Operating system services and structures

Module 1

Self study material

Operating systems 2020

1DT003, 1DT044 and 1DT096

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Program

A set of instructions which is in human readable format. A passive entity stored on secondary storage.

Executable

A compiled form of a program including machine instructions and static data that a computer can load and execute. A passive entity stored on secondary storage.

Process

A program loaded into memory and executing or waiting. A process typically executes for only a short time before it either finishes or needs to perform I/O (waiting). A process is an active entity and needs resources such as CPU time, memory etc to execute.

Process A

Process B

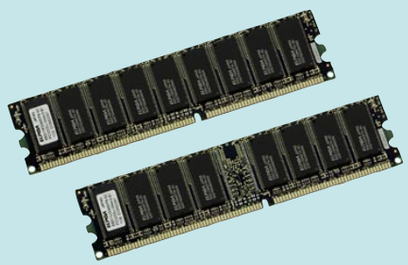
Process Z

A program in execution is called a process

An operating system provides an **environment for the execution of programs**.

It **provides certain services** to **programs** and to the **users** of these programs.

Computer Hardware



Services and structure

What services should the OS provide? How can these services be structured?

System calls

System and application programs

User interfaces

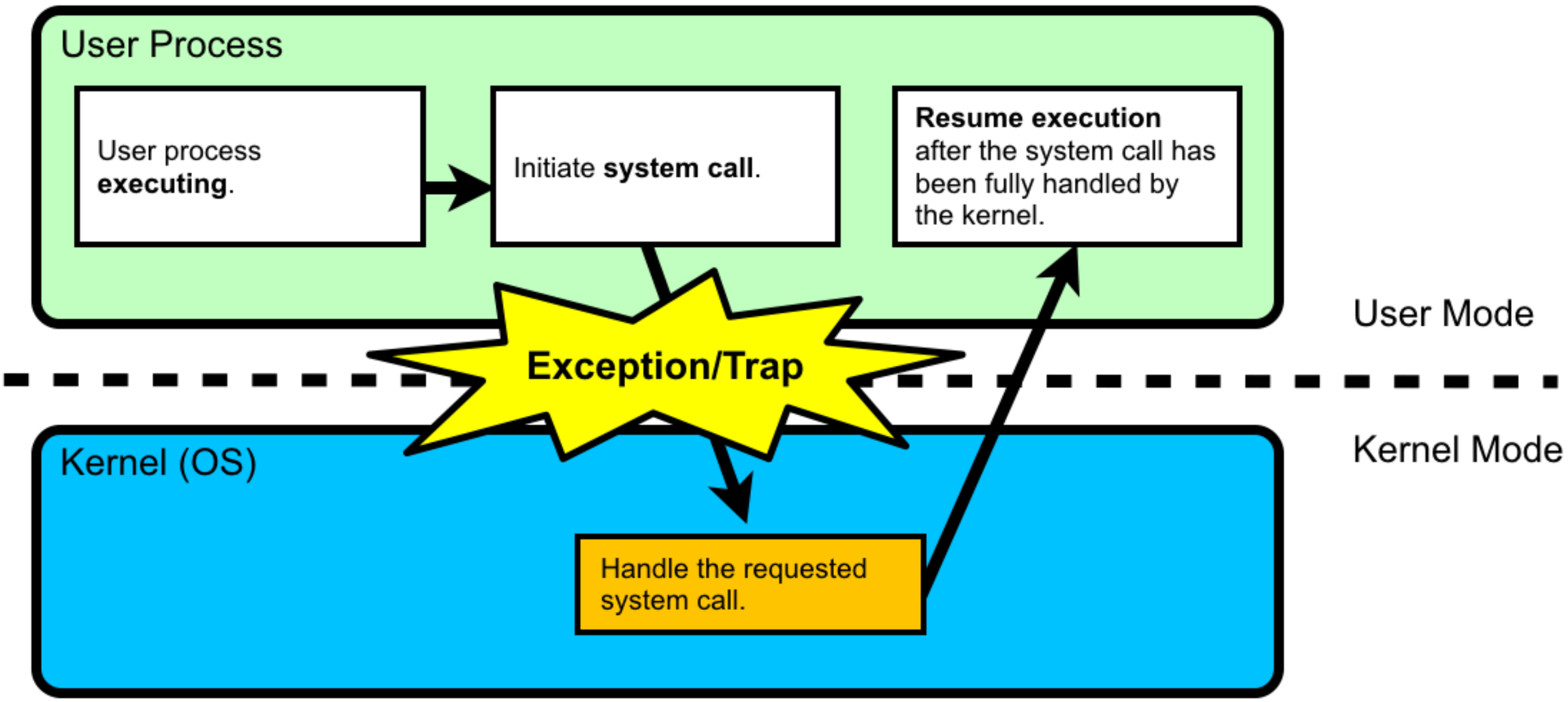
System calls

Services

Computer hardware

System call

A user program requests service from the operating system using system calls. System calls are implemented using a special system call exception. Another name for exception is trap. System calls forms an interface between user programs and the services provided by an operating system.



