1 Address Space

Vocabularies

1. **Multiprogramming**

   - Is a computer running more than one program at a time (like running Excel and Firefox simultaneously).

2. **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
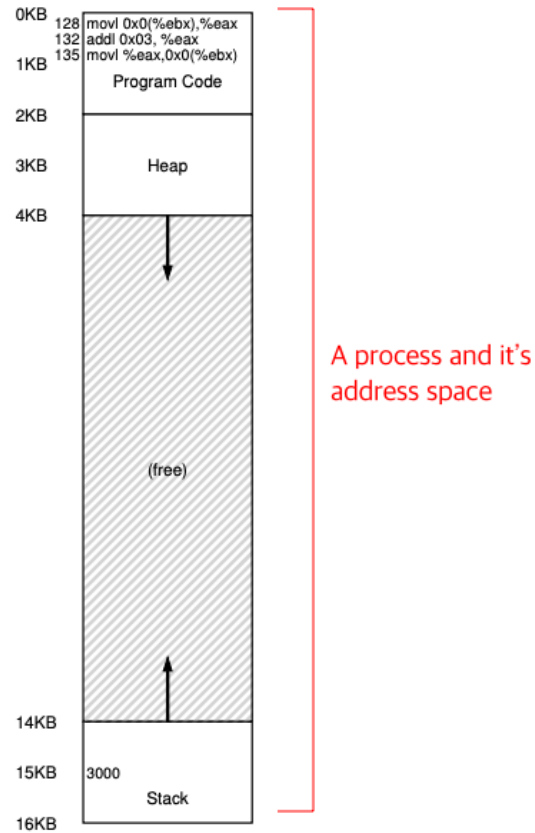
3. **Interactivity**

   - Is the ability of a computer to respond to a user's input

4. **Easy to Use**

   - Is a basic concept in design that describes how easily users can use a product

5. **Address Space**

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

```
0KB
        128 movl 0x0(%ebx),%eax
        132 addl 0x03, %eax
        135 movl %eax,0x0(%ebx)
1KB
           Program Code

2KB

3KB          Heap

4KB



                (free)



14KB

15KB   3000
             Stack
16KB
```

A process and it's
address space

6. **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

7. **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`

8. **Thread**

   - Is the unit of execution within a process.
     - A process can have anywhere from one thread to many threads

9. **Abstraction**

- the process of removing physical, spatial, or temporal details or attributes in the study of objects or systems to focus attention on details of greater importance; it is similar in nature to the process of generalization

10. **Virtualizing Memory**

    - Is the process of turning a single storage space in RAM into seemingly infinite number of the single storace space used by multiple programs

11. **Virtual Address**

    - Is the identification of a location in virtual storage that is mapped by the operating system into a location in real storage

    Example

    Pointer in C (i.e. &variable_name)

12. **Transparency**

    - (In OS) is an illusion provided by the OS that should not be visible to applications

13. **Efficiency**

    - the ratio of the useful work performed by a machine or in a process to the total energy

14. **Mechanism**

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

    Example

    Context Switching

15. **Policies**
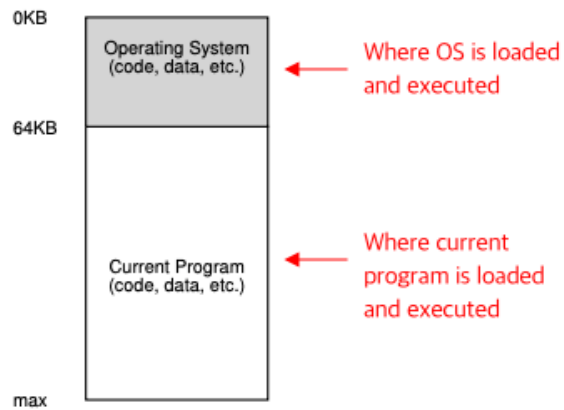
    - Is an algorithm for making some kinds of decision within the OS

    Example

    Scheduling Policy. That is, what kind of program should the OS run?
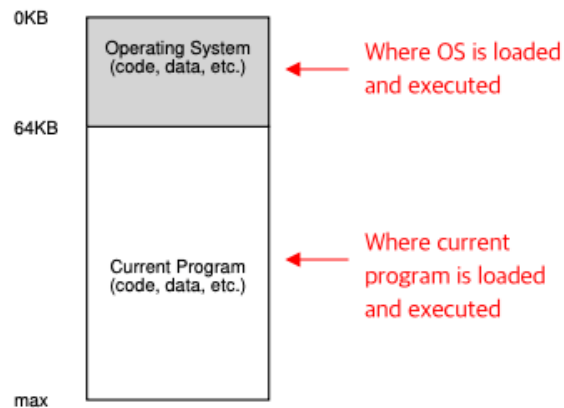
1.1 Address Space: Early Systems

- Was really simple

1.2 Multiprogramming and Time Sharing

- **Multiprogramming** was born from the need of many people wanting to run program on expensive computer (early days)

- **Time Sharing** was born from the limitation of batch computing, and programmers feeling tired of long program-debug cycle

- **Interactivity** was born from the need for timely response for each user

- **Protection** Was born from the need to prevent a process from reading or writing other processes' memory

1.3   The Address Space

- Is an easy to use abstraction of physical memory

- Has

  1. Code
  2. **Stack**
     - Grows upward
  3. **Heap**
     - Starts after code
     - Grows downward
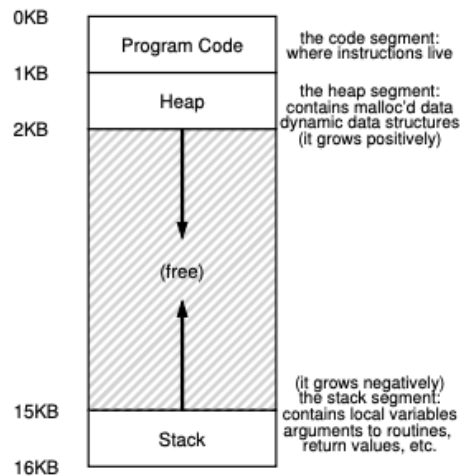
1.4   Goal

- **Transparency**

  - A program shouldn't be aware that memory is virtualized

- **Efficiency**

  - **Virtual Memory** must be **efficient** in both time and space
    * **time** - not making programs to run slow
    * **space** - not taking too much memory to support structures of virtualization

- **Protection**

  - **Virtual Memory** of a process must be protected from other processes and OS
    * One process cannot access or affect memory of other processes