BSc Computer Science

Final Year Projects
2020

Welcome

The School of Computer Science and Information Technology is very proud to have had you as a student of the BSc Computer Science for the last four years. It is with regret that it is not possible to hold the traditional Final Year Project Open Day this year due to the Coronavirus Covid 19 pandemic.

Our lecturing staff and our colleagues from industry were looking forward to meeting you at the open day and many have expressed disappointment that the open day is not possible.

The school would like to acknowledge the work you have completed. The projects are diverse in nature and demonstrate the knowledge gained by students across topics such as software development, the web, networks, data analysis, multimedia, embedded systems and databases.

I would like to congratulate you on behalf of the school and wish you all a very successful and rewarding career.

Professor Cormac Sreenan

Head of School, Computer Science and Information Technology

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Evaluating memory allocation algorithms

Casey, Denis

Supervisor:

Professor Michel Schellekens

The aim of this project is to compare different algorithms used for allocating memory. To do this, I have implemented several different algorithms using C++, including first fit, next fit and pool allocation (and maybe buddy allocation).

First fit allocates memory to the first available location in the memory buffer when requested. Next fit is a slight variation on this where, instead of always searching from the start of the memory buffer for a suitably large space in memory, it continues searching from the last allocation.

Pool allocation is probably the simplest algorithm. The memory buffer is divided into fixed size blocks of memory at the start and, when memory is requested, one block is allocated, regardless of how many bytes of memory are actually requested. Finally, buddy allocation consists of multiple different size blocks, usually powers of 2 (e.g. blocks of size 8B, 16B, 32B and 64B). When a number of bytes is requested from the managed memory, the smallest possible block size is allocated. If there are no more of this block size available, then a block of a larger size is divided up into smaller blocks.

I then compared these algorithms based on performance (how fast they can allocate, deallocate) and fragmentation (how much wasted space there is).

Keywords: C++, memory, allocation, comparison, performance, fragmentation

Technologies: C++, Google Test, CMake.

API Server for Cataloguing Comic Books/Graphic Novels

Choy, Calvin

Supervisor:

Dr Jason Quinlan

Abstract: The goal of this project is to create an API server for other developers to use to store information on comic books. For example, the server will store a comic book's volume name, cover photo and the id when it is being submitted by the user. Users will be able to create requests to login to their account and to query comic books that were previously stored by them, thus providing an intuitive and visual mechanism to determine what their catalogues contain. Any response from the server back to the user uses the low latency HTTP/3 QUIC transmission protocol to communicate. While within the application, Quart is a framework implemented in Python to allow for asynchronous tasks. Hypercorn is an ASGI server that can help host apps implemented in Quart. Hypercorn allows the use of HTTP/3 requests to be made to the server. By combining these technologies together, an API server that is asynchronous which provides HTTP/3 as a transport protocol is easily implemented.

Keywords: API server, Asynchronous server, ASGI

Technologies: Quart, Hypercorn, QUIC, HTTP/3, Python.

Chemical Incident Response Interface (CIRI) - IOS application for responding to chemical spillages

Cleary, Colm

Supervisor:

Mr Adrian O'Riordan

In the current chemical landscape, there are software applications which provide "pocket-rocket" hazard guides and incident reporting, but there isn't any application which supports detailed incident reports incorporating dispersion modelling, images, pre-populated fields based on the chemical conditions, and audio recordings and speech-to-text recognition for witness reports.

This iOS mobile application can be used by health and safety officers and all personnel working with chemicals, regardless of their level of technical expertise. With this app, users enter the substance or chemical name and are provided with the level of danger involved in dealing with the chemical in accordance with risk assessment guidelines;

	the actions required in case of chemical spillage; calculated air pollution dispersion, through the use of the Gaussian dispersion equation; and reporting requirements (e.g. HSA/EPA or internal report). The app will utilize the database provided by the European Chemical Agency to retrieve the most up-to-date details on chemicals. **Keywords:** Gaussian air pollutant dispersion modelling, COSHH Regulations, Hazard Classifications, Chemical Incident Reporting. **Technologies**: Swift, Firebase Realtime database, Firebase Firestore database, Firebase storage, Apple's speech recognition services, Core Location.
Creedon, Timothy **Supervisor:** Professor Gregory Provan	## Learning to drive in adverse weather conditions In pursuit of classifying weather one pertinent question we must ask is how resilient is the model we have trained? Safety is the primary concern with regard to autonomous driving, thus a model must be capable of adapting to any given driving environment. In light of this, we decided to investigate the domain of transfer learning. Within this investigation, we desired to determine the effect that the source data set used for training the model has on its transferability. A hypothesis we posed was that a more general training data set would yield a more transferable model. To test this hypothesis, two popular autonomous driving data sets were used, one from the University of Oxford and the other from the University of Berkeley. Preliminary results indicate that the more general data set does indeed result in comparably superior performance. In addition to this we considered the transferability of pre-trained models on ImageNet, notably the ResNet model. ImageNet is significantly more general than either of the two driving data sets, in fact it does not include any form of weather in its classes. With the inclusion of ImageNet we can assess how much specificity is appropriate when deciding on a training data set. **Keywords:** Transfer Learning, Classification, Neural Networks **Technologies:** Keras, Pandas, Scikit learn.
Cronin, Adrian Dominic **Supervisors:** Mr Cathal Hoare Mr Humphrey Sorensen	## CBT Web based application The idea behind this is to help the average business user de-stress and reduce any anxiety they are experiencing at work. With the use of cognitive behavioural therapy, the chatbot will guide the user through a session with the aim of helping the user think more logically instead of attaching feelings to thoughts and situations. Also there is a mindfulness section of the application that users may be redirected to at the end of a therapy session if they would like. There they will take part in a visually guided breathing exercise in an attempt to reduce their heart rate and again reduce their stress levels. A feature of the application is to have as many therapy/treatment centres on show for the user in order for them to seek professional help if they happen to see fit. The chatbot very contextually based instead of menu/button based of most chatbots. The goal here was to allow the user to get an impression of authenticity, as if they were talking to an actual therapist instead of pressing buttons. **Keywords:** CBT: Cognitive Behavioural Therapy, Mindfulness, Chatbot **Technologies:** Dialogflow, ReactJS, PHP, MySQL.
Dai, Anchen **Supervisor:** Dr Paolo Palmieri	## WiFi-based Localization The objective of this project is to test the WIFI locating techniques and compare the techniques which base on the new wireless standard to the current one and analyse its security. In the new wireless standard 802.11mc, the WIFI Round Trip Time (RTT) feature was introduced. The feature supporting devices to measure a distance to other supporting devices: whether they are Access Points (APs) or Wi-Fi Aware peers (if Wi-Fi Aware is supported on the device). In theory, the precision of this technology is within

