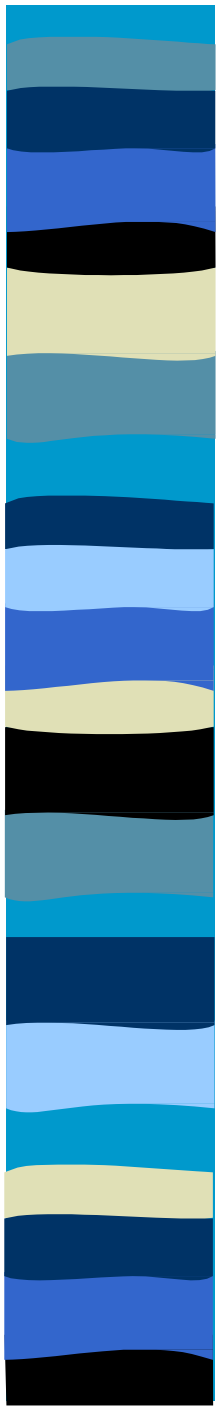
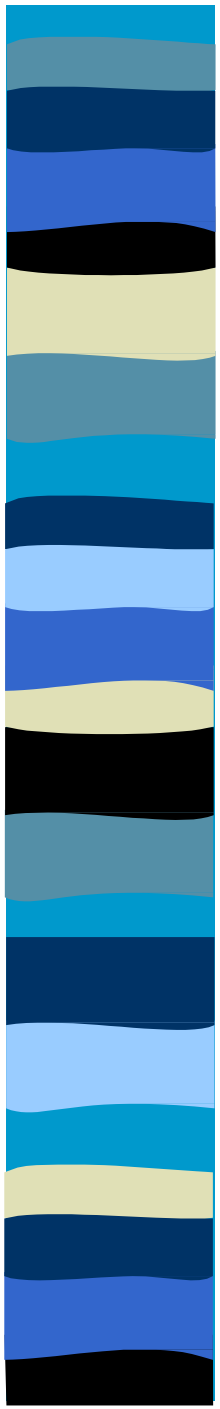


What is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware

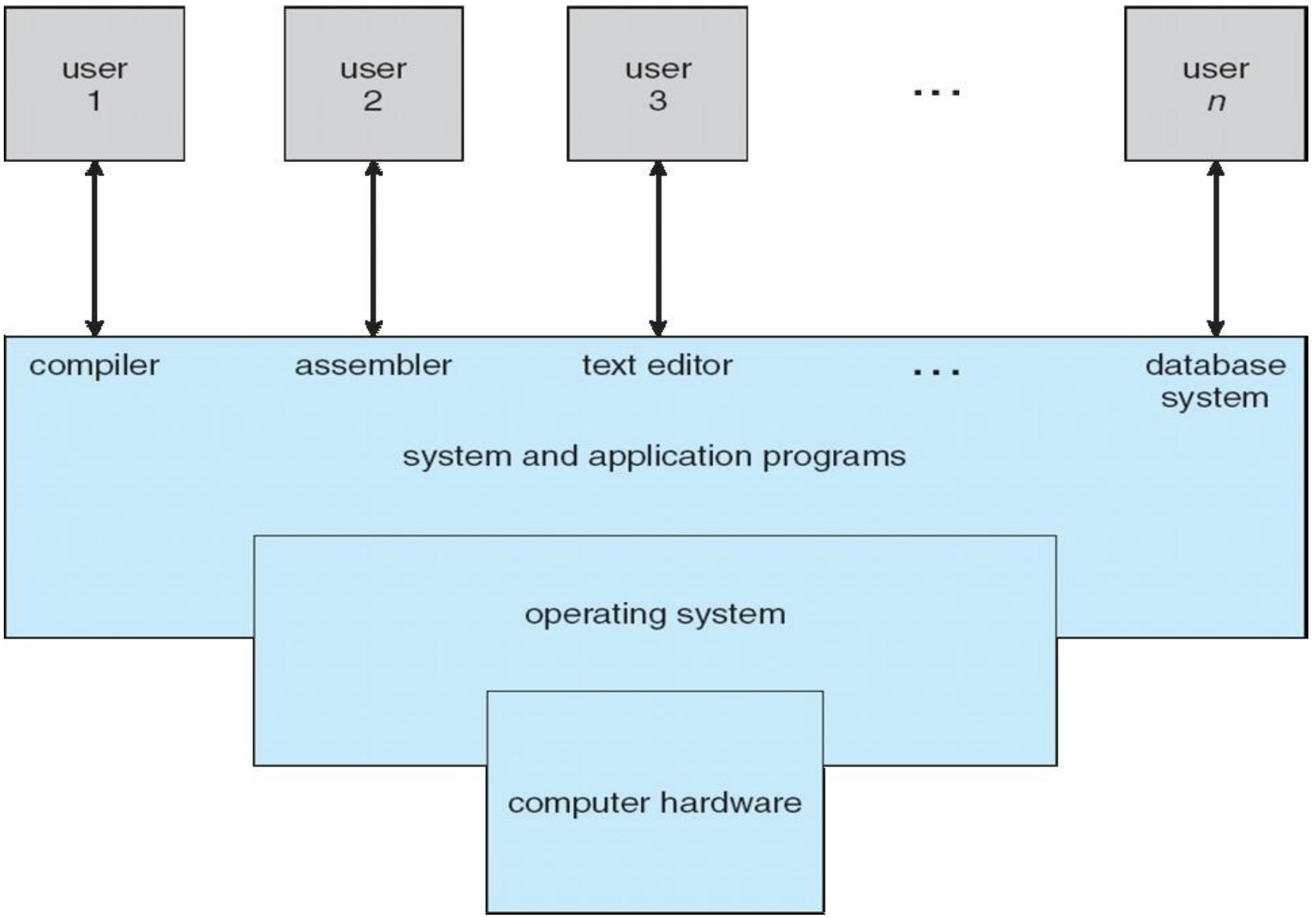
- **Operating system goals:**
  - Execute user programs and make solving user problems easier
  - Make the computer system convenient to use
  - Use the computer hardware in an efficient manner

