Krishna Wadhwani

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Education

- **Indian Institute of Technology Bombay** *July 2016-Present*
  B.Tech in Aerospace Engineering; Minor in Computer Science and Engineering *CPI: 9.20/10*

Undergraduate Thesis

- **Application of Deep Generative Networks in Fluid Mechanics** *July 2019 - Present*
  Guide: Prof. Suyash Awate, Prof. Prabhu Ramachandran; in Collaboration with Sony Corporation, Japan
  - Working on application of Generative Models in Deformable Image Registration for applications in Medical Image Analysis and Fluid Mechanics
  - Developing a novel Generative model with more tractable latent space and capable of working in few shot settings

Technical Experience

- **Vision System Development, Sony Research and Development, Japan** *May 2019 - July 2019*
  Guide: Takuya Narihira
  - Implemented **Single Shot MultiBox Detector** in Nnabla with ResNet50 as backbone model on COCO '17 data
  - Achieved a **mean Average Precision** of **0.244** on the validation dataset
  - Implemented **Mixed Precision**, **Distributed training** in Dynamic Graph configuration and employed **Nvidia's DALI** for data preprocessing, to achieve faster performance
  - Performed detailed profiling analysis with **Nvidia's Visual Profiler** to find auto forwarding bug in Nnabla's pretrained ResNet API, which led to around **16 % faster execution**
  - Implemented AutoRegressive Vision models - **PixelCNN** and **gated PixelCNN** in NNabla on MNIST Dataset
  - Implemented **Vector Quantized Variational AutoEncoders** in Nnabla on CIFAR10 and ImageNet dataset to achieve high quality image generation comparable to the original paper
  - Offered a **Pre-Placement Offer** for the work during the internship
- **Software subsystem, IITB Mars Rover Team** *December 2017 - July 2018*
  The IITB Mars Rover project is a student initiative to build a prototype Mars rover capable of extra-terrestrial robotics. The team participated in University Rover Challenge 2018 and was ranked 31 out of 95 teams worldwide.
  - Implemented **Gaussian Mixture Model** for tennis ball detection via color segmentation and contour detection
  - Developed a python script for **wireless control of GoPro camera** with Raspberry Pi
  - Worked on the implementation of **stereo camera vision** for distance legend mapping of the captured images
- **Capturing Semantic Structures in Neural Machine translations** *May 2018-July 2018*
  Seasons of Code, Web and Coding Club-IIT Bombay
  - Implemented **attention based encoder-decoder** architecture with deep **LSTM** cell network and beam search for **language translation** module
  - Implemented a **multi-decoder** module in the NMT code to capture a different semantic structure of the sequence
  - Modified the training loss by incorporating **cross entropy** on the predicted sequence and **divergence between different decoder models**
- **Controls system and UAVs, Show Genesis Pvt. Ltd** *December 2017 - January 2018*
  Show Genesis Pvt. Ltd is a company involved in hardware software solutions
  - Worked with **crazyflie quadcopters** to develop a server to control multiple drones on **ROS** framework
  - Developed ROS workspace for **stabilization** and **location positioning system** of the drone

Key Projects

- **Deep Neural Networks** *July 2018-April 2019*
  Undergraduate Research Award, Guide: Prof. Manoj Gopalkrishnan
  - Implemented **Capsule Networks** using **TensorFlow-GPU** on MNIST dataset to achieve **99.53 % accuracy**
  - Implemented different variants of **Generative Adversarial Networks - DCGANs and InfoGANs** in PyTorch to achieve high quality image generation on different datasets
  - Implemented novel Neural Architecture Search with iterative layer wise growth and training
  - Made the search more efficient by assigning just a single weight parameter for previously trained layer as an weighted expert setting
- **Parallelising N-Body Simulations** *January 2018-May 2018*
  High Performance Scientific Computing under Prof. Shivasubraminum Gopalakrishnan
  - Developed a program for calculation of the trajectory of n bodies under the influence of gravitational force
  - Used **gprof** to profile the serial code and determine the parallel algorithm for the simulation
  - Parallelised the code with **openMP** and **MPI** to obtain a **speedup of 6 times** over the serial code

- **Analysis of Deep Reinforcement Learning Algorithms** *July 2017-February 2018*
  Introduction to Machine Learning under Prof. Sunita Sarawagi
  - Solved **gym's** Cartpole environment with different deep reinforcement learning algorithms such as **Policy Gradients**, **Q-learning** (with experience replay memory) and **Actor-Critic algorithm** in **PyTorch**
  - Performed convergence study and performance analysis of the different learning algorithms along with comparison with non reinforcement learning approach
- **Mayavi** *July 2017-February 2018*
  Mayavi is an open source application and library for interactive scientific data visualization in python.
  Guide: Prof. Prabhu Ramachandran
  - Developed a **vtk** and **tvtk** script for rendering **multiblock data** files using **XML readers** and **composite data geometry filter** for structured and unstructured grids
  - **Improved Mayavi's documentation** by updating installation from conda, conda-forge and Enthought Deployment Manager (edm) and latest development version from git
  - Operated on various bugs filed on github related to documentation, python 3 and vtk
- **Human Detection Autonomous Hexacopter** *May 2017-July 2017*
  Institute Technical Summer Project
  - Used **pixhawk px4** with **qGroundControl** for positioning of the drone with **GPS** and **autonomous flight**
  - Developed an interface between **R-Pi** and camera module to **wirelessly transfer images** to the base station
  - Used **OpenCV** to build a human detection classifier using **Support Vector Machines** and **HOG descriptor**
- **Warehouse Inventory Check** *December 2017-January 2018*
  InterIIT Tech Contingent Meet 2018
  - Part of a 4 member team selected to **represent IIT Bombay** at Warehouse Inventory Check competition organised by Honeywell in InterIIT Tech Meet 2018
  - Built an **autonomous quadcopter** for indoor navigation with **px4Flow sensor** and **odroid xu4** using mavros
  - Implemented **Image processing via openCV** for **contour detection** to **extract QR code, barcode** and **hazardous symbols** and employed zbar module of python to decode them

