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

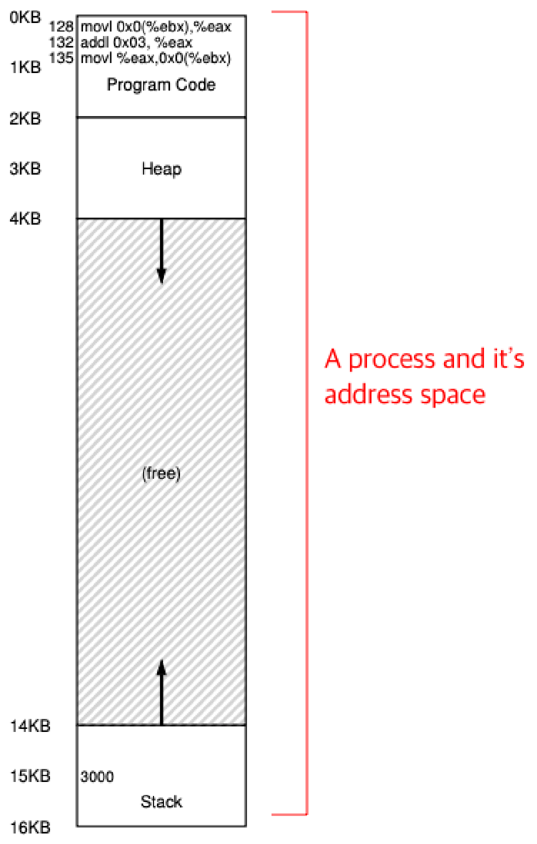
   Context Switching
6. **Policy**
   - Is an algorithm for making some kinds of decision within the OS

   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

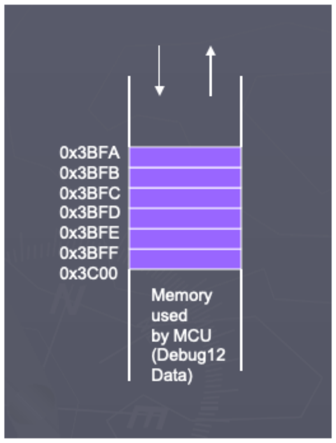


8. **Program Counter**

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

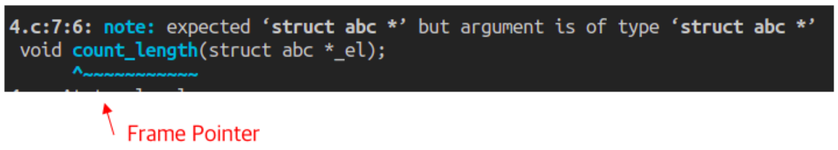
9. **Stack Pointer**

   - Is a resgister 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);
      ^~~~~~~~~~~~
```

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

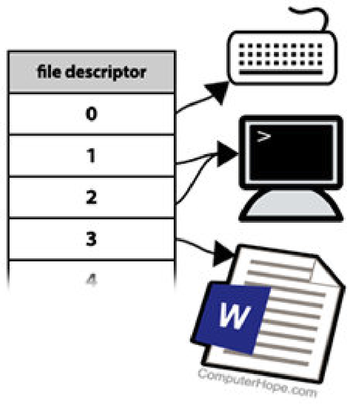
14. **Heap**

    - 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**

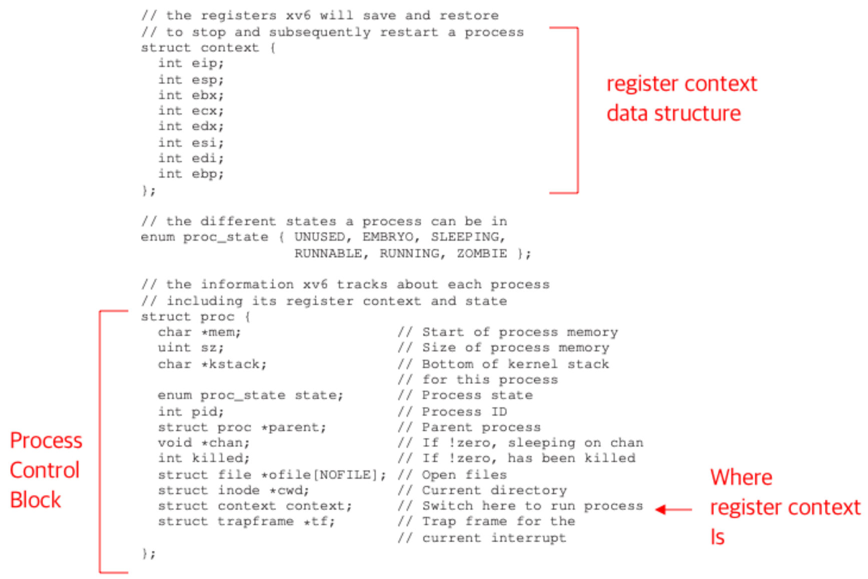
- Is also called **task list**
- Contains information about all the processes running in the system
- Contains **process control block** in each entry

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
};
```

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

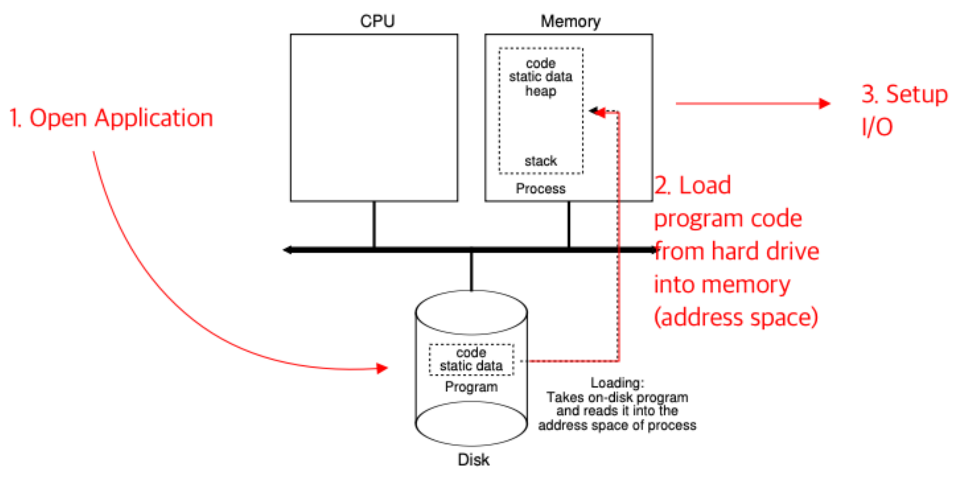
      `kill`
  - **Wait**
    - Is a method that causes a process stop running until a signal is given
  - **Miscellaneous Control**
  - **Status**
    - Is a method for getting information about a process

      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


CPU
Memory
code
static data
heap
stack
Process
1. Open Application
3. Setup I/O
2. Load program code from hard drive into memory (address space)
code
static data
Program
Disk
Loading: Takes on-disk program and reads it into the address space of process

- **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