CPU Scheduling Techniques

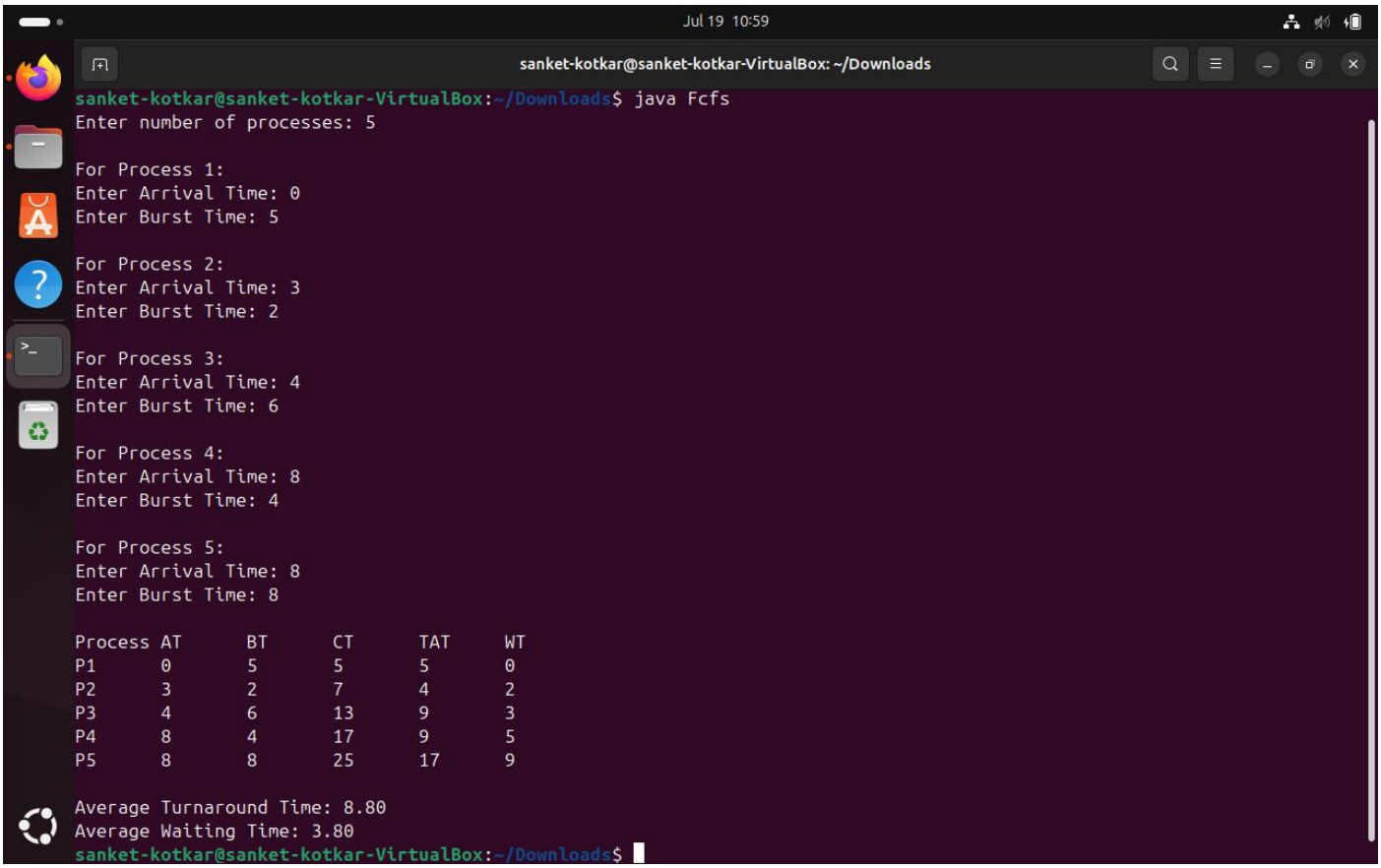
1. FCFS (First Come First Serve)

```
import java.util.Scanner;
class Fcfs {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter number of processes: ");
      int n = sc.nextInt();
      int[] at = new int[n];
      int[] bt = new int[n];
      int[] ct = new int[n];
      int[] tat = new int[n];
      int[] wt = new int[n];
      int[] pid = new int[n];
      for (int i = 0; i < n; i++) {
         pid[i] = i + 1;
         System.out.println("\nFor Process " + pid[i] + ":");
         System.out.print("Enter Arrival Time: ");
         at[i] = sc.nextInt();
         System.out.print("Enter Burst Time: ");
         bt[i] = sc.nextInt();
      }
      int currTime = 0;
      int totalTAT = 0, totalWT = 0;
      for (int i = 0; i < n; i++) {
         if (currTime < at[i]) {
            currTime = at[i];
         }

         ct[i] = currTime + bt[i];
         tat[i] = ct[i] - at[i];
         wt[i] = tat[i] - bt[i];
         currTime = ct[i];
         totalTAT += tat[i];
         totalWT += wt[i];
      }

System.out.println("\nProcess\tAT\tBT\tCT\tTAT\tWT");
      for (int i = 0; i < n; i++) {
         System.out.println("P" + pid[i] + "\t" + at[i] + "\t" + bt[i] + "\t" +
                  ct[i] + "\t" + tat[i] + "\t" + wt[i]);
      }
      System.out.printf("\nAverage Turnaround Time: %.2f\n", totalTAT / (double)n);
      System.out.printf("Average Waiting Time: %.2f\n", totalWT / (double)n);
   }
```

}



2. SJF (Shortest Job First)

```
import java.util.Scanner;
class Sjf {
    static class Process {
        int id, at, bt, ct, tat, wt;
