```c
#include <stdio.h>

void fifoPageReplacement();
void lruPageReplacement();
int findLRU(int[], int);

int main() {
  char processType;
  int choice, tq = 0;

  printf("a. Non-Preemptive Scheduling\n  1. First Come First Serve\n  2. Shortest Job
First\n  3. Priority (Non-Preemptive)\n");
  printf("b. Preemptive Scheduling\n  1. Shortest Job Remaining First\n  2. Round Robin\n
3. Priority (Preemptive)\n");
  printf("c. Page Replacement\n  1. First In First Out\n  2. Least Recently Used\n");

  printf("Enter process type (a for Non-Preemptive, b for Preemptive, c for Page
Replacement): ");
  scanf(" %c", &processType);

  if (processType == 'a' || processType == 'b') {
    int n;
    printf("\nEnter number of processes: ");
    scanf("%d", &n);

    int id[n], at[n], bt[n], ct[n], tat[n], wt[n], pri[n], rbt[n];

    printf("Enter arrival times: ");
    for (int i = 0; i < n; i++) scanf("%d", &at[i]);
    printf("Enter burst times: ");
    for (int i = 0; i < n; i++) {
      scanf("%d", &bt[i]);
      rbt[i] = bt[i];
      id[i] = i + 1;
    }
    printf("Enter priorities: ");
    for (int i = 0; i < n; i++) scanf("%d", &pri[i]);

    printf("\nProcess\tAT\tBT\tPriority\n");
    for (int i = 0; i < n; i++) {
      printf("P%d\t%d\t%d\t%d\n", id[i], at[i], bt[i], pri[i]);
    }

    if (processType == 'a') {
```

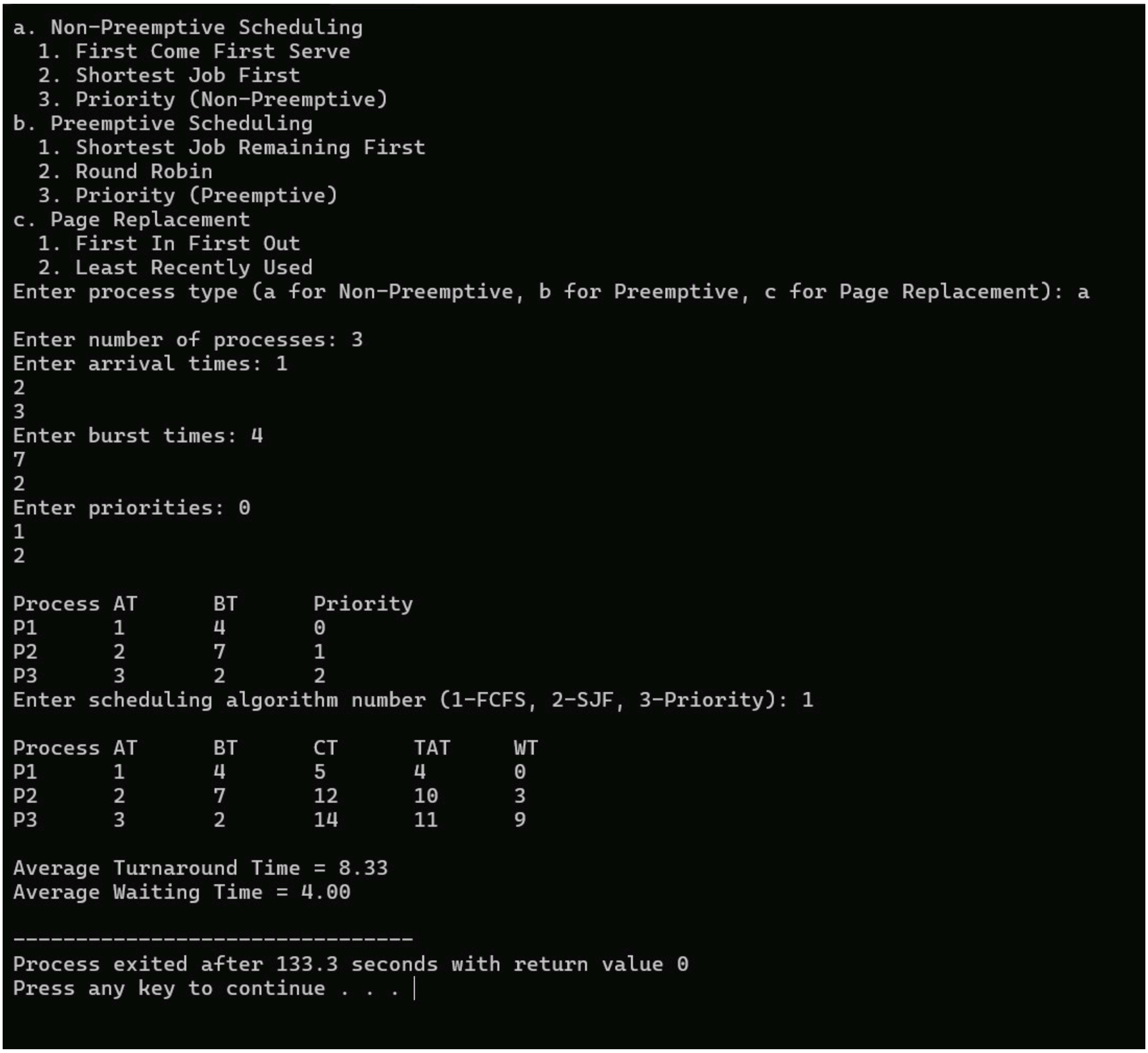
```
    printf("Enter scheduling algorithm number (1-FCFS, 2-SJF, 3-Priority): ");
} else {
    printf("Enter scheduling algorithm number (1-SJRF, 2-RR, 3-Priority): ");
}
scanf("%d", &choice);

if (processType == 'b' && choice == 2) {
    printf("Enter Time Quantum: ");
