FINAL REPORT

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Question Assigned:

Consider a scheduling approach which is non pre-emptive similar to shortest job next in nature. The priority of each job is dependent on its estimated run time, and also the amount of time it has spent waiting. Jobs gain higher priority the longer they wait, which prevents indefinite postponement. The jobs that have spent a long time waiting compete against those estimated to have short run times. The priority can be computed as : Priority = 1+ Waiting time / Estimated run time Write a program to implement such an algorithm.

Description:

For the given question the scheduling approach that we can follow is shortest job first/shortest job next which is non-pre-emptive in nature. In non-pre-emptive scheduling, once the CPU cycle is allocated to process, the process holds it till it reaches a waiting state or terminated.so once the process started executing there is no way to terminate its execution and Shortest Job First (SJF) is an algorithm in which the process having the smallest execution time is chosen for the next execution.

So at the beginning the process is executed which is already arrived i.e which is available for execution .And in case there are more than one process is available for execution then we will take process for execution which has shortest job to complete among the available processes and this process is repeated until all the processes get there execution done.

Advantages of SJF:

- Minimum average time for a given set of processes
- Decreases waiting time for short processes
- Increases waiting time for long processes
- Average waiting time is decreased

Disadvantages of SJF:

- Difficulty in knowing the length of the next CPU request or CPU burst
- SJF algorithm cannot be used for short term CPU scheduling

ALGORITHM:

Step 1: Start the process
Step 2: Accept the number of processes in the ready Queue along with arrival time and burst time.
Step 3: For each process in the Ready Queue, assign the process with low burst time if there are more than one process is arrived at the particular instant of time ,if there is only process is there for execution then assign that process for execution and since it is non pre-emptive in nature the process cannot be terminated until the completion.
(Calculate Priority = 1+ Waiting time / Estimated)
Step 4: For each process again assign the process repeating the step-3 until all the processes in the queue gets executed
Step 5: Calculate Waiting time for process(n) = waiting time of process(n-1)+ burst time of process(n-1)+ the time difference in getting the CPU from process(n-1)
(a) Turnaround time for process(n) = waiting time of process(n) + burst time of process(n)+ the time difference in getting CPU from process(n).
Step 6: Calculate
(a) Average waiting time = Total waiting Time / Number of process
(b) Average Turnaround time = Total Turnaround Time / Number of process
Step 8: Stop the process

Complexity:
In General for shortest job first **Time complexity** = O(nlogn) where n = number of processes
It can be done in O(nlogn) time complexity using segment tree. Take the inputs of processes in struct and sort the struct array according to arrival time. Now, we will use segment tree to find the range minimum burst time and corresponding process id which will take **2*logn** for query and update both.

