Jishnu **Mukhoti**

DPhil(PhD) Candidate in Torr Vision Group and OATML, University of Oxford
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Research Interest

Deep Learning Uncertainty Quantification and Calibration of Neural Networks, OOD Detection and Generalisation, Bayesian Deep Learning, Variational Inference, Computer Vision, Natural Language Processing

Education

University of Oxford — *Oxford, United Kingdom*

DPhil(PhD) in Engineering Science (focusing on Machine Learning) — *Oct. 2019 - Present*

- Supervised by Prof. Philip Torr in Torr Vision Group (TVG) and Prof. Yarin Gal in Oxford Applied and Theoretical Machine Learning (OATML) Group.
- Supported by a fully funded Research Studentship from the Department of Engineering Science, University of Oxford.

University of Oxford — *Oxford, United Kingdom*

MSc in Computer Science (focusing on Machine Learning) — *Oct. 2017 - Sept. 2018*

- Supervised by Prof. Yarin Gal in Oxford Applied and Theoretical Machine Learning (OATML) Group.
- Graduated with distinction.

Jadavpur University — *Kolkata, India*

BE (Bachelor of Engineering) in Computer Science and Engineering — *June 2012 - May 2016*

- University Topper and Gold Medalist, First Class with Honours

Featured Research Projects

Calibration of Neural Networks using Focal Loss — *Oxford, United Kingdom*

Oxford Research Group, FiveAI and Torr Vision Group

- Studied and 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** (`https://arxiv.org/abs/2002.09437`), accepted in NeurIPS, 2020.
- Workshop Paper: **On using Focal Loss for Neural Network Calibration**, received spotlight in ICML UDL 2020 workshop.
- Code: `https://github.com/torrvision/focal_calibration`
- Blog: `https://torrvision.github.io/focal_calibration`

Benchmarks for Bayesian Deep Learning in Semantic Segmentation — *Oxford, United Kingdom*

Oxford Applied and Theoretical Machine Learning Group (OATML)

- Developed evaluation metrics for measuring quality of uncertainty estimates from deep learning models in semantic segmentation.
- Modified the DeepLab-v3+ architecture to perform approximate inference and produce pixel-wise labels and uncertainty estimates.
- Evaluated the resulting models using the above-mentioned metrics to create new benchmarks against which other models can be compared.
- Paper: **Evaluating Bayesian Deep Learning Methods for Semantic Segmentation** (`https://arxiv.org/abs/1811.12709`)
- MSc thesis: **Benchmarks for Bayesian Deep Learning: Image Segmentation**
- Code: `https://github.com/yaringal/BDL_benchmarks`

Strong Baselines in Bayesian Deep Learning — *Oxford, United Kingdom*

Oxford Applied and Theoretical Machine Learning Group (OATML)

- Re-evaluated MC dropout as an approximate inference technique using the well-known UCI regression experiments.
- The experimental setup included training the models to convergence and using network ensembles which produced significantly stronger baselines for MC Dropout uncertainty on UCI regression.
- Paper: **On the Importance of Strong Baselines in Bayesian Deep Learning** (`https://arxiv.org/abs/1811.09385`) published in NeurIPS, 2018, Bayesian Deep Learning workshop.
- Code: `https://github.com/yaringal/DropoutUncertaintyExps`

Unsupervised Detection of Recurrent Patterns in a Time-Series

Kolkata, India

AI Lab, Jadavpur University

- Designed and implemented unsupervised, non-parametric algorithms for detecting repetitive patterns in a time-series as well as modeling the series for prediction.
- Journal Paper: **Learning Regularity in an Economic Time-series for Structure Prediction**, published in Elsevier, Applied Soft Computing (`https://www.sciencedirect.com/science/article/pii/S1568494618306859`).
- Conference paper: **Knowledge Extraction from a Time Series using Segmentation, Fuzzy Matching and Predictor Graphs**, published in FUZZ-IEEE, 2016 (`https://ieeexplore.ieee.org/abstract/document/7737825`).
- Code: `https://github.com/omegafragger/Time_Series_Structure_Detection`

Handwritten Digit Recognition

Kolkata, India

AI Lab, Jadavpur University

- Studied deep convolutional network architectures for recognising handwritten numerals in Bengali and Hindi.
- Also studied mechanisms of achieving high rotational invariance on these networks.
- Journal Paper: **Handwritten Digit Classification in Bangla and Hindi Using Deep Learning**, published in Taylor and Francis, Applied Artificial Intelligence (`https://www.tandfonline.com/doi/abs/10.1080/08839514.2020.1804228`).

Publications

Calibration 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.

Calibration 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 and Robustness in Deep Learning. (**Spotlight talk**)

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

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

Relocalisation Tommaso Cavallari*, Luca Bertinetto, Jishnu Mukhoti, Philip Torr, Stuart Golodetz*, *Let's Take This Online: Adapting Scene Coordinate Regression Network Predictions for Online RGB-D Camera Relocalisation*, in International Conference on 3D Vision (3DV), 2019.

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

Time-Series 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.

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

Industrial Experience

Oxford Research Group, FiveAI

Oxford, United Kingdom

Research Intern

Aug. 2018 - Aug. 2019

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

Amazon Development Centre

Hyderabad, India

Software Development Engineer (SDE)

June 2016 - Aug. 2017

- 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 Development Centre *Hyderabad, India*

Software Development Engineer (SDE) Intern *May 2015 - July 2015*

- Designed and implemented a validation engine to automate the workflow of validating critical fields in database records.
- Previously, the said validation was performed manually. The project reduced the duration of validating a batch of records (approximately 2000 records) from a week to less than 10 seconds.

Honors & Awards

Conferences

2020 **Spotlight Talk**, ICML 2020, Workshop on Uncertainty and Robustness in Deep Learning (UDL), `https://slideslive.com/38930949/on-using-focal-loss-for-neural-network-calibration` *Virtual*

2020 **Top Reviewer**, ICML 2020.

Scholarships

2019 **Oxford Fully Funded Research Studentship (Streetwise Project)**, supports my ongoing DPhil (PhD) by fully covering my tuition and living expenses *Oxford, UK*

2017 **Goa Education Trust Scholarship, British Council**, covered the tuition fees for my MSc in Computer Science. *Oxford, UK*

2012 **University Best Project Award**, awarded a prize of 15,000₹ for the best research project and bachelor's thesis in the Department of Computer Science and Engineering in Jadavpur University for the session 2012-2016. *Kolkata, India*

2012 **INSPIRE Scholarship**, awarded to the top 1% of the students in the 12th standard Board Examinations (Indian School Certificate Examinations). *Kolkata, India*

Others

2017 **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. *Hyderabad, India*

2016 **University Gold Medal**, awarded for securing the highest CGPA in the Department of Computer Science and Engineering of Jadavpur University for the session 2012-2016. *Kolkata, India*

2013 **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. *Kolkata, India*

Coding Toolbox

Java `https://github.com/omegafragger/IntelligentSystemsPracticals`

Python `https://github.com/omegafragger/DropoutUncertaintyExps/tree/Simple`

Matlab `https://github.com/omegafragger/Time_Series_Structure_Detection`

Others `C, C++, Shell, SQL`