

R249

Advanced Topics in Mobile Systems and Mobile Data Machine Learning

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Elevator Pitch

A close-up photograph of a hand pressing a button on an elevator control panel. The panel is metallic and has several circular buttons with numbers. The hand is in the foreground, and the background is slightly blurred, showing the interior of an elevator.

Develop efficient mobile systems to harvest human behaviour data: this involves developing new machine learning methods to work online and on the type of data generated by these devices.

The course

- The course is about anything to do with mobile systems
 - Systems aspects including power, computation
 - Novel Sensing aspects
 - Mobility/Sensor Data learning aspects
 - Modelling and Inference On Device
 - Mobile Health

The Schedule

- 🎬 1 Nov (1h) Introduction (TODAY!)
- 🎬 8 Nov System, Energy and Security
- 🎬 15 Nov Activity Recognition with Machine Learning and Mobile Sensor Data
- 🎬 22 Nov On Device Machine Learning
- 🎬 29 Nov Backscatter Communication, Battery Free and Energy Harvesting Devices
- 🎬 20 Jan New Sensing Modalities
- 🎬 27 Jan Urban Mobility and Human Mobility Modelling
- 🎬 3 Feb (3h) Mobile Health

Assessment

- ⊗ A total of 7 items of assessment:
 - ⊗ 1-2 Presentations
 - ⊗ 5-6 Reports
- ⊗ Each contributing 1/7
- ⊗ A contribution tick for class attendance and participation
- ⊗ A class list of attendance will be kept and apologies for absence should be sent to the lecturers prior the lecture.

Written Reports

- ⦿ In the weeks when a student is not presenting
- ⦿ Student assigned a paper among the ones listed to be presented for the following week.
- ⦿ Write no more than 1000 words (recommendation would be for ~800 words report).
- ⦿ A template list of headings online
- ⦿ Students presenting will submit slides instead of a report
- ⦿ All in PDF please!

Form

- ⦿ Paper Report Summary of the paper (200 words)
- ⦿ Discussion on novelty of the paper as stated (200 words)
- ⦿ Positives of this Paper (100 words)
- ⦿ Negatives of this Paper (100 words)
- ⦿ Ideas for Future Work, Critical discussion of potential impact and context setting (200 words)

How to Read a Paper

- ④ <https://www.cl.cam.ac.uk/teaching/1920/R249/report-guidelines.pdf>
- ④ Summary of the paper and key findings: Describe what the paper is about, the key problems it is trying to solve, its motivation (and maybe why it is an important problem) and the key contributions the paper spells out. Note that this is probably not the right place for your subjective views about the contributions.
- ④ Discussion on novelty : Novelty of the contribution wrt to literature. Note that if the paper is not extremely recent, the novelty needs to be put in the context of the time at which the paper is published. You will want to comment on the novelty at the time as well as contextualize with respect to the current literature. Here is your chance to comment on the contribution value with a more subjective angle.

How to Read a Paper

- ⊙ Positives of this Paper: Things to note, for instance, are if the paper is seminal, in the sense that works seem to have been citing this a lot, if it is very novel, if it has a thorough evaluation. Note that is often hard to be positive about a paper than finding flaws: remember to consider the difficulty of getting the work done and presented when you judge.
- ⊙ Negatives of this Paper: Here is where you can be critical and highlight the limitations of the work. Is the novelty limited? Is the evaluation constrained or artificial? Is the writing difficult? Note that highlighting more negatives than positives does not mean higher marks for your report. It always depends on what you write and how you justify it.

How to Write a Report

- ⦿ Ideas for Future Work: Critical discussion of potential impact and context setting. This is the space where you describe what potential the paper has. It might be that you have already set the paper into context in the novelty section so you can link to that and discuss more about the impact achieved and the future potential. If the paper is recent you can speculate on the take up of the research community or industry. This is really the space for your more subjective speculations and views.
- ⦿ Write concisely and precisely
- ⦿ Use scientific arguments

Presentation

- ⦿ Each student will present 1-2 times
- ⦿ No report when presenting (just submission of slides with same deadline) in PDF
- ⦿ Students assigned randomly each week
- ⦿ Presentations will be assessed for technical content, clarity, engagement, timeliness and question answering.

What do I put in the slides?

