Kushagra Chandak

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Research Interests

- Reinforcement Learning, Sequential Decision Making, Probablistic Graphical Models, Machine Learning, Computational Neuroscience/Cognitive Science, ML in Natural Sciences.

Education

International Institute of Information Technology (IIIT-H) Hyderabad, India
Bachelors in Computer Science & MS in Computational Natural Sciences by Research *Aug, 2014 - Jul, 2020*

- Thesis: Prospects of searches for leptoquarks decaying into top quarks and muons at the LHC. Advisor: Dr. Subhadip Mitra. (Link)
- Awards: Deans and Merit List awards for Spring-15, Monsoon-15, Spring-16, Monsoon-16 and Monsoon-17 semesters.

Preprints and Publications

- Combining Propositional Logic Based Decision Diagrams with Decision Making in Urban Systems. *Jiajing Ling*,* **Kushagra Chandak*,** *Akshat Kumar* (*equal contribution), Preprint: Under Review, Link
- Hunting for scalar leptoquarks with boosted tops in pair and single production channels. **Kushagra Chandak,** *Tanumoy Mandal, Subhadip Mitra*, Phys. Rev. D 100, 075019, Link

Work Experience

School of Information Systems, Singapore Management University Singapore
Research Engineer. Supervisor: Prof. Akshat Kumar *June, 2019 -*

- Working on reinforcement learning and multiagent sequential decision making.
- Combined ideas from propositional logic and probabilistic graphical models with RL to develop a generalized framework that can handle domain constraints for routing, path finding etc.
- Tested the above framework on multiagent RL and path finding approaches and found that it improves sample complexity of the RL algorithms.
- Developed a simulator for maritime traffic data and did a prototype using resource-constrained scheduling.

Okinawa Institute of Science and Technology Okinawa, Japan
Research Intern. Supervisor: Prof. Kenji Doya *Jul, 2018 - Aug, 2018*

- Studied and implemented the existing state of the art deep reinforcement algorithms like soft actor-critic (SAC) and deep deterministic policy gradients (DDPG). Evaluated and compared them against conservative value iteration (CVI), a new deep RL algorithm, on continuous control tasks. Found out that CVI performs better in terms of sample efficiency.
- Investigated the parameters of DDPG and found out that they have no significant impact on the performance or the solution quality on simple continuous control tasks.
- Studied the connection between CVI and other deep RL algorithms and the underlying mathematics. Learned how they all fit into the generalized maximum entropy framework.
- Explored how reinforcement learning can be applied to study brain functions and how brain computation can be viewed as a hierarchical abstraction.

Weizmann Institute Of Science   Rehovot, Israel
Summer Intern. Supervisors: Prof. Alexander Milov and Dr. Petr Balek   *Jun, 2017 - Jul, 2017*

- Performed first statistical data analysis and evaluated charged particle spectra for proton-lead collision data recorded with the ATLAS detector at the Large Hadron Collider, CERN. The data is used to study the hottest state of matter called quark-gluon plasma. Combined all the collisions recorded (10 orders of magnitude measurement) to produce a smooth unbiased spectrum.

Center for Computational Natural Sciences and Bioinformatics, IIIT-H   Hyderabad, India
Research Assistant   *Aug, 2018 - Apr, 2019*

- Worked on computational search strategies for discovering new kind of sub-atomic particles called *leptoquarks* at the Large Hadron Collider (LHC).
- Applied clustering algorithms on data generated using Monte Carlo simulations to detect leptoquarks at a very high energy and collision rate. Discovered that a process, which was neglected in earlier studies, is actually important in the production of these new particles.
- Our suggested strategy enhanced the discovery potential of these particles at 5σ significance at the LHC, and resulted in a publication.

IIIT Hyderabad   Hyderabad, India
Teaching Assistant: Conducted tutorials and graded exams   *Aug, 2016 - Apr, 2019*

- Linear Algebra and Group Theory (Jan, 2017 - Apr, 2017 & Jan, 2018 - Apr, 2018):
  Course name: Math II. Led a team of 8 TAs in a class of about 200 students.
- Probability, Statistics and Analysis (Aug, 2016 - Nov, 2016): Course name: Math III.
- Quantum Physics (Aug, 2017 - Nov, 2017): Course name: Quantum Mechanics, Symmetry and Spectroscopy.

SELECT PROJECTS

Multi-Objective Bandits: Optimizing the Generalized Gini Index (Link)   Aug, 2017 - Nov, 2017

- Studied multi-objective optimization in the multi-armed banded setting using the Generalized Gini Index function.
- Applied online gradient descent and linear programming methods for optimization. Modeled a practical problem of job hiring under the multi-objective bandit setting. Code: Link

The Automated Travel Agent: Hotel Recommendations Using ML (Link)   Aug, 2016 - Nov, 2016

- Applied and compared supervised algorithms like Bayes' classification, support vector machines and softmax regression to recommend hotels to users, after applying principal component analysis on a large dataset of 37 million instances and 23 features.

RELEVANT COURSES

- Statistical Methods in AI (ML), Topics in ML (Theoretical ML and RL), Math II (Linear Algebra and Group Theory), Math III (Probability, Statistics and Analysis), Math I (Discrete Math).

TECHNICAL SKILLS

- **Programming languages:** Python, C, C++, MATLAB
- **ML and Data Analysis:** PyTorch, TensorFlow, Keras
- **Miscellaneous:** Git, SQL