Operating System (OS)/ C402

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What is the objective of this course

- to understand key operating system concepts and techniques, including process management, memory management, and file management.
- to appreciate the tradeoffs between performance and functionality in an OS
- to apply an understanding of OS concepts to the evaluation of commercial operating systems.

Syllabus

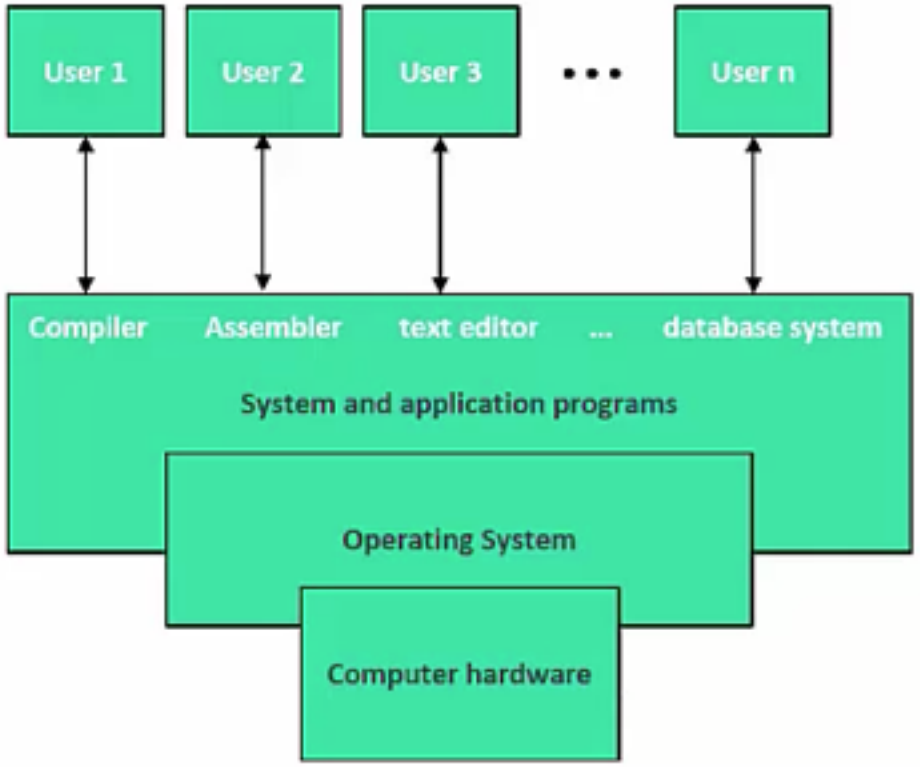
- Memory Organization.
- Virtual Memory.
- File Systems.
- Mass Storage.

Definition of OS

an OS is a collection of software that connects the user with the computer hardware

- ***user perspective:*** OS is an interface
  - makes interacting with the computer and running applications easy

- ***system perspective:*** OS is a resource allocator
  - controls and coordinates the hardware resources, services the application software



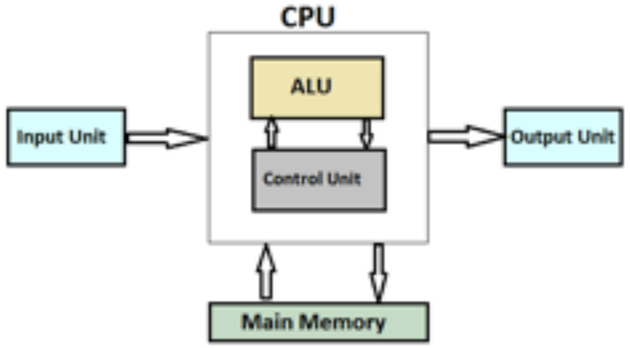
Memory Organization

- Memory management
  - swapping
  - contiguous allocation
  - paging
  - segmentation
  - segmentation with paging

Memory Management

- memory management and CPU scheduling are perhaps the two most central tasks of an OS
  - memory consists of a large array of words, each with its own address
  - both program and data are stored in memory

