CS341: Operating System

Introduction to Operating System

Lect01 : 30th July 2014

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Outline

- Course, Attendance, Reference Book
- What do we study in this course?
- Why should this be studied?
- What is *"Operating System"* ?
- How is the course structured?

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CS431 : Course site, Venue & Timing

- Course website: **http://jatinga.iitg.ernet.in/~asahu/cs431/**
- Class Venue
  - Core III: 3202
- Class Timing & Venue
  - Tue 09.00AM-09.55AM
  - Wed 10.00AM-10.55AM
  - Thu 11.00AM-11.55AM
  - *Mon 08.00 AM-08.55AM (Slot for makeup class)*

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Course Pre requisite

- **Require Knowledge of**
  - CS204 : Algorithms
    - Use of Algorithm design, Graph, Analysis, Approximation, Heuristics, etc..
  - CS222 : Computer Org. & Architecture
    - Interface to BIOS, Architecture and ISA

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CS431 OS: Text & Ref Books

- Text Book
  - Silberschatz, A. and Galvin P. B, ***Operating System Concepts***, 8/e. Wiley, 2008
- Reference Book
  - Stalling, W. ***Operating Systems: Internals and Design Principles*** , 6/e. Pearson, 2008.
  - Tanenbaum, A. S ***Modern Operating System***. 3/e. Pearson, 2007.
  - Dhamdhere, D. M ***Operating Systems: A Concept Based Approac***h, McGrawHill, 2008.

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CS431 OS: Other Ref. Books

- Others Reference Book
  - Maurice Herlihy, Nir Shavit, ***Art of Multiprocessor Programming***, Elsevier 2009
  - C. Crowley ***Operating Systems: A Design-Oriented Approach***, Tata McGraw - Hill Education, 2009
  - Buttazzo Giorgio C. ***Hard Real-Time Computing Systems*** , Springer Verlag, 2011
  - P. Brucker ***Scheduling Algorithms*** , Springer-verlag, 2007
  - J. Corbet, A. Rubini ***Linux Device Drivers***,,3rd Ed. O'Reilly Media, 2005

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CS341 : Rules

- 75% Attendance is Mandatory
- **Any kind of Copy/Plagiarism lead to `F' Grade**
  - Take home exam and Quiz
  - Both source (from copied) and destination (to copied) will be penalized
  - Open: If your are taking from some sources, please site/mention the source (Internet or peers or seniors)
- Relative Grading: But with
  - Above 80 point is mandatory for AA grades
  - May not ensure AA
- **Fail Grade**: less than 30% of highest score among all the students of CS341

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CS341 : Rules

- **Copy/Plagiarism lead to `F' Grade**
- Grading
  - ***5% class participation***
  - 30% mid semester + 45% end semester
  - 10% Quiz (2 Quiz) + 10% take home (2 times)
  - Take will be announced in class and to be submitted in the next class
  - Take home and quiz will not be announced earlier

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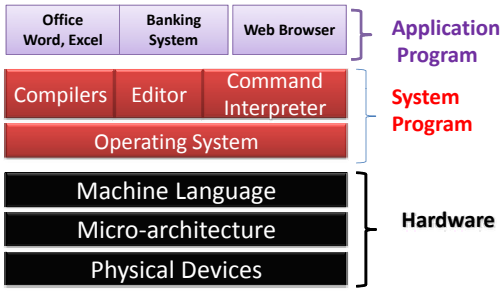
Introduction to Computer System

- A computer system consists of
  - Hardware, **System programs**, Application programs



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OS : Laymen Definition

An operating system manages all:

- **Input**
  - getting information into the computer from an external sources
  - keyboard, a mouse, a scanner, or a disk.
- **Processing**
  - After receiving input: manipulates or alters the data
- **Output**
  - Once the input has been processed
  - Result output to a monitor, printer, disk or sent via email or the Web

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OS Examples

- **PC OS**
  - Microsoft : Window 95, 98, XP, Vista, 7, 8, NT
  - Apple : Machintos, IBM : OS 2, OS 360/390
  - Unix, Linux, Ubuntu, Fedora, BSD Unix, Solaris
- **Embedded OS**
  - Android, iOS, Window CE/Phone 8.1, Bada OS, QNX, MeeGo, BlackBarry, uLinux, TinyOS
- **Web Browser OS :** Crome OS, EyeOS, YouOS
- **Router OS:** CSIR ONET, Netware, Cisco IOS, SAN-OS

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OS Types

- **Mainframe OS, Server OS**
- **Multiprocessor operating systems**
- **Personal computer operating systems**
- **Real-time operating systems**
  - **Air craft, Radar Detection, Naval/Space Machine**
- **Embedded operating systems**
  - **Mobile, Printer, Scanner, Projector, Camera, Washing Machine**
- **Smart card operating systems**
  - **Ecos, TinyOS, SensorOS**

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What is an Operating System

- **OS is an extended machine**
  - –Hides the messy details which must be performed
  - –Presents user with a virtual machine, easier to use
- **OS is a resource manager**
  - –Each program gets time with the resource
  - –Each program gets space on the resource

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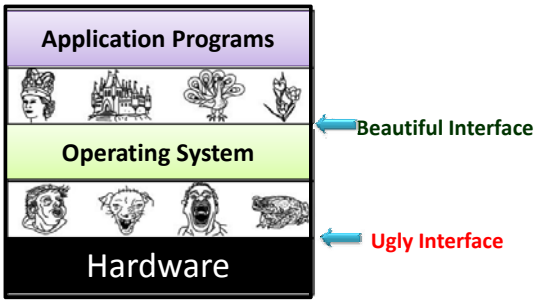
OS as an Extended Machine

Operating systems turn ugly hardware into beautiful abstractions.



