Title	CMMS Data Analysis using ISO 14224:2015 standards
Proposer	Hatem Ahriz (Industry project proposed by: John Crane Asset Management Solutions)
Email	h.ahriz@rgu.ac.uk
Keywords	Data Analysis, Maintenance and Asset Management
Background and motivation	**Purpose**: The purpose of this document is to describe a known issue that prevents Maintenance and Asset management professionals from fully understanding the performance of their equipment. It is hoped that by means of this document the RGU can recognise an opportunity for their students to deliver the means by which maintenance and operational performance can be closely tracked and assessed by the means of structured coding following ISO 14224:2015. **Background**: Computerised maintenance management system (CMMS), is a software package used manage an organisation's maintenance. The system is used by management to determine maintenance strategies and plans, used by the maintenance workforce to record the results of their work, used by purchasing and logistics professionals to organise and ship essential spares and support services and is used by warehouse staff to manage inventories and bills of material (BoM). It is essential that information held in the CMMS is complete and correct such that the management and user group can extract meaningful statistics and information. More often than not information is either missing or incomplete and in most cases of unsuitable quality when considered for analysis. **ISO 14224:2015 Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment** is an internationally recognised standard that is used to arrange and categorise equipment and thereafter label faults, repairs and causes so that accurate and meaningful analysis can be performed. Implementing an ISO 14224 based management system is the ideal scenario especially for Green Field projects using a correctly structured CMMS. In the case of existing projects, where data has been entered for years and years without regard for the standard, a greater challenge exists.
Aim	Using the ISO 14224:2015 standard review maintenance histories and determine the means by which that data can be assessed such that analysis codes can be retrospectively filled. For example a repair of a centrifugal pump might have some maintenance history suggesting that the pump was leaking and failed to start. The repair necessitated a seal to be replaced. The pump was then ok. Using the ISO codes we know a centrifugal pump is coded as PUCE and thereafter fault, cause and remedy codes will exist to allow the user to populate the correct values based on the described fault and repair. We are aware of search engine applications that can resolve data and extract values but we are not aware of tools that can then code the results based on a given standard. All ISO 14224:2015 codes and values will be supplied and examples of Maintenance history will also be supplied for analysis.
Objectives	• To elicit requirements from the project sponsor • To get familiar with the problem domain. • To analyse the requirements and draw a detailed system specification • To design/implement/test/evaluate a system for filling missing values in an asset management system in accordance with the ISO standard.
References	ISO 14224:2015 Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment**.** https://www.iso.org/standard/64076.html

Title	ISO 27001 Implementation
Proposer	Hatem Ahriz (Industry project proposed by: Aquidata XL Ltd.)
Email	h.ahriz@rgu.ac.uk
Keywords	Information Security Management, Compliance
Background and motivation	Aquidata XL Ltd., is a software company based in Blackburn, Aberdeen that delivers IT solutions to various industries but primarily the oil and gas sector. They have recently undergone a Cyber Essentials certification and would like to pursue ISO 27001 as the next step.
Aim	The aim if this project is to help the company prepare for an ISO 27001 certification, by auditing their current information security practices and help them implement an information security management system compliant with the standard.
Objectives	• To get familiar with the company's current information security practices. • To conduct an audit and a gap analysis with regard to the ISO 27001 standard. • To design/implement/test/evaluate an information security management system complaint with the ISO standard.
References	ISO 27001 Information Security Management System: https://www.iso.org/isoiec-27001-information-security.html

Title	Detecting Anomalous User Behaviour in Databases
Proposer	Hatem Ahriz
Email	h.ahriz@rgu.ac.uk
Keywords	Cyber Security, , Databases, Machine Learning
Background and motivation	In today's digital economy, databases play a central role in the success of businesses and organisations. They are also a primary target for malicious users (both external and internal). There has been a considerable effort in devising intrusion detection mechanisms for computers and networks in general but not necessarily tailored to databases.
Aim	The aim of this project is to investigate how to detect anomalous user access to, and usage of, the database. You will develop an application that will report, to the security analyst or database administrator, any suspicious activity that does not conform to the expected user profile or role. Note: you will be given the choice of the technology stack to use for this project (database, programming language…)
Objectives	• To investigate database security mechanisms (e.g., user roles, profiles…) • To investigate approaches for anomaly detection such as user and entity behaviour analytics (UEBA), data mining, and statistical analysis • To design/implement/test/evaluate an application that alerts security analysts to anomalous database access and usage
References	IBM (2018) IBM InfoSphere Guardium Data Activity Monitor. https://www.ibm.com/uk-en/marketplace/ibm-guardium-data-protection IMPERVA (2018) Imperva SecureSphere Data Security. https://www.imperva.com/products/data-security/database-audit-protection/ SANTOS, R.J., BERNARDINO, J. AND VIEIRA, M. (2014) Approaches and challenges in database intrusion detection, *ACM SIGMOD Record*, 43(3), pp. 36–47. DOI: 10.1145/2694428.2694435. THUSOO, A. AND JETHAVA, G.B. (2015) 'A Survey : Intrusion Detection System for database using data mining techniques', *International Journal of Engineering Research and General Science*, 2(3).

Title	Tour Guide App
Proposer	Hatem Ahriz (Project proposed by: Bryan Atchison – Oil & Gas Institute)
Email	h.ahriz@rgu.ac.uk
Keywords	App programming, Google map, GPS Tracking, Information Retrieval
Background and motivation	VoiceMap [1] takes audio stories and map tem on Google to provide audio walking tours created by users. Audio files start playing as soon as your GPS tracker detects that you are in the vicinity of an interest point. However, the VoiceMap could be enhanced in a number of ways, including: (i) giving the users more control over what elements of the tour is of interest to them, and (ii) complementing the audio with information scraped from online sources.
Aim	The aim of this project is to create a similar platform to VoiceMap to enhance the tourist experience.
Objectives	• To appraise the VoiceMap application • To elicit and analyse the app's requirements in consultation with the project sponsor • To design/implement/test/evaluate the Tour Guide App
References	[1] VoiceMap: https://voicemap.me

Title	Decision Support System for the thermal insulation of buildings
Proposer	Hatem Ahriz (Project proposed by: Amar Bennadji – Scott Sutherland School of Architecture and Built Environment)
Email	h.ahriz@rgu.ac.uk
Keywords	Programming, Multi-criteria decision making, Fuzzy logic
Background and motivation	When faced with thermally insulating a building, architects have to select one or a combination of solutions while considering multiple criteria and constraints (e.g., budget available, risk of fabric decay, risk of loss of building aesthetic, etc.) with the overall aim of reducing the energy consumption of that building. Given the subjective nature of many of the above requirements, a fuzzy logic approach can be employed as proposed in [1].
Aim	The aim of this project is to develop a decision support system that guides architects in the selection of a good thermal insulation solution for a given building.
Objectives	• To gain an understanding of the problem domain (thermal insulation of buildings) • To elicit and analyse the system's requirements in consultation with the project sponsor • To design/implement/test/evaluate a prototype decision support system for the thermal insulation of buildings
References	[1] Mohammed Seddiki, Karima Anouche, Amar Bennadji, (2018), "Integrated FAHP-FPROMETHEE for thermal insulation of masonry buildings". Facilities, Vol. 36 Issue: 3/4, pp.195-211, https://www.emeraldinsight.com/doi/full/10.1108/F-05-2016-0057

Title	**5th Generation Wireless Communication (5G)**
Proposer	Dr Mhd Omar Alkadri
Email	O.alkadri@rgu.ac.uk
Keywords	5G, wireless communications, simulation.
Background and motivation	Next generation wireless communication, or 5th generation wireless communication, abbreviated as 5G, is the next step in the development of mobile communication beyond the current 4G/IMT-Advanced. 5G will not only provide voice and data communication but also provide capabilities for exciting new technologies such as Internet of Things, Smart Cities, etc... Example candidates of 5G networking technologies is Software Defined Network (SDN), Network Functions Virtualisation (NFV), Full-Duplex Wireless Technology among other candidates, which will further enhance the 5G capability to provide an effective platform for new services to advance rapidly [1, 2].
Aim	This project will investigate the different technologies involved in 5G wireless communication, then one technology can be chosen to further investigate on, elaborate on its advantages/disadvantages and propose a way to further enhance it, by either designing a new/different protocol, enhance on its security, or propose a different architecture for it, etc.
Objectives	The student will be required to: • To investigate candidate technologies of 5G wireless communication • To extensively investigate a selected 5G technology • To investigate the advantages and disadvantages of the selected technology and how it fits with other candidates • To propose ways of enhancements, like designing a new/different protocol, enhance on its security, or propose a different architecture for it.
References	[1] A. Gupta and R. K. Jha, "A Survey of 5G Network: Architecture and Emerging Technologies," in IEEE Access, vol. 3, no. , pp. 1206-1232, 2015. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7169508 [2] https://5g.co.uk/

Title	**Medical Grade Networks/ Wireless Body Area Network**
Proposer	Dr Mhd Omar Alkadri
Email	O.alkadri@rgu.ac.uk
Keywords	WBAN, wireless communications, healthcare.
Background and motivation	Medical-Grade Networks (MGN) and Wireless Body Area Networks (WBAN) are networks that include a collection of wearable devices, implants or surface-mounted devices. It is a specific type of wireless network with a very particular use and scope. A WBAN covers the human body with a set of resident sensors or devices. For example, manufacturers may create WBAN systems to monitor a person's vital signs, activities or fitness information, for medical purposes. These networks are becoming more popular however, they are associated with many issues that needs to be addressed and resolved. In addition to the open issues in standardization, WBANs energy efficiency and quality of service (QoS), security and privacy issues are major concerns. These wearable system life-critical data should be protected, since they control. Nevertheless, these systems face some difficulties of addressing security.
Aim	The aim of this project is to investigate the issues/ security threats facing WBAN, then choose one issue/threat to focus on, extensively investigate and propose a viable solution for. It could save someone's life.
Objectives	• To investigate different issues/ security threats of WBAN. • Focus on one issue/threat and extensively investigate current research on it. • Propose a viable solution for the chosen issue/threat and back it up with implementation/simulation results.
References	- M. Li, W. Lou and K. Ren, "Data security and privacy in wireless body area networks," in *IEEE Wireless Communications*, vol. 17, no. 1, pp. 51-58, February 2010. - V. Mainanwal, M. Gupta and S. K. Upadhayay, "A survey on wireless body area network: Security technology and its design methodology issue," *2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS)*, Coimbatore, 2015, pp. 1-5.