- ④ <https://www.cl.cam.ac.uk/teaching/1920/R249/presentation-guidelines.pdf>
- ④ Structure similar to a report in terms of what to cover however remember your audience: some students have not read the paper as carefully as others (because assigned to other papers)!
- ④ Slides Format and Content: Remember that your slides are not your script. Use both channels (your talk and your slides)
- ④ Keep to the time!
- ④ Rehearse! Think of presentations you liked (or not liked!)
- ④ Use silence and pauses...
- ④ Q&A: don't be defensive. Do right by the authors.

Report and Slides Deadlines

Michaelmas Term Deadlines:

- 🎬 Assignment 1 due Thursday 7 November, noon
- 🎬 Assignment 2 due Thursday 14 November, noon
- 🎬 Assignment 3 due Thursday 21 November, noon
- 🎬 Assignment 4 due Thursday 28 November, noon

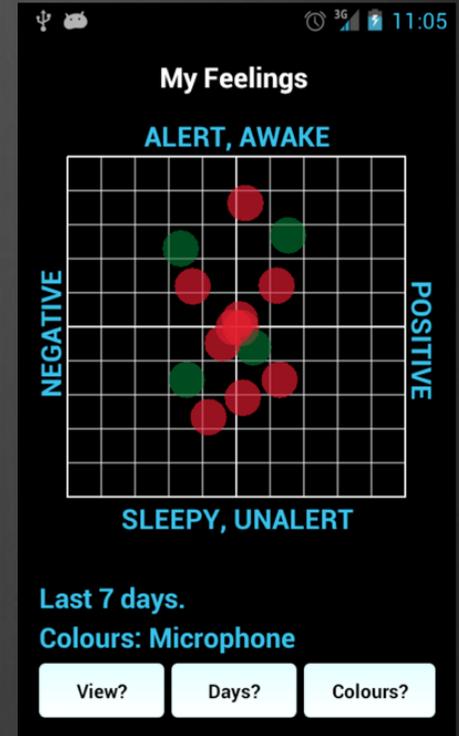
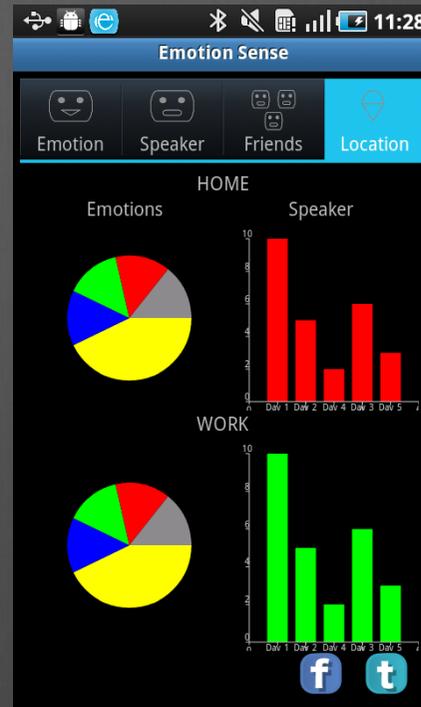
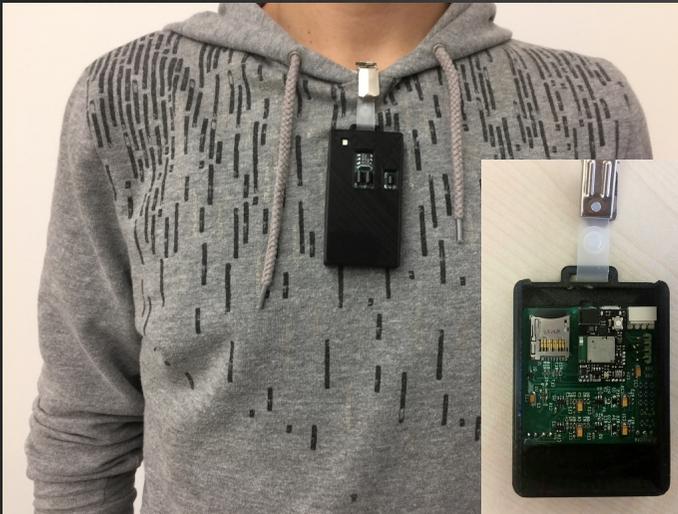
Lent Term Deadlines:

- 🎬 Assignment 5 due Friday 17 January, noon
- 🎬 Assignment 6 due Friday 24 January, noon
- 🎬 Assignment 7 due Friday 31 January, noon

The Papers!

- ⦿ <http://www.cl.cam.ac.uk/teaching/1920/R249/materials.html>
- ⦿ <http://www.cl.cam.ac.uk/teaching/1920/R249/paper-assignment.txt>

About the group's research...

