Operating Systems

Preemptive scheduling assignment

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Div.: B1 **Branch: Computer Engineering**

Aim -

CPU scheduling algorithms like Preemptive Priority, Round Robin etc.

Problem Statement -

1. Perform comparative assessment of various Scheduling Policies like
2. Priority preemptive and Round Robin.

Theory -

Scheduling algorithms are used when more than one process is executable and the OS has to decide which one to run first.

Terms used

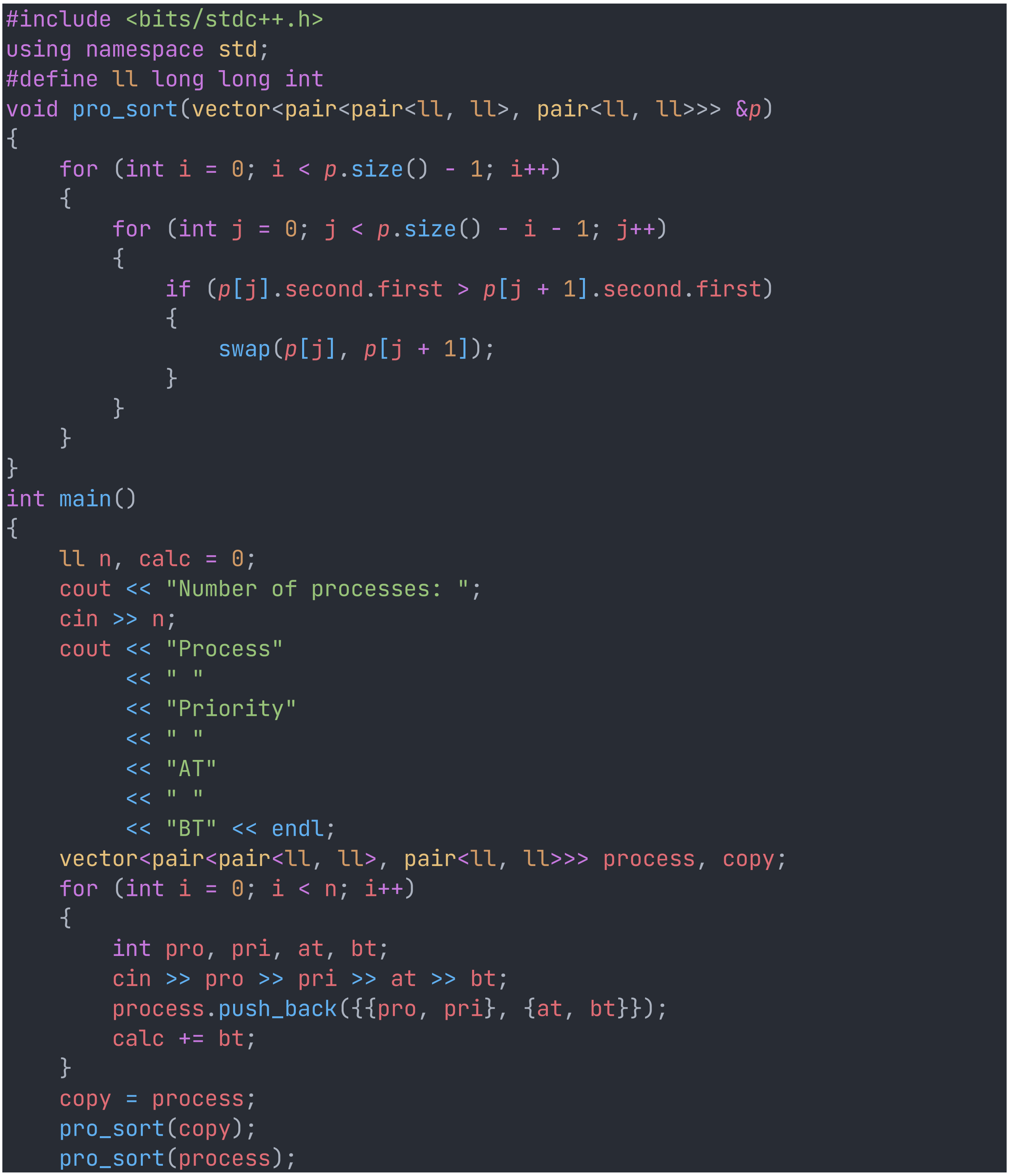
1. Submit time: The process at which the process is given to CPU
2. Burst time: The amount of time each process takes for execution
3. Response time: The difference between the time when the process starts execution and the submit time.
4. Turnaround time: The difference between the time when the process completes execution and the submit time.

