Adventures in Pi

David R. White
HATII Seminar
Tuesday 20th January 2015
These slides have been purged of all images, and the remaining content is for reference only!

I’ve annotated some of the slides, clumsily, so that you can get an idea of what was presented.

Any questions, queries — please get in touch!

David R. White.

Wed 21st Jan 2015.
Who am I?

RA in Computing Science at the University of Glasgow.

Funded by the EPSRC.

Member of the AnyScale Project http://anyscale.org

Interests include Cloud Computing and Evolutionary Computation.
Background about the Pi
The Raspberry Pi Cloud
Art Installation
Robot
I gave some background of the Raspberry Pi Project. Relating the Pi to the 8-bit home computing of the 1980s.

http://www.raspberrypi.org/about/
What’s in a Pi?

Costs around £30 for a Model B.

512MB RAM

Broadcom System-on-Chip

700MHz ARM Processor (ARM 11 Family, v6 IS)

Powerful GPU

Lots of GPIO pins
What’s in a Pi?

100Mbps Ethernet via USB 2.0 bus.

SD Card for Storage.

Component Video and HDMI Outputs.
Software

Invariably runs a version of Linux.

Raspbian, based on Debian, is the most popular and widely supported.

Also has CentOS and Arch Linux.
A Raspberry Pi Cloud
Edison’s Pearl Street Station

Steam generators,
Long Island Railways

Images © Smithsonian Institution
Discussed the analogy presented in Carr’s book. Recommended reading for anyone interested in how Cloud Computing is going to shape society.

“The Big Switch”
Nicholas Carr

http://www.nicholascarr.com/?page_id=21
Centralisation
For more technical insight into engineering Cloud Datacentres, and some of the software that runs within them, I recommended “The Datacentre as a Computer” by Barroso and Hölzle.

http://www.morganclaypool.com/doi/abs/10.2200/S00516ED2V01Y201306CAC024
Talked about “The Chaos Monkey” from Netflix.

https://github.com/Netflix/SimianArmy/wiki/Chaos-Monkey

http://blog.codinghorror.com/working-with-the-chaos-monkey/
Cloud Computing is blackbox — difficult to teach and research when the main interface is a bland webpage!
Discussed — how are we to evaluate ideas and teach Cloud Computing?
Showed some images of large data centres. They cost around $500 million to build.
Simulation

Simulate a Cloud Computer.
Fidelity? Convincing?
Intangible.
Build Something
Doesn’t scale — ends up in a machine room — messy!
What about a Scale Model?
Why Raspberry Pi?

£30 approx cost.

Ethernet (10/100Mbps).

Portable (small, low-power, < 500mA).

SD Cards (fast change).

GPIO pins.

Strong Community.

No more black boxes.
To contain the Pi’s, we build racks from…

Lego, of course…
Pi Cloud Software Stack

Applications

Web Server  Database  Hadoop

Container  Container  Container

Shipyard  RESTful APIs

Infrastructure

Docker

Raspbian Linux

ARM System on Chip
Ceci n’est pas un cluster de calcul.
Compute power of a supercomputer… from 1990. Not a computational beast!

Iridis-pi: a low-cost, compact demonstration cluster.
Cox et al.
Cluster Computing, June 2013.
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Example Student Project
An Art Installation
Discussed an art installation I was asked to produce.

Involve vision recognition.

Use a Raspberry Pi and a PiCam Camera Module.
When a user takes a photo, the app should check whether they're in a national park...

Sure, easy GIS lookup. Gimme a few hours.

... and check whether the photo is of a bird.

I'll need a research team and five years.

In CS, it can be hard to explain the difference between the easy and the virtually impossible.
Raw Image → Filtering → Greyscaling → Thresholding → Find Edges → Approximate Polygons → Locate Rectangle → Crop and Perspective Transform Original Image
Captured Symbol
Thresholding
Outline Finding
Calculate Moments
Distance Matching against database
Thresholds (hacks) → Classified image!
Since then, I’ve seen the Pi used in installations quite a lot.

Including at the Teller Gallery in Glasgow.

http://colocation-timedisplacement.migrating-origins.com
The Pi makes a great media player

Good first Pi project…

http://www.raspbmc.com
Raspberry Robot
Student project using Lego Mindstorms as an exemplar for the AnyScale project.

Do you have a similar problem?

http://anyscale.org
System Overview:

- USB-CAM-node
  - ROS-IMAGE, 3 Channel, uint8C
  - Pre-processing-node
    - ROS-IMAGE, 1 Channel, 8UC
  - Detect-face-node
    - Face Box
    - lk-tracker-node
      - AddFeatures(req)
      - (resp)
      - Output Image
      - 3 Channels
      - PruneFeatures(req)
      - (resp)
      - prune_features_server
      - ret-image-view
        - GUI
Conclusions

• The Raspberry Pi is a low-cost, portable and versatile self-contained computer.

• It’s a great teaching tool.

• It is too slow for many computationally-demanding tasks (but an update may be on the way!).
Acknowledgements

Posco Tso, Jeremy Singer, Dimitris Pezaros, Simon Jouet, Richard Cziva, Robbie Simpson.

Bobby Sayers, Joe Joiner.

Justin McManus.
Learn More

Get in touch!

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http://raspberrypicloud.wordpress.com

http://www.bobbysayers.com/origin