

Part IB Group Project Design Briefs 2014

Alpha: Algo-Trading Game

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Algorithmic trading is an essential part of today's financial markets, but releasing an algorithm out in the wild certainly comes with its own hassles. One of the challenges associated with carrying a trading algorithm into production is the evaluation of its performance, preferably under different market conditions, and using different parameterizations of the algorithm. This process, called back-testing, allows one to understand the characteristics of a trading algorithm before it hits the markets. In this project, the aim is to create a game, where users will submit their algorithms to be evaluated under a back-testing framework. An algorithm will pick which products it is interested in, and the framework will supply the historical data for those products. The algorithm can then give trading decisions, which will be evaluated in order to characterize the algorithm.

Bravo: Evolve a Pet

Client: Keira Cheetham, Illumina
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The goal of this project is to create a game that teaches GCSE or A level science students about genomes and genomic sequencing. The idea is for a number of users to run evolutionary optimisations (possibly genetic algorithms) that optimally combine the favourite features of their pets - or perhaps even alien species! As with dog breeding, there may be some genetic trade-offs between functional and aesthetic attributes. Local optimisation to meet a particular user's preferences can take place on individual users' computers - perhaps mobile phones, or even Raspberry Pis. Once a desirable local optimum has been reached, users should be able to select which part of the genome to exchange with their friend's pets. Exchanges could simply take place online, but it might be more interesting to require a physical meeting - exchanging genetic material via Bluetooth, with a network cable that directly connects one Raspberry Pi to another, or some other form of ad hoc networking.

Charlie: Intelligent Graph Reader

Client: Nilu Satharasinghe, Sparrho
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Google Scholar is a good way to find scientific results, but it only reads the words - not actual data. The goal of this project is to create document analysis algorithms that can automatically identify and describe graphs of scientific data - something like "find a graph where blood pressure decreases with age". Users should be able to feed in complete HTML or PDF documents, which are automatically parsed for graph content, and stored in an archive

that supports sophisticated data queries and comparisons between graphs in different documents.

Delta: Multi Chat

Client: Matt Johnson, Frontier
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Many games allow online players to chat in one form or another. More adult games allow free chat in lobbies, or within the game. Some products with younger appeal allow regimented exchanges of 'phrases', such as 'I'm the fastest', 'This time let's play Rainbow Road' to avoid inappropriate discussion. Both of these formats have drawbacks, either being too limited to make meaningful conversation, or too open for inappropriate behaviour and abuse.

Create a tool and module to provide a multiperson chat experience based on a configurable grammar where the users can converse through the stringing together of grammatical tokens to make meaningful, but limited conversational exchanges. The module should provide both a lobby and an ingame mode of conversation, and provide configurable options for the tokens visual and aural representation.

Echo: Multi-Touch Conference

Client: Catherine White, BT
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Rather than flying all over the world to attend meetings and conferences, it seems as though governments and businesses could save money and time by collaborating remotely. Existing collaboration tools such as Webex and Google Hangouts work quite well to connect small groups discussing a single topic. However, the face to face networking aspect of real world conferences is missing. Delegates can walk around, join conversations that interest them or say hello to people they want to meet. Your task is to create a multi-touch, multi-user browser extension that lets groups of people convene and spontaneously form discussions. Each user may use a smart phone or remote keyboard to type messages, with a single large screen supporting multiple users at the same location contributing to more than one topic. It should enhance conversation, for example by extracting keyword themes for each conversation cluster. It may be useful to arrange the conversation clusters and avatars in terms of relevance and relatedness rather than simply placing people in a simulated physical or geographic setting.

Foxtrot: Money World

Client: Ben Azvine, BT ben.azvine@bt.com

UK voters are quite accustomed to seeing good quality visualisations of economic data, tax and

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public expenditure. But these aren't accessible in many parts of the world having low literacy, or where the only internet access is via the mobile network. Your task is to create an app that will run on a low cost Android phone, not using too much bandwidth, that allows developing world users to visualise, share and comment on economic data. Initiatives such as Gapminder, Africa's Voices and the Open Data Initiative might provide a starting point for design ideas, but you'll need to think about what information sources are both useful to developing world users and publicly available - www.globalintegrity.org is one organisation with the right kind of focus. You could consider designs based on the Mo Ibrahim Foundation indices, or even allowing citizens to see how their country compares to others on the Millennium Development Goals. Keep in mind that the kinds of visualisation suitable on a small screen will be very different to what might appear on a newspaper site. JavaScript visualisation libraries might come in handy, for example using a platform like PhoneGap. In any case, users should be able to find out how the visualisation was derived from the data, so that people in other countries can share, reuse or extend it.

