INSTITUTE OF ENGINEERING AND TECHNOLOGY , INDORE

DEPARTMENT OF INFORMATION TECHNOLOGY

LAB ASSIGNMENT OF OPERATING SYSTEM

SUBJECT CODE: 4ITRC2

LAB ASSIGNMENT - 05

NAME : AAYUSH SAHU

ROLLNO : 23I4101

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1. First Come First Serve (FCFS) Scheduling

This scheduling algorithm processes jobs in the order they arrive.

- **Definition**: FCFS is the simplest CPU scheduling algorithm. The process that arrives first in the queue gets executed first. It operates like a queue (FIFO - First In, First Out).
- **Working**:
  - The CPU is allocated to the process that arrives first.
  - Once a process starts execution, it runs until completion (non-preemptive).
- **Advantages**:
  - Simple and easy to implement.
  - Fair as it executes processes in order of arrival.
- **Disadvantages**:
  - **Convoy Effect**: A short job may have to wait for a long job to finish.
  - Poor average waiting time when long processes arrive first.

Code:

```
#include <stdio.h>

void findWaitingTime(int processes[], int n, int bt[], int wt[]) {
    wt[0] = 0; // First process has no waiting time
    for (int i = 1; i < n; i++)
        wt[i] = bt[i - 1] + wt[i - 1];
}

void findTurnAroundTime(int processes[], int n, int bt[], int wt[], int tat[]) {
    for (int i = 0; i < n; i++)
        tat[i] = bt[i] + wt[i];
}
```

```
void findAverageTime(int processes[], int n, int bt[]) {
    int wt[n], tat[n];
    findWaitingTime(processes, n, bt, wt);
    findTurnAroundTime(processes, n, bt, wt, tat);

    printf("Processes  Burst Time  Waiting Time  Turnaround Time\n");
    for (int i = 0; i < n; i++)
        printf("%d          %d          %d          %d\n", processes[i], bt[i], wt[i], tat[i]);

    float total_wt = 0, total_tat = 0;
    for (int i = 0; i < n; i++) {
        total_wt += wt[i];
        total_tat += tat[i];
    }

    printf("\nAverage waiting time = %.2f", total_wt / n);
    printf("\nAverage turnaround time = %.2f\n", total_tat / n);
}

int main() {
    int processes[] = {1, 2, 3};
    int n = sizeof processes / sizeof processes[0];
    int burst_time[] = {10, 5, 8};

    findAverageTime(processes, n, burst_time);
    return 0;
}
```

- **Output**:

```
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D:\operating system>cd "d:\operating system\" && gcc fcfs.c -o fcfs && "d:\operating system\"fcfs

Process Burst Time      Waiting Time    Turnaround Time
1       6               0               6
2       8               6               14
3       7               14              21
4       3               21              24

Average Waiting Time: 10.25
Average Turnaround Time: 16.25
d:\operating system>
```

2. Shortest Job First (SJF) Scheduling

SJF schedules jobs based on the shortest burst time.

- **Definition**: SJF selects the process with the smallest burst time and executes it first. It can be **preemptive** (interruptible) or **non-preemptive** (once started, it runs till completion).
- **Working**:
  - The process with the shortest execution time is selected first.
  - If two processes have the same burst time, FCFS is used.
- **Advantages**:
  - Gives the lowest average waiting time.
  - Efficient CPU utilization.
- **Disadvantages**:
  - **Starvation**: Long processes may never get executed if short processes keep arriving.
  - Requires prior knowledge of burst times, which may not always be possible.
- **Code**:


```
#include <stdio.h>

void findWaitingTime(int processes[], int n, int bt[], int wt[]) {
    wt[0] = 0;
    for (int i = 1; i < n; i++)
        wt[i] = bt[i - 1] + wt[i - 1];
}
```

```
void findTurnAroundTime(int processes[], int n, int bt[], int wt[], int tat[]) {
    for (int i = 0; i < n; i++)
        tat[i] = bt[i] + wt[i];
}

void findAverageTime(int processes[], int n, int bt[]) {
    int wt[n], tat[n];
    findWaitingTime(processes, n, bt, wt);
    findTurnAroundTime(processes, n, bt, wt, tat);

    printf("Processes  Burst Time  Waiting Time  Turnaround Time\n");
    for (int i = 0; i < n; i++)
        printf("%d          %d          %d          %d\n", processes[i], bt[i], wt[i], tat[i]);

    float total_wt = 0, total_tat = 0;
    for (int i = 0; i < n; i++) {
        total_wt += wt[i];
        total_tat += tat[i];
    }

    printf("\nAverage waiting time = %.2f", total_wt / n);
    printf("\nAverage turnaround time = %.2f\n", total_tat / n);
}

void sortProcessesByBurstTime(int processes[], int bt[], int n) {
    for (int i = 0; i < n - 1; i++)
        for (int j = i + 1; j < n; j++)
            if (bt[i] > bt[j]) {
                int temp = bt[i];
                bt[i] = bt[j];
                bt[j] = temp;
```

```
            temp = processes[i];
            processes[i] = processes[j];
            processes[j] = temp;
        }
}

int main() {
    int processes[] = {1, 2, 3};
    int n = sizeof processes / sizeof processes[0];
    int burst_time[] = {6, 8, 7};

    sortProcessesByBurstTime(processes, burst_time, n);
    findAverageTime(processes, n, burst_time);
    return 0;
}
```