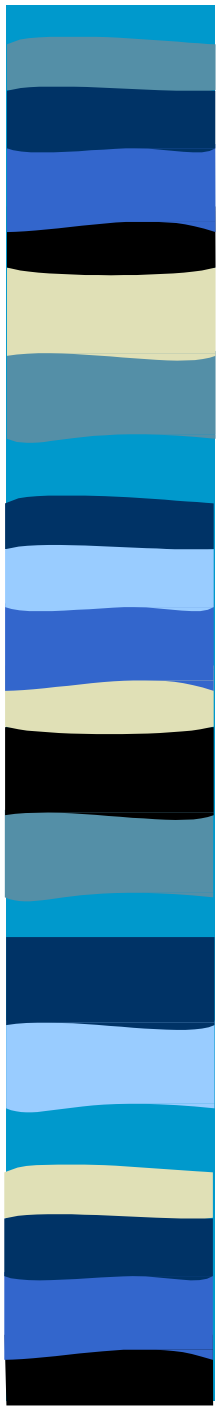


Computer System Structure

- Computer system can be divided into four components:
  - **Hardware** – provides basic computing resources
    - CPU, memory, I/O devices
  - **Operating system**
    - Controls and coordinates use of hardware among various applications and users
  - **Application programs** – define the ways in which the system resources are used to solve the computing problems of the users
    - Word processors, compilers, web browsers, database systems, video games
  - **Users**
    - People, machines, other computers

