

Rishabh Agarwal

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Final Year Undergraduate

Education

- 2014-Present **Indian Institute of Technology Bombay**,
B.Tech (Honours) in Computer Science and Engineering
Minor in Applied Statistics and Informatics,
CGPA: 9.66/10 after 6 semesters.
- 2012-2014 **Higher Secondary Examination**, *Aishly Public School*, Haryana,
96.6%.

Scholastic Achievements

- 2017 **Ranked 6th** out of 96 students in the CSE Department at IIT Bombay
- 2014-2017 Awarded AP grade for excellent performance(top 1% of class) in **Foundations of Machine Learning** (ranked 2/287 students), Psychology, Biology and Numerical Analysis
- 2015 Ranked 43 (Honorable Mention) in the ACM ICPC Programming Contest Regionals
- 2014 Secured **All India Rank 33** in JEE Advanced taken by over 1.3 million students
- 2014 Secured 99.99 percentile in JEE Mains amongst 14 million candidates
- 2014 Amongst the top 300 students selected from the country to qualify for Indian National Physics Olympiad and Indian National Astronomy Olympiad

Research Experience

- Ongoing **Genetic Algorithms for Scrabble**, *Bachelor's Thesis*.
Guided by: *Prof. Shivaram Kalyankrishnan, IIT Bombay*
The current state-of-the-art Scrabble agents are not learning-based but depend on the time-consuming Monte Carlo simulations and the quality of such agents is contingent upon the time available for running the simulations. This work involves developing a learning-based Scrabble agent using lots of Scrabble vs Scrabble games and bootstrapping genetic algorithms. Specifically, we are applying the CMA-ES algorithm to learn favorable weights for various hand-crafted features used in the static evaluation function used for predicting goodness of a move during the game play. The learned agent is being tested against the Quackle championship player, one of the top open-source Scrabble agents currently.
- Ongoing **Siamese Networks for Transductive Transfer**, *R&D Project*.
Guided by: *Prof. Amit Sethi, IIT Bombay*
Deep learning frameworks such as Convolutional Neural Networks (CNNs) take a lot of samples to train, even if the lower layers are transferred from a pretrained CNN. In this work, we propose that the ability to compare a pair of images for similarity should also be considered for such transfer learning. We are developing a Siamese network based CNN architecture which compares pairs of images for similarity; the output of the network can be transformed into a Mercer kernel to allow utilization of wide margin classification properties of a SVM that is useful when the amount of training data is scarce.
- Spring 2017 **Adapting Deep Learning Models**, *Seminar*, [\[report\]](#).
Guided by: *Prof. Sunita Sarawagi, IIT Bombay*
Learning quickly is a hallmark of human intelligence, however, one of the current limitations of deep learning is the need for tremendous amounts of data. Finding techniques to achieve state-of-the-art performance on tasks with orders of magnitude less data is a very active research area. In this work, we surveyed some of the recent approaches including "Meta learning", "Transfer learning" and "Learning to learn" to tackle this problem of learning new concepts rapidly with very little data.

Spring 2017 **Word, Entity & Knowledge Graph Embeddings**, *R&D Project*, [\[report\]](#).

Guided by: *Prof. Soumen Chakraborty, IIT Bombay*

Recently, word embeddings have been exceptionally successful in many NLP tasks. This work explored various new ideas such as contextdependent embeddings, conceptual subspaces for entity embeddings, and compositional vector space models for enhancing knowledge graph embeddings in order to use those embeddings for downstream NLP tasks. For example, we can't ignore polysemy and thus a word should have multiple embeddings depending on it's meaning which is precisely handled by contextual embeddings.

Internships

Summer 2017 **Modelling Dependencies between Order Books.**

Trading Team, Tower Research Capital, Gurgaon

In this work, we dealt with modelling dependencies between the limit order book data of various source products and a dependant product. We devised a model to predict significant price changes, within a few ms, in a dependant product using limit order book data from multiple source products. This was done by extracting novel input features from the order book data and analyzing various machine learning models such Random Forests and Neural networks on the highly imbalanced dataset with *moves* vs non-moves in the ratio 1 to 30. A trading strategy utilizing the probability confidence values of generated predictions was formulated and backtested, proving the utility of the devised approach.

