

## Thesis Topics for L-4 T-1 Students

<b>Title</b>	<b>Detail</b>	<b>Student count</b>	<b>TeacherID</b>
System of Linear Equations	Constructing iterative schemes using geometrical intuitions like orthogonal projections.	2	Dr. M. Kaykobad (kaykobad)
Majority Spanning Trees	A study of majority spanning trees, and discover its applications.	2	Dr. M. Kaykobad (kaykobad)
Study on Projective algorithm for LP	Study how nonlinearizing a linear problem results in efficient algorithms.	2	Dr. M. Kaykobad (kaykobad)
AKS algorithm for primality test	Study AKS algorithm as the first polynomial time deterministic algorithm for primality testing.	2	Dr. M. Kaykobad (kaykobad)
Degeneracy in linear programming problem	Study the problem of degeneracy and cycling and construct an algorithm for solving the problem.	2	Dr. M. Kaykobad (kaykobad)
Ontology Based Log Analysis of Web Servers Using Process Mining Techniques	See <a href="https://goo.gl/ZS3pTa">https://goo.gl/ZS3pTa</a> , Topic 1	3	Dr. Muhammad Masroor Ali (mmasroorali)
Ontology Based Clustering of Stack Overflow Topics Using Process Mining Techniques	See <a href="https://goo.gl/ZS3pTa">https://goo.gl/ZS3pTa</a> , Topic 2	3	Dr. Muhammad Masroor Ali (mmasroorali)
Algorithms on Motif Searching	No prior knowledge on Bioinformatics Algorithms is necessary.	2	Dr. Md. Abul Kashem Mia(kashem)
Algorithms on RNA Structures	No prior knowledge on Bioinformatics Algorithms is necessary.	2	Dr. Md. Abul Kashem Mia(kashem)
Algorithms on Protein Structures	No prior knowledge on Bioinformatics Algorithms is necessary.	2	Dr. Md. Abul Kashem Mia(kashem)

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Data Clustering with Privacy-Preserving Data Publication	<p>Clustering is a fundamental problem with a long history and a rich collection of results.</p> <p>A general clustering problem can be formulated as follows. Given a set of points <math>P</math> in a metric space, partition <math>P</math> into a set of disjoint clusters such that a certain objective function is minimized, subject to some cluster-level and/or instance-level constraints. Typically, cluster-level constraints impose restrictions on the number of clusters or on the size of each cluster. The former corresponds to the classical k-center, k-median, k-means problems, while the latter has recently received much attention from various research communities. On the other hand, instance-level constraints specify whether particular items are similar or dissimilar, usually based on some background knowledge. In analyzing big data sometimes a natural instance-level constraint on a clustering problem is imposed where the points are colored and all points partitioned into one cluster must have distinct colors. Such a problem is called clustering with diversity.</p> <p>The main motivation to study clustering with diversity is privacy preservation for data publication, which has drawn tremendous attention in recent years in both the database community and the theory community. The goal of all the studies in privacy preservation is to prevent linking attacks.</p>	2	Dr. Md. Saidur Rahman (saidurrahman)
Link Protection for Reliable Networks	<p>High reliability and performance are needed as the Internet becomes an important social infrastructure. Critical links are those whose failures significantly degrade the performance. Thus critical links must be protected by rapid recovery so that failures cannot be detected over the IP layer. The number of these protected links must be small to restrict investment cost of facilities and operational cost for Internet service providers. Some variations of this problem are proved as hard problems.</p> <p>Development of efficient approximation algorithm will be addressed under this research topic.</p>	2	Dr. Md. Saidur Rahman (saidurrahman)

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Algorithmics and Combinatorics for Beyond-Planar Graphs	Relational data sets, containing a set of objects and relations between them, are commonly modeled by graphs/networks, with the objects as the vertices and the relations as the edges. A great deal is known about the structure and properties of special types of graphs, in particular planar graphs. The class of planar graphs is fundamental for both Graph Theory and Graph Algorithms, and extensively studied. Many structural properties of planar graphs are known and these properties can be used in the development of efficient algorithms for planar graphs, even where the more general problem is NP-hard. Most real world graphs, however, are non-planar. In particular, many scale-free networks, which can be used to model web-graphs, social networks and biological networks, consists of sparse non-planar graphs. To analyze and visualize such real-world networks, we need to solve fundamental mathematical and algorithmic research questions on sparse non-planar graphs, which we call beyond-planar graphs. This research topic will focus on the issues of beyond-planar graphs.	2	Dr. Md. Saidur Rahman (saidurrahman)
Graph Theoretic Characterization of Rigid Structures with Applications in Structural Engineering and Bioinformatics	Rigidity of a structure is to be determined by graph theoretic characterization. Has applications in analysis of both civil engineering structures and protein structures.	2	Dr. Md. Saidur Rahman (saidurrahman)
Topics will be fixed by discussion after assignment	Other topics from Graph Theory Graph Drawing, Computer Networks, Complex Network Analysis Online Algorithms, Distributed Graph Algorithms might be fixed by discussion based on interest and ability of the students.	5	Dr. Md. Saidur Rahman (saidurrahman)
Information network		2	Dr. Md. Monirul Islam (mdmonirulislam)
Data Mining		2	Dr. Md. Monirul Islam (mdmonirulislam)
Evolutionary Computation		1	Dr. Md. Monirul Islam (mdmonirulislam)
Diabetic Prediction based on Personal Historical Data	There are many factors like food, exercise, family background etc. that affect the diabetic patient. A prediction model will be developed using data mining tool for the prediction of diabetic of a person.	2	Dr. Abu Sayed Md. Latiful Hoque (asmlatifulhoque)
Game-based e-Learning for the study of Mathematics	Game-based e-Learning has now widely been using in different area of learning. A game-based e-Learning system will be developed for the learning of Mathematics in primary level.	2	Dr. Abu Sayed Md. Latiful Hoque (asmlatifulhoque)

