Part IB Group Project Design Briefs 2019

AI Chef

Client: Isabella Gottardi, ARM

Arm is creating optimised computer vision and machine learning libraries for processors like the one in your phone. Anyone can train a neural network using these libraries to recognize images of vegetables, animals, objects, etc so long as they have enough examples of labelled classification decisions. In a vegetable market, the stallholder has "labelled" all the vegetables by putting them in different bins. So AI Chef aims to train a network that will use those thousands of those labels (from phone video) to solve the eternal dilemma "what do we eat this evening?": standing in front of a stall at the Cambridge Sunday market, AI Chef automatically recognizes which vegetables are on sale, identifies a recipe based on them and provides you with a shopping list of the other things you need to buy before you go home to cook.

Bone Doctor

Client: Ankit Sharma, TPP

Large databases of labelled X-ray images such as the MURA dataset of broken bones can be used to train AI systems for medical advice. An intelligent clinical assistant should be able to take a previously unseen X-ray image and link it directly to cases that can guide possible treatment. Your task is to train a neural network that will find a variety of other cases that are clinically similar, but visually distinct, presented in a visual overlay that highlights local differences for a clinician to review.

Clean Cycle

Client: David Paul, Magna

The CamBike Sensor project has been creating augmented sensing capabilities for future bicycles, including GPS, LoRaWAN data communications and air quality sensors. Your task is to create infrastructure that captures and buffers data, transfers it when links become available, and uses that data to profile air quality over time and distance. The user view of this should be a route-planning application that optimises daily and seasonal alternative routes, guiding riders in dirty cities to minimise their pollution exposure either for daily commutes or more intensive courier or delivery work.

Competing for Autonomy

Client: Lucy Mair, G-Research

As autonomous vehicles become more common, we are likely to see people tweaking algorithms to accelerate their journeys. Your task is to create a competitive 'market' in which users can submit algorithms to see which is the best. You'll need to define a simple scripting language and API suitable for creating the entries. Users should be able to enter their script into an interactive game then see its performance in a real-time car race against other user's scripts. The best entries should be stored and ranked in a leader board, with new players able to see existing code and tweak it for better performance. In future, this kind of algorithm market could be applied to other problem domains such as finance.

Distributed Microcontracts

Client: Phillip Pido Oyat, Infectious Diseases Institute Kampala

Personal and small business finance innovations increasingly come from low-income countries, as with the hugely successful M-Pesa mobile payment system. The goal of this project is to create a distributed payment and ledger system for organisations that commission many small pieces of work in remote locations. These contracts can often be passed on or subcontracted, making them hard to trace. Your system should use the sensor capabilities of smartphones (e.g. camera, accelerometer, GPS) to authenticate contracts, payment and verification of commissioned work in an intuitive, secure and traceable way.

Eyes on the Road

Client: Ben Catterall, IMC

Are VR-controlled vehicles the answer to postal woes? With e-commerce pushing package-delivery services to the brink and self-driving cars not yet available, we want to explore a new generation of remotely driven vehicles. Your exciting task: build a service that controls a smart vehicle (Lego Mindstorms EV3 Car with camera) using a VR headset (Oculus). Optionally, you could broadcast the video output of the smart vehicle to a web service.

Eyes in the Sky

Client: Ben Catterall, IMC

Package delivery by drone might become a reality. Until it does, postal and delivery services are considering the immediate potential in remotely driven vehicles. Your task: figure out how to monitor those vehicles from the sky! The goal is to build a service that tracks a vehicle with a drone (using a visual, wifi or bluetooth beacon) and broadcasts the drone's video output to a web-based interface.

Fever Finder

Client: Dan Storisteanu, SimPrints

Google Flu Trends was a famous (but unsuccessful) attempt to predict flu outbreaks on the basis of anxious people searching for symptoms. A more pressing need is to work out whether people in remote villages might be harbouring an outbreak of Lassa, Zika or Ebola. Your goal is to design a smartphone-based field station that geolocates fever symptoms for members of a family or village, using technology from Cambridge startup SimPrints to identify individual cases. With advice from an infectious disease specialist, you can use machine learning to model potential outbreaks as they occur.

Flyathlon

Client: Jennifer Border, British Trust for Ornithology

Major sporting events such as marathons and triathlons often raise funds and awareness for good causes including conservation. This is an opportunity to design a new global sport where humans compete digitally in relay teams alongside wildlife. Using the Strava API, and records of bird migration from the British Trust for Ornithology, create secure and fair infrastructure for a competition that includes joint teams of cyclists and wild birds, attracting large audiences through public engagement for refereeing, commentary, fan clubs and sponsors.

Grand Remote

Client: Rob Sinclair, NHS Digital

Grandparents and children both enjoy a quick chat, but often live too far apart for regular opportunities. Older people also have challenges with remote technology such as IoT, security devices, or media systems. You can solve both problems with a universal remote that establishes a voice channel to an available grandchild who can help complete a control function through network redirection, automation or scripting of commands while also providing regularly scheduled social contact. Your remote app should be highly usable by people with visual, motion control and memory impairments, while also being compatible with a wide range of IoT and media devices.

Groundwater App

Client: Mark Muller, British Antarctic Survey

British Antarctic Survey has developed a compact ground-penetrating radar for measuring melt rates at the base of ice-sheets. In principle, the same device can locate groundwater in arid regions, for borehole drilling and groundwater management. Your task is to create a phone app able to take data from the radar equipment and estimate groundwater depth. You will have access to the (Matlab) research algorithms that process the radar data at present, and your code may adapt or

refine these. You should provide visualisations to help nontechnical users control the system and interpret its output, and also use of the phone storage for "sneakernet" transfer of data to servers for more intensive cloud-based analysis by technical specialists.

