B.Sc. Professional Project
Proposed Project Topics

Department of Computing

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Contents

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Research Interests

My main research interests include Multimedia Security, Signal Processing, Error-Control Coding and Compression. I particularly like applications that cross the boundaries between the different fields. Other interests include the application of Parallel Computing, particularly with emerging architectures.

Effect of Information Hiding on JPEG Compression

Description

Spatial-domain information hiding in images consists in the modification of pixel data in order to represent some message sequence. When compressed with a lossy image compression scheme (such as JPEG), the stego-image will invariably require a larger file size than the cover image at the same compression quality.

This project investigates the relationship between the parameters for the hidden information (such as message length, embedding strength, etc.) and the compression parameters (such as file size and quality). This project is research-oriented, and has potential for publication.

Background Knowledge Required

- Interest in information hiding.
- Some knowledge of digital imaging fundamentals.
- Aptitude and willingness to program (the project is likely to use a selection of languages, including C++ and Python).

Preliminary Reading List

- Chen, B.; Wornell, G.W., *Quantization index modulation: a class of provably good methods for digital watermarking and information embedding*, IEEE Transactions on Information Theory, vol.47, no.4, pp.1423-1443, May 2001.
- Marvel, L.M.; Boncelet, C.G., Jr.; Retter, C.T., *Spread spectrum image steganography*, IEEE Transactions on Image Processing, vol.8, no.8, pp.1075-1083, Aug 1999.
- Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Third Edition, Prentice-Hall, 2007.
- Bjarne Stroustrup, *The C++ Programming Language*, Special Edition, Addison-Wesley, 2000.
- David M. Beazley, *Python Essential Reference*, Third Edition, SAMS, 2006.

Other Information

Project can be taken by:	1 student
Alternative supervisor:	Steve Wesemeyer
Project type:	Experimental research

Optimal Blind Signal Extraction for Information Hiding

Description

Spread Spectrum Image Steganography (SSIS) is a spatial-domain technique for information hiding in images. In prior work, we have already developed an optimal extraction algorithm, together with blind parameter estimation.

All algorithms are already implemented in Matlab. Unfortunately, this limits the resources that can be used in simulations. The objective of this project is a re-implementation of the extraction and blind estimation algorithms in C++, to facilitate integration with our existing error-control code base. This is an implementation project, with a significant research orientation.

Background Knowledge Required

- Interest in information hiding.
- Some knowledge of digital imaging fundamentals.
- Background in continuous mathematics (calculus) and numerical methods.
- Aptitude and willingness to program (the project requires the use of C++ and Matlab; prior OO development experience in another language is suitable).

Preliminary Reading List

- Marvel, L.M.; Boncelet, C.G., Jr.; Retter, C.T., *Spread spectrum image steganography*, IEEE Transactions on Image Processing, vol.8, no.8, pp.1075-1083, Aug 1999.
- Johann A. Briffa, *High-capacity information hiding in images*, Ph.D. dissertation, Oakland University, Rochester, MI, 2003.
- Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Third Edition, Prentice-Hall, 2007.
- Bjarne Stroustrup, *The C++ Programming Language*, Special Edition, Addison-Wesley, 2000.
- Duane C. Hanselman and Bruce L. Littlefield, *Mastering Matlab 7*, Pearson Eduction, 2004.

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Experimental research

Algorithm Implementation on Highly Parallel Architectures

Description

The Cell Broadband Engine is the heart of the Sony Playstation 3 and of today's most powerful supercomputers. Its architecture is unlike traditional multi-core processors from Intel and AMD. In the Cell, one general-purpose processing core (the PPU) is supplemented by a number of Synergistic Processor Units (SPUs), which are optimized for vector processing and have dedicated but limited memory.

CUDA is an interface for general-purpose programming on Graphical Processing Units (GPUs) from nVidia. The architecture of GPUs emphasises massive parallelism of arithmetic units at the expense of control units and memory caching. This allows a very high speed-up for classes of computationally-intensive data-parallel problems, often found in scientific computing.

This project is about implementing a compute-intensive algorithm for Error-Control Coding (ECC) in parallel on the Cell BE or GPUs. Suitable algorithms include the BCJR algorithm for convolutional codes and the forward-backward algorithm as used in the Davey-MacKay inner decoder. We already have serial implementations of these algorithms in C++. This is an implementation project, with a significant research orientation.

Background Knowledge Required

- Interest in parallel computing.
- Aptitude and willingness to program (the project requires the use of C++ and IBM's Cell SDK or nVidia CUDA; prior OO development experience in another language is suitable).

Preliminary Reading List

- Johann A. Briffa, Hans Georg Schaathun, and Stephan Wesemeyer, *An improved decoding algorithm for the Davey-MacKay construction.* In Proc. IEEE Intern. Conf. on Commun., Cape Town, South Africa, May 23–27, 2010.
- Matthew Scarpino, *Programming the Cell Processor*, First Edition, Prentice-Hall, 2009.
- David Kirk and Wen-mei Hwu, *Programming Massively Parallel Processors*, First Edition, Morgan-Kaufman, 2010.
- Bjarne Stroustrup, *The C++ Programming Language*, Special Edition, Addison-Wesley, 2000.

Other Information

Project can be taken by:	4 students
Project type:	Software development
	Experimental research

Cross-Platform Serialization of Simulation Results

Description

The current state of a simulation is generally representable by a vector of floating point and integer values. Of these, integer values are relatively easy to represent exactly. Unfortunately, floating-point numbers are not necessarily held in the same binary format on different computer systems, although most modern systems adhere to the IEEE floating point standard.

The objective of this project is to design and implement standards-based file formats for serializing simulation results. Two kinds of serializations must be considered: compact binary formats for inter-process communication, and human-readable text formats for disk storage. In each case, the numerical values must be reproduced exactly when read in from the serialized format. This is an implementation project, with a significant research orientation.

Background Knowledge Required

- Interest in low-level computing issues and parallel computing.
- Aptitude and willingness to program (the project requires the use of C++; prior OO development experience in another language is suitable).

Preliminary Reading List

- David Goldberg, *What every computer scientist should know about floating-point arithmetic*, ACM Computing Surveys (CSUR), vol. 23, no. 1, pp. 5–48, Mar 1991.
- Bjarne Stroustrup, *The C++ Programming Language*, Special Edition, Addison-Wesley, 2000.

Other Information

Project can be taken by:	1 student
Alternative supervisor:	Steve Wesemeyer
Project type:	Software development

High Density 2D Barcodes

Description

A number of standards for 2D barcodes exist, which allow the encoding of more data (in the same physical space) than conventional 1D barcodes. Various companies, including Microsoft and HP, have shown interest in techniques that increase the encoding density – that is, the amount of data that can be encoded per unit area. Other researchers have also used techniques from watermarking and steganography to create barcodes that do not look random.

This project investigates existing standards and proposed techniques, comparing their embedding density and decoding reliability. It is expected that some of these techniques will need to be implemented and tested; another option in this project is to implement a reader for a specific system on an embedded or portable device (such as a mobile phone). This project is research-oriented, and has potential for publication.

Background Knowledge Required

- Interest in information hiding.
- Some knowledge of digital imaging fundamentals.
- Aptitude and willingness to program (the project is likely to use a selection of languages, including C++ and Python).
- For a portable system implementation, knowledge of JavaME would be helpful.

Preliminary Reading List

- References on specific 2D coding methods to be added.
- Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Third Edition, Prentice-Hall, 2007.
- Bjarne Stroustrup, *The C++ Programming Language*, Special Edition, Addison-Wesley, 2000.
- David M. Beazley, *Python Essential Reference*, Third Edition, SAMS, 2006.

Other Information

Project can be taken by:	2 students
Alternative supervisor:	Steve Wesemeyer
Project type:	Software development
	Experimental research

Real-Time Video Upscaling

Description

High Definition (HD) TV sets are now widely available. While new content is often developed in HD format, there is still a wealth of existing material in Standard Definition (SD). There is therefore considerable interst in video upscaling algorithms – that is, algorithms that convert SD video into HD format. These are commonly embedded in HDTV sets and upscaling DVD players or game consoles (such as the Sony PS3).

This project investigates existing algorithms from the signal processing and consumer electronics literature, comparing their implementation complexity and visual quality. A number of routes are possible with this project:

1. Comparison of published algorithms in terms of implementation complexity and visual quality. Likely to require the implementation of a number of algorithms.
2. Real-time implementation (on a GPU) of one chosen algorithm.

This project is research-oriented, and has potential for publication.

Background Knowledge Required

- Some knowledge of digital imaging fundamentals.
- Aptitude and willingness to program (the project is likely to use a selection of languages, including C++ and Python).
- For a GPU implementation, knowledge of CUDA would be helpful.
- COM3012 Parallel Architectures (for GPU implementation) is recommended.

Preliminary Reading List

- References on specific video upscaling methods to be added.
- Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Third Edition, Prentice-Hall, 2007.
- Bjarne Stroustrup, *The C++ Programming Language*, Special Edition, Addison-Wesley, 2000.
- David M. Beazley, *Python Essential Reference*, Third Edition, SAMS, 2006.
- David Kirk and Wen-mei Hwu, *Programming Massively Parallel Processors*, First Edition, Morgan-Kaufman, 2010.

Other Information

Project can be taken by:	2 students
Project type:	Software development
	Experimental research

Image Forensics

Description

The area of Image Forensics has received considerable interest recently. The subject encompasses a number of areas, including:

- Source identification
- Tamper detection
- Image processing pipeline reconstruction

This project investigates existing algorithms for one of the above topics. It is expected that some of these techniques will need to be implemented and tested. A programming-oriented student could focus on the implementation of a number of algorithms in a clean, modular, and reusable way; a more analytically oriented student could focus on the interpretation of results and system evaluation. This project is research-oriented, and has potential for publication.

Background Knowledge Required

- Some knowledge of digital imaging fundamentals.
- Aptitude and willingness to program (the project is likely to use a selection of languages, including C++ and Python).
- COMM023 Introduction to Multimedia Security (recommended)
- COMM025 Advanced Multimedia Security (recommended)

Preliminary Reading List

- Bayram, S.; Sencar, H.; Memon, N.; Avcibas, I., *Source camera identification based on CFA interpolation*, IEEE International Conference on Image Processing, 11-14 Sep 2005. vol. III pp. 69-72.
- Tian-Tson Ng, Shih-Fu Chang, Ching-Yung Lin, Qibin Sun. *Passive-blind Image Forensics.* In "Multimedia Security Technologies for Digital Rights", W. Zeng, H. Yu, and Ching-Yung Lin (eds.), Elsvier, 2006.
- Popescu, A.C.; Farid, H., *Exposing digital forgeries in color filter array interpolated images*, IEEE Transactions on Signal Processing, vol.53, no.10, pp. 3948-3959, Oct. 2005.
- Tian-Tson Ng, Shih-Fu Chang, Ching-Yung Lin, Qibin Sun. *Passive-blind Image Forensics.* In "Multimedia Security Technologies for Digital Rights", W. Zeng, H. Yu, and Ching-Yung Lin (eds.), Elsvier, 2006.
- Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Third Edition, Prentice-Hall, 2007.
- Bjarne Stroustrup, *The C++ Programming Language*, Special Edition, Addison-Wesley, 2000.
- David M. Beazley, *Python Essential Reference*, Third Edition, SAMS, 2006.