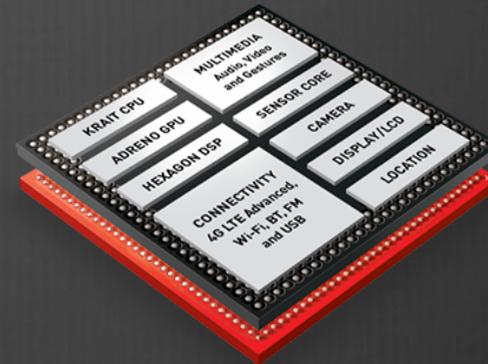


Sensing and Inference Efficiency for Continuous Sensing On Device

Snapdragon 800 MDP/S

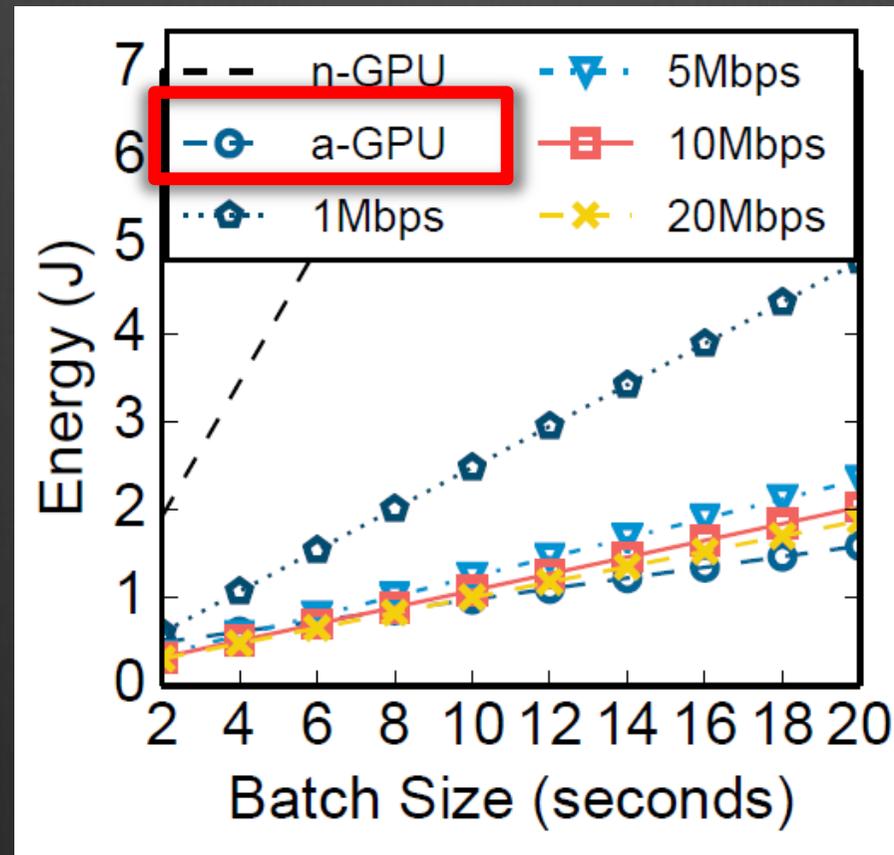


Qualcomm Hexagon DSP



Optimized GPU is Efficient

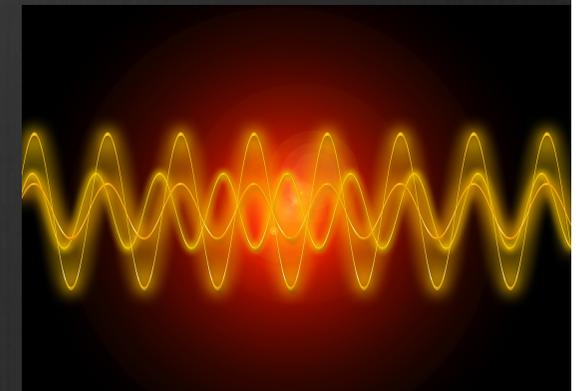
Optimized GPU with batching
outperforms cloud energy-wise