        boolean completed;

        Process(int id, int at, int bt) {
            this.id = id;
            this.at = at;
            this.bt = bt;
            this.completed = false;
        }
    }
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);
        System.out.println("Enter the Number of
Processes:");
        int n = sc.nextInt();
        Process[] processes = new Process[n];
        for (int i = 0; i < n; i++) {
            System.out.println("For Job " + (i + 1) + ":
");
            System.out.print("Enter Arrival Time: ");
            int at = sc.nextInt();
            System.out.print("Enter Burst Time: ");
            int bt = sc.nextInt();
            processes[i] = new Process(i + 1, at, bt);
        }
        int currTime = 0, completedCount = 0;
        int avg_tt = 0, avg_wt = 0;
        while (completedCount < n) {
            int idx = -1;
            int min_bt = Integer.MAX_VALUE;
            for (int i = 0; i < n; i++) {
                if (!processes[i].completed &&
processes[i].at <= currTime) {
```

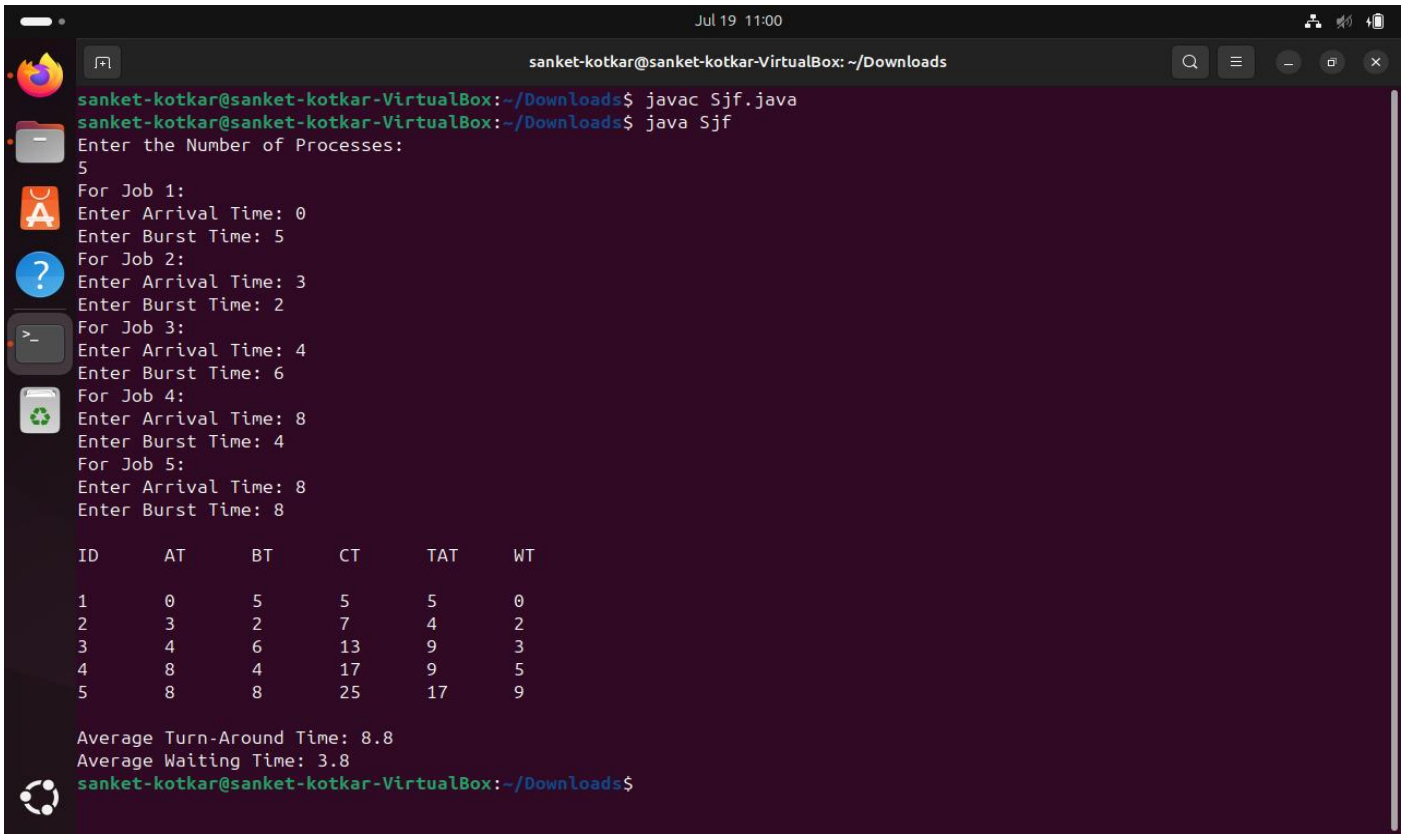
```
            if (processes[i].bt < min_bt) {
                min_bt = processes[i].bt;
                idx = i;
            }
        }
    }
    if (idx == -1) {
        currTime++;
        continue;
    }

    Process p = processes[idx];
    currTime += p.bt;
    p.ct = currTime;
    p.tat = p.ct - p.at;
    p.wt = p.tat - p.bt;
    p.completed = true;
    completedCount++;

    avg_tt += p.tat;
    avg_wt += p.wt;
        }

System.out.println("\nID\tAT\tBT\tCT\tTAT\tWT\n");

    for (int i = 0; i < n; i++) {
            System.out.println(