	2 meters. In this project, multiple devices will be used to test this technology. This project will collect multiple sets of data and set a control group using RSSI positioning. Then, the data obtained are compared and analysed, and the conclusion is finally drawn to evaluate how the RTT performs in the real situation. This project will also consider the security of WIFI locating and RTT prospects. **Keywords:** WiFi Localization, 802.11mc **Technologies:** WiFi Round Trip Time(RTT).
Daly, Marc **Supervisor:** Dr Jason Quinlan	## Web-Based tool for retrieving and displaying statistics and information relating to athletes or sports teams A one-stop-shop of sorts for a user to find statistics and information relating to athletes and teams across a number of different sports. The hope is to finish with a fully functional tool that will save users both time and effort by presenting them with all relevant information on a single page, saving them the need to search multiple web-pages to find the information they require. The tool will be web-based (built as a website), and will function as a single-page application, ie. there should be no page refreshes once the user has been successfully authenticated. This project makes use of some of the latest in cutting-edge web development technologies. The back-end of the project will be built with Laravel, an open-source PHP framework. The front-end of the project will be built using a mixture of ReactJS, a JavaScript Library built by Facebook that is perfect for handling rapidly changing data (the kind that might be relevant to sports!). The project will also utilise TailwindCSS, a brand-new, extremely-customisable CSS framework that provides utility-classes that allow you to build nice-looking, and responsive webpages. **Keywords:** Laravel, React, TailwindCSS, Web Development, Single-Page-Application, HTML, PHP, CSS, JavaScript **Technologies:** Laravel, React, TailwindCSS.
De l'Arago, Joey **Supervisor:** Dr Derek Bridge	## Recommending Artworks Using Machine Learning The aim of this project is to investigate if it is possible to make interesting recommendations for paintings using only content based methods. A few methods are used to gather information about the artworks such as scraping APIs and automated image tagging. The user interacts with the recommender through an android mobile app by swiping right for like and left for dislike. This information is then used to improve the recommendations to the user. Users can also match with an artist if they swipe right on one of their artworks. This leads to a virtual "date" where they can find out more about their history and other artworks. It is an android app written in Kotlin and interacts with the recommenders over REST. The backend is written in python and uses the Flask framework to manage the REST API. This project explores different recommender systems and compares their effectiveness at recommending pieces of art to the user. **Keywords**: Machine Learning **Technologies**: Android, Kotlin, Python, Keras.
Durkan, Donnchadh **Supervisor:**	## Python Package for Enumerating Combinatorial Objects The goal of the project is to create a programmer-friendly Python package that allows developers to access useful combinatorial algorithms. The package aims to build on the

Dr Kieran Herley	foundations of Donald Knuth's work in his book *The Art of Computer Programming Volume 4A: Combinatorial Algorithms,* and provides efficient implementations of several of the algorithms discussed there. Specifically, the package will include the ability to generate all permutations and combinations of a sequence, generate all trees for a given number of vertices, generate all partitions for a given integer, and all partitions for a given set. In addition to this functionality, the package will also allow for the random generation of a mapping of the objects mentioned. The algorithms will be tested against implementations provided by existing Python packages, such as *itertools*, which will provide a useful benchmark for their efficiencies, and give expectations for how the algorithms should function in terms of inputs and outputs. **Keywords:** Combinatorics, permutations, combinations, partitions, trees. **Technologies:** Python, Cython.
Fox, David **Supervisor:** Professor Ken Brown	## Solving Real-Time Dial-a-Ride Problems In the Dial-a-ride problem, a number of fixed-capacity vehicles are dispatched to service user requests. Each user can request a trip, specifying a starting location and a destination, as well as a time window, containing the earliest time for a user (passenger) to be picked up, and the latest time for the user to be dropped off. The service provider then allocates them a seat on a shared vehicle, and includes those locations in the vehicle's schedule. The dial-a-ride problem is a generalisation of the Vehicle Routing Problem with Pickup, Dropoff and Time Windows (VRPPDTW). Typically, these services are provided for social care or hospital appointments: the requests are made days in advance, and the service provider can run an optimiser to generate efficient routes and schedules. But as cities are trying to reduce congestion and improve public transport, there is a growing need for handling immediate bookings, either to carry people to and from public transport systems, or to reduce the number of single car trips. In this project, I have implemented Iterated Local Search, an effective, general purpose metaheuristic which iteratively builds a sequence of solutions generated by an embedded heuristic. Solutions are produced and their performance is tested on sets of generated customer orders. The project aims to determine, through testing and analysis, the most effective configurations of Iterated Local Search to optimise the solution for a number of objectives. The objectives include total journey cost, overall passenger satisfaction, degree of flexibility of each route, and time taken to produce solutions. **Technologies:** Java, Gradle, JComponent **Keywords:** Dial-a-Ride, Iterated Local Search, Metaheuristic, Vehicle Routing
Gallagher, Conor **Supervisor:** Dr Maurizio Mancini	## HCI and Commensality Commensality is defined as a "social group that eats together" and eating in a commensality setting has a number of positive effects on humans. The purpose of this project was to investigate the effects of HCI (Human Computer Interaction) and technology on commensality, and to identify if they can be exploited to replicate the effects of commensality for people who choose or are forced to eat alone. For the purposes of the experiment, the student designed a system consisting of a toy robot, computer vision tracking, and a simple interaction model, that can show non-verbal social behaviors to influence a user's food choice. The student then conducted an experiment using the system to attempt to influence the perception and taste of chocolate, as well as influence the food choices of the subjects taking part in the experiment. The student also used questionnaires to determine the participants reaction to the robot (Artificial Commensal Companion), and their favourability toward future interactions with similar robots.

	Keywords: food; eating; hci; robot; companion; interaction; non-verbal; commensality. **Technologies**: MyKeepOn Robot, Python, Arduino, Xbox Kinect.
Grabos, Julia **Supervisor:** Dr Derek Bridge	## Pets Furever! Predicting Pet Adoptability The aim of this project, using several data science and machine learning techniques, is to make best predictions on pet adoption speeds, from a given dataset. The data used for this goal, is made available through a past Kaggle competition and taken from a Malaysian animal welfare agency, providing an animal adoption service. Pets have digital profiles created, containing information such as name, appearance, age, health, textual profile description, images and so on. Throughout the project, numerous models are built, using Python machine learning libraries such as scikit-lean and keras, and their results are evaluated compared to a baseline. In conjunction to this, several other techniques as various data pre-processing methods, feature engineering and dimensionality reduction are also investigated. Significant areas explored throughout the project are the experiments completed with structured data, textual data and images. Lastly, all three types of data are merged together in a single experiment with the use of keras functional API to build a multi-input neural network and simultaneously feeding all the three types of data, producing a single set of predictions. The best predictions from these experiments will then be submitted to Kaggle to see the effectiveness of the models built in comparison to other entrants of the competition. **Keywords**: Data Science & Machine Learning **Technologies**: Python, scikit-learn, keras.
Greaney, Isolde **Supervisors**: Mr Humphrey Sorensen Mr Cathal Hoare	## Gym Management System The idea of implementing a gym management system came about when a friend had mentioned that while enrolling as a new member of a gym, they had noticed that all members information was filed as paper documents in a physical cabinet. It would be most people's assumption that a company in this era would have important documents with personal information securely stored on a software service. After some research, it was noticeable the amount of gym management systems that were available, but they did not incorporate many aspects that are necessary. Employee management integration and member engagement were the main elements missing. Not only that but while discussing this topic with other gym-goers, it was found that many of them could not pre-book classes resulting in them having to arrive earlier to receive a space in the class. This adds extra stress which is the opposite goal of any gym. Many gym websites display their class times but do not have a booking system implemented. In this project, all of these missing entities have been added, along with current features already available, to create one big management system covering the main necessities in managing and growing a gym's business. **Keywords:** member engagement, employee management integration, booking system, tracking **Technologies**: Pythonanywhere, Flask, Bootstrap.

