Kabir **Ahuja**

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Education

May 2019 **Aug 2015**	**Birla Institute of Technology and Science (BITS) Pilani** B.E. (Hons.), Chemical Engineering Department Rank: 1 Thesis Title: Learning To Optimize Molecular Geometries Using Reinforcement Learning	**Pilani, India**

Experience

Present **Aug 2021**	**Microsoft Research** *Research Fellow* [ ] *| Advisors: Dr. Sunayana Sitaram , Dr. Monojit Choudhury, Dr. Navin Goyal* Working on building linguistically fair Multilingual Models covering different aspects around their performance, calibration, evaluation, interpretation and data collection. Also working on analyzing the properties of Self Attention in Transformers and the types of functions that can be expressed and learned by these networks.	**Bangalore, India**
Aug 2021 **July 2020**	**Udaan.com** *Data Scientist	Mentor: Dr. Mohit Kumar* Worked on implementing and deploying Recommendation Systems to solve numerous use cases across various verticals of the company.	**Bangalore, India**
July 2020 **Jan 2020**	**Microsoft Research** *Research Intern	Advisor: Dr. Navin Goyal* Worked on on analyzing and contrasting the learning capabilities of Recurrent Neural Networks and Transformers in recognizing Context Free Languages in finite precision.	**Bangalore, India**
Dec 2019 **June 2019**	**Indian Institute of Science	MALL Lab** [ ] *Research Assistant	Advisor: Dr. Partha Talukdar* Worked on controlled text generation for generating paraphrases of sentences while following a specified syntactic structure provided in form of an exemplar sentence.	**Bangalore, India**
Dec 2018 **Aug 2018**	**Massachusetts Institute of Technology	Green Research Group** [ ] *Visting Student Researcher	Advisors: Prof. William H. Green, Prof. Yi-Pei Li* Worked on devising Reinforcement Learning based methods for Molecular Geometry Optimization for efficiently finding the local minima of non-convex energy surfaces.	**Cambridge, MA, USA**

Publications

S=In Submission, C=Conference, W=Workshop, J=Journal

[S.1] **On Calibration of Massively Multilingual Language Models**
Kabir Ahuja, Sunayana Sitaram, Sandipan Dandapat, Monojit Choudhury
[Under Review]

[C.4] **On the Economics of Multilingual Few-shot Learning: Modeling the Cost-Performance Trade-offs of Machine Translated and Manual Data** [ ][code]
Kabir Ahuja, Monojit Choudhury, Sandipan Dandapat
2022 Annual Conference of the North American Chapter of the Association for Computational Linguistics   **[NAACL'22]**

[C.3] **Multi Task Learning For Zero Shot Performance Prediction of Multilingual Models** [ ]
Kabir Ahuja*, Shanu Kumar*, Sandipan Dandapat, Monojit Choudhury
60th Annual Meeting of the Association for Computational Linguistics, Dublin, Ireland   **[ACL'22]**

[C.2] **On the Practical Ability of Recurrent Neural Networks to Recognize Hierarchical Languages** [ ][code]
Satwik Bhattamishra, Kabir Ahuja, Navin Goyal
28th International Conference on Computational Linguistics **[Best Short Paper Award]**   **[COLING'20]**

[C.1] **On the Ability and Limitations of Transformers to Recognize Formal Languages** [ ][code]
Satwik Bhattamishra, Kabir Ahuja, Navin Goyal
2020 Conference on Empirical Methods in Natural Language Processing   **[EMNLP'20]**

[J.2] **Learning to Optimize Molecular Geometries Using Reinforcement Learning** [✎]
<u>Kabir Ahuja</u>, William H. Green, Yi-Pei Li
Journal of Chemical Theory and Computation [**JCTC**]

[J.1] **Syntax-Guided Controlled Generation of Paraphrases** [✎][code]
Ashutosh Kumar, <u>Kabir Ahuja</u>, Raghuram Vadapalli, Partha Talukdar
Transactions of the Association for Computational Linguistics [**TACL**]

[W.1] **Beyond Static models and test sets: Benchmarking the potential of pre-trained models across tasks and languages** [✎]
<u>Kabir Ahuja</u>, Sandipan Dandapat, Sunayana Sitaram, Monojit Choudhury
NLP Power! The First Workshop on Efficient Benchmarking in NLP, ACL, Dublin [**NLPPower@ACL'22**]

Select Research Projects

Performance and Cost Trade-Offs of Machine Translated and Manual Data Oct'21 - Feb'22
Advisors: Dr. Monojit Choudhury, Dr. Sandipan Dandapat

› Adapted the Production Function theory from microeconomics to introduce Performance Functions that were used to measure the cost and performance trade-offs of using Machine Translated vs Manually Annotated data for fine-tuning Multilingual Models.

› Through a case study on TyDiQA benchmark we demonstrated that manual data is both more sample efficient for fine-tuning compared to translated data as well as essential to reach higher levels of performance.