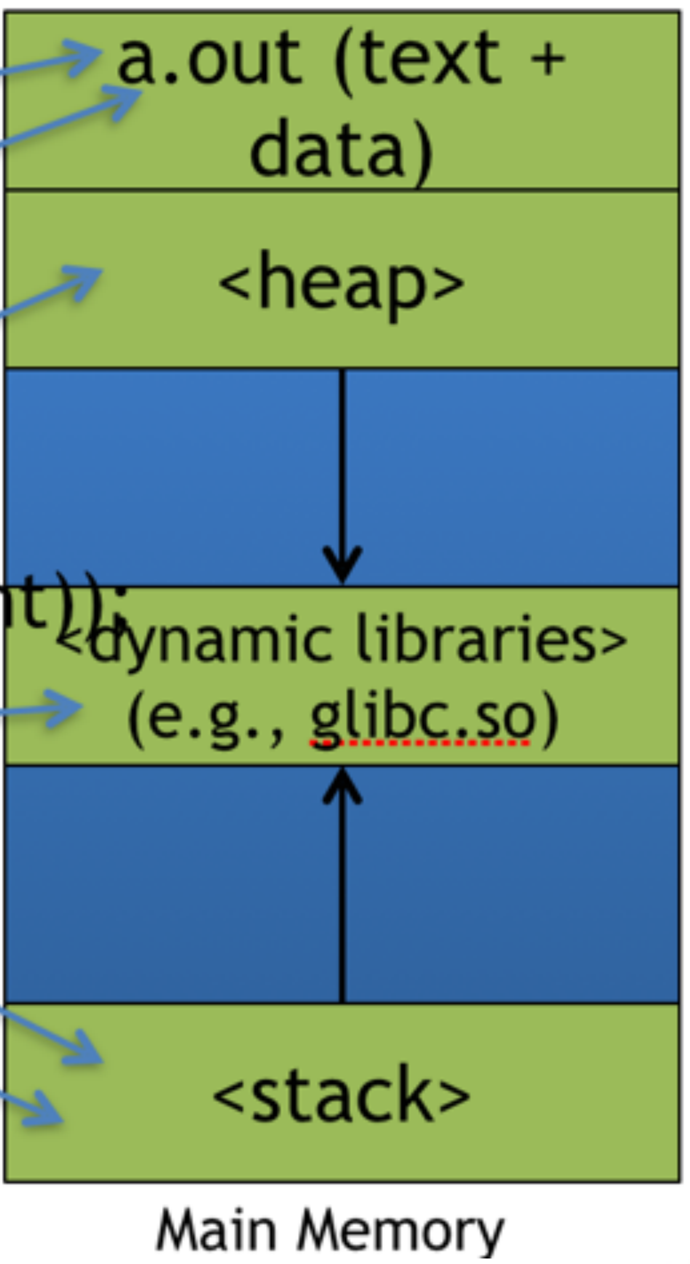
- Recall : CPU fetch-execute cycle
  1. fetch next instruction from memory (based on program counter)
  2. decode the instruction
  3. possibly fetch operands from memory
  4. execute the instruction
  5. store the result in memory



- Note : memory is given an address and it returns a value
  - it does not distinguish between instructions and data
  - it does not care how the address was arrived at

Data allocation

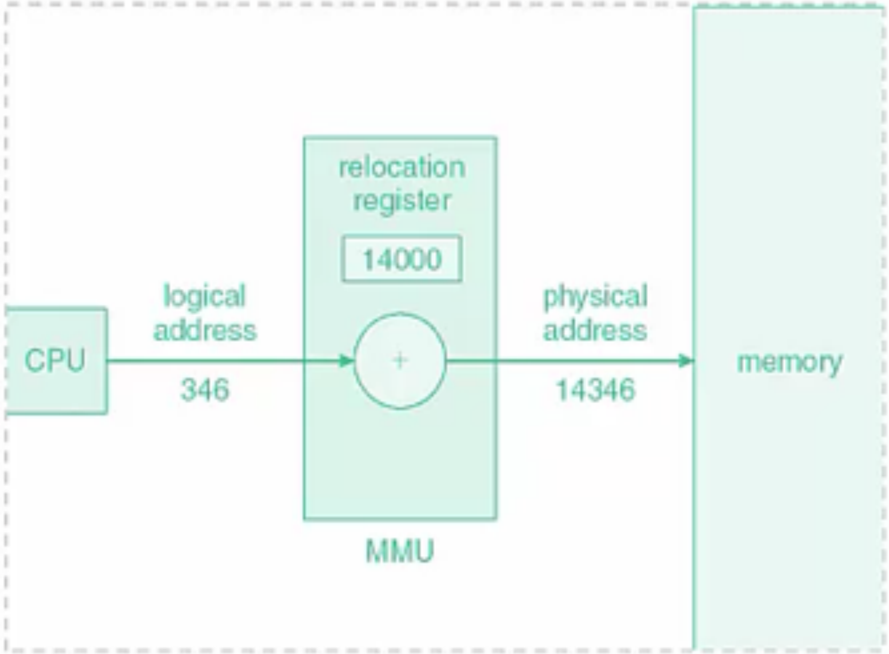
```
int global_variable;
const int constant_variable = 5;

int main(int argc, char *argv[]) {
    int *dynamic_variable = malloc(sizeof(int));
    int local_variable;
    printf("Hello world!\n");
    return 0;
}
```



