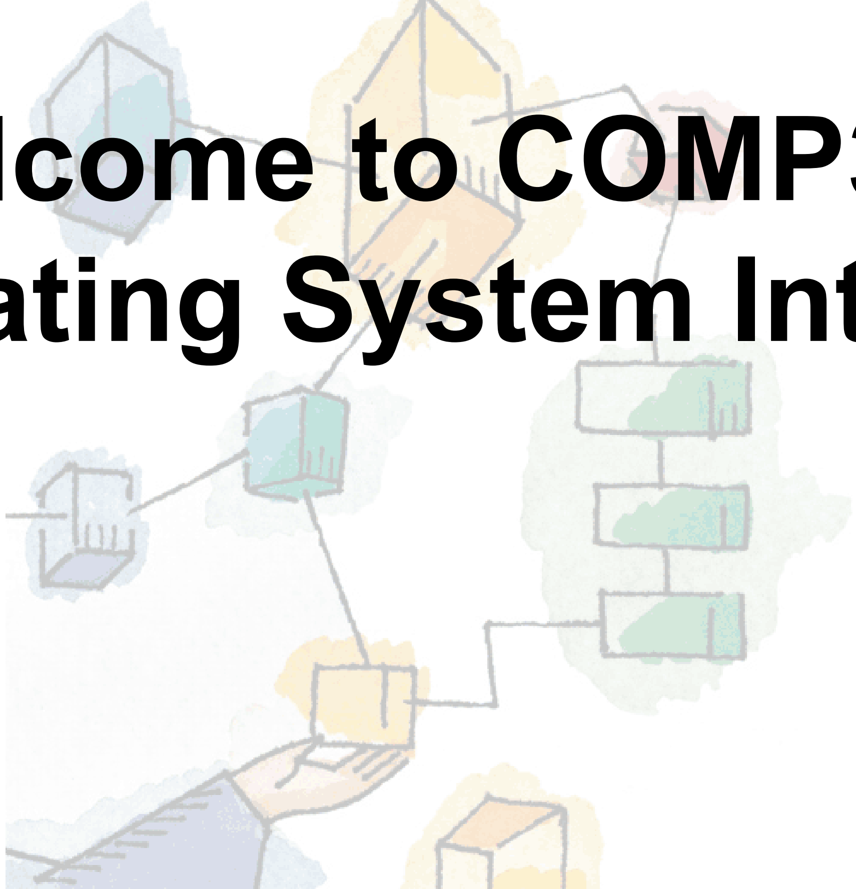
Welcome to COMP3520 Operating System Internals



Unit Coordinator/Lecturer

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Tutors

- Name: James Phung (also TA)
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- Name: Zhengjie Yang
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Course Delivery

- 4 hours per week class activities:
  - One 2 hr lecture:
    - Tuesday, 15:00 – 17:00
    - ABS Case Study Lecture Theatre 2140
  - One 2 hr tutorial:
    - Wednesday or Thursday
  - You are expected to attend for all the scheduled hours.

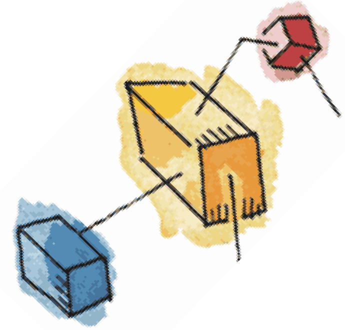
Course Delivery (cont.)

- Lectures are about key concepts, theory, design and optimizations to help you understand the fundamentals of OS internals
- In the lectures I'll also provide hints to help you tackle the assignments and programming exercises.
- Lectures are recorded and uploaded on the Canvas unit website
- Tutorials mixed with
  - **Programming exercises** – assistance for assignments.
  - **Short answer questions** – OS concepts

Assessment

- The course has
  - 40% assignments
  - 10% quizzes
  - 50% exam.

