31268 Web Systems

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Week 6: Operating Systems 3
Part 3 – Memory Management

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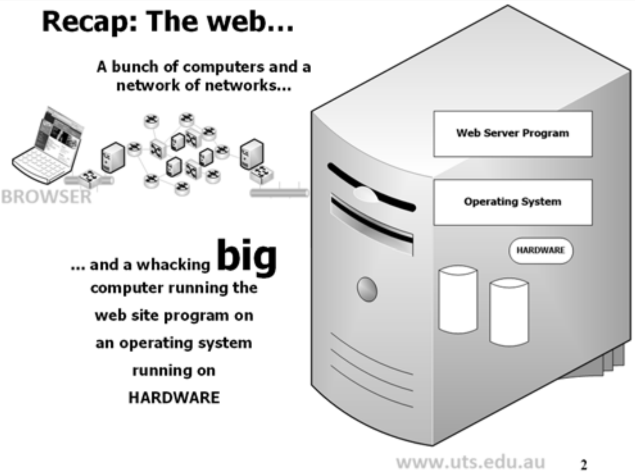
Recap: The web…


A bunch of computers and a network of networks…
BROWSER
… and a whacking big computer running the web site program on an operating system running on HARDWARE
Web Server Program
Operating System
HARDWARE
www.uts.edu.au

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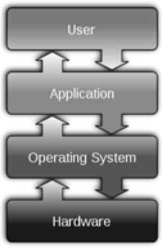
Recap: Operating System

- Manages your computer
- Runs programs
- Interface between user and hardware
- Provides services to programs & users
- Protects users and programs from each other….



wikipedia

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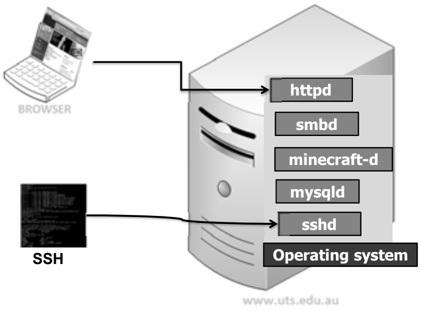
Web Example

Our Web Servers run various programs to provide services …..



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Web Example

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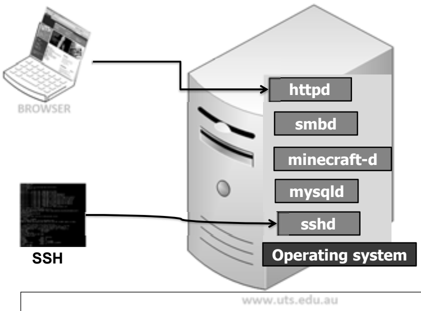

- **Today we will look at how O/S runs programs**

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Operating Systems - Outline

- *Operating Systems*
- *file systems and file manipulation*
  - *Disk physical structure*
  - *Disk logical structures*
  - *File allocation methods*
  - *Unix: files, directories and redirection*
- *Scripting and regular expressions*
  - *Unix and the Command-Line interface*
  - *Variables and bash scripts*
- *processes, threads, piping and redirection*
  - *Programs vs processes, IPC, deadlocks*
- memory and process management
  - Physical, Logical & Virtual memory

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Process Management

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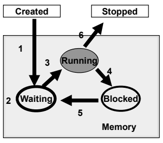
- Recall
  - – Processes are programs in execution.
  - – Operating System loads program into MEMORY to execute
  - – Processes run in 4 main states
    - Waiting
    - Running
    - Blocked
    - Stopped



- Operating System will manage allocation of memory to process

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Purpose of Memory Management

- Memory management allows the O/S to:
  - –run more processes than we can fit into physical memory
  - –**optimize** use of expensive RAM
  - –**keep track** of processes 'owning' blocks of memory
  - –provide **access control** to memory
  - –decide **where** process is loaded into memory
  - –handle **allocation/deallocation** of memory

Physical and Logical Addresses

–All computers have fixed amount of physical memory *E.g. 8 Gb RAM*

–Operating system kernel can directly access physical memory using physical addressing

–O/S **hides** physical memory from processes.
→ As far as each process is concerned, it sees logical memory.