            processes[i].id + "\t" +
            processes[i].at + "\t" +
            processes[i].bt + "\t" +
            processes[i].ct + "\t" +
            processes[i].tat + "\t" +
            processes[i].wt
            );
    }
     System.out.println("\nAverage Turn-Around Time: " + (avg_tt / (float) n));
     System.out.println("Average Waiting Time: " + (avg_wt / (float) n));
    }
}
```

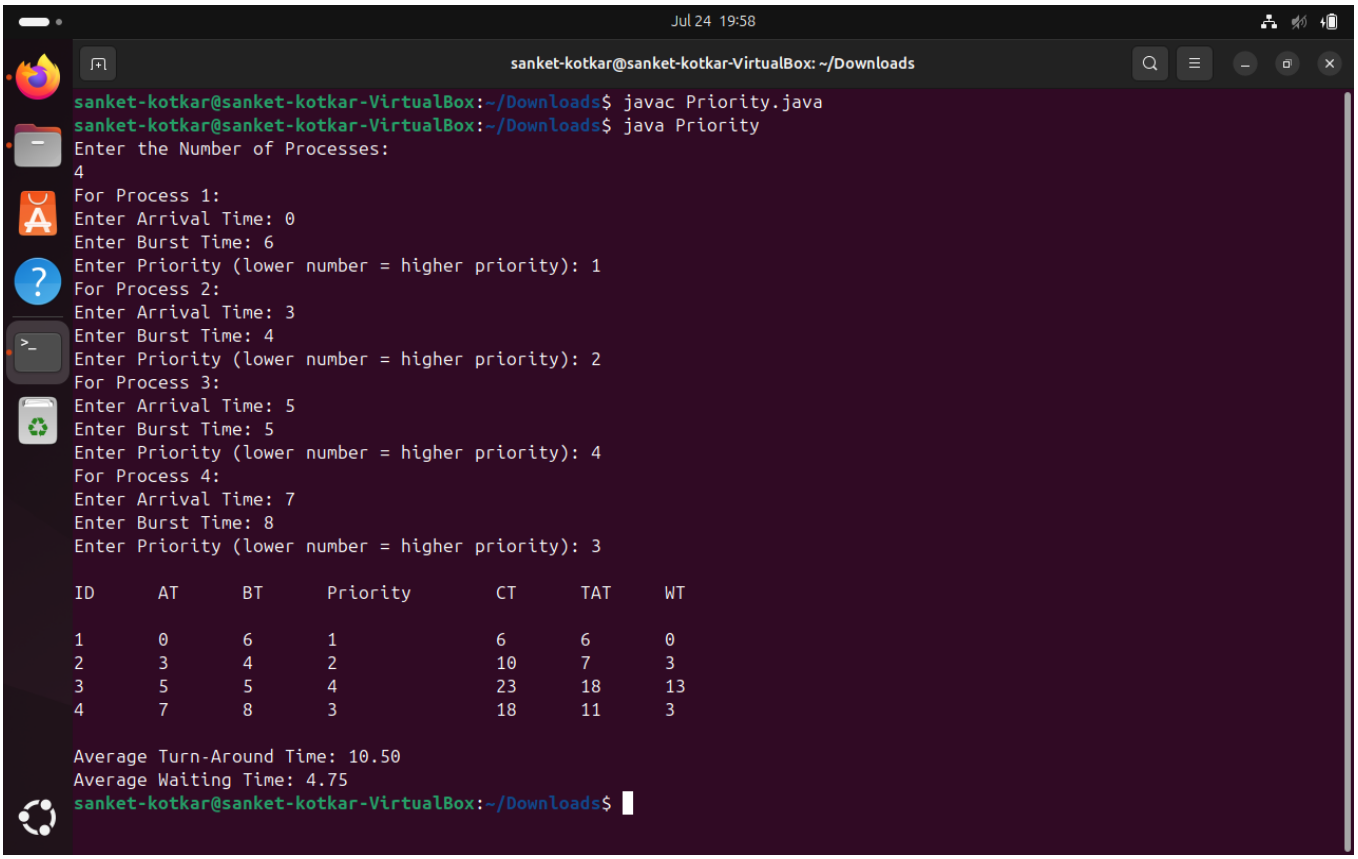


3. Priority Scheduling (Non-Preemptive)

```
import java.util.Scanner;
class Priority {
   static class Process {
      int id, at, bt, ct, tat, wt, priority;
      boolean completed;
      Process(int id, int at, int bt, int priority) {
         this.id = id;
         this.at = at;
         this.bt = bt;
         this.priority = priority;
         this.completed = false;
      }
   }
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.println("Enter the Number of
Processes:");
      int n = sc.nextInt();
      Process[] processes = new Process[n];
      for (int i = 0; i < n; i++) {
         System.out.println("For Process " + (i + 1)
+ ":");
         System.out.print("Enter Arrival Time: ");
         int at = sc.nextInt();
         System.out.print("Enter Burst Time: ");
         int bt = sc.nextInt();
         System.out.print("Enter Priority (lower
number = higher priority): ");
         int priority = sc.nextInt();
         processes[i] = new Process(i + 1, at, bt,
priority);
      }
      int currTime = 0, completedCount = 0;
      int avg_tat = 0, avg_wt = 0;
      while (completedCount < n) {
         int idx = -1;
         int highestPriority =
