Recall: Last few lectures we have been looking at the Operating System
- the OS is a key piece of software that heavily interacts with your programs

OS jobs
① Main memory ✓
② CPU time → this class

Process Management

- CPU management ⇒ hardware perspective
- Process management ⇒ software perspective.

What is process?
* a program in execution... (true... → starts with one process)
* but some programs run as multiple processes
* or the same program can be running multiple times

∴ We need a clearer idea of what a process is....

Process: A new perspective

* We can view a process as a data structure.

What is a data structure?
↳ Example – stack
* For a data structure we need
↳ Defined by the operations that can be done on the associated data
↳ In case of stack ⇒ Push, Pop, Create, Destroy

* We want to apply the same concept to a process
↳ look at a process in terms a set of operations and the associated data

associated data

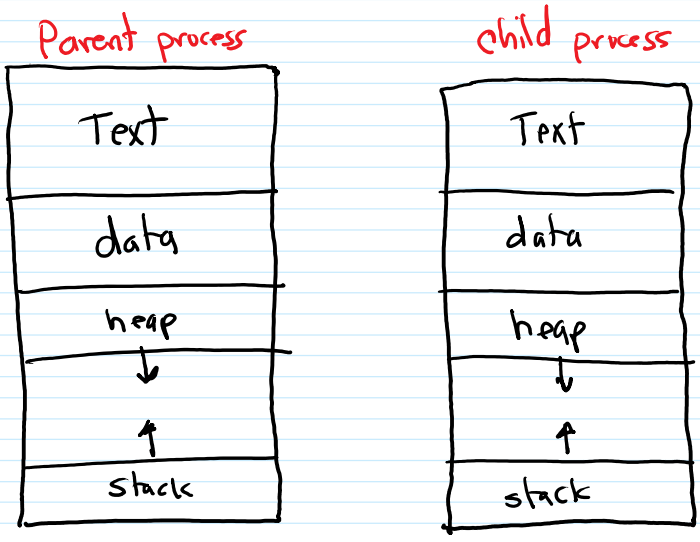
Process as a Data Structure

* What are the operations on processes?
  - ↳ process related **system calls**
    - ↳ fork(), exec(), wait(), exit(), ...

* similar to a stack, we need explicit data associated with a process.
  - ↳ conceptually ⇒ stack of books
  - ↳ reality ① A contiguous region of memory (1d array)
    ② Pointer ⇒ A Top of stack

* What is the data manipulated by process operations?
  - ↳ Think of fork() operation ⇒ creates a new process
    - conceptual
    - what is reality?

fork()



- ↳ ∴ fork() creates a new process
  - ↳ Text, data, stack and heap are copied from its parent process. ⇒ data associated with a process

What is the data manipulated by a process?

① Text, Data, Stack and Heap ⇒ true for fork(), exec()

② Data stored in hardware } instructions
↳ PC value, register values

③ Other information that maintained by the OS

- Process identifiers
  ↳ a unique name/integer for each process ⇒ PID
  ↳ for each child process, OS should remember its parent process id ⇒ PPID
- User identifier ⇒ USID
  ↳ The identity of the user who is running the program from which the process was created
  ↳ "root" ⟺ "system administrator"
- Memory management information → Page Table
- CPU time used by the process, in user/system
- File related info → Open files, File pointers etc.
  ↳ if the process I/O device

* Therefore, seems fair to look at a process as a data structures

Process vs. Program

Program → static, passive, dead

Process → dynamic, active, living.

Key property of a process ⇒ Dynamic

⇒ a process changes state with time

↳ ex ADD R1, R3;

→ value of R1 changes

→ values PC, IR

A technical term for a process is that it is running → "state"

A Fundamental Question of Running Processes

↳ Can 2 processes be running at the same time?

↳ NO!

↳ Answer: If you only have on PC, one IR, and one set GPR

↳ Question2 ⇒ If there are 100 processes running on a computer system, and process P_i is in running state, what state condition are the other 99 processes in?