Position of Responsibility

- **Cofounder and Director, Autonise AI Pvt. Ltd.** *July 2018 - January 2019*
  - Co-founded a Technical Consultancy firm, that sold end to end Artificial Intelligence Solutions to clients based on thorough research and high efficiency employment of the state of the art Machine Learning algorithms
  - Developed topic extraction and text classification analysis report examining the efficiency and performance of topic modelling, FastText and CNN based approaches
- **Mentor, Department Academic Mentorship Program** *April 2018 - May 2019*
  - Part of a 22 member team of mentors selected based on ethics and peer review, responsible for **mentoring 6 sophomores** to cope up with their academic and extracurricular activities efficiently
  - Attended a training and icebreaking case studies session conducted by **Tata Institute of Social Sciences**
  - Responsible for coordinating with faculty advisor for comprehensive course planning and guidance

Technical Skills

- **Programming Languages**: Python, C, C++, LaTeX, Matlab
- **Tool kits**: PyTorch, Nnabla, DALI, Tensorflow, OpenCV, Gym, OpenCL, CUDA, MPI, OpenMP, Mayavi, VTK, Git
- **Electronics**: ROS, Raspberry Pi, Pixhawk px4, Odroid XU4

Key courses undertaken

- **Aerospace**: Data Analysis and Interpretation, Aircraft Propulsion, Fluid Mechanics, Aerospace Structural Mechanics, Spaceflight Mechanics, Control Theory, Aerodynamics, Computational Fluid Dynamics, Navigation and Guidance*
- **Computer Science**: Computer Networks (*Minor*), Data Structures and Algorithms (*Minor*), Introduction to Machine Learning (*Minor*), Digital Image Processing (*Minor*), Operating Systems (*Minor*), Foundations of Intelligent and Learning Agents*, Computer Graphics*
- **Inter-disciplinary**: High Performance Scientific Computing, Introduction to Numerical Analysis, Linear Algebra, Calculus, Differential Equations, Quantum Physics and its Applications, Economics, Psychology

* *To be completed in November 2019*

Scholastic Achievements and Extracurricular Activities

- **Department Rank 4** in Aerospace Engineering Department, IIT Bombay
- Completed Minor in **Computer Science and Engineering**
- Pursuing Honors in **Aerospace Engineering**
- Secured **All India Rank 985 (99.5 percentile)** in JEE Advanced 2016 among 0.2 million students
- Secured **All India Rank 1208 (99.9 percentile)** in JEE Mains 2016 among 1.2 million students
- Secured a **State Rank 10 (99.9 percentile)** in Chhattisgarh Pre-engineering test among 10 thousand students
- Devoted **80+ hours** to social service under Vikas Department, **National Service Scheme**, IIT Bombay

Miscellaneous Projects

- **Parallelization using various tools**: Parallelized numerical integration methods using multiple processes on CPU using **openMP**, **MPI** and GPU computing using **CUDA** and **openCL** and analyzed the variation of execution time with number of sampling points and number of threads
- **Open source Development**: Debugged **neural networks notebook** and added **function and test cases for cross-entropy loss** in loss functions API in **aima-python**; Added pseudocode for back-propagation with regularization on **aima-psedocode**; Developed a script for differentiation in visual math solving repository **VisMa**
- **Deep Learning Specialization**: Completed a 5 course specializtion- **Neural Networks and Deep Learning; Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization; Structuring Machine Learning Projects; Convolutional Neural Networks; Sequence Models** by deeplearning.ai on Coursera
- **Survival**: Created a wildlife survival simulator game using **pygame**, which won **2nd prize in FOSSEE python Hackathon** among all IIT Bombay students
- **Ubisoft Game Jam 2018**: Developed a 3D Puzzle based treasure hunt **multiplayer game** in **Unity** with **C#** scripts, from scratch in a 48 hour Game Jam; Designed and Programmed game play mechanics and the game scene
- **Control Element design**: Designed a controller with four lag compensators in cascade to fulfill the requirement of settling time, closed loop damping and positioning of non-dominant poles using Root Locus based methods

References

- **Prof. Manoj Gopalkrishnan**, Electrical Engineering, IIT Bombay
- **Takuya Narihira**, Vision System Development, Sony Research and Development
- **Prof. Prabhu Ramachandran**, Aerospace Engineering, IIT Bombay