SIT Summer Research Projects 2017/2018
Round 2 Projects

SIT2017/1A Local Community Search in Large Graphs
Supervisor: Prof Lijun Chang lijun.chang@sydney.edu.au - School of Information Technologies

Project description: Given a graph G and a set of query vertices, this project aims to compute a local community (aka cohesive subgraph, e.g., with minimum degree at least k) in G that contains all query vertices. In this project, we will consider several cohesiveness measures, such as minimum degree, average degree, minimum number of triangles each edge participates in, and edge connectivity. Moreover, a demo system may be developed to compare the results of local community search based on different cohesiveness measures.

Requirements (if applicable): Strong C/C++ or Python programming skills

Reading material (if applicable)

SIT2017/2A Encrypted Traffic Analytics
Supervisor: Dr. Suranga Seneviratne suranga.seneviratne@sydney.edu.au - School of Information Technologies

Project Description: More than half of the web traffic is currently end-to-end encrypted. While encryption ensures privacy in communication, it poses number of challenges to network management and security. On the one hand, as the encryption traffic increases it is becoming increasingly difficult to detect malicious activities happening inside an enterprise network such as distribution of malware or the traffic generated by a compromised computer to its command and control server. On the other hand, in some occasions the users may assume total privacy in their communication, nonetheless TLS metadata, DNS messages, and statistical properties of the packet bursts will reveal their actions implicitly. Thus, it is important to understand the analytics potential of end-to-end encrypted web traffic.

This project aims to study what type of information can be inferred from the network traffic flows generated by popular messaging apps such as Viber, Skype, WeChat, i-Messages, and Facebook Messenger using machine learning methods. Example targeted inferences are, whether the user is making a call or text chat or whether the user is sharing an image or video. The project also aim to study the countermeasures that can be implemented to circumvent such threats.

Related Reading:

Requirements: Background in Networking and Machine Learning is required. Previous experience in WireShark and Python will be an added advantage.

SIT2017/3A Zero-shot learning based user identification network
Supervisor: Dr Suranga Seneviratne suranga.seneviratne@sydney.edu.au - School of Information Technologies

Project Description: Number of IoT solutions allow to continuously sense the ambient environment for human activities. For example, Amazon Echo and Google Home are always-on microphones that are able to record the sounds of the environment. WI-Fi CSI or Li-Pi based sensors allow to track people’s gait using the variations of the RSS or ht intensity/shadow.
The aim of this project is to leverage the capabilities of zero-shot learning to develop an user identification system that continuously learn and add users into its training algorithm and trigger the administrator when a new user is identified. For example, consider an always-on microphone located in an office space where it is initially trained to identify regular users of the office space. Once a visitor enters the space, the tracking system will identify that the user new and will add him to the training algorithm once sufficient number of audio data samples are acquired.

Related Reading:

Requirements: Background in Machine Learning and Python is required. Previous experience on Tensorflow/PyTorch will be an added advantage