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Performance Evaluation of Problem-Based e-Learning (PBeL) System for Programming Languages	A Problem-Based e-Learning (PBeL) System for Programming Languages has already been developed under a project of ICT Division, GOB. A model will be developed for the performance evaluation of the system.	1	Dr. Abu Sayed Md. Latiful Hoque (asmlatifulhoque)
Data Hiding through Image Steganography	Data hiding is an emerging and challenging research topics now-a-days as people like to hide the secret information from the attackers while transmitting it over a distance. Information like password, credit card information and military commands must hidden during transmission. One of my PhD student is just going to complete his PhD on this topic and several Masters and Undergraduate is working in this area.	1	Dr. Mohammad Mahfuzul Islam (mahfuz)
Data Hiding through Image Steganography	Data hiding is an emerging and challenging research topics now-a-days as people like to hide the secret information from the attackers while transmitting it over a distance. Information like password, credit card information and military commands must hidden during transmission. One of my PhD student is just going to complete his PhD on this topic and several Masters and Undergraduate is working in this area.	2	Dr. Mohammad Mahfuzul Islam (mahfuz)
Design an Auto-driver Architecture	With the advent of computing technology, human life is changing very rapidly. People are now thinking about smart city where driver-less car will move on the road to reduce accident and traffic Jam. Many companies has designed auto-driver but those are not suitable for Bangladesh. The primary architecture of the design has already been build and we need to design a good architecture for it.	2	Dr. Mohammad Mahfuzul Islam (mahfuz)
Design of Smart City Architecture	In Future, all the cities will be smart where all sort of devices will be connected as plug and play. The poles on road will be smart to handle the communications including that is required for smart navigation. The primary architecture has already been developed and it is required to extend the architecture to make it more elaborate. One PhD student is also working in this area.	2	Dr. Mohammad Mahfuzul Islam (mahfuz)
Detection identity Fraud in Social Network	Social network has become the part of our everyday life. However, many people theft the identity of others or create false identity to make crime. We need a protection system for avoid such incidents. We can use different statistical factors like writing speed, patterns of use etc to protect the identity of social network. Need to enhance the existing model or develop a new model for this.	2	Dr. Mohammad Mahfuzul Islam (mahfuz)

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Bangla Corpora	Bangla Corpora or Sketch Engine is a tool for linguists, lexicologists, lexicographers, researchers, translators, terminologists, teachers and students working with Bengali to easily discover what is typical and frequent in the language and to notice phenomena which would go unnoticed without a large sample of Bengali text.	2	Dr. Mohammad Mahfuzul Islam (mahfuz)
Bangla speech to text converter	Converting Bangla speech to text using IPA font	2	Dr. Mohammad Mahfuzul Islam (mahfuz)
Data Analytics	We plan to get some real life data from the industry and then analyze the data from different angles using graph theoretic concepts and/or learning tools etc.	3	Dr. M. Sohel Rahman (msrahman)
Bioinformatics Problems	We would like to work on a range of Bioinformatics problems. No prior knowledge is necessary but you should be a quick learner and not afraid to do simulations and learn new tools. Particular problem to work on will be fixed after discussion.	3	Dr. M. Sohel Rahman (msrahman)
Metaheuristics for Hard Real-life Problems	The goal here is to apply metaheuristics approaches to solve real-life problems that are hard to solve optimally. No need for prior knowledge; but you should be enthusiastic about research, a quick learner and not afraid to code. The actual problem to be handled will be fixed after discussion. Possible domains include but are not limited to Transportation, Bioinformatics, Networking etc.	3	Dr. M. Sohel Rahman (msrahman)

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Autonomous Navigation algorithms for Robots	<p>The main goal would be to develop the autonomous navigation algorithms. The algorithms can be programmed to the robot model and we can do the simulation in V-REP to see whether the robots can navigate through the environment.</p> <p>If the robots can navigate successfully in the simulation environments, we may consider implementing the algorithms in a toy car and in a Quadrotor. Possible cases:</p> <p>Project on Robotic (Self-driving) Car: Development, simulation and experimentation of a robotic (self-driving) toy car.</p> <p>Project on Flying Robot (Quadrotor): Design, development and simulation of an autonomous navigation algorithm for a flying robot (quadrotor) in the outdoor environment.</p>	2	Dr. M. Sohel Rahman (msrahman)
Simulation of GI Track	Development of a Simulator for GI (Gastro-intestinal) Track to aid the design and development of self-propelling capsule robot for capsule endoscopy.	2	Dr. M. Sohel Rahman (msrahman)
Graph Theoretic Characterization of Coverage Problem in Visual Sensor Networks	A visual sensor network (VSN) consists of a number of self-configurable visual sensors with adjustable spherical sectors of limited angle (often known as Field of View). One of the fundamental problems of VSNs is to cover maximum number of targets using minimum number of sensors. This classical Min-Max problem is known to be NP-hard. The existing heuristics have a number of weaknesses that influence their coverage. Therefore, in this research we plan to develop heuristics using novel graph theoretic approaches that will lead to near-optimal coverage.	2	Dr. A.K.M. Ashikur Rahman (ashikurrahman)