Title	**Crypto Currency Auto-Trader**
Proposer	Dr Mhd Omar Alkadri
Email	O.alkadri@rgu.ac.uk
Keywords	Blockchain, cryptocurrency, finance.
Background and motivation	Digital currencies or crypto currencies have recently caught the attention of both technological and financial medium for a variety of reasons. A Cryptocurrency is a form of digital money that is designed to be secure and, in many cases, anonymous. A cryptocurrency is supposedly difficult to counterfeit because of this security feature. A defining feature of a cryptocurrency is that it is not issued by any central authority.
Aim	This project will focus on creating a crypto currency auto-trader that makes its decision based on a set of financial metrics and indicators
Objectives	• To extensively explore the block chain technology and the crypto currency concepts. • To investigate different metrics that leads to informed decisions. • To implement, test and verify an auto trading system that uses the selected portion of the investigated metrics.
References	- Narayanan, Arvind, et al. "Bitcoin and cryptocurrency technologies." (2016) [online] Accessible via: https://www.bitmari.com/blog1/wp-content/uploads/2016/05/chapter_2.pdf , last accessed 16/02/2018. - Raymaekers, Wim. "Cryptocurrency Bitcoin: Disruption, challenges and opportunities." *Journal of Payments Strategy & Systems,* vol. 9. No. 1 pp. 30-46, 2015.

Title	**5th Generation Wireless Communication Security (5G-Security)**
Proposer	Dr Mhd Omar Alkadri
Email	O.alkadri@rgu.ac.uk
Keywords	Security, wireless communication, 5G, simulation.
Background and motivation	5th generation wireless systems, abbreviated as 5G, are the next step in the development of mobile communications beyond the current 4G/IMT-Advanced. 5G will not only provide voice and data communication but also provide capabilities for exciting new technologies such as Internet of Things, Smart Cities, etc... [1] These new technologies bring new threats and security remains one of its most controversial issues. Besides protecting the privacy of subscribers and the confidentiality and integrity of their communication, also the protection of the network itself against any forms of cyber attacks is of paramount importance. Communication networks are more and more becoming the target of cyber attacks, ranging from small local security breaches using simple exploits to highly sophisticated operations carried out at a global scale with what appears to be close to unlimited resources [2].
Aim	This project aims at investigating different security threats targeting 5G systems, then one threat can be chosen to further investigate on, and propose a way to defend against it, by either designing a new/different protocol, enhance/alter the functionality, or propose different architecture for it.
Objectives	• To investigate potential security threats targeting 5G systems. • To extensively investigate a selected 5G technology threat. • To propose ways of security, like designing a new/different protocol, enhance or alter the functionality to provide greater security, or propose a different architecture that ensures better security.
References	[1] https://5g.co.uk/ [2] P. Schneider and G. Horn, "Towards 5G Security," *2015 IEEE Trustcom/BigDataSE/ISPA*, Helsinki, 2015, pp. 1165-1170. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7345407

Title	A data quality enhancement tool
Proposer	Ines Arana
Email	i.arana@rgu.ac.uk
Keywords	Data cleansing, data quality
Background and motivation	The availability of data has led to companies appreciating the key role that data analysis can play in key business decisions. However, nice, clean datasets are often not available and the data analyst has to go through a lenghtly process of data cleaning before any actual analysis of the data can be conducted. This may involve a number of different processes and include Substituting equivalent content by a standard (e.g. Jan, 01, JANUARY with January. Identifying and correcting spelling mistakes Dealing with missing data in the most appropriate way (data dependant) Dealing with null values As databases may contain large amounts of data, it can be difficult to ensure their consistency and completeness, therefore compromising data quality.
Aim	To develop a tool to aid the users in the cleansing of their dataset.
Objectives	To investigate problems affecting data quality and ways to solve them. To design, implement, test and evaluate a tool which aids the user in the data cleansing of their datasets To document the work undertaken.
References	Sebastian-Coleman, L., 2013. Measuring data quality for ongoing improvement: a data quality assessment framework. Morgan Kaufmann. Dai, Wei, Kenji Yoshigoe, and William Parsley. "Improving Data Quality Through Deep Learning and Statistical Models." Information Technology-New Generations. Springer, Cham, 2018. 515-522. https://link.springer.com/content/pdf/10.1007/978-3-319-54978-1_66.pdf

Title	Improving data analysis with data from several sources
Proposer	Ines Arana
Email	i.arana@rgu.ac.uk
Keywords	Data cleansing, data quality
Background and motivation	The amount of data available is expanding rapidly. While a vast number of data sources are "closed", there are an increasing number of "open" data sources available at various levels, for example see [1,2,3]. The availability of open data sources makes it possible to work on a variety of data coming from different sources. At times, data sources are related and, therefore, could be used together to answer questions regarding the "link" between them.
Aim	The aim of this project is to produce a tool to facilitate the analysis and visualisation of at least two selected data sources.
Objectives	o Gather data about at least 2 sources o Clean and integrate the data as appropriate o Design, implement, test and evaluate a tool for the analysis and visualisation of the selected data o Document the work
References	[1] European Union Open Data Portal, open-data.europa.eu/en/data/ [accessed 08 April 2017] [2] Data.gov.UK, Opening Up Government, data.gov.uk/ [accessed 08 April 2017] [3] Datasets CKAN, data.glasgow.gov.uk/dataset [accessed 08 April 2017] [4] The R project www.r-project.org/ [accessed 08 April 2017]

Title	Improving data analysis with data from several sources
Proposer	Ines Arana
Email	i.arana@rgu.ac.uk
Keywords	Data cleansing, data quality
Background and motivation	Every year a large number of MSc students undertake an individual project. Some students propose their own project while others select 5 projects from a portfolio of projects proposed by staff. The project coordinator then assigns a project and a supervisor to each student who has selected projects from the portfolio, trying to satisfy as many students as possible while ensuring that no supervisor is given an unreasonable number of projects to supervise. This is a complex task to undertake manually, but could be done automatically. One technology that is particularly suitable for modelling the project assignment problem is that of network flow optimisation, specifically the minimum cost flow problem. A network can be constructed to represent the project assignment task, where nodes represent students and projects, and arcs link students to their chosen projects. Arcs to projects further down a student's list of choices will be assigned increasingly high costs. Additional arcs can be used to represent staff quotas (maximum number of projects to be supervised by a member of staff). An optimal flow through this network will correspond to an optimal assignment of projects to students.
Aim	The aim of this project is to produce a tool which allocates projects to students using a suitable optimisation technique such as minimum cost flow problem solving using network flow optimisation.
Objectives	• To investigate optimisation techniques including minimum cost flow techniques. • To design and implement a project assignment tool that can be used to: o Input all the data related to projects, staff and students. o Generate the corresponding network. o Run the optimisation software, interpret the results and display the corresponding project assignments. • To test, evaluate and document the work undertaken.
References	LAWRENCE, A.J. and PASTERNACK, B. A., 2002. Applied management science. Hoboken, NJ: John Wiley & Sons, Inc. Lpsolve 5.5., Documentation available at http://lpsolve.sourceforge.net/5.5/ . Software downloadable from: https://sourceforge.net/projects/lpsolve/ [Accessed 08 April 2018]. R.E. Burkard, M. Dell'Amico, S. Martello: Assignment Problems (Revised reprint). SIAM, Philadelphia (PA.) 2012. ISBN 978-1-61197-222-1

Title	Data analysis e-learning tool
Proposer	Ines Arana
Email	i.arana@rgu.ac.uk
Keywords	Software engineering, Basic analytics, e-learning systems, User interaction
Background and motivation	Data analytics is an important area which people generally find challenging. Having a good grasp of the basics is key to progressing in the field. In this project, you will develop an elearning tool to teach users the basics of data analytics. The interactive tool will use simple examples to illustrate key concepts, will present the user with the concepts and it will then ask the user to complete a series of guided exercises, giving constructive and corrective feedback as appropriate.
Aim	To develop a tool to teach users basic data analytics concepts.
Objectives	• To investigate data analytics and select key basic functions. • To research e-learning • To design, implement, test and evaluate a system which teaches users about basic analytics. • To conduct a usability test on actual users. • To document the work
References	Nesta. Decoding Learning – the proof, the promise and the potential of digital education. www.nesta.org.uk/sites/default/files/decoding_learning_report.pdf [accessed 21/02/2018] D. Diez, C. Barr, M. etinkaya-Rundel, *OpenIntro Statistics* (3rd Edition), OpenIntro, 2015 [available for download at www.openintro.org, accessed 31/01/2018] Association for Learning Technology: www.alt.ac.uk [accessed 21/02/2018] Learning Theory Connections – Constructivism compared to and developed from other learning theories. sites.google.com/site/constructivismgroupproject/home/learning-theory-connections. [21/02/2018].

Title	A game for sustainable fishing
Proposer	Ines Arana
Email	i.arana@rgu.ac.uk
Keywords	Software engineering, Web technologies (if the game is web-based), User interfaces and interaction, Databases
Background and motivation	Managing fish stocks is essential in order to maintain fish populations. Marine Scotland would like the fishing industry to be more aware of the impact of fishing on fish stocks, in a move to promote responsible fishing which benefits the industry while maintaining healthy population numbers. In this project, you will develop a game which will let users learn about sustainable strategies. In order to get a good game score, users will need to use strategies where the spawning stock is preserved, considering long-term profits over short-term gains. The game will use a real area (the North Sea), but an imaginary fish (coddack) which will have the biological characteristics of well known real white fish. Initially the game will simulate 10 years of fishing on coddack. Subsequently, a larger/shorter period may be simulated, depending on the results obtained. The population model has the following features: • An initial age structure (ie the number of fish of each age from 1 to 10); • Recruitment – ie new fish age 0 come in at the start of a year game step; • Distribution – at the start of the year the fish described above are distributed across the model grid based on a semi-random algorithm that allows certain ages to be preferentially allocated to certain areas; • Properties of fish – each age of fish has a set weight per fish and a value; • Death – the user catches fish, and there is some natural mortality to be set initially from real observations.
Aim	To develop a game aimed at teaching users the impact of fishing on fish stocks. The aim of the game is to maximise profits during a given period of time while maintaining healthy population numbers. The tool will take into account a number of factors (e.g. location, weather patterns, fish size, reproduction rate, wastage due to illness and predators, fish price, fishing costs, etc.).
Objectives	• To investigate the main factors contributing to fish populations and sustainable fishing. • To research game design. • To design, implement, test and evaluate a game which teaches users about sustainable fishing. The aim of the game is to maximise profits while maintaining healthy stocks. • To conduct a usability test on actual users. • To document the work
References	World Wide Web Consortium, Web Design and Applications, www.w3.org/standards/webdesign [accessed 21/02/2018] Interaction Design Foundation – Usability. www.interaction-design.org/literature/topics/usability [Accessed 21/02/2018] MySQL, www.mysql.com, accessed 21/02/2018

