جامعة الحسين التقنية
Al Hussein Technical University

ASSIGNMENT BRIEF

HTU Course No: 40201341	**HTU Course Name:** Operating Systems
BTEC Unit Code: R/615/1700	**BTEC UNIT Name:** Operating Systems

Version: 3

Student Name/ID Number/Section	
HTU Course Number and Title	40201341 Operating Systems
BTEC Unit Code and Title	R/615/1700 Operating Systems
Academic Year	2023-2024 Fall
Assignment Author	Malek Louzi
Course Tutor	Sultan Alrushdan - Samer Suleiman - Malek Louzi - Mohammad Yahia
Assignment Title	Operating System Analysis
Assignment Ref No	1
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Submission Date	29/01/2024
IV Name & Date	Razan AlQuran 29/11/2023

Submission Format

The submission of this assignment consists of Four parts:

- An individual written report that has a solution for tasks that ends with the word (**Report**).
- A full working source code for tasks that require code implementation, these tasks will end with the word (**Code**).
- **Discussion** with your instructor (and any other witness) about the submitted work.
- A signed declaration form.

Unit Learning Outcomes

LO1 Investigate different Operating Systems, their functions and user interfaces.

LO2 Explore the processes managed by an Operating System.

LO3 Demonstrate the use of DOS, Windows, UNIX and Linux.

LO4 Analyse appropriate techniques and technologies used in distributed and concurrent systems.

Assignment Brief and Guidance

· You are required to submit a well formatted **Word version** report that provides a complete answer for all required report tasks.

· Full and clear answers for all required tasks, mention the task number and the subtask number before each answer**.**

· Soft-copy submissions are only allowed, you are required to upload your submission files to the university's eLearning platform through (https://elearning.htu.edu.jo/) within the submission date and time stated above. **NO SUBMISSION by EMAIL and NO LATE SUBMISSIONS WILL BE ACCEPTED.**

· If you commit any kind of plagiarism, HTU policies and regulations will be applied.

· The oral discussion will be scheduled by your intructor after the assignment deadline.

· The attendance of the oral discussion is mandatory in the date and time determined by your instructor, the exact discussion schedule will be announced after your submission, and you need to be ready to open your camera from the beginning of the discussion.

Scenario

you are working as a junior computer science specialist in one of big companies in Jordan. As part of your responsibilities, you have been assigned to clarify the Operating Systems role in computer science by answering the following five tasks.

Part 1 of the Assignment

Task 1 (**Report**):

Investigate the process of job scheduling by considering a set of processes with the following burst times (in milliseconds) and arrival times (in milliseconds):

Process	Arrival Time	Burst Time	Priority
P1	0	8	3
P2	1	6	1
P3	2	10	2
P4	3	4	4

Assume a time quantum of 4 milliseconds for the Round-Robin scheduling algorithm.

1. **Round Robin (RR):** Implement the Round Robin scheduling algorithm and provide the sequence of execution for the given time quantum.
2. **Priority Scheduling:** Implement Priority Scheduling (preemptive) and provide the sequence of execution. Use the priority values given for each process.
3. **SJF Preemptive:** Implement Shortest Job First (SJF) scheduling algorithm with preemptive mode and provide the sequence of execution.
4. **SJF Non-Preemptive:** Implement Shortest Job First (SJF) scheduling algorithm in non-preemptive mode and provide the sequence of execution.

Answer the following questions for each scheduling algorithm:

- **Turnaround Time:** Calculate the turnaround time for each process.
- **Waiting Time:** Calculate the waiting time for each process.
- **Average Turnaround Time and Waiting Time:** Calculate the average turnaround time and average waiting time for all the processes.

Task 2 (**Code and Report**):

Illustrate the importance of process management by implementing a shared buffer with a maximum size of 5 slots for integer data. Implement a solution to the producer-consumer problem with the following specifications:

1. There are two types of processes: producers and consumers.
2. Multiple producers can produce items concurrently, and multiple consumers can consume items concurrently.
3. The buffer can hold a maximum of 5 items at a time.
4. Producers and consumers must synchronize to ensure the correct functioning of the buffer.

