O for OoD detection.

FiveAI **Aug 2018 - Aug 2019**

Research Scientist Intern *Oxford, UK*

- Worked on methods for getting reliable and calibrated uncertainty estimates from deep neural networks used in computer vision problems relevant to autonomous driving, like semantic segmentation, instance segmentation, object detection and image classification.

Amazon **June 2016 - Aug 2017**

Software Development Engineer (SDE) *Hyderabad, India*

- Designed and implemented a method to support real-time data transfer from OLTP datastores (AWS RDS and DynamoDB) to OLAP datastores (AWS Redshift and Elasticsearch).
- Designed and implemented a layered architecture for web based services which allows individual layers (like the API layer, datastore access layer etc.) to seamlessly interact with each other independently.

Amazon **May 2015 - July 2015**

Software Development Engineer (SDE) Intern *Hyderabad, India*

- Designed and implemented a validation engine to automate the workflow of validating critical fields in database records.
- Reduced the validation time of approximately 2000 records per week from around week to less than 10 seconds.

Honors & Awards

Scholarships

- **Oxford Fully Funded Research Studentship (FiveAI)**, supports my ongoing DPhil (PhD) by fully covering my tuition and living expenses.
- **Goa Education Trust Scholarship, British Council**, covered the tuition feed for my MSc in Computer Science in the University of Oxford.
- **INSPIRE Scholarship**, awarded to the top 1% of the students in the 12th standard Board Examinations (Indian School Certificate Examinations).

Awards

- **Amazon Excellence Award (Deep-Dive, Learn & Be Curious, Ownership)**, awarded for independently designing and implementing a method for near real-time incremental data transfer from primary databases to a data warehouse.
- **University Gold Medal**, awarded for securing the highest CGPA in Jadavpur University for the batch 2012-2016.
- **University Best Project Award**, awarded a prize of 15,000 INR for best research project and bachelor's thesis in the Department of Computer Science and Engineering for the session 2012-2016.
- **Indu Bhusan Putatunda and Shanti Sudha Putatunda Memorial Award**, awarded by the Alumni Association of Jadavpur University for securing the highest CGPA in the Department of Computer Science and Engineering in the second year.

Conferences & Talks

- **Talk at Waymo**, *Deep Deterministic Uncertainty*, 2021
- **Spotlight Talk**, *On using Focal Loss for Neural Network Calibration*, ICML 2020 Workshop on Uncertainty and Robustness in Deep Learning (UDL): `https://slideslive.com/38930949/on-using-focal-loss-for-neural-network-calibration`.
- **Top Reviewer** for ICML 2020