Title	Echo Chamber Buster
Proposer	Bill Ballew
Email	w.ballew@rgu.ac.uk
Keywords	Social media, echo chamber, fake news, data diet
Background and motivation	With recent events in social media (e.g. FaceBook fake news scandal) involving major global events such as election rigging, one of the most psychologically challenging problems we face is the confirmation bias in social media that creates personal echo chambers – i.e. people only take information feeds that reinforce their belief systems, thus come to strengthen and polarize their beliefs as a function of 'virtual validation' from specious sources and fake news feeds filled with agenda-laden propaganda.
Aim	To create an app that monitors your data intake and informs you when you are in danger of creating your own echo chamber by virtue of a lack of variety in your data diet, then makes recommendations that allow you to balance your data diet – i.e. the opposite of what targeted marketing attempts to accomplish when it catalogues your likes and feeds you more of the same
Objectives	1. Develop a user interface 2. Develop a monitoring program that passively observes and records data intake from information feeds 3. Develop criteria thresholds for excessive homogeneity of input 4. Develop a web crawler that seeks out alternative sources of information based on key words/phrases contained within the homogenous feeds that are in danger of creating the echo chamber
References	Quantifying Controversy on Social Media. ACM Transactions on Social Computing archive Volume 1 Issue 1, February 2018 Article No. 3 ACM New York, NY, USA. Mary, Mary, Quite Contrary: Exposing Twitter Users to Contrarian News. Proceedings of the 26th International Conference on World Wide Web Companion Pages 201-205, Perth, Australia — April 03 - 07, 2017. Political blend: an application designed to bring people together based on political differences. Proceedings of the 6th International Conference on Communities and Technologies Pages 120-130 Munich, Germany — June 29 - July 02, 2013. Reducing Controversy by Connecting Opposing Views. Proceedings of the Tenth ACM International Conference on Web Search and Data Mining Pages 81-90 Cambridge, United Kingdom — February 06 - 10, 2017

Title	Determining ISO 27001 maturity within an IT organisation
Proposer	William Ballew
Email	w.ballew@rgu.ac.uk
Keywords	ISO 27001, industry standards, ITIL
Background and motivation	More and more, companies providing a variety of IT services are being required to initiate the ISO 27001 Information Security Management standard within their organisations simply in order to be able to do business with larger clients involving more lucrative contracts. As such, it will become increasingly useful for companies to be able to gauge their level of maturity in implementing the standard in order to remain competitive against those with long-standing track records of successful audit cycles.
Aim	To better understand ISO 27001 maturity and its meaning for competitive advantage within the IT marketplace.
Objectives	1. Research a variety of metrics that could aid in determination of ISO 27001 maturity within an organisation (e.g. survey of implementation) 2. Apply those metrics across a variety of organisations in order to test validity across several companies known to be at varying levels of maturity 3. Relate the findings to market conditions and the value proposition of having ISO 27001 certification 4. Establish and implement the metrics within a consultancy-like framework in order to demonstrate usefulness within a business context
References	Alan Gillies, (2011) "Improving the quality of information security management systems with ISO27000", The TQM Journal, Vol. 23 Issue: 4, pp.367-376, https://doi.org/10.1108/17542731111139455 F. Pino, F. Garcia, M. Piattini**Software process improvement in small and medium software enterprises: a systematic review** Software Quality Journal, 16 (2) (2008), pp. 237-261 F. Ahmed, L.F. Capretz**A business maturity model of software product line engineering** Information Systems Frontiers, 13 (4) (2011), pp. 543-560 Wendler, R. The maturity of maturity model research: A systematic mapping study. Information and Software Technology. Volume 54, Issue 12, December 2012, Pages 1317-1339.

Title	Information System Dashboard for Moodle
Proposer	Bill Ballew
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Keywords	Information systems, dashboard, Moodle, student data, software development, data visualization

Background and motivation	Campus Moodle is the primary interface for students and staff alike, and the staff interface contains specific data about student logins and other activities for which a management information system dashboard could be set up in order to convey immediate information about online attendance, viewing of particular files, etc. by students engaged in any particular module. This could be done in order to provide better pastoral care for students and to spot difficulties before they arise by providing a series of relevant quick-view dashboards for staff to use in order to better understand participation and Moodle usage, particularly for larger groups of 50+ students.
Aim	The aim of the project would be to develop a useful, informative, and easy-to-use dashboard for staff to be able to view students' Moodle activities across a variety of available system data in order to determine where extra attention should be paid, head off potential problems, and see what types of data are of greatest interest to students in a given module.
Objectives	The student would be required to • Investigate the types of data available via Moodle in order to • Organize and construct a visualization interface such as a series of dashboards according to basic design principles and good practice • Develop a means of alerting staff to certain types of student behaviours such as non-access of Moodle, non-submission of assignments/assessments, etc. • Develop a means of auto-alerting students via e.g. campus email that they have an assignment/assessment due, or that they have missed a deadline.
References	Princely Ifinedo, Joanne Pyke, Amar Anwar, Business undergraduates' perceived use outcomes of Moodle in a blended learning environment: The roles of usability factors and external support, Telematics and Informatics,Volume 35, Issue 1, 2018, Pages 93-102, ISSN 0736-5853, https://doi.org/10.1016/j.tele.2017.10.001.. Konomu Dobashi, Automatic data integration from Moodle course logs to pivot tables for time series cross section analysis, Procedia Computer Science,Volume 112, 2017, Pages 1835-1844, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2017.08.222.

Title	Dark Data and Pattern of Device
Proposer	Bill Ballew
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Keywords	Dark data, emissions, Tempest, usage pattern, pattern of life

Background and motivation	'Dark data', i.e. data that is transferred at the Data Link Layer (Layer 2) of the Open Systems Interconnection model and deals with machine-to-machine communication traffic given off by all wireless devices, can be used to effectively derive potentially actionable intelligence data on individuals regarding their pattern of life, habitual behaviours, and home 'nest' as typified through their use of ubiquitous electronic devices such as mobile phones, iPads, and laptops as those devices connect to wireless networks via private and publicly available access points. The commonly held belief is that this type of metadata is 'safe' and 'meaningless', however the opposite can easily be demonstrated through the use of just a few data analysis tools that are freely available on the internet.
Aim	The aim of this project would be to develop a means of detecting that a particular device (the Device of Interest or DoI) is present in a wireless environment solely based on passive collection of dark data, then introducing a means of alerting its presence to a monitoring device (mobile phone, pad, etc.) using a simple interface with a directional indicator pointing back to the target source.
Objectives	The student would be required to • Investigate wireless networks' use of dark data in order to establish a means of identifying individual devices in the wireless environment • Construct an algorithm to establish an identifier (MAC address) for devices using cycling MAC address techniques • Develop an output interface to allow a user to identify direction of the target source graphically displayed on finder's device. • Develop a means of confirming the 'fingerprint' of that device based on dark data usage patterns.
References	Patrick Bonnel, Etienne Hombourger, Ana-Maria Olteanu-Raimond, Zbigniew Smoreda, Passive Mobile Phone Dataset to Construct Origin-destination Matrix: Potentials and Limitations, Transportation Research Procedia, Volume 11, 2015, Pages 381-398, ISSN 2352-1465. https://doi.org/10.1016/j.trpro.2015.12.032. John S. Atkinson, John E. Mitchell, Miguel Rio, George Matich, Your WiFi is leaking: What do your mobile apps gossip about you?, Future Generation Computer Systems, Volume 80, 2018,Pages 546-557, ISSN 0167-739X, https://doi.org/10.1016/j.future.2016.05.030.

Title	Motion Detection and Analysis
Proposer	Dr. Eyad Elyan
Email	e.elyan@rgu.ac.uk
Keywords	Image processing, video analysis, machine learning
Background and motivation	The project aims to develop a method to detect and track human movements in video files. The project requires using image-processing techniques such as segmentation, edge detection, etc…In addition, a machine learning (classifier) approach will be utilised to classify these movements. The type of activity to be monitored is to be discussed with the student, and this should be a simple one. Alternatively, a public data set may be used.
Aim	Develop strong theoretical and practical understanding of machine vision, and apply knowledge to a video dataset to detect and classify human movements/ actions
Objectives	1. Investigating existing literature and software technologies 2. Chose, design and implement algorithms to segment video footages 3. Build and evaluate a tracking algorithm to track human movement in video footage 4. Build an feature space and feed it into a classifier of your choice to classify human movements 5. Evaluate, discuss and document results
References	1. Open Computer Vision Library: http://opencv-python-tutroals.readthedocs.io/en/latest/ 2. Review of Motion Detection/ Tracking Techniques http://rd.springer.com/article/10.1186%2F1687-6180-2013-176

Title	Learning from Re-engineered Datasets
Proposer	Dr. Eyad Elyan
Email	e.elyan@rgu.ac.uk
Keywords	Machine learning, predictive analytics, unsupervised learning
Background and motivation	In this project you will explore different methods to re-engineer an existing dataset, and then apply a learning algorithm aiming at improving accuracy. For example, imagine we have a dataset that records patient's information, and label them as either having a certain disease or being healthy. One way to re-engineer this set is to take a closer look at the sick patients records and try to categorise according to the degree of the disease i.e. severe, mild, etc… This can be achieved by applying unsupervised learning algorithms such as k-means, and results in the literature suggest that with such approach performances significantly improve.
Aim	Apply unsupervised machine learning algorithms to improve the performance of supervised learning algorithms.
Objectives	• Develop strong and deep understanding of Machine Learning and how to apply it to real structured datasets • Carry out in-depth background investigation in the area of Ensemble Learning such as Random Forest, Gradient Boosting, etc… • Explore different unsupervised machine learning methods (i.e. clustering) and apply a chosen method to re-engineer the data • Apply and evaluate a learning algorithm and report results • Write technical report / documentation
References	• E Elyan, M M Gaber, A genetic algorithm approach to optimising random forests applied to class engineered data, Information Sciences, Volume 384, April 2017, Pages 220-234, ISSN 0020-0255, doi:10.1016/j.ins.2016.08.007 • E. Elyan and M. M. Gaber. A fine-grained random forests using class decomposition: an application to medical diagnosis. Neural Computing and Applications, 27(8):2279-2288, 2016, doi:10.1007/s00521-015-2064-z