Specifications:

- **Buffer Size:** 5 slots

- **Number of Producers:** 2
- **Number of Consumers:** 3
- **Producer Speed:** Each producer produces an item every 2 seconds.
- **Consumer Speed:** Each consumer consumes an item every 3 seconds.
- **Producer 1:** Will always writes integer values from 1 to 3.
- **Producer 2:** Will always writes integer values from 4 to 6.
- **Consumers:** read and Print the value on terminal.

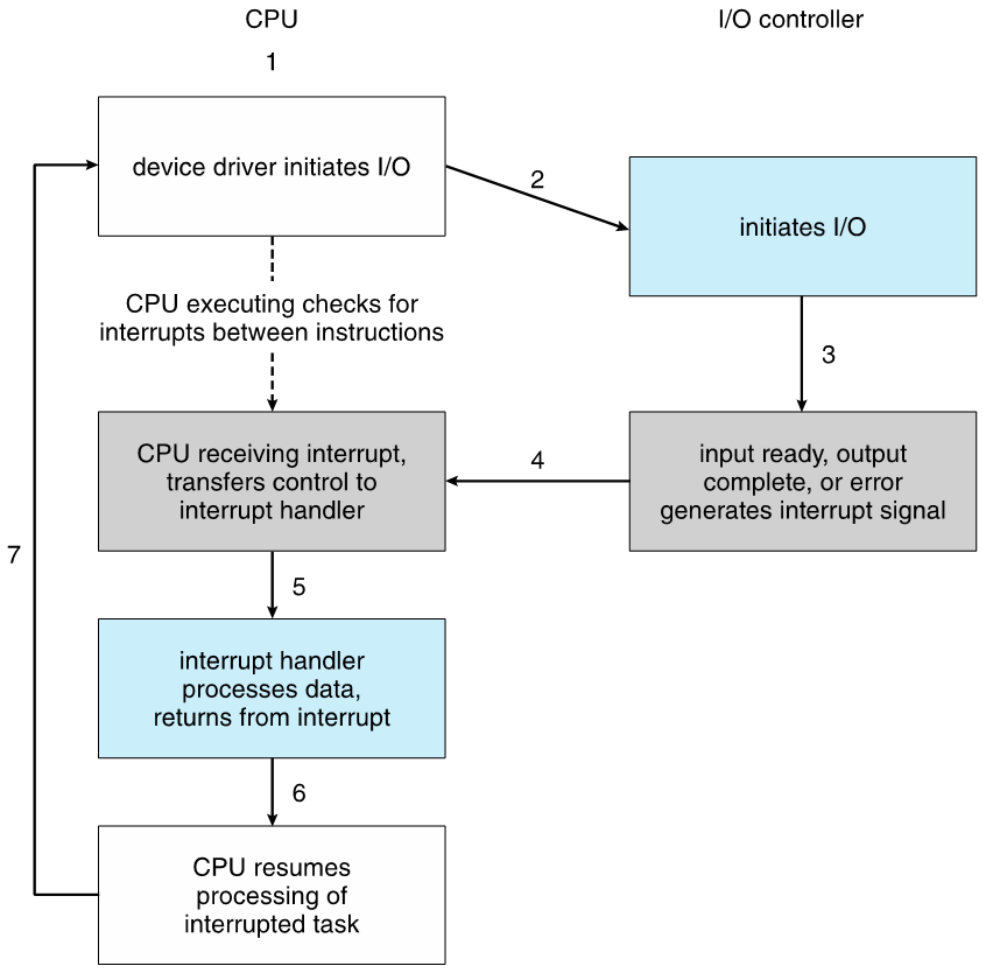
Instructions:

1. Using C language under Linux, implement a solution to the producer-consumer problem using synchronization mechanism that we used in the lab. (**Code**)
2. Provide a diagram to show relationships between processes. (**Report**)

Task 3 (**Report**):

In reference to the below figure, rearrange the following points to show their sequence in action and describe what are they and what is the OS role in each one of them:

- Interrupt Service Routine.
- Device diver.
- Interrupt signal.
- Interrupt vector table.



Task 4 (**Report**):

Research the evolution of the operating system scheduler, specifically in Multilevel Queue and Multi level feedback queue, what are their benefits over the traditional scheduling algorithm mentioned in Task 1.