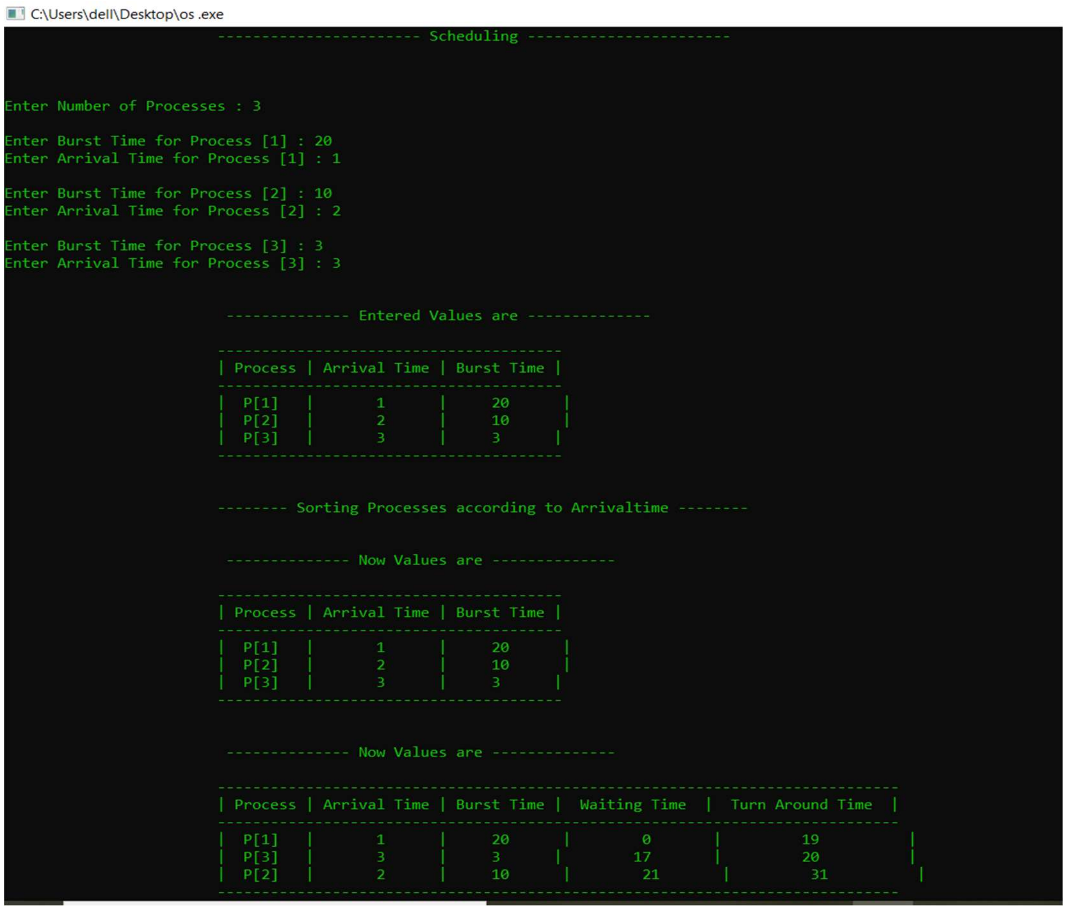
Code Snippet for assigned question:

```
#include<stdio.h>
#include<conio.h>
int main()
{
  printf("\t\t\t----------------------- Scheduling -----------------------\n\n\n\n");
  long int n,i=0,j=0;
  printf("Enter Number of Processes : ");
  scanf("%ld",&n );
  double
priority[n],avg_waiting,avg_turnaround,burstTime[n],arrivalTime[n],waitingTime[n],turnaround
Time[n], process[n], temp, completionTime[n],min,sum=0,sum2=0,wait_final, turnaround_final,
wait_avg, turnaround_avg;
  for(i=0;i<n;i++)
  {
    printf("\nEnter Burst Time for Process [%d] : ", i+1 );
    scanf("%lf", &burstTime[i]);
    printf("Enter Arrival Time for Process [%d] : ", i+1 );
    scanf("%lf", &arrivalTime[i] );
    process[i]=i+1;
  }

  printf("\n\n\t\t\t -------------- Entered Values are --------------\n\n");
  printf("\t\t\t---------------------------------------\n");
  printf("\t\t\t| Process | Arrival Time | Burst Time |\n");
  printf("\t\t\t---------------------------------------\n");
  for(i=0;i<n;i++)
  {
    printf("\t\t\t|  P[%0.0lf]  |       %0.0lf      |     %0.0lf
|\n",process[i],arrivalTime[i],burstTime[i]);
  }
    printf("\t\t\t---------------------------------------\n");


  printf("\n\n\t\t\t-------- Sorting Processes according to Arrivaltime --------\n");

  for(i=0;i<n;i++)
  {
    for(j=0;j<n;j++)
    {
      if(arrivalTime[i]<arrivalTime[j])
      {

        temp = burstTime[j];
        burstTime[j] = burstTime[i];
        burstTime [i] = temp;

                temp = process[j];
        process[j] = process[i];
        process[i] = temp;

                temp = arrivalTime[j];
        arrivalTime[j] = arrivalTime[i];
        arrivalTime[i] = temp;

      }
    }
  }
  printf("\n\n\t\t\t -------------- Now Values are --------------\n\n");
  printf("\t\t\t---------------------------------------\n");
  printf("\t\t\t| Process | Arrival Time | Burst Time |\n");
  printf("\t\t\t---------------------------------------\n");
  for(i=0;i<n;i++)
  {
    printf("\t\t\t|  P[%0.0lf]  |       %0.0lf      |     %0.0lf
|\n",process[i],arrivalTime[i],burstTime[i]);
  }
    printf("\t\t\t---------------------------------------\n");


/*Arranging the table according to Burst time,
Execution time and Arrival Time
Arrival time <= Execution time
*/


  long int k = 1;
  double b_time = 0;
  for(j=0;j<n;j++)
  {
    b_time = b_time + burstTime[j];
    min = burstTime[k];

    for(i=k;i<n;i++)
    {
      if((b_time >= arrivalTime[i])&&(burstTime[i]<min))
      {
        temp = burstTime[k];
        burstTime[k] = burstTime[i];
        burstTime[i] = temp;
        temp = arrivalTime[k];
        arrivalTime[k] = arrivalTime[i];
        arrivalTime[i] = temp;

        temp = process[k];
        process[k] = process[i];
        process[i] = temp;
      }
    }
    k++;
  }
  waitingTime[0] = 0;
  for(i=1;i<n;i++)
  {
    sum += burstTime[i-1];
    waitingTime[i] = sum - arrivalTime[i];
    wait_final += waitingTime[i];
  }
  wait_avg = wait_final/n;
  for(i=0;i<n;i++)
  {
    sum2 += burstTime[i];
    turnaroundTime[i] = sum2 - arrivalTime[i];
    turnaround_final += turnaroundTime[i];
  }
  turnaround_avg=turnaround_final/n;
printf("\n\n\t\t\t -------------- Now Values are --------------\n\n");
  printf("\t\t\t-----------------------------------------------------------------------------\n");
  printf("\t\t\t| Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |\n");
  printf("\t\t\t-----------------------------------------------------------------------------\n");
  for(i=0;i<n;i++)
  {
    printf("\t\t\t|  P[%0.0lf]  |       %0.0lf       |     %0.0lf      |        %0.0lf       |        %0.0lf
|\n",process[i],arrivalTime[i],burstTime[i],waitingTime[i],turnaroundTime[i]);
  }
    printf("\t\t\t-----------------------------------------------------------------------------\n");



  /*Now we have to prioritize the processes according to the formulae
      Priority = 1+ Waiting time / Estimated run time
  */


  completionTime[0] = burstTime[0];
  for(i=1;i<n;i++)
  {
    completionTime[i] = completionTime[i-1] + burstTime[i];
  }

  for(i=0;i<n;i++)
  {
    priority[i] = 1+waitingTime[i]/completionTime[i];
    printf("%lf\n",priority[i]);
  }


  printf("\n\n\t\t\t -------------- Final Values are --------------\n\n");
  printf("\t\t\t-------------------------------------------------------------------------------\n");
  printf("\t\t\t| Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |\n");
  printf("\t\t\t-------------------------------------------------------------------------------\n");
  printf("\t\t\t|  P[%0.0lf]   |      %0.0lf      |     %0.0lf      |       %0.0lf       |        %0.0lf
|\n",process[0],arrivalTime[0],burstTime[0],waitingTime[0],turnaroundTime[0]);
  for(i=n-1;i>0;i--)
  {
    printf("\t\t\t|  P[%0.0lf]   |      %0.0lf      |     %0.0lf      |       %0.0lf       |        %0.0lf
|\n",process[i],arrivalTime[i],burstTime[i],waitingTime[i],turnaroundTime[i]);
  }
    printf("\t\t\t-------------------------------------------------------------------------------\n");

  printf("\n\n\n\t\t\tAverage Turn Around Time : %lf",turnaround_avg);
  printf("\n\t\t\tAverage Waiting Time     : %lf\n\n",wait_avg);
  getch();
  return 0;
}
```