Other Information

Project can be taken by:	3 students
Project type:	Software development Experimental research Literature survey / comparison / review / evaluation

Physically Accurate Gameplay/Simulation Control

Description

Recent game consoles, with the advances in sensor technology and processing power available, have made it possible to control games using physical responses rather than pressing buttons. Well-known examples include motion-sensing on Nintendo's Wii Controller and Sony's PS3 DualShock3 controller. Emerging techniques such as Microsoft Kinect for the Xbox 360 do away with controllers completely, using computer vision instead.

This project investigates existing techniques for direct physical input. Two possible approaches are envisaged: the first involves the use of Sony's PS3 DualShock3 controller, which can be read in Linux through its HID raw interface. The second option is to implement a simple 3D motion capture system using stereo cameras. In either case, the implemented system is to be demonstrated by controlling a simple 3D game interface. This project is research-oriented, and has potential for publication.

Background Knowledge Required

- Some knowledge of digital imaging fundamentals.
- Some knowledge of 3D graphics and geometry.
- Aptitude and willingness to program (the project is likely to use a selection of languages, including C++ and Python).

Preliminary Reading List

- References on computer vision to be included.
- Microsoft Kinect, `http://www.xbox.com/en-GB/kinect/`, to be available in products Nov 2010.
- Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Third Edition, Prentice-Hall, 2007.
- Bjarne Stroustrup, *The C++ Programming Language*, Special Edition, Addison-Wesley, 2000.
- David M. Beazley, *Python Essential Reference*, Third Edition, SAMS, 2006.

Other Information

Project can be taken by:	2 students
Project type:	Software development
	Experimental research

Matthew Casey

Research Interests

In my research, my aim is to develop computational models of the brain, especially for low-level sensory systems. In particular, I model low-level vision and audition, such as found in the mid-brain, expanding my interests into multi-modal fusion (particularly in the superior colliculus and amygdala). From this, I hope that we can bridge the gap between large-scale computational neuroscience models of the cortex to real-world inputs and outputs. This involves working with other computer scientists, psychologists and biologists, as well as companies to exploit the computational principles of low-level sensory processing.

Other research interests include multiple classifier theory, looking at what 'diversity' means and how we might deduce properties of a combined system from its constituents, and game theory, exploring the link between on-line learning and ensemble systems within a game theory framework.

Prior to my academic career, I spent 10 years in industry as a professional software engineer, project manager and consultant. This has given me a wide range of experience in systems development and an interest in the strategic use of information systems.

Spiking Model of Low Level Sensory Processing

Description

Advances in our understanding of different brain functions are reaching the stage that we can build simple models of sensory processing. Low level sensory processing in mammalian brains is responsible for analysing and reacting to sensory stimuli rapidly so that we can react to potential threats. Key low level brain structures include the superior colliculus and amygdala, but all low level sensory structures are interesting from a modelling perspective.

This project would look at developing a spiking model of the superior colliculus (SC) or the amygdala. The SC is responsible for shifting our gaze in response to visual, auditory or somatosensory stimuli, especially when cues are multimodal. The amygdala is responsible for priming our body to react to threats. As such, it must operate in real-time on a range of sensory stimuli (visual, auditory, somatosensory, olfaction, etc.). Spiking (or pulse-coded) neural networks offer a degree of biological plausibility that may enable the model to be used real-time on video and audio.

Background Knowledge Required

- An ability to programme using tools such as Matlab or other programming languages required.
- A background knowledge of neural networks or machine learning techniques would be beneficial.
- An interest in neuroscience (cognitive psychology or physiology) would be beneficial.

Preliminary Reading List

- King, A.J. (2004). The Superior Colliculus. Current Biology, 14(9), R335–R338.
- Stein, B.E. & Stanford, T.R. (2008). Multisensory Integration: Current Issues from the Perspective of the Single Neuron. Nature Reviews Neuroscience, 9(4), 255–266.
- Stein, B.E. & Meredith, M.A. (1993). The Merging of the Senses. Cambridge,MA.: A Bradford Book, MIT Press.
- LeDoux, J.E. (1992). Brain Mechanisms of Emotion and Emotional Learning. Current Opinion in Neurobiology, 2, 191–197.
- Armony, J.L., Servan-Schreiber, D., Cohen, J.D. & LeDoux, J.E. (1997). Computational Modeling of Emotion: Explorations Through the Anatomy and Physiology of Fear Conditioning, Trends in Cognitive Sciences, 1(1), 28–34.
- Izhikevich, E.M. (2003). Simple Model of Spiking Neurons. IEEE Transactions on Neural Networks, 14(6), 1569–1572.

Other Information

Project can be taken by:	2 students
Project type:	Software development

Reactive Robots

Description

The aim of this project is to implement simple neural models of sensorimotor function in a suitable robot, such as the LEGO Mindstorms kit, Khepera II or Koala. This will involve implementing a simple neural network model of sensory processing (such as found in the superior colliculus) using rate-coded neural networks. The main focus would then be to see how we can get the robot to react under different conditions, such as when movement or sound is detected.

Background Knowledge Required

- An ability to programme using Java to link with LEGO Mindstorms, or Matlab or C for Khepera II and Koala.
- A background knowledge of neural networks or machine learning techniques would be beneficial.
- An interest in neuroscience (cognitive psychology or physiology) would be beneficial.

Preliminary Reading List

- Casey, M.C., Pavlou, A. & Timotheou, A. (2010). Mind the (Computational) Gap. Proceedings of the UK Workshop on Computational Intelligence (UKCI 2010), IEEE.
- King, A.J. (2004). The Superior Colliculus. Current Biology, 14(9), R335–R338.
- Brooks, R. (2001). The Relationship Between Matter and Life. Nature, 409(6818), 409-411.
- Brooks, R. (1986). A Robust Layered Control System for a Mobile Robot. IEEE Journal of Robotics and Automation, 2(1), 14-23.

Other Information

Project can be taken by:	2 students
Project type:	Software development
	Experimental research

Really Smart Phones?

Description

Could we put useful low level sensory processing onto a smart phone? Could a smart phone be used to detect threats in visual data from the phone's camera or microphone? Would this be of any benefit, say as a passive threat detector?

The aim of this project is to implement simple neural models of threat detection for a smart phone, such as the iPhone or Android. This will involve implementing a simple neural network model of sensory processing (such as found in the amygdala) using rate-coded neural networks. The main focus would then be to see how we can get the senses into the application to provoke a reaction.

Background Knowledge Required

- An ability to programme using C++, Java or equivalent and an understanding of smart phone APIs.
- A background knowledge of neural networks or machine learning techniques would be beneficial.
- An interest in neuroscience (cognitive psychology or physiology) would be beneficial.

Preliminary Reading List

- Casey, M.C., Pavlou, A. & Timotheou, A. (2010). Mind the (Computational) Gap. Proceedings of the UK Workshop on Computational Intelligence (UKCI 2010), IEEE.
- King, A.J. (2004). The Superior Colliculus. Current Biology, 14(9), R335–R338.

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Experimental research

Learning to Play Games

Description

Can a machine learn how to play games, from chess, Pac Man to first person style shoot-em-ups? Typically a brute force or rule-based approach is taken to game play, using heuristics to limit the search for moves. Can a machine learning technique (neural network, decision tree, etc.) learn to play such games or generate good heuristics from past examples of games?

The aim of this project is to investigate ways in which machine learning can be used to learn to play games. A good example is Ms Pac Man, where existing code templates can be used to bootstrap implementation and allow the focus of development to be on the algorithms.

Background Knowledge Required

- An ability to programme using C++ or Java.
- A background knowledge of machine learning, such as neural networks, decision trees, etc. would be beneficial.

Preliminary Reading List

- Schaeffer, J. & van den Herik, H.J. (2002). Games, Computers, and Artificial Intelligence. Artificial Intelligence, 134(1-2), 1-7.
- Levy, D. & Newborn, M. (1991). How Computers Play Chess. New York: Computer Science Press.

Other Information

Project can be taken by:	2 students
Project type:	Software development
	Experimental research

Cybercrime Prevention

Description

Identity theft, fraud and other types of cybercrime are big business. Stealing people's personal information is easy if you know how. So how do we prevent this? For example, social networking sites can offer up our personal information by default, and hide away the settings to prevent key information from being displayed.

The aim of this project is to investigate the impact and prevention strategies for cybercrime, whether that is from phishing, intrusion or identity theft. A target area will be to be selected and studied, with typical scenarios highlighted to allow prevention strategies to be evaluated.

Background Knowledge Required

- A good working knowledge of social networking, on-line banking, etc. is essential.
- An interest in interacting with various stakeholder communities is essential.
- A background in surveying or interviewing people would be useful.

Preliminary Reading List

- Symantec Corporation (2008). IT Risk Management Report 2: Myths and Realities. `http://www.symantec.com/business/theme.jsp?themeid=itrisk_report`. [Accessed 13-10-2010.]
- Identity Fraud Consumer Awareness Group (2010). Welcome to IdentityTheft.org.uk. `http://www.identitytheft.org.uk/`. [Accessed 13-10-2010.]

Other Information

Project can be taken by:	1 student
Project type:	Literature survey / comparison / review / evaluation

Strategic Use of Information Systems

Description

With the current economic climate, cuts in budgets are being made by both industry and governments. Perhaps the largest cost to any organisation is its people, and hence many organisations try to streamline and automate their business processes to reduce their workforce without reducing their operation. But does this really work? Information systems may provide opportunities and may make business processes more efficient, but in the long term, can they really replace people?

The aim of this project is to investigate the long term use of information systems in organisations to evaluate the claims that they can provide competitive advantage (in the short or long term) and efficiency. Are the systems responsible for potential improvement, or do they hinder things? Are they more or less than simple tools?

Background Knowledge Required

- An interest in the impact of information systems is essential.
- An interest in interacting with various stakeholder communities is essential.
- An interest or background in business strategy would be beneficial.
- A background in surveying or interviewing people would be useful.