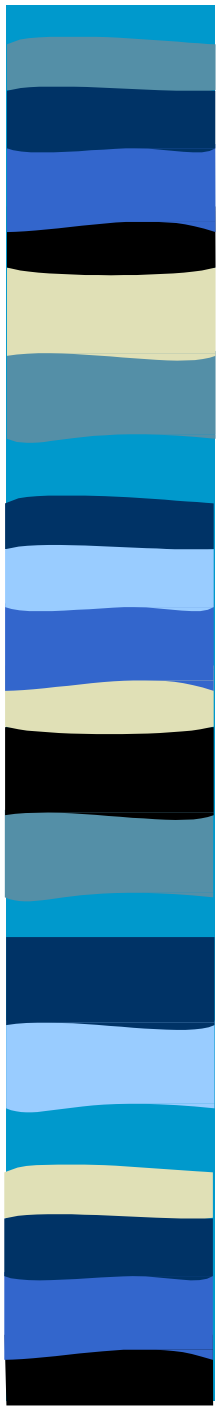
Four Components of a Computer System





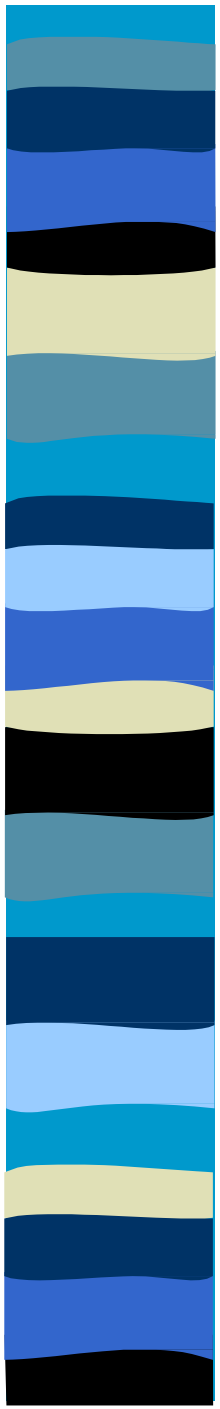
User View

- Depends on the point of view
- Users want convenience, **ease of use**
  - Don’t care about **resource utilization**
- But shared computer such as **mainframe** or **minicomputer** must keep all users happy
- Users of dedicate systems such as **workstations** have dedicated resources but frequently use shared resources from **servers**
- Handheld computers are resource poor, optimized for usability and battery life
- Some computers have little or no user interface, such as embedded computers in devices and automobiles



System View

- OS is a **resource allocator**
  - Manages all resources
  - Decides between conflicting requests for efficient and fair resource use
- OS is a **control program**
  - Controls execution of programs to prevent errors and improper use of the computer

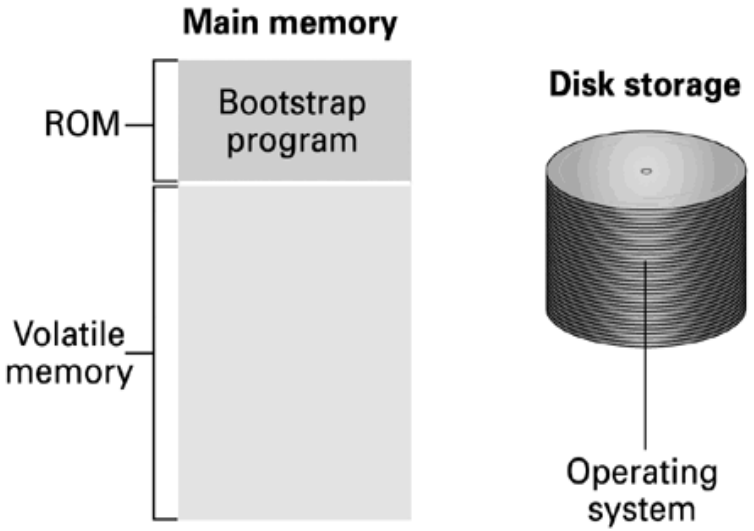


Operating System Definition (Cont.)

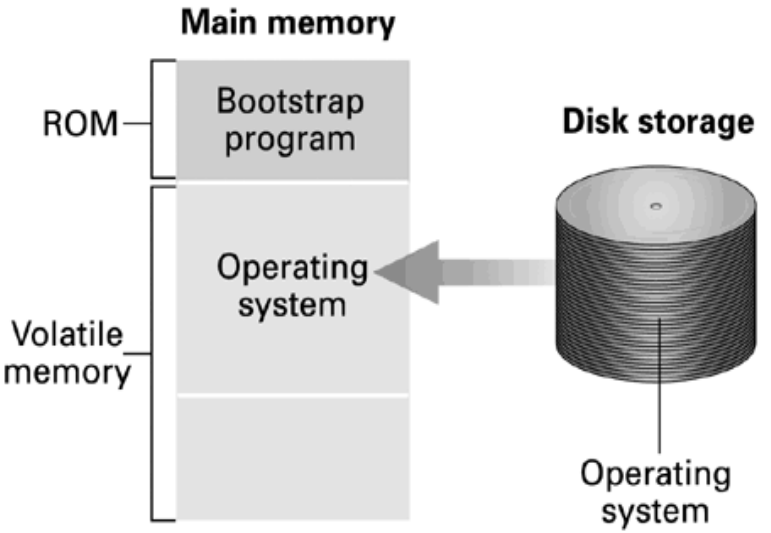
- No universally accepted definition
- “Everything a vendor ships when you order an operating system” is good approximation
  - But varies wildly
- “The one program running at all times on the computer” is the **kernel**. Everything else is either a system program (ships with the operating system) or an application program.