Summer 2016 **Lyrics Search - Mixed-Script Information Retrieval.**

Search and Algorithms Team, Saavn, Mumbai

Mixed-script IR entails challenges such as handling transliteration induced spelling variations in queries and documents, code-mixed query understanding and query completion. In this work, we added the capability in Saavn's search engine to handle transliterated queries involving lyrics. We devised a novel model involving word n-grams and expansion of a word into its phonetic variants. This model improved the relevance of search results as well as handled misspelled queries. The modified system with this new model was tested against queries generated by scraping lyrics from multiple websites, achieving >85% accuracy on those queries. We also automated the generation of spelling variants from the user query logs of Saavn using a modified version of the Editex algorithm.

Key Projects

Ongoing **NIPS 2017: Learning to Run, Reinforcement Learning**, [\[challenge\]](#).

In this competition, we are tasked with developing a controller to enable a physiologically-based human model to navigate a complex obstacle course as quickly as possible. We are provided with a human musculoskeletal model and a physics-based simulation environment where we have to synthesize physically and physiologically accurate motion. We are trying to solve this problem with the help of deep reinforcement learning techniques and have currently implemented the Deep Deterministic Policy Gradients agent.

Spring 2017 **Intelligent Pac-Man Agent**, *Artificial Intelligence*.

We built a intelligent agent which can play Pac-Man utilizing heuristic based Minimax and Expectimax search with Alpha-Beta pruning for tackling multiple ghosts. We also performed inference using Particle Filters and Dynamic Bayes Nets for tracking the approximate positions of the ghosts allowing our agent to play more effectively.

Spring 2016 **Movie Recommendation Engine**, *Foundations of Machine Learning*, [\[report\]](#).

We developed a movie recommendation engine in Python using popular collaborative filtering techniques, motivated by the research previously done on the Singular Value Decomposition method during the Netflix Prize competition. We also implemented and tested other techniques like the k-Nearest Neighbors (both user-based and movie-based) for comparison, observing that matrix factorization methods works better.

Summer 2015 **Sustenance**, *Microsoft's code.fun.do Finalists Forum*, [\[repository\]](#).

Targeting young users, we developed an environment based strategy game that showcases the natural inter-dependence of different species and the abiotic environment by simulating an ecosystem using a food web. We also modelled and implemented the trophic dynamics of this system and introduced players to concepts of extinction, epidemics and genetic strains as the game progressed. Developed in C# and XAML, this Windows 8.1 Universal App led us to win Microsoft's code.fun.do Finalists Forum, where 53 teams from 15 colleges across India participated.

Relevant Courses

- CS & Maths Machine Learning, Artificial Intelligence, Reinforcement Learning, Game Theory, Information Retrieval, Calculus, Linear Algebra, Differential Equations
- Statistics Probability Theory, Statistical Inference, Applied Stochastic Processes, Data Analysis and Interpretation, Financial Engineering

Technical Skills

- Programming C++, Python, Bash, Java, MATLAB, Octave
- Libraries/Tools Tensorflow, Keras, Numpy, Pandas, Spark, Scikit-Learn, Git, \LaTeX

Positions of Responsibility

- 2015-2016 **Convener**, *Web and Coding Club, IIT Bombay*.
- 2015-2016 **Teaching Assistant**, *IIT Bombay*.
- Abstractions and Paradigms in Programming [CS152]
 - Data Structures and Algorithms Lab [CS293]
 - Introduction to Quantum Mechanics [PH107]
- 2015-2016 **Academic Resource Person**, *46th International Physics Olympiad*.

Extracurricular Activities

- 2015 Amongst the top team from IIT Bombay to qualify for and participate in Microsoft's Build the Shield, a network security based competition
- 2015 Runner up at Institute level in code.fun.do Hackathon organised by Microsoft for developing a Windows Store App which was a modified version of Dots and Boxes game

References

Available on request