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Affective Computing: Within and Beyond the Basic Emotions	<p>One of the primary goals of Affective Computing (AC) is to develop systems that automatically detect and respond to users'™ emotions. Human emotions can be categorized into two category: "basic emotions" (e.g., anger, disgust, sadness etc) and "non-basic emotions" (e.g., engagement, boredom, confusion, frustration etc). Despite significant progress on the recognition of basic emotions, non-basic emotion received less attention from the research community. In this research, we shall systematically track down both basic and non-basic emotions from human expressions.</p>	3	Dr. A.K.M. Ashikur Rahman (ashikurrahman)
Why Google Glass Broke?	<p>Within couple of years of its invention, the famous Google Glass disappeared quickly from the market. As a lazy learner/researcher we couldn't get much exposure to Google Glasses within this short interval. But with the recent purchase of Google Glass at the CSE department, BUET under Higher Education Quality Enhancement Project (HEQEP), we are now in a position to investigate why it disappeared and explore some interesting research using Google Glass by developing research applications. Some of the applications that we envision are: real time Face recognition, Lie detection, Guiding people through a building/city, reading and translating road signs from images etc etc..</p> <p><b>Warning</b>: This will be a very challenging research project requiring good programming skills, attitude-to-learn, hard work and self motivation!!</p>	2	Dr. A.K.M. Ashikur Rahman (ashikurrahman)
Multi-Objective Similarity Search on Trajectories	<p>Spatial computing has recently been targeted as a key growth area as the quantity and quality of GPS data being collected in multiple domains has dramatically increased in recent years. For example, a sequence of foursquare check-ins give a data trail of a user'™s daily activities; a sequence of flicker photo uploads from different locations signifies the user'™s travel behaviour; a travel paths of taxis give a nice idea about the traffic and human movement in a city. In this project, we will develop a deep-learning based technique to search and rank trajectories based on user queries.</p> <p>Subject Areas: Spatial computing, data management, machine learning</p>	1	Dr. Mohammed Eunos Ali (eunos)

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Finding Optima Location for Location based Social Network Users	<p>A recent work presented an example application where the advertisements of the upcoming events are displayed to the users based on their proximity and social connectivity. Here, a user is likely to attend an event if it is nearby to his location, and several of his friends are also going there. Therefore, the application is to recommend an event to each user <math>u</math> such that (i) the distance/travel time between <math>u</math> and the event is minimized, and (ii) the number of friends of <math>u</math> to whom that event is also recommended, is maximized. The new problem is to find the optimal location to organize an event, so that the maximum number of users will likely to attend that event, or in other words, the event will be recommended to the maximum number of users based on the spatial proximity and social connectivity.</p> <p>Subject Areas: Social networks, query processing</p>	1	Dr. Mohammed Eunos Ali (eunos)
Augmented Reality Meets Spatial Databases	<p>Tango is an augmented reality computing platform from Google. It enable users to use their Tango-enabled smartphones to capture the physical environment through 3D mapping, to navigate in the space through visual positioning systems, to play with the augmented objects in the real space. Many interesting apps have been recently developed based on Tango platform. In this project, we will explore interesting applications and develop efficient techniques for indoor navigation by exploiting different spatio-temporal features of captured 3D environment. Please visit <a href="https://get.google.com/tango/">https://get.google.com/tango/</a> for more details.</p> <p>No of students: 1 or 2</p>	1	Dr. Mohammed Eunos Ali (eunos)



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Multi-Objective Similarity Search on Trajectories	<p>Spatial computing has recently been targeted as a key growth area as the quantity and quality of GPS data being collected in multiple domains has dramatically increased in recent years. For example, a sequence of foursquare check-ins give a data trail of a user’s daily activities; a sequence of flicker photo uploads from different locations signifies the user’s travel behaviour; a travel paths of taxis give a nice idea about the traffic and human movement in a city. In this project, we will develop a deep-learning based technique to search and rank trajectories based on user queries.</p> <p>Subject Areas: Spatial computing, data management, machine learning</p>	2	Dr. Mohammed Eunos Ali (eunos)
AB	<p>We will develop a deep-learning based Agricultural Bot (AB) that can intelligently answer farmers’s queries related to agricultural problem. AB will primarily work on the image data, where images of different agricultural problems like pests, diseases, etc will be analyzed to build deep learning based model, and then intelligently answer farmers queries.</p> <p>Subject Areas: Image processing, machine learning</p>	2	Dr. Mohammed Eunos Ali (eunos)
Sentiment Analysis from Bangla Social Media Content	<p>Sentiment analysis of social media contents (e.g., Facebook status, comments, etc. ) is a key for supporting a wide range of applications. These applications include identifying public reaction on a sensitive issue, getting public opinion on a Government policy, determining users’s feedback on a commercial product, predicting the trend of a share market, identifying malicious activities, etc. in this project, we propose to build techniques and tools for analyzing Bangla social media contents to identify and extract subjective information in source materials, which is known as sentiment analysis/opinion mining.</p> <p>Subject Areas: Text mining, machine learning</p>	1	Dr. Mohammed Eunos Ali (eunos)