    scanf("%d", &tq);
}

int time = 0, completed = 0;
int visited[n];
for (int i = 0; i < n; i++) visited[i] = 0;

if (processType == 'a') {
    switch (choice) {
        case 1:  // FCFS
            for (int i = 0; i < n; i++) {
                if (time < at[i]) time = at[i];
                ct[i] = time + bt[i];
                time = ct[i];
            }
            break;
        case 2:  // SJF
            while (completed < n) {
                int min_bt = 9999, index = -1;
                for (int i = 0; i < n; i++) {
                    if (!visited[i] && at[i] <= time && bt[i] < min_bt) {
                        min_bt = bt[i];
                        index = i;
                    }
                }
                if (index == -1) { time++; continue; }
                visited[index] = 1;
                ct[index] = time + bt[index];
                time = ct[index];
                completed++;
            }
            break;
        case 3:  // Priority (Non-Preemptive)
            while (completed < n) {
                int min_pri = 9999, index = -1;
                for (int i = 0; i < n; i++) {
```

```
                if (!visited[i] && at[i] <= time && pri[i] < min_pri) {
                    min_pri = pri[i];
                    index = i;
                }
            }
            if (index == -1) { time++; continue; }
            visited[index] = 1;
            ct[index] = time + bt[index];
            time = ct[index];
            completed++;
        }
        break;
    default:
        printf("Invalid choice!\n");
        return 0;
    }
} else if (processType == 'b') {
    switch (choice) {