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<th>Project Description</th>
<th>Supervisor</th>
<th>Email</th>
<th>School of Information Technologies</th>
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<tr>
<td>SIT2017/4A Health/medical data analytics platform pipeline</td>
<td>Dr Josiah Poon</td>
<td><a href="mailto:Josiah.poon@sydney.edu.au">Josiah.poon@sydney.edu.au</a></td>
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<td><strong>Project description:</strong> Diagnosis and treatment data for stroke patients are available. This dataset came from different sources. The project aims to use the stroke dataset as prototype to develop a generic data analytic platform and pipeline to for different types of disease. The project should demonstrate the platform that is capable to deliver useful results for such health/clinical data research project.</td>
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<td>SIT2017/5A AI-guided financial trading</td>
<td>Dr Matloob Khushi</td>
<td><a href="mailto:matloob.khushi@sydney.edu.au">matloob.khushi@sydney.edu.au</a></td>
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<td><strong>Project Description:</strong> Financial markets including stocks and forex constantly fluctuate. Apart from individual company performances, various external factors such as human psychology of the masses, local and international news contribute to the dynamics of the markets. Forecasting the level of the impact of these factors on financial markets is a dream of many decision makers. Development of an artificial intelligent (AI) agent based on Elliott Waves can make this dream a reality. Elliott Waves theory describes the repetitive patterns and impact of human psychology on financial markets. However, the manual analysis of these patterns is very laborious and subjective. AI has been shown to successfully unveil the hidden patterns in data. AI implementation to financial data can help to identify social mood of the masses and thus the movement in financial markets, which in turn can lead to stabilising of the socionomics of the society. Therefore, in this project, we anticipate studying the socionomics patterns by digging deep into the historical data and market reaction to predict future direction of the markets. We will explore the use of machine/deep learning to correctly identify the Elliott wave trend. We will also investigate the correlation and the level of the impact of news, human sentiments or company performances on a sector.</td>
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<td><strong>Requirements (if applicable):</strong> Machine Learning / Data Mining</td>
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<td>SIT2017/6A Secure Red Belly Blockchain Wallet</td>
<td>Dr Vincent Gramoli</td>
<td><a href="mailto:vincent.gramoli@sydney.edu.au">vincent.gramoli@sydney.edu.au</a></td>
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<td><strong>Project Description:</strong> Building upon recent research achievements in distributed computing, the University of Sydney has just developed the fastest blockchain, the Red Belly Blockchain. Unfortunately, at this stage there is no secure wallet application, and only expert users can make use of the blockchain to transfer usyd-coin. In this project, you will join the Concurrent Systems Research Group to design a new safe wallet that can tolerate up to a configurable amount t of hackers. The wallet will allow a user to retrieve the balance of his address (i.e., account), to generate new public-private key pairs and to send usyd-coins to his contact list.</td>
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To this end, the wallet will contact between \(t+1\) and \(2t+1\) of the peers running the Red Belly Blockchain and identify whether some respondents were hijacked and if it is necessary to send the request to other servers if the response is actually correct. This project requires knowledge in mobile application development and excellent programming skills in Java or Swift.

**SIT2017/7A Blockchain exchange platform**
**Supervisor:** Dr Vincent Gramoli – vincent.gramoli@sydney.edu.au - School of Information Technologies

**Project Description:** Building upon recent research achievements in distributed computing, the University of Sydney has just developed the fastest blockchain, the Red Belly Blockchain. In this project, you will join the Concurrent Systems Research Group to design an efficient blockchain exchange platform. The goal of this project is to design a web platform that consists of monitoring the balance of multiple accounts and crediting new coins. It will allow to connect with existing payment platforms and generate coins on the user account based on the amount transferred from fiat currency in a simulated environment. The research challenge will be to provide a platform that will guarantee the security and legitimacy of the transfers through KYC and authentication.

This project requires excellent programming skills and knowledge of electronic payment systems

**SIT2017/8A Development of reliable text recognition for historical prints**
**Supervisor:** Dr Masahiro Takatsuka masa.takatsuka@sydney.edu.au - School of Information Technologies

**Project Description:** This project aims to develop a new method, which will compensate the degraded printing of very old newspapers and reliably extract texts from them. It will involve the development of various image processing methods and also new heuristic machine learning technique to reliably extract text information.

**SIT2017/9A Visual Analytics for Complex Networks**
**Supervisor:** Prof Seokhee Hong seeokhee.hong@sydney.edu.au - School of Information Technologies

**Project Description:** This project will design, implement and evaluate visualisation methods for complex network data sets, including social networks and biological networks.

**SIT2017/10A Visual Analytics for Massive Networks**
**Supervisor:** Prof Seokhee Hong seeokhee.hong@sydney.edu.au - School of Information Technologies

**Project Description:** This project will design, implement and evaluate visualisation methods for massive networks, involving billions of nodes, in distributed computing environment.