Heroes in Conference

Client: Mark Ogilvie, Jagex

Even the best conferences and conventions experience a slump where engagement declines. Your job is to design and prototype a mobile AR experience to keep conference attendees interested - using gamification and social techniques to bring attendees together, predict and counter the slump, as well as deliver key information about the event. This should be offered as a downloadable app that supports the 2019 public show for the group projects, and also shows the potential to support RuneFest 2019, the JAGEX convention that's all about RuneScape.

LawBot

Client: Tetiana Bersheda, Lexsnap

Many people don't know where to start when they have legal problems, but lawyers are expensive. Would it be possible to combine standard approaches such as crowd-sourcing, wikis or forums with the free (but much too technical) online content available on sites like legislation.gov.uk? Your task is to create a system that works at first like a chatbot, but helps users to paraphrase and interpret both their own questions and pieces of actual legislation, so that the chatbot gets smarter over time.

Meeting Zoom

Client: Imdad Sardharwalla, Argon Design

Meetings by Skype often connect rooms full of people, each appearing as a tiny dot within the video from a wide-angle camera. It should be possible to use cross-correlation of signals from separated left and right microphones to identify who is currently speaking and automatically zoom the image to a specific region, enlarging the person who is currently talking to fill the screen. You should implement your solution as a replacement (software-defined virtual) camera that outputs a modified video stream, to a standard conferencing application such as Ring for Linux.

Million Plant Map

Lauren Gardiner, Cambridge University Herbarium

The University of Cambridge Herbarium has over a million specimens (including nearly 1000 personally collected by Charles Darwin). Many of these have alternative names and classifications. Public resources such as theplantlist.org have brought together a consensus list of names and their alternatives, but many specimens are stored under their old names. Your task is to use machine learning methods to optimise the indexing of the Herbarium specimens, provide simpler and more intuitive retrieval, and visualise the relationships between parts of the collection, using data from their databases, theplantlist.org and other scientific resources.

Probable Causes

Client: Theo Mauger, Morgan Stanley

The probabilistic programming stack developed by Mansinghka's team at the MIT AI Lab promises to deliver data science capabilities to a much broader range of users. Your task is to customise the bayeslite implementation of BayesDB to make an accessible and interactive tool for use in public debate, allowing more technically informed discussion of health and safety issues, for example among local administrators trying to improve bicycle safety in Nairobi, based on the data sets such as https://tinyurl.com/ybbj69cn

Robot Death Watch

Client: Will Boulton, Faraday Predictive

Many kinds of domestic robot and home appliances rely on small motors that have an unknown time to failure. Your task is to create a monitoring system that uses voltage and current profile to predict number of cycles until a failure. This should be offered as an online service that can be used by the homeowner to order spare parts, or a maintenance company responsible for keeping the household running without hitches. The project will involve testing a number of motors to destruction in order to build machine learning prediction profiles.

Text Farming

Client: Tim Wilkinson, KisanHub

Low-income countries often have network coverage in rural areas, but the devices and data contracts available to subsistence farmers make voice and SMS more practical then web services. You need to design a subscriber service that provides automated weather, health and market updates which users can personalise to their needs from a basic feature phone. You may need to use SMS gateways, off the shelf Interactive Voice Response techniques, and public APIs for information sources. Keep in mind the need for security, accessibility to low literacy users, and simultaneous support for a large number of local languages.

Visual Pick and Place

Client: Theo Markettos, Computer Lab

We have a LitePlacer robot that can automatically assemble circuit boards (https://youtu.be/t__ybwOufyg), with a machine vision system based on OpenPnP. Unlike many computer vision problems, the cameras can be moved around, for better field of view or details of specific regions. Our robot currently uses the vision capabilities for simple tasks such as recognising board features and component tapes to align components it is placing. We would like to extend the capabilities of the system to automate the setup of the machine, for instance printing part numbers from CAD data on sticky labels that the vision system reads; configuring placement of component tapes; recognising parts from their shape or markings to rotate the tape; detecting parts and boards from text printed on them; and guiding the user through setup with augmented image views.

VR Avatar

Client: Matthew Johnson, Frontier

With the growth of online VR spaces, users lack a consistent identity, and a way of expressing themselves to each other. Create 1) a VR Avatar API that provides an customisable animating model representing the user, and 2) an example app to demonstrate its application. The model must smoothly animate to reflect the user's physical pose from the hand controller and headset position and orientation data (perhaps employing inverse kinematics). Provide some means by which a user could drive emotive animations and expressions (such as shows of surprise, pity or anger). Consider customisations for the Avatars, and provide some back end service or 'Shop' for extensions or customisations to be downloaded.

West Augmentation

Client: Daria Jelonek, Studio Above&Below

The view from the William Gates building, until recently a peaceful meadow for grazing horses, is now a building site. The public exhibition for this year's group design projects will look out at it. Your task is to create an augmented reality experience for visitors to explore an alternative speculative design. Visitors should be able to toggle between an AR visualisation of the buildings currently planned for that site, and a radically different style of building including parametrically generated plants and environmental features such as "tree tenants" (after Hundertwasser), urban farming, wildlife sanctuary etc. Visitors should be able to explore and interact with the augmented scene via multiple linked devices, including mobiles, large screens, projectors and VR headsets.