Task 5 (**Report**):

suppose you have the following two C programs:

prgram1.c

```c
#include <stdio.h>

int main()
{

    int n;
    scanf("%d",&n);

    if(n > 0)
    {
        function1();
    }
    else
    {
        function2();
    }

    return 0;
}
```

function1.c

```
11110000
```

function2.c

```
00001111
```

program2.c

```c
#include <stdio.h>

int main()
{

    int n;
    scanf("%d",&n);

    if(n > 0)
    {
        function3();
    }

    function4();

    return 0;
}
```

function3.c

```
1010 1111
```

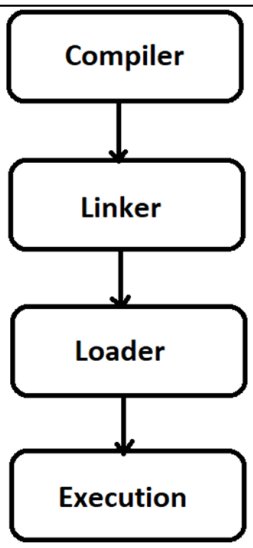
function4.c

```
1010 0000
```

Program1 will use function1 and function2 which their implementations are available in two different files, also Program 2 will use function3 and function4 which their implementations are available in two different files.

Hint: functions 1,2,3 and 4 are not shared functions, they are implemented by the programmers, but scanf function is a shared function for any C programmer.

Dynamic linking and dynamic loading are techniques used in operating systems to improve program efficiency and flexibility; you need to discuss their importance by answering the following questions according to the stages showed in the below figure:



1. What will happen during the stages if we didn't apply dynamic linking and dynamic loading.
2. What will happen during the stages after if we apply dynamic linking and dynamic loading.

Part 2 of the Assignment

Task 1:

Explain the concept of virtual memory and its role in the memory management process of operating systems, and how does virtual memory enhance the overall system performance.

Task 2:

Critically evaluate the memory management functionality of operating system that applies paging by solving the following task, after that you are requested to give an example of two operating systems of your choice that apply paging and mention if there are any differences in applying this concept.
Suppose you have a process that will take a 44-bit address space, and paging is applied in the memory management with 16 KB page size, and the entry size of the page table is 16 Bytes, answer the following:

1. What is the number of page tables required for this process.
2. From the CPU side, explain how the logical address will be divided and what will be the number of bits for each part.
3. Based on your solution in section (b), reflect where each part of the logical adders will be used for.

P. S. you should provide a clear step-by-step solution to your answers.

Task 3:

You have been asked to set up user accounts, groups, and file access controls on a Linux server as the primary system administrator in a corporate setting. A new group of workers called "TechTeam," a specialized team, is being formed by the organization. The group will work together on a project stored in the "project_files" directory. (you need to provide a screen shot for each part of the following 10 parts)

1. Run the required instructions to create the "karam" user account and set a strong password. Subsequently, extend the user account creation process to include a second local user named "jane" with heightened security configurations.

2. Your organization has formed a new project team named "TechTeam", contain karam and jane. It is your responsibility to facilitate efficient collaboration between teams.
3. After facilitating cooperation between the team, prepare a dedicated directory for the project called project_files. Two files are included in this directory (File1.txt and File2.txt). Hint: When you create a directory, precede the directory name with (/).
4. After successfully facilitating cooperation between the 'TechTeam' members, and creating the 'project_files' directory with precise file permissions, have you verified and set the correct group ownership for the 'project_files' directory and its contents, ensuring that the 'TechTeam' group has the necessary access for seamless collaboration, while maintaining security standards?"
5. In your role as the system administrator, you are tasked with the meticulous design and implementation of precise file permissions within the "project_files" directory, with a focus on tailoring access for the team, with focuses:
    1. Grant users' comprehensive permissions to ensure full control over files and directories.
    2. For groups and others, implement a restrictive access model, allowing only execution permissions.
    3. Develop a strategic allocation of file permissions within the "project_files" directory, afford users read and write capabilities, configure group permissions to read-only, providing a balanced level of access that aligns with collaborative efforts, and impose restricted access for others, ensuring they have no permissions.
6. Validate the implemented permissions to ensure the alignment with the team's operational requirements, and document your rationale for the chosen permissions, elucidating how they contribute to an organized and secure collaborative workspace for the team.
7. As a key team member known as "karam," it is your duty to verify that you have the right to access the files in the "project_files" directory. This validation is in line with the carefully designed file permission architecture, which guarantees smooth cooperation and security. Follow the instructions to determine your access capabilities and report any findings in accordance with the access control policies that have been set up.
8. User Karam has created a secret file called "secret.txt" in the data folder to which only that group has access. Your job is to modify system settings such that you have access to the secret file without the group owner knowing about it. The constraint is that you cannot change access rights to the file and you cannot spy being the root user.
9. In the context of the established file permission architecture within the "project_files" directory, specifically, ensure that users can create and modify their own files within the directory, while preventing them from deleting files owned by other users. solve the question using command.
10. In the final phase of the project, both Karam and Jane completed the tasks requested by the company, and you, as the system administrator, were instructed to remove the accounts of both Karam and Jane along with the directories associated with them.

