Operating Systems – EDA093/DIT401
Concluding remarks

Vincenzo Gulisano
vincenzo.gulisano@chalmers.se

UNIVERSITY OF
GOTHENBURG

Important before the exam

Kurskod	Kursnamn	Institution	Tentamensdatum	Börjar	Plats	Längd	Första dag för anmälan	Sista dag för anmälan
EDA093	Operativsystem Modul: 0117	DATA- OCH INFORMATIONSTEKNIK	**22 Okt 2022**	08:30	Johanneberg	4 timmar	08 Aug 2022	09 Okt 2022
EDA093	Operativsystem Modul: 0117	DATA- OCH INFORMATIONSTEKNIK	**03 Jan 2023**	08:30	Johanneberg	4 timmar	21 Nov 2022	18 Dec 2022
EDA093	Operativsystem Modul: 0117	DATA- OCH INFORMATIONSTEKNIK	**15 Aug 2023**	14:00	Johanneberg	4 timmar	03 Jul 2023	30 Jul 2023

- You **may only have** a dictionary (English - Swedish – English)

Important before the exam

- Summary study:

- accompany your summary study with the notes received, exercises (those solved in class and others, incl. those in the hard-copy notes) and summary questions at the end of each book chapter

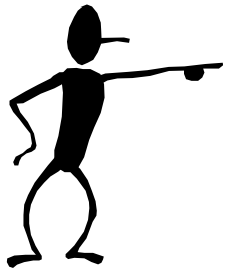
- keep a critical eye in your overview study:
  - why is this so? how does it work?
  - How do the puzzle pieces fit together?

- later: check OS web-page for news

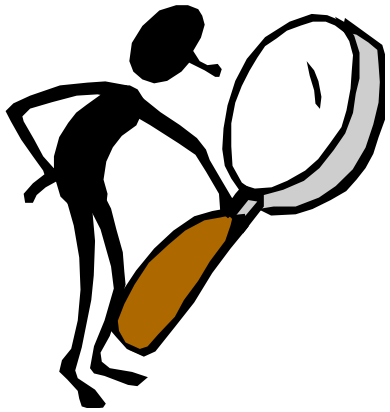
Important before the exam

- Check the reading instructions for the various parts

How do we address a challenge?



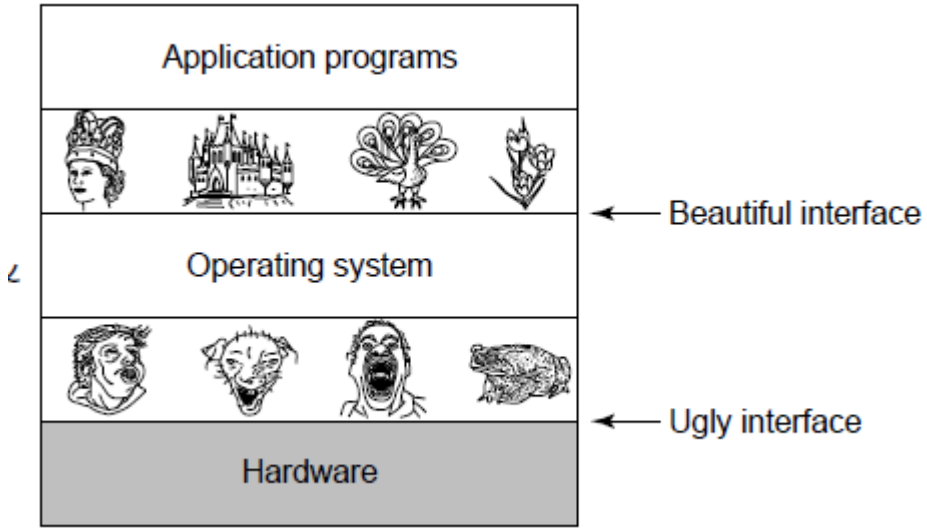
Like this!



Like this!
Or this!
Or this!
Maybe also like this…
Why not like this… mmm…

- **Introduction / System Structures**
- Processes / Threads
- Multithreaded Programming
- Process scheduling
- Synchronization
- Deadlocks
- Memory Management
- Virtual Memory
- File Systems
- I/O Systems
- Security / Protection
- Virtualization