Preliminary Reading List

- Porter, M.E. (1979). How Competitive Forces Shape Strategy. Harvard Business Review, 57(2), 137–145.
- Porter, M.E. (1980). Competitive Strategy. New York: The Free Press.
- Porter, M.E. (1985). Competitive Advantage. New York: The Free Press.
- Carr, N.G. (2003). IT Doesn't Matter. Harvard Business Review, 81(5), 41-49.

Other Information

Project can be taken by:	1 student
Project type:	Literature survey / comparison / review / evaluation

Jonathan Clark

Research Interests

My main research interests lie in the multidisciplinary interface between Biology (particularly Botany) and Computer Science. I am looking at this mostly from the point of view of how computers can be used to address classification and identification problems relating to plants and evolution, and I have a unique perspective on this due to my experience and qualifications both in Botanical Taxonomy, Computing, Artificial Intelligence (particularly Artificial Neural Networks) and Programming, together with my connections to the Royal Botanic Gardens, Kew. My interest in scientific applications for mobile devices leads to an interest in identification tools for field biologists on mobile phones, Apple iPhone and Pocket PCs. Other interests include (but are not limited to) Vintage Computers and Computer Game Design and Development, Digital Libraries, and Scientific Computing in general, eg. for Astronomy, Astrobiology and Physics.

Image processing for book digitisation

Description

This project is to create a system which will take a photograph of a book page and process that image so that it will be sufficient quality for optical character recognition.

Tasks:

1. To invesigate existing image processing software and algorithms for manipulating document images.
2. To investigate efficient ways of capturing text information from pages of books (there are problems such as curvature of image due to the book binding).
3. To construct a program which will load in existing images in a number of formats (jpg, tiff, bmp, etc), and perform automated staightening and flattening of the image, ie. convert a photograph of a curved or uneven page of text into what is effectively a flat page, suitable for input to an optical character reading (OCR) software package, such as Omnipage. The program should be be capable of displaying, zooming and saving the corrected pages in a number of formats (jpg, tiff, bmp, etc.). It should also be able to deal with any text font, and to correct curvature of photographs and diagrams.

Background Knowledge Required

- Programming ability
- Experience of Java/C++ or Matlab
- Some familiarity with image processing would be an advantage

Preliminary Reading List

- Gonzalez, R. C. & Woods, R.E. (2002). Digital Image Processing. Prentice-Hall, 2nd edition (there is a third edition, but that is expensive, and does not seem to be available as a paperback yet).

Herbarium leaf image processing

Description

This project is to use image processing techniques to extract information automatically from images of botanical (plant) specimens. A herbarium is a collection of dried pressed plants (eg tree branches) used as a physical database by botanists. So a herbarium specimen is a specimen held in a herbarium collection such as that at the Royal Botanic Gardens, Kew.

Tasks:

1. To extract characters (attributes) such as length and width from images of leaves.
2. To develop ways of locating important parts of the leaf automatically
3. To understand botanical terms for leaf structures, and correlate those with features extracted using image processing.

Background Knowledge Required

- Programming ability, experience of Java/C++ or Matlab.
- Some knowledge of image processing and/or an interest in plants/botany/horticulture plants would be an advantage.

Preliminary Reading List

- Hearn, David J. Shape analysis for the automated identification of plants from images of leaves. Taxon 58(3) pp. 934-954(21).

Random Dot Stereograms

Description

This project is about Single Image Random Dot Stereograms (SIRDS). These are 2D printed (or displayed) images that reveal a hidden 3D image when looked at in a certain way.

Tasks:

1. To understand the algorithms for creating SIRDS, and the history behind them.
2. To develop a program to create SIRDS, with any chosen background picture.
3. To examine ways of helping people see them who do not think they can (though people with good vision in only one eye would never be able to see them. It would be especially good if it was made possible to see them as a group, with the image projected on a screen from a data projector.
4. To develop a way of creating and displaying moving 3D stereograms (4D stereograms!)

Background Knowledge Required

- An ability to see random dot stereograms (not everyone can see them! – try looking on the website indicated).
- Experience in programming would be an advantage, but a student with limited programming ability, eg. some Java, and an ability to use existing graphics libraries would be OK.

Preliminary Reading List

- `http://cs.swan.ac.uk/~csharold/sirds/index.html`
- H. Thimbleby, I. H. Witten and S. Inglis. "Displaying 3D Images: Algorithms for Single-Image Random-Dot Stereograms," IEEE Computer, 27(10), pp38-48, 1994.

iPhone or i Pad game/application development

Description

Game/app development for the Apple iPhone or iPad, based on vintage games/apps that were originally developed for vintage computers such as the ZX Spectrum, Commodore 64 and Amstrad CPC.

Tasks:

1. To perform an in-depth study of vintage computers (history, capabilities, games, etc.)
2. To select a suitable game for developing on the iPhone platform
3. To design, develop, test, and validate the developed game.

Background Knowledge Required

- The student must already have a Mac and iPhone and/or iPad, or be prepared to purchase these.
- Also, programming ability in C/C++ (because development on the iPhone is in Objective C).
- An interest in old computers and games would be an advantage.

Preliminary Reading List

- `http://developer.apple.com/iphone/`
- `http://developer.apple.com/ipad/`
- `http://www.worldofspectrum.org/`

Mobile Software Development for Field-based Scientific Surveys

Description

The idea here is to design and develop computer applications that can run on Mobile Platforms such as SmartPhones, Pocket PCs and Apple iPhones that might be useful for scientists (eg. botanists, zoologists, geologists) who are working in the field.

1. To investigate existing systems for plant identification, and the problems they have.
2. To develop a system for plant identification. eg. Development could involve coding for the Windows CE operating system, or using java to produce platform-independent applications, or objective C for the iPhone. (We are expecting to provide the required botanical data to the student)

Background Knowledge Required

- Programming ability in Java/C++.
- Owning, or being prepared to purchase an appropriate phone/PocketPC/iPhone/iPad.

Preliminary Reading List

- An information hub for Pocket PC development `http://www.devbuzz.com/`
- Pocket PC development network `http://www.pocketpcdn.com/`
- Electronic Field Guides and Citizen Science `http://www.nescb.org/epublications/winter2004/stevenson.html#electronic_field_guides`
- `http://www.microsoft.com/windowsmobile/developers/default.mspx`

Lee Gillam

Research Interests

- Machine / Computer Ethics and Artificial Intelligence
- Information Retrieval (search technologies), Information Extraction and Natural Language Processing
- Cloud Computing, Mainframe Computing, Grids, P2P systems, High Performance Applications/Systems and Web Services.

Ethical Decisions

Description

This topic is concerned with so-called "Machine Ethics". A project may investigate how a computer would be able to make decisions that not only produce a perceived 'correct' response, but also that conforms to certain ethical theories, or to produce an ethical analysis of a particular situation given a set of situational knowledge. This may build on a previous MSc dissertation relating to Ethical Gambling in Virtual Worlds.

Preliminary Reading List

- IEEE Intelligent Systems 21(4)
- Anna Vartapetiance Salmasi and Lee Gillam (2009) "Machine Ethics for Metaverse Gambling" IEEE International Conference in Games and Virtual Worlds for Serious Applications (VS-Games)

"TurnItOff" – defeating plagiarism detection systems

Description

This topic focuses on automatic strategies that could be used in authoring texts in order to defeat plagiarism detection systems. Further information about this topic, and relevant references, will be made available on request

A Web-based UPDS

Description

Undergraduate only

This topic is concerned with the development of a Web-based system for creating and maintaining Professional Development plans along the lines of the BCS UPDS as used in relation to placements, or the Skills Framework for the Information Age (SFIA). Such a system should maintain information about profiles and allow for records to be created and maintained over time, along with capabilities such as allowing invited read-only access to these records, allowing for information to be captured sufficient to count as an electronic signature, and the generation of a printable document in the appropriate format.

Preliminary Reading List

- Personal BCS UPDS records (PTY students)
- Skills Framework for the Information Age (SFIA)

Email Clouds

Description

This topic aims to account for the kinds of services that could be offered for the protection of corporate email in an 'Email Cloud'. The email archive of any organization contains a significant trace of corporate activity: it retains evidence of business transactions and related knowledge of (the employees of) that organization. Email can be used to support legal proceedings, and institutions of various kinds have certain responsibilities for the emails on and originating from their own systems and user workstations. Acceptable Use Policies set certain expectations for the use of email in specific organisations, but are largely written documents. Projects within this topic will involve creating Cloud-based simulations that comprise implementations of AUP, involving a certain amount of relevant text analytics and data mining, and with considerations for information assurance and security.

An example project could involving developing a software omponent for leak detection, based around recipient recommendation and/or exploring recommender systems for such a purpose - building on a recently completed MSc dissertation, or the exploration of providing such detection oriented around P2P email services.

Preliminary Reading List

- Lee Gillam and Neil Cooke (2008) "Intellectual property escaped with the email? Press F1 for help". Journal of Information Assurance and Security 3(1)
- Gillam, L., Tariq, M. and Ahmad, K. (2005) Terminology and the Construction of Ontology. Terminology 11(1), pp55-81. John Benjamins Publishing Company. ISSN 0929-9971; E-ISSN 1569-9994.
- Nick Antonopoulos and Lee Gillam (2010) "Cloud Computing: Principles, Systems and Applications. Springer-Verlag.

Financial Clouds

Description

This project topic is concerned with assessing the risk associated with particular financial instruments and their portfolios using Cloud Computing infrastructures and Grid systems. For example, Collateralized Debt Obligations are an area in which calculation of risk represents a significant opportunity. Methods for calculating risk will be explored, and the opportunity exists to attempt to make use of large scale processing systems. A London-based financial services company may be interested in outcomes..

Preliminary Reading List

- Nick Antonopoulos and Lee Gillam (2010) "Cloud Computing: Principles, Systems and Applications. Springer-Verlag.

Mainframes and Clouds

Description

MSc only

This topic will provide for projects that span both the Mainframe Computing and Cloud Computing modules, and is likely to be co-supervised with IBM. Further information and references can be provided on request.

Adversarial Information Retrieval

Description

This project topic is concerned with spam-like problems relating to search engine optimization. Projects may investigate algorithms employed by search engines, and knowledge of the algorithms can lead to misleading results. This topic can build on a recently completed MSc dissertation, and may explore the notion of text readability or content divergence.

Preliminary Reading List

- `http://www.webworkshop.net/pagerank.html`
- Neil Newbold and Lee Gillam (2009) "Populating a Framework for Readability Analysis". 5th Corpus Linguistics Conference, 20-23 July 2009, Liverpool

Sentiment Analysis

Description

This topic is focused on automatic analysis of semantic orientation, an emerging topic referred to by some as sentiment analysis or opinion mining. Techniques applicable to this analysis, some of which have been developed and Grid-enabled at Surrey, will be investigated in one or more application areas. Application areas can be as diverse as providing feedback to students, customer relationship management, discovering political opinions, reviewing and suggesting products or movies, and decision support in financial analysis.