Computer Startup

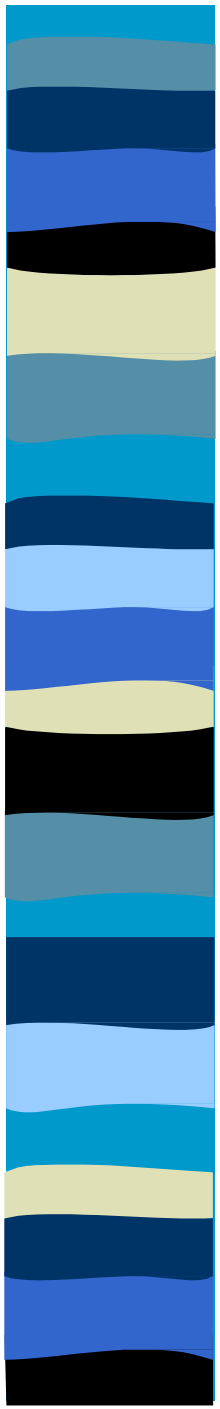
- **Bootstrap program** is loaded at power-up or reboot
  - Typically stored in ROM or EPROM, generally known as **firmware**
  - Initializes all aspects of system
  - Loads operating system kernel and starts execution



Step 1: Machine starts by executing the bootstrap program already in memory. Operating system is stored in mass storage.

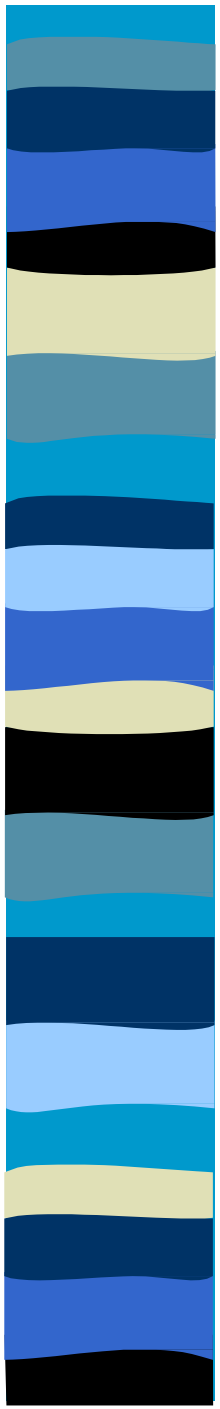


Step 2: Bootstrap program directs the transfer of the operating system into main memory and then transfers control to it.



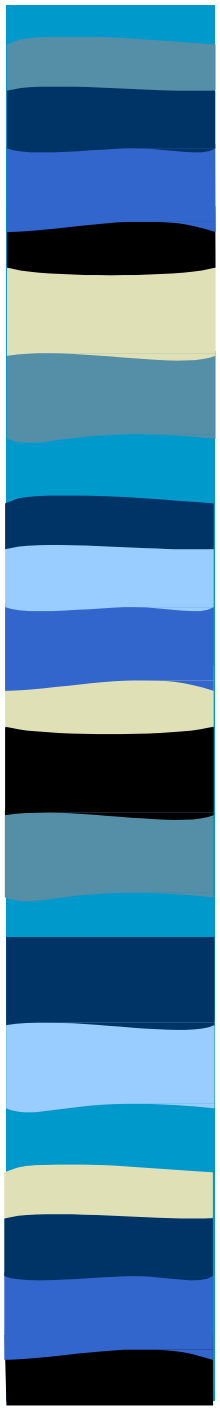
Operating-System Components

- Process Management
- Main Memory Management
- File Management
- I/O System Management
- Secondary Management
- Protection System
- Networking
- Command interpreter