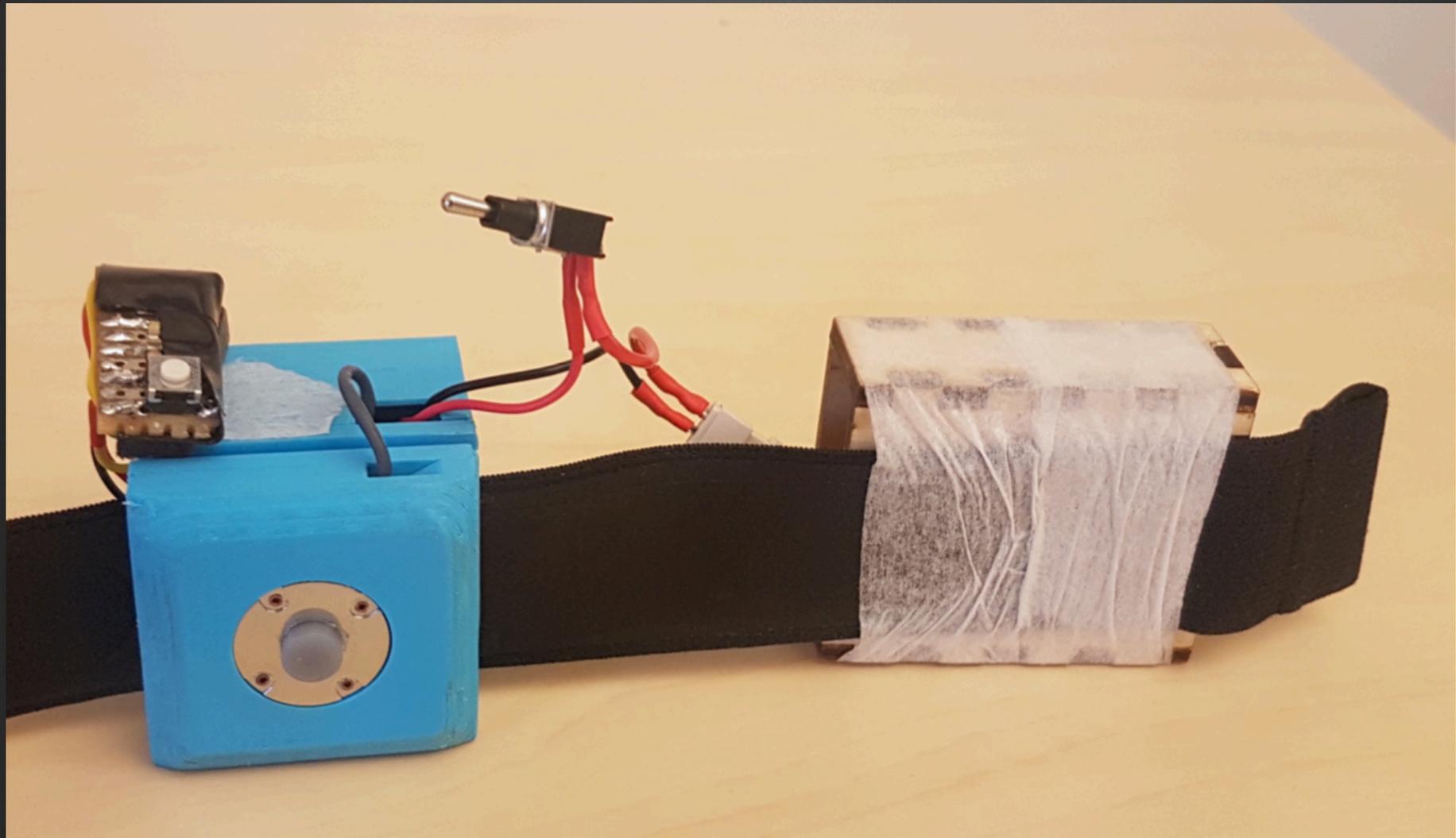


Acoustic based Sensing for Diagnostics

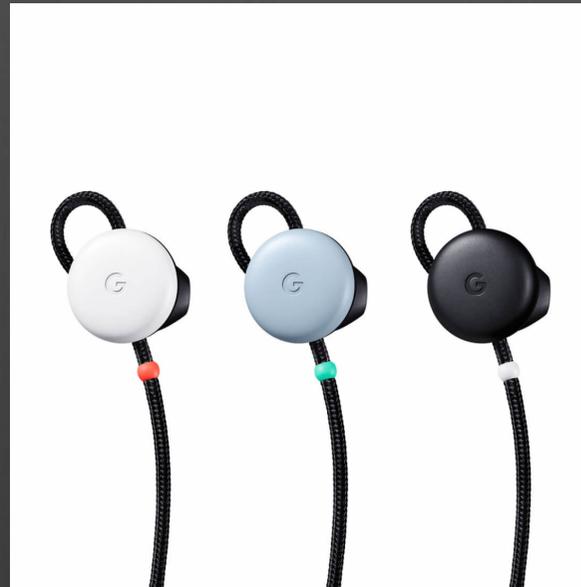
- Use of commodity devices or cheap built devices as sound recorders
- Bodily sounds
- Additional sensor inputs
- Challenges: on device inference, power, robustness to noise, machine learning models, interpretation



Auscultation Device



Ear-able Research



- 🎧 Sensing framework for behavior: what can be done?
- 🎧 Systems/Battery/Accuracy of ML tradeoffs

Training on Device



Student Mental Health Study



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School of Clinical Medicine



You Can Handle This!