Preliminary Reading List

- Benchmark collection of Movie Reviews: `http://www.cs.cornell.edu/people/pabo/movie-review-data/`
- Ahmad, K., Gillam, L. and Cheng, D. (2005) "Textual and Quantitative Analysis: Towards a new, e-mediated Social Science". Proc. of 1st Intl. e-Social Science Conference, Manchester, June 2005.

Andre Gruning

Research Interests

Theory, applications, simulation and analysis of artificial neural networks. Learning algorithms for neural networks (gradient descent, back-propagation, reinforcement and genetic algorithms, weight perturbation). Computational power of neural networks. Cognitive modelling. Language processing, language evolution and language modelling. Biological Evolution. Theory of computation.

Simulations, traffic flow control, traffic management systems, railway signalling and control systems.

Open Source software. Mobile programming. Java, Perl, PHP, JavaScript, C++ ...

My interests for supervising topics lie mainly in the fields of Neural Networks and Evolutionary Programming. These topics require a sound knowledge of C++ or Java programming language as well as a good understanding of mathematics. Projects in these area will involve computer simulations of natural systems and are usually based on current research articles.

Some limited projects are available on programming mobile device using eg Android or JavaME

Modelling a Synfire chain with Izhikevich Neurons

Description

A synfire chain is a wave of activation in the brain and believed to be important for information processing in the brain.

Your task will be to simulate such synfire chains with an artificial neural network consisting of Izhikevich neurons. First you will implement an artificial neural network using Java or C++ perhaps utilising existing packages that cover parts of the simulation. Second, you will then reproduce the results of a scientific paper in the area (with an appropriate paper provided by the supervisor). Finally you will then conduct new computer experiments with the neural network which are of interest from a cognitive or neuroscientific point of view. If a sufficiently high standard of experiments and results is achieved, publication at a scientific conference or in a scientific journal is aimed for.

Background Knowledge Required

- Interesting neural networks, learning algorithm, neuroscience.
- Good coding skills, in eg Java, C++ or MatLab.
- Sound A level maths.

Preliminary Reading List

- Eugene M. Izhikevich: "Polychronization: Computation with Spikes", Neural Computation, 2006(18), p245–282.
- Mark C.W. van Rossum, Gina G. Turrigiano and Sacha B. Nelson: "Fast Propagation of Firing Rates through Layered Networks of Noisy Neurons", Journal of Neuroscience, 2002(22), p1956–1966.

Other Information

Project can be taken by:	3 students
Alternative supervisor:	Matthew Casey
Project type:	Experimental research

Evolutionary Processes

Description

In this project you will implement an agent-based simulation of evolutionary processes. One example would is the formation of new species (ie new types of animals): At a certain point in time a once homogeneous population of animals of one kind (a single species) splits up into two new species that do not interbreed any longer. Modelling of such processes is important to understand for example biological evolution but also technical and societal evolution.

The project will be based on a scientific paper (provided by the supervisor) and the student's first task will be to reproduce the simulations in such a paper, implementing agent-based simulation. Later on the student will then do new interesting experiments beyond the original paper at the forefront of scientific research. If interesting new high-quality results are obtained during the project, these might well led to publication at a scientific conference or in a journal.

Background Knowledge Required

- Interest in evolutionary modelling, agent-based simulations
- Sound A-level maths
- Good coding skills in eg Java, C++ and/or MatLab.

Preliminary Reading List

- Kenneth A. De Jong: "Evolutionary Computation – A Unified Approach", MIT Press. Any edition will do, eg from the library.
- Wojciech Waga, Dorota Mackiewicz, Marta Zawierta and Stanislw Cebrat: "Sympatric Speciation as Intrinsic Property of the expanding population", Theory of Biosciences, 2007(126), p53–56.

Other Information

Project can be taken by:	3 students
Project type:	Experimental research

Computational properties of simple recurrent networks

Description

To understand what types of computations artificial neural networks are capable of when they are trained. What is the computational power of an artificial neural network? Can it process complicated formal languages? And is there a relation to the grammar of natural languages?

It is well established that simple recurrent networks can learn so called regular languages. These are formal languages without recursive structure and they require finite memory only. In this project we want to explore whether and how artificial neural networks can also process more complicated recursive structures that are both interesting from a computational and a linguistic viewpoint.

The task of the student will be to reimplement computer simulations from a scientific paper (the supervisor will help to find an appropriate one) and reproduce the original results of the paper. Finally new computer simulation will be conducted. If high-quality new results are obtained, publication at a scientific conference or in a journal can be aimed for.

Background Knowledge Required

- some experience with neural networks.
- a systematic and diligent approach to the network simulations
- some coding skills.
- fair A-level maths.

Preliminary Reading List

- Jeffrey L. Elman, Elizabeth A. Bates, Mark H. Johnson, Annette Karmiloff-Smith, Domenico Parisi, and Kim Plunkett. Rethinking Innateness: A Connectionist Perspective on Development. MIT Press, Cambridge, Mass., 1996.
- Mikael Bodén and Alan Blair. Learning the dynamics of embedded clauses. Applied Intelligence, 19(1/2):51–63, 2003.
- Paul Rodriguez. Simple recurrent networks learn context-free and context-sensitive languages by counting. Neural Computation, 13:2093–2118, 2001.
- André Grüning. Stack- and queue-like dynamics in recurrent neural networks. Connection Science, 18(1):23–42, 2006.

Other Information

Project can be taken by:	2 students
Alternative supervisor:	Matthew Casey
Project type:	Experimental research

A Rocrail or SRCP client for Java Microedition or Android

Description

Java Microedition is a down-sized version of Java that runs on mobile devices that have limited resources such as mobile phones and personal digital assistant.

Rocrail and SRCP are computer programmes to fully automatically control a model railway lay-out. They function as servers and are connected to the railway lay-out.

A client for Rocrail and SRCP is a programme which sends commands to the server to operate locos and switches on the layout via a TCP/IP protocol.

Your task will be to design and implement such a client for either rocrail or SRCP on either Java ME or under Android.

Background Knowledge Required

- a basic understanding of Java or Android.
- the willingness to learn Java Microedition or Android.
- the willingness to understand Rocrail and SRCP protocols.
- interest in model railways.

Preliminary Reading List

- Java ME – Sun Java Wireless Toolkit for CLDC: `http://java.sun.com/products/sjwtoolkit/`
- General Reference to the Andriod OS (eg Wikipedia and therein)
- General References for Rocrail and SRCP (eg Wikipedia and therein)

Other Information

Project can be taken by:	2 students
Project type:	Software development
Suitable for students taking:	Security Technologies and Application Internet Computing Information Systems

Yaochu Jin

Research Interests

My research main interests are to understand major principles behind biological evolution, learning and developmenmt by building up computational models and to solve complex real-world problems using bio-inspired methodologies.

Solving Multi-Modal Optimization Problems with Evolutionary Algorithms

Description

Multi-modal optimization problems are a class of tasks where more than one equally good optimal solution exists. Such problems are difficult to solve using gradient based search methods.

This project aims to find out multiple optimums using evolutionary algorithms. A variety of measures for maintaining the diversity of population, such as niching and species conservation, will be investigated. These methods will be compared on a number of multi-modal test functions.

Background Knowledge Required

- Background knowledge in evolutionary computation is desired but not required.
- Knowledge in programming in c++ or Java is required.

Preliminary Reading List

- D. E. Goldberg. *Genetic Algorithms in Search, Optimization and Machine Learning.* Addison-Wesley, 1989
- S. W. Mahfoud. Niching methods for genetic algorithms. PhD Thesis, University of Illinois at Urbana Champaign. 1995
- J. P. Li et al. A Species Conserving Genetic Algorithm for Multimodal Function Optimization. Evolutionary Computation, 10(3):207-234, 2002

Handling Constraints in Evolutionary Design Optimization

Description

Many optimization problems are subject to equality or ineuqality constraints. Such constraints pose difficulties for search heurostics such as evolutionary algorithms.

This project studies the efficiency of a class of methodologies for handling linear or nonlinear constraints, i.e., penalty function based methods. Penalty functions with a fixed, non-stationary and adaptive co-efficient will be investigated on a number of design optimization problems.

Background Knowledge Required

- Background knowledge in evolutionary computation is desired but not required.
- Basic knowledge in programming in c++ or Java is required.

Preliminary Reading List

- D. E. Goldberg. *Genetic Algorithms in Search, Optimization and Machine Learning.* Addison-Wesley, 1989
- C. A. C. Coello. *Theoretical and numerical constraint-handling techniques used with evolutionary algorithms: a survey of the state of the art.* Computer Methods in Applied Mechanics and Engineering, vol.191, pp. 1245–1287, 2002
- J. A. Joines and C. R. Houck. *On the use of non-stationary penalty functions to solve nonlinear constrained optimization problems*, Proc. IEEE Conference on Evolutionary Computation. pp.579-584, 1994.

Evolutionary Multi-objective Design Optimization

Description

Multi-objective optimization is different to single-objective optimization in that they have multiple, conflicting objectives. For such problems, no single optimum can be found.

This projects compares two classes of methodlogies for solving multi-objective optimization problems. The first approach is to sum up all objectives with a set of weights and thus converting multi-objective optimization into single-objective optimization. The second approach adopts a so-called Pareto-approach, where Pareto-dominance of the solutions are compared. The efficiency of these two different approaches will be compared using genetic algorithms on 3-bar truss design.

Background Knowledge Required

- Background knowledge in evolutionary computation is desired but not required.
- Basic knowledge in programming in c++ or Java is required.

Preliminary Reading List

- D. E. Goldberg. *Genetic Algorithms in Search, Optimization and Machine Learning.* Addison-Wesley, 1989
- K. Deb. *Multi-objective optimization using evolutionary algorithms.* Wiley, 2001

Evolutionary optimization of neural networks for time series prediction

Description

This project is concerned with prediction of time series using artificial neural networks. Two main learning methods will be studied for training feed-forward neural networks. The first method is a gradient based method, known as back-progapation, and the second method is based on evolutionary algorithms. The hybridation of the evolutionary algorithms with the gradient based method will be explored.

Background Knowledge Required

- Basic knowledge in evolutionary computation and machine learning is desired.
- Good knowledge in programming in c++ or Java is required.