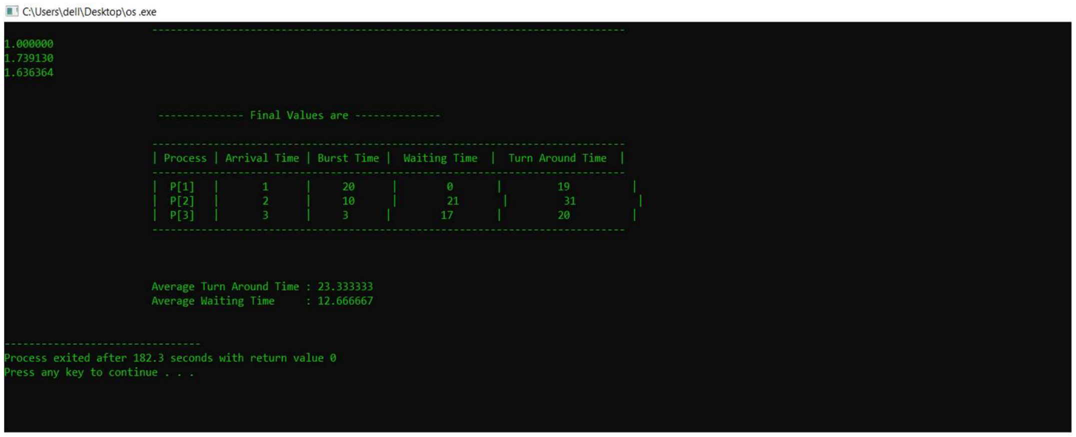
All the boundary conditions mentioned in the assigned question are satisfied successfully in the above program

Test Cases:

Test Case 1:



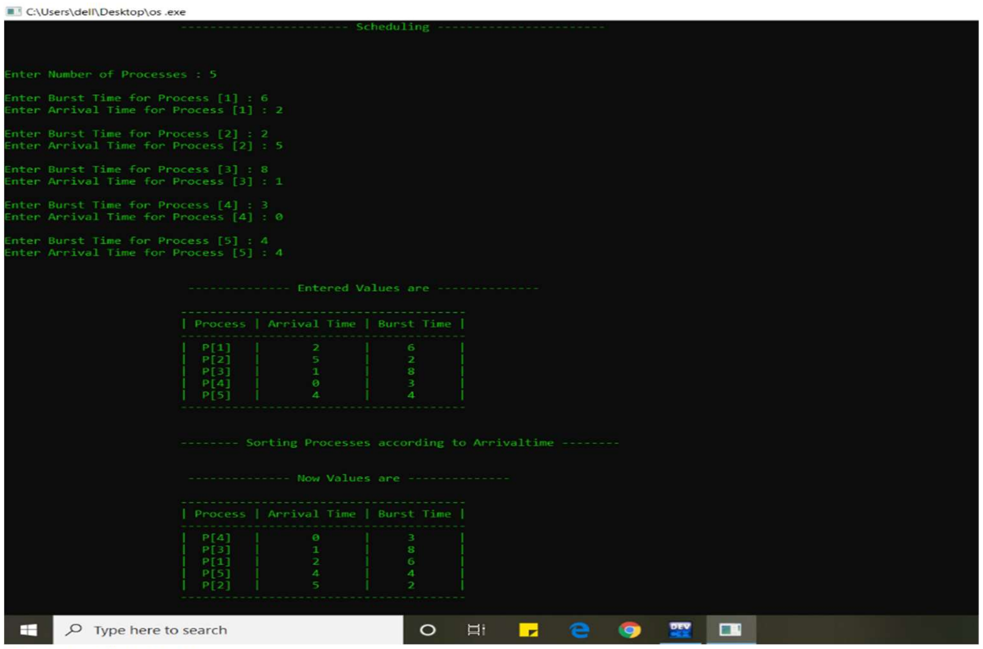
```
C:\Users\dell\Desktop\os .exe
                        ----------------------- Scheduling -----------------------



Enter Number of Processes : 3

Enter Burst Time for Process [1] : 20
Enter Arrival Time for Process [1] : 1

Enter Burst Time for Process [2] : 10
Enter Arrival Time for Process [2] : 2

Enter Burst Time for Process [3] : 3
Enter Arrival Time for Process [3] : 3


                         -------------- Entered Values are --------------

                        ---------------------------------------
                        | Process | Arrival Time | Burst Time |
                        ---------------------------------------
                        |  P[1]   |       1      |     20      |
                        |  P[2]   |       2      |     10      |
                        |  P[3]   |       3      |     3      |
                        ---------------------------------------


                        -------- Sorting Processes according to Arrivaltime --------


                         -------------- Now Values are --------------

                        ---------------------------------------
                        | Process | Arrival Time | Burst Time |
                        ---------------------------------------
                        |  P[1]   |       1      |     20      |
                        |  P[2]   |       2      |     10      |
                        |  P[3]   |       3      |     3      |
                        ---------------------------------------


                         -------------- Now Values are --------------

                        ----------------------------------------------------------------------------
                        | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                        ----------------------------------------------------------------------------
                        |  P[1]   |       1      |     20      |        0       |         19          |
                        |  P[3]   |       3      |     3      |       17       |         20          |
                        |  P[2]   |       2      |     10      |        21       |         31           |
                        ----------------------------------------------------------------------------
```



```
C:\Users\dell\Desktop\os .exe
                        ----------------------------------------------------------------------------
1.000000
1.739130
1.636364



                         -------------- Final Values are --------------

                        ----------------------------------------------------------------------------
                        | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                        ----------------------------------------------------------------------------
                        |  P[1]   |       1      |     20      |        0       |         19          |
                        |  P[2]   |       2      |     10      |        21       |         31           |
                        |  P[3]   |       3      |     3      |       17       |         20          |
                        ----------------------------------------------------------------------------




                        Average Turn Around Time : 23.333333
                        Average Waiting Time     : 12.666667



--------------------------------
Process exited after 182.3 seconds with return value 0
Press any key to continue . . .
```