    case 1:  // SJRF
        while (completed < n) {
            int shortest = -1, min_bt = 9999;
            for (int i = 0; i < n; i++) {
                if (at[i] <= time && rbt[i] > 0 && rbt[i] < min_bt) {
                    min_bt = rbt[i];
                    shortest = i;
                }
            }
            if (shortest == -1) {
                time++;
                continue;
            }
            rbt[shortest]--;
            time++;
            if (rbt[shortest] == 0) {
                ct[shortest] = time;
                completed++;
            }
        }
        break;
    case 2: { // RR
        int remaining = n;
        while (remaining > 0) {
            int executed = 0;
            for (int i = 0; i < n; i++) {
                if (rbt[i] > 0 && at[i] <= time) {
                    int execTime = (rbt[i] < tq) ? rbt[i] : tq;
                    rbt[i] -= execTime;
                    time += execTime;
                    if (rbt[i] == 0) {
                        ct[i] = time;
                        remaining--;
                    }
                    executed = 1;
                }
            }
            if (!executed) time++;
        }
        break;
    }
    case 3:  // Priority (Preemptive)
        while (completed < n) {
            int min_pri = 9999, index = -1;
            for (int i = 0; i < n; i++) {
                if (at[i] <= time && rbt[i] > 0 && pri[i] < min_pri) {
                    min_pri = pri[i];
                    index = i;
                }
            }
            if (index == -1) {
                time++;
                continue;
            }