Need to decouple Applications/Users from Hardware



… need to build upon a basic instruction cycle

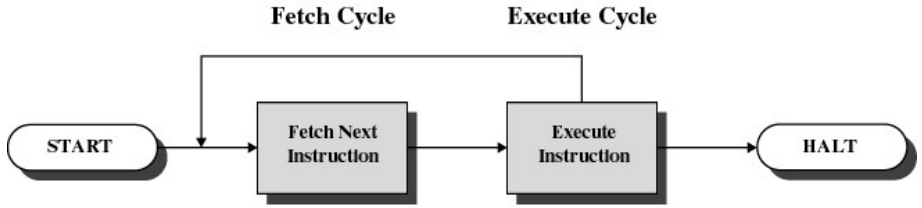


Figure 1.2 Basic Instruction Cycle

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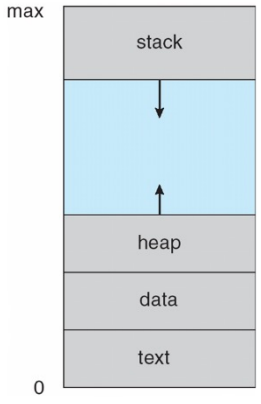
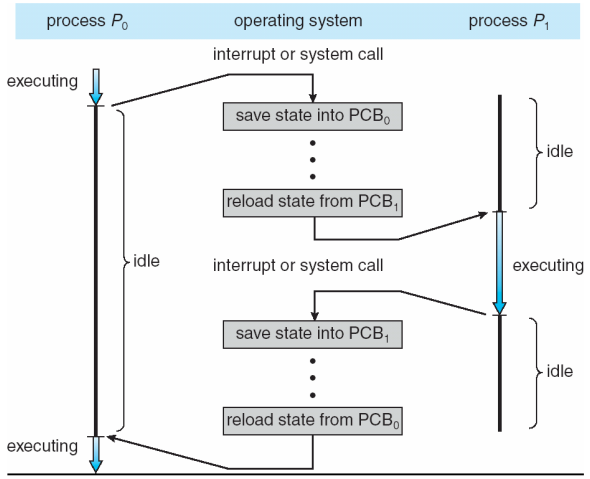
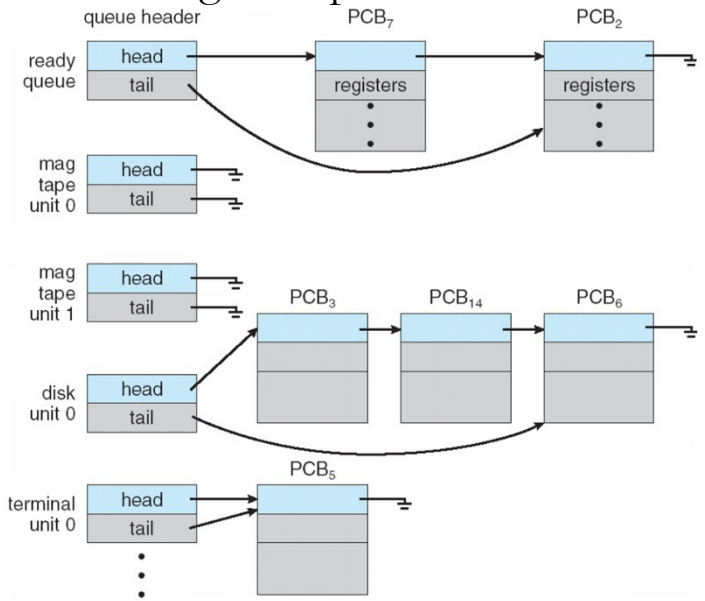
Need to maintain information about processes running in the OS



