SHASHI KANT GUPTA

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EDUCATION

Indian Institute of Technology, Kanpur, India
Major: *Electrical Engineering*
Minor: *Cognitive Science* — *Aug. '16 – Jul. '21*
GPA: 8.9/10.0 *(Eight Semesters)* — *(Expected)*

Munam Public School, Hazaribagh, India
Intermediate
Percentage: 91.2% — *April 2016*

DAV Public School, Hazaribagh, India
Matriculation
GPA: 10.0/10.0 — *April 2014*

INTERESTS

AGI • Cognitive Science • Computer Vision • Deep Learning • Reinforcement Learning • Robotics

HONORS & ACHIEVEMENTS

- Founded **Brain and Cognitive Society** at IIT Kanpur (An interdisciplinary student society which aims to study brain science and reverse engineer human intelligence to create more general and intelligent Artificial Intelligence) [BCS@IITK Homepage]
- Fellowship awardee for the prestigious **Khorana Program for Scholars 2019, IUSSTF** (only 47 students were selected all over India to conduct research in the United States).
- Selected for a Summer Internship at **SUTD Singapore** in the second year (2018)
- Received **Academic Excellence Award** twice for outstanding academic performance (awarded to top 7% of students in the institute) for the year 2016 and 2016-17
- Won **3rd prize** in Techkriti Innovation Challenge, conducted by Techkriti IIT Kanpur (2017).
- **99.89 percentile** in Joint Entrance Examination (**IIT-JEE 2016)** among 1.5 million students.
- Secured **All India Rank 842** in **KVPY 2015,** a fellowship exam conducted by IISc Bangalore and funded by Department of Science and Technology, Govt. of India

RESEARCH EXPERIENCE

Implementing Eccentricity Dependent Sampling into Deep Convolutional Neural Network — *May. '19 – Ongoing*
Dr Gabriel Kreiman, Harvard Medical School

- Implemented eccentricity dependent sampling (i.e., high acuity in the fovea, with decreasing acuity towards the visual periphery) into deep CNN models.
- The complete model was developed in **python** using **TensorFlow** module.
- Developed a computational model of vision and studying the effect on different visual tasks and comparing them with human performances.
- Presently, working on preparing a paper for the results that we found.

Introducing Spike-Timing-Dependent Plasticity in Multi-Layer Perceptron — *Dec. '18 – Apr '19*
Guidance: Prof Nisheeth Srivastava, IIT Kanpur

- Derived a local learning rule based on **spike-timing-dependent plasticity** (aka STDP, assumed to be found in Biological Neurons) which uses the information about only neighbouring neurons to get weight updates in an ANN network.
- An empirical evaluation was done using **IRIS** and **MNIST** dataset on One Vs All binary classification test.

Optical Flow for Localisation of UAVs in Deep Tunnel — *Jun. '18 – Jul. '18*
Summer Internship, Dr Hock Beng Lim, Centre for Smart System, SUTD Singapore

- Worked on the **Optical Flow** algorithm based on **SAD block matching** to determine UAV position in deep tunnels i.e. GPS denied environment (coded in python, for actual prototype **PX4FLOW** was used)
- Developed an algorithm to correct the errors in inconsistent flow calculation
- Worked on implementing **Extended Kalman Filter** to use acceleration data to improve the accuracy
- Demo Presentation at **IEEE Consumer Communications & Networking Conference, Las Vegas, USA**

Humanoid IITK — *Dec. '16 – Apr '19*
Team Member, Dean of Research and Development Project, IIT Kanpur — ***[Report] [Video]***

- Helped the team in designing and developing the **Institute's first Humanoid Robot (AUTOMI)**
- Worked on developing the **bipedal walking algorithm**, designed a MATLAB simulation for the same
- Worked on **Object Tracking** using various computer vision algorithms in **OpenCV**
- Team participated at **Fira Huro Cup 2019,** an international athletic event for humanoid robots.
- Served as **Tech Head** for the team from *May. '18 – Nov '18*

KEY PROJECTS

tf_deepRL: RL library for TensorFlow *Mar. '20 - Ongoing*
Self-Project
- Developing an RL library for python for easy building of deep RL model with TensorFlow as backend.
- Features implemented: Vanilla policy gradient agent, continuous visualization of reward vs. epoch curve during training, custom environment creation, gym compatible.

3D Human Pose Estimation using Multi Camera *Feb. '20 – Apr. '20*
Undergraduate Project – Prof K S Venkatesh, IIT Kanpur ***[Code]***
- Extraction of 2D joints position using **Cascaded Pyramid Network.**
- Estimate of 3D poses using those 2D joints position and camera parameters.

Real Time Human Facial Emotion Recognition *Nov. '18 – Dec' 18*
Self Project ***[Video] [Code]***
- Extracts human faces (using OpenCV haar-cascade/ dnn based classifier) from a camera stream and classifies them into 7 different moods i.e. Angry, Disgust, Fear, Happy, Sad, Surprise and Neutral
- CNN classifier (with ensemble) was designed, which was trained on the **ICML 2013** dataset of Facial Expression Recognition Challenge on Kaggle to achieve an accuracy of ~**65.34%** on the private test data

How Close are Artificial Neural Networks to the Brain? *Sep. '18 – Nov. '18*
CS771A - Machine Learning, Prof Piyush Rai, IIT Kanpur ***[Pres] [Report]***
- Studied different types of **ANN** models to compare their structure and performance to realise their biological resemblance to the processing in the human brain.
- Tried explaining how a rate-based neuron in conventional NN can be realised as spiking neuron in **SNN.**
- Studied variational EM method as explained by (Yoshua Bengio et al., 2015) on the biological plausibility of deep learning.