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Study of Micro-structure of Cellular Tissue	<p>Subject: Biomedical Imaging</p> <p>Abstract: This project is to study image and micro-structure of cellular tissue and to find properties to provide computational model. Programming knowledge is required. Machine learning knowledge is preferred.</p> <p>(This project will be done in collaboration with Dr. Tanvir R. Faisal, Northwestern University, USA)</p>	2	Dr. Mahmuda Naznin (mahmudanaznin)
A Reliable Routing Approach in Underwater Sensor Network	<p>Subject: Systems and Networking</p> <p>This is to study routing algorithm for under water network.</p> <p>(NS3 Simulator has to be used)</p>	1	Dr. Mahmuda Naznin (mahmudanaznin)
Quick Communication in Smart Vehicular Network	<p>Subject: Systems and Networking, Smart City</p> <p>Abstract: This project is to study better communication in Vehicular Network. The method has been already implemented in NS2 and for realistic approach it has to be mapped in VANETsim.</p>	1	Dr. Mahmuda Naznin (mahmudanaznin)
Distributed Method for Finding Optimized Network Flow	<p>(Subject: Distributed Algorithm, Machine Learning)</p> <p>This project is to find the optimized value for heterogeneous data in network flow. Machine learning can be helpful in this case.</p> <p>(Programming knowledge is required)</p>	2	Dr. Mahmuda Naznin (mahmudanaznin)
Data Forwarding Strategy in Named Data Networking	<p>(Subject: Bid Data, Systems and Networking)</p> <p>Abstract: Content based networking is attracting researchers as a part of next generation internet and web structure. NDN is a content based networking where data is identified by its name. This project is to study data forwarding rules and strategies in NDN. (NS3: NDNsim has to be used)</p>	2	Dr. Mahmuda Naznin (mahmudanaznin)
Digittization of Bangladesh Land Maps		2	Dr. Md. Monirul Islam (mmislam)
scene reconstruction/person tracking from multiple CCTV cameras		2	Dr. Md. Monirul Islam (mmislam)
Deep learning for automatic annotation in large image databases		2	Dr. Md. Monirul Islam (mmislam)

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Data analytics and business intelligence	Data analytics and business intelligence is very important in recent trends. The use of Weka in such analytics provides a useful tool for efficient and easy analysis.	3	Dr. S. M. Farhad (smfarhad)
Data analysis in health domain using R and Python	Data analysis in health domain using Python and R.	2	Dr. S. M. Farhad (smfarhad)
Performance evaluation of Mobile Edge Computing (MEC) architecture	Mobile Edge Computing (MEC) is a network architecture that enables cloud computing capabilities and an IT service environment at the edge of the cellular network. By using mobile edge computing technology, a cellular operator can efficiently deploy new services for specific customers or classes of customers. MEC technology reduces the signal load of the core network, and also reduces costs to host new services. Students will study MEC architecture and conduct performance evaluation of MEC. This is a joint research work with Prof. Ying-Dar Lin, NCTU, Taiwan.	2	Dr. Md. Shohrab Hossain (mshohrabhossain)
Cyber Threat intelligence Data mining and botnet detection	Cyber attacks cause huge losses to Government, businesses. Cyber Threat intelligence (CTI) is collection of intelligence from open source, social media or from the deep and dark web. Threat intelligence can help organizations better prepare for the incoming cyber attacks by Botnets. This is work students will analyze threat intelligence data and propose techniques for botnet detection	2	Dr. Md. Shohrab Hossain (mshohrabhossain)
Deep Packet Inspection and Privacy violation	Deep packet Inspection (DPI) examines the data (payload) part and also the header of a packet as it passes an inspection point, for protocol non-compliance, viruses, intrusions, or defined criteria to decide whether the packet may pass or not. Deep packet inspection gives ISP gives a lot of information users connections and habits of Internet usage. This work will investigation of privacy violation by ISP through DPI.	2	Dr. Md. Shohrab Hossain (mshohrabhossain)

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Crowdsourcing	<p>Delivery of packages by involving crowd has become a popular model in recent years. In this research project, we envision a novel way for delivering packages in an efficient manner. We plan to exploit public transport network. Passengers of transports usually have some routine travel paths like going to office or a supermarket or a bank. During their journeys, they might become interested to carry a package for delivery if in return they are rewarded. We will develop a crowdsourcing based approach to schedule package delivery tasks with the minimum cost.</p> <p>This work will be done in collaboration with Dr. Flora Salim, RMIT University, Australia</p>	1	Dr. Tanzima Hashem (tanzimahashem)
Data Mining	<p>Differential Privacy is a widely accepted framework to achieve privacy. In the centralized setting, users share data with central trusted authority. In local setting, users don't share their data with any trusted party and want their data to be protected from others before leaving their devices. Differential privacy in local setting is termed as local differential privacy (LDP). In this project, our aim is to construct a classifier that yields good prediction while maintaining privacy within the framework of LDP.</p>	1	Dr. Tanzima Hashem (tanzimahashem)
Spatial Database	<p>Planning user trips in an effective and efficient manner has become an important topic in recent years. Family members normally have many outdoor tasks to perform within a short time for the proper management of home. For example, the members of a family may need to go to a bank to withdraw or deposit money, a pharmacy to buy medicine, or a supermarket to buy groceries. Similarly, organizers of an event may need to visit different points of interests (POIs) such as restaurants and shopping centers to perform many tasks. In this research project, we will develop a novel query type in spatial database that will enable a group to schedule their tasks with the minimum cost. To know more details, you can have a look at <a href="https://openproceedings.org/2017/conf/edbt/paper-99.pdf">https://openproceedings.org/2017/conf/edbt/paper-99.pdf</a></p>	1	Dr. Tanzima Hashem (tanzimahashem)