Title	What makes a 'good' tweet or online post?
Proposer	Dr. Eyad Elyan
Email	e.elyan@rgu.ac.uk
Keywords	NLP, Features Engineering, Machine Learning, Social Media Content Analysis
Background and motivation	The project aims at developing a set of tools to extract social media contents from social networks such as www.twitter.com. Methods will then be developed to explore, visualise and analyse the content aiming at identifying the key characteristics that makes a tweet popular or an online post scores higher than other posts.
Aim	In-depth analysis of social media content using advanced machine learning and Natural Language Processing (NLP) methods.
Objectives	• Identify a social media platform to work with and extract contents (i.e. Twitter, Reddit, etc…) • Develop methods to analyse the text and build a feature space (i.e. the length of each tweet, does it contain links to images, videos or other sources, etc…) • Label /rank tweets according to their popularity (one way to do so is to label them according to how many times they have been retweeted (in case of twitter), other metrics may be used for other platforms • Build a machine learning method to predict tweet popularity, • Test, report and discuss results • Provide technical document / report
References	• Text mining in R https://www.tidytextmining.com/ • Text Mining in Python http://snf.es/Jacob%20Perkins-Python%203%20Text%20Processing%20with%20NLTK%203.pdf

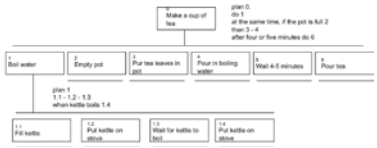
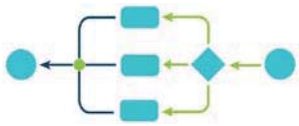
Title	Class-imbalance Data Classification
Proposer	Dr. Eyad Elyan
Email	e.elyan@rgu.ac.uk
Keywords	Under-sampling, SMOTE, Class-Decomposition, Class Imbalance, Machine Learning
Background and motivation	Classification is a supervised machine learning technique where the aim is to build a predictive model (classifier) to learn from historical data. Examples include email-spam detection, fraud detection, and so on. In this project you will investigate and apply methods to solve the class-imbalance problem. This is very challenging problem in Supervised Machine Learning, where the majority of instances are belonging to one class, and the class of interest is rare.
Aim	Apply and evaluate different methods to imbalanced datasets.
Objectives	• Investigate related literature • Develop strong and deep understanding of Machine Learning and how to apply it to real structured datasets • Investigate class-imbalance problem and existing methods to handle it (i.e. oversampling, under-sampling, SMOTE, etc…) • Build an experimental framework to handle dataset with imbalanced distribution • Write technical report / documentation
References	https://www.sciencedirect.com/science/article/pii/S0950705111001286 https://www.sciencedirect.com/science/article/pii/S0957417408002121

Title	Automatic Accessibility Analysis for Tabletop Games
Proposer	Michael Heron
Email	m.j.heron1@rgu.ac.uk
Keywords	Accessibility, gaming
Background and motivation	Board games are in the middle of something of a golden age – the range, sophistication and popularity of tabletop experiences has never been greater. Don't think Monopoly or Cluedo for this – board games are amazing now. However, along with this comes a range of accessibility problems for people with disabilities – these games are often challenging to play because of their strong emphasis on non-standard user interactions. Little attention has historically been given to this area, but this is changing as the topic gains more focus, primarily driven by the website http://meeplelikeus.co.uk. Designers often do not have the necessary skills to do significant analysis of their own games, and this project would aim to develop a tool that combined data science and case based reasoning to assist in that regard.
Aim	The aim of this project would be to develop a tool that used information processing and data science to automatically analyse proposed games for their likely accessibility issues, using the data set of Meeple Like Us to inform the analysis.
Objectives	The student would be required to 1. Identify a common data representation that would permit meaningful analysis with data science techniques. 2. Convert existing data into a suitable format for analysis for calibration purposes. 3. Develop a piece of software that would convert user-entered data into an accessibility audit. 4. Test and evaluate that software with users.
References	Currently the only significant source of information on this topic is the supervisor's website, http://meeplelikeus.co.uk. You will also find the topic occasionally discussed on http://geekygimp.com. This is a broad overview that may be helpful: https://www.tabletopgaming.co.uk/board-games/articles/its-time-to-turn-grumbles-about-inaccessibility-in-board-games-into-a A reasonable overview of data science techniques can be found here: https://www.nap.edu/read/23670/chapter/6 And an overview of Text Analysis is here: http://www.predictiveanalyticsworld.com/patimes/text-analytics-the-next-generation-of-big-data-061215/5529/

Title	Digital Tools for Board Game Accessibility
Proposer	Michael Heron
Email	m.j.heron1@rgu.ac.uk
Keywords	Accessibility, gaming
Background and motivation	The aim of this project would be to develop software which would address accessibility issues in tabletop games, either as a broad-based tool applicable to many games or a specific, bespoke tool aimed at a single troublesome game or game context.
Aim	The student would be required to • Investigate the landscape of accessibility within tabletop games. • Identify potential software solutions to accessibility problems in the tabletop gaming space. • Develop a piece of software that would address an identified accessibility need. • Test and evaluate that software with users.
Objectives	The student would be required to 1. Identify a common data representation that would permit meaningful analysis with data science techniques. 2. Convert existing data into a suitable format for analysis for calibration purposes. 3. Develop a piece of software that would convert user-entered data into an accessibility audit. 4. Test and evaluate that software with users.
References	Currently the only significant source of information on this topic is the supervisor's website, http://meeplelikeus.co.uk. You will also find the topic occasionally discussed on http://geekygimp.com. This is a broad overview that may be helpful: https://www.tabletopgaming.co.uk/board-games/articles/its-time-to-turn-grumbles-about-inaccessibility-in-board-games-into-a And an overview of Text Analysis is here: http://www.predictiveanalyticsworld.com/patimes/text-analytics-the-next-generation-of-big-data-061215/5529/

Title	Adaptive Accessibility for Video Games
Proposer	Michael Heron
Email	m.j.heron1@rgu.ac.uk
Keywords	Accessibility, gaming
Background and motivation	Accessibility in Video Games has become a hot topic of late – one that is not without its controversies. While there is still much work to be done with regards to ensuring video games are playable for all people with disabilities there is at least a broad consensus in how it can be done in most cases. This project will look beyond this current consensus into the realm of **adaptive** accessibility – accessibility solutions that present themselves as a result of player difficulties with the game as opposed to difficulties with the game presentation. For example, when a player fails to get past a particular obstacle several times in a row that obstacle might be made slower, or smaller, or disappear entirely with enough failures
Aim	The aim of this project will be to develop and refine generalised techniques for building adaptive accessibility into game engines, primarily Unity.
Objectives	The student would be required to • Research accessibility issues within the video game domain • Identify accessibility issues that could be addressed with adaptive techniques. • Identify a universally applicable format by which a developer could make use of an external library to support adaptive accessibility. • Incorporate adaptive accessibility into an existing game • Test and evaluate with users
References	The Game Accessibility Guidelines give a good overview of the current consensus in this topic: http://gameaccessibilityguidelines.com/ This paper discusses some of the ways in which developers inadvertently introduce inaccessibility into their games: http://tcjg.weebly.com/uploads/9/3/8/5/9385844/whitsun2012_m_heron.pdf Wikipedia (it's okay, I can cite this – I'm a professional) has a reasonable overview of the idea of Dynamic Game Difficulty Balancing, of which this would be a specialisation. https://en.wikipedia.org/wiki/Dynamic_game_difficulty_balancing

Title	Gesture Based VR Game
Proposer	Michael Heron
Email	m.j.heron1@rgu.ac.uk
Keywords	Accessibility, gaming, virtual reality
Background and motivation	VR games tend, at least for the moment, to offer relatively shallow patterns of interaction. Developers still aren't entirely sure how best to make them better. This project would investigate the possibilities of physical gestures as gameplay interaction systems – the physical formation of shapes and patterns with the human body, with a special emphasis on how to make sure such systems are broadly accessible to players with disabilities. Possible ways this might be done include offering multiple gestures to accomplish the same action, offering alternative systems to support players, or perhaps exploring co-operative play.
Aim	The aim of this project will be to develop a proof of concept VR game that makes use of physical gestures as the main form of game interaction.
Objectives	The student would be required to • Research gesture based interactions in VR and in normal user interfaces. • Design a VR game suitable for testing gesture based interaction in a physically situated context. • Develop a proof of concept gesture-based VR game using Unity or some other appropriate game development engine. • Test and evaluate with users
References	Gesture based interfaces in app design: https://www.netguru.co/blog/gesture-based-interface Accessibility in VR: https://blog.google/products/google-vr/daydream-labs-accessibility-vr/ Gesture Recognition in VR: https://appreal-vr.com/blog/gesture-recognition-in-virtual-reality/

Title	Visualising Workflows from Hierarchical Task Analysis Plans
Proposer	Patrik Holt
Email	p.holt@rgu.ac.uk
Keywords	Workflows, HTA, visualisation
Background and motivation	Hierarchical Tasks Analysis (HTA) is a fundamental technique used in User Interface design as well as most branches of engineering to decompose and represent complex tasks. An HTA consists of a procedural plan that describes a task and an HTA diagram that visually represents the plan. An example is shown below.  A key element in User Interface design is to capture and represent the workflow of a given task that a user carries out. An example generic workflow is shown below.  The challenge in this project is to combine HTA and workflows to produce a single visualisation that represents workflow better than current methods.
Aim	To design and implement a tool that allows the capture of an HTA plan and visualisation and converts it to a visual workflow model that can be the basis of dialogue design for that particular task.
Objectives	1. Investigate the background to HTA and workflow models and visualisations. 2. To design a system that allows a user to specify an HTA plan that is visualised with help from the user. 3. To design a way for the system to produce a workflow visualisation of the plan and HTA. 4. Evaluate the system.
References	1. Kirwan, B. and Ainsworth, L. (Eds.) (1992). A guide to task analysis. Taylor and Francis. 2. Hackos, JoAnn T. & Redish, Janice C. (1998). User and Task Analysis for Interface Design. Wiley. 3. Garcia et al (2008) Modeling User Interfaces to Workflow Information Systems. Fourth International Conference on Autonomic and Autonomous Systems, ICAS 2008, 16-21 March 2008, Gosier, Guadeloupe 4. Barjis et al (2010) Enterprise and 5. Organizational Modeling and Simulation 6th International Workshop, EOMAS 2010 held at CAiSE 2010, Hammamet, Tunisia, June 7-8, 2010 Selected Papers