Need to switch between processes…



Need to organize processes and devices



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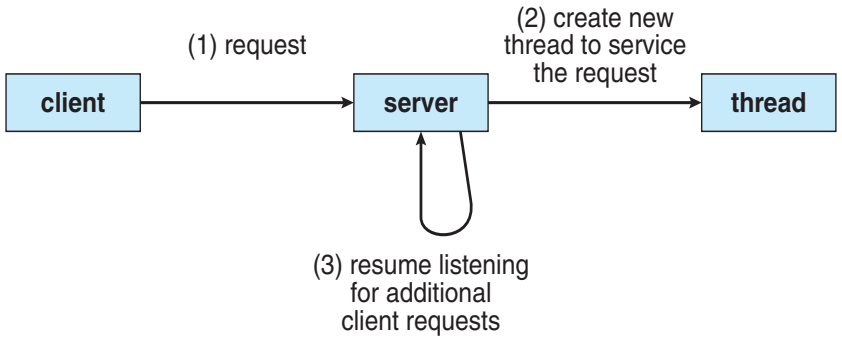
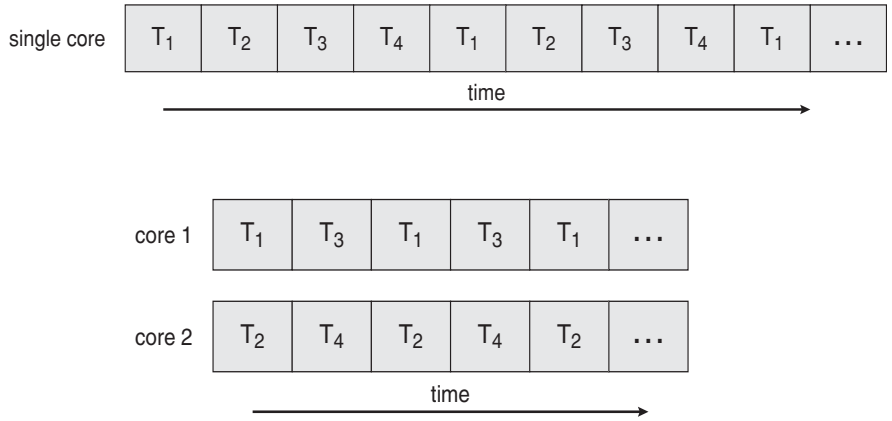
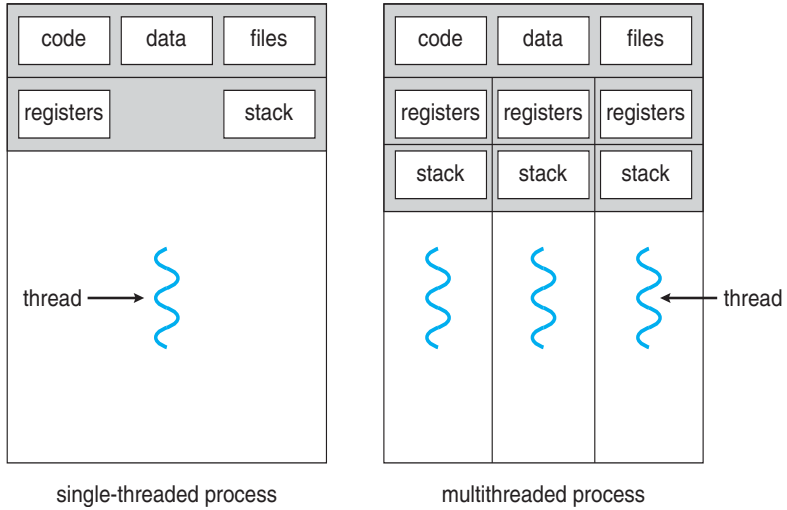
Need mechanisms to improve processes performance / take advantage of hardware

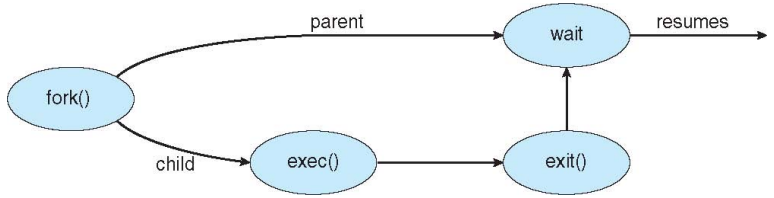




Need to maintain more information…



…and synchronize threads and processes



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Need scheduling at different granularities