Priority Scheduling

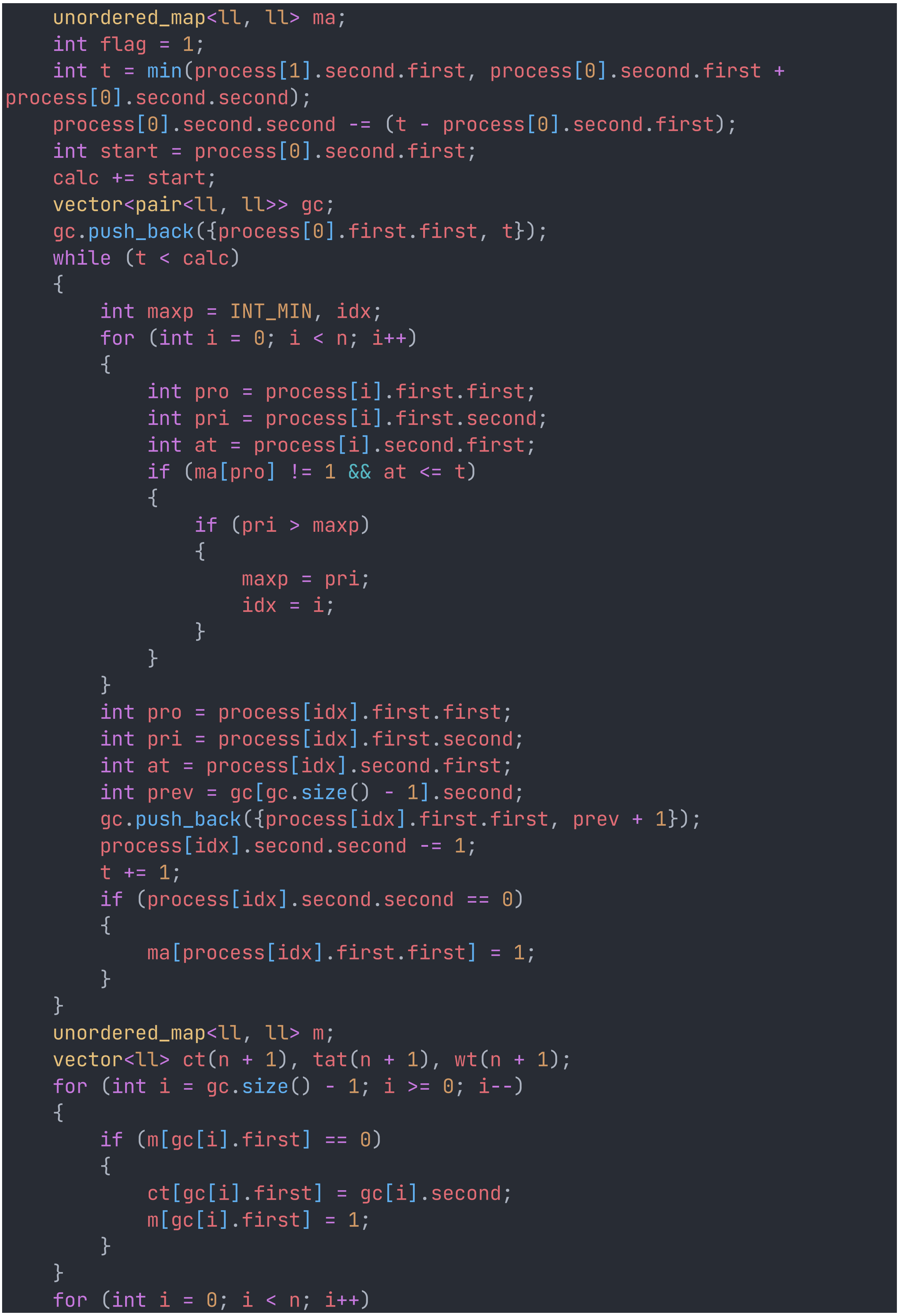
Each process is assigned a priority and executable process with highest priority

