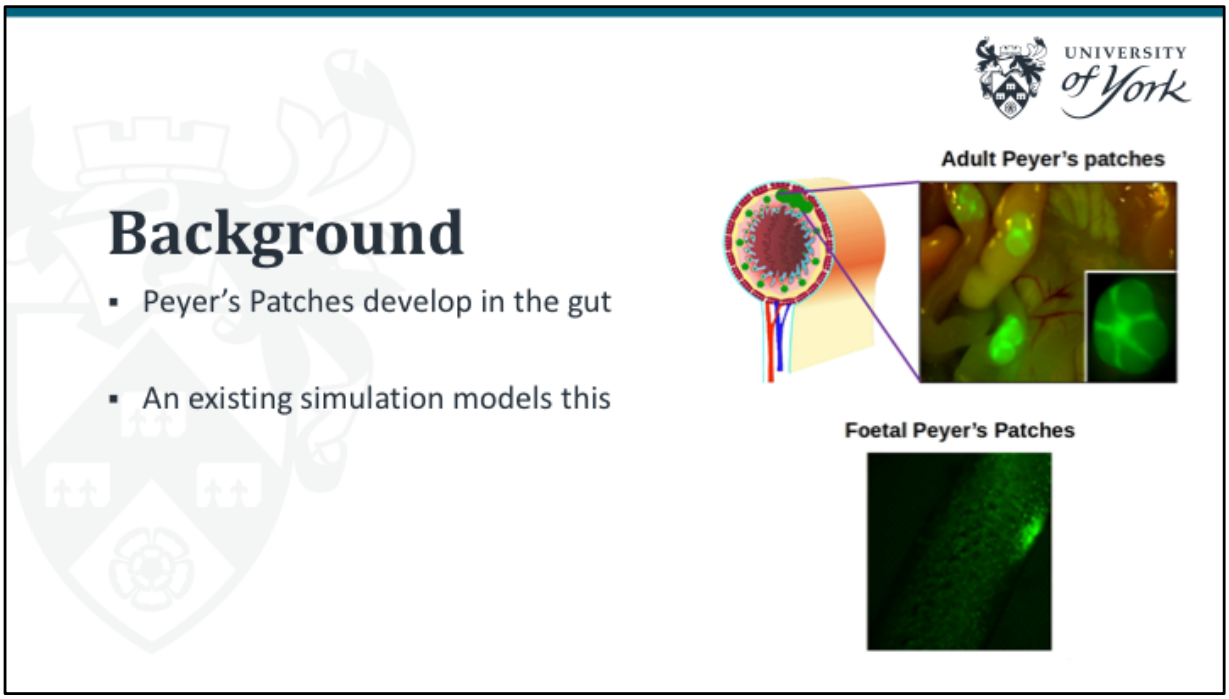
Final Year Project

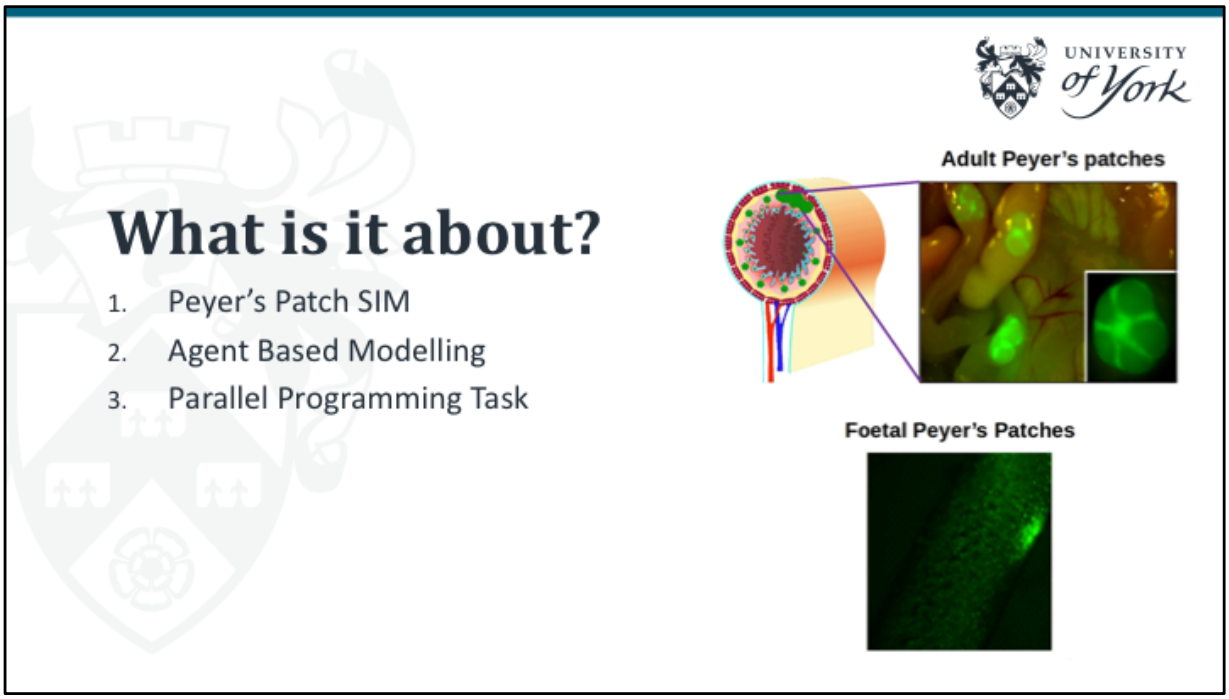
PCSW PRESENTATION

Lets take these in turn (but backwards)…



Peyer's Patches are clusters of lymphoid cells which are an essential part of the immune system
12h before birth, until about 48 after..? – is this 100% correct?

PPSim is an existing simulation that was created to explore the development of clusters of lymphoid cells in the gut.



That's the background, but..

<u>If we add some abstraction into the mix (every programmer's dream):</u>

At the top level, it's work on a simulation of Peyer's Patch's that helps further biological understanding