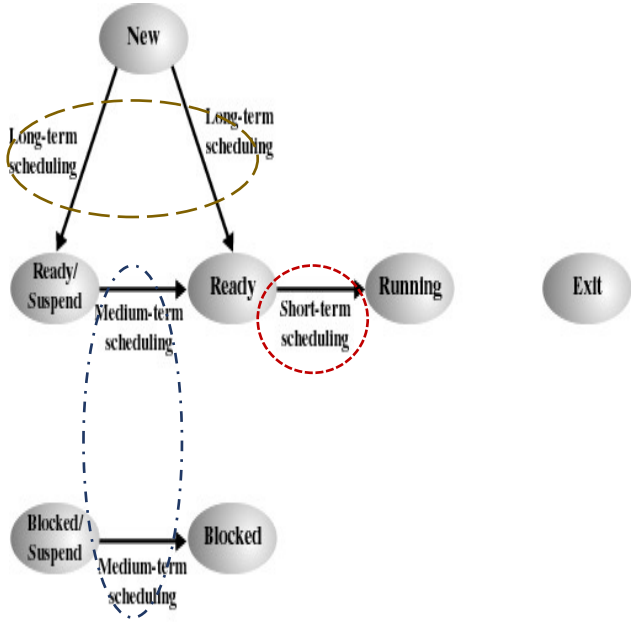

Figure 9.1 Scheduling and Process State Transitions

Need scheduling criteria

CPU utilization

Throughput

Turnaround/Response time

Fairness

Overhead

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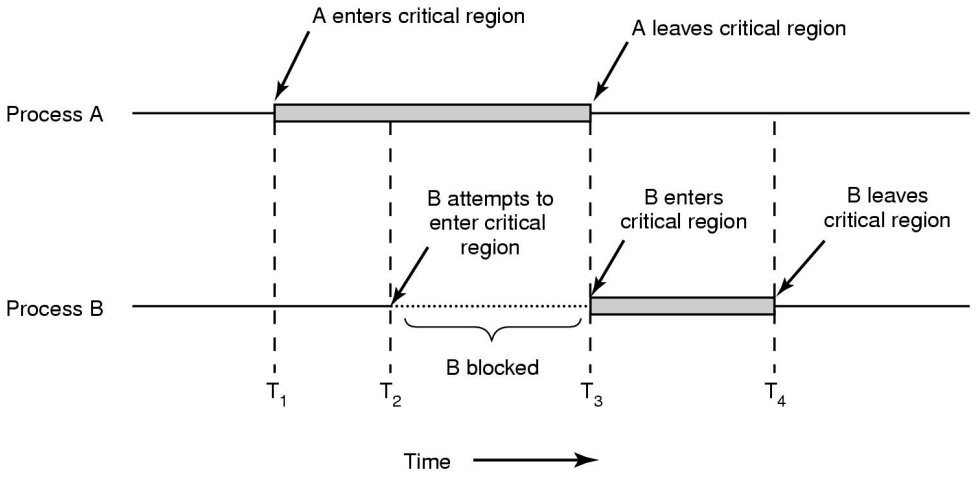
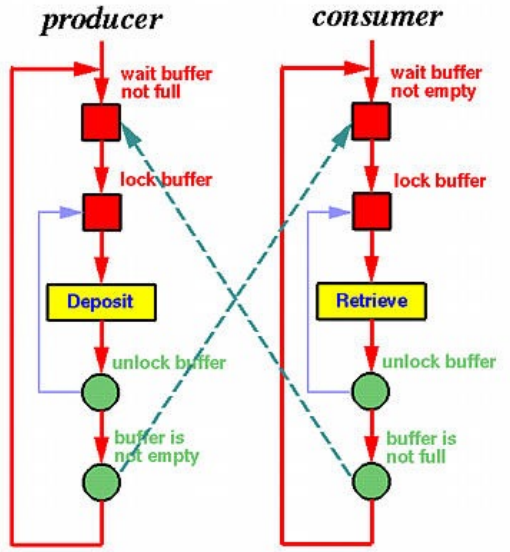
Need to prevent overlapping execution of critical sections



Need to synchronize threads communication



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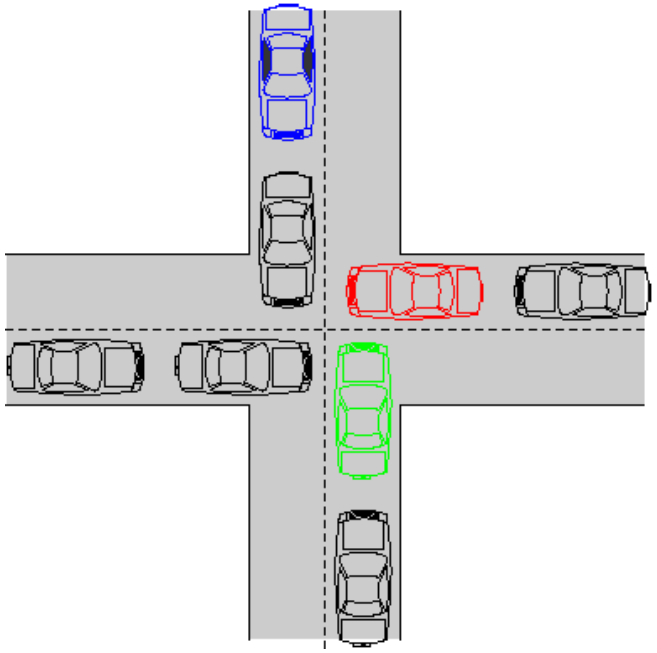
Need to avoid deadlocks



