

# 1 Process

## Vocabularies

### 1. Process

- Is a program in execution

### 2. Running Program

- Is a collection of coded software instructions that can be executed by a computer to perform a specific task

### 3. Time Sharing

- Is a basic technique used by an OS to share a resource
- Allows an entity to use the resource for a little while, and then a little while by another, and so forth

#### Example

CPU

### 4. Space Sharing

- Is where a resource (space) is divided among those who wishes to use it

#### Example

Disk, and Memory

### 5. Mechanism

- Is a low-level method or protocol that implement a needed piece of functionality.

#### Example

Context Switching

### 6. Policy

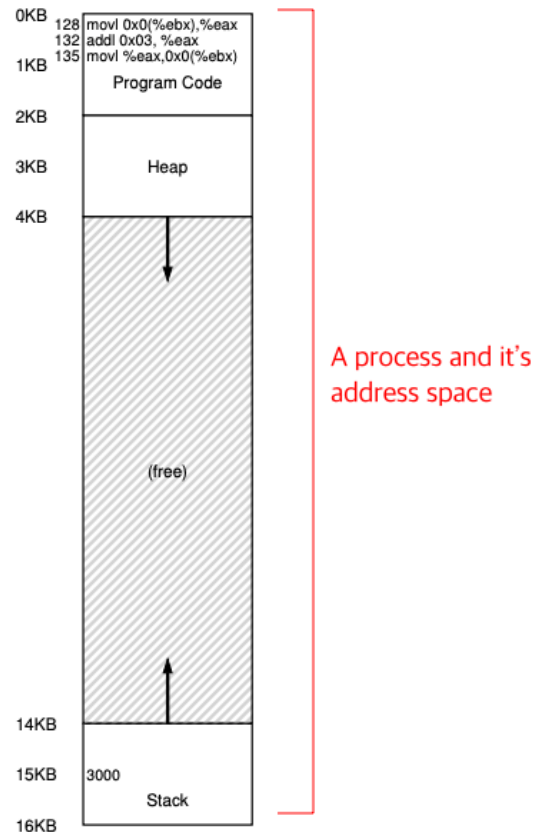
- Is an algorithm for making some kinds of decision within the OS

#### Example

Scheduling Policy. That is, what kind of program should the OS run?

## 7. Address Space

- Is a range of discrete addresses where each corresponds to a memory cell

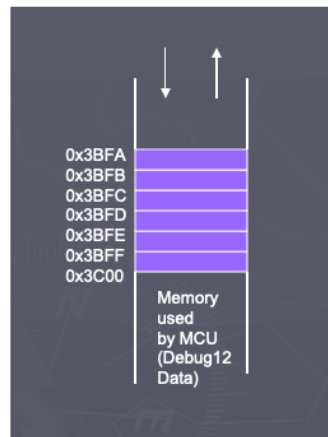


## 8. Program Counter

- Is also called **Instruction Pointer**
- Is a process register that tells which instruction of the program is currently being executed

## 9. Stack Pointer

- Is a register that points to the location of last item placed in memory block



## 10. Frame Pointer

- Is a reference pointer allowing a debugger to know where local variable or an argument is at with a single constant offset

```
4.c:7:6: note: expected 'struct abc *' but argument is of type 'struct abc *'
void count_length(struct abc *_el);
```

↑  
Frame Pointer

## 11. Eager Loading Process

- Is the process that loads all code and data before running the program

## 12. Lazy Loading Process

- Is the process that loads piece of code or data only as they are needed during program execution

## 13. Stack

- Is also called **runtime stack**, **automatic memory**
- Is a special region in computer's memory that temporarily stores local variables, function parameters, and return addresses
- Is managed by compiler

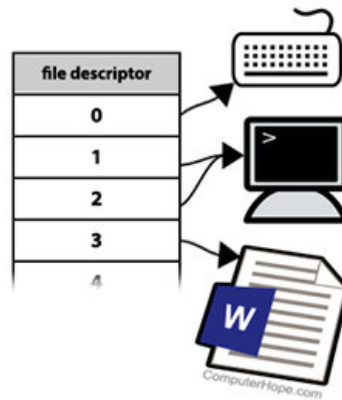
## 14. Heap

- Is a user-managed region in computer memory
- Is used for dynamically-allocated data structures such as linked list, hash-tables, and trees

- Is allocated using `malloc`, `calloc`, and `realloc`

## 15. File Descriptors

- Is a number that uniquely identifies an open file in a computer's operating system



## 16. Process States

- Is also called **kernel state**
- Is the state field in a **process control block**.

