# Ishaan Singh Rawal

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https://israwal.github.io/


My primary focus is Computer Vision and Deep Learning, in general, with a tangential interest in Computational Biology. I want to work towards interpretability and representation learning in generative models for Computer Vision and human-inspired AI to advance towards the ultimate goal of robust, fair and privacy-preserving AGI.

## Education

- **Birla Institute of Technology and Science (BITS) Pilani** — Pilani, India
  *Integrated B.Engg. Computer Science and M.Sc. Biological Science* — *Aug. 2017 – May. 2022*
  *GPA: 8.86/10 (top 1 percentile)*

- **Hislop Junior College** — Nagpur, India
  *Class XII, (Electronics)* — *Jun. 2015 – May 2017*
  *Percentage: 90.44% (top 1 percentile)*

## Work Experience

- **Neural Dynamics of Visual Cognition Group, Freie University Berlin** — Berlin, Germany
  *Master's Thesis (Supervisors: Prof. Radoslaw Martin Cichy, Prof. Gemma Roig)* — *Dec. 2020 – Present*
  - Working on **inverse problem** of natural video reconstruction from fMRI signals using deep learning.
  - Extending Deep Image Prior (Ulyanov et. al.) to videos for using activations as a proxy for constrained mapping of fMRI features to the video space while understanding neuro-AI representations.
  - Investigating **architectural priors** in neural networks to probe and invert non-invertible neural networks for restricting the predictions in the manifold of natural and temporally consistent videos.

- **Visual Computing Center, KAUST** — Thuwal, Saudi Arabia
  *Remote Research Intern (Supervisor: Prof. Peter Wonka)* — *Jul. 2021 – Oct. 2021*
  - Investigated the role of architecture and input transformation in **neural implicit representations**.
  - Incorporated neighbourhood information with Random Fourier Features (**RFF**) mapping for images.
  - Experimented with hierarchically-scaled RFF mappings and multi-step implicit representations to improve the PSNR by 0.3 and analyzed it with Neural Tangent Kernel theory.

- **Advanced Data Analytics and Parallel Technologies Lab, BITS Pilani** — Pilani, India
  *Research Assistant (Supervisor: Prof. Poonam Goyal)* — *Jan. 2021 – May 2021*
  - Proposed and built a **graph compaction** module for a de-novo distributed genome assembler.
  - Developed an efficient solution for the problem, modelled as a partial **string reconstruction** (NP-Hard) problem, by designing unitigs and other statistically relevant features for the merge phase.
  - Designed the downstream pipeline for efficient contig generation and scaffolding phases.

- **Laboratory for Orthopaedic Biomechanics, ETH Zürich** — Zürich, Switzerland
  *Remote Project Assistant (Supervisor: Prof. Jess G. Snedeker)* — *May 2020 - Jul 2020*
  - Constructed a Deep Learning model for **intervertebral disc segmentation** from MRI scans.
  - Compared the architectural variants of U-Net (viz. vanilla, skip connections, inception).
  - Achieved the state of the art dice score of **94.1%** using skip connections and inception modules in the architecture and a weighted combination of MSE and dice loss for optimization.

## Awards and Scholarships

- Awarded with **Zukunftskonzept Stipendium**: Internationale Netzwerkuniversität from Freie University Berlin for pursuing research in the interface of AI and Neuroscience. (worth 5,700 USD)
- Received **Young Investigator Scholarship** from UC San Diego School of Medicine for attending and presenting poster at the COVID-19 Dynamics and Evolution Virtual Conference.
- Recipient of INSPIRE- Scholarship of Higher Education (**INSPIRE-SHE**), Department of Science and Technology, Govt of India, for meritorious academic performance and research. (worth 5,300 USD).

## Projects

- **Computational modelling of gene regulatory networks using formal methods**
  *Supervisor: Prof. Rajesh Kumar, BITS Pilani* *Aug 2020 - Dec 2020*
  - Implemented a Boolean model of stochastic gene regulatory network using context-sensitive Probabilistic Boolean Networks (**cs-PBN**) to identify stable attractor cycles on ASSA-PBN.
  - Proved Stochasticity in Nodes and Stochasticity in Function models as special cases of cs-PBN.
- **Optimizing structure of novel heavy metal complexes for cancer detection**
  *Supervisor: Prof. Shibasish Chowdhury, BITS Pilani* *Aug 2020 - Dec 2020*
  - Identified a set of candidate cancer biomarkers with unique hydrophobic pockets compatible with the in-house developed novel aggregation induced emission complexes.
  - Conducted **molecular docking** studies to find the docking sites and hence to predict ligand aggregation which drove the experimental framework for the future course of the project.
- **Analysis of long-distance linked selection in Indian variants of SARS-CoV-2**
  *Supervisor: Prof. Arun Sethuraman, CSU San Marcos* *Jun 2020 - Sept 2020*
  - Analyzed over 1,200 sequences of SARS-CoV-2 sequences from India amidst the COVID-19 pandemic.
  - Identified 14 significant non-synonymous mutations and conducted homology analysis.
  - Re-purposed **apriori algorithm** to build the first ever explainable model to understand the long-distance association of mutations in SARS-CoV-2.

## Programming Skills

- **Languages**: C, Python, Java, MATLAB, Verilog, LaTeX, SQL, Bash
- **Tools and Frameworks**: PyTorch, Keras, Git, Linux, NumPy, Matplotlib, pandas

## Publications

- **Rawal, I.**,Sethuraman, A., Assessing linked selection and long-distance association of functional mutations in SARS-CoV-2 variants in India. Poster presented at COVID-19 Dynamics and Evolution Virtual Conference, organised by UCSD CME; 2020 Sep 19-20

## Extra Curricular

- **Students' Academic Cell, BITS Pilani**
  *Senior Member* *Aug 2018 – Aug 2021*
  - Impacted 500+ students via mentorship sessions to enhance the research and the academic environment.
  - Conducted placement talks and gyaan sessions to expose the students to various available opportunities.
- **BITS Embryo**
  *Secretary* *Aug 2017 – May 2020*
  - Worked to augment the academic culture by extending the bounds beyond textbooks and classrooms.
  - Organized over 30 live and virtual talks on topics ranging from journalism to science and technology.
- **National Service Scheme**
  *Core Team Member, Project Umang* *Aug 2017 – May 2019*
  - Worked to improve the reach and quality of education for underprivileged kids of Pilani village.
  - Raised 22,500 USD for scholarships for needy students through week-long crowdfunding campaigns.
  - Conducted counselling and academic guidance sessions for 200+ poor students.