As a computer science project, it's an Agent Based Modelling implementation

- This simulation already exists
- For statistical tests and full analysis, the simulation takes around 3 month to run

ABM lends itself well to parallelism because each agent can run separately apart from interaction

So for me in particular, it's primarily a parallel programming task, as I've been given an (all-but) correct platform model

Research

- Research into Biological Modeling
  - Prevalence
  - YCIL Papers
  - Others…
- Research into Parallelism
  - Previous York Projects
  - Hardware Documentation
  - Papers & FlameGPU

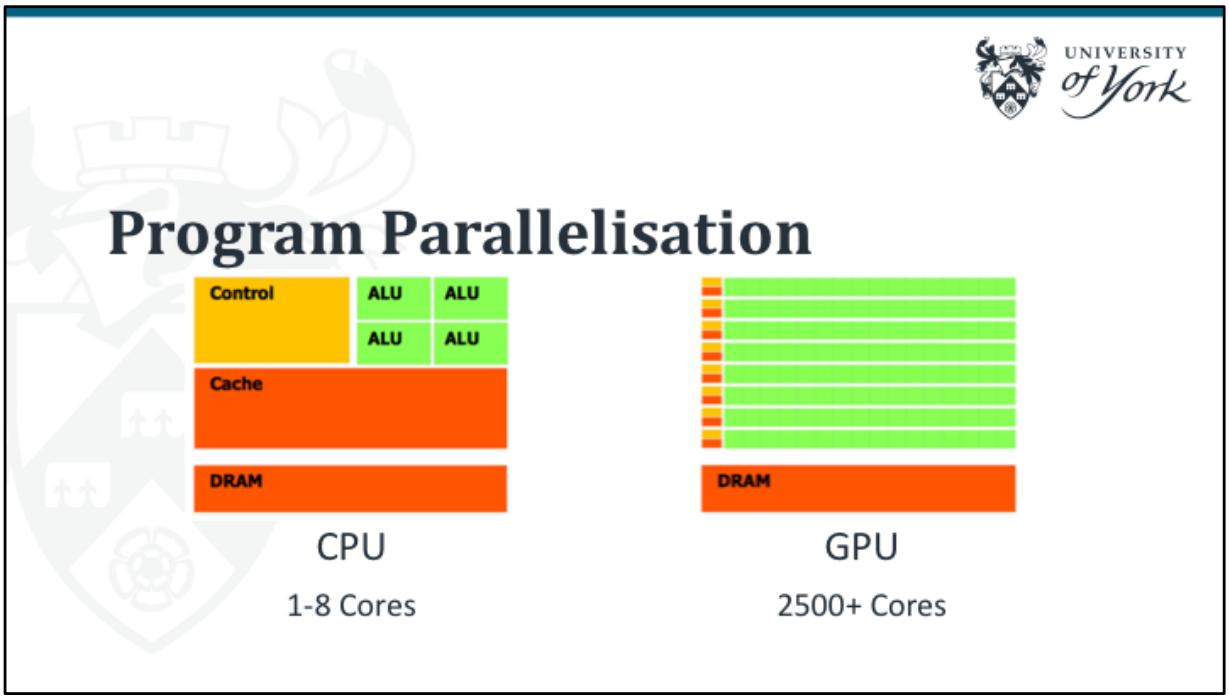
Aiming to build up a justification for any work

