Reconfigurable Computing

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Overview

• Reconfigurable Computing
• Career and Study Paths in ICT
• Study at UNSW Asia
Reconfigurable Computing
What does it mean to compute?

- Transform data into new representations
- Do so at high speed and/or low cost
- Within physical and economic limits
3 fundamental computing resources

1. logic
2. interconnect
3. memory
At a higher level of abstraction…
Von Neumann computing

- Fetch instruction
- Decode & Fetch data
- Done?
- Execute
- Result writeback

Instruction fetch
Dec./Op fetch
Execute
Mem access
Result writeback

a = b + c;

a

b
c
+

Bus

Memory

Processor

Memory

Bus

a = b + c;

a

b
c
+

Result writeback
Pipelined execution

Clock cycles

cc1 cc2 cc3 cc4 cc5 cc6 cc7

Instructions

inst1
IF → DEC → EX → MEM → WB

inst2
IF → DEC → EX → MEM → WB

inst3
IF → DEC → EX → MEM → WB

inst4
IF → DEC → EX → MEM → WB
Superscalar processor

- Instr. fetch
- Dec./Op fetch
- Integer OP
- FP OP
- Address generate
- Mem access
- Result write-back
Prescott Pentium4 micrograph

90 nm technology
125 M transistors
112 mm²
Approaches to Implementing Computing Systems

1. Flexible, general-purpose, programmable Von Neumann model
   - Limited to performing a small number of operations in parallel

2. Fixed, special-purpose circuit
   - Main limitation is design complexity and inflexibility
   - Note that even processors are examples of fixed circuits
   - Other examples include HDTV decoders, network routers,

- Speed, Design time.
- Custom VLSI
- Flexibility, Power consumption, Cost/Unit (large volume)
- Cost/Unit (small volume)
3. Builds computer systems out of “flexible circuits” implemented in Field-Programmable Gate Arrays

- The “programmer” designs circuits specifically suited to each application
- Running a new application amounts to loading the corresponding circuit into an FPGA and feeding it the data that is to be processed
Reconfigurable Computing

No single universally satisfactory organisation

Use off-the-shelf, yet customisable components

Hardware is fixed

Architecture is configured to provide an effective platform for system & application software

No need to retrieve and decode instructions once circuit loaded

Can exploit inherent parallelism
Challenges of Reconfigurable Computing

• How to build commercially viable computers from programmable logic, conventional processors and memory – what is the right arrangement and mix of components?

• Designing good digital circuits is more difficult and challenging than programming computers
  – Training programmers with the right skills mix
  – Providing tools to help programmers map computational problems into reconfigurable systems and achieving good performance
  – Moving VLSI design techniques into the fast-paced environment of applications development

• Is it feasible to design computers that adapt themselves so as to most efficiently process the problems they are currently computing?
Career and Study Paths in ICT
Careers in ICT

• Technical
  – Analysis
  – Design
  – Development
  – Support
  – Web
  – Database
  – Applications

• Managerial
  – Projects
  – Organisational

• Sales
  – Marketing

• Consulting

• Sectors
  – Enterprise
  – Embedded systems
    – Vehicles
    – Consumer Electronics
  – Services
    – Media
    – Entertainment
    – Finance
    – Logistics
  – Government
    – Education
    – Health
    – Defence

• Activities
  – R&D
  – MIS
Study Paths in ICT

- Technical training required
- Wide spectrum of entry points into careers in ICT

<table>
<thead>
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<th>Discipline based</th>
<th>Institutional</th>
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<tr>
<td>Mathematics/Science</td>
<td>Universities</td>
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<tr>
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<td>Polytechnics</td>
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<td>Engineering (Computer, ...)</td>
<td>Private Colleges</td>
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<td>Information Systems</td>
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<td>Business/Commerce</td>
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UNSW Asia

• Established by invitation of the Singaporean Government

• Singapore’s FIRST Comprehensive, International Teaching and Research University

• The 4th fully-fledged university in Singapore
  – Status of “Institution of Higher Learning” (IHL)
Tanglin Campus
The University of New South Wales (UNSW)
Our parent university

Australia’s leading international university

- No 1 Accounting School in Asia and Australia
  (Review of Quantitative Finance & Accounting – 2005)
- Amongst top Engineering Schools in Australia
  (Times Higher Ed rank 1 (2005), 2 (2006))
- In the Top 100 Global Universities, ranked 41st
  (Times Higher Ed Supplement, 2006)
- Home to the prestigious AGSM, No 1 Business School in Asia
  and Australia (Forbes Magazine)
Benefits of studying at UNSW Asia

• Research Intensive → Better Teaching
• International Community
• Degrees of UNSW – International Recognition
• Privilege of an IHL
• Tropical Garden Campus
Tropical garden campus at Changi in 2009

An iconic campus for the 21st century
The Library - water to see, feel, hear or silence
The young bamboo-shoot, growing tall and bolder
The library is open, transparent, accessible, connected
Space that allows students to manage the social dimensions of learning
Engineering, Science and Technology programs commencing 2007

Bachelor of Science (Advanced)
Bachelor of Engineering
BSc programs commencing 2007

Bachelor of Science (Advanced)

- Computer Science
- Mathematics
Engineering programs commencing 2007

Bachelor of Engineering

- Computer Engineering
- Electrical Engineering & Telecommunications
- Mechanical and Mechatronics Engineering
- Chemical Engineering
Intake in 2007

There will be two intakes in 2007

Session 1 starts in March
Session 2 starts in August

Admissions are now open
Pathway for admission
Undergraduate programs

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<th>Completion of GCE A Levels</th>
<th>Entry Points</th>
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<td>Bachelor of Engineering</td>
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<td>- Computer Engineering</td>
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<td>Bachelor of Engineering</td>
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<tr>
<td>- Chemical; Electrical;</td>
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<tr>
<td>- Mechanical; Telecommunications</td>
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<tr>
<td>Bachelor of Science (Advanced)</td>
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Contact Us

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Thank you