            rbt[index]--;
            time++;
            if (rbt[index] == 0) {
                ct[index] = time;
                completed++;
            }
        }
        break;
    default:
        printf("Invalid choice!\n");
        return 0;
  }
}

float atat = 0, awt = 0;
printf("\nProcess\tAT\tBT\tCT\tTAT\tWT\n");
```

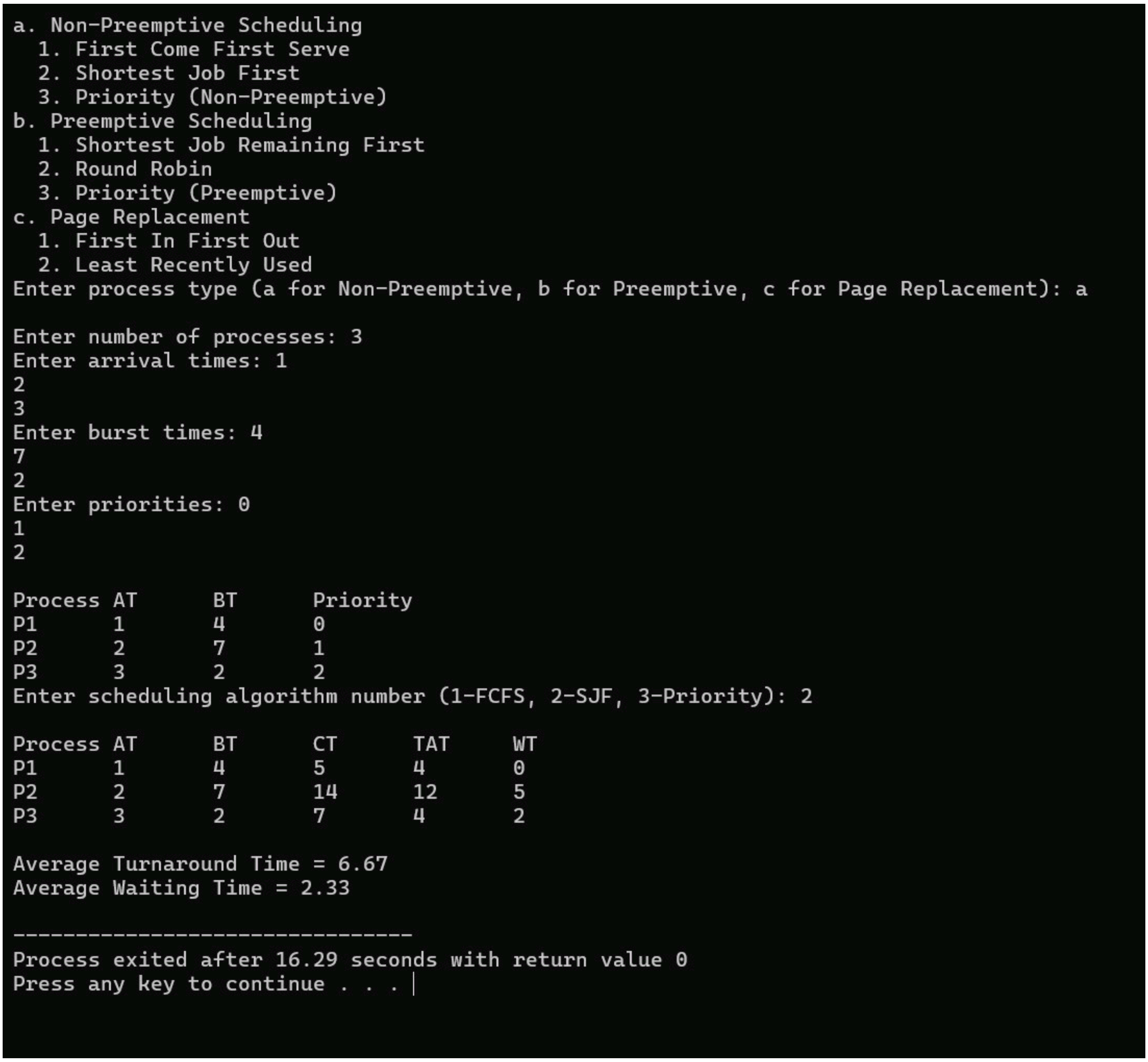
```c
        for (int i = 0; i < n; i++) {
            tat[i] = ct[i] - at[i];
            wt[i] = tat[i] - bt[i];
            atat += tat[i];
            awt += wt[i];
            printf("P%d\t%d\t%d\t%d\t%d\t%d\n", id[i], at[i], bt[i], ct[i], tat[i], wt[i]);
        }
        printf("\nAverage Turnaround Time = %.2f\n", atat / n);
        printf("Average Waiting Time = %.2f\n", awt / n);
    }

    else if (processType == 'c') {
        printf("Enter page replacement algorithm number (1-FIFO, 2-LRU): ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                fifoPageReplacement();
                break;
            case 2:
                lruPageReplacement();
                break;
            default:
                printf("Invalid page replacement choice!\n");
        }
    } else {
        printf("Invalid process type!\n");
    }

    return 0;
}

void fifoPageReplacement() {
    int frames, pages[50], frame[10], n, i, j, k = 0, flag, fault = 0;
    printf("Enter number of pages: ");
    scanf("%d", &n);
    printf("Enter the reference string: ");
    for (i = 0; i < n; i++) scanf("%d", &pages[i]);
    printf("Enter number of frames: ");
    scanf("%d", &frames);

    for (i = 0; i < frames; i++) frame[i] = -1;

    printf("\nPage\tFrames\n");
