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2-hour Lecture Course in Semester 1 2005/2006
Monday, 2pm
Wednesday, 10.00am

Examination:
100 % written examination in May

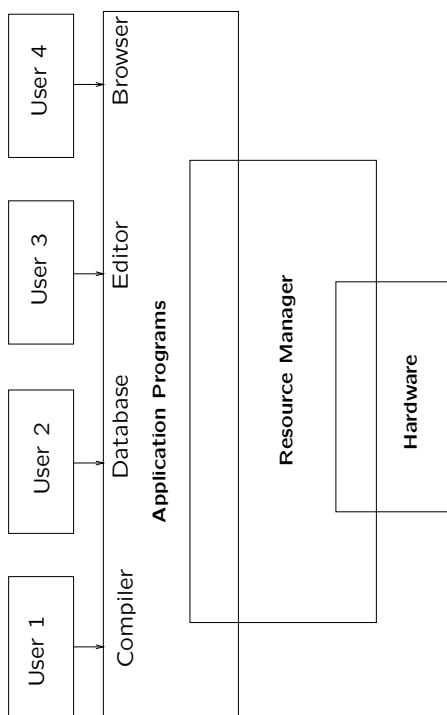
For advanced MSc students, examination will contain additional material

In addition, there will be exercise sheets every two weeks

A. Silberschatz, P.B. Galvin, G. Gagne. *Operating Systems Concepts*, Sixth edition, Addison Wesley, 2001.

A.S. Tanenbaum. *Distributed Operating Systems*. Prentice-Hall 1995.

A.S. Tanenbaum, *Modern Operating Systems*. Prentice-Hall, 1992.



1 What is an Operating System?

Functions:

1.) Implement **multi-user programming**:

- several processes ready to be executed; OS chooses next one
- Have to **simulate parallelism** on a sequential machine
⇒ Must avoid Starvation, Deadlock and achieve fairness.
- **Protection of processes** from each other
⇒ Separation of logical and physical address spaces.

2.) Memory Management

Main memory is **fast** but **expensive**
Disc storage is **slow** but **cheap**

- ⇒ **Only part** of memory needed for process execution in main memory
- ⇒ **OS manages memory allocation**

View from process: **One large address space** (“**virtual memory**”).

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Examples of Operating Systems

- **Unix:** Started 1969 as Multi-user Time-sharing System
Vital for development of the Internet in the 1980's
- **Linux:** Unix derivative, started in 1991 when PC-HW was powerful enough to run Unix
- **MS-DOS/Windows 95/98/ME:** Started in 1980's as OS for PC's
Restricted Power of 1980's PC's meant very limited functionality
- **Windows NT/2000/XP:** RE-implementation started in the 1980's with extended functionality
- **Mac OS** OS with limited functionality for Apple Mac
- **Mac OS X** Unix-like re-implementation for Apple Mac

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3) Input/Output

OS manages highly complex **interaction with I/O-devices:**

real-time constraints have to be observed

4.) Distributed Computing

Data or programs can be on different computer

Aim: Transparency (same interface for local and remote access)

⇒ need to support protocols for file transfer, remote login as part of the OS

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OS for embedded systems

Have variety of embedded systems from special-purpose controllers to programmable chips

⇒ wide variety of OS's to satisfy very different needs systems

Due to limited resources of embedded systems re-emergence of OS-issues of 1970's and 1980's

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OS relies on hardware to **ensure protection** of processes from each other.

Need at least two different execution modes for hardware:

1. **Kernel or Supervisor mode**: Allows unrestricted access to all resources
2. **User Mode**: Only instructions not affecting other users are allowed; sanity checks are enforced.

Instructions allowed only in Supervisor mode are called **privileged instructions**.

OS requires **feedback from hardware** when operations are finished.

Standard mechanism: **Interrupt**:

- **Hardware generates signal**, which is transferred to processor
- **Processor interrupts current activity**
- Processor executes appropriate **interrupt service routine**
- Processor **resumes previous activity**

Short response time important, so interrupt service routines tend to be small