Memory Organization: logical vs. physical addresses

- the concept of a logical address space that is mapped to a physical address space is central to memory management
  - CPU works in a logical (virtual) address space
    users, processes, instruction operands, program counter refer to logical addresses
  - memory is a physical address space
    real memory accesses require real addresses

- Memory Management Unit (MMU) maps logical addresses to physical addresses
  - implemented in hardware
  - for example, might have a relocation register that provides the base address for a process' block of physical memory



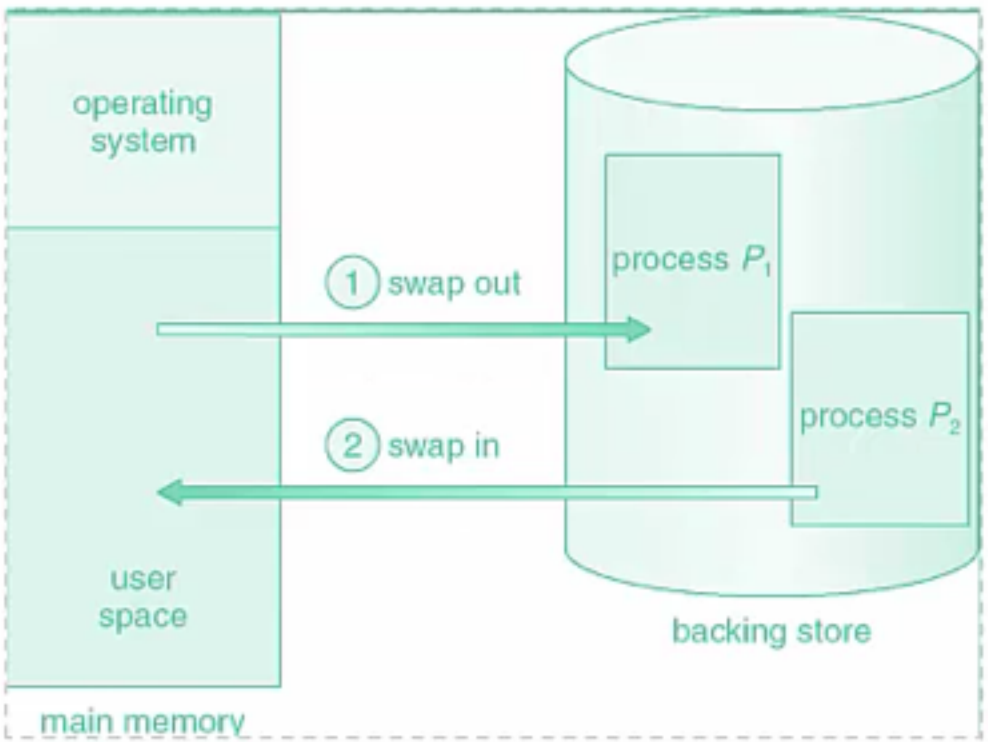
Note: The value of relocation register will be set by the OS and no user process can access this value. Only the Memory Management Unit knows this value.

Memory Organization: swapping

- a process needs to be in memory to be executed
  - however, it may be temporarily swapped out of memory into a backing store
  - the process can later be restarted by swapping it back into memory
  - backing store is generally a fast disk – speed is important!