is allowed to run

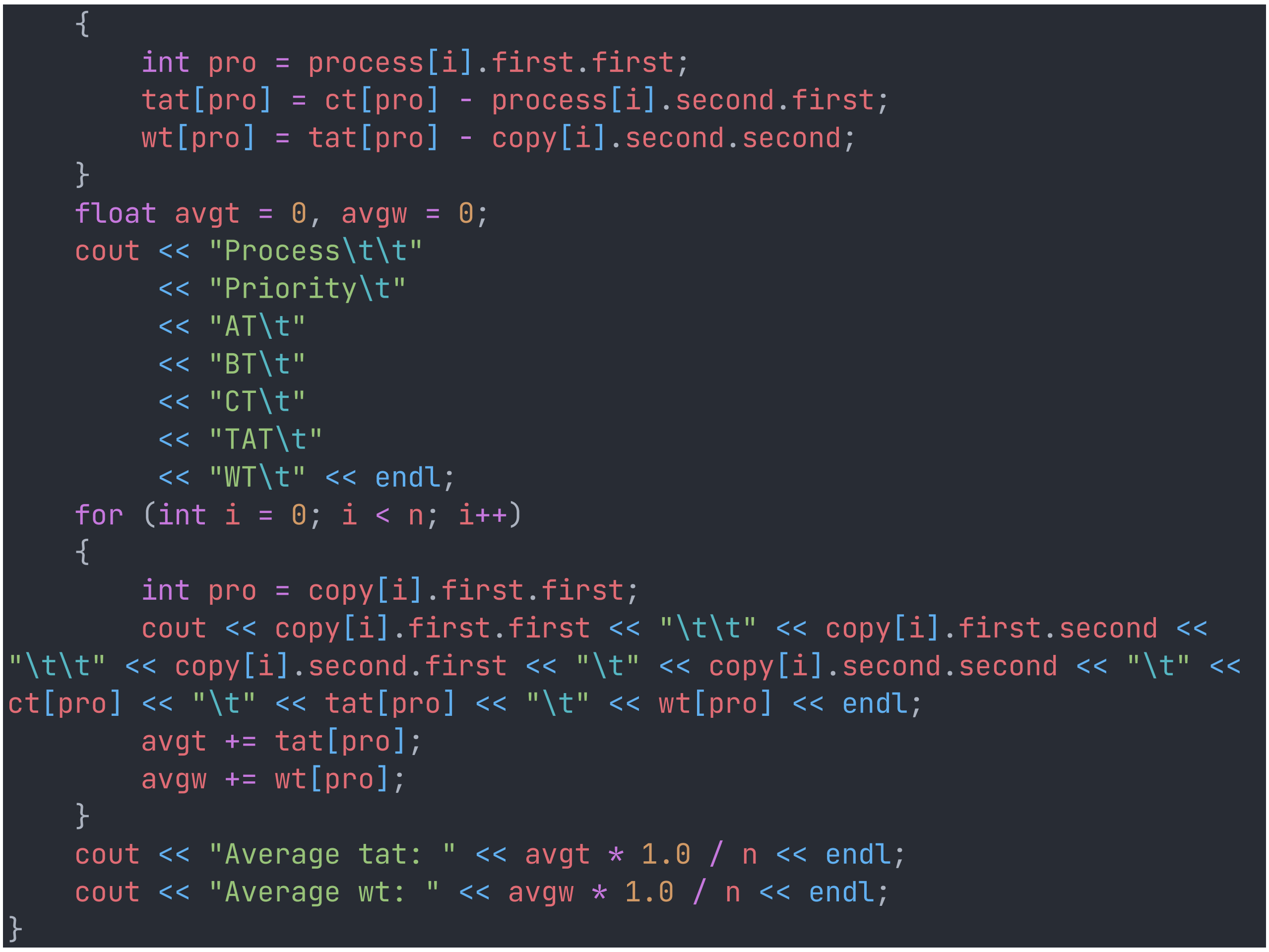
Code –



```cpp
#include <bits/stdc++.h>
using namespace std;
#define ll long long int
void pro_sort(vector<pair<pair<ll, ll>, pair<ll, ll>>> &p)
{
    for (int i = 0; i < p.size() - 1; i++)
    {
        for (int j = 0; j < p.size() - i - 1; j++)
        {
            if (p[j].second.first > p[j + 1].second.first)
            {
                swap(p[j], p[j + 1]);
            }
        }
    }
}
int main()
{
    ll n, calc = 0;
    cout << "Number of processes: ";
    cin >> n;
    cout << "Process"
         << " "
         << "Priority"
         << " "
         << "AT"
         << " "
         << "BT" << endl;
    vector<pair<pair<ll, ll>, pair<ll, ll>>> process, copy;
    for (int i = 0; i < n; i++)
    {
        int pro, pri, at, bt;
        cin >> pro >> pri >> at >> bt;
        process.push_back({{pro, pri}, {at, bt}});
        calc += bt;
    }
    copy = process;
    pro_sort(copy);
    pro_sort(process);
```