The above screen shorts represent the sample inputs taken and output obtained accordingly, we can observe that the test case passed successfully

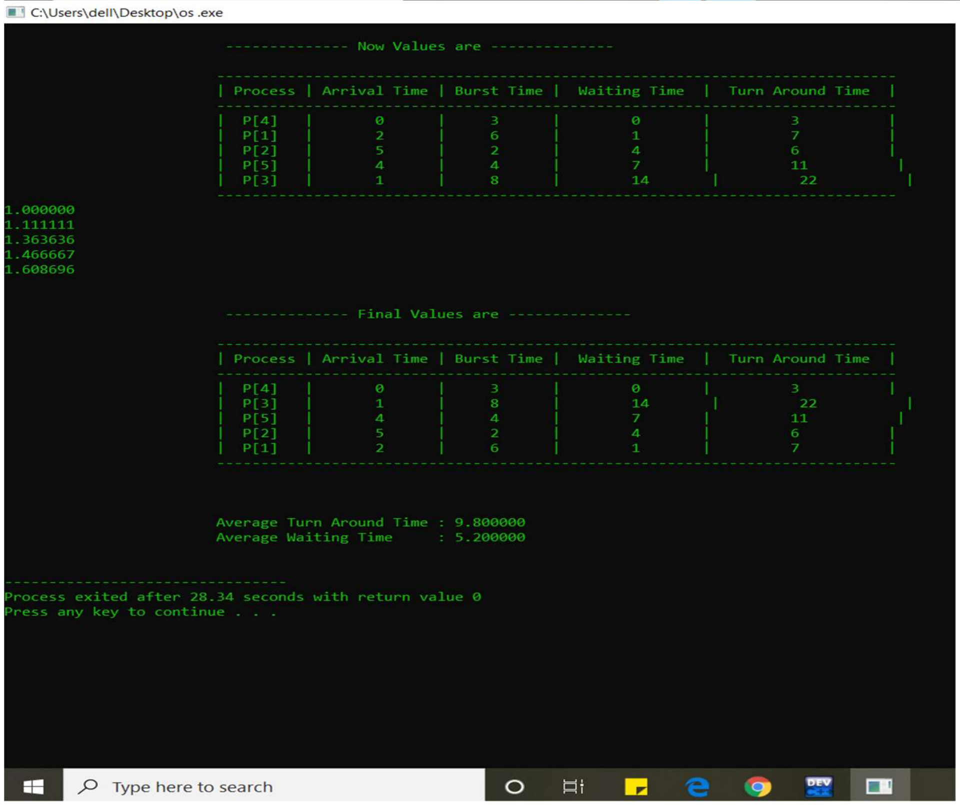
TestCase2:



C:\Users\dell\Desktop\os .exe

```
                       ---------------------- Scheduling ----------------------


Enter Number of Processes : 5

Enter Burst Time for Process [1] : 6
Enter Arrival Time for Process [1] : 2

Enter Burst Time for Process [2] : 2
Enter Arrival Time for Process [2] : 5

Enter Burst Time for Process [3] : 8
Enter Arrival Time for Process [3] : 1

Enter Burst Time for Process [4] : 3
Enter Arrival Time for Process [4] : 0

Enter Burst Time for Process [5] : 4
Enter Arrival Time for Process [5] : 4


                        ------------- Entered Values are -------------

                       --------------------------------------
                       | Process | Arrival Time | Burst Time |
                       --------------------------------------
                       |  P[1]   |       2      |      6     |
                       |  P[2]   |       5      |      2     |
                       |  P[3]   |       1      |      8     |
                       |  P[4]   |       0      |      3     |
                       |  P[5]   |       4      |      4     |
                       --------------------------------------


                       -------- Sorting Processes according to Arrivaltime --------


                        ------------- Now Values are -------------

                       --------------------------------------
                       | Process | Arrival Time | Burst Time |
                       --------------------------------------
                       |  P[4]   |       0      |      3     |
                       |  P[3]   |       1      |      8     |
                       |  P[1]   |       2      |      6     |
                       |  P[5]   |       4      |      4     |
                       |  P[2]   |       5      |      2     |
                       --------------------------------------
```