Hayes, Aaron **Supervisor**: Dr Alejandro Arbelaez	## Use of AI to generate Sokoban puzzles with different levels of difficulty This project investigates the possibility of generating, with the use of AI, varying difficulties of Sokoban like puzzles. Sokoban is a simple puzzle game where the premise is for the player to control a warehouse keeper who must push boxes or crates into specific locations. Each level is a storeroom which varies with a different number of boxes that are randomly placed throughout the room. These rooms have multiple walls, creating a map like feel that the player must traverse in order to find a solution where every box is in a storage location. For this project many sokoban levels were generated with the use of scripts and defined using the planning domain definition language (PDDL). They were then solved using a pddl planner and information of the puzzles, such as how they were solved or aspects of the puzzles itself like how many walls are in the puzzle or the Euclidean distance of the player to the goal, were gathered and used in a prediction system allowing for the ability to see if these puzzles are able to be solved on aspects of the puzzles alone and giving us an understanding of how difficult each puzzle is. **Keywords**: Sokoban, Planning Domain Definition Language (PDDL), PDDL Planner.
Jefferies, Michael **Supervisor**: Professor John Morrison	## Fraud Detection using Big Data and Machine Learning Financial institutes have a growing interest in using machine learning as a method to predict fraudulent credit card transactions. These financial institutes have access to a vast amount of datasets which can be used to create suitable machine learning models, including transaction history of cardholders. The major issue with detecting fraudulent transactions is that they are significantly less common than non-fraudulent transactions. In machine learning terms, this is known as a class imbalance. This class imbalance results in machine learning models that claim to have a high accuracy measure, but fail to label fraudulent transactions correctly. Previous research has primarily relied on smaller datasets, as financial institutes do not wish to share the private data of cardholders. These datasets often lack information about the transactions and offer less transaction history of cardholders. With more transactions and more information about these transactions available now, it potentially opens up new correlations to analyse in the data and have machine learning models learn on these correlations. This project uses a dataset provided by Vesta corporation. This dataset is fed into various different machine learning algorithms after various data preprocessing steps take place. My findings indicate that it's possible to detect fraudulent and non-fraudulent transactions correctly using different machine learning algorithms. My solution to this problem includes tackling the class imbalance present in the dataset and employing measures other than accuracy to evaluate machine learning models. **Keywords:** Fraud, Machine Learning, Class imbalance **Technologies**: Tensorflow, Sci-kit Learn, ZeroMQ, Keras.
Kavanagh, Sean **Supervisor**: Dr John O'Mullane	## Image noising and its effects on the accuracy of facial recognition systems "If your face has ever appeared in a photo on Flickr, it could be currently training facial recognition technology without your permissions." (Mashable UK). In this project we will be analysing how image noising(blurring or speckling an image), such as random noise, fixed noise and banding noise, will affect performance within facial recognition systems and algorithms with a strong reference to modern day use of images on social media like Instagram and Facebook. These images that users of these platforms upload may be used unbeknownst to them for the training onf A.I. in facial recognition

systems, we hope to analyse a possible solution and its effectiveness on preventing this from happening through image noising. We hope to provide you with results that will prove that the images can be noised enough such that the facial recognition system will be tricked into not recognising the individual in the image while still being recognisable to a human view of the image.

Keywords: Image Noising (The destruction of some pixels in the image to create a blur-like effect), Facial Recognition Systems (Systems that can scan an image and detect if it contains a specific person)

Technologies: Python3.6, *face_recognition* package for Python.

Kelleher, Alex **Supervisor**: Dr Derek Bridge	## Recommendation as a Balloon Debate You are trying to decide which of the movies at your local cineplex to go and see. A recommender system can help you. In this project we implemented a recommender system as a Balloon debate. In a normal Balloon debate, a small number of speakers pretend to be famous people who are overloading the basket of a hot-air balloon. Someone must be thrown overboard. Each speaker gives reasons why they should be saved. An audience must decide who to sacrifice. In this debate a set of movies compete against each other to see which one the cinema patron will pick. The movies can either be selected from current movies or from movies the patron's neighbours like. At the start of the debate each movie gives an explanation as to why they should be kept. The patron then removes a movie based on the given explanations. In the next round each movie gives a new explanation. This continues until a single movie is left standing. **Keywords**: AI, Recommendations, Explanations, Explainable AI **Technologies**: Flask, Python3.7, SQLite.
Kijanko, Maciej **Supervisor**: Professor John Morrison	## Distributed recommender system for music suggestion Recommender systems play a large role in determining what kind of content we see online on a daily basis. Services such as Facebook, Twitter, Spotify, etc. all rely on them to serve appropriate content to their users. One problem that a system like this faces is the amount of people to serve content to. Spotify, for example, has over 270 million users and 50 million songs, adding as many as 40,000 new songs every day. Even given those numbers, the system should be able to make highly relevant recommendations in an efficient manner. This project's goal is to create an efficient recommender system that is able to handle large datasets and produce quality recommendations. The challenges posed by this project include ● choosing the correct type of dataset ● choosing the best algorithm given various types of data ● efficient training using a large amount of data ● evaluating the results All of the work is carried out using python. The proposed solution makes use of the pandas, implicit and mpi4py packages and the Million Song Dataset. In order to generate recommendations, it deduces how similar a given song is to another based on user behaviour. This is achieved through matrix factorization. It clusters artists based on those similarity values and uses the split up clusters to achieve parallelization. **Keywords**: Music recommendation, distributed system, Python, MPI **Technologies**: Python, Implicit, mpi4py.