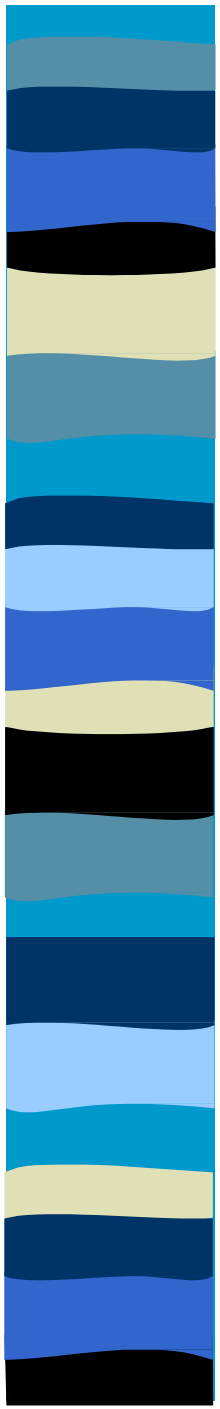
Process Management

- A *process* is a program in execution.
- A process needs certain resources, including CPU time, memory, files, and I/O devices, to accomplish its task.
- The operating system is responsible for the following activities in connection with process management.
  - Process creation and deletion.
  - process suspension and resumption.
  - Deadlock handling
  - Provision of mechanisms for:
    - process synchronization
    - process communication



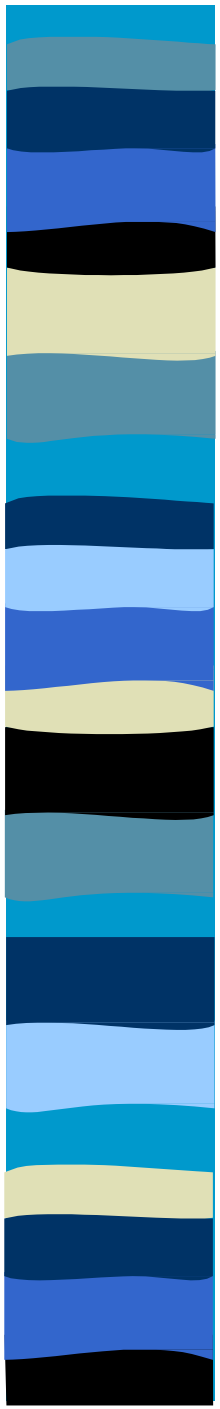
Main-Memory Management

- Memory is a large array of words or bytes, each with its own address.
- It is a repository of quickly accessible data shared by the CPU and I/O devices.
- Main memory is a volatile storage device. It loses its contents in the case of system failure.
- The operating system is responsible for the following activities in connections with memory management:
  - Keep track of which parts of memory are currently being used and by whom.
  - Decide which processes to load when memory space becomes available.
  - Allocate and deallocate memory space as needed.



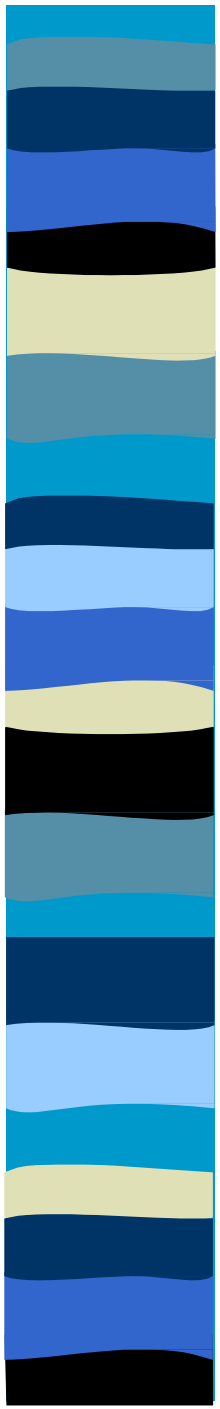
File Management

- A file is a collection of related information defined by its creator. Commonly, files represent programs (both source and object forms) and data.
- The operating system is responsible for the following activities in connections with file management:
  - File creation and deletion.
  - Directory creation and deletion.
  - Support of primitives for manipulating files and directories.
  - Mapping files onto secondary storage.
  - File backup on stable (nonvolatile) storage media.