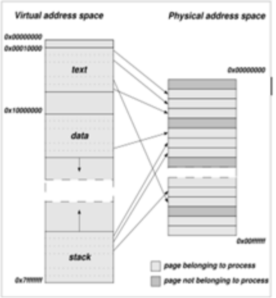
Physical and Logical Addresses

–Typical O/S will allocate **PAGES** (e.g. 4k blocks of RAM) to a process

–O/S translates logical addresses to physical addresses
→ called **logical/virtual addressing**

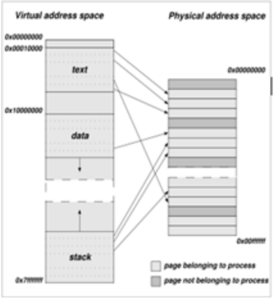
Physical and Logical Addresses

- During execution of an process, the same logical address may be mapped to many different physical addresses as data and programs are paged out and paged in to other locations



Physical and Logical Addresses

- During execution of an process, the same logical address may be mapped to many different physical addresses as data and programs are paged out and paged in to other locations
- The logical address space is larger than the physical address space (RAM) if we have virtual memory available.



Virtual Memory

- Virtual Memory is a concept which is related to, but distinct from, the memory hierarchy.
  - → *do NOT confuse Virtual addressing with Virtual memory*

Virtual Memory

- Virtual Memory is a concept which is related to, but distinct from, the memory hierarchy.
  - → *do NOT confuse Virtual addressing with Virtual memory*
- Virtual Memory makes part of the hard disk like main memory to the process.
  - →this means that programs can appear to have a lot more memory than is available.
  - →Virtual memory is **MUCH** slower than RAM

Virtual Memory

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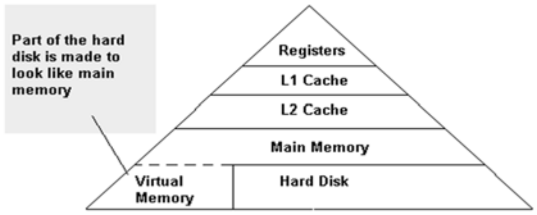

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Virtual Memory

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Some Terms to memorise…

- **VM**: The logical address space. Physically: RAM + Disk
- **Swap file:** Part of disk used for VM.
- **A page:** The amount of data that can swap between RAM and Disk at a given time.
- **Page table:** Maps "logical addresses" to either to physical or virtual memory
- **Paging**: The action of swapping a page between RAM and Disk.
- **Page fault:** When data to be accessed is not in RAM and needs to be swapped back from Disk.
- **Thrashing**: When OS spends more time paging, than running applications.

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Virtual Memory: Paging and Page Tables

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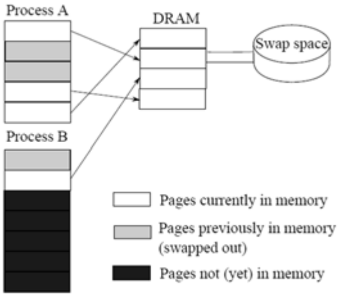
Process A
DRAM
Swap space
Process B
Pages currently in memory
Pages previously in memory (swapped out)
Pages not (yet) in memory

Process A page table

Page	Frame	Valid
0	1	T
1	-	F
2	-	F
3	3	T
4	0	T

Process B page table

Page	Frame	Valid
0	-	F
1	2	T
2	-	F
3	-	F
4	-	F
5	-	F
6	-	F

Valid means page in memory

Virtual Memory and Locality

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- Paging is slow - minimize to avoid thrashing.
- Locality is "guesswork" on what needs to be in RAM.
- Temporal Locality recently accessed memory is likely to be accessed again.
  - Example: for loop variables
- Spatial Locality Locations near recently accessed memory are likely to be accessed soon
  - Example: arrays

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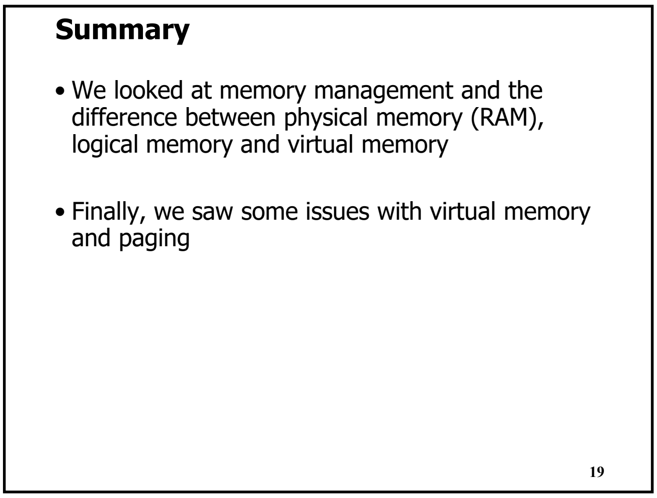

Summary

- We looked at memory management and the difference between physical memory (RAM), logical memory and virtual memory

- Finally, we saw some issues with virtual memory and paging