Lee, Yat Yi **Supervisor**: Dr Klaas-Jan Stol	## UCC Accommodation broker site University College Cork (UCC) is hiring new staff every year. Some UCC staff want to rent out their property, while some want to find an accommodation. One of the ways they did was to send emails about looking for an accommodation, or rent out property to a UCC shared mailbox. The purpose of the project was to create an accommodation broker website, which work similar to renting website like draft.ie, but only for UCC staff. The website will check the emails received about rent out property, extract and display the relative information as an advertisement to the broker website. It will also obtain the renter and landlord or landlady's information from those emails, automatically create an account and auto fill in the renter profile for them. Meanwhile, Renter could contact to the landlord by email or leave an interest message in the system, while landlord could post the advertisement and choose to contact the renter who interested with their advertisement. This project was to set up a virtual Ubuntu machine with Apache server installed, and use PHP, Bootstrap, CSS and HTML, phpMyAdmin to develop the website. **Keywords**: PHP, HTML, Apache, CSS, Bootstrap, Ubuntu, Virtual Box **Technologies**: PHP, HTML, Apache, CSS, Bootstrap, Ubuntu, Virtual Box.
Lehane, Timothy **Supervisor**: Professor John Morrison	## An online platform for investing in growing music artists and rewarding early adopter fans Fanfund is an online platform that allows growing music artists to gain exposure to music fans looking for artists with mainstream potential. Artists can run a funding round and gain capital from fans. These fans can purchase currency on the platform and build a portfolio of artists that they believe will grow overtime. Growth is measured relative to the change in 'FFXP' - a metric calculated by the platform's API based on multiple factors including followers on: popular streaming services; relevant social media sites; etc. A funding round has a maturation time chosen by the artist. When that date is reached, there is a calculation based on relative 'FFXP' growth. This dictates how much of the funding round's total value is retained by the artist and how much will be issued to each contributor in the form of a discount on tickets/merchandise. The discount issued is proportional to respective funding round contributions. This platform aims to enable small artists to monetise their popularity amongst underground listeners while simultaneously rewarding fans who believed they would grow to amass a mainstream audience. If they do not grow, they can use the capital to continue to operate as artist and satisfy their fanbase. **Keywords**: Web App; Full Stack; Web Development; Angular; ASP NET CORE; .NET; C#; Web API; API; SQL; NuGet; NPM; Dapper; MVC; Investing; Music; Crowdfunding; Crowdsourcing; Music fans; Artists; Labels **Technologies**: Client/View: Angular 8, Client Package Management: Node Package Manager (NPM), Controller: C# ASP NET CORE 3.1 Web API, Controller Package Management: NuGet Package Manager, Model: AWS hosted SQL RDS Database, Version Control: Git, Software Development Lifecycle Management: Azure DevOps Boards (Kanban), Azure DevOps Repos; Azure DevOps CI/CD, Cloud App Deployment: Azure App Deployment Service.

McCarthy, Michael **Supervisors**: Professor Barry O'Sullivan Dr Maurizio Mancini	## Gait Analysis Using Mobile Sensors Human computer interfaces play a major role in our use of technology in this rapidly evolving era of technological advancement . And as such these interfaces can be used to our benefit in ways we would not expect. This project focuses on the use of the built-in tri-axial accelerometer and gyroscope of the a typical mobile phone to capture a subjects gate as they walk and then to classify this with a view towards using Gait as a biometric to streamline human computer authentication in a non intrusive manner. Previous studies on gait analysis provided positive results using multiple motion capture devices and cameras. These studies explore the angle of infection of the limbs of the body to build a model. These studies have had varying degrees of success but the sheer amount of research that has been put into this topic suggests that it is possible to identify a user based on their gait with high levels of accuracy. What is proposed in this project is to use only the inbuilt sensors in a consumer grade mobile phone to capture walking data from a test group and to then build a model and perform feature engineering on the raw sensor data. **Keywords**: Gait, Machine Learning, AI, Human Computer Interfaces **Technologies**: Python.
McCarthy, Olan **Supervisor**: Dr Dan Grigoras	## Personal Activity Planner for Reducing Impact on the Climate Since the end of the 20th Century temperatures have been increasing globally year by year 1 . A large amount of studies have shown that this global warming is directly linked to the amount of carbon in the atmosphere 2 . This increase in temperature has multiple ill effects including; links to increased number of natural disasters 3 , the melting of glacial ice 4 and rising of sea levels 5 . Since this is a global problem, it is then the responsibility of everyone to help solve this issue. While the average person may think that their actions alone cannot possibly make a difference or that they are already doing enough already, it is imperative that this mindset must be broken. This project aims not only to make that person as well as all other people more aware of their carbon footprint but also to suggest meaningful changes to their lifestyle to help reduce their carbon footprint in a way that is both accessible and sensible. To achieve this a mobile application was developed that is lightweight and easy to use. It shows that use of the application can increase a user's awareness of their carbon footprint as well as actions they can take to help reduce this carbon footprint. **Keywords:** climate change, global warming, mobile application **Technologies:** Kotlin, Android, Firestore, Firebase, Google Maps, Flask.
McDonnnell, Lauren **Supervisor**: Dr Jason Quinlan	## 8-Bit Gaming in Python The project consists of a single person 8-bit, side scrolling, platformer game, similar to that of the old Mario games. The game is set in a post apocalyptic world, after an alien invasion, where aliens and humans co-exist. The main character is a mail carrier who must deliver a package to a mailbox. As the player the objective is to reach the end goals alive. There are multiple enemies that will try to attack the player, to defend themselves the player may use the gun provided to them to shoot the enemies. The enemies have been programmed with some form of Artificial Intelligence to chase the player once they have been detected. When certain parts of the level have been reached, the gun can be upgraded to help aid the player to defend themselves better. The user can jump and run from platform to platform to travel through the level. **Keywords**: 8-bit, game, Artificial Intelligence, platformer