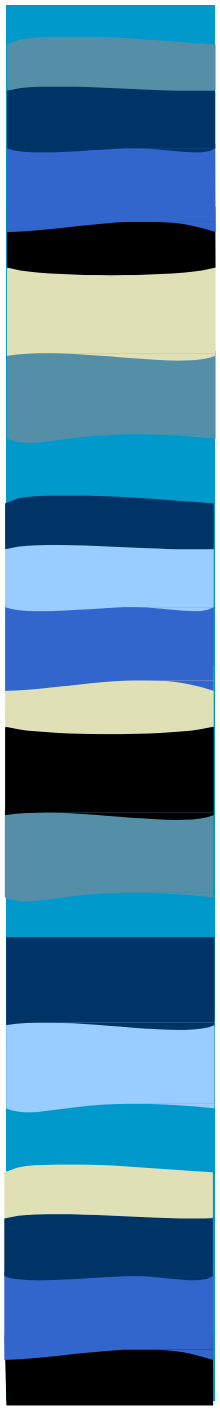
I/O System Management

- The I/O system consists of:
  - A buffer-caching system
  - A general device-driver interface
  - Drivers for specific hardware devices



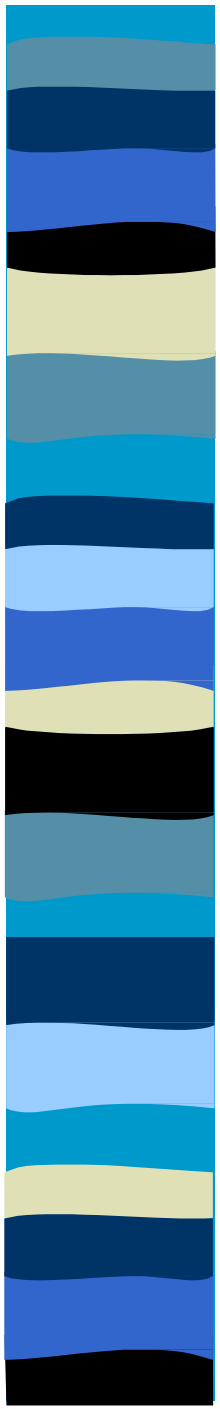
Secondary-Storage Management

- Since main memory (*primary storage*) is volatile and too small to accommodate all data and programs permanently, the computer system must provide *secondary storage* to back up main memory.
- Most modern computer systems use disks as the principle on-line storage medium, for both programs and data.
- The operating system is responsible for the following activities in connection with disk management:
  - Free space management
  - Storage allocation
  - Disk scheduling



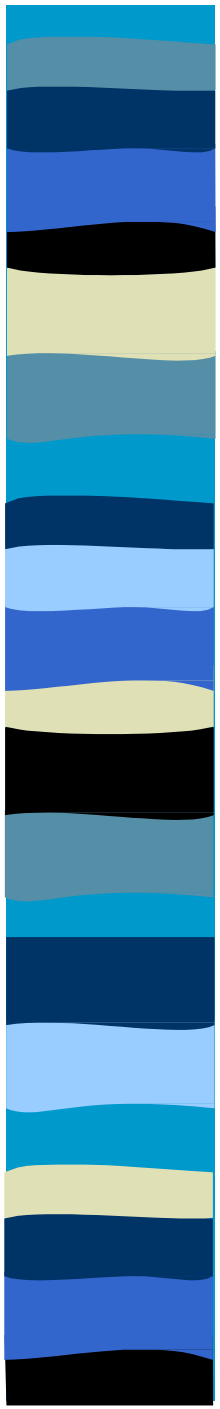
Protection System

- *Protection* refers to a mechanism for controlling access by programs, processes, or users to both system and user resources.
- The protection mechanism must:
  - distinguish between authorized and unauthorized usage.
  - specify the controls to be imposed.
  - provide a means of enforcement.