Departmental Groups

Resources

MRC Epidemiology Unit

MRC | Epidemiology Unit



Get updates about our work

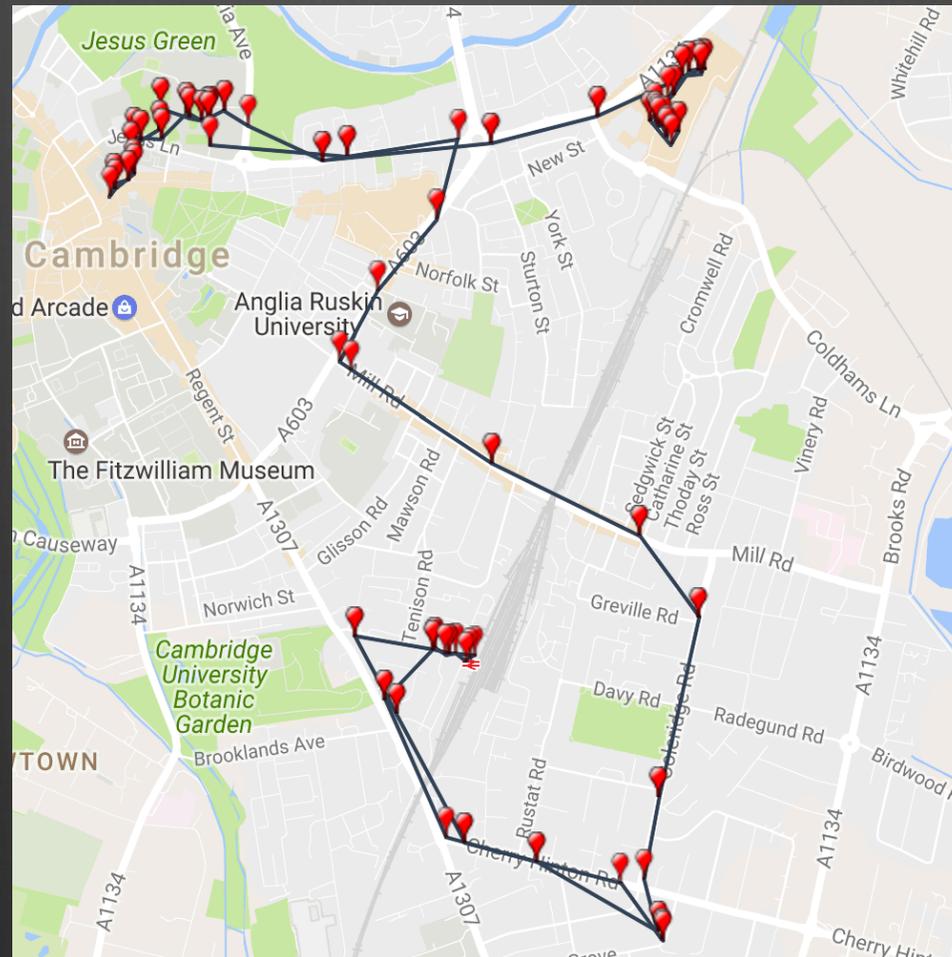
SUBSCRIBE

Department of Clinical Neurosciences



Department Intranet - to enter:

Early Alzheimer's Disease Diagnostics



Usable Security

- Passwords are problematic.
- Alternatives – Physiological, Behavioural Biometrics
- Breathing based authentication
 - Showed potential as a biometric
 - Can be easily deployed on multiple mobile devices (deep learning models)
- Challenges I am currently looking at:
 - Longer term studies, more users
 - Changing contexts, ambient noises etc.

Continual Learning

- ⊙ Reality of most machine learning models today: Deploy and forget
- ⊙ What we need: Ability to learn continually.
- ⊙ Challenges/Questions:
 - ⊙ Does current CL algorithms work?
 - ⊙ Continual learning on severely resource-constrained devices.

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