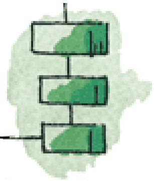
- To pass the unit you must achieve
  - an overall mark of 50 or better, AND
  - at least 40% average in the assignments, AND
  - at least 40% of the available marks in the final examination

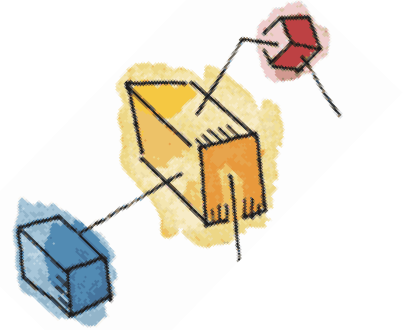


Assignments

- Two programming assignments (**using C**)
  - Assignment 1 (20%), due in week 7
  - Assignment 2 (20%), due in week 13

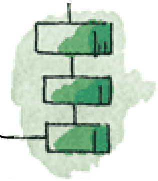
- **Don’t expect to finish each assignment in just a few hours, or even a couple of days!**
- A set of programming exercises, to assist you for completing your assignments
- A lot of hints will be given in lectures/tutorials

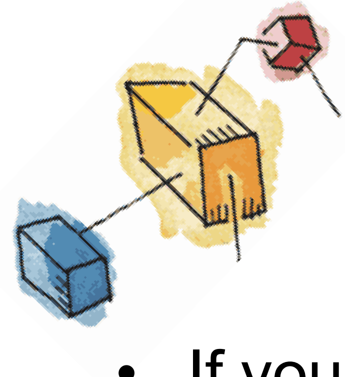




Assignments

- Note: Your programs are required to run in the CS lab environment
  - if you work on a home machine, you must check it in the lab too
  - **Marks will be deducted if your programs cannot compile and run in the CS lab environment**!
- In fairness to all students, late work may incur penalties.
  - Consistent penalty of 5% of the full marks per day late
  - more than 10 days late get 0
- In exceptional cases, you must make an official application for Special consideration.
- Plagiarism is where you use the work of another person and present it as your own. This is NOT PERMITTED.

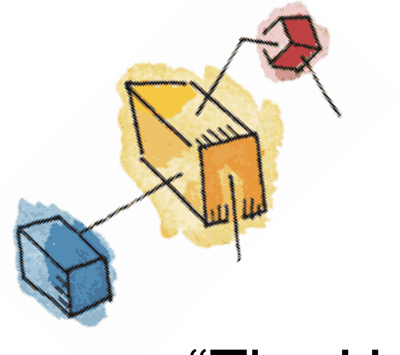




Special Consideration (University policy)

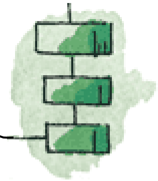
- If your performance on assessments is affected by illness or misadventure
- Follow proper bureaucratic procedures
  - A new centralised online application system to apply for special consideration and special arrangements.
  - Visit the university website for more information on eligibility and deadlines:

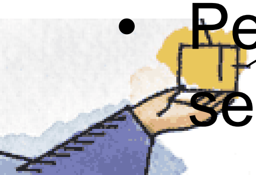
    http://sydney.edu.au/current_students/special_consideration/
- Also, notify coordinator by email as soon as anything begins to go wrong
- There is a similar process if you need special arrangements eg for religious observance, military service, representative sports



Academic Integrity (University policy)

- “The University of Sydney is unequivocally opposed to, and intolerant of, plagiarism and academic dishonesty.
- Academic dishonesty means seeking to obtain or obtaining academic advantage for oneself or for others (including in the assessment or publication of work) by dishonest or unfair means.
- Plagiarism means presenting another person’s work as one’s own work by presenting, copying or reproducing it without appropriate acknowledgement of the source.”
- https://www.sydney.edu.au/students/academic-integrity/breaches.html
- Penalties for academic dishonesty or plagiarism can be severe

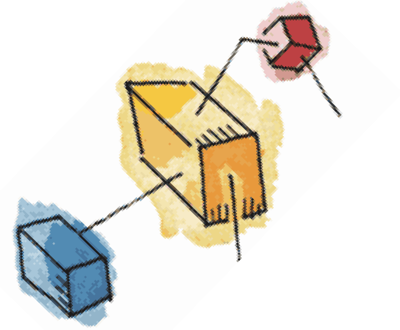




Exam

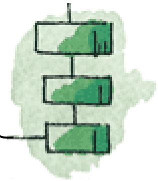
- The written exam (Worth 50%)
  - Concepts, Design and Optimizations, covered by the Lectures, tutorials and assignments
  - No large programming questions, but may require to write small programs, or pseudo codes for conceptual construction.

