

# Abhranil Chandra

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## EDUCATION

**Research Masters (Thesis), University of Waterloo** Ontario, Canada  
*Major: Computer Science | 100% Graduate Funding + MITACS Graduate Fellowship* *Sept'23 - June'25 (expected)*

**BTech, Indian Institute of Technology, Kharagpur** Kharagpur, India  
*Major: Mechanical Eng. | Minor: Maths and Computing | Micro-Spl: AI | GPA: 8.52/10 (3.61/4)* *Jul'19 - May'23*

## RESEARCH INTERESTS

Deep Reinforcement Learning, Probabilistic ML (Graphical and Generative Models); Deep Representation Learning; Foundational Models (LLMs and Multimodal Models)

## PUBLICATIONS & PREPRINTS

### CABACE: Character-Aware BERT for ACronym Extraction

*SDU Workshop at AAAI 2022 (Oral Presentation and Best Paper nomination)*

### Leveraging recent advances in Pre-Trained Language Models for Eye-Tracking Prediction

*CMCL Workshop at NAACL 2021*

### Improving Question Answering with Generation of NQ-like Questions

*Preprint- Submitted in MRQA Workshop, EMNLP 2021*

### You Make me Feel like a Natural Question: Training QA Systems on Transformed Trivia Questions

*Full Paper, under review at EMNLP 2023*

## RESEARCH EXPERIENCES AND INTERNSHIPS

**Efficient & Generalizable RL Agents and Offline RL** Sept 2021–pres  
*IRL Lab, University of Alberta, Canada | [Code Link](#)* *Advisor: Prof. Matthew Taylor & Manan Tomar*

- Improved sample efficiency and generalization using pre-trained policies through transfer learning on similar MDPs
- Showed efficacy on State Value (DQN), Policy Gradient (REINFORCE), and Actor-Critic (DDPG) based RL algorithms on OpenAI Gym environments with various parameter variations to check for policy generalization
- Working on reward learning for non-stationary procedurally generated environments using Inverse RL algorithms from sub-optimal demonstrations and generalization of offline RL using transformers for sequential decision making

**Retrieval Augmented Generation using Large Language Models (LLMs)** May 2023–Aug 2023  
*Thought Labs Pvt. Ltd.*

- Working with open-sourced LLM models like Llama, MPT, and Falcon to finetune these models on extremely long context documents, particularly of the legal, financial, and biotechnology domains
- Developed an end-to-end pipeline for users to pre-process data, load appropriate models, finetune them easily
- Developed the vector-embedding search module for contextual information extraction to reduce hallucination
- Developing a chat model by finetuning the base models on open sourced legal case data from Indian Supreme Court. Models will be open-sourced and hosted on HuggingFace Model Hub with Apache 2.0 license

**Continual Domain Generalization (CLDG)** May 2022–Aug 2022  
*MITACS GRI, Vector Institute & Western University, Canada* *Advisor: Prof. Boyu Wang*

- Designed experiments to model real-life CLDG learning settings to evaluate the efficacy of existing standard DG and CL algorithms like CORAL, GroupDRO, ProgNN on this novel setup and create the baselines to overcome.
- Developed a novel state-of-the-art CLDG algorithm from scratch to handle both the domain shift and out-of-distribution problem of DG and catastrophic forgetting problem on sequentially arriving data in CL.
- Used a Gaussian Mixture Model (GMM) to update and consolidate the joint internal distribution of classes that are formed in the embedding space, making it tolerant to domain shifts. Further used samples drawn from this GMM in a buffer-based replay mechanism with an exponential moving average knowledge distillation method to handle the catastrophic forgetting problem. Submitting the work in upcoming ML conferences, code will soon be released.

**Synthetic Generation of Natural Questions: QB to NQ** May 2021–June 2022  
*CLIP Lab, University of Maryland, USA | [Pre-print](#) | Under Review EMNLP'23* *Advisor: Prof. Jordan Boyd-Graber*

- Used larger and better quality data to improve open domain RAG and closed domain BERT QA systems
- Developed a heuristic algorithm (parse-tree, coreference-resolution, linguistic features) to convert long trivia to short questions with a quality classifier filter and answer disambiguation algorithm to remove duplicates
- Devised a cosine similarity-based pipeline to extract the most relevant context for the closed domain system from the wiki page, leading to improved EM scores and eliminating the need for large and costly annotated datasets

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## RESEARCH AND APPLICATION PROJECTS

