Capstone projects COMP5703 – Semester 1 2018

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CP 1	Graphonomics	Individual project
CP 2	The Logbook Suite	Group project
CP 3	Fine Grained visual categorization	Group project
CP 4	Academic Capability Mapping	Group project
CP 5	Decision Making over Street Networks	Group project
CP 6	Relationship between Social Media and Crime	Group project
CP 7	Visualisation of Spatial Temporal Density Functions	Group project
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CP 12	An online platform for promoting healthy eating and physical activity	Group project
CP 13	Animal Welfare Rating System App	Group project
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CP 15	Mobile phone usability analysis	Group project
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CP 20	Building a health data analytic platform	Group project
CP 21	Analysing eczema data	Individual project
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CP 24	Automatic identification and mapping of fine scale structures using hyperspectral data	Individual project
CP 25	SkulBot: Visual Programming Environment for 3d-Printed Robots	Group project
CP 26	Job scheduling in fog computing environment.	Individual project
CP 27	Routing Protocol for Internet of Things.	Individual project
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CP 1 - Graphonomics

Graphonomics is a cutting-edge interdisciplinary field in the scientific analysis of the handwriting process, end-product and associated features with increasingly prevalent applications in forensics, digital security and neuroscience. Handwriting movement is unique to an individual and can provide insights into mental state and health condition. This project consists of 2 parts: (i) develop and/or install a suitable handwriting app on a tablet device to collect relevant key handwriting data from randomised individuals, and (ii) apply machine learning techniques to develop a simple handwriting motion analysis program to accurately identify handwriting ownership based on measurements including stroke length, pressure, velocity and unique landmark events in person-specific datasets from part (i) akin to a digital fingerprint.

Required skills: Suitable students will have strong written and verbal communication skills as well as excellent programming skills in Python or Matlab. Suitable students will be strongly interested in applied data sciences, be self-motivated and have achieved academic excellence in units related to statistical analysis, data science and app development.

CP 2 - The Logbook Suite

Doglogbook is an existing app with an associated dashboard. This project has been well received by dog owners and veterinarians, and was selected to feature at the 2016 Vice Chancellor's Recognition Reception.

This free app has been designed for use by dog owners to log details about their animal's health, behaviour and welfare. This information can then be tracked on the dashboard and shared with veterinarians and others involved in the care of the dog. The data entered will then be used for research that will contribute to our knowledge and understanding of dogs.

Following on from the success of this citizen science project, we are looking to expand it to include multiple species, including cats, rabbits and birds. We have been through the process of rebuilding the system for a new species and have learned that a more efficient approach is needed. For this we will build a templating engine, allowing us to add small database elements that are specific to different species and rapidly deploy multiple applications without having to rebuild the system every time.

The project client is Sophie Masters, Project Manager of Doglogbook, with the support and input of Jim Cook, Innovation Lead at the University of Sydney.

Required skills: SQL scripts; Mobile application development and deployment (Android and iOs); some experience with system administration;

The existing stack includes:

- .Net MVC
- ASP.Net Web API
- Entity Framework
- Angular
- Ionic 1

Reference material/links (if applicable):
The main Doglogbook site: doglogbook.com
A Dogmanship project: sydney.edu.au/vetscience/research/dogmanship/projects
Featured on ABC's Catalyst: abc.net.au/catalyst/stories/4532828 and abc.net.au/catalyst/stories/4537241

CP 3 - Fine grained visual categorization

Description: Computer vision field has seen significant advances on image classification. The state-of-the-art models are able to achieve around 5% top-5 error rate. Many published models are trained on ImageNet with 1000 categories. The categories contain a wide range of natural or manmade objects such as Egyptian cat or grand piano. The training set is carefully crafted to have the same number of training samples in each class.

Fine Grained Visual Categorization is a sub field of image classification. It tries to distinguish sub categories within an entry-level category, for instance, fine-grained birds or flower species. FGVC deals with much larger number of categories with overlapping features. The data set is usually highly imbalanced due to the variations of species' popularity. FGVC has many potential applications, for instance; it can be used as field guide for general or education purpose. This project aims to explore various ways to build models for fine grained visual categorization. Publicly available data set will be used for training and testing.

Requirements: fluency in Python language and some knowledge on machine learning

CP 4 - Academic Capability Mapping

Estimating academic capability and potential collaboration by conducting researcher network analysis and visualisation is a key insight for various areas of a complex organisation. Many institutes have implemented such collaborative networks on the researchers' profile pages based con co-authorship. However, such similarity metrics do not show much value to the researchers their own because they already know whom they have collaborated with in the past. This project seeks using state of the art statistical analysis and visualisation techniques to build and show network of collaboration between researchers based on Natural Language Processing of their existing publications and grants.

This project intends to further develop a network visualisation app that connects researchers based on the potential of establishing future collaborations. This interactive visualisation can be used as an exploratory tool to encourage a researcher expanding his/her network to a wide variety of researchers based on different distance metrics. Currently there is an existing prototype for automatically generating the research collaboration network.

 The goal of this project is to further develop the front, back ends of the existing prototype web app, and develop the following features:

(1) New distance metrics between researchers. How can potential successful collaborations be described and predicted? Not only based on document similarity.
(2) Implement other visualisation options.
(3) Including search capabilities on front-end for adding new academic comparison and project proposal.