    for (i = 0; i < n; i++) {
        flag = 0;
        for (j = 0; j < frames; j++) {
            if (frame[j] == pages[i]) {
                flag = 1;
                break;
            }
        }
        if (flag == 0) {
            frame[k] = pages[i];
            k = (k + 1) % frames;
            fault++;
        }
        printf("%d\t", pages[i]);
        for (j = 0; j < frames; j++) {
            if (frame[j] != -1)
                printf("%d ", frame[j]);
            else
                printf("- ");
        }
        printf("\n");
    }
    printf("Total Page Faults = %d\n", fault);
}

int findLRU(int time[], int f) {
    int min = time[0], pos = 0;
    for (int i = 1; i < f; i++) {
        if (time[i] < min) {
            min = time[i];
            pos = i;
        }
    }
    return pos;
}

void lruPageReplacement() {
    int frames[10], pages[30], time[10], numPages, f, i, j, pos, faults = 0, counter = 0;
    int flag1, flag2;

    printf("Enter number of pages: ");
    scanf("%d", &numPages);
    printf("Enter the page reference string: ");
    for (i = 0; i < numPages; i++) scanf("%d", &pages[i]);
```

```
printf("Enter number of frames: ");
scanf("%d", &f);

for (i = 0; i < f; i++) {
   frames[i] = -1;
   time[i] = 0;
}

printf("\nPage\tFrames\n");
for (i = 0; i < numPages; i++) {
   flag1 = flag2 = 0;

   for (j = 0; j < f; j++) {
      if (frames[j] == pages[i]) {
         counter++;
         time[j] = counter;
         flag1 = flag2 = 1;
         break;
      }
   }

   if (flag1 == 0) {
      for (j = 0; j < f; j++) {
         if (frames[j] == -1) {
            counter++;
            faults++;
