

# Gurpreet Singh

B. TECH · DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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## Education

Year	Degree	Institute	CPI / Score
2015 - 2019	B. Tech, Computer Science and Engineering	Indian Institute of Technology, Kanpur	9.3 / 10.0
2015	Class XII (CBSE)	Delhi Public School, Kalyanpur	94.4%
2013	Class X (CBSE)	Delhi Public School, Kalyanpur	9.6 / 10.0

## Scholastic Achievements

Got Academic Excellence Award, IITK for the year 2016-2017	2018
Got selected for ACM ICPC Regionals, 2017 at two sites, Chennai and Amritapuri (Overall Rank - 70)	2017
Secured All India Rank 174 in the JEE Advanced examination amongst 1.2 lakhs shortlisted students	2015
Kishore Vaigyanik Protsahan Yojana (KVPY) Scholar with All India Rank 464	2015

## Projects

### DISCRETE VARIATIONAL AUTOENCODERS AND STOCHASTIC BLOCK MODELS

Fall 2018 (Ongoing)

PROF. PIYUSH RAI

Undergraduate Project

- Surveyed continuous relaxations to discrete latent variables such as Gumbel-Softmax, Spike-and-Exp, Overlapping, Gumbolt, etc.
- Implemented GumBolt relaxation for binary latent variables with RBM prior using tensorflow and performed analysis on MNIST dataset
- Augmented GVAEs with binary latent embeddings to offer interpretable latent representations, imitating mixed membership models
- Tested the resultant model for link prediction on graph datasets such as Citeseer and Cora and achieved superior results to baseline models

### MIXTURE OF EXPERTS USING DISCRETE VAE

Fall 2018

PROF. ARNAB BHATTACHARYA

CS685: Data Mining

- Proposed a novel model using the VAE framework for clustering in latent space, extending the ideas of the VaDE model
- Modeled the cluster assignment using a deep neural network, and added regularization using Virtual Adversarial training
- The proposed model worked comparable to VaDE on clustering tasks without the need for careful layer wise pretraining
- Extended the proposed model as a gating function for Mixture of Experts tasks and achieved better performance than naive baseline models

### CATTALKS: A CENTRALIZED VIDEO + TEXT CHAT TOOL

Fall 2018

PROF. DHEERAJ SANGHI

CS425: Computer Networks

- Developed a web-app for text and video chat using Flask and socket programming on python
- Login credentials, requests and messages were stored using MongoDB

### INCREMENTAL NEURAL NETWORKS TRAINING

Spring 2018

PROF. PURUSHOTTAM KAR

CS777: Statistical and Algorithmic Learning Theory

- Two layer NNs can be represented as an ensemble of multiple single node hidden layer networks, which can be individually trained using generic boosting methods (gradient boosting), which also afford definite theoretical convergence guarantees
- Applied gradient boosting to train two layer networks incrementally and studied the convergence analysis under various constraints
- Implemented incremental NN training in python using sklearn, and applied for Softmax Regression on the MNIST Dataset
- Applied incremental training as pre-training, along with backpropagation for fine-tuning and observed remarkably better convergence

### SURVEY ON METHODS FOR CONVEX OPTIMIZATION

Spring 2018

PROF. PURUSHOTTAM KAR

CS777: Statistical and Algorithmic Learning Theory

- Surveyed prominent Gradient Descent based techniques (SGD, AdaGrad, etc.) for optimization and perused the convergence bounds of each
- Reviewed and paraphrased a paper which disproves guaranteed convergence of Adam for even convex objectives using a counterexample
- Identified inconsistencies within the convergence proof for Adam as an attempt to explain its incorrectness

### CLUSTERING AND MOE FOR ARBITRARY SHAPED CLUSTERS

Spring 2018

PROF. PIYUSH RAI

CS698X: Bayesian Modelling and Inference

- Studied VAEs and surveyed clustering models (iWMM, SVAE, VaDE, etc.) for data existing in non-Gaussian shaped clusters
- Implemented Variational Deep Embeddings (VaDE) in Tensorflow to experiment on MNIST and spiral dataset to learn arbitrary shaped clusters
- Proposed gating functions based on VaDE and Stick Breaking-VAE for mixture of experts models

### JAVA TO X86 ASSEMBLY COMPILER

Spring 2018

PROF. SUBHAJIT ROY

CS335: Compiler Design

- Developed an end-to-end compiler in node.js for a subset of Java language to compile into x86 Assembly using json (for parsing)
- Implemented advanced features such as classes and type casting, along with support for floats. Adjudged one of the best projects