Preliminary Reading List

- D. E. Goldberg. *Genetic Algorithms in Search, Optimization and Machine Learning.* Addison-Wesley, 1989
- R. D. Reed and R. J. Marks II. *Neural Smithing.* Bradford. 1999
- Y. S. Ong et al. *Classification of Adaptive Memetic Algorithms: A Comparative Study.* IEEE Transactions on Systems Man and Cybernetics – Part B. 36 (1): 141

Evolving toggle switches in gene regulation using evolutionary algorithms

Description

Analysis of gene regulatory motifs is believed to be an effective approach to understanding complex biological networks (Alon, 2007). It remains elusive, however, how natural evolution has shaped complex regulatory networks by coupling simple regulatory motifs such as toggle switches.

This project studies the feasibility of evolving toggle switches widely found in biology using evolutionary algorithms (Jin et al, 2007). The first step is to evolve parameters in a gene regulatory network. In the next step, both the structure and the parameters of the gene regulatory network will be subject to evolution.

Background Knowledge Required

- Background knowledge in evolutionary computation and bioinformatics is desired but not required
- Good knowledge in programming in c++ or Java is required.

Preliminary Reading List

- U. Alon. *An Introduction to Systems Biology.* CRC Press, 2007.
- D. E. Goldberg. *Genetic Algorithms in Search, Optimization and Machine Learning.* Addison-Wesley, 1989
- Y. Jin, Y. Meng, B. Sendhoff. *Influence of regulation logic on the easiness of evolving sustained oscillation for gene regulatory networks.* In: IEEE Symposium on Artificial Life (IEEE-ALIFE), pp.61-68, 2009

Heterogeneous neural network ensembles for classification

Description

A neural network ensemble consists of a number of neural networks in contrast to a single neural network model. By a heterogeneous ensemble, we mean here that the members in the neural network ensemble have different input structure.

In this project, an ensemble with two classes of neural network models will be studied. The first class of models are obtained by boosting the training data, whereas the second class of models are obtained by projecting the inputs in a lower dimension using principal component analysis. These two classes of neural network ensembles will be compared and combined for classfication tasks such as breast cancer diagnosis.

Background Knowledge Required

- Background knowledge in neural networks is desired
- Good knowledge in mathematics and programming in c++ or Java is required

Preliminary Reading List

- T. Hastie, R. Tibshirani and J. Friedman. *The elements of statistical learning.* Springer, 2001.
- S. Yang and A. Brown. Neural network ensembles: combining multiple models for enhanced performance using a multistage approach. Expert Systems, 21(5): 279-288, 2004

Evolutionary optimization using surrogates based on Gaussian processes

Description

Gaussian processes distinguish with other machine learning models by providing outputs in terms of Gaussian distributions. Such prediction is more natural compared to neural networks in that they can give an error bound of the estimation automatically. This error bound can be used for assessing the quality of the models without additional efforts.

This project studies the use of Gaussian models for fitness approximation (surrogate) in evolutionary optimization. The error bound of the model will be used to guide the frequency of using the surrogate model in contrast to the original model.

Background Knowledge Required

- Background knowledge in neural networks is desired
- Good knowledge in mathematics and programming in c++ or Java is required

Preliminary Reading List

- C. Rasmussen and C. Williams. *Gaussian Processes for Machine Learning.* MIT Press. 2006
- Y. Jin, M. Olhofer and B. Sendhoff. *A framework for evolutionary optimization with approximate fitness functions.* IEEE Transactions on Evolutionary Computation, 6(5), 481-494, 2002
- Y. Jin. *A comprehensive survey of fitness approximation in evolutionary computation.* Soft Computing, 9(1), 3-12, 2005.

Paul Krause

Research Interests

See personal website.

Location based Search

Description

This project is a joint project with a local company, iGeolise. iGeolise is trying to solve some consumer frustrations. The big one is that although Location Based Services (LBS) work, they are don't "fit into" the way normal people lead their normal lives. Around 50% of all location based searches fail, and not everyone has the capacity to download an iPhone app. Many LBS intrude awkwardly into an average users way of life, and require constant personal attention (check ins) while not much returning much by way of benefits. We believe that LBS should help people with their current daily lives, with requiring that the user to change the way they do things.

How does iGeolise aim to make LBS better? Well with two new filters. The first is "time" - instead of saying to a user that something is "10 miles away" we can display a search result based on the usrer's travel time away - so perhaps "5 minutes walking time away". To do this we combine route-mapping software with a huge data source that is growing all the time. The second filter is personal preferences, where we leverage users Social Graph through Social Network integration, along with geo-specific behaviours in one area; we call this "Social Warmth".

This project will explore the potential for innovative LBSs that use the iGeolise framework. It will require development of some familiarity of Ruby on Rails.

Collaborative Editing

Description

Google Apps offers support for collaborative editing of documents. However, it has no explicit control over simultaneous editing of documents - their model assumes the editors will synchronise amongst each other using some other medium (chat, e-mail or phone) to ensure there are no lost updates through two or more people simultaneously editing the same part of a document.

In one of our research projects, we have developed a simple locking mechanism that enables us to develop a collaborative editor that is free of resource contentions. Some code exists as the beginning of a prototype implementation. This project will continue to develop this into a fully distributed collaborative editor. The project will require a good standard of Java programming.

Semantic search for scientific papers

Description

With the increasing numbers of scientific papers being published, so it is becoming harder to be sure one is up to date with all the relevant papers in a particular area. The problem is particularly acute at one of our research partners, Lhasa Limited, who develop toxicological risk prediction systems to support the pharmaceutical and cosmetic industries.

This project will develop an automated web crawler, that will search on-line abstracts for scientific results in specific scientific subject areas, and present them in a ranking of importance and relevance based on a range of criteria. The system will be implemented in Java, and its implementation will require some understanding of text analysis and the theory of search engines.

Data integrity of chemical databases

Description

Chemical databases are being developed to support a range of services for the pharmaceutical industry. They use specific standard formats for representing chemical structures and physical chemical properties. However, these are not easy for a human to interpret. In addition, they may contain many tens of thousands of records. Hence it is not possible for humans to easily check these databases for transcription errors. This project will explore techniques for the automated generation of association rules that can be used to generate warnings of potential errors in a chemical database, using textual analysis to compare scientific abstracts with the knowledge represented in the database. Experience in Java programming and AI will be essential for this project.

"Green IT"

Description

Cloud computing and virtualisation offer significant potential to reduce the energy required to support a given level of service in IT. However, history has shown that as you reduce the cost of a particular resource, then so consumption of that resource increases. Paradoxically, this can result in an *increase* in resource consumption. This project will use data from a local data centre, Memset Ltd, and others, to produce a prediction of the change in energy consumption, and CO2 emissions, from data centres over the next ten years. If time allows, it will continue with an analysis of the possibilities for using IT to support changes in behaviour that could lead to reductions in energy use. For example, our current estimate is that a music download is more energy efficient by a factor of 7 than delivery of music to a consumer on a CD. Another area where even more significant savings can be made is travel replacement. Approximately 40% of a UK citizen's energy budget is due to travel, and of this the majority is accounted for through overseas travel. Yet there are still arguments as to whether use of IT to support home working really does lead to a net energy reduction (the claim that has been made is that reduction in energy used in commuting is compensated for by increased energy use in the home). We would like to produce "deep" models of the potential impact of IT on "dematerialisation" (of which music downloads are an example) and travel replacement.

Emergent Ontologies

Description

A fundamental problem in distributed systems is that of ontology: how different agents can agree on common meanings for symbols. The naive approach is to use a preconfigured or centralised ontology but this is not flexible to rapid change and also makes the agents dependent on the controller of the ontology. Humans deal with this problem in a naturally distributed manner with the use of language. In this project we examine approaches such as Luc Steele's 'grounded communications' (`http://arti.vub.ac.be/~steels/`), market-driven approaches, and the phenomenon of 'hashtags' on micro-blogging service Twitter for methods on how agents can establish and extpand shared ontologies based on their interactions. This is the continuation of a very successful Masters project from the 2009/10 academic year.

Sotiris Moschoyiannis

Research Interests

Semantic models of concurrency; logic and automata theory; complex interactions; UML design models (SBVR, MSC); transactions; databases; service-oriented architectures; P2P systems; web-style architectures and the future Internet.

Model-based Verification of Complex Systems

Description

Software applications today are becoming increasingly complex and are often expected to carry out previously unrelated functions. Applications nowadays typically comprise a number of interacting parts whose interactions need to be coordinated in ways that can guarantee that the overall system satisfies certain properties at all times. One component of the system may be expecting input from other components sequentially while it may actually receive it concurrently. This project will focus on the analysis of the complex interactions that may take place in executing various scenarios successfully. It builds on previous work on a formal language that is used to underpin design models and describe the possible scenarios of execution. The aim is to design and implement a tool that can reason about alternative, parallel and sequential scenarios and can identify missing scenarios that may either correspond to undesirable behaviour or were simply unthought of in early design phases.

Background Knowledge Required

- Background or interest in UML design models and particularly interaction diagrams
- Background or interest in formal methods would be beneficial
- This project is research-oriented, and has potential for publication

Preliminary Reading List

- Sotiris Moschoyiannis, Paul Krause and Mike W Shields. A True-Concurrent Interpretation of Behavioural Scenarios. ENTCS 203(7):3-22. Elsevier, 2009.
- S. Moschoyiannis, A. Razavi, and P. Krause. Transaction Scripts: Making Implicit Scenarios Explicit. ENTCS 238(2010): 63-79, Elsevier, 2010.
- `http://www.uml.org/`
- `http://www.w3.org/XML` and `http://www.w3schools.com/xml/`
- Moschoyiannis, S., Razavi, A., Zheng, Y., Krause, P. On long-running transactions: semantics, schemas, implementation. In Proc. IEEE Int'l Conf. on Digital Ecosystems and Technologies (IEEE-DEST 2008), 2008.

Other Information

Project can be taken by:	2 students
Project type:	Software development Experimental research Theoretical research (mathematical/technical)

Software Verification using Model-checking: techniques and applications

Description

Software applications today are becoming increasingly complex and are often expected to carry out previously unrelated functions. A burning question has to do with how to design and engineer high-integrity software systems whilst dealing with dependability and performance. Model-checking techniques promise to address this concern by bringing together logic and modelling. Logic in computer science is used extensively to express properties of the system under development. A model of the system is created so that designers and developers can get a handle on how the application might behave when it is actually deployed. The model combined with the logic can aid formal reasoning about correctness of the software application, especially when certain guarantees of a successful outcome are important. The idea is that a property of the system is expressed in logic and this can then be checked against the underlying model (e.g. an automaton).

There is a long strand of research work on different kinds of logic - first-order, computational-tree, temporal, probabilistic, to name a few. There are also various models that can be used to capture different aspects of a system. The aim of this project is to produce a comprehensive survey of model-checking techniques and applications. It will focus on a comprehensive review of different kinds of logics in computer science as well as a comprehensive description of existing model-checkers. The objective is to arrive at a categorisation of what aspects of a system each model-checker is intended to verify and what techniques are applicable depending on the nature of the system in question and the properties that we need to verify.