Type here to search



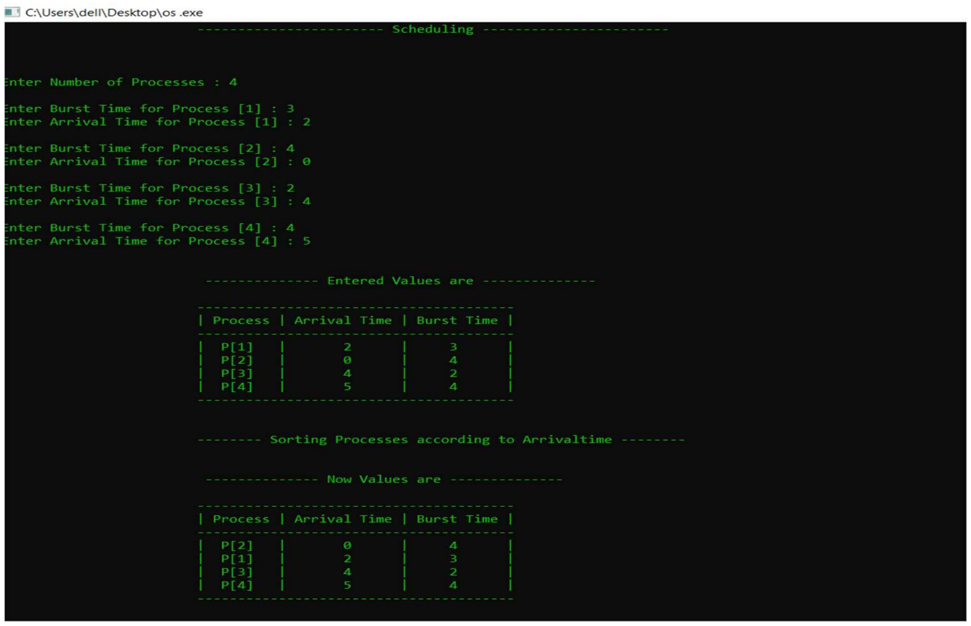
C:\Users\dell\Desktop\os .exe

```
                              ------------- Now Values are -------------

                             -----------------------------------------------------------------------------
                             | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                             -----------------------------------------------------------------------------
                             |  P[4]   |      0       |     3      |       0        |         3          |
                             |  P[1]   |      2       |     6      |       1        |         7          |
                             |  P[2]   |      5       |     2      |       4        |         6          |
                             |  P[5]   |      4       |     4      |       7        |         11          |
                             |  P[3]   |      1       |     8      |       14        |         22          |
                             -----------------------------------------------------------------------------
1.000000
1.111111
1.363636
1.466667
1.608696



                              ------------- Final Values are -------------

                             -----------------------------------------------------------------------------
                             | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                             -----------------------------------------------------------------------------
                             |  P[4]   |      0       |     3      |       0        |         3          |
                             |  P[3]   |      1       |     8      |       14        |         22          |
                             |  P[5]   |      4       |     4      |       7        |         11          |
                             |  P[2]   |      5       |     2      |       4        |         6          |
                             |  P[1]   |      2       |     6      |       1        |         7          |
                             -----------------------------------------------------------------------------



                             Average Turn Around Time : 9.800000
                             Average Waiting Time     : 5.200000



--------------------------------
Process exited after 28.34 seconds with return value 0
Press any key to continue . . .
```