… which can be challenging

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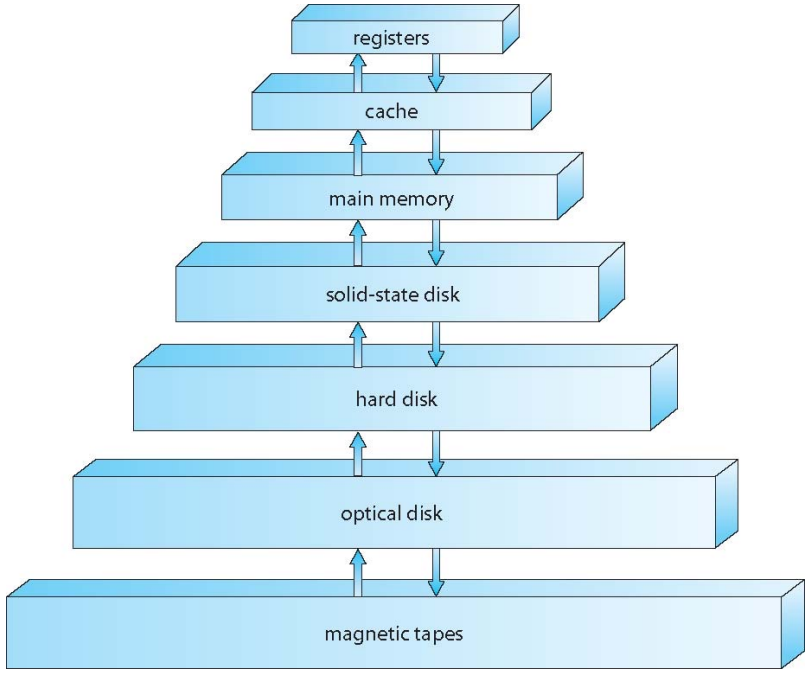
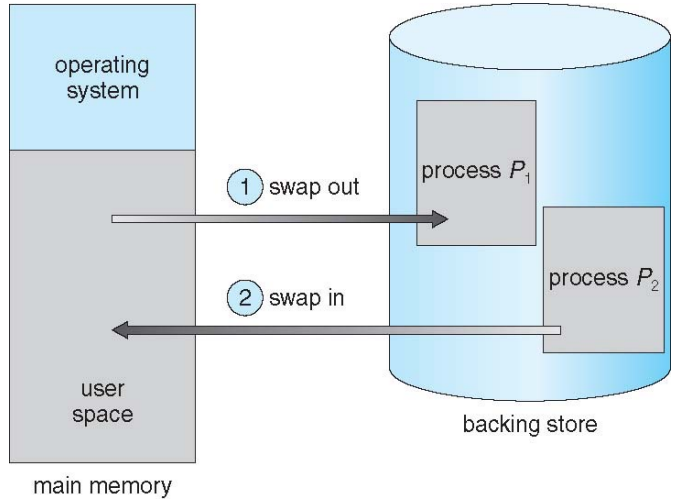
Need to manage information (read / write) based on the available hierarchy



E.g., by swapping processes…



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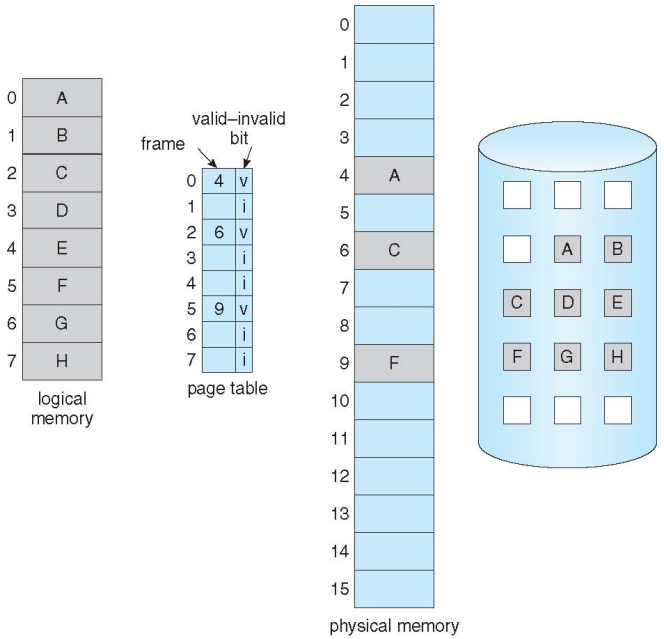
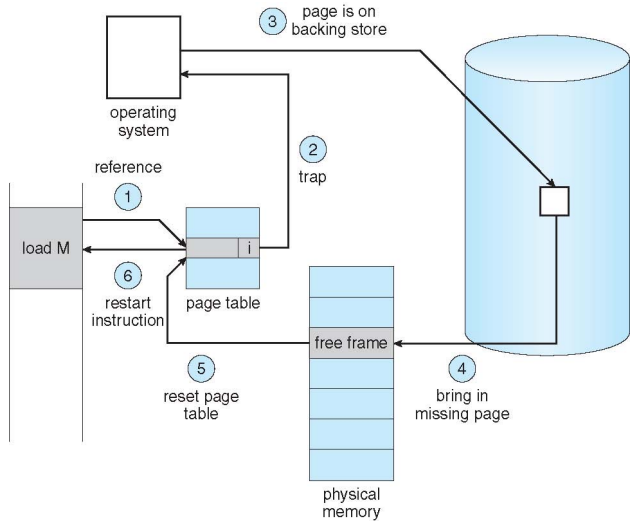
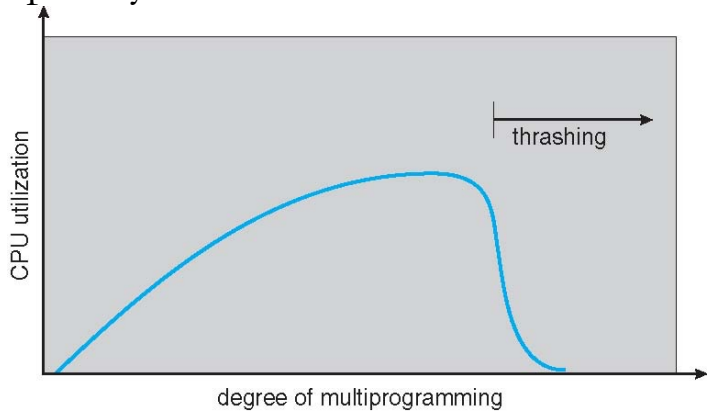
Need to provide more (virtual) memory than available