Background Knowledge Required

- Background or familiarity with Java and/or C++
- Background or interest in logic would be beneficial
- Background or interest in automata or other behavioural models would be beneficial
- Willingness to read and digest research articles
- This project is research-oriented, and has potential for publication.

Preliminary Reading List

- Farhad Arbab, Sun Meng, Young-Joo Moon, Marta Z. Kwiatkowska, Hongyang Qu. Reo2MC: a tool chain for performance analysis of coordination models. ESEC/SIGSOFT FSE 2009: 287-288, 2009.
- Marta Z. Kwiatkowska, Gethin Norman, David Parker. Probabilistic symbolic model checking with PRISM: a hybrid approach. STTT 6(2): 128-142, 2004.
- Rajeev Alur and Mihalis Yannakakis. In Proceedings of the Tenth International Conference on Concurrency Theory (CONCUR'99), Lecture Notes in Computer Science 1664, Springer-Verlag, pp. 114–129, 1999.
- `www.prismmodelchecker.org/`
- `http://www.kenmcmil.com/smv.html`

Other Information

Project can be taken by:	2 students
Project type:	Empirical survey and analysis Theoretical research (mathematical/technical) Literature survey / comparison / review / evaluation

Distributed Social News

Description

Current social news sites try to produce a list of current important news items by applying algorithms and voting by the community. While more decentralised than a traditional publication, the system still relies on a select few (moderators, administrators) to safeguard it from manipulation (spam, vote-rigging) while maintaining the culture of the website. Further, by providing a centralised view of the current news, they necessarily average the preferences of their members instead of addressing the needs of each one based on their voting patterns. This project aims to develop a new type of social news aggregator that allows each user to see a personalised view of current events while allowing them to customise the algorithm by which the items get selected and uses their browser's processing capacity to deal with the scalability issues.

Background Knowledge Required

- Background or familiarity with Java and/or C++ and/or another programming language
- Background or interest in ranking algorithms
- Background or familiarity with JavaScript and/or other client-side programming languages
- Background or willingness to learn to program efficient communication between web servers, databases, and web pages
- This project is research-oriented, and has potential for publication.

Preliminary Reading List

- `http://digg.com/`
- `http://www.reddit.com/`
- `http://delicious.com/`
- `http://blog.linkibol.com/post/How-to-Build-a-Popularity-Algorithm-You-can-be-Proud-of.aspx`

Other Information

Project can be taken by:	1 student
Project type:	Software development Experimental research Theoretical research (mathematical/technical)

Applying a FeedPacer

Description

The advent of the Web has brought up a need for managing web content which changes regularly. Feeds such as Atom and RSS have become a major way of disseminating news. However, one may want to consume different resources in a feed-like pace. For instance, a user may want to receive feeds from an old blog or a book, so they would be interested in archived messages rather than the latest entries, and would like to receive those at a certain pace they find most suitable for their current needs. This project aims to create a new method of consuming feed-like content while exploring the capability of the user to signal back to the server the need to increase or decrease the flow of the items.

Background Knowledge Required

- Background or familiarity with Java and/or C++ and/or other programming language
- Background or interest in Web 2.0 technologies
- Background or familiarity with JavaScript and/or other client-side programming language
- Background or willingness to learn to program efficient communication between web servers, databases, and web pages

Preliminary Reading List

- `http://www.whatisrss.com/`
- `http://www.atomenabled.org/`
- `http://tools.ietf.org/html/rfc4287`

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Experimental research

Social Network Analysis

Description

Social network analysis (SNA) tries to extract information about a community by analysing the interactions between its participants. This project will analyse the data found in a 5-year old community (www.opadoi.gr) with 1500 members and more than 450,000 messages, aiming to deduct its history, user interconnections, significant events and other information that can be gleaned from the given data set.

Background Knowledge Required

- Background or interest in analysing online communities
- Background or familiarity with data analysis
- Background or interest in deriving and reading advanced analytics for online communities

Preliminary Reading List

- `http://www.insna.org/`
- `http://www.orgnet.com/sna.html`

Other Information

Project can be taken by:	1 student
Project type:	Software development Experimental research Empirical survey and analysis

Mobile App - Integrating SMS with Email

Description

SMS and Email are popular methods of communication. Smartphones today bring together both these services in one device. Think of the scenario where someone is working on their laptop and receives an sms on their mobile phone which might be sitting in the next room. This project will look into allowing users to send and receive sms messages directly from their email client. Another usage scenario of this mobile application is that users could avoid roaming charges when abroad by simply leaving their phone plugged in at home.

Background Knowledge Required

- Background in or interest in mobile applications
- Background in or familiarity with Java
- Background in or willingness to learn Android application development

Preliminary Reading List

- `http://developer.android.com/index.html`
- `http://developer.android.com/sdk/index.html`

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Experimental research

Integrating Open Data into a Web Presence

Description

This project builds on previous work on a database management interface and a RESTful API for databases. The objective is to integrate these with the existing web presence of the Institute of Animal Health who want to move towards open data. The strategy to implement this solution involves XSLT transformations of query results from the API. The latter will also need to be documented so that it can be used by other programmers.

Background Knowledge Required

- Background in database design and SQL
- Background in web programming (PHP, JavaScript, SQL)
- Willingness to learn about REST and XSLT
- This is a collaborative project with the Institute of Animal Health

Preliminary Reading List

- Leonard Richardson, Sam Ruby. RESTful Web Services - Web services for the real world. O'Reilly Media, May 2007 `http://oreilly.com/catalog/9780596529260`
- `http://www.iah.bbsrc.ac.uk/`

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Experimental research
	Literature survey / comparison / review / evaluation

Translating UML models: from scenario-based to state-based specifications

Description

Scenario-based specifications are widely used in software design as a way of expressing the behaviour that results from the intended interactions between parts of the system. Although intuitive, the scenario-based specification is not the most appropriate in subsequent stages of software development - typically, state machines are used in subsequent phases. This means that at some point there is a need to move from the scenario-based specification to a state-based description of system behaviour while retaining all the properties of the interaction captured in the initial specification. This is where a translation to a more formal language might be required and it is important especially in the context of concurrent systems where a number of anomalies can come to view if the behaviour of the system is only partially specified.

This project will build on previous work on the formal translation of UML sequence diagrams into UML state diagrams and will involve the implementation of a tool that takes UML sequence diagrams and generates the corresponding state diagrams, expressed in UML protocol state machines.

Background Knowledge Required

- Background or interest in UML design models and particularly interaction diagrams
- Background or interest in formal methods would be beneficial
- Some coding skills, and willingness to develop these
- This project is research-oriented, and has potential for publication

Preliminary Reading List

- http://www.uml.org/
- http://www.w3.org/XML
- http://www.w3schools.com/xml/
- S. Moschoyiannis, P. Krause, M. W. Shields. A true-concurrent interpretation of behavioural scenarios. Electronic Notes in Theoretical Computer Science 203(7):3-22, Elsevier, 2009.

Other Information

Project can be taken by:	1 student
Project type:	Software development Experimental research Literature survey / comparison / review / evaluation

Hongying (Lilian) Tang

Research Interests

Image processing; computer vision; machine learning and pattern recognition; uncertainty reasoning; probabilistic computation; natural language processing; machine translation.

Image processing of bacterial growth time-lapse pictures

Description

This is a collaborative project with Biosciences Department. The project is to study drug resistance in the bacteria that cause Tuberculosis (TB). We need to measure growth rates in individual cells. We have recorded time-lapse images of growing cells but we need some means of tracking individual cells and their descendants and measuring the time of cell division in thousands of individual cells.

Background Knowledge Required

- Good understanding of image processing and computer vision techniques is required.
- Knowledge in boilogy and mathematics will be an advantage.

Preliminary Reading List

- Rafael Gonzalez, Richard Woods, Digital Image Processing (International Edition), 2nd Edition, ISBN 0-13-094650-8, Prentice Hall, 2002
- Nick Efford, Digital Image Processing, A Practical Introduction using Java, Addison Wesley, ISBN 0201596237, May 2000

Other Information

Project can be taken by:	2 students
Project type:	Software development
	Experimental research

Video Object Tracking

Description

Based on the following various scenarios, a few projects can be offered.

Scenario 1: Given videos of cataract surgeries performed by various surgeons, who can be experienced or novice, the work aims to identify surgical instruments in the videos and track their movement, which can be used to measure surgeons' dexterity.

Scenario 2: The aim of this project is to track the motion of one particular meaningful object such as a football, a moving car, an animal or a human. This is to provide high level analysis on the results. For example, to detect the abnormality in a scene (someone suddenly started to run in a shopping mall); or someone arrived at a place with a handbag, but left without it.

Background Knowledge Required

- Good understanding of computer vision techniques is required.
- Background in mathematics will be an advantage.

Preliminary Reading List

- IBM people vision, `http://www.research.ibm.com/peoplevision/publications.html`
- Video tracking, `http://en.wikipedia.org/wiki/Video_tracking`, accessed on 12th August 2008.
- M Piccardi, "Background Subtraction Techniques: a Review", 2004 IEEE International Conference on Systems, Man and Cybernetics, pp. 3099-3104.
- C. Wren, A. Azarbayejani, T. Darrell, and A.P. Pentland, "Pfinder: real-time tracking of the human body," IEEE Trans. on Pattern Anal. and Machine Intell., vol. 19, no. 7, pp. 780-785, 1997.
- Comaniciu, P Meer, "Mean Shift: A Robust Approach, Toward Feature Space Analysis", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 24, No. 5, May 2002, pp. 603-619.
- M. S Arulampalam, S Maskell, N Gordon, and T Clapp, "A Tutorial on Particle Filters for Online Nonlinear/Non-Gaussian Bayesian Tracking", IEEE Transactions on Signal, Vol. 50, No. 2, February 2002, pp.174-188.

Other Information

Project can be taken by:	2 students
Project type:	Experimental research

Feature Extraction for Herbarium Images

Description

Image analysis of herbarium images, in order to extract and analyse morphological measurements (morphometric features) from plant specimens for various ecological/botanic applications.

Two related but independent projects can be offered. This can be either more technical, such as to perform analysis or classification of different types of leaves based on shape information; or to more information analysis oriented, to perfrom evalation and analysis of existing systems.

Background Knowledge Required

- Good understanding of image processing and computer vision techniques is required.
- Background in mathematics will be an advantage.
- For students who are not totally interested in programming, but keen to perform information analysis on various existing sytems, please come to discuss the possibilities.