	Technologies: Godot game engine, GDScript.
McGrath, Ian **Supervisor:** Dr Steve Prestwich	## Reinforcement Learning for Elevator Scheduling In this project, Distributed Reinforcement Learning techniques will be applied to the well-known problem of elevator dispatching. This has been done before using a team of agents, one per elevator, each applying its own learning algorithm and acting as part of the environment of the other agents. Neural networks were used to handle the large number of possible states. The states will be defined differently to avoid the need for neural networks and test the result. **Keywords:** Reinforcement Learning, Machine Learning, Q-learning. **Technologies:** Python, Reinforcement Learning.
McKeon, Jacob **Supervisor**: Dr Derek Bridge	## Bayesian Navigation The focus of this project is recommender systems. Specifically, this project explores Navigation-by-Preference recommender systems. These recommender systems tackle the problem of users not being satisfied with the initial recommendations provided by a system. Navigation-by-Preference focuses on providing recommendations based on users' current tastes, referred to as short-term tastes, and their past tastes, referred to as long-term tastes. A user is given a choice of three movie recommendations, they choose the one closest matched their current tastes and they are then provided three more. Movies are recommended based on past information a user has provided, specifically looking at tags used to describe movies they have previously selected. This cycle repeats until the user discovers a movie they are satisfied with. This project explores Navigation-by-Preference using a Bayesian approach. It contrasts the Bayesian method to the original methods used in a Navigation-by-Preference recommender system. We explore the benefits and short comings of using a more probability-based algorithm in a recommender system. **Keywords**: Recommender systems, Navigation-by-Preference, Bayes Theorem, Machine Learning **Technologies**: Flask, Python, SQL, Web Scraping.
McVeigh, Lorcan **Supervisor:** Dr Jason Quinlan	## Android application for cataloguing graphic novels and comics With the recent rise in interest in comic books and comic book characters the main goal of this project was to design and develop an Android application that could catalogue a collection of comic books and graphic novels, both digital and physical copies. With the emphasis of the project on large collections, the project wass to investigate a way to develop such an app that can scale from initially a single collection and grow to a larger one but using open source tools and technologies such as open source database management technologies, Android OS and open source online content of free API's for comic book references. The majority of the project was on the app itself but had a primitive backend developed for the purpose of data storage. The purpose of the app was to fill a niche in the market which has so far not been filled. Although the theme of the project was for comic books this is not its limit, the tools and technologies and codebase was designed so that it can be built upon to extend to other collections that may need them. **Keywords** : Android, Kotlin, Google, Comic Books, Marvel, DC comics **Technologies** : Kotlin, Android Studio, Google Firebase, Comicvine.

Middleton, Jack **Supervisor**: Mr Humphrey Sorensen	## FifaGen The goal of this project was to design and develop a social networking Android app for players of the FIFA video game series. It allows these players to set up games against other players using random teams. The app will be used for random match generation and recording matches and results against other users. A user will be able to create an account and login to the app. Once logged in, they will be able to generate two random teams for a match. The app will display various information about the two teams that are generated by random, such as the team's badge, stats, league and country. When the two teams have been chosen, the user will be able to play the match on their game console and then save the results of the match between the two randomly generated teams in the app, choosing an opponent from a list of users and then entering the score. Users can approve match results and view their match history. **Keywords**: Android app **Technologies**: Firebase, Android, Java.
Miskella, Aidan **Supervisors**: Mr Humphrey Sorenson Mr Cathal Hoare	## Using the iOS application platform, build a Temporary Staff Management System Staffy is an iOS application which allows recruitment agencies to find, hire and manage staff for a variety of jobs in the hospitality sector from restaurant staff to local events. Users can apply for upcoming temporary jobs and manage them from start to finish. There are many problems that recruitment agencies face when it comes to hiring temporary staff. They can hire between 20-30 staff per week and 100+ for local events such as concerts and festivals. Managing all of these temporary staff can be difficult without some organisation and management system. Staffy solves these issues by providing: ● Accurate staff timing for payroll ● A platform to advertise upcoming temporary jobs ● Staff monitoring and review with all times and information ● Document uploading for Curriculum Vitaes and other necessary documentation ● Everything is stored in one secure place for reviewing ● Provides proof of clocked hours by staff ● Rating and feedback system for staff and recruiters **Keywords**: staff - jobs - recruitment - temporary employment - iOS applications - clocking **Technologies**: XCode - Swift - Firebase – Github.
O'Brien, Eoghan Brendan **Supervisor:** Dr Klaas-Jan Stol	## CSIT News System The goal of this project was to build a system that would update users with news that had been submitted by their colleagues from the previous week. The system is split into two parts, the online web dashboard and the email system that will generate and send an email containing the news from the previous week to all subscribed users. The users will be able to submit news of different categories to be displayed on the dashboard. The email will send out at the start of every week and will contain only news from the previous week. The dashboard contains an archive system and will support search by dates, topics and username. Every user must register for the system and it is intended for a small-scale business but could be scaled to accommodate for a larger organisation. Use of different browser and email clients was taken into account and the system is expected to accommodate most of these. Artificial intelligence will hopefully be implemented in this system if time can be found, the aim being to use artificial intelligence to read incoming emails to the account and to be able to pick the

	news stories out of these emails. On the dashboard there will be links to each week of the year and every post will be stored in the database and can be easily viewed here.
O'Connell, Stephen **Supervisor**: Dr Steve Prestwich	## Optimisation problems from the Game of Life This project aims to use genetic algorithms to solve optimization problems in Conways "The Game of Life '' by achieving certain goal states as quickly as possible.These states are: Still life(state that does not change), Oscillator(state that changes and then returns to its starting state) and glider(state which moves across the grid while maintaining its shape).The game of life is "0-player", meaning only the initial input is required, in this case a grid,then the "player" simply observe how the grid behaves according to certain rules.Each pixel changes from one frame to the next depending on its surrounding pixels values.This lends the problem of achieving grids with certain properties to a genetic algorithm as when given a broad fitness function the algorithm could find unseen before configurations of certain states.The student tried various heuristics including tournament selection, random point crossover,random parent crossover and variable mutation rates, along with some others. **Keywords:** Game of Life, Genetic Algorithm,Variable mutation,Microbial selection,Random point crossover **Technologies**: Python,Numpy,MatPlotLib.
O'Connor, Fergal **Supervisor:** Professor Ken Brown	## Evaluating Bitcoin's Lightning Network: The impact of Atomic Multi-path Payments & Just In Time Routing Bitcoin, in its current state cannot scale, limited to a mere seven transactions per second. The purpose of this project is to evaluate Bitcoin's Lightning Network, an off-chain solution intended to overcome this scalability issue. The solution is composed of a mechanism known as payment channels which allow two parties to transact almost instantaneously – and these channels may be linked together to form a network, typically allowing non-connected parties to transact without a direct payment channel in a trustless manner. In particular, we investigate how the usage of atomic multi-path payments and just in time routing affect the success rate of payments on this network. In addition, various network conditions are considered to evaluate how these methods scale and to identify what tipping points cause the system to start to break down. **Keywords:** Bitcoin, blockchain, payment channels, lightning network, atomic multi-path payments, just in time routing. **Technologies:** Python, NetworkX, Google Cloud Platform.
O'Gallchoir, Ruairi **Supervisor**: Professor Cormac Sreenan	## All politics is local: a system for improving door-to-door electoral canvasing "I worked with Prof. Corman Sreenan to devise an app that would allow for more efficient canvassing of the public. This app came to be known as "Canvasser's Edge". The mobile application is used by canvassers as they go door-to-door and enables the easy collection of data from the public about topical issues. It also reports their rough location (for privacy purposes) in order to see which areas have already been canvassed. The mobile application is accompanied by a web app of the same name. This is used for data analytics purposes, and would be utilised by campaign staff who want an overview of the canvasser's data. It utilises many different tools to make sense of the plentitude of data collected by canvassers. This allows political campaigns to make more informed decisions and always have their finger on the pulse of public opinion.

