Mobile Computing Theme

Introduction

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Mobile Computing Theme

• Provides an overview of the state of the art in Computer Science for supporting mobile phones, tablets & other mobile devices.
• Includes technology for Internet of Things.
• Discusses:
  • Design of low-power hardware for battery driven applications and energy efficient systems in general
  • The way in which communications are supported and exploited in applications. (voice & data, cellular mobile networks & WiFi)

Components of theme

• COMP 61232: Mobile & Energy Efficient Systems.
• COMP 61242: Mobile Communications.

Mobile & Energy Efficient Systems (COMP61232)

• Schedule: 31 Jan-7 March 2018
• Lecturer: Dr. Dirk Koch
• Aim: to introduce practical aspects of high-performance low-power system design
• Focus: practical use of ARM 32-bit RISC processor core
  • World-leading processor for power-sensitive applications
  • Widely used in mobile devices incl. phones

COMP61232 Objectives

• To understand
  • low-power RISC processor design
  • the ARM and Thumb instruction sets
  • memory hierarchy and its influence on power-efficiency
  • system issues

Baby (1948)
ARM9 (2008)

50 years of progress

- Baby:
  - filled a medium-sized room
  - used 3.5 kW of electrical power
  - executed 700 instructions per second

- ARM968:
  - fills ~1mm$^2$ of silicon
  - uses 20 mW of electrical power
  - executes 200,000,000 instructions per second

Energy efficiency

- Baby:
  - 5 Joules per instruction

- ARM968:
  - 0.000 000 000 1 Joules per instruction

50,000,000,000 times better than Baby! (James Prescott Joule born Salford, 1818)

AAA battery can store up to about 5000 Joules (Watt-seconds)

Power

- Power is already a vital parameter
  - in mobile systems, for battery life
  - in tethered systems, for performance
  - in ecology, for human survival

- Despite x50 billion progress
  - electronics consumes more resources
  - low power expands the market faster than the power goes down!

- "Batteries not Included"
  - a Grand Challenge for future microelectronic design
  - leakage power is a big problem
  - variability will demand locally higher supply voltages
  - delivering "Moore for Less"

ARM milestone

- 2016 – ARM processors
  - over 86 billion shipped
  - ~100,000 transistors
    - ignoring memory
    - total: $10^{15}$ transistors

= number of synapses in one human brain!

COMP61232 Syllabus

- Basics of processor design
- Processor design trade-offs
- ARM and Thumb instruction sets in outline
- Exceptions and special instructions
- Thumb instruction set in detail
Topics

- ARM integer cores
- Memory hierarchy
- ARM memory management & memory protection units
- ARM CPUs
- System development
- Performance tuning

COMP 61232 Course Delivery

- On-line course
- Lectures & self-study
- On-line material & exercises (Blackboard)
- Textbook: “ARM System-on-Chip Architecture”
- Some exercises are assessed
- Two post-course projects
- Weekly face-to-face ‘workshop’
- Exam at end (worth 50%)

COMP61242: Mobile Comms

- Schedule: 14 March - 9 May 2018
- Lecturer: Dr. Barry Cheetham
- Aim: to introduce the techniques used for:
  - WiFi & cellular mobile networks (2G, 3G, 4G, etc)
  - Mobile speech & data communications
  - Layered communications within a mobile device
  - Comms between mobile devices & internet access points (wired & wireless)
  - Comms between access points

Focus: Mobile Comms

- Human interaction with battery powered portable devices.
- Convergence of telephony & computing.
- Advances in hardware, software & comms
  - Software platforms for applications, some with DSP requirements
  - Infrastructure (WI-FI) & ad-hoc network technology with protocols, data formats & technologies.

Mobile Communications (COMP61242)

Syllabus

1. Intro to mobile computing & comms (including 4G/5G).
3. Application layer issues – including voice & multimedia
4. Network & transport layer issues: incl. DHCP, mob-TCP, handover (homogeneous and heterogeneous)
5. ‘Data link layer’ issues 1 - Medium access control (MAC)
6. ‘Data link layer’ issues 2 - Error control
7. Physical layer issues - Digital modulation & transmission.

Recommended Text Books:

- Mobile Communications, Jochen Schiller, Addison-Wesley, 2nd ed., 2003
  (may replace with directed readings)
COMP 61242 Delivery

- Weeks 1-5: Lectures & laboratories
- Week 6: Complete lab work/assignments
- Laboratory work has 2 assignments:
  - Network Routing Issues
  - Android based App programming.
- Assessment:
  - Routing assignment: 15%
  - Android assignment: 35%
  - Exam (2 hours): 50%

Where are we?

- IT Building (cross bridge near 1st floor Kilburn LT1.5).
- Barry Cheetham – IT204
- Dirk Koch – IT414
- (Barry’s office is really hard to find)