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Ubiquitous Computing	<p>Building a Fundus IoT Camera Using Android Mobile Phone in Ubiquitous Environment</p> <p>This work will be done in collaboration with Dr. Sheikh Iqbal Ahamed, Professor of Computer Science and Director, Ubicomp Lab, Marquette University</p> <p>Retinal diseases like diabetic retinopathy, glaucoma, age-related muscular degeneration as well as other retinal diseases are leading causes of blindness worldwide. The blindness can be avoided/cured if the retinal diseases are diagnosed in an earlier stage. To detect the retinal diseases, eye specialists need to take Fundus images of the back of the eye. However, the device used for taking the fundus images is very costly, heavy and immobile in the current situation.</p> <p>Our goal is to build a Fundus IoT Camera Using Android Mobile Phone in the Ubiquitous environment that will take images inside the fundus of the eye. This will be an application of IoT generating Big Dataset of retinal images and will help to find a common pattern in data sets of Retinal images by doing Data Analysis Research to detect Retinal diseases. This camera should have the following features:</p> <ul style="list-style-type: none"> <li>(i) Able to take images of at least 45 degrees of retina</li> <li>(ii) Able to go through pupil size smaller than 2mm</li> <li>(iii) Compact</li> <li>(iv) Light weight</li> <li>(v) Have green and infrared mode</li> </ul> <p>Upon completion of this project, the following accomplishments can be done right away-</p> <ul style="list-style-type: none"> <li>(i) It will be a very powerful application of IoT in Ubiquitous Computing Environment.</li> <li>(ii) Big Dataset of Retinal images can be collected very easily.</li> <li>(iii) The Big Data collected through this IoT camera will contribute in Data Analysis Research Field to find a Pattern to detect Retinal diseases.</li> </ul>	2	Dr. Tanzima Hashem (tanzimashem)

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Redesigning Road Networks of Dhaka City through Simulation	Road networks, exhibiting performance below expectation such as that of Dhaka, demand redesign and reformation. Traffic simulator can substantially facilitate such redesigning and reformation tasks. This thesis is expected to focus on redesigning road networks of Dhaka based on traffic simulation to enhance on-road experience in Dhaka. Tentative work to be done in the thesis covers simulating existing road networks of Dhaka using DhakaSim (a traffic simulation tool), identifying different alternative redesigns for the road networks, and evaluating performance of the alternatives in through DhakaSim.	1	Dr. A. B. M. Alim Al Islam (razi)
Deploying Smart Sensors on Railways for Avoiding Derailments	Derailments of trains due to uprooting or damage of rail tracks are common in third-world countries such as Bangladesh. Solutions for this problem adopted in developed countries are not applicable here, as rail lines in third-world countries often experience different environment and settings such as open exposure to public. This necessitates designing and deploying new smart sensors on the rail lines, which are expected to be focused in this thesis.	1	Dr. A. B. M. Alim Al Islam (razi)
Enhancing Human Interaction in an On-line Open Reporting System	On-line open reporting systems are required for different reasons such as anti-corruption enforcement, harassment reporting, etc. However, people are often reluctant to participate in such systems both from reporter and action-taking ends. This thesis is expected to focus on minimizing the reluctance. Tasks involved in this thesis could be identifying reasons for the reluctance, designing the systems to resolve the reasons, and evaluating performance of the designs.	1	Dr. A. B. M. Alim Al Islam (razi)
Future Disease Prediction through Biological Data Mining	People often face new diseases over the period of time. Can we predict what would be the nature of new diseases that we are going to face in future? This thesis is expected to explore this through biological data mining pertinent to different diseases and different species.	1	Dr. A. B. M. Alim Al Islam (razi)
Artificial Intelligence through Quantum Computing	Quantum computing is experiencing substantial enhancements in recent times. When it would get matured will the contemporary AI remain in its current stage or it will exhibit a leap on progressing? This thesis is expected to explore this.	1	Dr. A. B. M. Alim Al Islam (razi)

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Interaction between Machine Learning and Neuroscience	<p>Neural computing captures a set of problems and approaches in modeling the brain, and designing biologically-inspired information processing systems. The ultimate goal for an artificial system is to learn from experience and understand the world in terms of concepts, which in turn helps the system to create new experiences and understanding of its world. Recent algorithmic advances and availability of computational resources has helped in coming closer to this goal and changed the field of artificial intelligence and machine learning immensely.</p> <p>The term "deep learning" was coined a few years ago, and has its foundations in decades of artificial neural networks (ANNs) research. Deep learning algorithms are focused on learning good underlying representations of the data, expressed as a hierarchically organized and multi-layered ANN, where layers are usually separated by a non-linear transformation. Deep learning has been shown to perform as well as, or in some examples better than, human experts in a variety of tasks including object classification in images, automated handwriting generation, image caption generation, natural language understanding using question and answering systems, and machine translation.</p> <p>Some evidence suggests a close relationship between the representations that are learned by these deep learning algorithms and biological nervous systems. Striking similarities between the visual system organization and the representations learned by deep learning algorithms have been demonstrated recently. Yet how closely different layers of deep learning architectures are related to representations in different brain systems (e.g. audition, high-level cognition) is still an area of active research. In this thesis, we will explore recent findings in computational neuroscience and new advances in deep learning. We will dig for evidence that links neuronal responses to stimuli in the brain with representations of the same stimuli learned by deep learning.</p>	2	Dr. Muhammad Abdullah Adnan (adnan)