User interfaces

System and application programs

GUI

batch

command line

User interfaces

System calls

Services

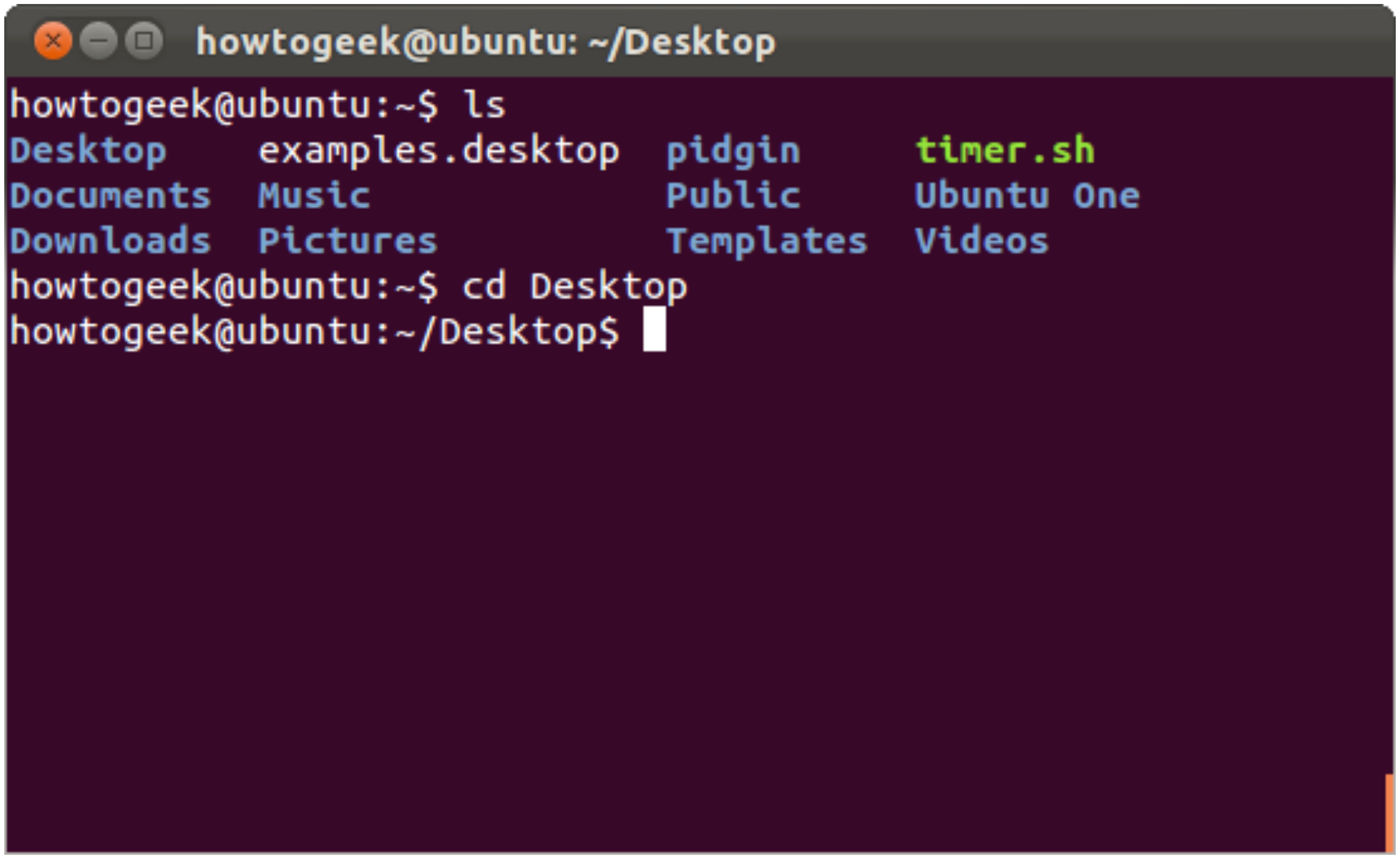
Computer hardware

Graphical user interface (GUI)

Usually a window system with a pointing device to direct I/O, choose from menus and make selections and a keyboard to enter text.