- **Output**:

```
D:\operating system>cd "d:\operating system\" && gcc sjs.c -o sjs && "d:\operating system\"sjs
Processes  Burst Time  Waiting Time  Turnaround Time
1          6          0           6
3          7          6           13
2          8          13           21

Average waiting time = 6.33
Average turnaround time = 13.33

d:\operating system>
```

3. Round Robin Scheduling

This algorithm executes each job for a fixed time quantum in a cyclic order.

- **Definition**: RR scheduling assigns a fixed time quantum (time slice) to each process in a cyclic order. If a process is not finished within its time slice, it goes to the end of the queue.
- **Working**:
  - A fixed time slice (quantum) is assigned.
  - Each process gets CPU time in a circular manner.
  - If a process doesn't complete within the quantum, it is preempted and moved to the back of the queue.
- **Advantages**:
  - Ensures **fairness** as all processes get equal CPU time.
  - **Avoids starvation** because every process eventually gets executed.
- **Disadvantages**:
  - High context switching overhead if the quantum is too small.
  - If the quantum is too large, it behaves like FCFS.


```
#include <stdio.h>
```

```
void findWaitingTime(int processes[], int n, int bt[], int wt[], int quantum) {
    int rem_bt[n];
    for (int i = 0; i < n; i++)
        rem_bt[i] = bt[i];

    int t = 0;
    while (1) {
        int done = 1;
        for (int i = 0; i < n; i++) {
            if (rem_bt[i] > 0) {
                done = 0;
                if (rem_bt[i] > quantum) {
                    t += quantum;
                    rem_bt[i] -= quantum;
                } else {
                    t += rem_bt[i];
                    wt[i] = t - bt[i];
                    rem_bt[i] = 0;
                }
            }
        }
        if (done)
            break;
    }
}

void findTurnAroundTime(int processes[], int n, int bt[], int wt[], int tat[]) {
    for (int i = 0; i < n; i++)
        tat[i] = bt[i] + wt[i];
}

void findAverageTime(int processes[], int n, int bt[], int quantum) {
```

```
    int wt[n], tat[n];
    findWaitingTime(processes, n, bt, wt, quantum);
    findTurnAroundTime(processes, n, bt, wt, tat);

    printf("Processes  Burst Time  Waiting Time  Turnaround Time\n");
    for (int i = 0; i < n; i++)
        printf("%d          %d          %d          %d\n", processes[i], bt[i], wt[i], tat[i]);

    float total_wt = 0, total_tat = 0;
    for (int i = 0; i < n; i++) {
        total_wt += wt[i];
        total_tat += tat[i];
    }

    printf("\nAverage waiting time = %.2f", total_wt / n);
    printf("\nAverage turnaround time = %.2f\n", total_tat / n);
}

int main() {
    int processes[] = {1, 2, 3};
    int n = sizeof processes / sizeof processes[0];
    int burst_time[] = {24, 3, 3};
    int quantum = 4;

    findAverageTime(processes, n, burst_time, quantum);
    return 0;
}
```

- **Output**:

```
d:\operating system>cd "d:\operating system\" && gcc roundrobin.c -o roundrobin && "d:\operating system\"roundrobin
Processes  Burst Time  Waiting Time  Turnaround Time
1          24          6           30
2          3          4           7
3          3          7           10

Average waiting time = 5.67
Average turnaround time = 15.67
```