	Keywords: Politics, data analysis, iphone, web app, elections, data, privacy
	Technologies: Flask, Python, Xcode, Swift.
O'Sullivan, John **Supervisor**: Dr Jason Quinlan	## Optimising Wireless Bandwidth Usage Using a Co-Operative Model for Video Streaming This project aims to develop a Cooperative Video Streaming model. Video currently makes up 65% of all internet traffic. This demand for video content will only grow in the coming years. This project intends to address this high level of consumption of bandwidth by allowing devices to share video content on the local network. This project implements a Hybrid Peer-to-Peer network in Golang, utilising gRPC for Peer-to-Peer communications. This project uses Hashicorp's Consul software to track which Peers are currently connected to the network, as well as what video content is currently available in the network. This model allows for the reduction of bandwidth usage while streaming video content. This reduction in bandwidth usage allows other devices to avail of previously unavailable bandwidth, while also maintaining a high quality of experience for end users who are streaming video content. Testing and evaluation of this project was completed using goDASH and Mininet. GoDASH is a DASH player that is implemented in Golang. GoDASH evaluates the quality of experience of end users who are streaming content. For this reason, goDASH was used to assess the effectiveness of the model. Mininet was used to simulate real network traffic between peers. This enabled realistic testing of the project. **Keywords:** goDASH, Dynamic Adaptive Streaming Over HTTP (DASH), Golang, Hybrid Peer to Peer, Quality of Experience (QOE), Hashicorp Consul, gRPC, Mininet, Bandwidth Optimisation, Video on Demand, H.264, Mininam **Technologies**: goDASH, Dynamic Adaptive Streaming Over HTTP (DASH), Golang, Hybrid Peer to Peer, Hashicorp Consul, gRPC, Mininet, H.264, Mininam, goDASHbed.
Pagalyte, Elinga **Supervisor**: Dr Laura Climent	## Machine Learning in Games Difficulty in video games is, in most cases, a set thing. While some games do include difficulty that changes over time, very rarely does this tailor to the player particularly well. Dynamic Difficulty Adjustment (DDA) is a solution that is becoming researched much more frequently in the recent decade, with an increase in the number of research papers published. The project mainly focuses on applying DDA to turn-based battle games, and how that can affect the player experience. Each player is different from the other, and so when playing a game each player experiences the game differently. Considering things like the player's skill level, gaming experience, learning rate, and their playing style, can drastically change the way a game's difficulty should be set. Games such as Pokémon, and Dragon Quest contain turn-based combat systems, these games increase difficulty by introducing stronger opponents (monsters with high stats). The project explores how applying DDA to such games (ones containing turn-based combat), and producing smarter opponents, can enhance the overall experience. By applying DDA, the battles are more interesting and balanced, and adjust to player as they start to play in a smarter or more casual way. **Keywords**: Dynamic Difficulty Adjustment (DDA), Turn-Based Battle **Technologies:** Unity2D, Accord.NET Framework.
Panayotova, Ina **Supervisor**: Professor Gregory Provan	## Deep Learning for Pedestrian Collision Avoidance This project looks at using deep learning methods to predict the probability of a collision involving pedestrians in the context of autonomous vehicles.

In recent years, developments in deep learning concerning image processing has made object classification more accurate and performant. Previous research using various deep learning methods has been conducted on predicting the angle a person is facing based on images. Such methods involve analysing a person's head position based on their facial features, hand positions, as well as overall posture.

In the scope of this project, Convolutional Neural Networks (CNN) are used to predict the orientation of pedestrian paths based on head orientation. The predictions output by the models are then used to estimate the probability of collision between pedestrian and vehicle through time. The report also explores what differences using finer groupings of head orientation angles make when attempting to compute possible collisions. The challenge with this is finding and creating a large enough dataset labelled with the corresponding directions of facial orientation.

Collision probabilities will also be estimated by placing the predicted direction into a 2-dimensional space and simulating a velocity. As the possible path of the pedestrian and vehicle become more uncertain over time, a cone of probable locations is used for calculations.

Keywords: Deep learning, Convolutional Neural Network, Transfer Learning

Technologies: TensorFlow, Keras.

Candiddly, a photo sharing app using the Android platform with the Kotlin programming language

Phelan, Darragh

Supervisors:

Mr Humphrey Sorensen

Mr Cathal Hoare

The inspiration for this app was the realisation that many people would like more candid photographs of themselves. Candid photos are ones in which the subject does not know they are being photographed, giving them a far more authentic quality. People are able to look at these photos and remember a good time spent with family or friends when they were truly in the moment.

The situations where this app may be used would be for events and for general life. For an event, a group of people would come together with the goal of everyone getting a candid photo of themselves for the event that is sent directly through the app. Each group member is assigned a random person in the group to take a candid photo of for the duration of the event with notification reminders in case it slips anybody's mind. Use in general life would include everyone in your friends list in the situation where a good candid photo could be taken.

Keywords: Candid photo sharing, social media, Kotlin, Firebase, Android

Technologies: Android Studio, Firebase, Kotlin programming language, Github.

A demonstration of secure Data Processing using Homomorphic Encryption

Quinlan, Kyle

Supervisor:

Dr Paolo Palmieri

Homomorphic Encryption is a new technology that allows arithmetic operations to be performed on encrypted data without the need for decryption - this allows third parties to perform computations on this data without sacrificing the privacy of the data. This Project consists of a productivity application that reads in user information, operate's on this data securely, and returns a result that describes how productive they are based on input they provide. This will successfully demonstrate secure end to end data processing as the data is only ever visible in plaintext,to the user.. At no point in the execution is the encrypted data viewable by a third party once decryption has occurred.The adoptation of this technology will provide greater data security to users, and will also allow greater outsourcing of computation to cloud service providers. As a result Homomorphic Encryption will also make large datasets more easily accessible

due to the inherent privacy of the user's data when being operated on, making users more inclined to share sensitive information.

Keywords: Security, Homomorphic Encryption, Computational Outsourcing, Data Protection.

Technologies: Microsoft SEAL, C#, ASP.Net, .NetCore.

Quinn, Dylan

Supervisors:

Dr Klaas-Jan Stol

Social Research Ethics Information System

Development of an Web-based Information System for use by UCC Social Ethics Research Committee (SREC). The system will handle applications to the committee from any person within UCC undertaking research that involves humans, allow reviewers to review them, and allow the committee coordinator to give a final judgement on an application. This system should replace the current email/spreadsheet workflow. The system should implement an elegant, simple, secure and usable design.

Keywords: Information system, database, web application, testing, authentication, authorization, email, deployment.
Technologies: Ruby Programming Language, Ruby on Rails, HTML, SCSS, CoffeeScript.