Golf: Project Darknet

Client: Russell Bender, Potential Difference
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"Darknet" is a new experimental theatre production under development by a Cambridge graduate for performance next year. It explores computer hacking, cyber espionage and cyber warfare and aims to give the audience an experience of the dark side of internet use. We're not sure if this is legal*, but we've been thinking that we might use data from the theatre ticket booking system to mess with their minds at some point during the show and make them feel like they have been hacked. Your job is to build a system that helps us do this by any means you can think of. You can assume that there will be a data projector built into the set or lighting design, that there's a sound system, that we can change the script, and we can ask the audience to leave their phones on ... we have their numbers (and also their seats)! It's up to you to create effects that will take the story somewhere a little creepy

* (oh, alright ... we could ask their permission first)

Hotel: Purchase Abandonment Predictor

Client: Philip Wilson, The Hut Group
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There are many online shopping sites where users become frustrated - they can't find what they want, get bored, or simply fail to complete a purchase. Retailers would be happy to help out such customers, if only they knew which ones were most likely to benefit. If you could predict which

shoppers are about to abandon their shopping basket based on click stream analysis, then it would be possible to offer the customer incentives to stay on the site. Incentives could be discounts, pop-ups or contextual product recommendations. If successful, the system may be trialled on a large popular e-commerce site such as MyProtein.com, LookFantastic.com or IWantOneOfThose.com.

India: Recipe Curator

Client: Chris Roberts, Cambridge Consultants
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One area of my life that could do with the addition of a bit of technology is recipe curation. I have a shelf full of cookery books, a few websites that I like, and I occasionally get given recipes by other people. I also have a veg box delivery with unpredictable contents, a desire to eat seasonal ingredients and try new recipes, a variable availability of cooking time, two daughters with an only partially overlapping Venn diagram of food fussiness and not a poor memory. What I'd like is some sort of database of recipes to which I can send queries such as "Find me something that doesn't contain cabbage or tomatoes that takes less than 30 minutes to prepare" or "I've got kohlrabi in the veg box AGAIN, are there any recipes I haven't tried that might make something edible out of it?" or "I've actually got a couple of hours free to cook this weekend, what was that complicated Ottolenghi recipe I flagged two weeks ago to try later?" The database needs to cope with the fact that ingredients can have different names but mean the same thing: e.g "flour" and "plain flour", and that "1/4 lb" and "4oz" are the same thing and equal to "100g" (and not 113g). It would be great if once I've chosen this week's menu, it could produce a shopping list I can plug into www.<my_favourite_supermarket>.com, and it needs to be usable by non-engineers.

Juliet: Resilient and Rapid Raspberries

Client: Dominic Nancekievill, G-Research
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In today's world of high frequency trading, understanding the rapidly changing quotes from a myriad of trading algorithms is a colossal data processing problem. With tens of thousands of updates per second in a single market, and limited space and power constraints, it is important to be able to maximise throughput and resiliency with the hardware available. Given a day of actual stock exchange data, your challenge is to create a cluster to process and aggregate the data. Doing this with real hardware is more fun - we can't give you our data centre, but we can supply you with a Raspberry Pi cluster.

Dynamically dealing with hardware failure, visualisation of the order book, automated

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deployment and performance statistics are all areas that you can explore. (At project start, see additional notes on sample data and some background information).