- swapping example:

  when a process blocks or timeouts,
  - swap it out to disk
  - swap in a new (ready) process from disk to memory
  - dispatch the new process



- another example: *roll out, roll in*
  - in a priority-based system, lower-priority process may be swapped out so higher-priority process can be loaded and executed

Memory Organization: swapping

- few operating systems use standard swapping
  - the context-switch time is generally too costly
  - special care must be taken, e.g., can't swap out a process waiting on I/O

- some operating systems use variations on swapping
  - Windows 3.1 : if new process is loaded but insufficient memory, swap out old however, user decides when to swap out & swap in processes

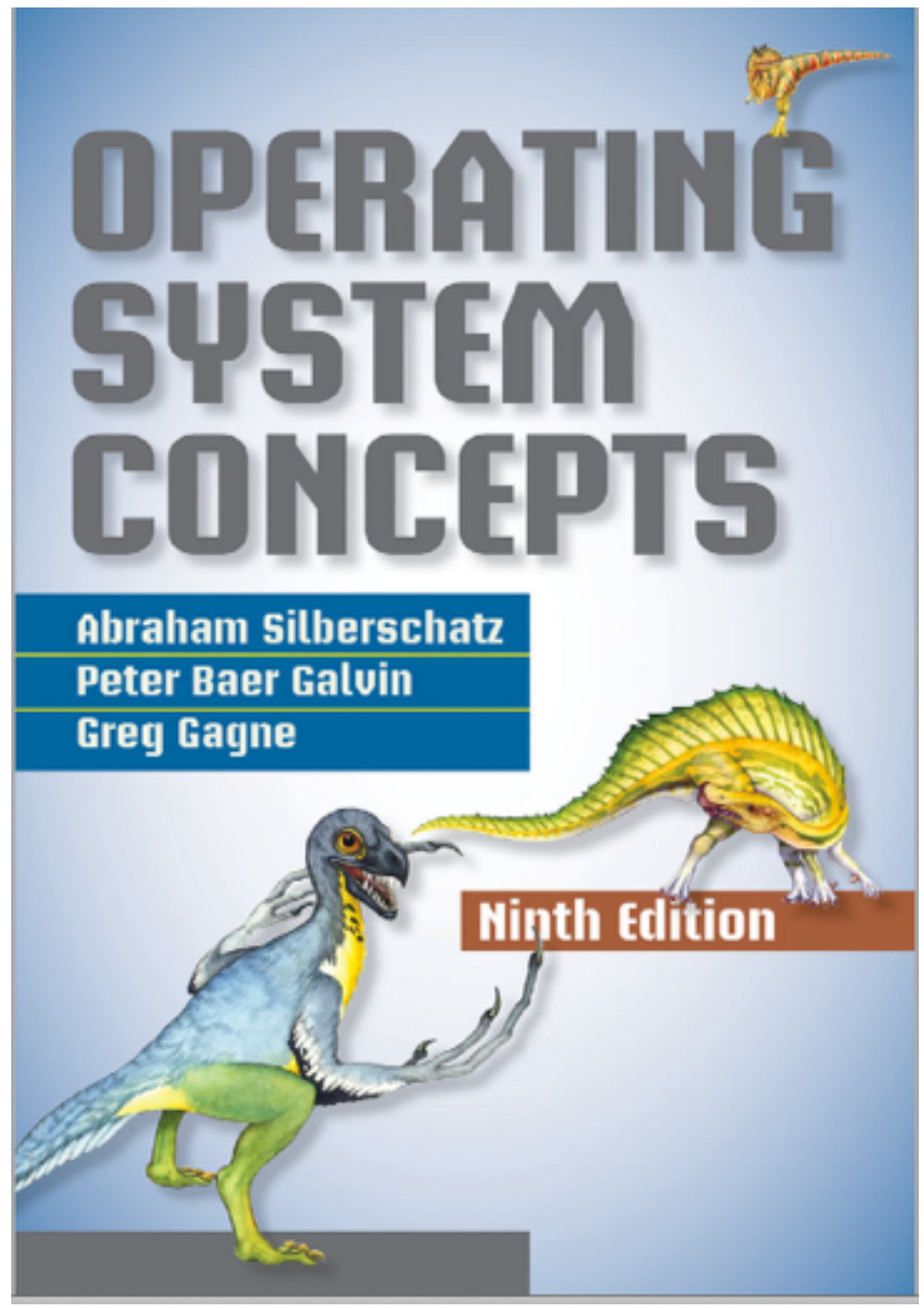
- swapping may be used in combination with other approaches (e.g., segmentation – later)

Examinations

- Lecture

- First exam: / /2018.
- Second exam: //2018.

References


OPERATING SYSTEM CONCEPTS
Abraham Silberschatz
Peter Baer Galvin
Greg Gagne
Ninth Edition