Ruth, Ronan

Supervisor:
Prof. Ken Brown

Multi-Agent Pathfinding Algorithms

This work presents the problem of Multi-Agent Pathfinding (MAPF) which is the task of organising the movement of multiple agents in shared space, ensuring there is no collisions between them. This problem has many applications such as planning the paths of robots in automated warehouses or determining the movement of non-player-characters in video games.

In traditional MAPF, collision free plans for each agent would be generated and then these plans would be executed. Here we focus on the implementation and evaluation of online MAPF algorithms, which is a variant of MAPF where agents do not have to have determined the full path they will take before they start moving toward their goal.

We focus on a recently published algorithm titled "Bounded Multi-Agent A*" and implement extensions to the algorithm to address some of the problems which it presents, namely the behaviour of agents with the presence of obstacles and dead ends in the environment. Through experimental evaluation of our approaches, it was found that we can improve the efficiency of agents, making it so that they take shorter paths to their goals and avoiding obstacles, but with the cost of increased time spent planning paths.

Keywords: Multi-agent pathfinding, artificial intelligence, algorithms.

Technologies: Java.

Ryan, Kieran

Supervisors:

Professor Gregory Provan

Professor Dirk Pesch

V2V Pedestrian Collision-Avoidance

Vehicle-to-Vehicle (V2V) communication will result in improved road safety; allowing vehicles to utilise data gathered through the sensor stack of nearby vehicles and forming an important component in the architecture of autonomous vehicles.

A current challenge to autonomous vehicles is the traversing of high-density, urban environments; where scenes can be busy with clusters of vehicles, street furnishings; and vulnerable road users, such as pedestrians. It is being considered currently, that it may be some time before this is realised, and that geo-fencing autonomous driving to exclude these zones, may be required.

This project aims to implement fundamental V2V protocols, such as a continuously broadcast Basic Safety Message (BSM), also known as a Heartbeat message; and a Common Safety Request (CSR) message (CSR) where a vehicle participating in the exchange of the basic safety message can make specific requests to other vehicles for additional information required for safety procedures.

This will be implemented by continuously broadcasting a BSM message between two Raspberry Pis, and by one Pi making a CSR message to the other; which will be running a pedestrian-detection model on a live camera feed. The Pi will detect the pedestrian's location relative to a crosswalk, and report to the other Pi, whether an action is required. The Pi running the detection model will also run a GPS receiver to provide accurate location information in its BSM message.

Keywords: Vehicular Communication, Computer Vision, Autonomous Driving, GPS

Technologies: Python, OpenCV, TensorFlow Lite, Raspberry Pi, GPS receiver.

Ryan, Luke **Supervisor**: Professor Utz Roedig	## A Participatory Service That Guides Users on Where and How to Dispose of Waste Correctly In recent decades, recycling has become increasingly imperative as a means of protecting the environment and combating the effects of climate change. However, despite this, a fundamental misunderstanding of how to recycle correctly remains in the lifestyles of many members of the public. This project proposes and details the development of a mobile-based service that guides people on how to dispose of their waste correctly, and exactly where to put it. **Keywords**: recycling, waste management, android, google maps, user-driven data **Technologies**: Android, Google Maps, Firebase, MongoDB, Flask, REST.
Samani, Karan **Supervisor:** Dr Derek Bridge	## Federated Machine Learning In Machine Learning (ML), the learning process ideally requires a lot of data. This data is often provided by the consenting users, but what happens when the users no longer want to share their data? A few years ago, Google released an article describing the idea of federated learning. The users no longer need to share their data, but only share the parameters learnt during training on local data. Each user trains a model locally and learns some parameters which are shared with a central server. The server averages the parameters and sends them back to the users who then use the averaged parameters as a starting point for the next round of local training. We implemented idea of federated learning, as described above, from scratch in python. Along with that, we also implemented extended ideas based around selective and weighted averaging in a central and peer-to-peer setting. After doing so, we conducted experiments on all the approaches and compared the results to see whether the extended ideas resulted in performance gains. **Keywords:** Machine Learning, Neural Networks, Privacy **Technologies:** Python, Keras (with Tensorflow), Pandas, Numpy, Matplotlib.
Santschi-Cooney, Noah **Supervisor**: Dr Jason Quinlan	## Alternative Visualisation of Distributed Tracing data in a complex, large-scale distributed system Distributed Tracing is a modern concept first introduced to the world by Google in 2010 through their whitepaper outline of Dapper, their internal distributed systems tracing service. The concept was coined to describe the instrumenting of applications to trace operations and requests through distributed systems and microservice architected

software services. With the shift from traditional monolithic applications to modern service-oriented designs where requests can traverse the network between multiple services and codebases, traditional tooling used to derive introspection into applications and their operations are no longer viable, especially at larger scale.

Distributed Tracing data is most commonly presented to users in a flame graph/gantt chart style. Each so-called "trace" consists ofmultiple "spans", where each span constitutes one unit of work as defined at the time of instrumenting. Spans can also have additional metadata associated with it to give users additional context for the entire operation and its individual units of work.

The aim of this project is to explore alternative ways to visualise distributed tracing data as well as implementing an explored alternative. A Visual Studio Code debugger integration, utilizing span metadata to step through code based on distributed trace metadata, was created for this project.

Keywords: Distributed Tracing, Observability, IDE Integration, Debugger, Microservices

Technologies: Typescript, Visual Studio Code, Kotlin, OpenTracing, Golang, Rust, Python, GraphQL, Elasticsearch.

Website tracking and cookies after the GDPR

Shan, Feng

Supervisor:

Dr Paolo Palmieri

We all know the annoying cookie setting pop-up windows that appear on new websites we visit. This project will focus on the working process of cookies and how website can track users using cookies. Imagine a scenario when you browse an e-commerce website and then browse other websites, you find that the pop-up ads on the page are the products you have just viewed in the e-commerce website. Does this indicate that your personal privacy data has been leaked? Is this a problem with the site itself or users are ignoring privacy related settings of the browser? This project will let users know how websites set cookie to user and how users 'privacy is leaked through cookies. What should users do after their privacy data is leaked. How to properly select and set up a browser to prevent privacy data from being leaked. After this project, users will know what to do and determine whether the cookie settings of Irish websites comply with GPDR regulations, and How to prevent the tracking of website cookies.

Keywords: Cookies, Privacy, Tracking, Security, Data

Technologies: Cookies tracking and generating.