OS as a Resource Manager

- Allow multiple programs to run at the same time
- Manage and protect memory, I/O devices, and other resources
- Includes multiplexing (sharing) resources in two different ways:
  - In time
  - In space

Abstraction

- Delving into the depths reveals more information
- An abstraction omits unneeded detail, helps us cope with complexity

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Software Abstraction

```
int sum(int x, int y)
{
  int t = x+y;
  return t;
}
```

C

```
_sum:
     pushl %ebp
     movl %esp,%ebp
     movl 12(%ebp),%eax
     addl 8(%ebp),%eax
     movl %ebp,%esp
     popl %ebp
     ret
```

assembly

```
0x401040 <sum>:   0x55
                  0x89
                  0xe5
                  0x8b
                  0x45
                  0x0c
                  0x03
                  0x45
                  0x08
                  0x89
                  0xec
                  0x5d
                  0xc3
```

machine code

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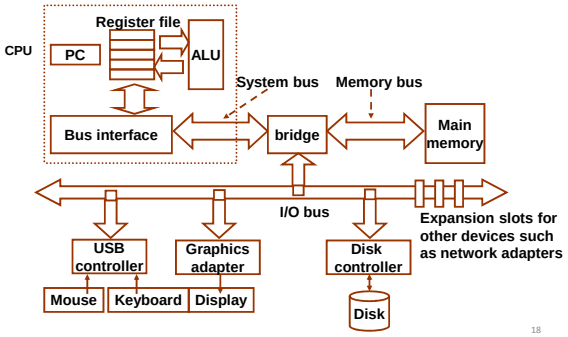
Hardware Abstraction



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Operating System

- Bridge the gap between hardware and software
- Establish a foundation for building higher-level programs
  - How to optimize programs?
  - How to debug large systems
  - How to deal with complexity

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Operating System

- Provides a virtual execution environment on top of hardware
  - That is more convenient than the raw hardware interface
- "All of the code you did not write"
- More Simple, More reliable, More secure, More portable, More efficient……

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What do OSes do?

- Manage physical resources
- Provide virtual resources
- Implement mechanisms and enforce policies for the control and use of resources
- Mediate the interaction of mutually distrusting applications

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What Physical Resources Do OSes Control?

- CPU, Memory
- Storage Devices, Networks
- Input Devices (keyboard, mice, cameras)
- Output Devices (printers, displays, speakers)
- And many virtual resources

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CS431 Course Objectives

To learn –

- Theory behind resource management
- Theory behind concurrency and related issues
- How to adopt to new hardware resources and standardization
- Issues affecting modern operating systems (Android, VxWork, Distributed OS,)

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CS431 Course Objectives

To learn –

- Advanced Power Management Support
- Multi-core support in OS
- How to ***device driver*** and how all the interface works
- How the system call works..

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How the Resource Management is Difficult ?

A simple example with algorithmic analysis…

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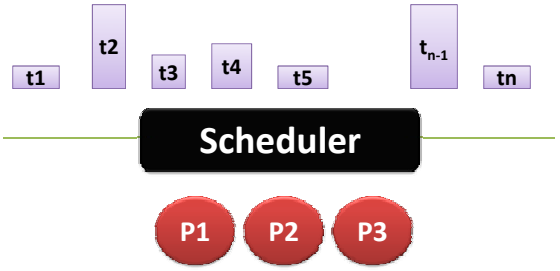
Scheduling : *N* Tasks on *3* Processors



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Scheduling : *N* Tasks on *3* Processors

- **Assumption (Very simplistics)**
  - Lets N Task arrives at time 0
  - All tasks are independent task
  - i_{th} task takes t_i amount of time to execute on any processor
  - Homogenous: All processor are of same type and speed
  - Interruption not allowed : Task assigned to a processor will execute completely without interruption

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Scheduling : *N* Tasks on *3* Processors

- **Optimization Criterion**
  - Minimize finishing time of last executed task: Minimize C_{max}

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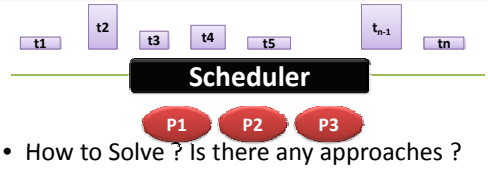
Scheduling : *N* Tasks on *3* Processors



- How to Solve ? Is there any approaches ?
  - Schedule Longest Task first === > FAIL
  - Schedule shortest Task first ====> FAIL
  - Dynamic Programming ==== > FAIL

  NP-Complete Problem

  Need to solve using Approximation or Heuristics

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Course Structure

1st Half (Algorithmic Prospects)

- Process Management
  - Process and thread, scheduling examples
  - ***Scheduling Algorithms: Theoretical prospects***
- Concurrency
  - Mutual exclusion, synch., semaphores, deadlocks
  - Atomic Instructions, ***design and proof of Synchronization algorithms and polices***
- Memory Management
  - Allocation, protection, hardware support, paging, segmentation, virtual memory, demand paging, allocation, replacement, TLBs
  - ***Algorithmic treatment: Memory management***

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Course Structure
2nd Half (System Prospective)

- File Management
  - Naming, file operations and their implementation;
- File Systems
  - Allocation, free space management, directory management, mounting;
  - ***Distributed File System***
- I/O Management
  - Device drivers, disk scheduling
  - **Linux Device Driver & Kernel Programming**

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Thanks

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