Title	LaTeχ Interactive Learning System for Students
Proposer	Patrik Holt
Email	p.holt@rgu.ac.uk
Keywords	LaTeχ, learning, writing, student_assignments, typesetting
Background and motivation	There is no doubt that LaTeX represents the best document description formalism for postscript printing. It is superior in terms of layout, page control, document format, tables and graphics. However, LaTeX does involve an investment in learning how to use it although a number of filters and converters are available for automating the conversion. Other solutions involve specialist LaTeX WYSIWYG editors such as LyX that offer a user experience similar to Dreamweaver. Some writers find that they are more creative and comfortable with text editors that offer direct WYSIWYG support, e.g. MS Word and Apple Pages. However, LaTeX is still superior in terms of document markup for postscript printing. As the use of various markdown formalisms become commonplace in editors there is a need to provide help to learners to use markdown, markup and of course LaTeX. The challenge in this work is to design learning that is appropriate for users and to implement around that LaTeX support.
Aim	To design and implement an interactive prototype eLearning system for teaching students about markdown, markup and LaTeX.
Objectives	1. Review current provision of eLearning support for LaTeX. 2. Produce requirements report for an eLearning systems. 3. Design and implement a prototype. 4. Evaluate the prototype with a small group of MSc students at RGU.
References	https://www.lyx.org/ E.g. LATEX 2ε for authors https://www.latex-project.org/help/documentation/usrguide.pdf Branham, JA (2015) Markdown vs Latex for Academic Writing. https://jabranham.com/blog/2015/09/rmarkdown-vs-latex/

Title	Tool for Sorting and Mapping Medical Images
Proposer	Patrik Holt
Email	p.holt@rgu.ac.uk
Keywords	Medical_imaging, sorting, mapping, clustering, prototyping
Background and motivation	Sorting techniques of various kinds are commonly used to capture human mental models in order to maximise web site organisation or menu linkages in user interfaces such as MS Word. A variety of methods are used to analyse results ranging from qualitative descriptions to cluster analysis. Relatively little work has been done to apply academic research knowledge to the sorting of medical images for the purpose of classifications that might aid diagnosis. The challenge in the project is to explore ways of quantifying classified images and to use those measures in cluster analysis.
Aim	To design and implement a software tool that allows uploaded images to be sorted by users while capturing user justifications for membership of given categories. Also, to visualise the sorted images and allow interactive exploration with cluster analysis.
Objectives	1. To investigate current work on sorting and clustering. 2. To design and implement a prototype system for user sorting. 3. To implement a visualisation method to display the sorting results. 4. To implement a cluster analysis module that will allows the results to be analysed and displayed. 5. Evaluate with a small user the effectiveness of the tool.
References	1. Spencer, D (2009) Card Sorting: Designing Usable Categories. Rosenfelt Press. 2. Padilla et al (2017) Understanding Concept Maps: A Closer Look at How People Organise Ideas. CHI 2017

Title	Tools for comparative evaluation of visualisations in cyber security
Proposer	Patrik Holt
Email	p.holt@rgu.ac.uk
Keywords	Visualisation, cybersecurity, evaluation
Background and motivation	The visualisation of cybersecurity threats is common place and while research is carried out that evaluates the effectiveness of visualisation there is no reported toolkit available to aid evaluators.
Aim	To develop a prototype platform that will systematically present users with visualisations for security threats and provide a range of qualitative and quantitative tools for evaluating how effective the visualisation is for identifying threats. The challenge in this project is to identify and embed appropriate evaluation tools and to automate the evaluation process.
Objectives	1. Review current visualisation and evaluation methods, tools and techniques. 2. Design, implement and prototype a platform for experimental evaluations of cybersecurity threats. 3. To test and evaluate the platform.
References	Staheli et al (2014) Visualization evaluation for cyber security: trends and future directions, VizSec '14 Proceedings of the Eleventh Workshop on Visualization for Cyber Security Pages 49-56 Paris, France — November 10 - 10, 2014

Title	Drone delivery scheduling
Proposer	Kit Ying Hui
Email	k.hui@rgu.ac.uk
Keywords	Drone, scheduling, constraint, genetic algorithm

Background and motivation	Recently, the use of Unmanned Autonomous Vehicles (UAV, aka drone) is a hot topic. With the advances in technologies and the fall in prices, drone has opened up the door to fast and autonomous courier. Big companies, like Amazon and Google, have been exploring the use of drones for delivery. Despite the hype, delivery by drones has many limitations: • A typical drone can only carry a limited weight. E.g. 1kg. • Depending on the battery capacity, and payload, a typical drone has a flight time of 10-30 minutes. • Drones are affected by weather. Flying against the wind means using more power and a shorter flight time. • There are areas where drones should not be flying (e.g. near power lines, airports). • Some destinations are not suitable for drone delivery (e.g. a flat without a landing space). Given a fleet of drones and a set of delivery orders, the problem of scheduling drones for delivery has challenges at different levels: • At the top level, a company wants to deliver all orders in the shortest time. This is a typical optimisation problem which can be solved by genetic algorithm or constraint solving. • To take into consideration the effect of weather on a drone's performance, the wind speed and direction along the flight path need to be considered in estimating flight time. Weather information of locations can be obtained from online sources. • Instead of simply specifying the starting and ending locations, a drone accepts a flight path defined by a sequence of way points. An intelligent system should include geographical factors into the scheduling process.
Aim	To investigate, design and implement a system for scheduling drone delivery.
Objectives	• To model the drone delivery problem, taking into consideration the characteristics (e.g. load capacity, flight time) of different drones in the fleet. • Solve the drone delivery problem using AI techniques. • Optionally, include weather information in the flight time estimation model. • Optionally, generate flight plans for drones instead of making simple task allocations.
References	• Open Weather Map API: http://openweathermap.org/api • Wikipedia's entry on Constraint Satisfaction Problem: http://en.wikipedia.org/wiki/Constraint_satisfaction_problem • A quick introduction to Genetic Algorithm: http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol1/hmw/article1.html

Title	Car Share Web App
Proposer	Kit Ying Hui
Email	k.hui@rgu.ac.uk
Keywords	Resource sharing, web app
Background and motivation	The Robert Gordon University promotes car sharing where staff and students commuting to the campus using similar routes can share transportation. The scheme has the following benefits: • Reduce the number of parking space needed on campus. • Be eco-friendly by reducing the number of cars on the road. • Lower the cost of driving as passengers are encouraged to make financial contributions. At the moment "match making" of car share partners are done via the LiftShare UK website. Weekly transport requirements are specified by a single pattern which cannot cope with sudden changes. It is desirable to have a more flexible system which allows last minute pairing and notify users via an instant messaging infrastructure.
Aim	To design and implement a web app for RGU staff and students to share car commuting to the campus.
Objectives	• Design and implement a web-based interface for RGU users to register their car sharing offers and requests. • Design and implement a database to store collected data. • Devise a match-making algorithm that finds staff on similar commuting routes. • Optionally use online messaging to inform users of any last minute change of arrangement.
References	• RGU Car Share scheme: http://www.rgu.ac.uk/contact-us/transport-information/car-share/ • LiftShare website: https://liftshare.com/uk

Title	Car parking using artificial neural network
Proposer	Kit Ying Hui
Email	k.hui@rgu.ac.uk
Keywords	Neural network, artificial intelligence
Background and motivation	Car parking is a multi-level decision making task. At the lowest level, car parking involves the association between some inputs (e.g. orientation and distance of the designated parking space) and some outputs (e.g. the speed and steering of the vehicle). With available training examples, this mapping between the input and output patterns can be learned by an artificial neural network (ANN) through supervised learning. While a particular parking scenario (e.g. parallel parking) requires some specific skills which can be learned by a single ANN, a higher-level task is to categorise a parking scenario and decide which lower-level ANN to use (e.g. "L" vs parallel parking). This categorising knowledge can be learned by another ANN which takes the relationship between the car's initial position and the parking space to decide which lower-level ANN to use. Without resorting to a real car and hardware engineering, we can simulate the domain using software. Perception can be simulated by calculation on the modelled environment.
Aim	Design and implement a simulation that uses artificial neural network to park a car.
Objectives	• To model the dynamics of a car and its manoeuvre. • To model the environment in which the car operates. • To design and implement a tool for collecting training data for the car parking problem. • Train and apply an artificial neural network to control parking of a car in the simulated environment. • To design and implement a visualisation tool for the simulation.
References	• A tutorial on artificial neural network from Tutorials Point: https://www.tutorialspoint.com/artificial_neural_network/index.htm • Another online tutorial on artificial neural network: http://adventuresinmachinelearning.com/neural-networks-tutorial/ • Deep Learning for Java: https://deeplearning4j.org/ • Neuroph Java library for artificial neural network: http://neuroph.sourceforge.net/

Title	A cloud-based running data sharing web app
Proposer	Kit Ying Hui
Email	k.hui@rgu.ac.uk
Keywords	Cloud computing, running, web app
Background and motivation	About a decade ago, runners were mostly confined to collecting timing information only. With the advances of mobile and wearable devices, it is now easy to collect information of running speed, distance, heart rate, and GPS locations. Instead of being a solo training activity, runners can now share their running data in a community, compare data with friends, and even send real-time cheering messages to someone participating in a run. Most running apps on mobile phones allow the export of data in a format like the "Training Center XML" (TCX). Data in the TCX can be graphically visualised to provide useful information on a runner's performance through the years.
Aim	To design and implement a cloud-based SaaS for the storing and sharing of running data.
Objectives	• To extraction running data from a common data interchange format like TCX. • To store running data on a cloud-based data service. • To design and implement a web UI for the manipulation and visualisation of stored running data. • To build a web-based community for runners to share their running data.
References	• Wikipedia's entry on Garmin Training Center XML (TCX): https://en.wikipedia.org/wiki/Training_Center_XML

Title	Social Network Information Visualisation
Proposer	John Isaacs
Email	j.p.isaacs@rgu.ac.uk
Keywords	Social network, data vis, info viz
Background and motivation	Social networks contain vast amounts of linked information about for content, context and trends in real world events. Analysing this information can be performed by purely computational means such as machine learning, however, often these techniques produce information that cannot be understood by general users or social/ political commentators. Area such as bot detections, political commentary and event analysis are all examples of where expert analysis by a human as well as analysis by machine based techniques may provide a more nuanced understanding of an unfolding situation.
Aim	The aim of this project would be to develop visualisation methods coupled with existing machine learning or data processing techniques to help explain social media data. The study could be applied to political analysis, special event analysis (eg sporting events) or some aspect of bot/spamming or otherwise harmful user detection. The point of the system is that it will be able to produce data visualisations that can be interpreted or compared by a user to better understand the data being analysed.
Objectives	The student would be required to • Develop techniques to collect and store live social media streams and data • Investigate the theory of information & data visualisation and data processing • Construct software which would allow a range of visualisation techniques to be used on social media data • Perform experiments to determine the most appropriate techniques Key Techniques 1. Software Development: Construction of software based tools to collect and store social media data streams 2. Visualisation : Creation of visualisation methods using visualisation frameworks and libraries to help explain the provided data 3. Social Understanding : A working knowledge of the basic s of social media platforms and API use 4. Experimentation : An understanding of how visualisation techniques can be tested with different types of user.
References	Information is beautiful provides information on different types of visualisation techniques https://informationisbeautiful.net/ D3 i s a web language used for data visualisation https://d3js.org/ Examples of Political analysis through visualisation http://blogs.lse.ac.uk/politicsandpolicy/scottish-leaders-debates-ontwitter-sturgeon-davidson-and-indyref2-dominated-proceedings/

