Lecture 8

CprE 308

January 29, 2013

Intro

Today's Topics

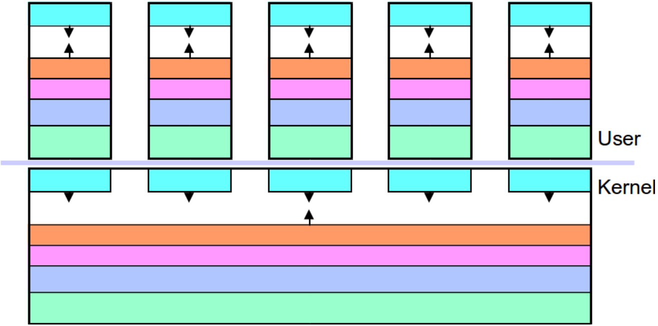
- Processes and Multiprogramming
- How is multiprogramming implemented?
  - Process context switch

Multiprogramming

Processes and Multiprogramming

- Multiprogramming
  - Many processes executing in parallel
- Imagine not having it (DOS)
  - Type in command
  - Wait for result
  - Can't browse in the meanwhile!

Multi Processes = Multiple Address Spaces



Well..we still have only one processor

Will the following get sped up with multiprogramming?

- Four compilations running in parallel

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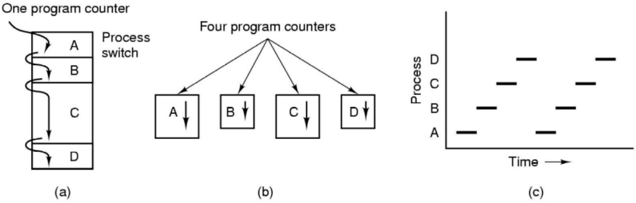
Well..we still have only one processor

Will the following get sped up with multiprogramming?

- Four compilations running in parallel
- A compilation and a text editor
- Four parallel internet downloads

The Process Model



- Conceptual model of 4 independent, sequential processes
- Only one program active at any instant
- Switch from one process to another by “context switch”

Process Creation and Termination

When do new processes get created?

- Any command – Ex: Click on the IE icon
- First process?

When do processes get terminated?

1. Normal exit (voluntary) - `exit()` system call
2. Error exit (voluntary) - `exit()` system call
3. Fatal error (involuntary)
4. Killed by another process (involuntary)

Implementation

Implementation of Multiprogramming

- Context Switch
  - Resources (CPU) taken away from one process and given to another
- Save the context of previous process and restore context of new process

Process Context?

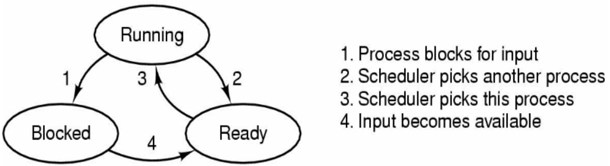
- Contents of Registers
- Program Counter
- Stack Pointer
- Process State
- Open file descriptors
- . . .

Operating System stores process contexts in *Process Table* - one entry per process

When to Switch Context

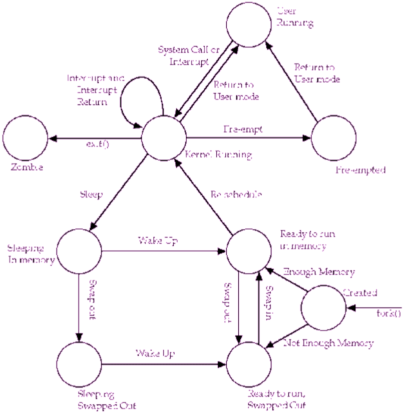
- When a process waits for I/O
- When a process has got its quota of time
- When a previously started I/O has completed

Process States



- Possible process states:
  - Running
  - Blocked
  - Ready

Process States (cont)



Process State Transition Diagram (After Bach)

How to Switch Context?

How would you force a process to give up the processor to another process?

Interrupt Driven Context Switch

- Interrupt occurs (timer or I/O)
- Each interrupt has its own service procedure (address given by interrupt vector)
- Save some context and then jump to interrupt service procedure
- **Scheduler** might context switch after the interrupt is serviced

Process Implementation

Skeleton of what lowest level of OS does when an interrupt occurs

1. Hardware stacks program counter, etc.
2. Hardware loads new program counter from interrupt vector.
3. Assembly language procedure saves registers.
4. Assembly language procedure sets up new stack.
5. C interrupt service runs (typically reads and buffers input).
6. Scheduler decides which process is to run next.
7. C procedure returns to the assembly code.
8. Assembly language procedure starts up new current process.

Some Questions

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- Why can't we voluntarily change to privileged (kernel) mode?
- Why do we need a separate kernel stack for each process?
- Is the scheduler a separate process?