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Distributed Computing with Blockchains and Databases	<p>A new era is emerging in the world of distributed computing with the growing popularity of blockchains (shared, replicated and distributed ledgers) and the associated databases as a way of integrating inter-organizational work. Originally, the concept of a distributed ledger was invented as the underlying technology of the cryptocurrency Bitcoin. But the adoption of it for use in the commercial or permissioned environments is what is of utmost interest and hence will be the focus of this thesis. Computer companies like IBM and Microsoft, and many key players in different vertical industry segments have recognized the applicability of blockchains in environments other than cryptocurrencies. IBM did some pioneering work by architecting and implementing Fabric, and then opensourcing it. Now Fabric is being enhanced via the Hyperledger Consortium as part of The Linux Foundation. A few of the other efforts include Enterprise Ethereum, R3 Corda and BigchainDB.</p> <p>While there is no standard in the blockchain space currently, all the ongoing efforts involve some combination of database, transaction, encryption, consensus and other distributed systems technologies. Some of the application areas in which blockchain pilots are being carried out are: smart contracts, supply chain management, know your customer, derivatives processing and provenance management. In this thesis, we will survey some of the ongoing blockchain projects with respect to their architectures in general and their approaches to some specific technical areas. We will focus on how the functionality of traditional and modern data stores are being utilized or not utilized in the different blockchain projects. We will also distinguish how traditional distributed database management systems have handled replication and how blockchain systems do it. Since most of the blockchain efforts are still in a nascent state, the time is right for database and other distributed systems researchers and practitioners to get more deeply involved to focus on the numerous open problems.</p>	2	Dr. Muhammad Abdullah Adnan (adnan)



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<p>Online Principal Component Analysis on Streaming Big Data</p>	<p>Principal component analysis (PCA) is a method of choice for dimension reduction in Big Data Analytics. It projects high dimensional data into a lower dimensional space, and is widely used for dimensionality reduction, signal denoising, regression, visualization etc. In the current context of data explosion, online techniques that do not require storing all data in memory are indispensable to perform the PCA of streaming data and/or massive data. Despite the wide availability of algorithms that can efficiently update the PCA when new data are observed, the literature offers little guidance on how to select suitable sampling for a given application. In this thesis, we will review the main approaches to online PCA, namely, perturbation techniques, incremental methods and stochastic optimization, and compare the most widely employed techniques in terms statistical accuracy, computation time and memory requirements using artificial and real data.</p> <p>Large-scale matrix computation becomes essential for many data applications, and hence the problem of sketching matrix with small space and high precision has received extensive study for the past few years. Recent work on matrix sketching has developed various constructions based on either sampling or embedding streaming matrix sketches (such as frequent direction) into a sliding-window data summary for both time-based and sequence-based windows. In this thesis, we intend to use sliding-window based sketching techniques to derive new algorithm for online PCA. We will provide both formal theoretical guarantees, in terms of update cost and space approximation error tradeoff, and extensive experimental evaluations over a large collection of real and synthetic data sets evaluating performance of our algorithm in practice. Extensions of online PCA to missing data, to distributed data and to functional data will also be explored while understanding their behaviors in different error metrics.</p>	1	Dr. Muhammad Abdullah Adnan (adnan)

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Offloading Computation in Mobile Environment	<p>Offloading computation to the cloud for energy conservation has recently been studied in the context of mobile devices. To address the challenges in response time and communication overhead, two level hierarchical architecture has been proposed to bring data and computation close to each other by adding an intermediate layer of surrogate servers (cloudlets) which are in logical proximity (within WiFi) of the end nodes. Existing techniques for task delegation in such environments have only considered offloading computation to a single/multiple surrogate servers considering stationary end nodes. However, in scenarios like wearable computers (e.g. google glass, smart watch etc. enabled with constant collection of data), the end nodes are highly mobile and surrogates have small coverage area with small cells (e.g. femtocells placed on bus stop, lamp post etc.). In these cases, the end-nodes can be connected to different sets of surrogates at different times. This brings new challenge to the offloading problem, as we need to keep track of the sets of surrogates that are connected to an end node and move unfinished tasks and data between surrogates for effective offloading.</p> <p>In this thesis, we seek to build tools for runtime support on mobile devices to partition, migrate and concurrently execute subtasks at nearby surrogate servers. We intend to develop solutions for augmented reality applications that involve significant computation that can be delegated and distributed among surrogate servers. In progress, we have modified the MapReduce framework to incorporate mobility and modified the source code of XML-RPC to incorporate fault-tolerance on Android platform. The remaining tasks are to (i) automate the partitioning decision based on the response time and resource availability both in the mobile device and nearby surrogates, (ii) develop efficient algorithm for load balancing among surrogates with resource and timing constraints and (iii) deploy our implementation on femtocell/picocell.</p>	1	Dr. Muhammad Abdullah Adnan (adnan)