- PPSIM works already!
- Want to be able to work towards generalising any optimisations and cell interactions that might be useful for other models
- Increasingly popular for many forms of work, including genome modelling, and cell dynamics which is the focus here

Talk about original project brief

What has **changed**?

What **hasn't**?



Two great ways of parallelism on a single PC

Central Processing Unit

Every PC has them

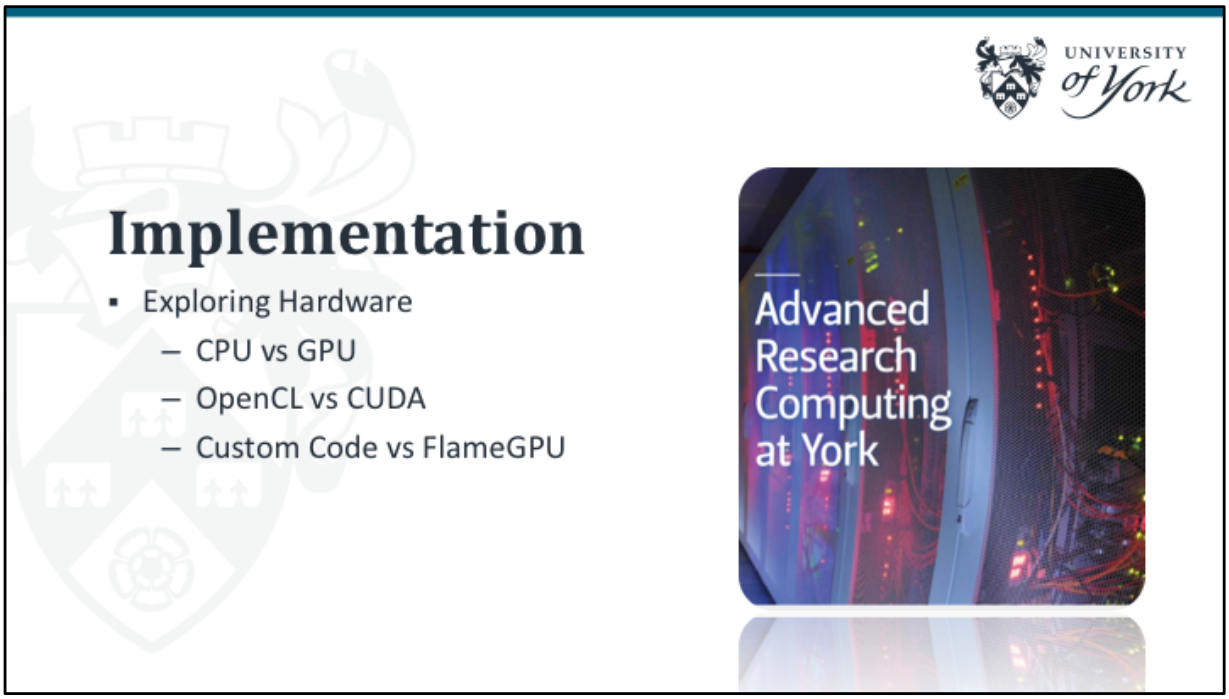
Easy to parallelise, just perform different runs in parallel for statistical analysis

But not as fast

Graphics Processing Unit

Significantly faster for basic tasks- number crunching

But each agent is performing similar actions in each turn..!