Cooperative Localization Using Posterior Linearization Belief Propagation *Sep. '18 – Nov '18*
EE602A – Statistical Signal Processing, Prof R. M. Hegde, IIT Kanpur ***[Code] [Report]***
- Implementation of a research paper, which presents the **PLBP** algorithm for cooperative localization
- Learned about and implemented **Statistical Linear Regression** using **unscented transform** on a chosen sets of **sigma points** to linearize the proposed non-linear model.
- Implemented the **Belief Propagation** algorithm to infer the marginals for different sensor nodes.

Achieving CRLB in Sensor Network Estimation *Sep. '18 – Nov '18*
EE602A – Statistical Signal Processing, Prof R. M. Hegde, IIT Kanpur ***[Code]***
- Implementation of a research paper, which proposes a general framework to achieve CRLB bounds
- Successfully implemented the proposed method in **MATLAB** to produce the results

SL-COM (Sign Language Communication) *Mar. '17*
Robotics Club, IIT Kanpur
- Patterns were generated using different **hand gestures** to produce different letters
- Produced letters were sent to a Chat-App, were a text2speech engine was used to produce voices
- Demonstrated the prototype in **Techkriti Innovation Challenge** and was awarded with the **3rd prize**

PROJECTS MENTORED

Comparing DNN features with Psychological Representations
Students - Abhishek Jain, Aditya Jindal, Amartya Dash, Sahithi Macharla, Sanket Agrawal UGs at IIT Kanpur

Do Deep Nets Capture Color Based Emotions?
Students – Shivi Gupta, UG at IIT Kanpur

OPEN SOURCE CONTR.

jsPsychSheet ***[GitHub]***
Self-Project *[1 star, 9 forks]*
- Developed a simple JavaScript library for running behavioural experiments online

Open AI gym ***[GitHub]***
- Some issue fixations for gym environment library

Brain-Score ***[GitHub]***
DiCarlo Lab, MIT, USA
- Implementing a new benchmark based on a visual search task

PixhawkArduinoMAVLink ***[GitHub]***
Self-Project *[4 star, 5 forks]*
- Developed an Open Source Arduino library to communicate between Pixhawk and Arduino

RELEVANT COURSES

Machine Learning and Computer Vision
- Introduction to Machine Learning
- CNN for Visual Recognition (Stanford AI) [#]
- Reinforcement Learning Specialisation (Coursera – University of Alberta) [o] [c]
- Computer Vision: Foundations and Applications (Stanford AI) [#]
- Deep Learning Specialisation (Coursera – deeplearning.ai) [o] [c]

Signal Processing
- Statistical Signal Processing
- Image Processing
- Signals, Systems and Networks
- Digital Signal Processing

Cognitive Science
- Foundation of Cognitive Science
- Psychology of Language
- Psychology of Adjustment
- Computational Cognitive Science
- Neurobiology

Mathematics and Algorithms
- Data Structures & Algorithms
- Fundamentals of Computing [*]
- Basic Statistics, Data Analysis & Inference [*o*]
- Probability and Statistics
- Linear Algebra and ODE

** - Exceptional Performance* *c – Link to online course certificates* *# - Online (Audit)* *o - Ongoing*

TECHNICAL SKILLS

Languages: C • Python • MATLAB

Software and Tools: TensorFlow • Keras • OpenCV • NumPy • ROS (Robot OS) • jsPsych • PsyToolkit • Git • Arduino • HTML/CSS • Jekyll

LECTURES/ TALKS / TUTORIALS

[28-03-2020] to [20-04-2020]	Brain and Cognitive Society workshop covering topics on Basic Machine Learning, Computational Modelling, Psychophysics, Data Analysis and Experiment Design [BCS @IITK] [Around 150+ participations]	*[Link]*
[13-12-2019]	Basic ML, Deep Learning Libraries and Google Colab [BCS @IITK]	*[Link]*
[12-12-2019]	Artificial and Biological Neural Networks [BCS @IITK]	*[Link]*
[10-12-2019]	Python, NumPy, SciPy, Matplotlib Tutorial [BCS @IITK]	*[Link]*
[25-10-2019]	Talk on Role of Brain Science in AI [BCS @IITK]	*[Link]*
[29-05-2017]	Introduction and Quick Start to ROS [Robotics Club, IITK]	*[Link]*

LEADERSHIP & ACTIVITIES

Coordinator *Brain and Cognitive Society, IIT Kanpur*	*Jan. '20 – Jul, '20*
Student Volunteer *PRAYAS, IIT Kanpur*	*Dec. '18 – Jan. '19*
Technical Head *Humanoid IITK Team, IIT Kanpur*	*May. '18 – Nov '18*
UG Coordinator *EEA, Dept. of Electrical Engineering, IIT Kanpur*	*Aug. '17 – Aug. '18*
Secretary *Robotics Club, IIT Kanpur*	*Apr. '17 – Mar. '18*
Secretary *Fine Art Club, IIT Kanpur*	*Apr. '17 – Mar. '18*
Student Guide *Counselling Service, IIT Kanpur*	*Aug. '17 – Jul. '18*
Student Volunteer *National Service Scheme, IIT Kanpur*	*Aug. '16 – May. '17*

REFERENCES

Prof. Gabriel Kreiman
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