Recommended knowledge: Python, D3 visualisation

CP 5 - Decision Making over Street Networks

How to navigate within a complex street network in order to maximise a reward function is a complex problem. There are existing algorithms that allow approximate decision making under uncertainty in a Euclidian space. However, this project aims to provide better-informed decision making by planning directly over street networks.

The applications of this novel framework allows generalisation of existing techniques for decision making in street networks and a new family of kernels for non-parametric regression models that can improve accuracy over Euclidian space kernels.

The goals of this project are the following:

(1) Conduct decision making over a street network using Open Street Maps.
Apply Decision Making algorithm to police patrolling scenario and car sharing/pooling optimisation.

CP 6 - Relationship between Social Media and Crime

The occurrence of crime can be modelled by using probabilistic models that capture demographic and environment information. Given the strong presence of Social Media in modern society, it is imperative to use the information captured in these channels to explore potential patterns that can help identify the occurrence of specific types of crime, developing more sophisticated models for crime risk assessment tools.

The goals of this project are the following:

1) Conduct a review on existing methods for social media and crime pattern recognition.
2) Extract geo-referenced information from social media, or to use pre-gathered datasets.
Use social media data and aggregated crime data to find patterns of criminal activity. The basic idea is to conduct a regression model based on demographic and social media features.

CP 7 - Visualisation of Spatial Temporal Density Functions

There are an increasing number of tools to visualise spatial/temporal data. Lately, the use of java-script and web visualization applets is becoming the norm due to its flexibility. Data61 has developed an open source platform called TerriaJS. However, it is not easy to interface in order to represent continuous density function.

The goal of this project is to:

1) Implement the visualisation of spatial/temporal density surfaces over a geographical map. In order to achieve this, the project will make use of the latest release of Deck.gl a large-scale WebGL-powered Data Visualization platform.
Visualise over Deck.GL the paths of autonomous cars, including the decision tree and reward function over street levels to understand decision making.

CP 8 - Connect

Information submitted by the project proposer/supervisor will go up on web site; (Please keep as closely to this model as possible as all project proposals need to be uniform to go onto the web site):

Connect is a mobile-and-tablet app, with elements of a blended virtual learning environment. This app will change the way we communicate and engage with prospective future undergraduate students in a modern channel they use and understand. It will complement, streamline and consolidate our outreach and marketing efforts, and enable us to achieve broader reach than physical on campus activities. It will provide an ongoing communication and engagement platform allowing further contact following an interaction, either directly or by referral (to NCSS, GPN, First Robotics, etc). It will contain content to help students understand the possibilities our engineering and IT degrees afford. It will alert them to events they may be interested in and enable event registration and attendance tracking. It will track and reward user interactions.

We will gather user contact and behavioural data (learning analytics) which we will mine.

From a business perspective, *Connect* could be viewed as a CRM and loyalty program.

Multi-year strategy:

Years 8-10

- Attract and engage through a mobile game
- Gather user and behavioural data
- Identify potential students based on game play and other criteria

Years 9-12

- Introduce and facilitate other engagement opportunities, open days, events, programs
- Maintain communication through news and updates
- Include gamification elements to link back to the game and maintain engagement