Command line interface (CLI)

A mechanism for interacting with a computer operating system or software by typing commands to perform specific tasks.

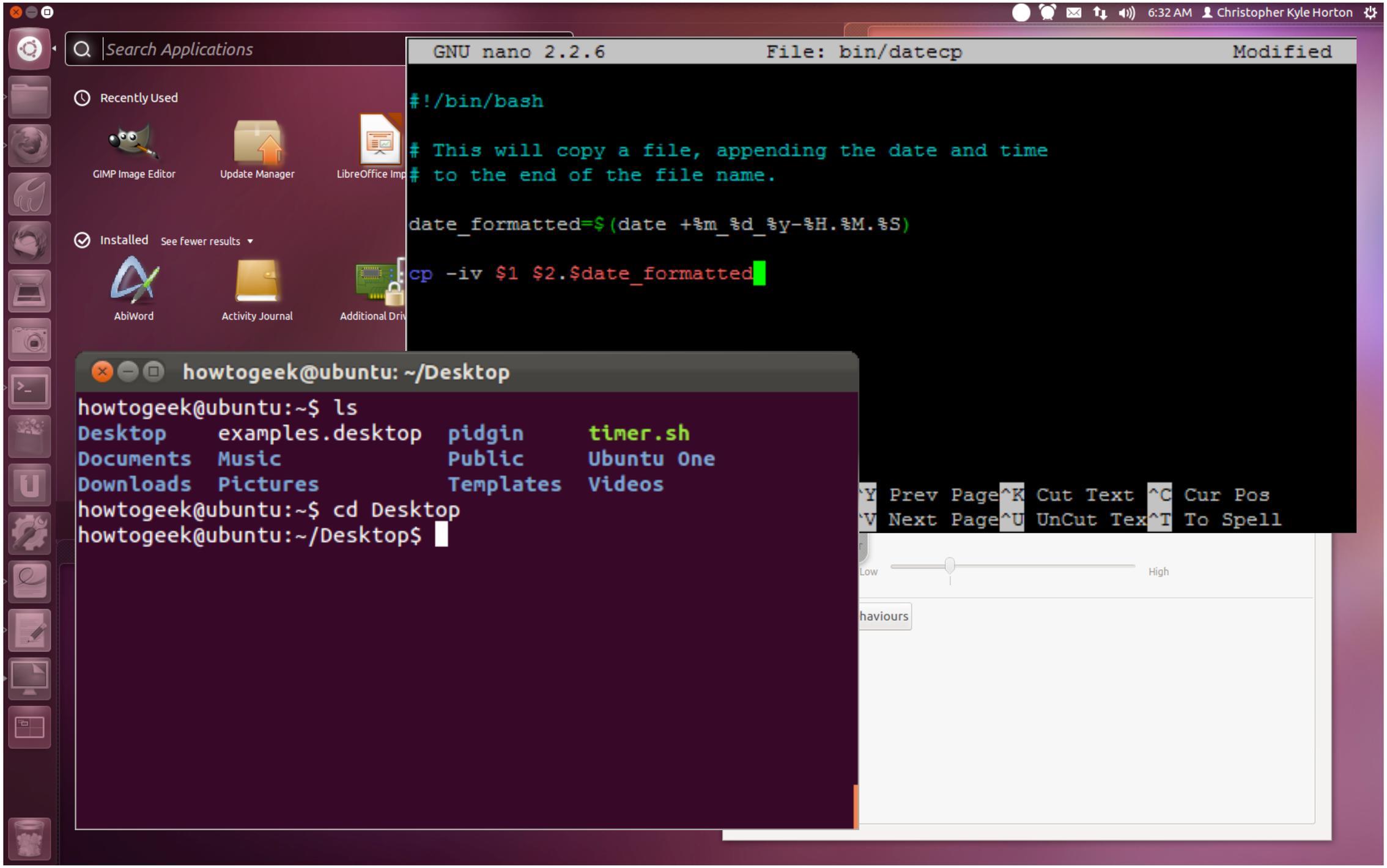


Batch interface (shell scripting)

Commands and directives to control those commands are entered into files, and those files are executed.