Title	Mobile Based Visitor Movement Optimisation
Proposer	John Isaacs
Email	j.p.isaacs@rgu.ac.uk
Keywords	Mobile app, web app, optimisation, visitor movement, smart guide
Background and motivation	Large numbers of both local and international tourists visit Scotland's historic monuments (e.g Edinburgh Castle, Neolithic Orkney) every year. In some areas the sheer numbers of visitors at a single time point is causing a strain on the safety of the monuments andpotentially damaging the natural environment in which they sit. The visitor experience is also reduced due to congestion around the exhibits or monuments. It is plausible that a live updating , optimised visitor path around an exhibit or area could be devised using AI and Machine Learning techniques . This can then be used to create an intelligent visitor guide that can navigate the visitors in real time, easing visitor congestion while providing a useful guide to the area.
Aim	The aim of this project would be to develop an intelligent mobile guide that uses AI techniques to navigate visitors around a chosen area.
Objectives	The student would be required to • Develop a mobile app that can report its location to a central server • Investigate and construct an appropriate technique to aid visitor congestion around a given path • Develop the mobile app to provide a visitor guide which is informed in real time from the server about other visitor movement. • Test the application on a given visitor path/monument Key Techniques Mobile Development: Construction of the mobile app will require some knowledge of mobile development frameworks AI : Using real time (or near real time) location data from other visitors to produce a least congested visitor Experience Real Time Data Streams : Data will need to be processed and delivered in realtime or near real time. An understanding in the basics of data streams and real time data would be beneficial.
References	There are a number of good recent papers on mobile visitor guides here https://scholar.google.co.uk/scholar?as_ylo=2017&q=mobile+visitor+guides There is a nice pathfinding sim in JS here https://qiao.github.io/PathFinding.js/visual/ React Native is a great cross platform JS based mobile environment https://facebook.github.io/react-native/ NativeScript is another cross platform dev framework https://www.nativescript.org/

Title	Visual Crowd Simulation
Proposer	John Isaacs
Email	j.p.isaacs@rgu.ac.uk
Keywords	Crown Simulation, data analysis, visualisation
Background and motivation	This project will build on previous research performed by the school in the area of emergency evacuation from historic buildings. Crowd modelling can be performed through a number of AI and agent based techniques. While these techniques can be purely mathematical and computational often these systems do not convey the actual situation to the decision maker who is responsible for the building or area. This project will look at creating a visual system (primarily 2D) which will allow decision makers to play what-if games with a scenario to determine the effect on the evacuation times from a building floor plan.
Aim	The aim of this project is to develop a visual interactive crowd simulation system that can produce quick analysis of emergency evacuation scenarios from building floor plans.
Objectives	Objectives • The student would be required to • Investigate the theory of crowd modelling and simulation • Construct software which would allow for a 2D visual representation of an agent based evacuation simulation. • Perform experiments to determine the most appropriate crowd modelling and visualisation techniques Key Techniques 1. Software Development: Construction of a crowd modelling system using either novel development or customisation of existing libraries. 2. Visualisation: Development of a visual simulation system to communicate the results of the crowd models andconvey the evacuation scenario. 3. Experimentation : An understanding of how visualisation techniques can be tested with different types of user.
References	Advances and trends in visual crowd analysis: A systematic survey and evaluation of crowd modelling techniques https://www.sciencedirect.com/science/article/pii/S092523121502041X Using Crowd Modelling in Evacuation Decision Making https://pdfs.semanticscholar.org/08c4/2c913a168ccaf496f2f0db0332b7496c512e.pdf The Effect of Person Order on Egress Time: A Simulation Model of Evacuation From a Neolithic Visitor Attraction http://journals.sagepub.com/doi/abs/10.1177/0018720817729608

Title	Complex Data Visualisation for Decision Support
Proposer	John Isaacs
Email	j.p.isaacs@rgu.ac.uk
Keywords	Data analysis, data vis, info viz
Background and motivation	CSDM has a number of strong research areas in the field of data science, optimisation and artificial intelligence. These research areas work on and often produce large complex data sets that are subsequently used to make decisions in a wide array domain, e.g transport, energy, health, tourism and security. Analysing this information can be performed by purely computational means such as machine learning, however, often these techniques produce information that cannot be easily understood by the decision makers who may not be data experts . This project will look at ways of turning these complex datasets into something than can be understood by the decision makers.
Aim	The aim of this project would be to develop visualisation methods to aid the understanding of complex data sets. The student will be given a range of possible datasets to choose from and these will be provided by the various research groups within the school.
Objectives	The student would be required to • Investigate the theory of information & data visualisation and data processing • Construct software which would allow a range of visualisation techniques to be used on and to help explain complex data. • Perform experiments to determine the most appropriate techniques Key Techniques 1. Software Development: Construction of software based tools to collect, store and process data from the provided datasets. 2. Visualisation : Creation of visualisation methods using visualisation frameworks and libraries to help explain the provided data 3. Experimentation : An understanding of how visualisation techniques can be tested with different types of user.
References	Information is beautiful provides information on different types of visualisation techniques https://informationisbeautiful.net/ D3 i s a web language used for data visualisation https://d3js.org/ The data used for such project can often be sensitive and that makes it difficult to provide examples, however if you are interested in the project please contact me directly an d I can show you some examples of this type of large set visualisation.

Title	**WITSML data management or visualisation**
Proposer	Dr David Lonie
Email	d.p.lonie@rgu.ac.uk
Keywords	Oil and Gas, WITSML, data visualisation
Background and motivation	Oil and Gas drilling operations generate large volumes of data. To facilitate the management and transfer of this data, a set of standards and protocols have been developed by the industry. One such standard is WITSML (see [1]).
Aim	To investigate the WITSML standards; and design, implement and evaluate a software solution involving it. This could take several forms, depending on the particular interest of the student. The project might focus on creating a WITSML server (for someone with an interest in data management); or might focus on visualisation of WITSML formatted data (for someone with an interest in data visualisation), or a combination of these.
Objectives	• Investigate the WITSML (and associated) standards. • Investigate appropriate technologies for accessing test WITSML or WITSML server held data e.g. the C# Standards DevKit [2] (most widely supported), or third-party open source tools; • If appropriate, investigate appropriate data management and/or visualisation techniques; • Design, implement, test and document a software solution involving WITSML data on a suitable platform which could be a standalone application, a mobile application, a web or cloud based solution.
References	[1] www.energistics.org for an overview of WITSML (and associated standards) [2] https://www.energistics.org/developer-resources/ for some developer resources [3] https://www.pds.group/Software/WITSMLstudio For some open source resources

Title	**An application of machine learning to financial or commodities markets**
Proposer	Dr David Lonie
Email	d.p.lonie@rgu.ac.uk
Keywords	Machine learning, finance, commodities markets
Background and motivation	Modern financial, forex and commodities markets trade in a wide variety of assets directly but also in futures and options. Traditionally financial market analysis has focussed on analytic techniques (heavy on maths and statistics), or technical analysis (where market practitioners attempt to identify trading patterns in charts). However advances in machine learning along with the computational power of modern computing create opportunities for interesting new techniques for pricing assets or forecasting price trends. There is considerable flexibility as to the choice of markets (e.g. shares, oil, currencies, etc.) and as to the pricing model(s) and techniques that could be used. The student should be prepared to have input into deciding on the techniques and context on which the project will focus.
Aim	To design, implement and evaluate an analysis and visualisation tool for modelling and/or forecasting assets from financial or commodities markets using machine learning techniques.
Objectives	To investigate one or more category of financial, forex or commodity asset or derivatives. To investigate relevant techniques from the domain of machine learning and AI, that have been, or that could be applied in the context of financial data sets. To design and implement a pricing or forecasting tool capable of calculating and displaying prices and related quantities within a real, or a simulated, market. To critically evaluate the performance of the tool relative to existing techniques.
References	For financial data see e.g. Quandl https://www.quandl.com/ Introduction to machine learning, Alpaydin, Ethem (2010) Ebook RGU Library

Title	**Scrabble® Type Game**
Proposer	Dr David Lonie
Email	d.p.lonie@rgu.ac.uk
Keywords	Programming, Scrabble, Word Games
Background and motivation	Scrabble® is a popular word game played on a 15x15 board where players take turns to create valid words in a crossword style pattern from randomly selected letters, with scoring based on word length, position on the board, and the letters used. Many variations of this basic theme would be possible in terms of different rules, board design and scoring methods.
Aim	To design, implement, test and evaluate an application that can play and display a turn-based word game for two or more human players and/or computer players. The application could be developed for PC, web or smartphone to suit the programmers preferred platform.
Objectives	• Investigate the rules of word-based games, and investigate the legal issues surrounding game design; • Create a set of rules, and a board design for an interesting word-game which did not infringe the intellectual property rights of the owners of the Scrabble® trademark; • Design, implement, test and document an application that can manage, play and display a turn-based word game; • Programming tasks would include: o creating or incorporating one or more searchable dictionaries of valid words; o checking the validity of words input by human players; o efficient selection techniques for a creating and positioning valid words from a given set of letters by a computer player; o proper scoring of words according to game's rules. o Implementation of computer logic to play against a human opponent, with different computer-player skill levels.
References	Official Scrabble® website www.scrabble.com