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Rate of Convergence of Iterative Machine Learning Algorithms	Convergence rate study for probabilistic machine learning algorithms is a very important but very difficult task. In this thesis, we will formulate a model for Probabilistic Principal Component Analysis (PPCA) and analyze the convergence rate of PPCA and prove the convergence rate based on property of Markov chain.	1	Dr. Muhammad Abdullah Adnan (adnan)
Research on Smart Grid	Cyber Security/Game Theory/Intelligent Systems	2	Dr. Rifat Shahriyar (rifat)
Research on Memory Management	Large scale systems/Apache Spark systems or applications	2	Dr. Rifat Shahriyar (rifat)
Research on Stack Overflow Data	Exploratory Analysis/Empirical Analysis/Prediction Model	1	Dr. Rifat Shahriyar (rifat)
Research on Smart Healthcare	Android/iOS application design and development for intelligent depression detection and support system	1	Dr. Rifat Shahriyar (rifat)
Phylogenetic tree (evolutionary history) reconstruction using whole genome sequences.	<p>The overarching goal of this research project is answering impactful biological questions, especially those related to the study of evolution, by developing algorithms that can accurately analyze very large genome-scale datasets. The ongoing big data revolution in genomics can vastly increase our understanding of biology only if our computational toolkit can keep up with the pace of ever increasing abundance of molecular data.</p> <p>In this project, we will be developing efficient algorithms for inferring phylogenetic trees (evolutionary trees) from genome-scale data. Phylogenetic trees provide insights into basic biology, including how life evolved, the mechanisms of evolution and how it modifies function and structure, orthology detection, disease evolution, criminal investigation etc. A species tree represents the evolutionary history of a group of organisms, while a gene tree shows the evolutionary pathways of a particular gene within a group of organisms. Interestingly, different genes evolve in different ways, meaning that they do not necessarily have identical evolutionary histories. This is known as gene tree discordance, and can arise from incomplete lineage sorting, gene duplication and loss, horizontal gene transfer, hybridization etc. In this particular project, our research will contribute to the problem of fast and accurate species tree estimation from genes sampled throughout the whole genome, considering the presence of gene tree discordance due to gene duplications and losses.</p>	2	Dr. Md. Shamsuzzoha Bayzid (bayzid)

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DNA storage: incorporating medical imaging data with DNA sequence	<p>DNA storage refers to the process of storing digital data in the base sequence of DNA. Recently, researchers from the University of Washington and Microsoft Research have collaborated in working on how to take digital files and convert them into strings of DNA that can be easily stored and read back. They successfully developed a complete system to encode, store and retrieve digital data using DNA molecules, which can store information millions of times more compactly than current archival technologies. Please see the following links:</p> <p><a href="http://www.washington.edu/news/2016/04/07/uw-team-stores-digital-images-in-dna-and-retrieves-them-perfectly/">http://www.washington.edu/news/2016/04/07/uw-team-stores-digital-images-in-dna-and-retrieves-them-perfectly/</a></p> <p><a href="http://www.dailymail.co.uk/sciencetech/article-3530591/Radical-breakthrough-stores-digital-pictures-DNA-time-revolutionise-computer-storage.html">http://www.dailymail.co.uk/sciencetech/article-3530591/Radical-breakthrough-stores-digital-pictures-DNA-time-revolutionise-computer-storage.html</a></p> <p><a href="https://homes.cs.washington.edu/~luisceze/publications/dnastorage-asplos16.pdf">https://homes.cs.washington.edu/~luisceze/publications/dnastorage-asplos16.pdf</a></p> <p><a href="http://www.sciencemag.org/news/2017/03/dna-could-store-all-worlds-data-one-room">http://www.sciencemag.org/news/2017/03/dna-could-store-all-worlds-data-one-room</a></p> <p><a href="https://en.wikipedia.org/wiki/DNA_digital_data_storage">https://en.wikipedia.org/wiki/DNA_digital_data_storage</a></p> <p>With the advent of cheap and fast dna sequencing technologies and the growing interest in personalized medical care, DNA sequences of patients are becoming very important in health care system. In this exciting project - considering the recent success in storing digital data in DNA sequence - we will be focusing on the possibility of incorporating a patient's imaging data (CT scan, MRI etc.) with his DNA sequence. The basic idea is to convert ones and zeroes in digital data into the four basic building blocks of DNA - Adenine (A), Guanine (G), Cytosine (C) and Thymine</p>	2	Dr. Md. Shamsuzzoha Bayzid (bayzid)

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Application of machine learning in disease prediction using electronic health records (EHRs)	<p>An electronic health record (EHR) is a digital version of an individual's medical data. EHRs include a wide range of data, including demographics, medication, doctor's notes, laboratory test results, imaging reports, vital signs, hospital discharge summary, billing information etc. The widespread availability of observational health data, collected throughout the health care spectrum in the form of EHRs, enables us to apply big data analytics for preventative medical care. The primary goal is recognizing disease risk and taking action at the earliest stage.</p> <p>In this project, we will be using advanced machine learning techniques for early prediction of various diseases by mining hidden clues in EHRs. The recent years have witnessed a surge of interests in data analytics with EHRs. Companies like Google, IBM (IBM Watson), Dell are investing billions of dollars for data driven healthcare to leverage the EHRs for preventative and personalized medical care. Our goal in this project will be contributing towards this direction. In addition to the classical data mining techniques, we will particularly explore the application of "deep learning" in mining EHRs. We aim to explore TensorFlow (<a href="https://www.tensorflow.org/">https://www.tensorflow.org/</a>), a fascinating open-source software library for machine learning developed by Google. We will be using the MIMIC dataset (<a href="https://mimic.physionet.org/">https://mimic.physionet.org/</a>) - a very popular critical care database which is freely available and quite comprehensive in terms of EHR recordings in Intensive Care Unit (ICU) settings.</p>	1	Dr. Md. Shamsuzzoha Bayzid (bayzid)
1. Evading malware classifier for different software security attacks.	<p>Nowadays machine learning classifiers have become a strong tool to detect malwares. Availability and popularity of malware classifier motivate adversary to devise techniques that can fool malware classifiers. Thus the robustness of a malware classifier has become a very important metric to analyze performance of the classifier. In this project, we try to develop a deep neural network based malware classifier and test its robustness against known adversarial attacks.</p>	1	Dr. Anindya Iqbal (anindyaiqbal)