GUI + CLI + Batch

Many systems now include both CLI, Batch and GUI interfaces



Services

System and application programs

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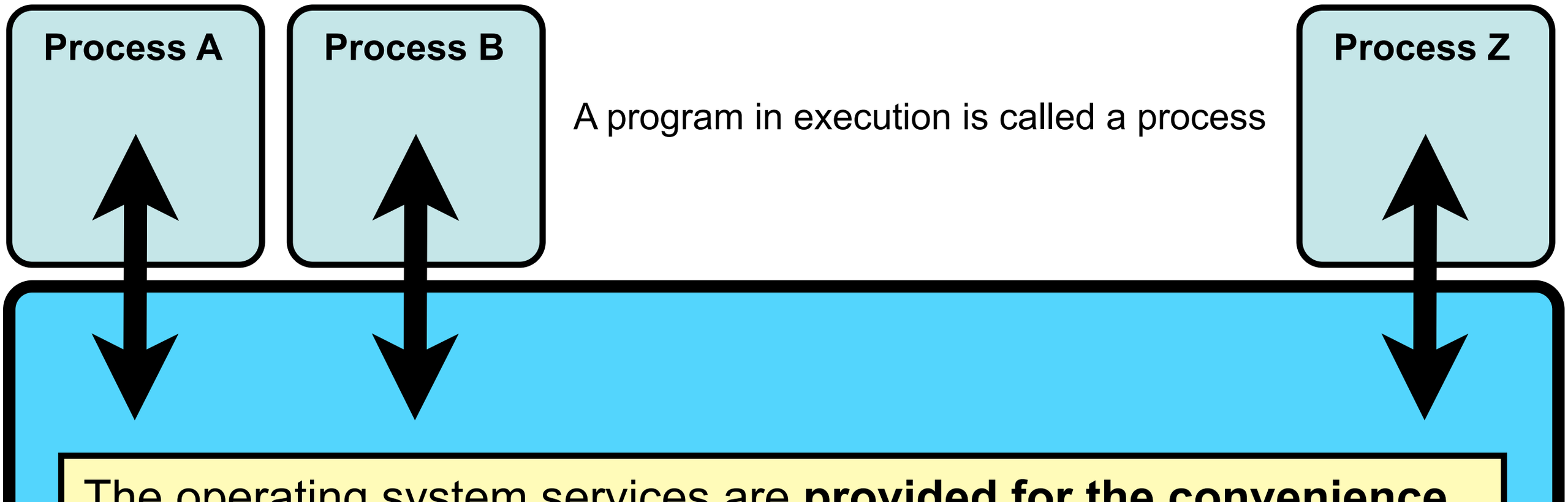
Process A
Process B
A program in execution is called a process
Process Z
The operating system services are **provided for the convenience of the programmer**, to make the programming task easier.
One set of services provides functions that are **helpful to the user**.
Another set of services for **ensuring the efficient operation of the system itself**.
Systems with multiple users can gain efficiency by sharing the computer resources among the users.

System and application programs

GUI

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program execution

I/O operations

communication

helpful for the user

error detection

file systems

Services

ensuring the efficient operation of the system itself

Computer hardware

Program execution

The system must be able to **load** a program into memory and to **run** that program. The program must be able to **end** its execution, either normally or abnormally (indicating error).

I/O operations

For **efficiency** and **protection**, users usually cannot control I/O devices directly. Therefore, the operating system must provide a means to do I/O.

File systems

Programs needs to **read** and **write** files and directories. They also need to **create** and **delete** them by name, **search** for a given file and list file information. May want to **restrict access** to files or directories based on ownership.

Communication

Processes needs to exchange information.
Communication can be implemented via **shared memory** or through **message passing**.

Error detection

Errors may occur in the CPU and memory hardware, in I/O devices (network failure, out of paper, etc...) and in user programs (arithmetic overflow, attempts to access an illegal memory location).

For each type of error, the operating system should take the appropriate action to ensure correct an consistent computing.

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resource allocation

accounting

ensuring the efficient operation of the system itself

protection and security

Services

Computer hardware

Resource allocation

When there are multiple users or multiple jobs running at the same time, resources must be allocated to each of them. Critical resources:

- ★ CPU time
- ★ main memory
- ★ file storage

Accounting

May want to keep track of which users use how much and what kind of resources. Could be useful for **billing** or for usage **statistics**.

Protection and security

When several separate processes execute concurrently, **it should not be possible for one process to interfere with the others or with the operating system itself**. Security of the system from outsiders is also important.

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