Preliminary Reading List

- Rafael Gonzalez, Richard Woods, Digital Image Processing (International Edition), 2nd Edition, ISBN 0-13-094650-8, Prentice Hall, 2002
- Nick Efford, Digital Image Processing, A Practical Introduction using Java, Addison Wesley, ISBN 0201596237, May 2000

Other Information

Project can be taken by:	2 students
Project type:	Experimental research
	Literature survey / comparison / review / evaluation

The Story of Art

Description

Vision is not a mechanical recording of elements but the grasping of significant structural patterns. If this is true for the simple act of perceiving an object, it is all the more likely to hold also for the artistic approach to reality. The exalted kind of seeing that leads to the creation of great art appears as an outgrowth of more common activity of the eyes in everyday life, because it involves giving and finding colour, shape and meaning. This work will involve research into the relationships and elements between art and visual perception, such as balance, shape, form, space, light, colour etc in art paintings and drawings (including children drawings) and developing computational methods that are able to identify such elements and relationships.

More specifically, this can be finding a particular shape in paintings or drawings; Colour analysis; Quantitative measure of different objects in a painting; Correlate visual information and its perception; A particular application domain must be defined at the early stage of the project. Some applications can be: The analysis of Chidlren's drawings; or to compare Chinese calligraphy charaters between experts' writings and novices'. Two projects can be offered.

Background Knowledge Required

- Knowledge of AI, image processing and computer vision techniques.
- strong interest in art.

Preliminary Reading List

- Rudolf Arnheim, Art and Visual Perception; ISBN 0571 081541
- Rafael Gonzalez, Richard Woods, Digital Image Processing (International Edition), 2nd Edition, ISBN 0-13-094650-8, Prentice Hall, 2002
- Nick Efford, Digital Image Processing, A Practical Introduction using Java, Addison Wesley, ISBN 0201596237, May 2000

Other Information

Project can be taken by:	2 students
Project type:	Experimental research

Automatic Image Analysis for Retinal Images

Description

Diabetes is one of the most prevalent diseases in the world. The analysis of retinal images is crucial for understanding the progression of diabetic retinopathy (DR) and will benefit an automatic DR screen programme in the future. The project involves two major processes: clinical sign feature extraction and classification. Research on how to represent, organise and extract key clinically meaningful visual features, and how to classify clinical cases based on those features are required. Experiments on various classification strategies and their combination could be performed. A final working system prototype should be developed.

Two projects can be offered under this topic. One is to develop clinical sign detection and integrate it into a larger project. The other is more suitable for student who may want to perform a thorough evalation and analysis on existing systems.

Background Knowledge Required

- Good understanding of image processing and computer vision techniques is required.

Preliminary Reading List

- G Shapiro, George C. Stockman, Computer Vision, Prentice Hall, ISBN 0-13-030796-3
- Rafael Gonzalez, Richard Woods, Digital Image Processing (International Edition), 2nd Edition, ISBN 0-13-094650-8, Prentice Hall, 2002
- Nick Efford, Digital Image Processing, A Practical Introduction using Java, Addison Wesley, ISBN 0201596237, May 2000

Other Information

Project can be taken by:	2 students
Project type:	Experimental research
	Literature survey / comparison / review / evaluation

Helen Treharne

Research Interests

Model Transformation using Epsilon. Formal Modelling using CSP||B and CSP. Concurrent Systems. Protocol Verification. Computer Security - Distributed Identity Management, Role Based and Attribute Based Access Control. Applications of Peer to Peer Networking.

Evaluation of peer-peer approaches

Description

This project will compare two peer-peer approaches: Pastry and Chord. Make a critical review and evaluation of two established peer-peer approaches. The motivation for this project comes from research into federated identity management which is considering using peer-peer technologies. Currently, Identity Management systems require one-to-one relationships between all Identity management systems in the federation. Instead we wish to be able to discover and broker trust with a large number of other identit management systems by utilising only a small number of direct relationships with IdM systems, where direct trust can be easily established. Therefore examining what peer-peer approaches are available and evaluating their strengths and weaknesses will be a step forward in the direction of choosing an appropriate one for use with federated identity management systems.

The project will have the following tasks:

- Identify what was the purpose of Pastry/Chord? What do they do? What were they designed for in the first place?
- Implement a simulator which allows use to compare them or to identify existing simulators in the literature that can be used as a basis for the comparison
- Critical review of them

Background Knowledge Required

- The student should have good practical programming skills in Java because the student will be required to write code to demonstrate the two approaches.
- No pre-requisite is required but a keen interest in learning about peer-peer networks is essential.

Preliminary Reading List

- `http://cst.mi.fu-berlin.de/teaching/SS07/19554-S-TI/reports/radke07pastry.pdf`
- `http://research.microsoft.com/en-us/um/people/antr/pastry/`
- `http://iris.csail.mit.edu/irisbib/papers/pastry:ifipacm/paper.pdf`

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Experimental research
	Literature survey / comparison / review / evaluation

Automatically Testing Java Coursework

Description

This project will investigate how to provide a framework for automatically testing code. There are many approaches that can be taken, batch testing via the command line or using OSGI to dynabmically load in jar files. There is also an automatic framework already available called Coursemaster. The project will aim to see what could be developed/used in order to support the feedback of students' learning in Level 1 undergraduate teaching labs.

The project will have the following tasks:

- Conduct a literature review of the available code marking schemes. Demonstrate their use on comparable examples.
- Develop a framework to support the automatic feedback of Level 1 Java laboratory sessions.

The nature of the scope of the project will depend on the initial review findings. The outcome will be a recommendations on the strenghts and weaknesses of what's available. The framework developed may be as a result of an exisiting methodology or it maybe as a result of the student's own development using OSGI.

Background Knowledge Required

- The student should have good practical programming skills.
- No pre-requisite is required but a keen interest in learning about peer-peer networks is essential.

Preliminary Reading List

- David Binkley. (2007). *Source Code Analysis: A Road Map*, Future of Software Engineering (FOSE'07), IEEE.
- `http://www.cs.nott.ac.uk/~cah/pdf/thesis-PavlosSymeonidis.pdf`

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Literature survey / comparison / review / evaluation

Meta-Modelling

Description

Model driven approaches are fast becoming accepted approaches for transformations from one language to another. There are many research tools that support this. In this project an evaluation of how to define a formal model from a VHDL description. Current research in the Department is examining how to map the hardware description language VHDL to the process algebra CSP which is industry sponsored. This project will examine how to transform VHDL to another formal modelling language Event-B. This project will require the student to develop a good understanding of how to model systems in Event-B to start with and then implement a transformation.

The project will have the following tasks:

- Develop a working knowledge of Event-B.
- Identify how to VHDL in Event-B.
- Define a transformation from VHDL to Event-B and evaluate it.

The last tasks will require meta-models. These are descriptions of the syntax of a language and their relationship. We have already developed one for VHDL and there are ones in the Event-B literature that could be defined. Then the student will need to develop an understanding of how to use the Epsilon tool suite to support model transformations.

Background Knowledge Required

- There are no requirements for the students to know the hardware description language VHDL in the first place. They will not be developing hardware during the course of the project.
- A background in the use of discrete mathematics would help because Event-B is a mathematical modelling method.

This project fits into the research of the formal methods group within the Department. A complete transformation is not expected at the end but good progress towards the end goal is what is required.

Preliminary Reading List

- `http://www.eclipse.org/gmt/epsilon/`
- `http://www.emftext.org/index.php/EMFText`

Other Information

Project can be taken by:	1 student
Project type:	Experimental research
	Theoretical research (mathematical/technical)
	Literature survey / comparison / review / evaluation

Mobile Phone Application to inform students of cancelled lectures, labs and other events

Description

Currently, the cancelling of lectures is done by emailing students. This project will investigate alternatives for this approach. Some local secondary schools already have applications for informing parents by text when schools are closed due to bad weather. The project will investigate whether to inform students by text or via an RSS feed or use a mobile phone app. The project's scope will initially investigate this for our Department. It will need to consider how the application will be viewed by students and used by our administrator. It will need to consider whether the software to be developed is implemented as an Andriod or Iphone app. The outcome of the project will be a demonstrator together with an evaluation of the approach with a set of recommendations. It may be possible during the course of the project that the scope is extended beyond just one Department to look at how it used by more than one Department.

The project will have the following tasks:

- Evaluation from the student point of view on how they would wish to receive information about cancelled lectures
- Critical review of what technology could be appropriate to achieve the project aim
- Implementation of a demonstrator to illustrate the concept. This implementation will follow good software engineering practice and must be able to be extended beyond use by only our Department.
- Through evaluation which would be needed in order to provide recommendations to the Department on future possibilities.

There is scope for more than one student to do this project. The project could take several different directions.

Background Knowledge Required

- The student must have good practical programming skills.

Preliminary Reading List

- `http://www.timeshighereducation.co.uk/story.asp?storycode=405904`
- `http://www.ericsson.com/ericsson/corpinfo/programs/the_role_of_mobile_learning_in_european_education/products/wp/socrates_mlearning_wp4.pdf`
- `http://handheld.softpedia.com/get/Business/Organizer/BunkM-Bunkulator-Mobile-105255.shtml`

Other Information

Project can be taken by:	2 students
Project type:	Software development
	Literature survey / comparison / review / evaluation

Investigation into access control models

Description

Investigation into access control models, particularly into Role-based Access Control models and MLS models. This investigation inspired by an industrial collaboration. The project will require a thorough examination of the literature to demonstrate a solid understanding of what the differnt models. The project must demonstrate via a practical element the security issues of different models.

The project may look into access control models by examining the use of SELinux for labelling data in a simple scenario, including capturing potential problems, but this will depend on the scope of the project as agreed with the supervisor.

Background Knowledge Required

- This project will require strong students because the project is wide in scope and open-ended because it is research driven.

Preliminary Reading List

- `http://csrc.nist.gov/groups/SNS/rbac/`
- `http://www.centos.org/docs/5/html/Deployment_Guide-en-US/sec-mls-ov.html`

Other Information

Project can be taken by:	1 student
Project type:	Experimental research
	Theoretical research (mathematical/technical)
	Literature survey / comparison / review / evaluation

Bogdan Vrusias

Research Interests

My main broad research interests are artificial intelligence and distributed systems, but also a combination of the two. More specifically I have worked in the area of Multimedia Information Retrieval (storing and retrieving images and videos), Visual Information Processing and Retrieval (object recognition in images and videos), Distributed Systems (eCommerce, Web application development), Collective Intelligence (recommendation systems), Semantics and Knowledge Representation (discovering knowledge associations), Business Intelligence and Data Mining (extracting useful patterns from raw databases), and Neural Computing (Neural Networks, Machine Learning, etc).