Need extra overhead to provide that…



Sometimes (hidden?) complexity leads to unexpected behavior…



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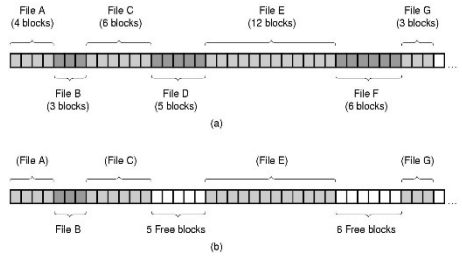
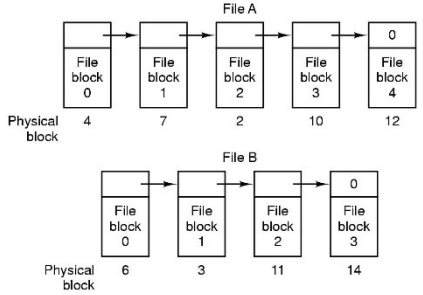
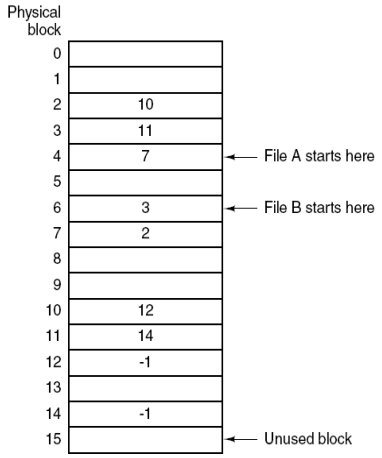
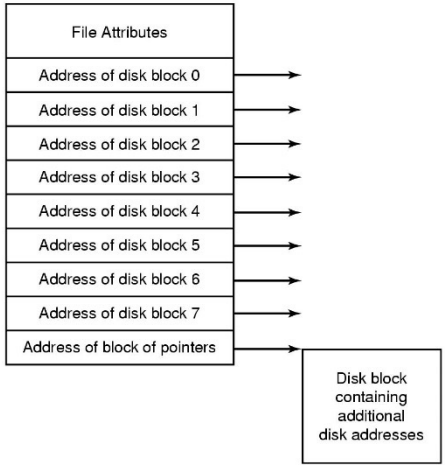
Need to keep track of where files are