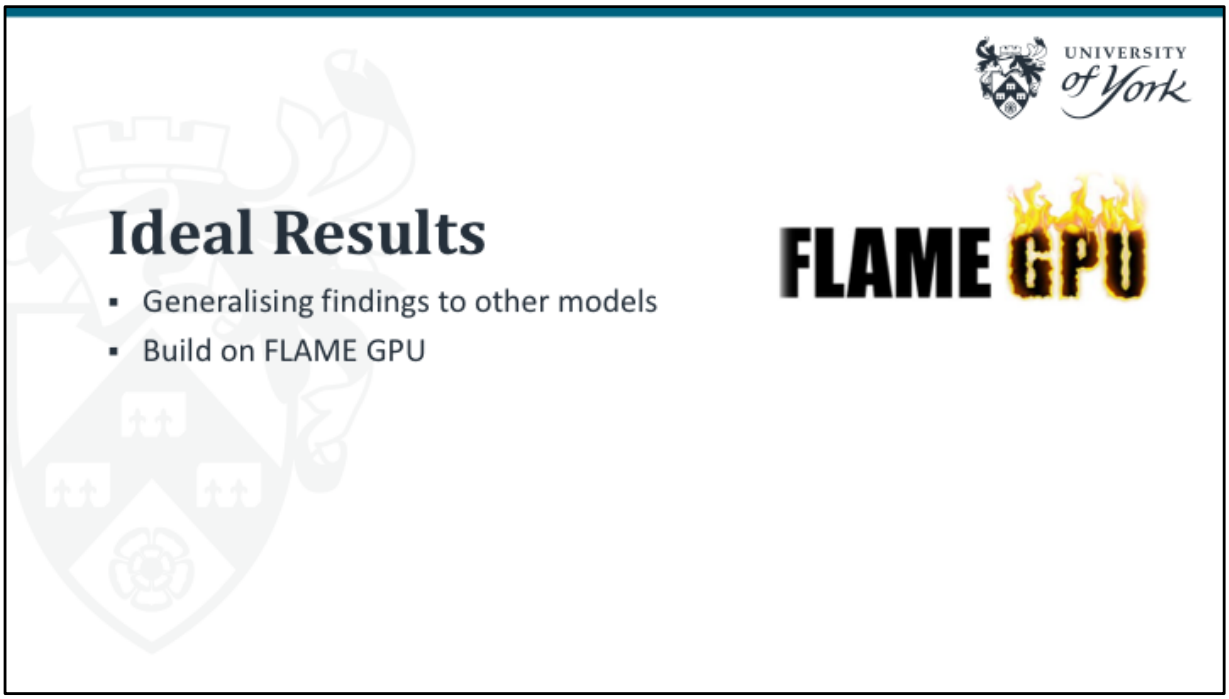


Talk about difficulty accessing hardware:

- *Compare solutions:*
  - *CPU vs GPU*
    - *YARCC access + training*
      - *Not ideal for development*
    - *Development PC coming soon*
  - *OpenCL vs CUDA*
    - *OpenCL runs on GPUs from multiple vendors but must be tailored to each piece of hardware*
    - *Limited literature comparison but general consensus:*
      - *Better library support (CUDA)*
        - *CuRand – parallel random number generator*
      - *Easier to setup (CUDA)*
  - *CUDA vs FlameGPU*
    - *FlameGPU uses X-Machines, similar to an FSA but with memory*
    - *CUDA is obviously going to be the fastest as its developed for*

controlling the hardware directly with no abstraction

- *BUT FINDINGS MUST BE GENERALISABLE- we don't NEED this particular simulatio general findings will be useful*
- *Custom code will likely be more tailored to the specific solution!*



Attempt to compare to original SIM to calculate significance of any performance improvements

FLAME GPU is notoriously complicated to get to grips with and this has been a struggle.
A lot of powerful tools are, by definition, complicated as they offer plenty of features. I believe the next step for FLAME is to provide to tool to allow non-technical/biological users to access power through some form of FLEXIBLE MODELLING tool- R. PAIGE

Impact

- Generally
  - $2.5bn R&D cost per drug
  - Reduction in Animal Testing
- PPSIM so far
  - New knowledge of the immune system
  - Worked with labs to prove this in Vitro

Faster and easier simulations is the end goal

Obviously there's a lot of scope within biology for simulations to help with testing.

- Ideally want to make simulations far faster and easier than animal testing
- Clearly more ethical

- So far it's been used to gain a greater understanding of Peyer's Patch formation.
- Further understanding means we could trigger a faster immune response to pathogens
- Impact of work has gone to three pharmaceutical firms and one cosmetic firm

Any Questions?