Julian D'Costa

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Profile

I am interested in applying insights and tools from math and theoretical computer science to reason about and build intelligent and useful systems.

Education

University of Oxford   **2020–present**
Oxford   *DPhil in Computer Science*
Inaugural Stephen Cameron Scholar at Keble College + CS Department Scholarship

Indian Institute of Science   **2016–2020**
Bangalore   *B.S. (Research) in Mathematics*
First Class with Distinction · KVPY Fellow · CGPA: 9/10

Experience

Innovate India Drug Discovery Hackathon 2020   **July 2020–October 2020**
ddhackiisc
Collaborated with a team of biochemists in a Govt of India competition to develop machine learning models to identify better drugs. I combined ideas from sequence to sequence neural translation with variational autoencoders to develop SMILES VAE (link), a generative model for molecules represented in the SMILES text format. I also collaborated on a moonshot proposal to develop miniprotein inhibitors using an end-to-end differentiable model leveraging geometric deep learning-based molecular fingerprints. We won the Grand Prize and our proposal has been shortlisted for grant funding by the Indian government.

Monsoon Math Camp   **April 2020**
IISc, MIT, GMU students
Organized a online mathematics camp for talented Indian high-schoolers, aiming to introduce them to advanced matheamtical topics not covered in the school or university curriculum. Currently responsible for administering the Monsoon Math Fund, which makes small grants to support students with self-driven projects.

Bachelor Thesis: Error-Prone Model Learning   **January–June 2020**
IISc
Worked on speeding up classical automata learning techniques with recurrent neural networks. Implemented RNNs that learned finite state systems like the gnuTLS protocol using pytorch. Combined Python models with Java-based automata libraries. Analysed sample complexity of learning with errors.
Experimental work joint with Alvin George. Advised by Deepak D'Souza and Chiranjeeb Bhattacharya (IISc CSA) and Sriram Rajamani (Director, Microsoft Research India)

Machine Learning Experiment Contractor and Analyst   **July 2019–February 2020**
Ought, San Francisco (Remote)
Participated in experiments and ran analyses for ought.org, a research lab aiming to train machine learning systems to answer complex and open-ended questions

MPI-SWS Summer Internship   **May–July 2019**
Max Planck Institute for Software Systems, Saarbrucken
Worked on analysis of continuous linear dynamical systems as models of cyber-physical systems with Prof. Joël Ouaknine and Prof. James Worrell (Oxford CS). Presented our results at STACS 2020.

IISc Summer Research Internship   **May–July 2018**
Mathematics Department, IISc
Worked with Prof Siddhartha Gadgil on the ProvingGround project (link). The ProvingGround project aims to convert structured mathematical text (eg latex source of a paper) to something that can be formalized in Homotopy Type Theory. Studied basic functional programming, parse trees and recursive translation of a controlled natural language.

European Summer Program on Rationality   **August 2017**
King's College London

Invited back to ESPR on a full scholarship as a Junior Counselor, after attending as a student in 2016. Studied functional programming, deep learning and statistical inference, guided younger students and assisted with logistics.

Skills

ML coursework (all graduate level courses): Machine Learning, Practical Data Science, Foundations of Data Science & High Dimensional Probability, Deep Learning Theory and Practice (IISc & Microsoft Research)

Selected other math and CS coursework: Algorithms, Automata Logic & Games , Probability & Computing, Computer Security, Scientific Computing, Measure Theory, Linear Algebra, Complex Analysis

Languages: Python, C++, LaTeX, Scala (beginner), Javascript (beginner)

Other skills include technical and creative writing (340/340 GRE), leadership and public speaking experience

Selected Research and Writing

On the Complexity of the Escape Problem for Linear Dynamical Systems over Compact Semialgebraic Sets: With E. Lefaucheux, E. Neumann, J. Ouaknine, and J. Worrell. Under submission, 2021. (pdf link)

The Pseudo-Skolem Problem is Decidable: With T. Karimov, R.Majumdar, J. Ouaknine, M. Salamati, S. Soudjani and J. Worrell. Under submission, 2021. (link)

How fast can you escape a compact polytope?: With Engel Lefaucheux, Joël Ouaknine and James Worrell. Accepted to **STACS 2020.** (link)

Adversarial Examples for CNNs: Analysed Wasserstein distance based approaches to building robust image classifiers. Experimented with various types of adversarial attacks and training using approximations to the Wasserstein ball. With Gaurang Sriramanan. Final project for Deep Learning: Theory and Practice. (pdf link)

Resistance: Tales from A Post-Antibiotic World: Edited an anthology of short fiction themed around antibiotic resistance. 96pp. Published by IIScPress (2019).

GCODe: Engineering project, Summer-Fall 2017. Designed an automated process to speed up synthetic biology experiments as part of iFLOAT, the IISc iGEM 2017 project. Wrote the technical documentation at `http://2017.igem.org/Team:IISc-Bangalore/Hardware`.

Selected Awards and Honours

Grand Prize Winner: Innovate India Drug Discovery Hackathon	**2020**
Awarded 100,000 INR grand prize + offered grant funding for 2 projects	*Delhi*
Ministry of Innovation, Government of India	
International Genetically Engineered Machine Competition (iGEM) Gold Medallist	**2017 and 2018**
Gold Medal + Best Hardware Nomination for iFLOAT ('17), Gold Medal for PhageShift ('18)	*Boston*
iGEM Foundation	
National Bal Shree Awardee in Creative Scientific Innovation	**2012**
1 of 8 Science Awardees that year across India	*Delhi*
Ministry of HRD, Government of India	
IIT-Bombay Mathematics Olympiad	**2015**
2nd Place in India	*Mumbai*
Indian Institute of Technology, Powai	