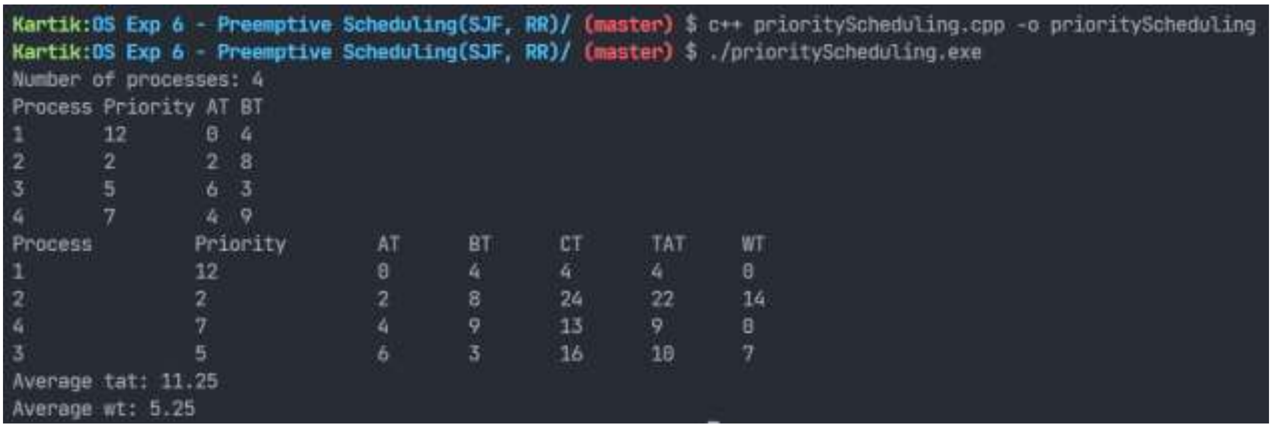


```
    unordered_map<ll, ll> ma;
    int flag = 1;
    int t = min(process[1].second.first, process[0].second.first +
process[0].second.second);
    process[0].second.second -= (t - process[0].second.first);
    int start = process[0].second.first;
    calc += start;
    vector<pair<ll, ll>> gc;
    gc.push_back({process[0].first.first, t});
    while (t < calc)
    {
        int maxp = INT_MIN, idx;
        for (int i = 0; i < n; i++)
        {
            int pro = process[i].first.first;
            int pri = process[i].first.second;
            int at = process[i].second.first;
            if (ma[pro] != 1 && at <= t)
            {
                if (pri > maxp)
                {
                    maxp = pri;
                    idx = i;
                }
            }
        }
        int pro = process[idx].first.first;
        int pri = process[idx].first.second;
        int at = process[idx].second.first;
        int prev = gc[gc.size() - 1].second;
        gc.push_back({process[idx].first.first, prev + 1});
        process[idx].second.second -= 1;
        t += 1;
        if (process[idx].second.second == 0)
        {
            ma[process[idx].first.first] = 1;
        }
    }
    unordered_map<ll, ll> m;
    vector<ll> ct(n + 1), tat(n + 1), wt(n + 1);
    for (int i = gc.size() - 1; i >= 0; i--)
    {
        if (m[gc[i].first] == 0)
        {
            ct[gc[i].first] = gc[i].second;
            m[gc[i].first] = 1;
        }
    }
    for (int i = 0; i < n; i++)
```



```
    {
        int pro = process[i].first.first;
        tat[pro] = ct[pro] - process[i].second.first;
        wt[pro] = tat[pro] - copy[i].second.second;
    }
    float avgt = 0, avgw = 0;
    cout << "Process\t\t"
         << "Priority\t"
         << "AT\t"
         << "BT\t"
         << "CT\t"
         << "TAT\t"
         << "WT\t" << endl;
    for (int i = 0; i < n; i++)
    {
        int pro = copy[i].first.first;
        cout << copy[i].first.first << "\t\t" << copy[i].first.second <<
"\t\t" << copy[i].second.first << "\t" << copy[i].second.second << "\t" <<
ct[pro] << "\t" << tat[pro] << "\t" << wt[pro] << endl;
        avgt += tat[pro];
        avgw += wt[pro];
    }
    cout << "Average tat: " << avgt * 1.0 / n << endl;
    cout << "Average wt: " << avgw * 1.0 / n << endl;
}
```