Fig. Tanenbaum, Modern Operating Systems

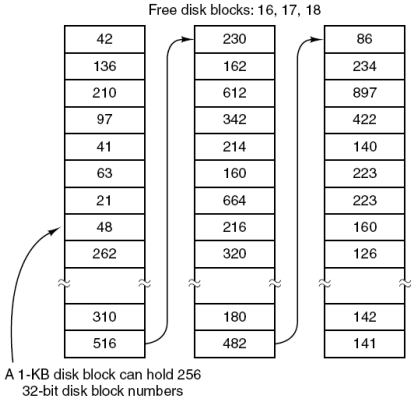


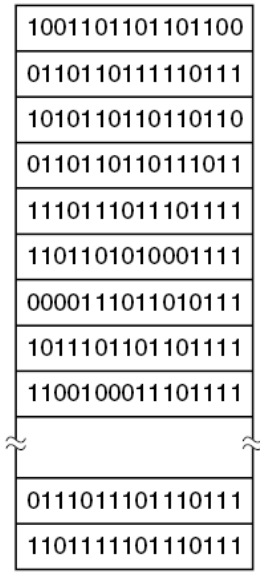




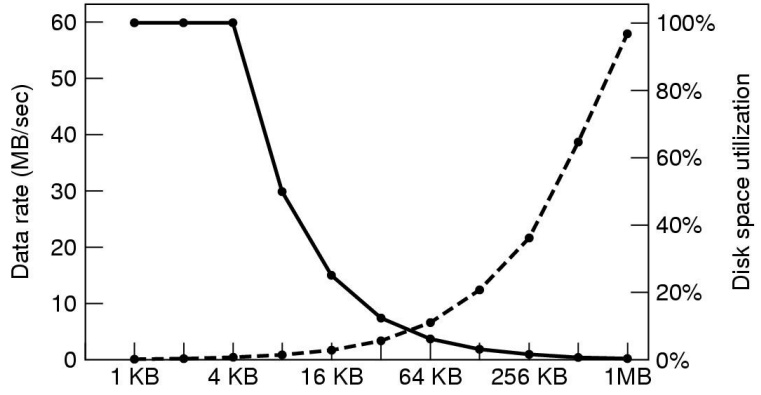


Need to keep track of free space





Need to decide how to use secondary storage



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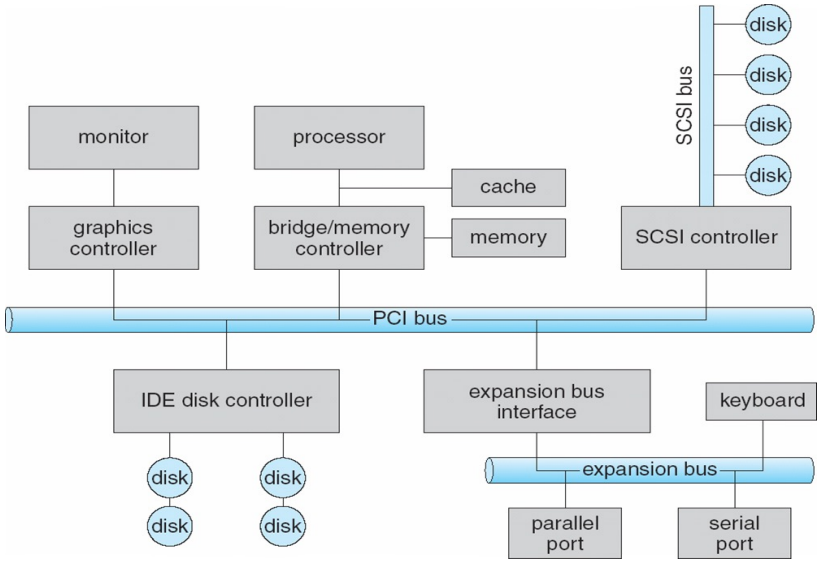
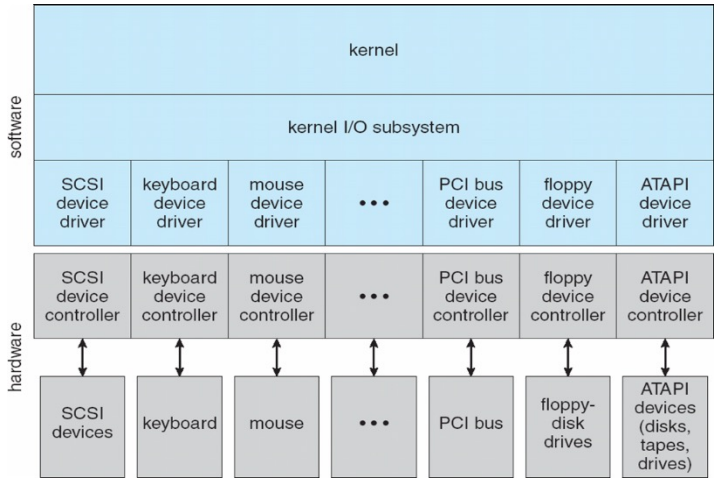
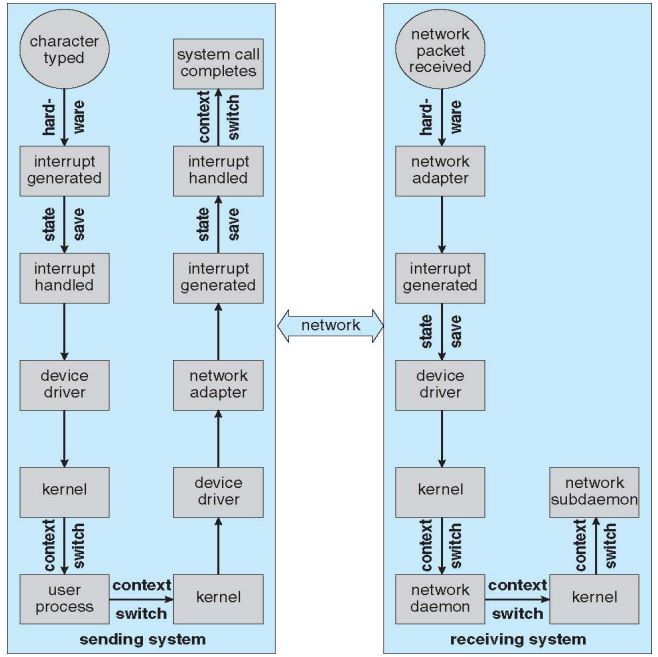
Need to communicate / exchange information with devices