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2. Automatic detection of different software development vulnerabilities (e.g. NOSql injection, cross-site scripting) using Machine learning techniques.	For automatic detection, codes will be analyzed and features will be designed automatically applying natural language processing techniques. This project will require application of machine learning and NLP techniques.	1	Dr. Anindya Iqbal (anindyaiqbal)
3. Machine learning based prediction/detection of Post-Chikungunya Rheumatoid Arthritis (in collaboration with the relevant doctors of BSMMU).		1	Dr. Anindya Iqbal (anindyaiqbal)
4. Prediction on Typosquatting errors for URLs registered under .bd domain (with real URL log dataset from BTCL).		1	Dr. Anindya Iqbal (anindyaiqbal)
5. Sentiment analysis on community discussions on the articles published about European football leagues.		1	Dr. Anindya Iqbal (anindyaiqbal)
Dynamic Waste Management System for Smart Cities	A smart city is a vision to adopt multiple information and communication technology (ICT) solutions in the management of public affairs. Waste management problem is acute in the cities and urban areas now a days. Number of trucks roaming around, collecting waste at any time, excessive manpower requirement and inefficient monitoring are some of the difficulties we face with the conventional waste collection approach. The purpose of our work is to introduce a smart and intelligent waste management system that is able to handle the process dynamically and cost effectively.	2	Dr. Sadia Sharmin (sadia)
Application for Well-being of Hypertensive Patients	Hypertension is the single most significant risk factor for heart disease, stroke and kidney disease. The key causes of hypertension can be directly linked to the lifestyle of the patient, including age, family history, smoking, obesity etc. Our work consists of an interactive mobile application that acquires these lifestyle information and use several recommendation techniques to warn and guide the user towards well-being.	1	Dr. Sadia Sharmin (sadia)

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Application for Well-being of Hypertensive Patients	Hypertension is the single most significant risk factor for heart disease, stroke and kidney disease. The key causes of hypertension can be directly linked to the lifestyle of the patient, including age, family history, smoking, obesity etc. Our work consists of an interactive mobile application that acquires these lifestyle information and use several recommendation techniques to warn and guide the user towards well-being.	1	Dr. Sadia Sharmin (sadia)
A step towards Smart city	<ul style="list-style-type: none"> <li>a. Smart irrigation using weather prediction and type of crops</li> <li>b. Water logging management</li> <li>c. Personal marketing</li> <li>d. e-health, m-health applications</li> </ul>	1	Dr. Sadia Sharmin (sadia)
Algorithms for sustainable network	Application of algorithms in Link Prediction, sustainability, Fault tolerance	2	Dr. Sadia Sharmin (sadia)
Estimation of copy numbers in genomes	<p>Copy number variations (CNVs) are variations in the number of times some sections in the genome are present in different individuals. CNVs have been associated with cancer and other diseases. Moreover, presence of repeats is the main challenge in genome assembly. The goal of this project will be to devise and implement a method for estimating copy numbers using generative models for sequencing.</p> <p>* For some background on genome assembly please see <a href="http://escholarship.org/uc/item/6hx4q2gm">http://escholarship.org/uc/item/6hx4q2gm</a></p> <p>** No prior knowledge of biology is necessary</p>	2	Dr. Atif Hasan Rahman (atif)
Genome assembly reconciliation	<p>Genome assembly is the process of merging 'reads' generated by sequencing technologies to construct the original genome. Most of the genome assemblies are incomplete due to the computational hardness of the problem and practical challenges. Genome assembly reconciliation is the process of merging multiple assemblies in order to produce a higher quality consensus assembly. We will devise and implement a method for reconciliation of assemblies generated by multiple assemblers and/or multiple types of data.</p> <p>* For some background on genome assembly please see <a href="http://escholarship.org/uc/item/6hx4q2gm">http://escholarship.org/uc/item/6hx4q2gm</a></p> <p>** No prior knowledge of biology is necessary but will be helpful</p>	2	Dr. Atif Hasan Rahman (atif)

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Estimation of genetic risk of diseases of various populations	In the last decade, many genetic variants have been identified that elevate or decrease risk of various diseases (or traits). We will combine data from GWAS Catalog ( <a href="https://www.ebi.ac.uk/gwas/">https://www.ebi.ac.uk/gwas/</a> ), the 1000 Genomes Project ( <a href="http://www.internationalgenome.org/">http://www.internationalgenome.org/</a> ) and other sources to assess genetic risk of diseases of various populations and develop a web-based tool to explore the results. * No prior knowledge of biology is necessary but will be helpful	1	Dr. Atif Hasan Rahman (atif)