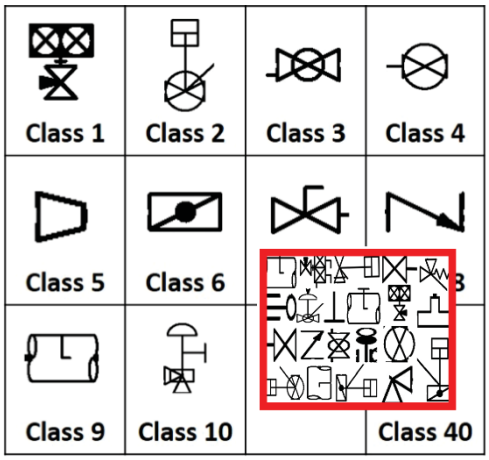
Title	**Computer Modelling of Crowds**
Proposer	Dr David Lonie
Email	d.p.lonie@rgu.ac.uk
Keywords	Computer modelling, programming, visualisation, simulation, swarms, crowds.
Background and motivation	The motion and behaviour of crowds is a complex and difficult phenomena to model analytically. It is an important topic with applications in contexts such as the design of large buildings and public spaces; public safety at large gatherings such as demonstrations, concerts or sporting events. Many computer models rely on fluid flow analogies, but these lead to complex mathematical modelling, because the problem is intrinsically non-linear. Recent results however e.g. [1] use simple models where individual members of the crowd act independently according to simple rules of behaviour. Such models have proved successful in replicating real crowd behaviour.
Aim	To design, implement, test and document an application that can model and visualise crowd motion and behaviour, based on simple behavioural rules
Objectives	To briefly research the field of computer modelling of crowds to identify a simple model(s) of crowd behaviour. To investigate pre-existing packages or frameworks within which models can be implemented. And hence design, implement, test and document an application that can model and visualise crowd motion and behaviour, based on simple behavioural rules (e.g. similar to [1]). Specifically to: • simulate crowd motion • allow the user to design a "space" in which the crowd exists • allow the user to experiment with parameters and settings of the model(s) • allow the user to run and visualise crowd behaviour simulations in a given space .
References	[1] "How simple rules determine pedestrian behaviour and crowd disasters" http://www.pnas.org/content/early/2011/04/08/1016507108.abstract http://www.pnas.org/lookup/suppl/doi:10.1073/pnas.1016507108/-/DCSupplemental [2] **"**Crowd modelling", Economist Magazine article http://www.economist.com/node/13174313 [3] Wikipedia article on Crowd Simulation http://en.wikipedia.org/wiki/Crowd_simulation

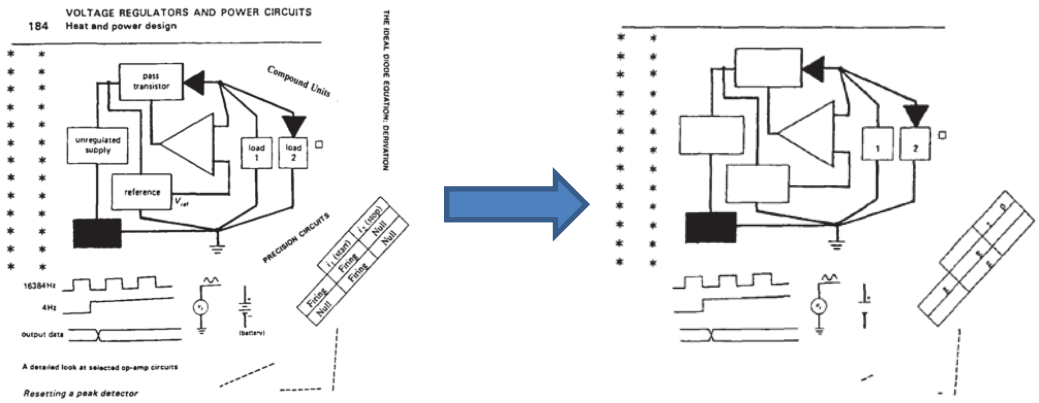
Title	University Timetabling Software
Proposer	Rob Lothian
Email	r.m.lothian@rgu.ac.uk
Keywords	Scheduling
Background and motivation	Scheduling, rooming and staffing all classes for a university is a difficult and time-consuming task. Even creating the CSDM School Timetable is highly demanding. A tool that automated all or part of this task would improve the efficiency and effectiveness of the CSDM timetabling process.
Aim	To design and develop a tool to help the CSDM timetabler in their role.
Objectives	Variant A: A software tool that automatically creates a valid timetable. This is a difficult task in itself, so the user interface could be quite basic. Variant B: A software tool that allows the user to add events to the timetable and gives alerts if there is a clash. The tool could also report on the quality of the timetable in terms of various metrics. This tool should have quite a sophisticated interface.
References	

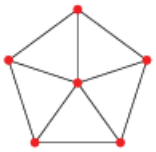
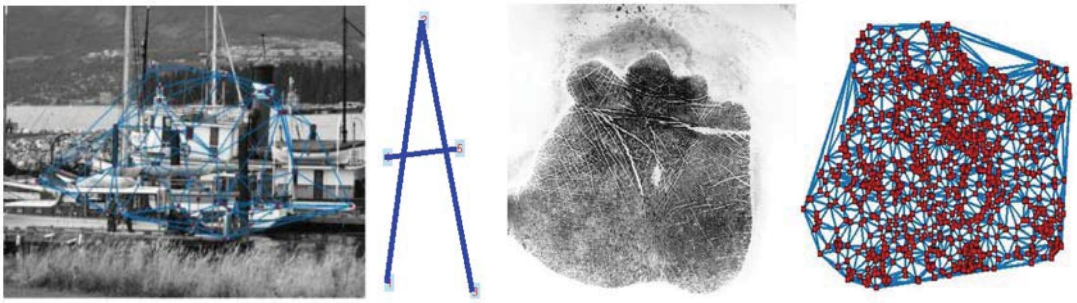
Title	Verbal Arithmetic
Proposer	Rob Lothian
Email	r.m.lothian@rgu.ac.uk
Keywords	Recreational Computing; Combinatorics
Background and motivation	Verbal arithmetic is a form of mathematical recreation involving the substitution of letters for digits, usually presented as a problem with a unique solution. For example, the classic: SEND + MORE = MONEY. A computer tool could be useful to aid solvers or support composers or even to independently compose puzzles
Aim	To design and develop a tool to solve and possibly also generate verbal arithmetic puzzles.
Objectives	It is reasonably easy to solve puzzles by computer and example code for this task can be found on the web. However, this project would provide additional functionality in one or both of the following ways: Variant A: The tool would attempt to solve the puzzle in a logical, human-like way, rather than brute force computation. Solvers could then be provided with an explanation of how to solve a given puzzle, rather than just the solution. Variant B: The tool would automatically generate examples or help a composer to produce good examples. Human-composed puzzles tend to form phrases or juxtapose words to humorous effect. Could a computer program be creative in this way?
References	The Wikipedia page on *Verbal Arithmetic* provides some more information and the solution to the above puzzle. This would be a good place to start your research (and, of course, a terrible place to end it).

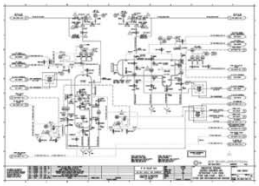
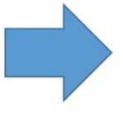
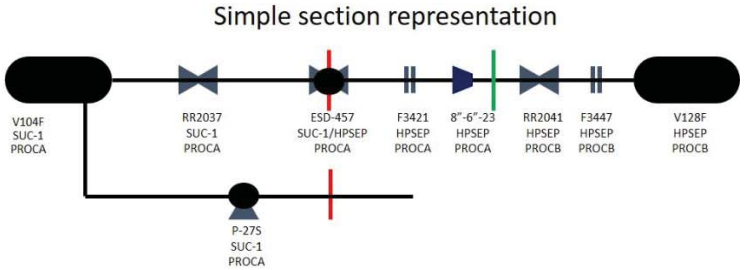
Title	A Computer-Based Learning Tool for Computing Mathematics
Proposer	Rob Lothian
Email	r.m.lothian@rgu.ac.uk
Keywords	Computer-Based Learning; Mathematics
Background and motivation	There are many areas of mathematics found useful in computing, mostly falling under the broad description of discrete mathematics. It would be useful to have a computer-based tool to support computing students in learning mathematics.
Aim	To investigate the ways in which computer-based learning can enhance the learning of those mathematical topics most relevant to computing,
Objectives	To design and develop a computer-based learning tool to support the learning of (some aspects of) mathematics relevant to computing. Examples of suitable topics include: • Introduction to topics such as sets, logic and modular arithmetic, which are typically taught in introductory computing modules. • Algorithms and data structures. • Linear algebra (matrices and vectors) as used in computer graphics.
References	

Title	Scrabble-Playing Program
Proposer	Rob Lothian
Email	r.m.lothian@rgu.ac.uk
Keywords	Artificial Intelligence
Background and motivation	Scrabble ® is a board game in which players score points by placing letter 'tiles' on the board to create words. Special squares multiply scores and there is a bonus for using all (seven) tiles in one turn. Producing a computer Scrabble player is an interesting exercise in AI. Much of the progress made involves the development of data structures to hold the dictionary.
Aim	To investigate the ways in which AI can be an effective player of Scrabble (and similar games).
Objectives	To create a program to play the game (in an intelligent manner) against a human opponent. The student would require to research and/or devise AI approaches to the problem.
References	

Title	Symbol Classification in Engineering Diagrams from the Oil & Gas industry
Proposer	Dr. Carlos Moreno
Email	c.moreno-garcia@rgu.ac.uk
Keywords	Computer vision, symbol classification, engineering drawings, machine learning, Piping and Instrumentation Diagrams
Background and motivation	Engineering drawings are printed or digital assets used in the industry to represent the schematics of a circuit, process or plant. Recently, there has been an increasing interest from the Oil & Gas sector to develop systems that can automatically detect and recognise the shapes depicted in a sub-class of drawings called Piping & Instrumentation Diagrams (P&ID). While these drawings contain a dense amount of shapes, one of the key elements contained are symbols, which represent entities such as valves, pumps or sensors in an oil rig. 
Aim	The aim of the project is to develop methods and applications which increase the classification accuracy rates in symbols collected from P&IDs from the Oil & Gas industry.
Objectives	1. Investigate on classical and current work developed for symbol detection, representation and classification. 2. Collect a class of symbols from P&IDs (and other sources if required) by either manual or automatic methods (an initial set of symbols can be provided). 3. Implement methods to better represent and store symbols collected (initial code is provided). 4. Train and test methodologies based on machine learning which are capable of effectively classifying symbols from a range of diagrams (initial code is provided).
References	1. Lladós, J., Valveny, E., Sánchez, G., & Martí, E. (2002). Symbol Recognition: Current Advances and Perspectives. In *Graphics Recognition Methods and Applications (GREC)* (pp. 104–128). 2. Cordella, L. P., & Vento, M. (2000). Symbol recognition in documents: A collection of techniques? International Journal on Document Analysis and Recognition, 3(2), 73–88. http://doi.org/10.1007/s100320000036 3. Howie, C., Kunz, J., Binford, T., Chen, T., & Law, K. H. (1998). Computer Interpretation of Process and Instrumentation Drawings. Advances in Engineering Software, 29(7–9), 563–570. http://doi.org/10.1016/S0965-9978(98)00022-2 4. Howie, C., Kunz, J., Binford, T., Chen, T., & Law, K. H. (1998). Computer Interpretation of Process and Instrumentation Drawings. Advances in Engineering Software, 29(7–9), 563–570. http://doi.org/10.1016/S0965-9978(98)00022-2