### Example

Ready, Running, Blocked

## 17. Process List

- Is also called **task list**
- Contains information about all the processes running in the system
- Contains **process control block** in each entry

## 18. Context Switch

- is the process of storing the state of a process or thread, so that it can be restored and resume execution at a later point

## 19. Register Context

- Is the data structure where contents of registers are saved before a process switches into blocked state

```

// the registers xv6 will save and restore
// to stop and subsequently restart a process
struct context {
    int eip;
    int esp;
    int ebx;
    int ecx;
    int edx;
    int esi;
    int edi;
    int ebp;
};

// the different states a process can be in
enum proc_state { UNUSED, EMBRYO, SLEEPING,
    RUNNABLE, RUNNING, ZOMBIE };

// the information xv6 tracks about each process
// including its register context and state
struct proc {
    char *mem;           // Start of process memory
    uint sz;             // Size of process memory
    char *kstack;        // Bottom of kernel stack
                        // for this process
    enum proc_state state; // Process state
    int pid;             // Process ID
    struct proc *parent;  // Parent process
    void *chan;          // If !zero, sleeping on chan
    int killed;           // If !zero, has been killed
    struct file *ofile[NOFILE]; // Open files
    struct inode *cwd;    // Current directory
    struct context *context; // Switch here to run process
    struct trapframe *tf; // Trap frame for the
                        // current interrupt
};

```

register context data structure

Process Control Block

Where register context is

## 20. Process Control Block

- Is also called **process descriptor**
- Is a data structure used by computer operating systems to store all the information about a process

## 21. Zombie State

- Is a process that has completed execution but still has an entry in the process table

## 1.1 Process

- Is named by process ID or PID
- Is comprised of
  - Address Space
  - CPU Registers
  - Program Counter
  - Stack Pointer
  - Frame Pointer
  - I/O Information

## 1.2 Process API

- has the following methods in any operating systems
  - **Create**
    - \* Is a method for creating a new process
    - \* Invoked to OS when
      - A command is typed into shell
      - An application icon is double-clicked
  - **Destroy**
    - \* Is a method for forcefully destroying a process

### Example

```
kill
```

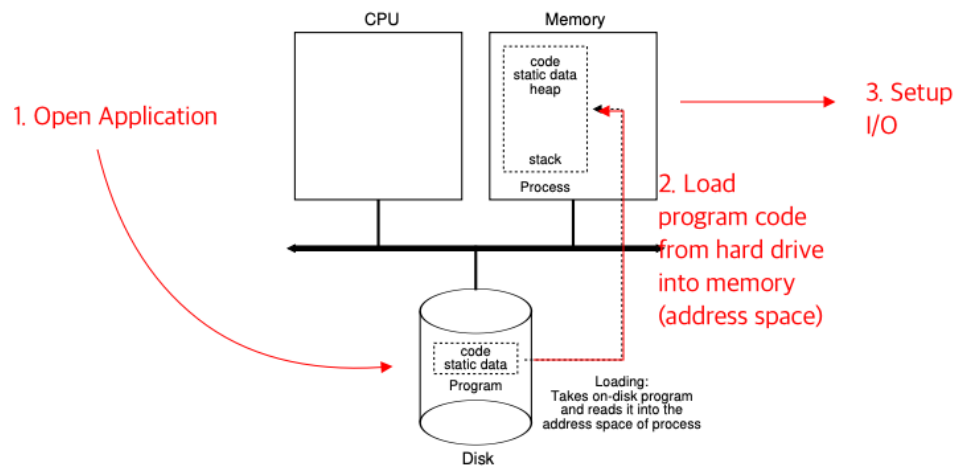
- **Wait**
  - \* Is a method that causes a process stop running until a signal is given
- **Miscellaneous Control**
- **Status**
  - \* Is a method for getting information about a process

### Example

How long it has run for, what state it is in

## 1.3 Process Creation: A little more detail

- Steps
  1. Type a command into commandline / Double click an application
  2. Load program code and static data (e.g. initialized variables) into memory, into the address space of the process
  3. Allocate stack memory
  4. Allocate heap memory (if applicable)
  5. Setup I/O
    - Each process has 3 open **file descriptors** by default: input, output and error
    - Allows easy reading of input from the terminal and output to screen



- Eagerly loading process in early days
- Lazy loading process today

## 1.4 Process States

- A **process** is in one of three states
  - **Running**
    - \* Means a process is running on a processor. That is, coded instruction is being executed.
  - **Ready**
    - \* Means a process is ready to run, but OS has chosen not to execute it at this moment
  - **Blocked**
    - \* Means a process has performed some kind of operations that makes it not ready to run until some other event takes place

## 1.5 Data Structures

- **Process list**
  - Contains information about all processes
- **Register context**

- Contains contents of registers after **context switch**

**Example**

Stack Pointer, Frame Pointer, Program Counter

- **Process control block**

- Contains information about a specific process