Multi-Level Python Gaming

Sheenan, Darragh

Supervisor:

Dr Jason Quinlan

For several years gaming has been a huge part of society and with its increasing support from loyal fans whether they played old Nintendo products or are part of the new wave of gamers playing games like Fortnite and competing in different eSports games, it is clear that gaming has come a long way. With the development of new technologies games are getting easier to make and are becoming much more advanced with all the features that are added. Indie games have become more and more popular over the years and have been gaining huge support by the gaming community. It is clear that game development has advanced quite quickly in the past few years, with the growing interest of computers and technology as a career option it is important that there is a way to effectively teach people how to make games in an engaging way. This report will not only show how well a game can be made using Python and Pygame and how advanced Python actually is as a coding language but will also provide a tutorial like structure that will allow inspiring game developers to work with the report and get started developing games.

Designing Alexa Skills for use in Amazon Echo hardware

Subedi, Shiva

Supervisor:

Dr Jason Quinlan

The goal of my project is to develop a natural language processing functionality which will offer college students a virtual option to engage with the services provided by the University. For this project Alexa was chosen as the virtual assistant as Amazon offers a range of services to help develop Alexa skills. This project focused on developing an Alexa skill to retrieve the students timetable information and make it readily available to the student. With this skill enabled on the students' Alexa-enabled device, the student can ask Alexa questions such as "When is my next class" and Alexa will reply with the next class the student has on their calendar.

Keywords: AWS, Amazon Alexa, Natural Language Understanding

Technologies: Alexa Skill Kit, AWS, Python.

Mental Health Management iOS Application (*MindManage*)

Tariq, Ahmad

Supervisor:

Mr Humphrey Sorenson

This project aims to tackle the current challenges that are present in mental health services. With the technological advancements and its availability to most people, an iOS app will be developed to assist in the evaluation and measuring of the recovery process of a patent. This will assist clinicians and other mental health service providers, to make access to this vital aspect of therapeutic practice convenient, accessible and affordable.

Keywords: Mental health, iOS Application

Technologies: Xcode, Swift, Firebase.

EasyCare: A Patient Management System

Twohig, Kayleigh

Supervisor:

Mr Adrian O'Riordan

The EasyCare Patient Management System is an iOS app, with its main goal being to help manage patients' most important medical needs in one easily accessible place. It assists individuals who have issues with managing appointments, storing medical documents, managing prescriptions, and locating GPs and hospitals. The app eliminates the need to bring many paper-based documents to medical consultations or using a range of external apps for managing patients' medication and appointments. It was built using Apple's Swift, a powerful programming language for macOS, iOS, watchOS, tvOS and beyond. Google's Firebase was also used for secure authentication and storage. The app was designed to be straightforward and uncomplicated so that any individual can use it. The use of this app will improve patient experience, especially with regard to being able to access any information they may need related to their health needs at any time, from an easy to use, simple app.

Keywords: Patient management, patient care, mobile health app

Technologies: Swift, Firebase, MapKit, iOS.

Political Poster Blitz

Twomey, Megan

Supervisor:

Professor Cormac Sreenan

A system for guiding the erection and removal of political posters During election time it is common for candidates to hire canvassers to put up vast amount of posters around one local area in a bid to sway public opinion.The Department of Communication,Climate Action and Environment publishes rules that dictate where canvassers can place a poster as well as the time frame for them to be taken once the election is over.Not abiding by such rules can result in penalties and fees in the amount of 150.

At minimum this app will record posters going up or going down.By the click of a button it will record the location, time and date of poster being put up or taken down and add a marker to the map on the users home screen.It will also provide a other map of

	polling stations in an area showing the exclusion zones hinting to the user where posters can not be put up.Extended functionality would include a user being suggested a optimized route to take in order to minimise time,staff or vehicles needed. **Keywords**: This app will tackle the problem of tracking posters during a campaign and is implemented using android studio and firebase. **Technologies**: The technologies used in this mobile application are android studio and firebase.
Wall, Jack **Supervisor**: Dr Alejandro Arbelaez	## Machine Learning for Soccer Analysis The objective of this project is to create a Constraint Programming model to solve Soccer leagues given positioning constraints (eg. Team 1 finishes in the Top 4, etc.). Once these solutions are obtained, research into AI models to predict these results were developed, giving insight into the runtime and results of such problems. The predictions can then be used to make educated estimations for Cloud computing usage, as well as restricting state space searching across Constraint Programming models. **Keywords:** AI, Soccer, Research, Constraint, Satisfiability, Machine Learning **Technologies**: Python, MiniZinc.
Walsh, Arran **Supervisor:** Mr Humphrey Sorenson	## Clinic/Hospital Management System This online system would address the needs of many participants within the medical clinic environment. It is an online tool prototype which could potentially be used by Hospitals, Clinic and Pharmacy's across the country. Its main features include the use of an electronic prescription, which makes the process paperless, more secure and less susceptible to fraud. The tool will allow the admins at Clinicare*(temporary name of tool) to create and delete accounts of users, mainly used in creating Clinic and Pharmacy Admin Accounts. These admin accounts can create end user accounts who use the tool. Patients will be able to register through the website and view any prescriptions they have that are available to them, as well as any doctors notes left to them as part of their treatment. Doctors will have an online database where they can keep records of their patients. They will also be able to keep a timetable which is also kept by the Reception account. The Doctor account also can have an alert when prescribing conflicting medicines which could harm the patient. **Design** The website is hosted on pythonanywhere as it has a great structure to support the building of websites using flask. It uses mainly HTML5, CSS, PHP, Javascript and Pythons Flask to create the tool. The design of the tool was made using CSS and Javascript, using HTML5 and PHP for structure and content. For the backend of the website Flask was utilised, which is a micro web framework written in Python.
Walsh, Daragh **Supervisor**: Mr Humphrey Sorensen Mr Cathal Hoare	## FINITE – A Student Budgeting Application This project will focus on the building of a modern web application that will be used for the recording of transactions (once off or recurring) while also providing the user with graphical representations of their spending habits. This insight will allow users to make any changes they see fit to their spending habits and trends (identify over-spending or other positive/negative financial trends). From a developer standpoint this project will serve as a chance to work with a combination of programming languages, tools and frameworks used in industry to create web applications. This will include both industry standards and up-and-coming options.

	Technologies: React.js, TypeScript, GraphQL, Apollo Client, TailwindCSS, MongoDB
	Keywords: Progressive, Web, Application, React, TypeScript, GraphQL, Budgeting, MongoDB.
Zhu, Lanqing **Supervisor**: Professor Michel Schellekens	## Decision Tree Create a tool that can display decision tree for a wide variety of sorting algorithm. The tool could display decision tree for three sorting algorithms: insert sort, bubble sort, and select sort. The language used by the project is mainly Python, which involves some basic syntax of Python, and package `graphviz` for drawing the decision tree graph. The user can enter the desired length, such as 3 or 4 or greater. After entering the length again, the user can choose whether to see only a certain sub tree. The user is prompted to make the correct input and return to the decision tree that user wants to see. **Keywords**: Decision tree, Sorting algorithm **Technologies**: Python.

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