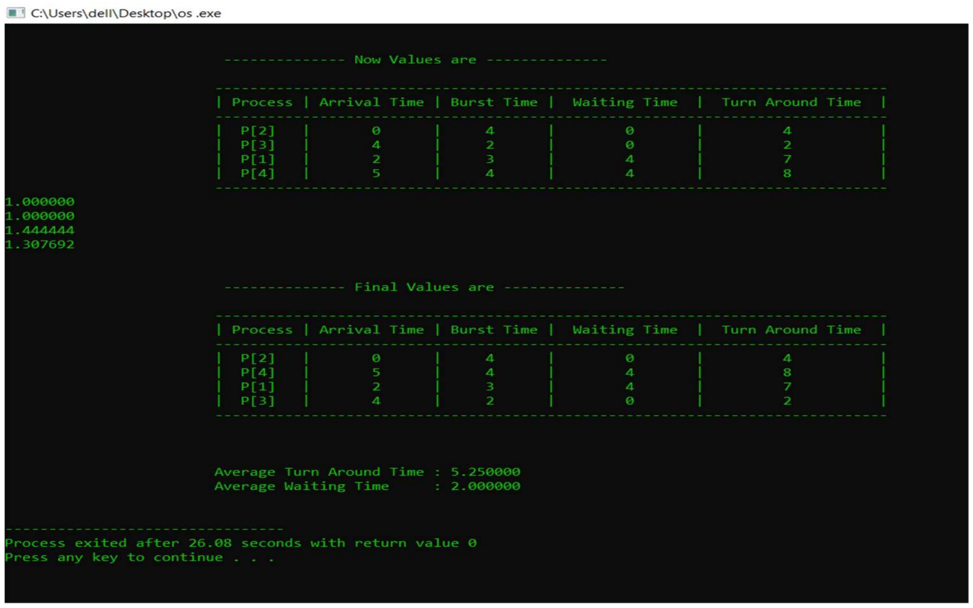
Type here to search

Test case passed successfully

Test Case 3:



```
C:\Users\dell\Desktop\os .exe
                         ---------------------- Scheduling ----------------------



nter Number of Processes : 4

nter Burst Time for Process [1] : 3
nter Arrival Time for Process [1] : 2

nter Burst Time for Process [2] : 4
nter Arrival Time for Process [2] : 0

nter Burst Time for Process [3] : 2
nter Arrival Time for Process [3] : 4

nter Burst Time for Process [4] : 4
nter Arrival Time for Process [4] : 5


                          ------------- Entered Values are -------------

                         --------------------------------------
                         | Process | Arrival Time | Burst Time |
                         --------------------------------------
                         |  P[1]   |       2      |      3     |
                         |  P[2]   |       0      |      4     |
                         |  P[3]   |       4      |      2     |
                         |  P[4]   |       5      |      4     |
                         --------------------------------------


                         -------- Sorting Processes according to Arrivaltime --------


                          ------------- Now Values are -------------

                         --------------------------------------
                         | Process | Arrival Time | Burst Time |
                         --------------------------------------
                         |  P[2]   |       0      |      4     |
                         |  P[1]   |       2      |      3     |
                         |  P[3]   |       4      |      2     |
                         |  P[4]   |       5      |      4     |
                         --------------------------------------
```

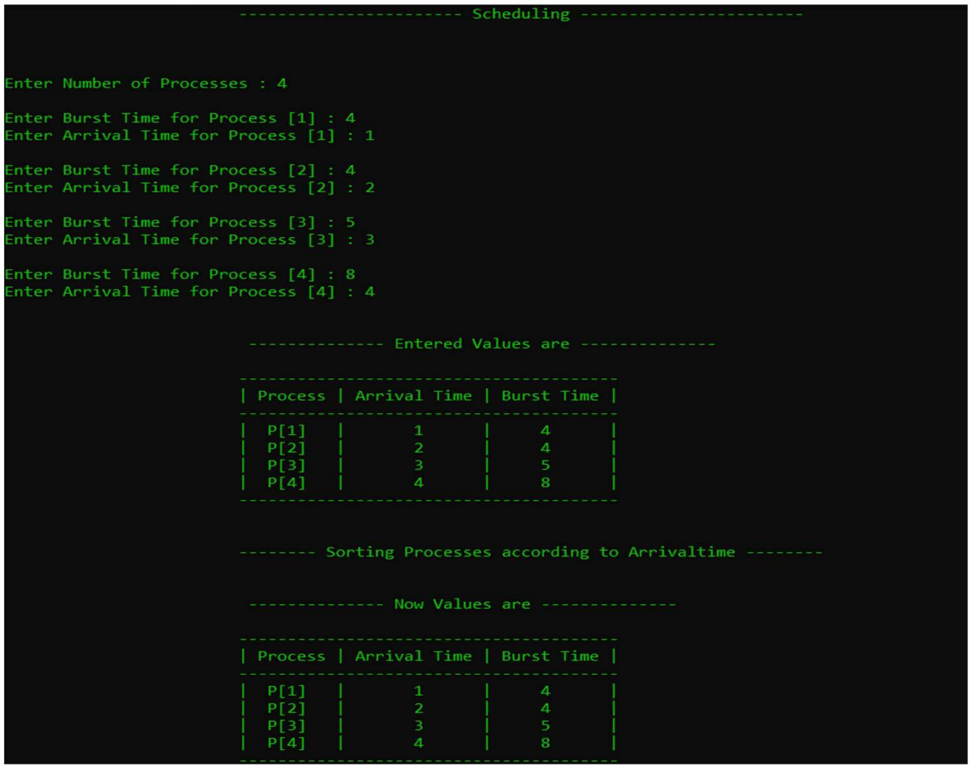


```
C:\Users\dell\Desktop\os .exe

                          -------------- Now Values are --------------

                         ------------------------------------------------------------------------------
                         | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                         ------------------------------------------------------------------------------
                         |  P[2]   |       0      |      4     |       0        |         4          |
                         |  P[3]   |       4      |      2     |       0        |         2          |
                         |  P[1]   |       2      |      3     |       4        |         7          |
                         |  P[4]   |       5      |      4     |       4        |         8          |
                         ------------------------------------------------------------------------------
1.000000
1.000000
1.444444
1.307692



                          -------------- Final Values are --------------

                         ------------------------------------------------------------------------------
                         | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                         ------------------------------------------------------------------------------
                         |  P[2]   |       0      |      4     |       0        |         4          |
                         |  P[4]   |       5      |      4     |       4        |         8          |
                         |  P[1]   |       2      |      3     |       4        |         7          |
                         |  P[3]   |       4      |      2     |       0        |         2          |
                         ------------------------------------------------------------------------------



                         Average Turn Around Time : 5.250000
                         Average Waiting Time     : 2.000000


--------------------------------
Process exited after 26.08 seconds with return value 0
Press any key to continue . . .
```

