COMP20003
Algorithms and Data Structures
Introduction

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Semester 2

Staff

Lecturers:

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Acknowledgement:

- Slides based on earlier courses by Linda Stern and Toni Wirth

Staff

- **Tutors:**
  - Head Tutor: Grady Fitzpatrick
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  - Anh Vo
  - Karl Flores
  - Sayyaf Waseem
  - Texuan Leo Wu
  - Thomas Minuzzo
  - Tuong Pham Nhat

Timetable

- Lectures
  - Wednesday 17:15 PAR-Redmond Barry-200 (Rivett Theatre)
  - Thursday 12:00 PAR-Redmond Barry-200 (Rivett Theatre)

Timetable

- Workshops (2 hrs)
  - Link to the timetable: Click here

Piazza!

Q&A and in-class quizzes and polls

- **No emails**: TA's and Lecturer will answer **only in piazza**
  - Only personal issues can be addressed through emails
- Wiki style answers! Either:
  - comment or
  - just edit other answers
- Students **encouraged to answer**, important skill to practice!

What you will learn in this subject – *and why*.

- A number of useful algorithms.
- How to analyze algorithms for efficiency.
- Build further proficiency in C programming through implementing algorithms.

Outline of the first few lectures

- Algorithms: general
- This subject: details
- Algorithm efficiency
- Computational complexity
- Data structures
  - Basic data structures
  - Algorithms on basic data structures
  - Complexity analysis of basic algorithms

What is an algorithm?

Algorithms

- Al Khwarizmi
  - Baghdad, 9th century
  - Textbook:
    - Arabic numerals
    - decimal positional number system
    - how to add
    - multiply
    - extract square roots
    - calculate pi

Cartoon from Sydney Harris

Algorithms

- Al Khwarizmi
  - Baghdad, 9th century
  - Also:
    - Showed how to solve linear and quadratic equations.
    - Corrected Ptolemy's estimate for size of Mediterranean.
    - Analyzed Hebrew calendar 19-year cycle.
    - and much more!


Hunter Johnson: Creative Commons
http://upload.wikimedia.org/wikipedia/commons//04/Al-Khwarizmi%2C_Khiva.jpg

Algorithms

- Al Khwarizmi
  - Baghdad, 9th century
  - Arithmetic, geometry, astronomy, cartography
- Leonardo Pisano Bigollo, aka Leonardo di Pisa, aka Fibonacci (filius Bonacci)
  - Italy, 13th century
  - Brought Arabic numerals to the west
  - Popularized the Fibonacci number series


Image in Public Domain

Algorithm classification

- Classified by task:
  - Sorting
  - Searching
  - Numeric
  - Routing
  - Scheduling
  - *etc.*

Algorithm classification II

- Classified by approach:
  - Brute force
  - Divide and conquer
  - Decrease and conquer
  - Greedy
  - *etc.*

Algorithm classification III

- Classification based on the answer:
  - Exact
  - Approximation
  - Heuristic

General approach in this subject

- Introduction to data structures, algorithms, and computational complexity.
- For every algorithm:
  - How it works
  - Complexity analysis
  - Implementation
- NP-completeness

Algorithms in the real world 20th century

- Navigation software: get shortest path to destination.

  -- And do it quickly.
- Connect towns or houses to telecommunications network.

  -- With the least cost in wire.

Algorithms in the real world: 21st Century

- Self-Driving cars: trajectory planning, object recognition, Localization etc.
- Determine whether someone should get a mortgage. Determine how likely he's to pay back?

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  - Algorithms on basic data structures
  - Complexity analysis of algorithms on basic ds's

This subject: some details

- Lectures:
  - Theory of algorithms
  - High-level how-to of algorithms
  - A little bit of code
- Workshops: tutorial + computer lab
  - Apply theory
  - Practice implementing

Workshops and assignments

- C programming in the workshops and for assignment submissions can be done on the platform of your choice, BUT…
- We are supporting one platform and compiler
  - MobaXterm: for ssh, also has an editor
    - Atom: alternative opensource editor with 1000s of extensions https://atom.io
  - CIS machines new virtual machines, to test code:
    - nutmeg.eng.unimelb.edu.au
    - dimefox.eng.unimelb.edu.au
  - C compiler: gcc

Workshops and assignments

- See document on LMS:
  - *Resources→Introduction to UNIX (and MobaXterm)*
- Note, however, new machines…
- See more documentation on the LMS:
  - *Resources->The New CIS Virtual Machines*

Workshops and Assignments

- MobaXterm / atom:
  - Installed on laboratory machines
  - Download (free) for home use: http://mobaxterm.mobatek.net/download.html or http://atom.io
  - For problems: see your tutor
- CIS (new) virtual machines:
  - Red Hat Enterprise Linux 6.5
    - dimefox.eng.unimelb.edu.au
    - nutmeg.eng.unimelb.edu.au
  - https://ithelp.eng.unimelb.edu.au/itservices/students/general_unix.html
    For problems: lodge a ticket at http://ithelp.eng.unimelb.edu.au/servicedesk/, select "Teaching Support", start your request with "New CIS Teaching Servers"

Workshops and Assignments

- Working from home…
  - You must connect via the university's VPN.
  - Direct access from the Internet is not permitted.
- VPN:
  - https://studentit.unimelb.edu.au/findconnect/vpn
  - You will have to install Cisco AnyConnect
    - There is a web launcher on this page.
    - If the web launcher doesn't work, there are instructions for manual install.
  - For problems:
    - Lodge a help request at this URL
    - or ring 8344 0888 M-F 8AM-6PM
- More help…

More help

- Student IT Support:
  web requests, drop-in centers and hours:
  - http://studentit.unimelb.edu.au/contact/index.html
- It is strongly suggested that you work out your machine access this week.

Books

- Prescribed textbook:
  - Steven Skiena, *The Algorithm Design Manual.*
  - Available as an eBook from the MU library.
  - http://library.unimelb.edu.au/ → Catalogue → eBooks → Skiena
  - Note: The copyright license *does* permit you to download and print for your own personal study.
- Other highly recommended books on reserve (ERC High use area):
  - Sedgewick, *Algorithms in C vol 1*, and *Algorithms in C, Part 5: Graphs*
  - Levitin, *Introduction to the Design and Analysis of Algorithms.*
  - Cormen, Leiserson, and Rivest, *Algorithms.*

Assessment

- Continuous assessment 30% (week 4 and 10)
  - Two C coding assignments + experimentation.
  - Hurdle 15/30.
- Mid-semester test 10% - (week 7)
  - **6th of September, 12 – 1pm, Wilson Hall**
- Final examination 60%
  - 3 hours
  - The practical component will *not* be at a computer.
  - Hurdle test+final exam 35/70