Integer.MAX_VALUE;
         for (int i = 0; i < n; i++) {
            if (!processes[i].completed &&
processes[i].at <= currTime) {
               if (processes[i].priority <
highestPriority) {
                  highestPriority =
processes[i].priority;
                  idx = i;
               } else if (processes[i].priority ==
highestPriority) {
                  // Tie-breaking: shorter burst time
                  if (idx == -1 || processes[i].bt <
processes[idx].bt) {
                     idx = i;
                  }
               }
            }
         }
         if (idx == -1) {
            currTime++;
            continue;
         }
         Process p = processes[idx];
         currTime += p.bt;
         p.ct = currTime;
         p.tat = p.ct - p.at;
         p.wt = p.tat - p.bt;
         p.completed = true;
         completedCount++;
         avg_tat += p.tat;
         avg_wt += p.wt;
      }

System.out.println("\nID\tAT\tBT\tPriority\tCT\tT
AT\tWT\n");
```

```
        for (int i = 0; i < n; i++) {
            Process p = processes[i];
            System.out.println(
                p.id + "\t" +
                p.at + "\t" +
                p.bt + "\t" +
                p.priority + "\t\t" +
                p.ct + "\t" +
                p.tat + "\t" +
                p.wt
            );
        }
        System.out.printf("\nAverage Turn-Around Time: %.2f\n", (avg_tat / (float) n));
        System.out.printf("Average Waiting Time: %.2f\n", (avg_wt / (float) n));
    }
}
```



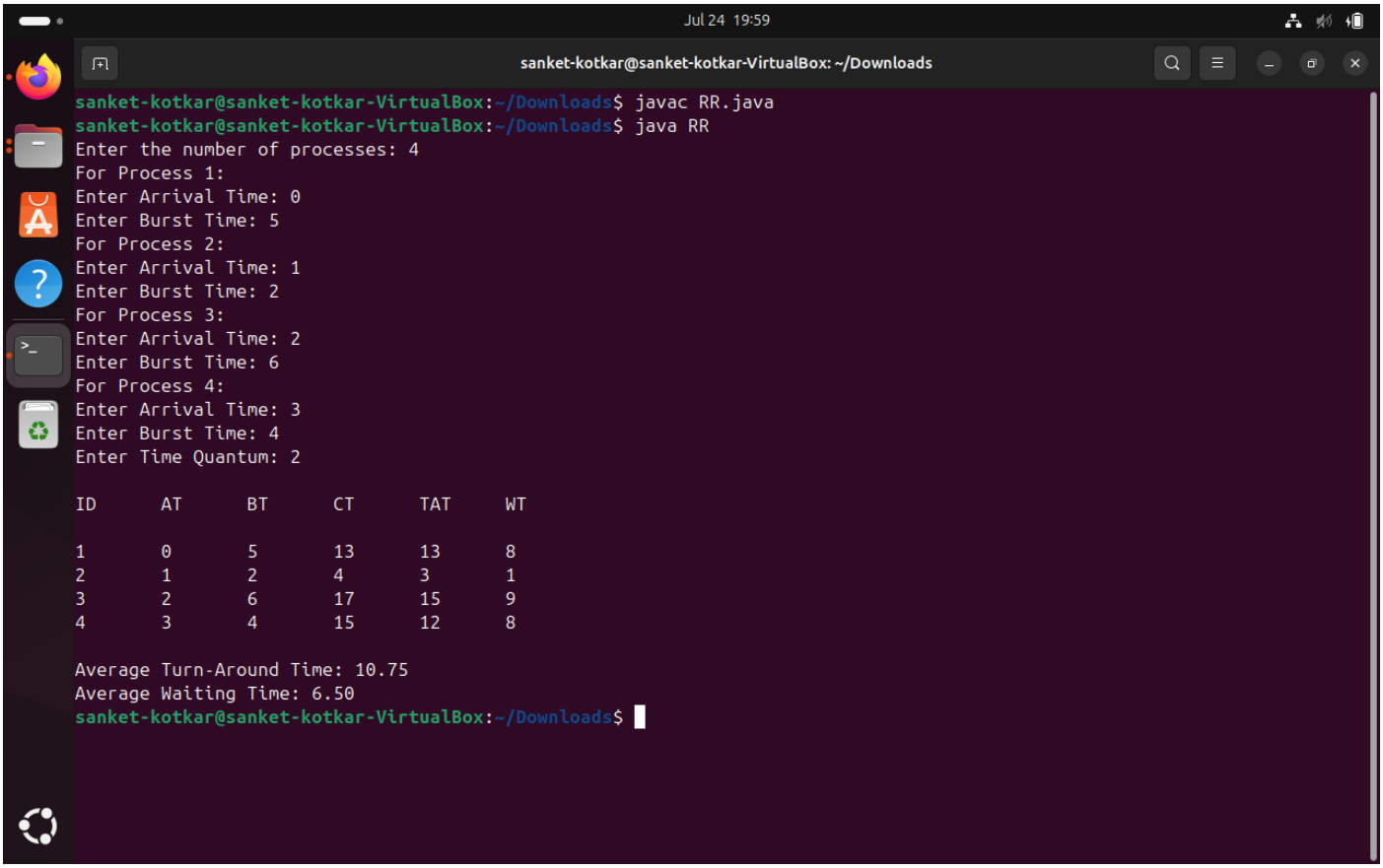
4. Round Robin (RR)

```
import java.util.*;
class RR {
    static class Process {