A Web Logistics Framework for Coupling Small and Medium Enterprises.

Description

Building a Web based logistics framework/system that connects businesses related to production of products or services all the way to consumers. The unique selling point of this framework is the clear separation between the layers and that there are no tight links between the suppliers, service or product providers, and consumers. The system should allow for suppliers to be registered in the system, so that the service/product providers can select the appropriate one for their job. End users are then allowed to order a product and monitor the progress of their order through the system, from order to production and delivery. Such a generic framework would allow small to medium companies setup their business on the web and find the needed suppliers to construct and then sell products or services on the web. One example of a potential company that would use this framework could be one that sells customised picture frames. This business should have the ability to register their business and start searching for suppliers that sell wooden (or plastic etc) frames, suppliers that sell glass (glazing), and a supplier that can put them together and post them to the consumers via a currier (another of your suppliers). Practically this system needs a front end for suppliers and one for the end users (consumers), a data layer for accessing the database, and a middle layer for the business logic.

Preliminary Reading List

- Ghiani G., Laporte G. and Musmanno R., Introduction to Logistics Systems Planning and Control, JohnWiley & Sons, 2004, ISBN: 0-470-84916-9 [accessed at: `http://media.wiley.com/product_data/excerpt/77/04708491/0470849177.pdf`]
- Kayal D., Pro Java EE Spring Patterns: Best Practices and Design Strategies Implementing Java EE with the Spring Framework, Apress, 2008, ISBN: 1430210095
- Vukotic J., Chakraborty A., Ditt A. & Machacek A., Pro Spring 2.5, Apress, 2008, ISBN: 1590599217
- Logistics Systems: `http://en.wikipedia.org/wiki/Logistics`
- Logistics Automation: `http://en.wikipedia.org/wiki/Logistics_automation`

Other Information

Project can be taken by:	2 students
Project type:	Software development

Web Mining for Building Company Profiles

Description

This project topic is concerned with the development of a system that automatically identifies, based on given key words, web pages related to a particular company and then it build its profile. The purpose of this exercise is to automatically construct a model for building a summarised report for a given company, based on information that is available online. This information could be news stories, trade show listings, trade directories, etc. The web pages should be harvested by a web crawler (spider) that automatically recognises the appropriate data, based on some heuristics. After the information is collected by the web crawlers, it should be fed into a system that generates the profile of the company. The project also requires the student to initially conduct an investigation into the techniques and methods for building such system. Eventually the student should build a prototype that can be used as a proof of concept, which eventually needs to be evaluated via scientific experimentation.

Preliminary Reading List

- B. Liu, Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-centric Systems and Applications), Springer; 1st ed. 2007. Corr. 2nd printing edition, 2006, ISBN-10: 3540378812
- S. Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data (The Morgan Kaufmann Series in Data Management Systems), Morgan Kaufmann, 2002, ISBN-10: 1558607544
- C. D. Manning, P. Raghavan & H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008, ISBN-10: 0521865719
- R. Belew, Finding Out About: A Cognitive Perspective on Search Engine Technology and the WWW, Cambridge University Press, ISBN: 0521630282.
- Thomas Mitchell, Machine Learning, McGraw-Hill Education, ISBN: 0071154671
- Web Crawler: `http://en.wikipedia.org/wiki/Web_crawler`

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Experimental research

Video Retrieval: Identifying Events in CCTV footages

Description

This project topic is concerned with the development of a system that retrieves video scenes, based on a text queries. The system should automatically analyse videos and store the most important results within a database. In order for the system to identify events in the video, appropriate heuristics need to be embedded in the system. The first step into this video analysis method is to use existing object tracking mechanisms for capturing the moving blobs in the scene. The next step will then be to recognise the objects and then monitor their behaviour. When the behaviour of an object matches the required event, appropriate flags should be raised by the system. The project should also conduct an initial investigation into the techniques and methods for building such systems.

been developed in the department)

Preliminary Reading List

- `http://www.computing.surrey.ac.uk/ai/reveal/`
- `http://www-nlpir.nist.gov/projects/trecvid/`
- `http://wang.ist.psu.edu/IMAGE/`
- `http://www.eecs.berkeley.edu/Research/Projects/CS/vision/vision_group.html`

Other Information

Project can be taken by:	1 student
Project type:	Software development Experimental research Literature survey / comparison / review / evaluation

Android Mobile Application for Classifying Emails

Description

This project topic is concerned with the development of an Android based mobile application that classifies the incoming email messages. The classification can either be on specific topics such as business, work, personal, adverts, spam, etc., or based on their importance as defined by the user. The basis of the classification can either be based on simple statistical methods or artificial intelligence principles. The project may conduct an investigation into the techniques and tools for text processing and classification.

Preliminary Reading List

- Michael W. Berry, Jacob Kogan, Text Mining: Applications and Theory, Wiley-Blackwell, ISBN: 0470749822
- Ronen Feldman, James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, ISBN: 0521836573
- Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press, ISBN: 0521865719
- Dr Ricardo Baeza-Yates, Dr Berthier Ribeiro-Neto, Modern Information Retrieval: The Concepts and Technology Behind Search, Addison Wesley (2 Ed), ISBN: 0321416910

Other Information

Project can be taken by:	2 students
Project type:	Software development Experimental research

Distributed and E-Commerce Applications

Description

This project topic is concerned with the development of a distributed system or an eCommerce application that complies to current state of the art technology and architectures (e.g. J2EE and .NET). The project may conduct an investigation into the techniques and architectures for building such systems. Applications of that could be building Web Service based systems, information share, data management, etc.

Preliminary Reading List

- Glen Daniels et al, Building Web Services with Java: Making Sense of XML, Soap, WSDL and UDDI, Que, ISBN: 0672326418.
- Darrel Ince, Developing Distributed and E-Commerce Applications, Addison Wesley, ISBN: 0321154223.
- `http://java.sun.com/webservices/index.jsp`
- `http://msdn.microsoft.com/webservices/`
- `http://www.w3.org/`

Other Information

Project can be taken by:	2 students
Project type:	Software development
	Experimental research

Collective Intelligence for Product Recommendation

Description

This project investigates the power of social networks and e-commerce applications as a way for exchanging knowledge and information between end users. The main focus of the project is to implement a prototype system that is capable of recommending products to clients based on the traffic generated by other users. In order to do that, a system needs to monitor the behaviour of other users and eventually identify similar patterns that can be generalised and recommended to other similar users. Applications of that could be movie or music recommendation systems, Amazon-like web applications, personalised search engines, etc.

Preliminary Reading List

- Segaran T. Programming Collective Intelligence: Building Smart Web 2.0 Applications, O'Reilly Media, 2007, ISBN: 0596529325
- Alag S., Collective Intelligence in Action, Manning Publications, 2008, ISBN: 1933988312
- Collective Intelligence: `http://en.wikipedia.org/wiki/Collective_intelligence`
- Recommendation Systems: `http://en.wikipedia.org/wiki/Recommendation_system`

Other Information

Project can be taken by:	1 student
Project type:	Software development
	Experimental research
	Literature survey / comparison / review / evaluation

Steve Wesemeyer

Research Interests

My main research interest are Digital Image Watermarking, Error Correcting Codes, Security and Cryptography. Other interest include Free/Libre Open Source Software(FLOSS) development, JAVA & C++ programming and Project Management.

Open-sourcing an existing project

Description

The aim of this project is to take an existing project (50,000 lines of C++ code) and make it available under an open source licence(TBD) on a Sourceforge or Google code. The student is expected to design the web site, provide tutorials and even contribute to the code base in terms of simple examples. Other possible aspects include:

- investigating the most appropriate version control software (CVS, svn, git, mercurial, etc)
- evaluating various open source software licences and their implications on how the code can be used
- introducing unit tests and automatic builds

Background Knowledge Required

- C++ knowledge is essential
- Linux or Unix experience is highly desirable
- a strong interest in error-correcting codes

Preliminary Reading List

- B. Stroustrup: *Programmming: Principle and Practice using C++*, Addison-Wesley, 2009
- S. Lin, D. Costello:*Error Control Coding-2nd edition*, Prentice Hall, 2004

Other Information

Project can be taken by:	1 student
Alternative supervisor:	Johann A. Briffa
Project type:	Software development
	Literature survey / comparison / review / evaluation

Insertion-Deletion-Substitution(IDS) code comparison

Description

The idea behind this project is to implement an insertion deletion code described by Schlauweg (see references) within the framework provided by an existing code base (C++). This implementation will then be compared to the published results as well as an existing implementation of a different IDS to see how they compare with respect to IDS performance, complexity and speed. This might result in publishable results.

Background Knowledge Required

- C++ knowledge is essential
- a very strong interest in error-correcting codes

Preliminary Reading List

- B. Stroustrup: *Programmming: Principle and Practice using C++*, Addison-Wesley, 2009
- S. Lin, D. Costello:*Error Control Coding-2nd edition*, Prentice Hall, 2004
- M. Schlauweg, D. Pröfrock, E. Müller: *Correction of Insertions and Deletions in Selective Watermarking*, IEEE International Conference on Signal Image Technology and Internet Based Systems, 2008

Other Information

Project can be taken by:	1 student
Alternative supervisor:	Johann A. Briffa
Project type:	Software development
	Experimental research

Robust digital watermarking

Description

This project is a continuation of previous research requiring the student to explore different improvements to an existing code base to improve the performance of a robust digital watermarking system. This might result in publishable results.

Background Knowledge Required

- Python and C++ knowledge is essential
- a very strong interest in error-correcting codes
- Multimedia security

Preliminary Reading List

- B. Stroustrup: *Programmming: Principle and Practice using C++*, Addison-Wesley, 2009
- S. Lin, D. Costello:*Error Control Coding-2nd edition*, Prentice Hall, 2004
- S. Wesemeyer, J. Briffa, H. Schaathun: *Multi-bit watermarking robust against Stirmark*(in preparation)

Other Information

Project can be taken by:	1 student
Alternative supervisor:	Johann A. Briffa
Project type:	Software development
	Experimental research

Open Source software contribution - your suggestion of topic

Description

Identify an open-source project that is not undergoing rapid development. Add significant extra functionality to this project, and release your results back into the open-source community at the end.

Tasks should include:

- Identify a project, and a goal to achieve.
- Design your enhancement, possibly in conjunction with the existing project community.
- Write software, carefully documenting what you have done because the environment around you will change during the year.

Background Knowledge Required

- Programming skills in the selected area
- Enthusiasm for the selected application domain

Preliminary Reading List

- Depends on topic selected.
- You might like to look at several years of Google Summer of Code projects to see what can be achieved in a few months.

Other Information

Project can be taken by:	85 students
Project type:	Software development