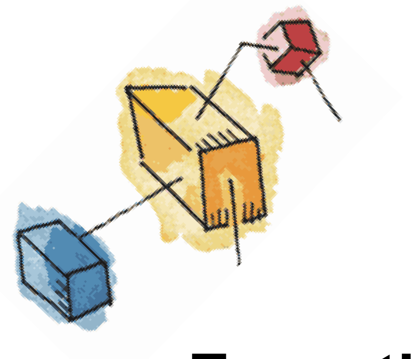
- To pass the exam you must score at least 40% of the available marks on the final examination



Quizzes

- 12 very small online open-book quizzes (10%)
  - One each week starting from week 2
    - 10 min in lecture
    - The online quiz page will only be available for 10 min and then closed in each lecture
- To obtain the full marks you need to take at least 10 quizzes
- Bring your laptop with you to attend the lectures





Textbooks

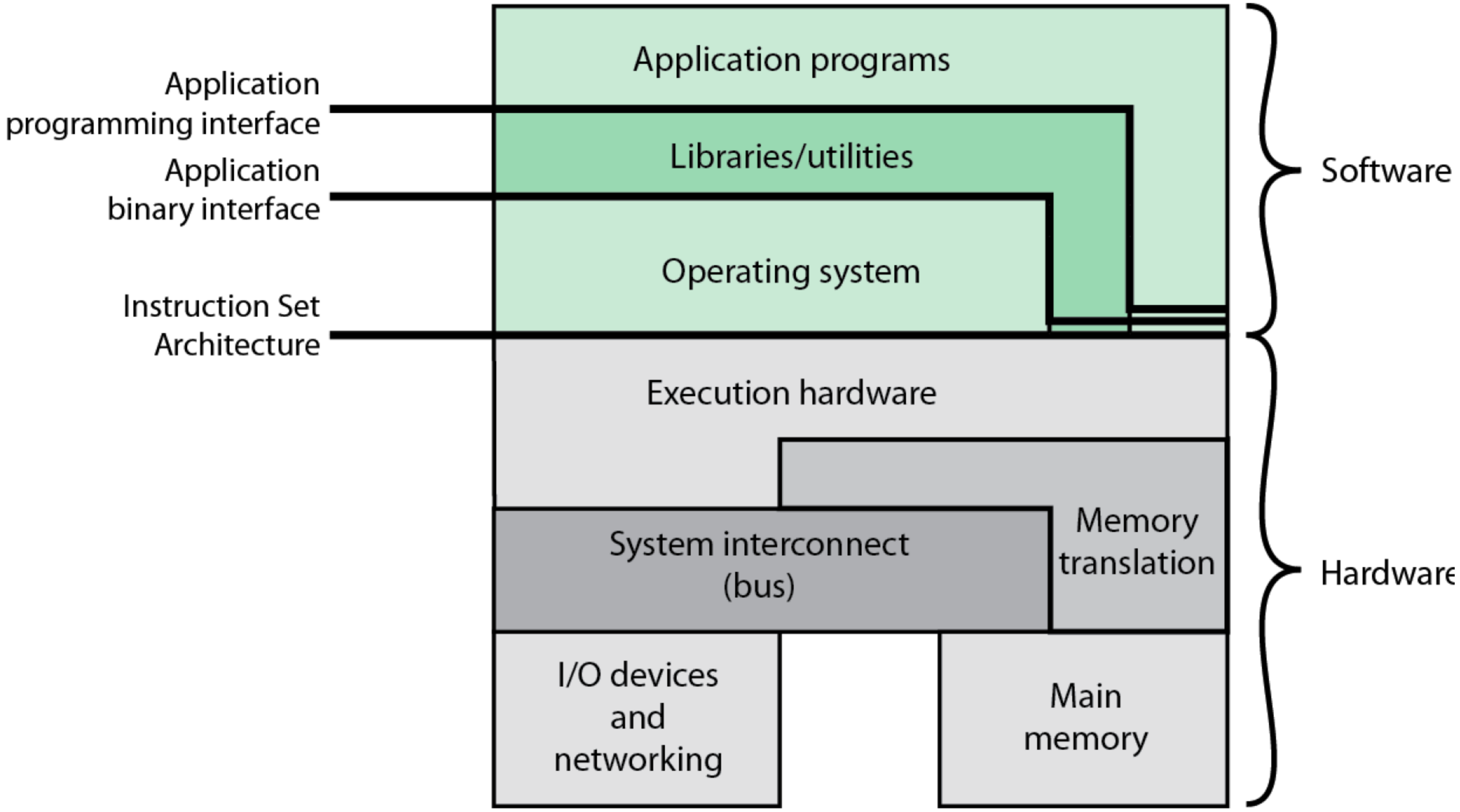
- **Essential:**
  - Operating Systems: Three Easy Pieces
  - (online: https://pages.cs.wisc.edu/~remzi/OSTEP/