› Also showed that Translated data can be helpful in low resource settings where there is less amount of data in any language to begin with and can act as a form of Data Augmentation.

› Accepted as a long paper at NAACL 2022.

Predicting Performance of Multilingual Models Across Languages Aug'22 - Present
Advisors: Dr. Monojit Choudhury, Dr. Sandipan Dandapat

› Formulated Multi-Task regression approaches to predict Zero-Shot performance of Multilingual models across different languages without explicitly evaluating them on test data, using model-specific, linguistic and tokenizer features.

› Demonstrated that our proposed approach out-performed existing single-task and averaging baselines significantly for low-resource tasks and languages.

› Interpreted the factors influencing zero-shot performance by analyzing the SHAP values of the regression models and demonstrated importance of Tokenizer Quality for tasks involving token-level predictions.

› Accepted as a long paper at ACL 2022. Coverage/Mentions - ruder.io/acl2022

› Currently working on improving confidence calibration of Multilingual models across languages for estimating their performance from unlabelled data.

Analysis of Neural Sequence Models on Formal Languages Jan'20 - July'20
Advisor: Dr. Navin Goyal

› Worked on analyzing and contrasting the learning capabilities of Recurrent Neural Networks and Transformers in recognizing Formal Languages in finite precision.

› Showed that encoder only Transformers can learn to recognize certain counter languages but are limited in their capabilities to recognize regular languages.

› Investigated the extent of generalization exhibited by these models in acquiring the underlying rules of a formal language and how it is impacted by architectural choices in a model like depth, number of attention heads, the type of Positional Encodings used etc. This work got accepted at EMNLP'20

› Also showed theoretically and empirically that RNNs can recognize context-free languages with bounded depth.

› Developed probing tasks to interpret the intermediate representations and validate the findings. This work was accepted at COLING'20.

Syntax Controlled Paraphrase Generation June'19 - Dec'19
Advisor: Dr. Partha Talukdar

- Worked on developing a sequence to sequence model for **Syntactically Controlled Paraphrase Generation** composed of Bidirectional LSTMs, Tree LSTM and Pointer Generator Networks.
- Incorporated the desired syntax using Constituency Parse Trees and implemented a gated mechanism to selectively choose leaf node representations while decoding.
- Trained on Quora Question Pairs (QQP) and ParaNMT datasets, our proposed model outperformed existing methods by a significant margin on metrics like BLEU, ROUGE, METEOR and Tree-Edit Distance as well as in Human Evaluation.
- Published in TACL (Volume 8, 2020)

Reinforcement Learning for Molecular Geometry Optimization Aug'18 - Dec'18
Advisors: Advisors: Prof. William H. Green,Prof. Yi-Pei Li

- Designed a Reinforcement Learning based approach to find the local minima of Potential Energy Surfaces of different molecules while minimizing the number of optimization steps.
- Utilized Self Attention to handle variable size state and action spaces while implementing Policy and Value Networks and trained them using Proximal Policy Optimization.
- Achieved better performance (30% fewer steps on average) than the state of the art optimization schemes for geometry optimization like BFGS, L-BFGS, FIRE etc, on both in-domain and out of domain optimization environments.
- Published in Journal of Chemical Theory and Computation (2021)

Honours and Awards

Best Short Paper Award in COLING, 2020 [🌐]   For our paper: On the Practical Ability of Recurrent Neural Networks to Recognize Hierarchical Languages

BITS Merit Cum Need Scholarship, 2015-2019   Recipient of university's Scholarship awarded to top 2% students of a batch.

Flipkart Grid Challenge [🌐]   Appeared among top 10 finalists in the Flipkart Grid Challange 2019 originally participated by 6000 teams.

Teaching and Volunteering Roles

SNLP Reading Group, MSR India *Organizer* Jun'22 - Present
- Organize weekly meet-ups discussing recent papers and trends in Natural Language Processing as well arrange invited talks in the related areas.

Natural Language Processing, Plaksha University *Teaching Assistant* Jan'22 - Apr'22
- Designed Assignments covering different topics in NLP from Bag Of Word Models to Massively Multilingual Language Models.
- Mentored students for their course projects.

Neural Networks and Fuzzy Logic, BITS Pilani *Teaching Assistant* Jan'19 - May'19
- Helped the course be more hands-on by introducing programming assignments for the course encompassing topics like K-nearest neighbours, Logistic Regression and Deep Autoencoders.
- Hosted a Kaggle competition where students were asked to implement a Recommendation System using Deep Auto-Encoders.
- Conducted workshops on Python programming, Neural Networks in practice and Deep Learning frameworks to provide a practical flavour to the concepts taught in class.

National Service Scheme, BITS Pilani *School Volunteer and Class Head* Aug'15 - May'17
- Taught under-privileged students high-school level Physics, Chemistry and Mathematics.
- Prepared assignments and conducted tests to prepare them for High-School and College Entrance Exams.

Academic Service

Workshop Organizer   SumEval Workshop at AACL'22
Peer Reviewer   NAACL'22, ACL'22