## MACHINE COMPREHENSION USING MATCH-LSTM

Spring 2018

PROF. HARISH KARNICK

CS671: Natural Language Processing

- Surveyed various models for Machine Comprehension (FastQA, R-Net, Match-LSTM, etc.) and implemented Match-LSTM using Tensorflow
- Experimented with SQuAD and combated inefficiency of Match-LSTM to apply separate attention mechanisms for different question types
- Additionally, introduced simple changes to loss function to improve the EM score on SQuAD by a total of over 5%

## SCALING RECOMMENDATION SYSTEMS USING K-MEANS CLUSTERING

Fall 2017

PROF. PURUSHOTTAM KAR

CS771: Introduction to Machine Learning

- Used K-Means clustering to divide users into cliques, and applied Collaborative Filtering independently within each clique
- Clustered songs based on MFCC features using K-Means and quantified user features based on song clusters from the user's learning history
- Applied the model on MSD. Also proposed simple exploration strategy based on song clusters to allow variations in suggestions provided

## NACHOS OPERATING SYSTEM

Fall 2017

PROF. MAINAK CHAUDHURI

CS330: Operating Systems

- Implemented basic operating system functions (Fork, Join, etc.) on a truncated NachOS code (provided) in C++ programming language
- Implemented and evaluated performance of algorithms for various scheduling processes and various page replacement strategies
- Implemented Shared Memory Allocation, Demand Paging and various Page Replacement Algorithms

## SMART IMAGE ADVERTISING

Fall 2016

- Developed a web-app for smart advertising using image analysis with basic controls
- Wrote a back-end program to detect objects in an image on upload using an API service from Clarifai
- Stored objects as tags in database and used these to search through products on different e-commerce websites using their affiliate APIs

\* Code and reports for all projects are available at <https://github.com/fat-fighter>

## Industry Experience

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**GOLDMAN SACHS** | SUMMER ANALYST

Bangalore, May'18 - Jul'18

### Objectives

- (i) Introduce changes in existing models for asset liability gap management for deposits and clearing house initial margin, and
- (ii) Build a lite calculator for customer margin allocation for proper internalization
- Understood working of financial firms, along with basic concepts of Asset-Liability Gap (AL Gap) Management
- Identified bugs in pre-written code, augmented proper AL Gap Management, and built a waterfall logic for customer margin (CM) allocation
- Built a greedy strategy for CM allocation per stock taking various parameters into consideration, improving the run time of the allocation logic

**INMOBI** | DATA SCIENCE INTERN

Bangalore, May'17 - Jul'17

- Extracted Features from Ad creative images using OpenCV (in python) and Google Cloud Vision API
- Analysed Pearson Correlation with the Click Through Rate (CTR) and used variable selection (Weka) to detect explainable features
- Created a python server to handle feature extraction and prediction for building suggestions for possible Ad enhancements based on CTR

**EXXAMM.COM** | WEB DEVELOPMENT INTERN

Delhi + Remote, Jan'16 - Jul'16

- Lead architect of the core content engine and front-end web interface
- Designed and developed a dashboard to add and edit questions using PHP and MySQL

**INMOBI** | SOFTWARE ENGINEERING INTERN

Bangalore, Dec'15

- Worked on Strategic Advertising for better in-app product discovery and user experience
- Developed a Curator Tool which scraped and rendered information from the web using python

## Technical Skills

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<b>Programming/Scripting</b>	C/C++, Python, Bash, Octave/MATLAB, R, LaTeX
<b>Assembly Languages</b>	MIPS, Verilog
<b>Web Development</b>	PHP, Javascript, JQuery, MySQL, CSS/HTML, node.js
<b>Utilities and Tools</b>	Git, Linux Shell Utilities, Tensorflow

## Coursework

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### COMPUTER SCIENCE AND ENGINEERING

Data Mining *	Networks	Probabilistic Modelling and Inference *
Statistical Learning Theory	Natural Language Processing	Introduction to Machine Learning
Compiler Design	Operating System	Algorithms - II
Computing Laboratory - II	Computing Laboratory - I	Data Structures and Algorithms
Computer Organization	Fundamentals of Computing *	

### MISCELLANEOUS

Probability and Statistics	Linear Algebra	Numerical Methods in Engineering
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\* - Excellent Performance

## Positions of Responsibility

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**TUTOR** | ESC101: FUNDAMENTALS OF COMPUTING

*Prof. Swaprava Nath, IITK, Spring 2019 (Ongoing)*

- Tutored a class of 35 students; Responsible for taking a class and grading quizzes every week
- Mentored two students in a project on building a CF Recommendation System

**COURSE MENTOR** | CS771: INTRODUCTION TO MACHINE LEARNING

*Prof. Piyush Rai, IITK, Fall 2018*

**ACADEMIC MENTOR** | ESC101: FUNDAMENTALS OF COMPUTING

*Counselling Service, IITK, 2016-17*

- Took multiple doubt clearing sessions, both hall level and institute level and also gave one-on-one tutoring to a few students