- **Recommended:**
  - *Operating Systems: Internals and Design Principles,* 9th Edition, William Stallings, Pearson Prentice Hall, 2018
  - *Operating System Concepts,* 10th Edition, A. Silberschatz, P. B. Galvin and G. Gagne, John Wiley & Sons, Inc, 2018

What is an Operating System?

- **An OS itself is a software program** that manages the hardware and software resources of a computer
- An OS performs basic tasks, such as managing execution of other programs, controlling and allocating memory, controlling input and output devices, managing files and facilitating networking
- Operating system goals:
  – Make the computer system convenient to use
  – Use the computer hardware in an efficient manner
  – Make solving user problems easier

Systematic Layers and Views


Application programming interface
Application binary interface
Instruction Set Architecture
Application programs
Libraries/utilities
Operating system
Execution hardware
Memory translation
System interconnect (bus)
I/O devices and networking
Main memory
Software
Hardware

Operating System Definition

- **Resource manager**
  - Manages all resources in a computer system, CPUs, main memory, disks, and I/O devices
  - Protect applications at a common layer
  - Provide efficient access to resources (cost, time, energy)
  - Provide fair access to resources
- **Control program**
  - Controls execution of other programs to prevent errors and improper use of the computer

Operating System Definition

- **Extended machine**
  - Turns complicated hardware into nice abstractions
  - Make different devices look the same
  - Allow applications to reuse common facilities
  - Provide higher-level or more useful functionality

Operating System Definition (cont.)

- No universally accepted definition
- “Everything a vendor ships when you order an operating system” is good approximation
  - But varies wildly
- “The one program running at all times on the computer” is the **kernel.** Everything else is either a system program (ships with the operating system) or an application program

Operating System Definition (cont.)

- The operating system is part of system software.
- However, it is distinguished from other system software:
  - interacts directly with the hardware to provide an interface used by other system/application software
  - domain independent, i.e., can be used to support a broad range of application domains
  - allows different applications to share the hardware resources
- Other system software, e.g., compilers, debuggers, system utilities

OS: Three Easy Steps

- Three conceptual pieces:
- 1. Virtualization
  - Make each application believe it has each resource to itself
- 2. Concurrency
  - Events occur simultaneously and may interact with one another
  - Need to
    - Hide concurrency from independent processes
    - Manage concurrency with interacting processes
  - Provide abstractions (locks, semaphores, condition variables etc.)

OS: Three Easy Steps

- Three conceptual pieces:
- 3. Persistence
  - Lifetime of data is longer than lifetime of any one process
  - Machine may lose power or crash unexpectedly
  - Issues:
    - High-level abstractions: Files, directories (folders), links
    - Correctness with unexpected failures
    - Performance: disks are very slow!

Why Studying Operating Systems?

- Modify, administer, or even build an operating system
- Understand system performance
  - behaviour of OS impacts entire machine
  - Tune workload performance
- Fun and challenging to develop large, complex systems
- …

- Operating systems are an essential part of any computer system – a course on OS is thus an essential part of any computer science education

Main Topics

- The basic concepts on which all operating systems are built:
  - Process management
  - Memory management
  - I/O device management
  - File management
  - Protection and security