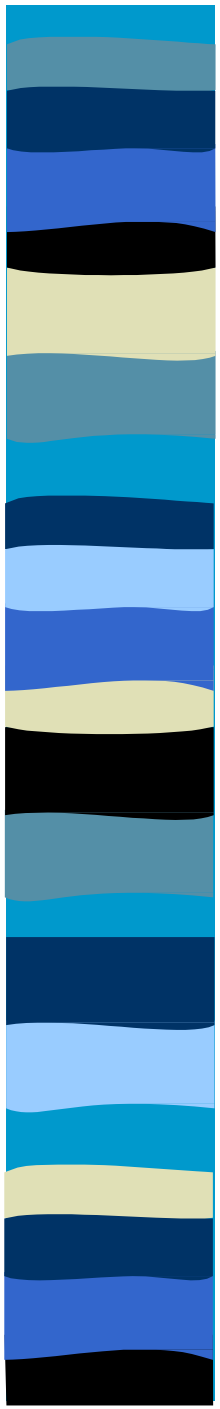
Networking (Distributed Systems)

- A *distributed* system is a collection of processors that do not share memory or a clock. Each processor has its own local memory and clock.
- The processors in the system are connected through a communication network.
- A distributed system provides user access to various system resources.
- Access to a shared resource allows:
- Computation speed-up
- Increased data availability
- Enhanced reliability



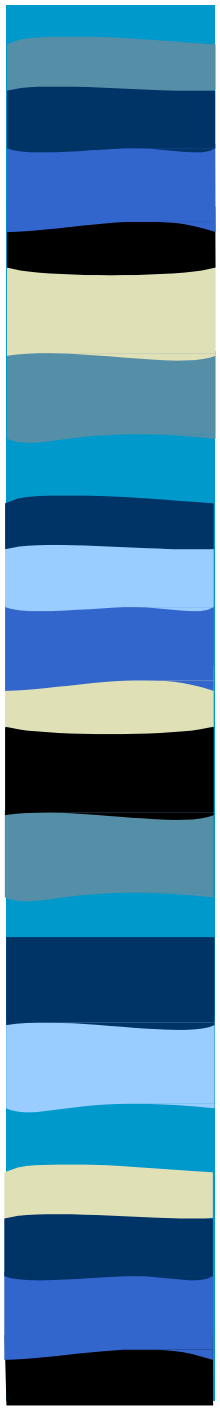
Command-Interpreter System

- Command-Interpreter system is a system program, which is the interface between the user and the operating system.
- Command-Interpreter system is known as the shell.
- Some operating systems provide a user-friendly interface (mouse-based window) such as, Macintosh and Microsoft Windows.
- Some operating systems provide text interface (commands are typed on keyboard) such as MS-DOS and Unix shells.



Operating System Services

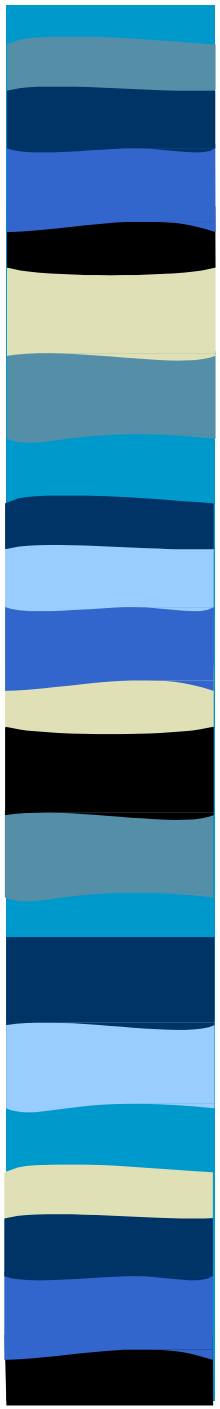
- **Program execution** – system capability to load a program into memory and to run it.
- **I/O operations** –since user programs cannot execute I/O operations directly, the operating system must provide some means to perform I/O.
- **File-system manipulation** – program capability to read, write, create, and delete files.
- **Communications** – exchange of information between processes executing either on the same computer or on different systems tied together by a network. Implemented via *shared memory* or *message passing*.
- **Error detection** – ensure correct computing by detecting errors in the CPU and memory hardware, in I/O devices, or in user programs.



Additional Operating System Functions

Additional functions exist not for helping the user, but rather for ensuring efficient system operations.

- **Resource allocation –** allocating resources to multiple users or multiple jobs running at the same time.
- **Accounting –** keep track of and record which users use how much and what kinds of computer resources for account billing or for accumulating usage statistics.
- **Protection –** ensuring that all access to system resources is controlled.



Thank You