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Chapter 3A – Process Concept

Spring 2023

Process Concept

- The Process
- Process State
- Process Control Block

The Process

- An operating system executes a variety of programs that run as a process.
- **Process** – a program in execution; process execution must progress in sequential fashion. No parallel execution of instructions of a single process
some modern CPU might predict and run in parallel.

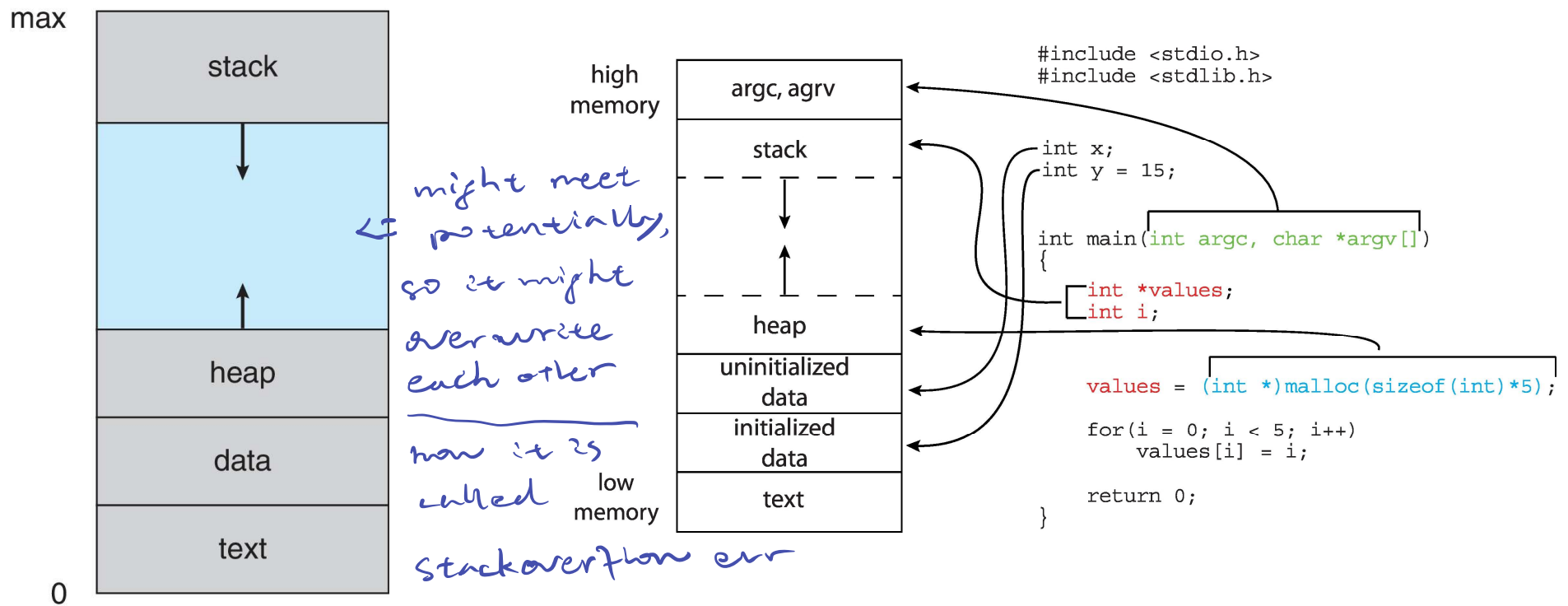
The Process

- Multiple parts
 - The program code, also called text section *not changed in processing*
 - Current activity including **program counter**, processor registers
 - **Stack** containing temporary data *e.g. variables in main, each func would be pushed into stack while declared.*
 - Function parameters, return addresses, local variables
 - Data section containing global variables
 - Heap containing memory dynamically allocated during run time *malloc / calloc*

The Process

- Program is **passive** entity stored on disk (**executable file**); process is **active**
- Program becomes process when an executable file is loaded into memory
- Execution of program started via GUI mouse clicks, command line entry of its name, etc.
- One program can be several processes *but with different PID*
- Consider multiple users executing the same program

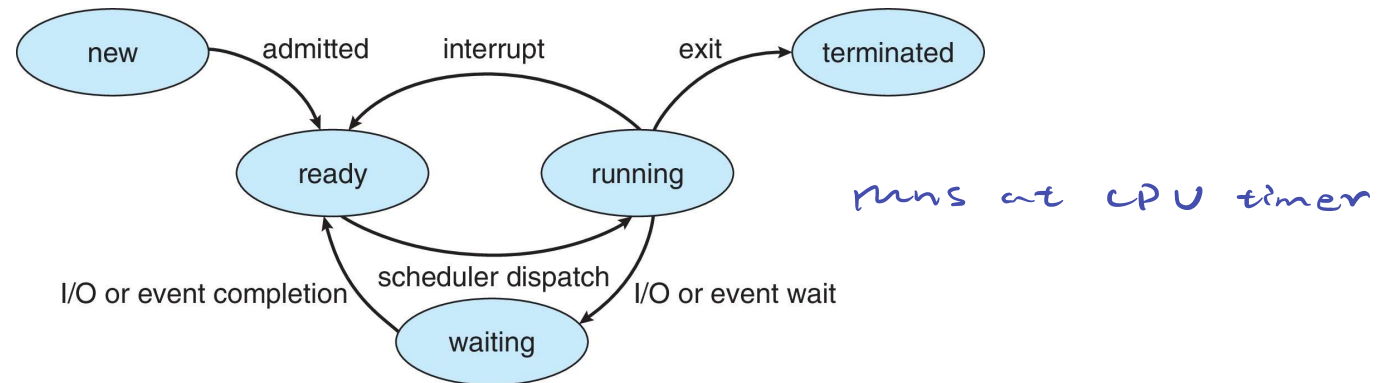
The Process



Process State

- As a process executes, it changes **state**
 - **New:** The process is being created
 - **Running:** Instructions are being executed
 - **Waiting:** The process is waiting for some event to occur *e.g. some io*
 - **Ready:** The process is waiting to be assigned to a processor
 - **Terminated:** The process has finished execution
clean memory, etc

Process State



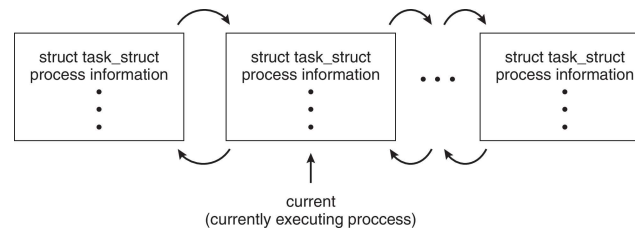
Process Control Block

- Information associated with each process (also called task control block)
 - Process state – running, waiting, etc.
 - Program counter – location of instruction to next execute
 - CPU registers – contents of all process-centric registers
 - CPU scheduling information- priorities, scheduling queue pointers
 - Memory-management information – memory allocated to the process
 - Accounting information – CPU used, clock time elapsed since start, time limits
 - I/O status information – I/O devices allocated to process, list of open files

process state
process number
program counter
registers
memory limits
list of open files
...

Process Control Block

- Process Control Block in Linux
 - Represented by the C structure `task_struct`
(<https://github.com/torvalds/linux/blob/master/include/linux/sched.h>)
 - ```
pid_t pid; /* process identifier */
long state; /* state of the process */
unsigned int time_slice /* scheduling information */
struct task_struct *parent; /* this process's parent */
struct list_head children; /* this process's children */
struct files_struct *files; /* list of open files */
struct mm_struct *mm; /* address space of this process */
...
```





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