Output -



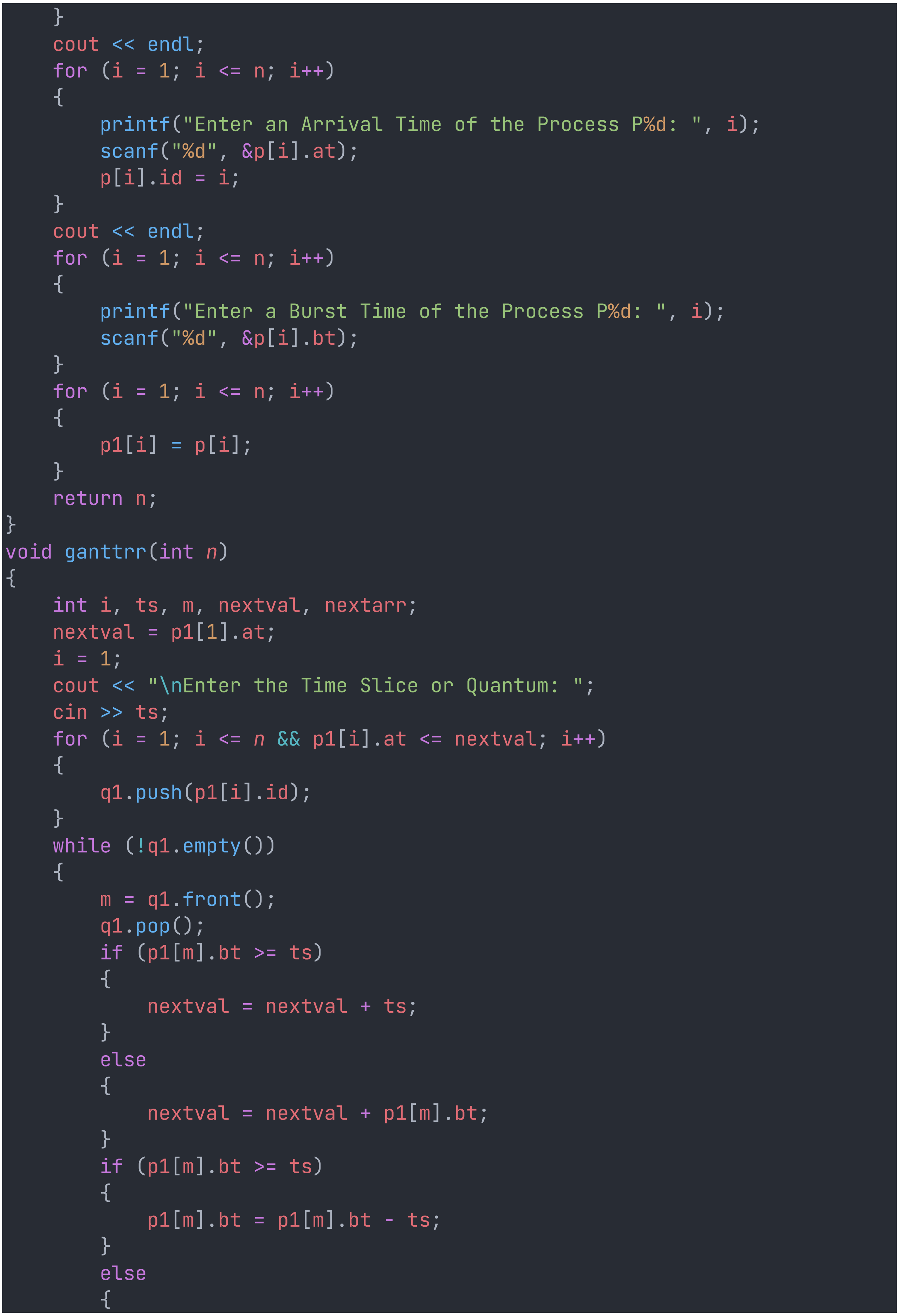
```
Kartik:OS Exp 6 - Preemptive Scheduling(SJF, RR)/ (master) $ c++ priorityScheduling.cpp -o priorityScheduling
Kartik:OS Exp 6 - Preemptive Scheduling(SJF, RR)/ (master) $ ./priorityScheduling.exe
Number of processes: 4
Process Priority AT BT
1       12       0  4
2       2        2  8
3       5        6  3
4       7        4  9
Process         Priority        AT      BT      CT      TAT     WT
1               12              0       4       4       4       0
2               2               2       8       24      22      14
4               7               4       9       13      9       0
3               5               6       3       16      10      7
Average tat: 11.25
Average wt: 5.25
```

Round Robin (RR)