        int id, at, bt, remainingBt, ct, tat, wt;
        boolean completed;

        Process(int id, int at, int bt) {
            this.id = id;
            this.at = at;
            this.bt = bt;
            this.remainingBt = bt;
            this.completed = false;
        }
    }
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);
        System.out.print("Enter the number of processes: ");
        int n = sc.nextInt();
        Process[] processes = new Process[n];
        for (int i = 0; i < n; i++) {
```

```
            System.out.println("For Process " + (i + 1) + ":");
            System.out.print("Enter Arrival Time: ");
            int at = sc.nextInt();
            System.out.print("Enter Burst Time: ");
            int bt = sc.nextInt();
            processes[i] = new Process(i + 1, at, bt);
        }
        System.out.print("Enter Time Quantum: ");
        int tq = sc.nextInt();
        Queue<Process> queue = new LinkedList<>();
        int currTime = 0, completedCount = 0;
        int avgTat = 0, avgWt = 0;
        Arrays.sort(processes, Comparator.comparingInt(p -> p.at));
        int index = 0;
        while (index < n && processes[index].at <= currTime) {
            queue.add(processes[index]);
            index++;
        }
        while (!queue.isEmpty()) {
            Process p = queue.poll();
            if (p.remainingBt > tq) {
                currTime += tq;
                p.remainingBt -= tq;
            } else {
                currTime += p.remainingBt;
                p.remainingBt = 0;
                p.ct = currTime;
                p.tat = p.ct - p.at;