Task 4:

Repeat parts from 1 to 5 of the previous task (Task 3) under windows using command prompt or MacOS and provide a screenshot for each part.

Task 5:

Discuss what is a distributed operating system and explain how distributed operating systems differ from traditional centralized operating systems. Provide an example of a real-world application that benefit from distributed operating systems.

Task 6:

Discuss the concept of concurrency in operating systems and whether it maximizes or minimizes the performance of the computer. Provide an example of one technique that is used to achieve concurrency.

Task 7:

Explain what Remote Procedure Call (RPC) and Remote Method Invocation in distributed operating systems is and justify how RPC and RMI facilitate the distributed operating system work in a distributed environment.

Task 8:

Cloud computing is the on-demand availability of computer system resources, especially data storage (cloud storage) and computing power, without direct active management by the user. Large clouds often have functions distributed over multiple locations, each of which is a data center.

There are three standard service models in Cloud Computing:

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

Discuss the service models of cloud computing and describe how functionalities and operations of modern and Distributed OS implemented in Cloud Computing Service models.

Learning Outcomes and Assessment Criteria			
Learning Outcome	**Pass**	**Merit**	**Distinction**
LO1 Investigate different Operating Systems, their functions and user interfaces.	**P1** Explore what an Operating System is. **P2** Research the evolution of Operating Systems.	**M1** Discuss the importance of Operating Systems.	**D1** Critically evaluate the functionality, interface design and processes of a range of operating systems.
LO2 Explore the processes managed by an Operating System.	**P3** Research the process of Memory Management in an Operating System **P4** Investigate the process of job scheduling.	**M2** Analyse, with the aid of a diagram, the importance of Resource Management in an Operating System to aid its efficiency.	
LO3 Demonstrate the use of DOS, Windows, UNIX and Linux.	**P5** With an aid of screenshots, prove the use of MS-DOS and Windows. **P6** With an aid of screenshots, prove the use of UNIX and Linux and MacOS.	**M3** Justify the security of each operating system discussed in P5 and P6.	
LO4 Analyse appropriate techniques and technologies used in distributed and concurrent systems.	**P7** Discuss distributed Operating Systems. **P8** Discuss Concurrent Operating Systems.	**M4** Justify which techniques and technologies you would use in a Distributed Operating system.	**D2** Critically evaluate your work and make some recommendations about current Operating Systems and future advancements.

STUDENT ASSESSMENT SUBMISSION AND DECLARATION

When submitting evidence for assessment, each student must sign a declaration confirming that the work is their own

Student name:	**Assessor name:**	
Issue date: 30/11/2023	**Submission date:** 29/01/2024	**Submitted on:**
Programme: Computing		
HTU Course Name: Operating Systems **HTU Course Code:** 40201341	**BTEC Course Title:** Operating Systems **BTEC Course Code:** R/615/1700	
Assignment number and title: 1, Operating System Analysis		

Plagiarism:

Plagiarism is a particular form of cheating. Plagiarism must be avoided at all costs and students who break the rules, however innocently, may be penalised. It is your responsibility to ensure that you understand **correct referencing practices.** As a university level student, you are expected to use appropriate references throughout and keep carefully detailed notes of all your sources of materials for material you have used in your work, including any material downloaded from the Internet. Please consult the relevant unit lecturer or your course tutor if you need any further advice.

I certify that the assignment submission is entirely my own work and I fully understand the consequences of plagiarism. I understand that making a false declaration is a form of malpractice.

Student Name: **Student Signature:**

Date: