LAB ASSIGNMENT-04

Experiment Title: System Calls, VM Detection, and File System Operations using Python

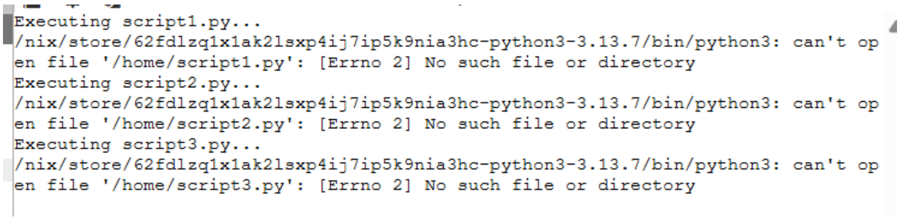
Task 1: Batch Processing Simulation (Python)

Write a Python script to execute multiple .py files sequentially, mimicking batch processing.

Implementation:

```
import subprocess

scripts = ['script1.py', 'script2.py', 'script3.py']

for script in scripts:

    print(f"Executing {script}...")

    subprocess.call(['python3', script])
```

Output:



```
Executing script1.py...
/nix/store/62fdlzq1x1ak2lsxp4ij7ip5k9nia3hc-python3-3.13.7/bin/python3: can't op
en file '/home/script1.py': [Errno 2] No such file or directory
Executing script2.py...
/nix/store/62fdlzq1x1ak2lsxp4ij7ip5k9nia3hc-python3-3.13.7/bin/python3: can't op
en file '/home/script2.py': [Errno 2] No such file or directory
Executing script3.py...
/nix/store/62fdlzq1x1ak2lsxp4ij7ip5k9nia3hc-python3-3.13.7/bin/python3: can't op
en file '/home/script3.py': [Errno 2] No such file or directory
```

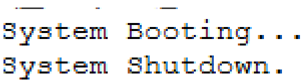
Task 2: System Startup and Logging

Simulate system startup using Python by creating multiple processes and logging their start and end into a log file.

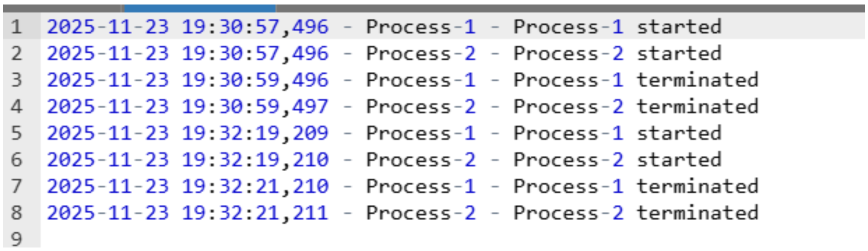
Implementation:

```
import multiprocessing

import logging

import time

logging.basicConfig(filename='system_log.txt', level=logging.INFO,
                    format='%(asctime)s - %(processName)s - %(message)s')
def process_task(name):
    logging.info(f"{name} started")
    time.sleep(2)
    logging.info(f"{name} terminated")
if __name__ == '__main__':
    print("System Booting...")
    p1 = multiprocessing.Process(target=process_task, args=("Process-1",))
    p2 = multiprocessing.Process(target=process_task, args=("Process-2",))
    p1.start()
    p2.start()
    p1.join()
    p2.join()
    print("System Shutdown.")
```

Output:



```
System Booting...
System Shutdown.
```



```
2025-11-23 19:30:57,496 - Process-1 - Process-1 started
2025-11-23 19:30:57,496 - Process-2 - Process-2 started
2025-11-23 19:30:59,496 - Process-1 - Process-1 terminated
2025-11-23 19:30:59,497 - Process-2 - Process-2 terminated
2025-11-23 19:32:19,209 - Process-1 - Process-1 started
2025-11-23 19:32:19,210 - Process-2 - Process-2 started
2025-11-23 19:32:21,210 - Process-1 - Process-1 terminated
2025-11-23 19:32:21,211 - Process-2 - Process-2 terminated
```

Task 3: System Calls and IPC (Python - fork, exec, pipe)

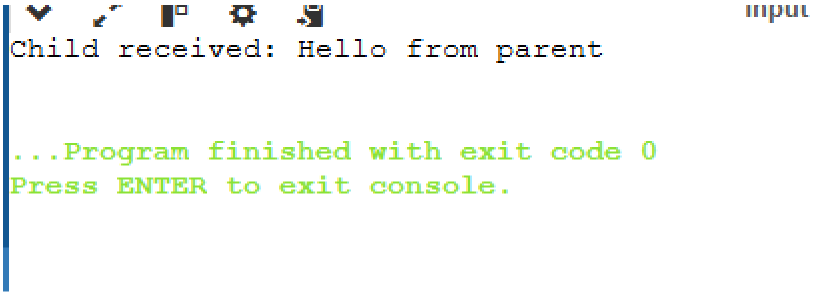
Use system calls (fork(), exec(), wait()) and implement basic Inter-Process Communication using pipes in C or Python.

Implementation:

```
import os
r, w = os.pipe()
```

```
pid = os.fork()

if pid > 0:

    os.close(r)

    os.write(w, b"Hello from parent")

    os.close(w)

    os.wait()

else:

    os.close(w)

    message = os.read(r, 1024)

    print("Child received:", message.decode())

    os.close(r)
```

Output:



```
Child received: Hello from parent


...Program finished with exit code 0
Press ENTER to exit console.
```

Task 4: VM Detection and Shell Interaction

Create a shell script to print system details and a Python script to detect if the system is running inside a virtual machine.

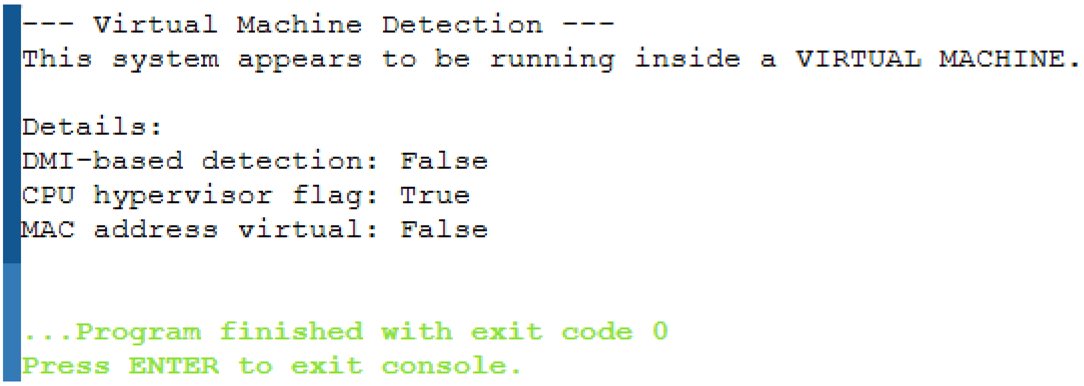
Implementation:

```
#!/bin/bash

echo "Kernel Version:"

uname -r

echo "User:"

whoami

echo "Hardware Info:"

lscpu | grep 'Virtualization'
```

Python Script:

```
import os
import subprocess
def check_dmi():
    """Check system DMI data for known VM identifiers."""
    vm_signatures = ["virtual", "vmware", "kvm", "qemu", "hyper-v", "xen"]
    try:
        output = subprocess.check_output(["sudo", "dmidecode"],
stderr=subprocess.DEVNULL).decode().lower()
        return any(sig in output for sig in vm_signatures)
    except:
        return False
def check_cpu_flags():
    """Check CPU flags for hypervisor bit."""
    try:
        with open("/proc/cpuinfo") as f:
            data = f.read().lower()
        return "hypervisor" in data
    except:
        return False
def check_mac_address():
    """Check if the MAC address belongs to a VM vendor."""
    vm_mac_prefixes = [
        "00:05:69", "00:0C:29", "00:1C:14",   # VMware
        "08:00:27",                           # VirtualBox
        "52:54:00",                           # QEMU / KVM
        "00:15:5D",                           # Hyper-V
    ]
    try:
        output = subprocess.check_output(["ip", "link"]).decode().lower()
        for prefix in vm_mac_prefixes:
            if prefix.lower() in output:
                return True
    except:
        pass
    return False
def detect_vm():
    print("\n--- Virtual Machine Detection ---")
    dmi = check_dmi()
    hypervisor_flag = check_cpu_flags()
    mac_vm = check_mac_address()
    if dmi or hypervisor_flag or mac_vm:
        print("This system appears to be running inside a VIRTUAL MACHINE.")
    else:
        print("This system appears to be running on BARE METAL hardware.")
    print("\nDetails:")
    print(f"DMI-based detection: {dmi}")
    print(f"CPU hypervisor flag: {hypervisor_flag}")
    print(f"MAC address virtual: {mac_vm}")
if __name__ == "__main__":
    detect_vm()
```

Output:



```
--- Virtual Machine Detection ---
This system appears to be running inside a VIRTUAL MACHINE.

Details:
DMI-based detection: False
CPU hypervisor flag: True
MAC address virtual: False


...Program finished with exit code 0
Press ENTER to exit console.
```

Task 5: CPU Scheduling Algorithms

Implement FCFS, SJF, Round Robin, and Priority Scheduling algorithms in Python to calculate WT and TAT.

Implementation:

“””FCFS Scheduling:”””

```
def fcfs(processes):
    processes.sort(key=lambda x: x['arrival'])
    time = 0
    for p in processes:
        if time < p['arrival']:
            time = p['arrival']
        p['wt'] = time - p['arrival']
        time += p['burst']
        p['tat'] = p['wt'] + p['burst']
    return processes
```

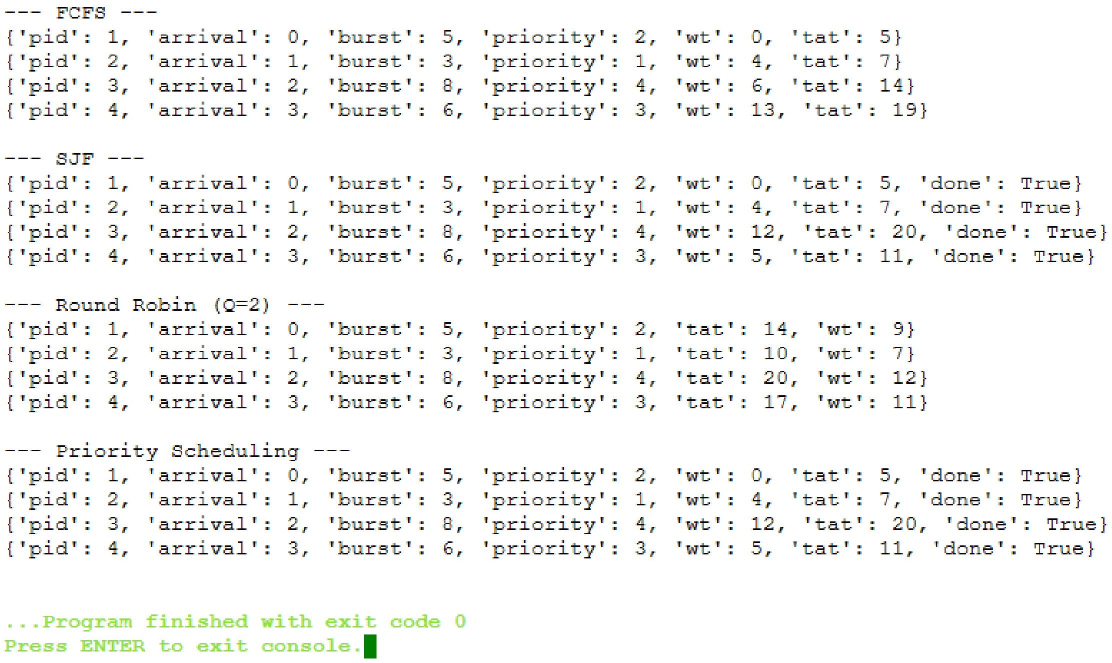
“””SJF Scheduling”””

```
def sjf(processes):
    processes = sorted(processes, key=lambda x: x['arrival'])
    completed, time = 0, 0
    n = len(processes)
    while completed < n:
        available = [p for p in processes if p['arrival'] <= time and 'done' not in p]
        if not available:
            time += 1
            continue
        p = min(available, key=lambda x: x['burst'])
        p['wt'] = time - p['arrival']
        time += p['burst']
        p['tat'] = p['wt'] + p['burst']
        p['done'] = True
        completed += 1
    return processes
“””Round robin”””
def round_robin(processes, quantum):
    from collections import deque
    q = deque()
    time = 0
    remaining = {p['pid']: p['burst'] for p in processes}
    processes.sort(key=lambda x: x['arrival'])
    i = 0
    completed = 0
    n = len(processes)
    while completed < n:
        while i < n and processes[i]['arrival'] <= time:
            q.append(processes[i])
            i += 1
        if not q:
            time = processes[i]['arrival']
            continue
        p = q.popleft()
        exec_time = min(quantum, remaining[p['pid']])
        remaining[p['pid']] -= exec_time
        time += exec_time
        while i < n and processes[i]['arrival'] <= time:
            q.append(processes[i])
            i += 1
        if remaining[p['pid']] == 0:
            p['tat'] = time - p['arrival']
            p['wt'] = p['tat'] - p['burst']
            completed += 1
        else:
            q.append(p)
    return processes
```