Title	Text/Graphics Separation and Optical Character Recognition for Engineering Diagrams
Proposer	Dr. Carlos Moreno
Email	c.moreno-garcia@rgu.ac.uk
Keywords	Computer vision, text/graphics separation, engineering drawings, text recognition, optical character recognition
Background and motivation	Engineering drawings are printed or digital assets used in the industry to represent the schematics of a circuit, process or plant. One of the most popular approaches to detect the different shapes contained in these drawings (i.e. symbols, connectors and text) is to split these images into layers, with each layer containing a different type of shape. To this aim, several authors have proposed a framework called "Text/Graphics Separation" (TGS), where it is possible to locate the text shapes from a drawing and segregate them from the drawing. These methods have been successfully applied for drawings such as maps, musical scores, circuit diagrams and mechanical drawings. Recently, the Oil & Gas Industry has shown increasing concern in the digitisation of a specific kind of drawings called Piping and Instrumentation Diagrams (P&IDs). These drawings, in contrast to classic engineering drawings, are harder to digitise given their size and complexity. Nonetheless, TGS appears to be a viable initial step to perform P&ID digitisation. 
Aim	The aim of the project is to study and implement TGS frameworks to P&IDs considering the challenges that these drawings arise to the problem.
Objectives	1. Investigate on classical and current work developed for TGS. 2. Implement TGS methods on classical engineering drawings and P&IDs (initial code is provided). 3. Overcome challenges of the TGS task such as overlapping text splitting, string grouping. 4. Implement optical character recognition methods to interpret the detected text (initial methods are provided).
References	1. Fletcher, L. A., & Kasturi, R. (1988). A robust algorithm for text string separation from mixed text/graphics images. IEEE Transactions on Pattern Analysis and Machine Intelligence, 10(6), 910–918. http://doi.org/10.1109/34.9112 2. Tombre, K., Tabbone, S., Lamiroy, B., & Dosch, P. (2002). Text/Graphics Separation Revisited. In DAS (Vol. 2423, pp. 200–211). 3. Moreno-García, C. F., Elyan, E., & Jayne, C. (2017). Heuristics-Based Detection to Improve Text / Graphics Segmentation in Complex Engineering Drawings. In Engineering Applications of Neural Networks (Vol. CCIS 744, pp. 87–98).

Title	Graph Representations and Matching applied in Images
Proposer	Dr. Carlos Moreno
Email	c.moreno-garcia@rgu.ac.uk
Keywords	Computer vision, pattern recognition, graph matching, image classification, correspondences
Background and motivation	Graph Matching is a long withstanding area of study which attempts to solve problems such as pattern recognition, computer vision, biometrics and computer or social networks (amongst others) through the use of structured representations known as graphs. A graph is composed of two parts: a set of nodes and a set of edges that interconnect these nodes.  In the specific case of image recognition, graphs can be used to represent the structural information of an image by using nodes as the features of the image, and edges as the relations between these images. Numerous publicly available graph image repositories and graph matching methodologies have been published in recent years. 
Aim	The aim of the project is to study and implement the latest methods for graph matching in a set of recently published graph repositories. Also, this project aims at producing a novel repository of graphs based on information collected from the Oil & Gas industry.
Objectives	1. Investigate classical and current graph representation and matching literature. 2. Analyse recent graph matching repositories. 3. Implement graph matching methodologies for classification and compare their usability and efficiency with respect to other image classification proposals. 4. Generate a new graph repository based on information collected from the industrial practice.
References	1. Vento, M. (2015). A long trip in the charming world of graphs for pattern recognition. Pattern Recognition, 48(2), 291–301. https://doi.org/10.1016/j.patcog.2014.01.002 2. Brun, L., Foggia, P., & Vento, M. (2018). Trends in Graph-based Representations for Pattern Recognition. Pattern Recognition Letters. https://doi.org/10.1016/j.patrec.2018.03.016 3. Moreno-García, C. F., Cortés, X., & Serratosa, F. (2016). A Graph Repository for Learning Error-Tolerant Graph Matching. In Structural, Syntactic, and Statistical Pattern Recognition (Vol. 10029, pp. 519–529). https://doi.org/10.1007/11815921

Title	Visualising Subsections of Digital Assets from the Oil & Gas Industry using Graph Representations.
Proposer	Dr. Carlos Moreno
Email	c.moreno-garcia@rgu.ac.uk
Keywords	Graph representations, Piping and Instrumentation Diagrams
Background and motivation	Piping and Instrumentation Diagrams (P&IDs) are printed and/or digital assets used in the Oil & Gas industry used to represent the schematics of an oil rig. Recently, there has been an increasing interest from this sector to develop more efficient ways to present small amounts of the information collected from these diagrams, given the large amount of data contained on the original drawing or spreadsheet. For instance, risk specialists may only need a subsection of the P&ID in order to run a risk analysis. Large Drawing  or Large Spreadsheet   Simple section representation  One of the possible solutions for this problem is by means of graphs, which are data representations that allow structural information to be stored and depicted in practical ways.
Aim	The aim of the project is to develop an application which, given a spreadsheet containing the parts and characteristics of a P&ID drawing, generates a visual representation of a subsection.
Objectives	1. Develop a system capable of converting the information extracted from a P&ID (contained on a spreadsheet) into a data representation such as graphs and/or others. 2. Develop a visual interface which allows a user to visualise a specific subsection of the P&ID.
References	1. Howie, C., Kunz, J., Binford, T., Chen, T., & Law, K. H. (1998). Computer Interpretation of Process and Instrumentation Drawings. Advances in Engineering Software, 29(7–9), 563–570. http://doi.org/10.1016/S0965-9978(98)00022-2 2. Wen, R., Tang, W., & Su, Z. (2017). A 2D engineering drawing and 3D model matching algorithm for process plant. Graphical Models, 0, 1–15. http://doi.org/10.1109/ICVRV.2015.13

Title	Cuda C Programming
Proposer	Dr Yann Savoye
Email	y.savoye@rgu.ac.uk
Keywords	Parallel programming, Cuda, GPU, graphic card.
Background and motivation	Cuda is the state of the art language for parallel programming on the GPU, namely a graphic card. This language is heavily used in the entertainment industry for movie and game. The general context for this project is to develop a research-oriented, open source library offering light management of data structures like dynamic array and matrices on the GPU, along with algorithms designed for application in deep learning and artificial neural networks. This project involves coding tasks, understanding of GPU, data structure and algorithmic.
Aim	The aim of this project would be to develop a library of code examples for classical data structures and key learning algorithms using cuda. The user should be able to integrate this library to make his code runnable on the GPU.
Objectives	The student would be required to: • Perform a relevant state of the art review • Implement classical and novel exploratory algorithms • Produce re-usable code • Evaluate the code extensively with proper unit tests. • Involve some original research results • Write technical description of the algorithm in the report
References	[1] - https://devblogs.nvidia.com/easy-introduction-cuda-c-and-c [2] – http://docs.nvidia.com/cuda/cuda-c-programming-guide

Title	Spiking Neural Network
Proposer	Dr Yann Savoye
Email	y.savoye@rgu.ac.uk
Keywords	Artificial intelligence, neural network, spiking neural network
Background and motivation	Spike neurons are the late-breaking, the top of the pop trend in artificial intelligence. This technique unleashes strong potential for learning space-time data in industry. The general context for this project is to develop a research-oriented, open source library offering light management of artificial neural networks with spike neurons, along with algorithms designed for application in deep learning and artificial neural networks. This project involves coding tasks, understanding of AI, learning theories and algorithmic.
Aim	The aim of this project would be to develop software to implement the spiking neural network technique. The user should be able to perform learning using spiking neural network.
Objectives	The student would be required to • Perform a relevant state of the art review • Implement classical and novel exploratory algorithms • Produce re-usable code • Evaluate the code extensively with proper unit tests. • Involve some original research results • Write technical description of the algorithm in the report
References	[1] - Computing with Spiking Neuron Networks Helene Paugam-Moisy and Sander Bohte

Title	GLSL Shading
Proposer	Dr Yann Savoye
Email	y.savoye@rgu.ac.uk
Keywords	Computer graphics, shading, GLSL, shaders.
Background and motivation	GLSL is the most important technology for shading in industry, allowing the rendering of 3D objects with complex setup on the GPU. The general context for this project is to develop a research-oriented, open source library ables to offer several GLSL functionalities for real time rendering and cartoon style shading. This project involves coding tasks, understanding of the rendering pipeline, as well as the exploration of visual human perception.
Aim	The aim of this project would be to develop software to load and apply GLSL shader on render-to-texture images. The user should be able to control the shading, and camera viewpoint
Objectives	The student would be required to • Perform a relevant state of the art review • Implement classical and novel exploratory algorithms • Produce re-usable code • Evaluate the code extensively with proper unit tests. • Involve some original research results • Write technical description of the algorithm in the report
References	[1] - OpenGL Shading Language Paperback, Randy , J Rosy

Title	Voronoi Diagram
Proposer	Dr Yann Savoye
Email	y.savoye@rgu.ac.uk
Keywords	Computer graphic, geometry processing
Background and motivation	Exploring the Voronoi Diagram is an opportunity to study the geometry structures that are observed ubiquitously in the Nature, from the leaves pattern, and inner bone structures, to honeycomb cells. Real-world geometric patterns always lead to fascinating problems in Computational Geometry. The general context for this project is the generation of geometry Voronoi structure for 2D and 3D shapes. There is currently a lot of interest in the generation process of the so-called Voronoi Diagram, leading naturally to its dual: the Voronoi tessellation. This is a difficult task that requires stable computational geometry algorithms.
Aim	The aim of this project would be to develop software to create a Voronoi tessellation via the diagram in 2D and 3D as well as the processing of the wall clipping defined by the 3D model surface boundary. The user should be able to input a shape and then output the inner voronoi structure.
Objectives	The student would be required to • Perform a relevant state of the art review • Implement classical and novel exploratory algorithms • Produce re-usable code, use existing framework. • Construction of the Voronoi diagram software. • Evaluate the code extensively with proper unit tests. • Involve some original research results • Write technical description of the algorithm in the report
References	[1] - Lu, Lin and Sharf, Andrei and Zhao, Haisen and Wei, Yuan and Fan, Qingnan and Chen, Xuelin and Savoye, Yann and Tu, Changhe and Cohen-Or, Daniel and Chen, Baoquan Build-to-last: Strength to Weight 3D Printed Objects - ACM Trans. Graph, July 2014