Years 11-12

- Encourage visits to the University
- App transforms into utility and sales tool
- Maintain direct communication
- Continue to include gamification elements, keeping it fun
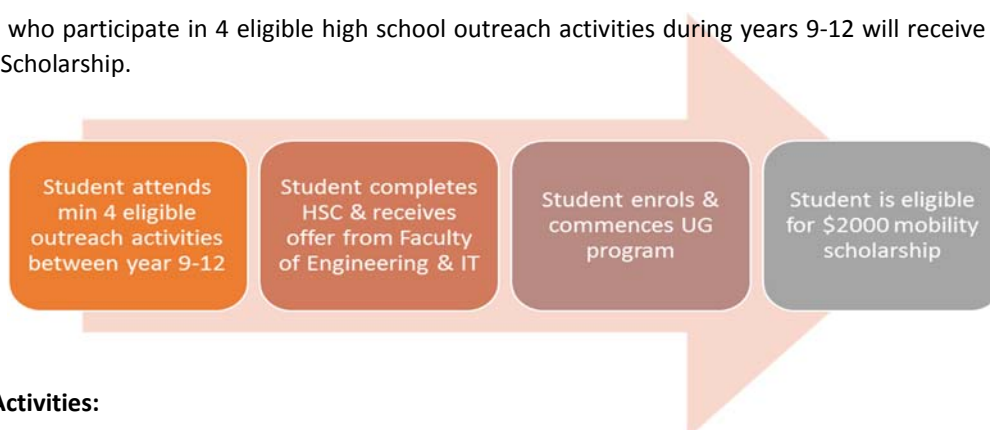
Connect incorporates 'Propel' - https://sydney.edu.au/engineering/propel
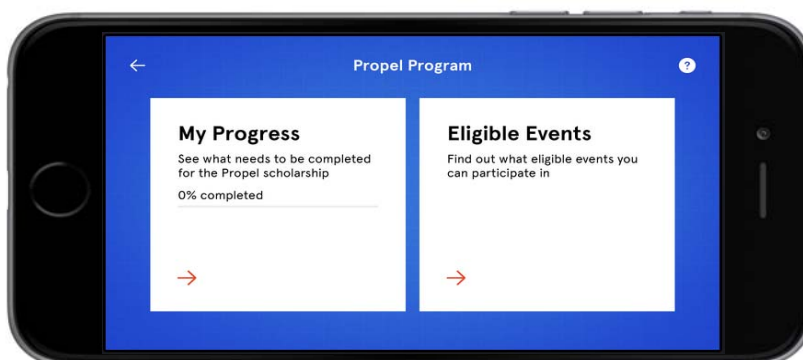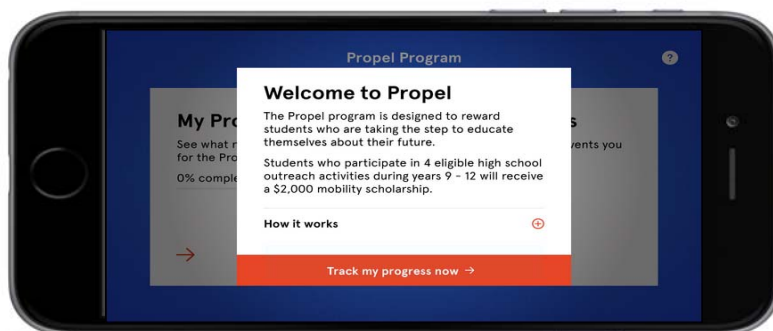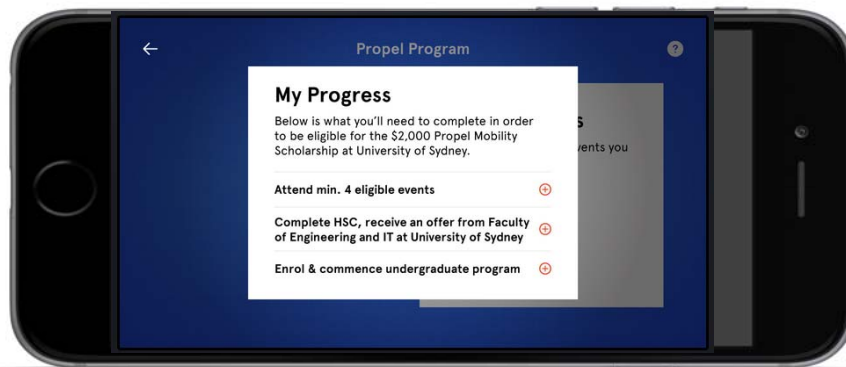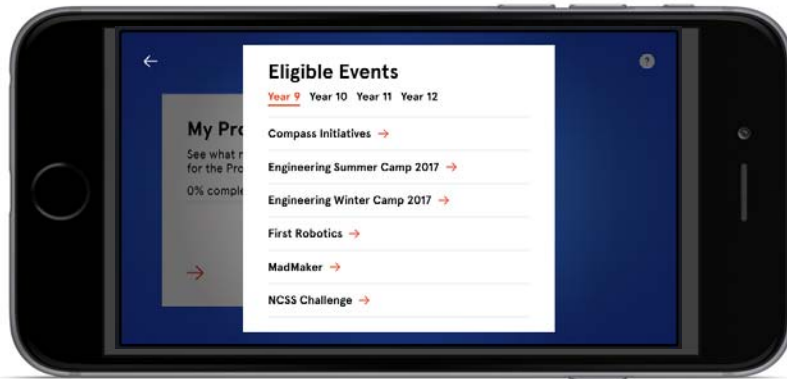
Propel is a sub-app and has its own specific requirements.

How it works:

Students who participate in 4 eligible high school outreach activities during years 9-12 will receive the Propel Mobility Scholarship.

Eligible Activities:

There are 9+ (and growing) eligible activities that students in Yr 9-12 can participate in.

Activity	Y9	Y10	Y11	Y12
Cochlear Autumn School of Engineering			x	x

Compass Initiatives (15+ available)	x	x	x	x
Explore Engineering Summer Camp	x	x		
Explore Engineering Winter Camp	x	x		
First Robotics	x	x	x	x
Honeywell Engineering			x	
Indigenous Australian Engineering Summer School		x	x	x
Indigenous Student Engineering Spring Workshop			x	
Information Day				x
Life @ Sydney			x	
MadMaker	x			
NCSS Challenge	x	x	x	x
NCSS Girls Programming Workshop	x	x	x	x
NCSS Summer School			x	x
Open Day	x	x	x	x
Project Management Winter Camp		x	x	x
STEM Girls @ Sydney	x	x		
Work Experience		x		
Zero Robotics	x	x	x	x

What we need:

We require a CRM platform, which will be able to capture the following:

- Min Required Specs.
    o Name
    o High School
    o Year at School
    o Email address
    o Activities completed (and points gained)
    o Calendar of upcoming activities with links to registration

This is part of a Multi Phase Rollout Plan

Connect Project - MVP Rollout Plan

Focus for this project

Out of scope (S2)

Deliverables:

CRM activated in sandbox mode and sample comms prototyped. 'Propel' logic is defined and inserted into CRM. CRM Data model documented. Clickable prototype or better developed.

Specific requirement:

The target CRM is Salesforce. The target mobile development environment is Unity 3D. A role based permissions system will operate to control access to the relevant functions.

Able and willing to meet with partner is necessary for satisfactory completion of the project; English language competency; Experience in modern programming languages, namely C/C++, JavaScript, SQL; Experience in iOS and Android mobile development environments; Experience working with UNIX Operating System, Windows Operating Systems. Experience establishing and maintaining code repositories.

Reference Material/Links:

https://sydney.edu.au/engineering/propel

Detailed wireframes have already been created and will be supplied to this project for reference, extension and improvement.

A prototype Unity 3D game has also been developed that will be available to the project team.

CP 9 - BluPrint

Information submitted by the project proposer/supervisor will go up on web site; (Please keep as closely to this model as possible as all project proposals need to be uniform to go onto the web site):

**This is a companion project to *Connect*.**

BluPrint, part of *Connect*, is a mobile-and-tablet game based around engineering and IT principles. *Connect* is a blend of CRM, loyalty program and quasi virtual learning environment providing an ongoing communication and engagement platform with future undergraduates (ie: current Australian high-school students). *Connect* will contain content to help students understand the possibilities our engineering and IT degrees afford. *Connect* will alert them to events they may be interested in and enable event registration and attendance tracking. *Connect* will track and reward user interactions. The *BluPrint* game is designed to be a honey-pot that attracts them to enroll in *Connect* and to consume our other digital offerings / websites.

A game design brief has been prepared and will be supplied.

A companion prototype Unity 3D game has been developed and will be supplied.
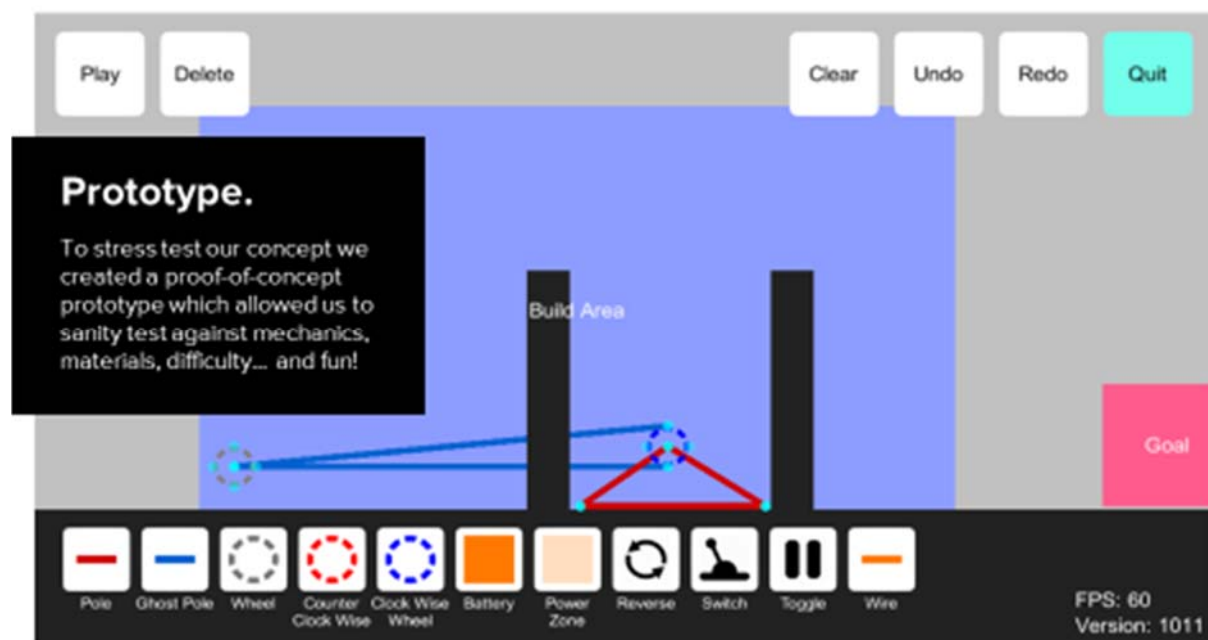
Detailed wireframes have already been created and will be supplied for reference, extension and improvement.

Build mode A.

Using a blueprint metaphor, we provide a 'sandbox' type environment for the players to combine materials in an attempt to solve the objective on each level.

Each material has its own unique properties.

Here you can see the build area, a set of available materials, obstacles and the goal.

We plan an inventory management system. Different challenges require different materials. Game play may unlock materials. Materials are subject to rules and other constraints we can vary.

The purpose of this project is to prepare a functional specification for the technical platform (client-server-database with advanced analytics) that underpins the game design brief and that anticipates the CRM components (built on Salesforce, however this is a separate project).

What we need:

We require a technical design for the platform, preferably including:

- Client environment built upon Unity3D, deployable to iOS and Android for mobile and PC and Apple desktop/laptop
  Back end architecture on AWS ec2 and S3 (or suitable alternative)
- Build scripts for (AWS) architecture
- Investigation of suitability of AWS GameLift - https://aws.amazon.com/gamelift/
- Github repository to support dev/staging/prod environments
- Web Services (REST?) + mobile game
- Integration to Facebook gameroom
- Game logic configurable from Google Sheets or suitable alternative
- Game data schema and storage (Google sheets, SQL database or suitable alternative)
- User database with integration to Salesforce CRM
- Learning analytics – snowplow analytics https://snowplowanalytics.com/ or suitable alternative