Test case passed successfully

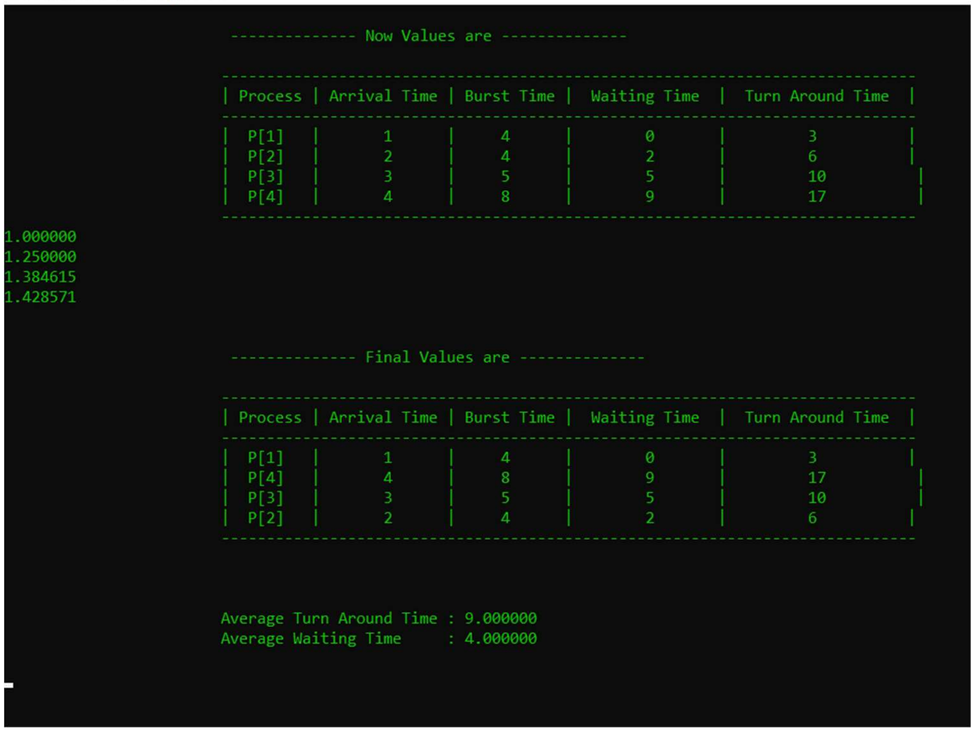
Test Case -4:

C:\Users\dell\Desktop\os .exe



```
                        ----------------------- Scheduling -----------------------



Enter Number of Processes : 4

Enter Burst Time for Process [1] : 4
Enter Arrival Time for Process [1] : 1

Enter Burst Time for Process [2] : 4
Enter Arrival Time for Process [2] : 2

Enter Burst Time for Process [3] : 5
Enter Arrival Time for Process [3] : 3

Enter Burst Time for Process [4] : 8
Enter Arrival Time for Process [4] : 4


                         -------------- Entered Values are --------------

                        ---------------------------------------
                        | Process | Arrival Time | Burst Time |
                        ---------------------------------------
                        |  P[1]   |       1      |     4      |
                        |  P[2]   |       2      |     4      |
                        |  P[3]   |       3      |     5      |
                        |  P[4]   |       4      |     8      |
                        ---------------------------------------


                        -------- Sorting Processes according to Arrivaltime --------


                         -------------- Now Values are --------------

                        ---------------------------------------
                        | Process | Arrival Time | Burst Time |
                        ---------------------------------------
                        |  P[1]   |       1      |     4      |
                        |  P[2]   |       2      |     4      |
                        |  P[3]   |       3      |     5      |
                        |  P[4]   |       4      |     8      |
                        ---------------------------------------
```

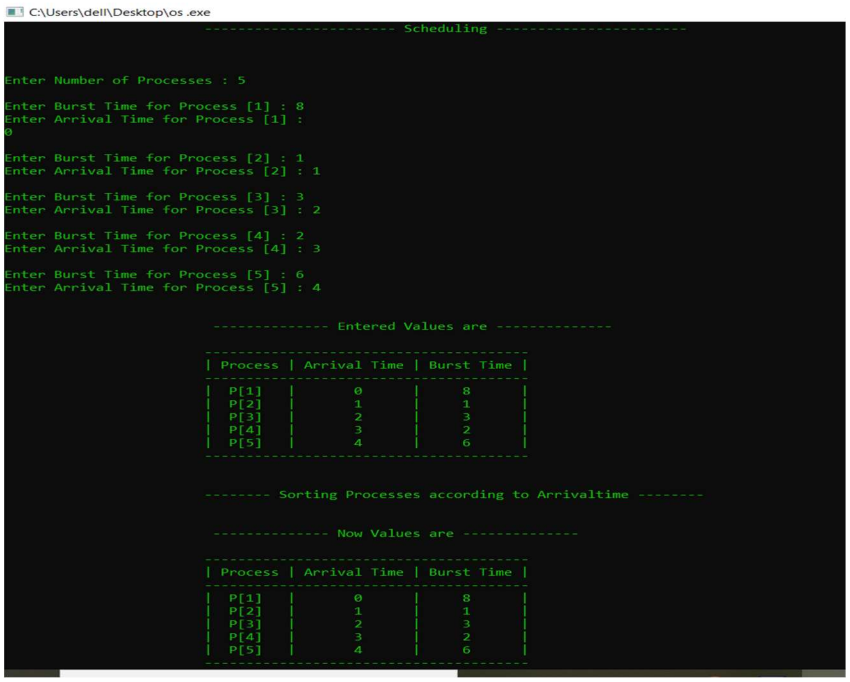
C:\Users\dell\Desktop\os .exe



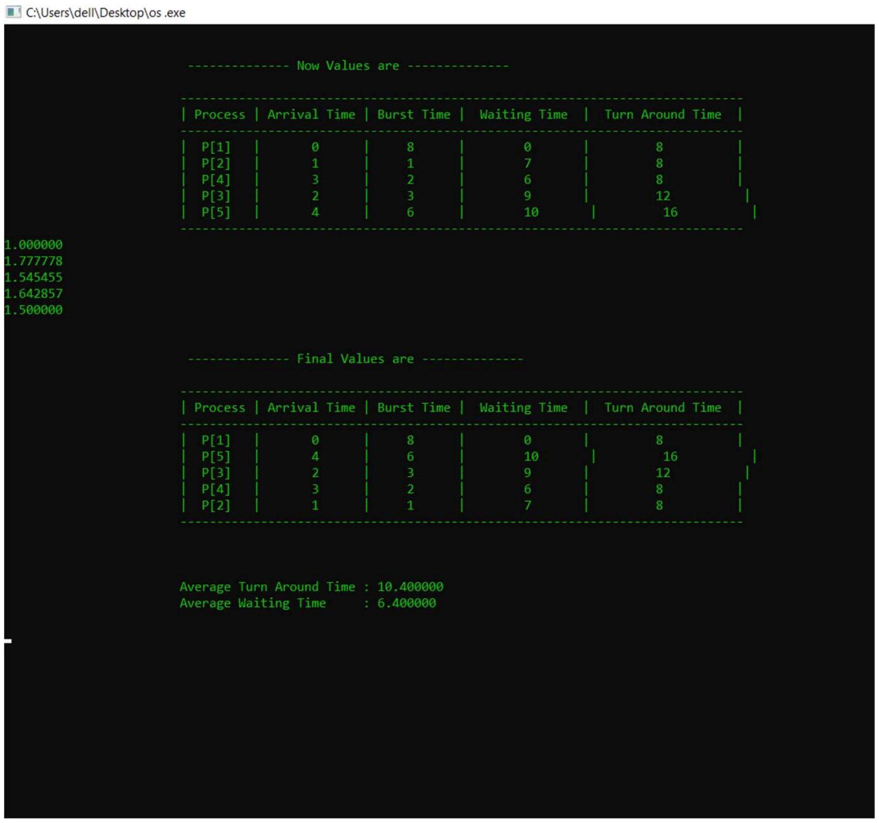
```
                      ------------- Now Values are -------------

                      -----------------------------------------------------------------------
                      | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                      -----------------------------------------------------------------------
                      |  P[1]   |      1       |     4      |       0        |        3           |
                      |  P[2]   |      2       |     4      |       2        |        6           |
                      |  P[3]   |      3       |     5      |       5        |        10           |
                      |  P[4]   |      4       |     8      |       9        |        17           |
                      -----------------------------------------------------------------------
1.000000
1.250000
1.384615
1.428571



                      ------------- Final Values are -------------

                      -----------------------------------------------------------------------
                      | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                      -----------------------------------------------------------------------
                      |  P[1]   |      1       |     4      |       0        |        3           |
                      |  P[4]   |      4       |     8      |       9        |        17           |
                      |  P[3]   |      3       |     5      |       5        |        10           |
                      |  P[2]   |      2       |     4      |       2        |        6           |
                      -----------------------------------------------------------------------



                      Average Turn Around Time : 9.000000
                      Average Waiting Time     : 4.000000
```

Test case passed successfully

Test Case-5:



```
C:\Users\dell\Desktop\os .exe
                        ----------------------- Scheduling -----------------------


Enter Number of Processes : 5

Enter Burst Time for Process [1] : 8
Enter Arrival Time for Process [1] :
0

Enter Burst Time for Process [2] : 1
Enter Arrival Time for Process [2] : 1

Enter Burst Time for Process [3] : 3
Enter Arrival Time for Process [3] : 2

Enter Burst Time for Process [4] : 2
Enter Arrival Time for Process [4] : 3

Enter Burst Time for Process [5] : 6
Enter Arrival Time for Process [5] : 4

                         -------------- Entered Values are --------------

                        ---------------------------------------
                        | Process | Arrival Time | Burst Time |
                        ---------------------------------------
                        |  P[1]   |       0      |      8     |
                        |  P[2]   |       1      |      1     |
                        |  P[3]   |       2      |      3     |
                        |  P[4]   |       3      |      2     |
                        |  P[5]   |       4      |      6     |
                        ---------------------------------------


                        -------- Sorting Processes according to Arrivaltime --------

                         -------------- Now Values are --------------

                        ---------------------------------------
                        | Process | Arrival Time | Burst Time |
                        ---------------------------------------
                        |  P[1]   |       0      |      8     |
                        |  P[2]   |       1      |      1     |
                        |  P[3]   |       2      |      3     |
                        |  P[4]   |       3      |      2     |
                        |  P[5]   |       4      |      6     |
                        ---------------------------------------
```



```
C:\Users\dell\Desktop\os .exe

                        ------------- Now Values are -------------

                       ---------------------------------------------------------------------
                       | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                       ---------------------------------------------------------------------
                       |  P[1]   |       0      |      8     |        0       |         8          |
                       |  P[2]   |       1      |      1     |        7       |         8          |
                       |  P[4]   |       3      |      2     |        6       |         8          |
                       |  P[3]   |       2      |      3     |        9       |        12           |
                       |  P[5]   |       4      |      6     |        10       |        16           |
                       ---------------------------------------------------------------------
1.000000
1.777778
1.545455
1.642857
1.500000



                        ------------- Final Values are -------------

                       ---------------------------------------------------------------------
                       | Process | Arrival Time | Burst Time |  Waiting Time  |  Turn Around Time  |
                       ---------------------------------------------------------------------
                       |  P[1]   |       0      |      8     |        0       |         8          |
                       |  P[5]   |       4      |      6     |        10       |        16           |
                       |  P[3]   |       2      |      3     |        9       |        12          |
                       |  P[4]   |       3      |      2     |        6       |         8          |
                       |  P[2]   |       1      |      1     |        7       |         8          |
                       ---------------------------------------------------------------------


                       Average Turn Around Time : 10.400000
                       Average Waiting Time     : 6.400000
```

Test case passed successfully

We can observe from the above code and testcases that all the constraints and boundary conditions mentioned in the assigned question have been implemented successfully.

GitHub Repository Link:

https://github.com/SRIKANTHNALUMACHU/CSE-316-Project