“””Priority Scheduling”””

```
def priority_scheduling(processes):
    time = 0
    completed = 0
    n = len(processes)
    processes.sort(key=lambda x: x['arrival'])
    while completed < n:
        available = [p for p in processes if p['arrival'] <= time and 'done' not in p]
        if not available:
            time += 1
            continue
        p = min(available, key=lambda x: x['priority'])
        p['wt'] = time - p['arrival']
        time += p['burst']
        p['tat'] = p['wt'] + p['burst']
        p['done'] = True
        completed += 1
    return processes


processes = [
    {'pid': 1, 'arrival': 0, 'burst': 5, 'priority': 2},
    {'pid': 2, 'arrival': 1, 'burst': 3, 'priority': 1},
    {'pid': 3, 'arrival': 2, 'burst': 8, 'priority': 4},
    {'pid': 4, 'arrival': 3, 'burst': 6, 'priority': 3},
]
import copy
print("\n--- FCFS ---")
for p in fcfs(copy.deepcopy(processes)):
    print(p)
print("\n--- SJF ---")
for p in sjf(copy.deepcopy(processes)):
    print(p)
print("\n--- Round Robin (Q=2) ---")
for p in round_robin(copy.deepcopy(processes), quantum=2):
    print(p)
print("\n--- Priority Scheduling ---")
for p in priority_scheduling(copy.deepcopy(processes)):
    print(p)
```

Output:



```
--- FCFS ---
{'pid': 1, 'arrival': 0, 'burst': 5, 'priority': 2, 'wt': 0, 'tat': 5}
{'pid': 2, 'arrival': 1, 'burst': 3, 'priority': 1, 'wt': 4, 'tat': 7}
{'pid': 3, 'arrival': 2, 'burst': 8, 'priority': 4, 'wt': 6, 'tat': 14}
{'pid': 4, 'arrival': 3, 'burst': 6, 'priority': 3, 'wt': 13, 'tat': 19}

--- SJF ---
{'pid': 1, 'arrival': 0, 'burst': 5, 'priority': 2, 'wt': 0, 'tat': 5, 'done': True}
{'pid': 2, 'arrival': 1, 'burst': 3, 'priority': 1, 'wt': 4, 'tat': 7, 'done': True}
{'pid': 3, 'arrival': 2, 'burst': 8, 'priority': 4, 'wt': 12, 'tat': 20, 'done': True}
{'pid': 4, 'arrival': 3, 'burst': 6, 'priority': 3, 'wt': 5, 'tat': 11, 'done': True}

--- Round Robin (Q=2) ---
{'pid': 1, 'arrival': 0, 'burst': 5, 'priority': 2, 'tat': 14, 'wt': 9}
{'pid': 2, 'arrival': 1, 'burst': 3, 'priority': 1, 'tat': 10, 'wt': 7}
{'pid': 3, 'arrival': 2, 'burst': 8, 'priority': 4, 'tat': 20, 'wt': 12}
{'pid': 4, 'arrival': 3, 'burst': 6, 'priority': 3, 'tat': 17, 'wt': 11}

--- Priority Scheduling ---
{'pid': 1, 'arrival': 0, 'burst': 5, 'priority': 2, 'wt': 0, 'tat': 5, 'done': True}
{'pid': 2, 'arrival': 1, 'burst': 3, 'priority': 1, 'wt': 4, 'tat': 7, 'done': True}
{'pid': 3, 'arrival': 2, 'burst': 8, 'priority': 4, 'wt': 12, 'tat': 20, 'done': True}
{'pid': 4, 'arrival': 3, 'burst': 6, 'priority': 3, 'wt': 5, 'tat': 11, 'done': True}


...Program finished with exit code 0
Press ENTER to exit console.
```