This is part of a Multi Phase Rollout Plan

Connect Project - MVP Rollout Plan
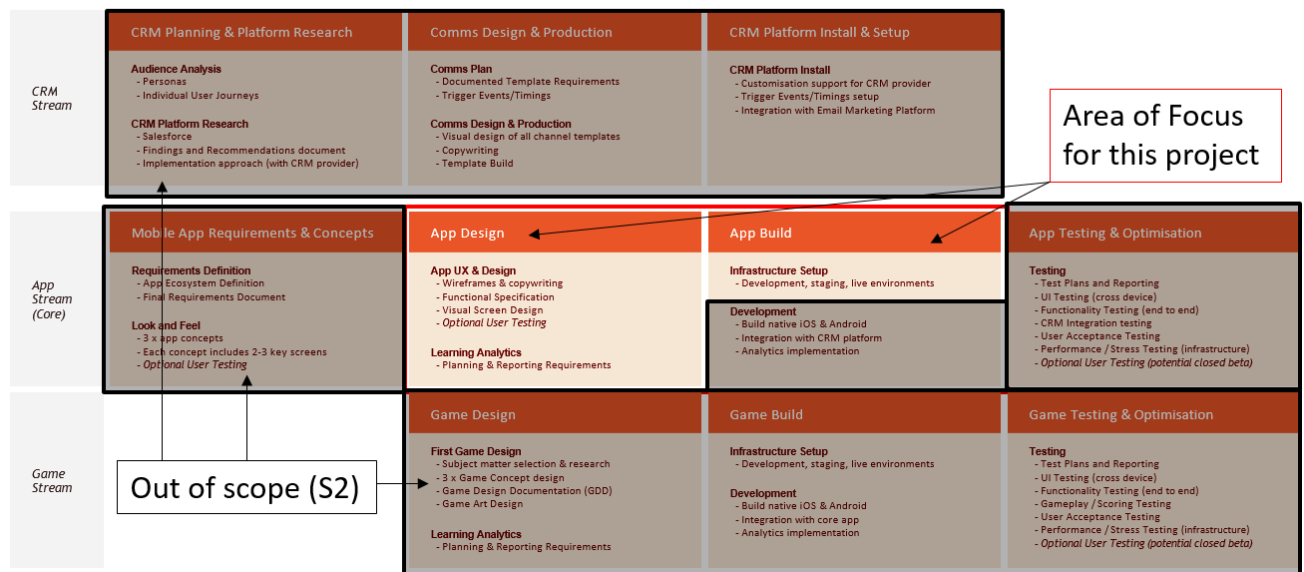
Deliverables:

Functional specification for data model and architecture of both client and server, including github repository.

Specific requirements/skills (if applicable):

The target CRM is Salesforce. The target mobile development environment is Unity 3D. The target server is AWS. A role based permissions system will operate to control access to the relevant functions.

Able and willing to meet with partner is necessary for satisfactory completion of the project; English language competency; Experience in modern programming languages, namely C/C++, JavaScript, SQL; Experience in iOS and Android mobile development environments; Experience working with UNIX Operating System, Windows Operating Systems, AWS. Experience establishing and maintaining Github code repositories.

Reference Material/Links (if applicable):

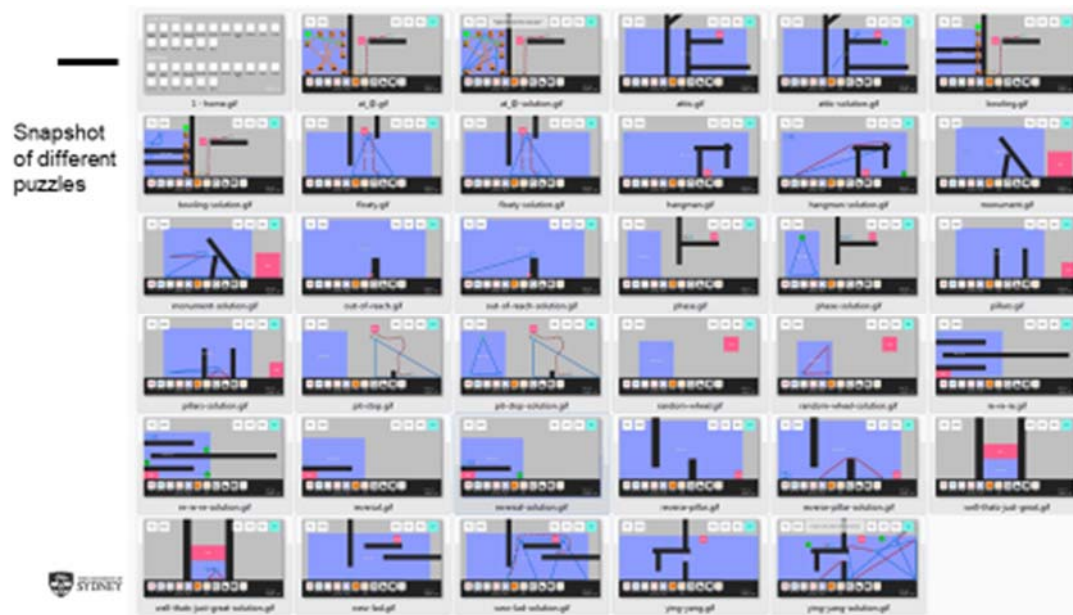Detailed wireframes have already been created and will be s

upplied for reference, extension and improvement.

A prototype Unity 3D game has also been developed that will be available to the project team. Sample games include:

A game design brief has been developed and will be supplied to the project team.

CP 10 - Object Tracking Applications

Object tracking is one of the core tasks in the field of computer vision and plays a critical role in many applications such as security surveillance. This project is to develop an object tracking system with advanced techniques in computer vision and artificial intelligence.

Technique skills: strong programming skills and math

CP 11 - Vision based Food Safety Analysis

Food safety is critical for everybody's health. This project aims to develop advanced vision based solutions to evaluate food safety with advanced imaging and pattern recognition techniques.

Technique skills: strong programming skills and math

CP 12 - An online platform for promoting healthy eating and physical activity

Over 25% of adolescents in Australia are overweight or obese. However, adolescents are a relatively underserved group for primary prevention of obesity in Australia. This project aims to build a web based online platform for The Students As Lifestyle Activists (SALSA) program to support teenagers to promote healthy eating and physical activity within their home.

Technique skills: strong web programming skills

CP 13 - Animal Welfare Rating System App

In Australia and around the world, public concern for animal welfare has grown, and people increasingly want to find animal-based products that have been produced more humanely. The current project involves using scientific animal welfare ratings for pork, poultry and egg products to create a user-friendly app, which would enable shoppers to find information regarding the animal welfare conditions of certain products.

The animal welfare ratings app will enable users to "search" "scan" or "browse" by category (pork, poultry or eggs) to find ratings for products, as well as at which stores these products can be bought.

The ratings will be based on scientific welfare criteria that have been peer-reviewed by a global panel of animal welfare experts to assign ratings of "unverified"/ "good"/ "better"/ "best" to pork, poultry and egg products based on their existing third party accreditations (such as RSPCA Approved Farming Scheme).

The ratings will improve the convenience and ease of making welfare-friendly purchase decisions, and improve consumer access to knowledge and information, while reducing confusion around product labels and claims on packaging.

Secondarily, availability of products will be reinforced by the location-based awareness in the application, improving the model. This will also inform a research dashboard, which can be overlaid with demographic information from the Australian Bureau of Statistics to provide reporting on how supermarkets and stores engage with consumers and what the ethics look like on a location-by-location basis. Ideally, such statistics will be mapped over time.

Similar apps include:

CluckAr: https://itunes.apple.com/au/app/cluckar-augmented-reality-free-range-egg-detector/id1093350776?mt=8

Seafood Watch: https://itunes.apple.com/au/app/seafood-watch/id301269738?mt=8

Good On You: https://goodonyou.eco/app/

In regards to app IP, it is proposed that the University of Sydney and the project lead Amelia Cornish own the app jointly.

Specific requirements/skills (if applicable):

English language competency; Experience in C/C++ programming languages; an interest in animal welfare causes (the project is partially funded by an RSPCA grant)

CP 14 - Evaluation Metrics for Health Management App

There are many mobile apps available for people to manage their health and wellbeing. However, the effect of these Apps varies. The project requires you to conduct a systematic literature review and develop a theoretically driven metrics to evaluate the success of a Health App.

You also need evaluate at least 50 Apps using your metrics. Implications to the design of such App in the future should be discussed.

CP 15 - Mobile phone usability analysis

People are replying on mobile phone heavily now, and some of them have become excessive dependent on the phone. An app has been developed to track people's phone usage activities such as number of screen locks. This project requires the students to conduct a pilot test on the App and analyse users' phone usage behaviour.

Skills required Pattern extraction, data analysis.

CP 16 - Predicting transcription factor

Predicting transcription factor binding sites using deep learning the advance of ultrafast sequencing (ChIP-seq) allows the profiling of transcription factor (TF) binding sites genome-wide in a cell. The massive amount of sequencing data generated from these genome-wide profiling of TF requires sophisticated computational algorithm to be developed for accurately identifying TF binding sites.
 Deep learning is the latest development in machine learning that has been successfully utilised to address many bioinformatics applications. In this project, we aim to develop and apply deep learning models for predicting TF binding sites by integrating ChIP-seq data with other biological knowledge. This project will allow you the opportunity to develop and apply cutting-edge deep learning algorithms for solving a key biological problem. You will get involved in all aspects of the development including algorithm design, implementation and testing.

CP 17 - Rare cell type discovery

Rare cell type discovery using AdaSampling Single-cell RNA sequencing (scRNA-seq) is a revolutionary technique that enables the gene expression profiling of thousands of cells. One of the key task in scRNA-seq data analysis is to identify rare cell types that are hiding in the tissue samples such as various cancer stem cells in tumour tissues.
AdaSampling is a semi-supervised machine learning approach that we developed recently for detecting noisy samples in a given dataset. In this project, we will be look into transferring the AdaSampling technique for identifying rare cell types that are previously unknown and therefore labeled "incorrectly" in the initial dataset.

CP 18 - WiFi CSI Based Human Identification

This project explores the possibility of collecting a chosen biometric from a distance (gait, breathing characteristics, or heart rate) using WiFi Channel State Information (WiFi CSI). For example, capturing walking patterns using such a method allows building a human identification system that is able to identify users without extra effort from them (e.g. passwords or wearing a device). The basic experiment set-up is to instrument a corridor with several WiFi transmitters and collect WiFi CSI data for group of users over multiple sessions and build a machine learning model that will be able to to predict the user who is walking in the corridor.

Related Reading: https://www.ceid.upatras.gr/webpages/courses/sensornets/papers/paper12.pdf

Skills required Networking, Machine Learning

CP 19 Designing Robust Controller for Dynamic Resource Allocation in Timely Dataflow and Streaming Data Processing Engines (Apache Storm, Spark & Dask framework)

Today, more and more companies are faced with huge amounts of streaming data that need to be quickly processed in a real time fashion to extract meaningful information. As a concrete example, big enterprises apply sophisticated machine learning algorithms to extract deeper insights from raw data that are continuously generated by their systems. Two of the most popular platforms that can be used for real-time streaming data processing are Apache Storm and Apache Spark. In both systems huge amounts of data must analysed/transformed continuously in main memory units before it is stored on hard drives. One of the major issues posed by such platforms is maintaining the promised QoS level under fluctuations of request rates. Past research shows that the presence of high arrival rate of streaming data within short periods can cause serious degradation of the overall performance of the underlying system.

In this project, we are looking to develop advanced controller techniques for famous Streaming Data Processing Engines such as Apache Storm, Apache Spark and Dask platform to allocate effectively available computing resources. Our main goal is to preserve the QoS enforced by end-users while keeping the resources throughput at an optimal level.

 Requirements:
- Good knowledge of at least one programming language, preferably Rust, C++, C#, Python, Java, Go
- Writing reusable, testable, and efficient code
- Familiarity with Linux, SSH
- Understanding of the multi-threading programming paradigm
- Experience working with Git
- Work closely with the rest of team to solve problems, and transfer knowledge
- Interest in and commitment to learn Design and implementation of low-latency and performant applications
- Interest in and commitment to learn and work with Apache Storm/Spark and improving mathematical background knowledge on controlling systems

Reading material:
- Timely Dataflow, Naiad, Apache Storm, Apache Spark and Dask platform's developer guide
- Model Predictive Control: Basic Concepts
- Control Theory And Its Application to Computing Systems

CP 20 - Building a health data analytic platform

The aim of this project is to create a generic platform for health data analysis. Sample and structure of an instance of data format will be given, but the final data warehouse should have a general schema to to store and manage health data from different sources (including the handling of different languages) for meta-analysis. In other words, an efficient ETL mechanism should be built. The platform should have built in analytic engine as well as easy linkage to popular data mining packages.

Skills required database, software development

CP 21 - Analysing eczema data

This data analytic project studies the effectiveness of treating eczema using Chinese medicine. Since extreme temperatures, these patients poorly tolerate (humidity) or sudden changes in temperature (humidity). The analysis will also be coupled with meteorological data.

Skills required (if applicable) data mining, statistics, it is an advantage to know Chinese

CP 22 - Data analysis of lung cancer treatment using complementary alternative medicine

This data analytic project studies the effectiveness of treating lung cancer using Chinese medicine.

Skills required (if applicable) data mining, statistics, it is an advantage to know Chinese

CP 23 - Data analysis of stroke patients

This data analytic project studies the effectiveness of treating lung cancer using Chinese medicine.

Skills required (if applicable) data mining, statistics, it is an advantage to know Chinese

CP 24 - Automatic identification and mapping of fine scale structures using hyperspectral data

Automatic identification and mapping of mineralogical structures within rocks is important for a great diversity of applications. For example, mapping of minerals in ancient (~2.9 Ga) rocks at fine spatial resolution may identify structures, which are indicative of early life on earth. In addition, the study of diagenesis, which alters minerals in rocks, can shed new light on the mechanisms, which underpin this process. A new generation of imaging sensors, which measure reflected light in a great number of bands (or colours), are able to identify and map minerals at fine spatial resolution. These hyperspectral sensors open up new possibilities for mapping of minerals at small spatial scales. Robust mathematical tools based on machine learning for analysing these data offer great potential for automated clustering of minerals that have a similar composition, thus unlocking important information about the origins of the rock.

Recent advances in deep learning have yielded improvements over more traditional approaches on various tasks. Deep learning consists of algorithms that provide high-level, complex abstractions as data representations through a hierarchical learning process. A benefit of deep learning is the ability to analyse and learn from large amounts of complex data. This makes it a valuable tool for across many domains including engineering, geology, medicine, physics and ecology.

This project will explore how deep learning can be used to identify and map mineralogical structure within ancient rocks using hyperspectral imagery. The Deep Learning results will be compared with existing methods for geological classification. Further, this work will incorporate t-SNE with deep learning in order to capture the network's representation on test data over time.

Skills: Proficiency in Matlab and/or Python, R, knowledge of machine learning/algorithms

CP 25 SkulBot: Visual Programming Environment for 3d-Printed Robots

Background

With the increasing focus on Science, Technology, Engineering and Maths (STEM) in schools across Australia, there is a need to provide primary and high schools with educational STEM platforms for their students. It has

been shown that robots are the most suitable learning aids conveying STEM skills to primary and high school children.

However, existing platforms are expensive and/or limit the children's creativity to design, build, and program robots. With the presence of cheap consumer 3D printers (cf. Aldi's Cocoon Create for $500), and cheap capable microcontroller such as Raspberry Pi Zero W (cf. https://raspberry.piaustralia.com.au for $15), we would like to create a new affordable open-source STEM platform for programmable 3d-printed robots at The University of Sydney.

A new open-source collaborative software suite will give students the capabilities to interactively design, build, and program 3d-printed robots in a step-by-step fashion. With the availability of cheap 3d-printer filament, sensors, actuators, and cheap microcontrollers, the unit price per 3d-printed robot will be less than $50 AUD.

Project

The aim of this project is to develop a collaborative visual programming environment for 3D printed robots. The visual programming environment is geared towards children in the age between 8 and 18. With the visual programming environment, the programming of self-printed 3D robots should become fun, educational, and easy-to-learn. Children will program their robots by dragging blocks from a toolbox and attaching them to other blocks like a mosaic. The method of programming is usually referred to as visual programming / drag-and-drop programming exposing the syntax rules visually rather than on a textual level. The student's programs can be either kept privately or shared publicly such that other children can modify/remix the code.

Google has introduced an open-source initiative called Blockly (cf. https://developers.google.com/blockly/), which is an interactive visual programming language similar to MIT's Scratch. Blockly is a library and, hence, can be extended with ease.

Tasks

1. extend Blockly with new blocks for sensors and actuators of the robot,
2. build an infrastructure that permits the transfer of programs from an internet browser to a 3d-printed robot that is equipped with a Raspberry Pi Zero W,
3. execute the Blockly program on the Raspberry Pi Zero W in Python,
4. extend Blockly with an underlying database such that children can store and share their codes.
5. provide various examples to test the infrastructure. There will be plenty of opportunity to print, build, and program 3d-printed robots; we will use the open-source SMARS robot platform with very simple sensors and actuators.

Requirements: Javascript, Python, Linux

TODO:
1. *FIND BETTER NAME*
2. *BUILD FIRST TESTBED*

CP 26 Job scheduling in fog computing environment.

Equipped with easy-to-access micro computation servers, fog computing architecture provides low-latency and ubiquitously available computation offloading services too many simple and cheap Internet of Things (IoT) devices with limited computing and energy resources. One obstacle, however, is how to efficiently schedule different jobs generated from different IoT devices, so that jobs are completed before deadlines. It is a challenging task since different jobs are featured with different workload, resource requirement, as well as delay constraints. In this project, you will be able to test cutting-edge scheduling algorithms and implement them in real-world systems. You will also have opportunities to design your own algorithms.

Skills required Good math skills

CP 27-Routing Protocol for Internet of Things.

Routing Protocol for Low power and Lossy networks (RPL) has been developed by IETF with the goal of designing a routing protocol for Internet of Things (IoT) applications. RPL is a distance vector based, IPV6 routing and it can be used in a wide variety of IoT applications including Home Automation, Industrial Control, and Smart Grids. RPL builds Directed Acyclic Graphs (DAGs) as the logical topologies over the shared physical network based on the Objective Functions (OFs) specified by users. Creating DAGs starts from border routers, and each node selects the preferred parent by calculating ranks for its one-hop neighbours. However, RPL standard did not specify any particular OF nor routing metrics and left this as an open area for future research. In addition, RPL does not provide any solution for supporting mobility and it has a slow response to changes in the network topology. The goal of this project is to design a new extension of RPL for enhancing packet delivery ratio and supporting real-time communication in mobile IoT applications.

Skills required Cooja, and NS2 simulators will be used for evaluating the performance of new contributions in this project and applicants must be knowledgeable about C, C++ programming. Also, In addition to simulation, TinyOS and ContikiOS will be used as the operating systems of IoT nodes in the test-bed and applicants need to be familiar with Linux environment and writing shell scripts.

CP 28 - An Online Web-Streaming Service for Bitcoin-Exchanges

In recent years, there has been a surge of interest in cryptocurrencies such as Bitcoin from private investors, major financial institutions and governments. Investors require a mechanism to convert between fiat currency and cryptocurrency (and between cryptocurrencies) so several public exchanges (e.g. GDAX) have been created to enable cross-currency trading. Like any exchange, cryptocurrency exchanges have attracted day traders employing a variety of computational finance techniques.

In this project, students will retrieve, store, and visualize data from various cryptocurrency exchanges. Students will also employ data modelling techniques to find suitable data-structures to represent order books of exchanges, will store them in a relational database, and visualize them via a web-interface using java-script.

Required: python, some web-server technologies (preferable the ones based on python) Helpful: git, familiarity with bitcoin, familiarity with stock/currency exchanges. Student cohort: This project is suitable for MIT/MITM students

CP 29 - Visualisation and Prediction for Bitcoin-Exchanges

In recent years, there has been a surge of interest in cryptocurrencies such as Bitcoin from private investors, major financial institutions and governments. Investors require a mechanism to convert between fiat currency and cryptocurrency (and between cryptocurrencies) so several public exchanges (e.g. GDAX) have been created to enable cross-currency trading. Like any exchange, cryptocurrency exchanges have attracted day traders employing a variety of computational finance techniques.

In this project, students will retrieve, store, and analyse data from one or more cryptocurrency exchanges using data visualisation and analysis techniques. Students will also employ various machine-learning techniques to

make predictions about price movements using tensor flow, and test their predictions against live exchange data.

No actual trading will take place during this project; although several exchanges offer a "sandbox" environment, which could be incorporated into a project.

Required: python, some knowledge of popular machine learning techniques. Helpful: git, familiarity with bitcoin, familiarity with stock/currency exchanges Student cohort: This project is suitable for MDS students

CP 30 - AI-guided financial trading

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.

Requirements (if applicable): Machine Learning / Data Mining