                p.wt = p.tat - p.bt;
                p.completed = true;
                completedCount++;
                avgTat += p.tat;
                avgWt += p.wt;
            }
            while (index < n && processes[index].at <= currTime) {
                queue.add(processes[index]);
                index++;
            }
            if (!p.completed) {
                queue.add(p);
            }
            if (queue.isEmpty() && index < n) {
                currTime = processes[index].at;
                queue.add(processes[index]);
                index++;
            }
        }

System.out.println("\nID\tAT\tBT\tCT\tTAT\tWT\n");
        for (Process p : processes) {
            System.out.println(p.id + "\t" + p.at + "\t" + p.bt + "\t" + p.ct + "\t" + p.tat + "\t" + p.wt);
        }
        System.out.printf("\nAverage Turn-Around Time: %.2f\n", (avgTat / (float) n));
        System.out.printf("Average Waiting Time: %.2f\n", (avgWt / (float) n));
    }
}
```


Jul 24 19:59
sanket-kotkar@sanket-kotkar-VirtualBox: ~/Downloads
sanket-kotkar@sanket-kotkar-VirtualBox:~/Downloads$ javac RR.java
sanket-kotkar@sanket-kotkar-VirtualBox:~/Downloads$ java RR
Enter the number of processes: 4
For Process 1:
Enter Arrival Time: 0
Enter Burst Time: 5
For Process 2:
Enter Arrival Time: 1
Enter Burst Time: 2
For Process 3:
Enter Arrival Time: 2
Enter Burst Time: 6
For Process 4:
Enter Arrival Time: 3
Enter Burst Time: 4
Enter Time Quantum: 2
ID AT BT CT TAT WT
1 0 5 13 13 8
2 1 2 4 3 1
3 2 6 17 15 9
4 3 4 15 12 8
Average Turn-Around Time: 10.75
Average Waiting Time: 6.50
sanket-kotkar@sanket-kotkar-VirtualBox:~/Downloads$