Kilo: Sound Garden

Client: Jonathan Baldwin, Madingley Hall
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Surprisingly satisfying music can be defined in terms of simple regular grammars. Simple grammars can be derived from observing the traversal of a graph. Your task is to make a system that automatically generates original music, according to rules that are derived from the path of visitors walking through the formal garden at Madingley Hall (<http://goo.gl/maps/9utLI>). A small number of infrared detectors hidden in the flowerbeds will detect people passing. A Raspberry Pi should use these signals to create a grammar that can also be viewed and modified by members of the public, in the form of source code (any language – or your own invention) that can be edited from any web browser via an HTTP server on the Raspberry Pi. Of course, everyone should be able to hear the resulting music, whether played over speakers in the garden, or by remote viewers from their browsers. As an example of the kind of generative music that might result, check out the video of Dave Griffiths' techno music composing robots in al-jazari.

Lima: The Technical Textbook of the Future

Client: Rupert Gatti, Open Book Publishers
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In fast-moving technical fields, it is hard to keep good textbooks up to date. Online resources such as Wikipedia are useful ways to collect expertise, but articles written by technical experts are not always the best way to learn. Someone has to collect good teaching examples, suggest tests and exercises and so on. Your task is to design an application that offers the best of both worlds - a book that can be accessed from browsers or mobile devices, preserving a clear voice for the author, but also allowing mashups at varying levels of granularity with other textbooks, student forums, class exercises and presentation materials, and discussion among expert teachers at any level of content. Different users (schools, teachers, or learners with special needs) should be able to create the learning paths that suit them best, and also share them with others. The final product shouldn't look like another blog, forum or wiki - you will need to think what design elements and user experiences are associated with a professional and authoritative knowledge source.

Mike: Transport Game

Client: Steve Platt, Cambridge Architectural Research
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It's hard for voters and taxpayers to assess what impact different funding policies will really have on their lives. The goal of this project is to create an online game that will enable users to explore issues of transport funding and, in particular, to measure their personal costs and benefits from road pricing. An underlying model provided by the Cambridge Centre for Smart Infrastructure and Construction can be used to simulate the key features of the Cambridge transport network, with users plotting a number of their typical journeys to create a baseline. They will then be given the opportunity to “purchase” benefits in the form of a range of transport infrastructure and service improvements, for example road quality and public transport. According to the choice of benefits made, the user will incur a variable mileage-based road user charge, whose proceeds are available for spending on transport. Making changes in travel behaviour - for example making a journey by bus or bicycle rather than by car - will allow the user to reduce or avoid the charge. The model will also allow users to opt for a reduced rate of charge and/or a compensating reduction in fuel duty, with a personalised benefit-cost ratio compared to other players.

November: Unlocking the Graphics Power of the Raspberry Pi

Client: Milos Puzovic, MathWorks

The Raspberry Pi has become incredibly popular, and it's great for hobby applications, but its appeal to children is reduced by the fact that it's a little slow. However, most applications are using only a fraction of its computational power. The good news is that the Raspberry Pi's System-On-Chip BCM2835 has a hidden gem: a Graphics Processing Unit (GPU) that can significantly improve performance of applications that use large blocks of data. At the moment, the GPU on Raspberry Pi is under-utilised. Your task is to enable applications written in the MATLAB language and models designed in Simulink to exploit the Raspberry Pi GPU. As a demonstration of what can be achieved, it should be possible to implement game physics such as real time cloth dynamics on a human character with moving clothes and hair (created using MATLAB and Simulink toolboxes). It's your choice whether this is a mobile character in a sandbox game, a narrative cut-scene, or even an intelligent avatar such as the Zoe talking head. (At project start, contact the client for access to the Simulink target development tools, and advice on the GPU porting process).

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Oscar: Virtual Reality Trading Desk

Client: Taylan Toygarlar, IMC

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Financial markets today are one of the biggest raw data generators of our time, with billions of data points per day for some products. Most traders need to digest a very large number of numerical and graphical inputs - they use four, six, eight or more screens - but can't see or reach all the data they need. In this project, you will use an Oculus Rift VR headset to distribute market data and visualisations in the virtual space around a trader. By turning their head, or looking up and down, they should be able to review rapidly changing data in various formats, and have their attention drawn to the most urgent changes if they need to act. The design of the visualisations could emulate those found in products such as Thomson Reuters Eikon - but it will be necessary to adjust these to the display characteristics of the Oculus Rift.