Need to separate applications' and hardware's logic



Need good design to increase performance



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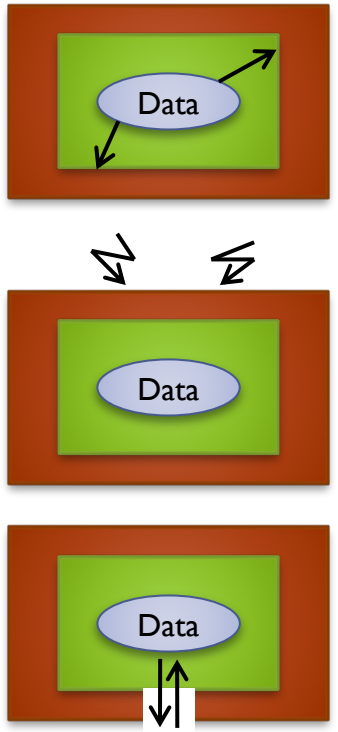
We need mechanisms to protect and share data…

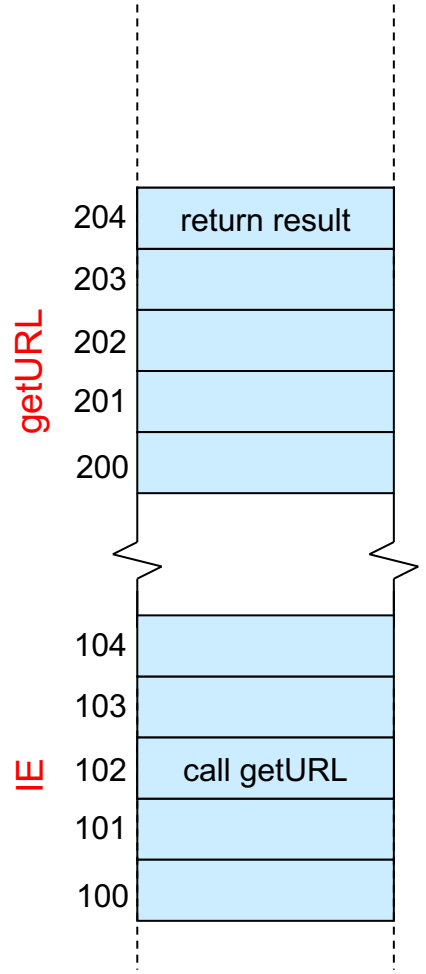


Confidentiality

Integrity

Availability

… from programs' vulnerabilities (e.g., buffer overflows)



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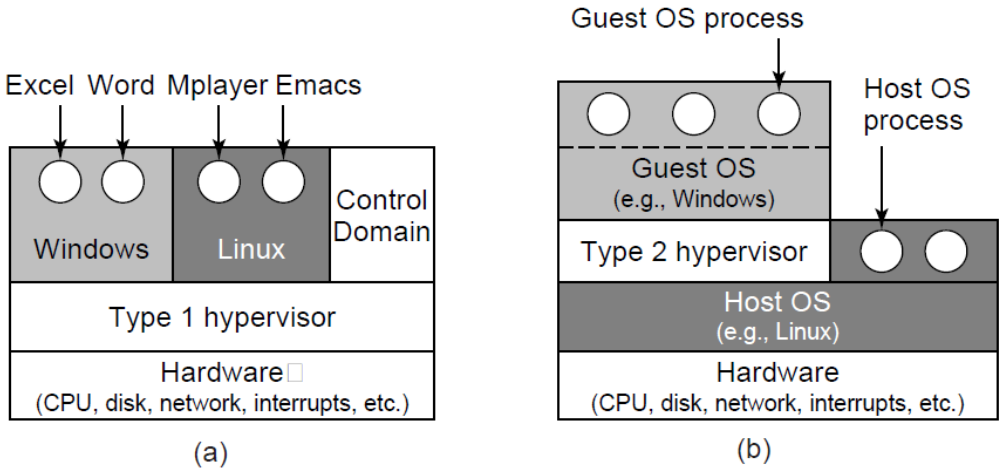
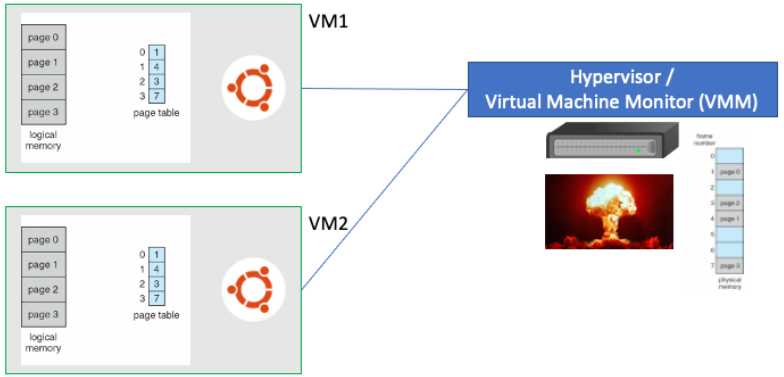
Types of Hypervisors



Why do we need to virtualize memory too?



Thank you for your attention!

…and good luck!