### Improving Computer Vision using BayesianNNs

Dec 2021–May 2023

*Bachelor's Thesis, IIT Kharagpur | Thesis Report | 10/10 Grade*

*Advisor: Prof.Pabitra Mitra*

- Did extensive literature review of PGMs for uncertainty estimation and explainability in Bayesian Neural Nets
- Incorporated predictive uncertainty, epistemic uncertainty (from model weights), and aleatoric uncertainty (inherent in input) in object detection and segmentation models to create better visual understanding models.
- Used Bayes by Backprop to develop an uncertainty-aware efficient CNN architecture (BayesianCNN) for classification and explainable calibration on safety-critical road accident dataset with very limited data.
- Created a novel Bayesian-UNet model with an augmented loss function using Monte Carlo Dropout as a Bayesian inference scheme for segmentation on C.Elegans biomedical dataset with uncertainty maps for explainability
- Trying to extend uncertainty analysis to RL settings for uncertainty-guided exploration and OOD generalization

### DevRev's Domain Specific Question Answering (QA) Challenge

Dec 2022–Feb 2023

*Gold Medal | Inter IIT Tech Meet 11.0 | PS | Report | Github*

*Independent Research Engineering Work*

- Developed a chatbot for Closed Domain Question Answering based on the Stanford Question Answering Dataset, performed augmentation using T5, BART, GPT-3 models and Back-Translation, synonym replacement techniques
- Implemented sentence/para level variations of FAISS DPR & DrQA retrievers for retrieving contexts for a question, deployed ensemble of multiple noisy-tuned LLM's with a contrastive loss for predicting answer's start, end tokens
- Employed FedAvg algorithm on semantically similar themes clustered using k-means, LSA for Domain Adaptation
- Used Reptile meta-learning, Incremental Replay Mechanism to handle Domain Adaptation and OOD shift
- Achieved 0.85 F1 using Electra-BERT ensemble with 2.65x improved runtime using caching, ONNX, quantization

### CABACE: Acronym Disambiguation (Workshop Best Paper Finalist)

Sept 2021–Dec 2021

*Workshop on Scientific Document Understanding- AAAI 2022*

*Independent Research Work*

- Developed CABACE: Character-Aware BERT for ACronym Extraction, for finding acronyms and full forms.
- Pretrained transformer based language models on scientific and legal texts from Wikipedia, Arxiv etc. to mitigate Out of Vocabulary problem of standard language models since acronyms rarely occur in normal text corpora.
- Leveraged data augmentation using pseudo-labeling and adversarial-training to mitigate low dataset size problem.
- Finetuned this pretrained mBERT model using augmented loss function with additional max and mask loss terms to account for character sequences in addition to cross entropy loss thereby surpassing existing baselines and also showing efficacy on zero-shot generalization to non-English languages. See code and paper in [github link](#).

### Other Projects

2019–2023

*Short Research Collaborations, Independent Research, Course Projects, and Term Papers*

- Robust visual embeddings using CLIP on a custom generated illusion dataset [Mentor: Sumedh Sontakke, USC]
- Adversarial attack on sparse images (sketch & signature) [Mentor: Ayan Kumar Bhunia, University of Surrey]
- DL to detect heart diseases from stethoscope audio [Mentor: Prof.Abdulhamit Subasi, University of Turku]
- Term Paper: Approximate Bayesian inference|Air Quality Detection using DL|Robot arm manipulation using RL
- Segmentation of Satellite Images for Agent-Based Disease Modelling [Mentor: Prof.Adway Mitra, IIT Kgp]
- GANs from Scratch | RL for Atari games | Image Processing Workshop ([certification](#) and [code](#))

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## TECHNICAL SKILLS

**Languages:** Python, C++/C, LaTeX | **Libraries:** PyTorch, HuggingFace, TensorFlow, Keras, Sklearn, Stable-Baselines, RLLib, OpenAI Gym | **Tools & OS:** Git, Sublime, VS Code, PyCharm, Linux(Ubuntu)

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## POSITIONS OF RESPONSIBILITY & VOLUNTEER EXPERIENCE

Reviewer AAAI-2022;EMNLP'22,23 | Senior Member, Kharagpur Data Analytics Group | National Service Scheme(NSS) Volunteer | Member University of Maryland's Multi-Agent RL Reading Group | Research Week with Google 2023-Theoretical ML Track (One among 250 selected BS, MS, PhD students)