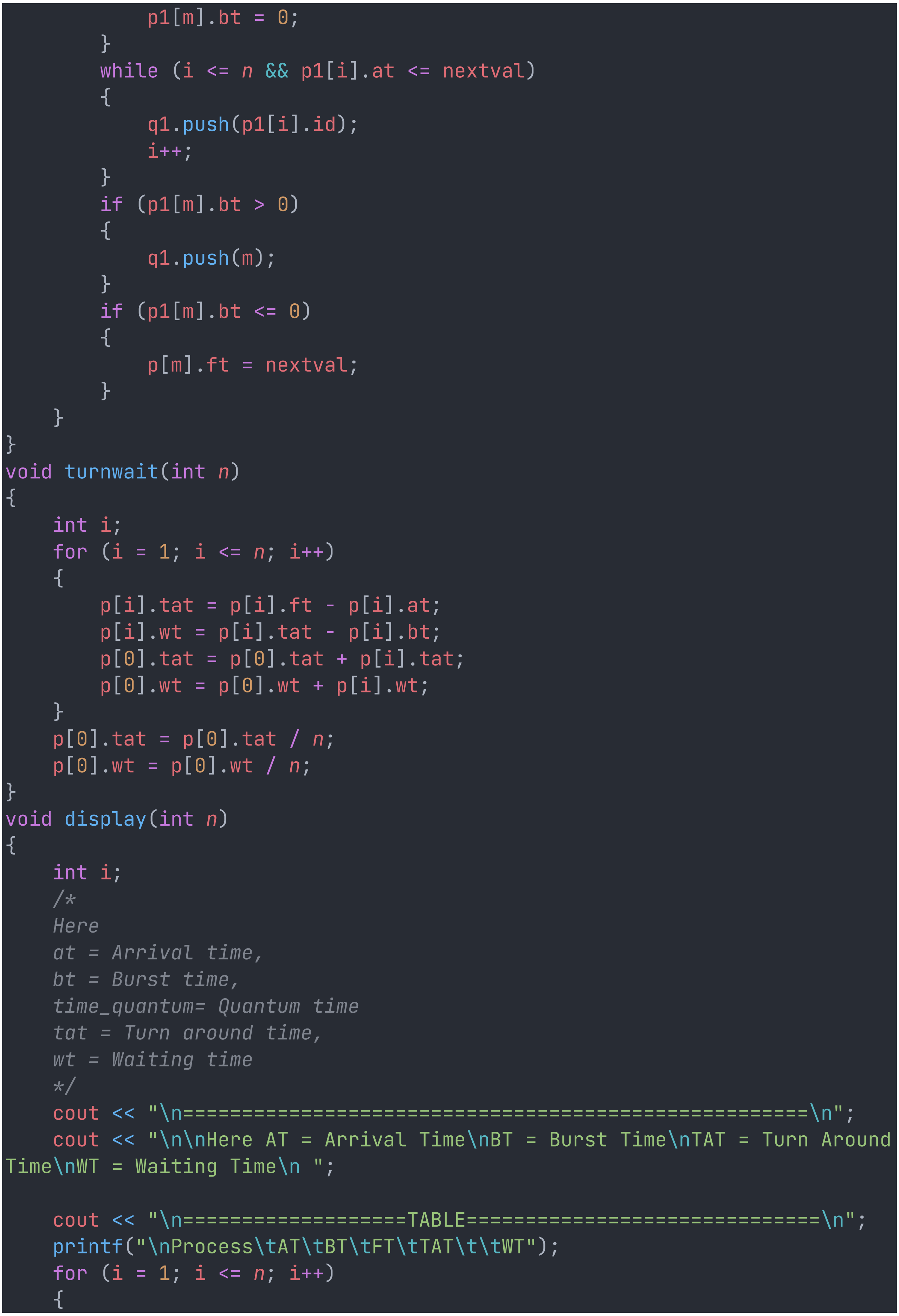
- Each process is assigned a time interval called its quantum (time slice)
- If the process is still running at the end of the quantum the CPU is preempted and given to another process, and this continues in circular fashion, till all the processes are completely executed

Code –

```
#include <iostream>
#include <cstdlib>
#include <queue>
#include <cstdio>
using namespace std;
/* C++ Program to Round Robin*/
typedef struct process
{
    int id, at, bt, st, ft, pr;
    float wt, tat;
} process;
process p[10], p1[10], temp;
queue<int> q1;
int accept(int ch);
void turnwait(int n);
void display(int n);
void ganttrr(int n);
int main()
{
    int i, n, ts, ch, j, x;
    p[0].tat = 0;
    p[0].wt = 0;
    n = accept(ch);
    ganttrr(n);
    turnwait(n);
    display(n);
    return 0;
}
int accept(int ch)
{
    int i, n;
    printf("Enter the Total Number of Process: ");
    scanf("%d", &n);
    if (n == 0)
    {
        printf("Invalid");
        exit(1);
```

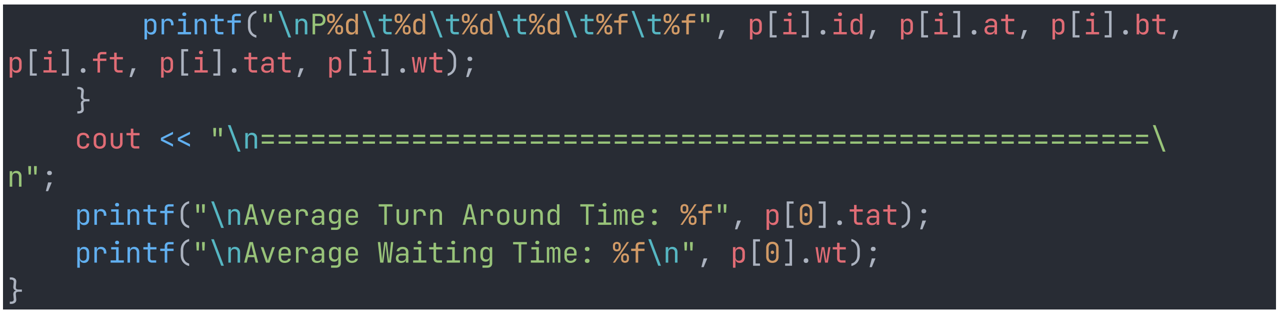


```
    }
    cout << endl;
    for (i = 1; i <= n; i++)
    {
        printf("Enter an Arrival Time of the Process P%d: ", i);
        scanf("%d", &p[i].at);
        p[i].id = i;
    }
    cout << endl;
    for (i = 1; i <= n; i++)
    {
        printf("Enter a Burst Time of the Process P%d: ", i);
        scanf("%d", &p[i].bt);
    }
    for (i = 1; i <= n; i++)
    {
        p1[i] = p[i];
    }
    return n;
}
void ganttrr(int n)
{
    int i, ts, m, nextval, nextarr;
    nextval = p1[1].at;
    i = 1;
    cout << "\nEnter the Time Slice or Quantum: ";
    cin >> ts;
    for (i = 1; i <= n && p1[i].at <= nextval; i++)
    {
        q1.push(p1[i].id);
    }
    while (!q1.empty())
    {
        m = q1.front();
        q1.pop();
        if (p1[m].bt >= ts)
        {
            nextval = nextval + ts;
        }
        else
        {
            nextval = nextval + p1[m].bt;
        }
        if (p1[m].bt >= ts)
        {
            p1[m].bt = p1[m].bt - ts;
        }
        else
        {
```



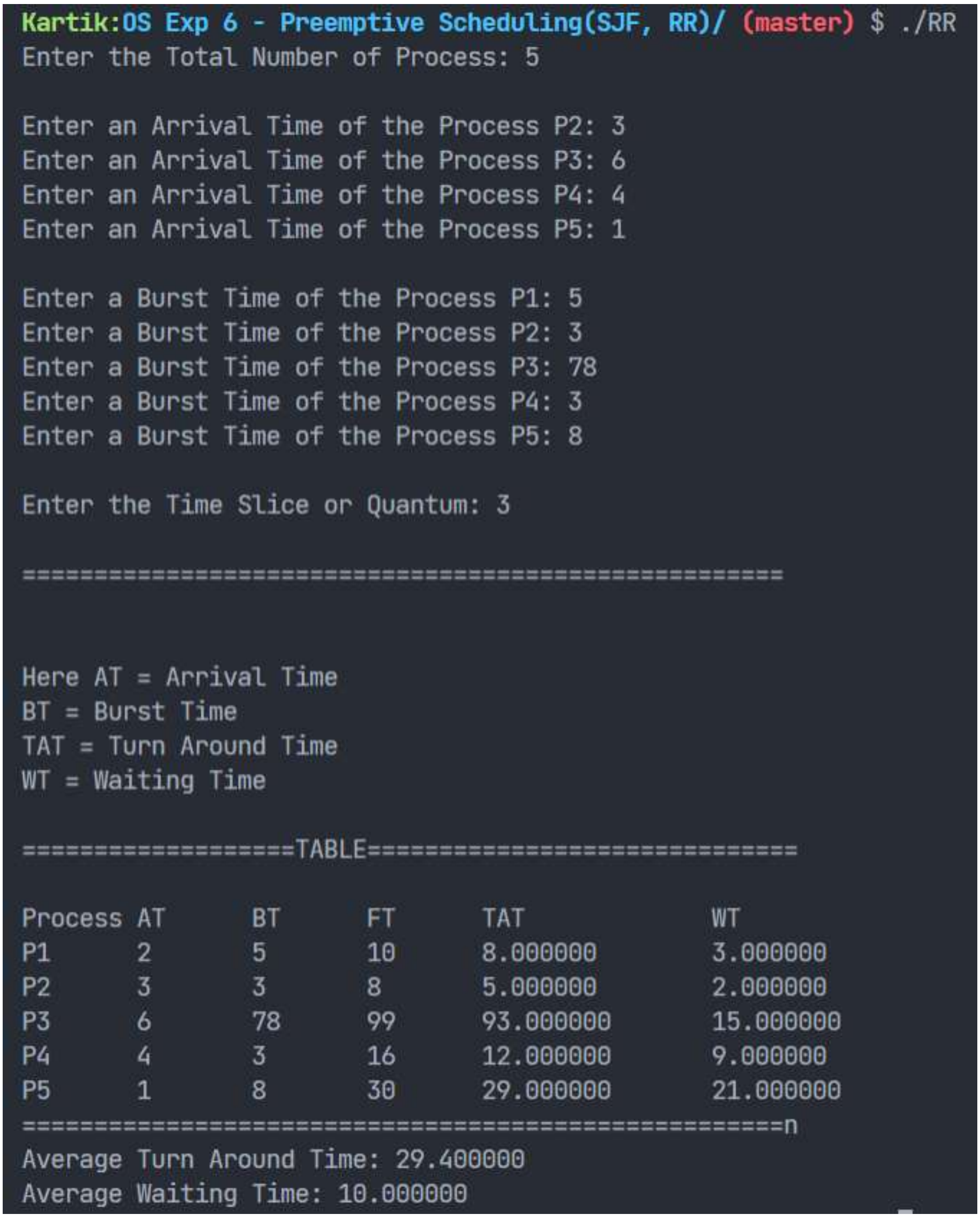
```
            p1[m].bt = 0;
        }
        while (i <= n && p1[i].at <= nextval)
        {
            q1.push(p1[i].id);
            i++;
        }
        if (p1[m].bt > 0)
        {
            q1.push(m);
        }
        if (p1[m].bt <= 0)
        {
            p[m].ft = nextval;
        }
    }
}
void turnwait(int n)
{
    int i;
    for (i = 1; i <= n; i++)
    {
        p[i].tat = p[i].ft - p[i].at;
        p[i].wt = p[i].tat - p[i].bt;
        p[0].tat = p[0].tat + p[i].tat;
        p[0].wt = p[0].wt + p[i].wt;
    }
    p[0].tat = p[0].tat / n;
    p[0].wt = p[0].wt / n;
}
void display(int n)
{
    int i;
    /*
    Here
    at = Arrival time,
    bt = Burst time,
    time_quantum= Quantum time
    tat = Turn around time,
    wt = Waiting time
    */
    cout << "\n=====================================================\n";
    cout << "\n\nHere AT = Arrival Time\nBT = Burst Time\nTAT = Turn Around
Time\nWT = Waiting Time\n ";

    cout << "\n===================TABLE==============================\n";
    printf("\nProcess\tAT\tBT\tFT\tTAT\t\tWT");
    for (i = 1; i <= n; i++)
    {
```



```
        printf("\nP%d\t%d\t%d\t%d\t%f\t%f", p[i].id, p[i].at, p[i].bt,
p[i].ft, p[i].tat, p[i].wt);
    }
    cout << "\n=====================================================\
n";
    printf("\nAverage Turn Around Time: %f", p[0].tat);
    printf("\nAverage Waiting Time: %f\n", p[0].wt);
}
```

Output –



```
Kartik:OS Exp 6 - Preemptive Scheduling(SJF, RR)/ (master) $ ./RR
Enter the Total Number of Process: 5

Enter an Arrival Time of the Process P2: 3
Enter an Arrival Time of the Process P3: 6
Enter an Arrival Time of the Process P4: 4
Enter an Arrival Time of the Process P5: 1

Enter a Burst Time of the Process P1: 5
Enter a Burst Time of the Process P2: 3
Enter a Burst Time of the Process P3: 78
Enter a Burst Time of the Process P4: 3
Enter a Burst Time of the Process P5: 8

Enter the Time Slice or Quantum: 3

=====================================================


Here AT = Arrival Time
BT = Burst Time
TAT = Turn Around Time
WT = Waiting Time

===================TABLE==============================

Process AT      BT      FT      TAT             WT
P1      2       5       10      8.000000        3.000000
P2      3       3       8       5.000000        2.000000
P3      6       78      99      93.000000       15.000000
P4      4       3       16      12.000000       9.000000
P5      1       8       30      29.000000       21.000000
=====================================================n
Average Turn Around Time: 29.400000
Average Waiting Time: 10.000000
```