            frames[j] = pages[i];
            time[j] = counter;
            flag2 = 1;
            break;
         }
      }
   }

   if (flag2 == 0) {
      pos = findLRU(time, f);
      counter++;
      faults++;
      frames[pos] = pages[i];
      time[pos] = counter;
   }

   printf("%d\t", pages[i]);
   for (j = 0; j < f; j++) {
```

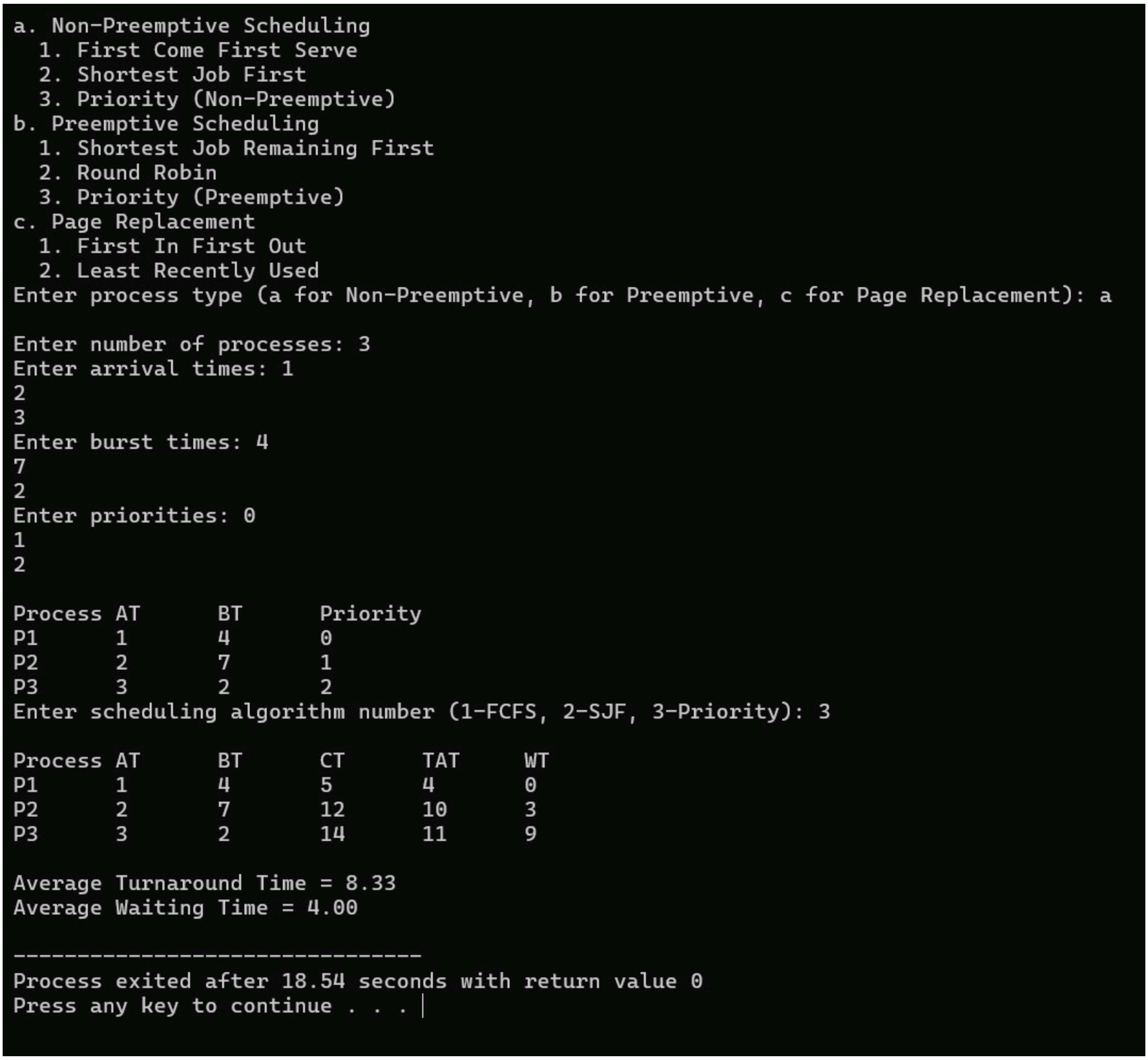
```
            if (frames[j] != -1)
                printf("%d ", frames[j]);
            else
                printf("- ");
        }
        printf("\n");
    }

    printf("Total Page Faults = %d\n", faults);
}
```



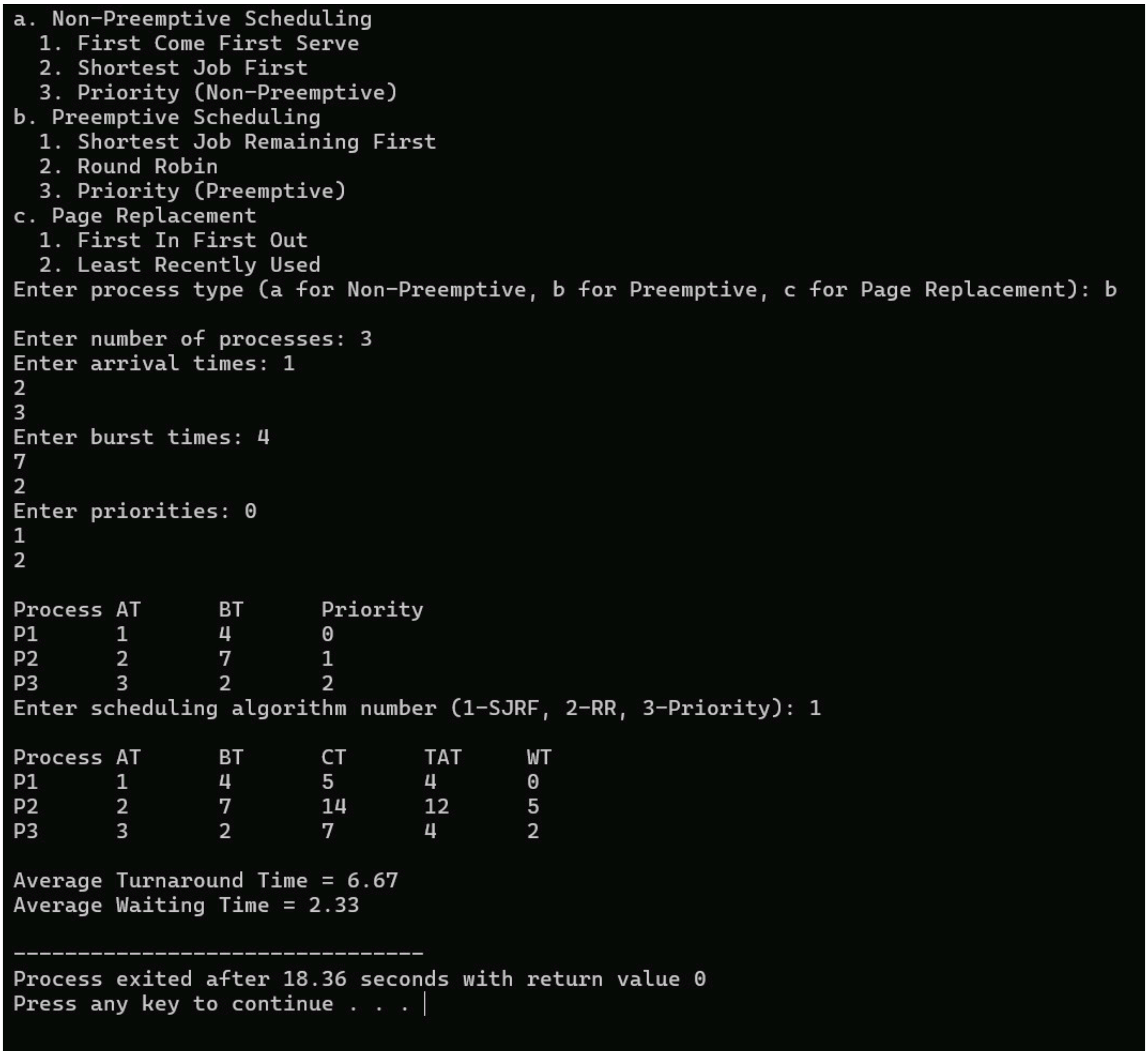
```
a. Non-Preemptive Scheduling
  1. First Come First Serve
  2. Shortest Job First
  3. Priority (Non-Preemptive)
b. Preemptive Scheduling
  1. Shortest Job Remaining First
  2. Round Robin
  3. Priority (Preemptive)
c. Page Replacement
  1. First In First Out
  2. Least Recently Used
Enter process type (a for Non-Preemptive, b for Preemptive, c for Page Replacement): a

Enter number of processes: 3
Enter arrival times: 1
2
3
Enter burst times: 4
7
2
Enter priorities: 0
1
2

Process AT      BT      Priority
P1      1       4       0
P2      2       7       1
P3      3       2       2
Enter scheduling algorithm number (1-FCFS, 2-SJF, 3-Priority): 1

Process AT      BT      CT      TAT     WT
P1      1       4       5       4       0
P2      2       7       12      10      3
P3      3       2       14      11      9

Average Turnaround Time = 8.33
Average Waiting Time = 4.00

--------------------------------
Process exited after 133.3 seconds with return value 0
Press any key to continue . . .
```



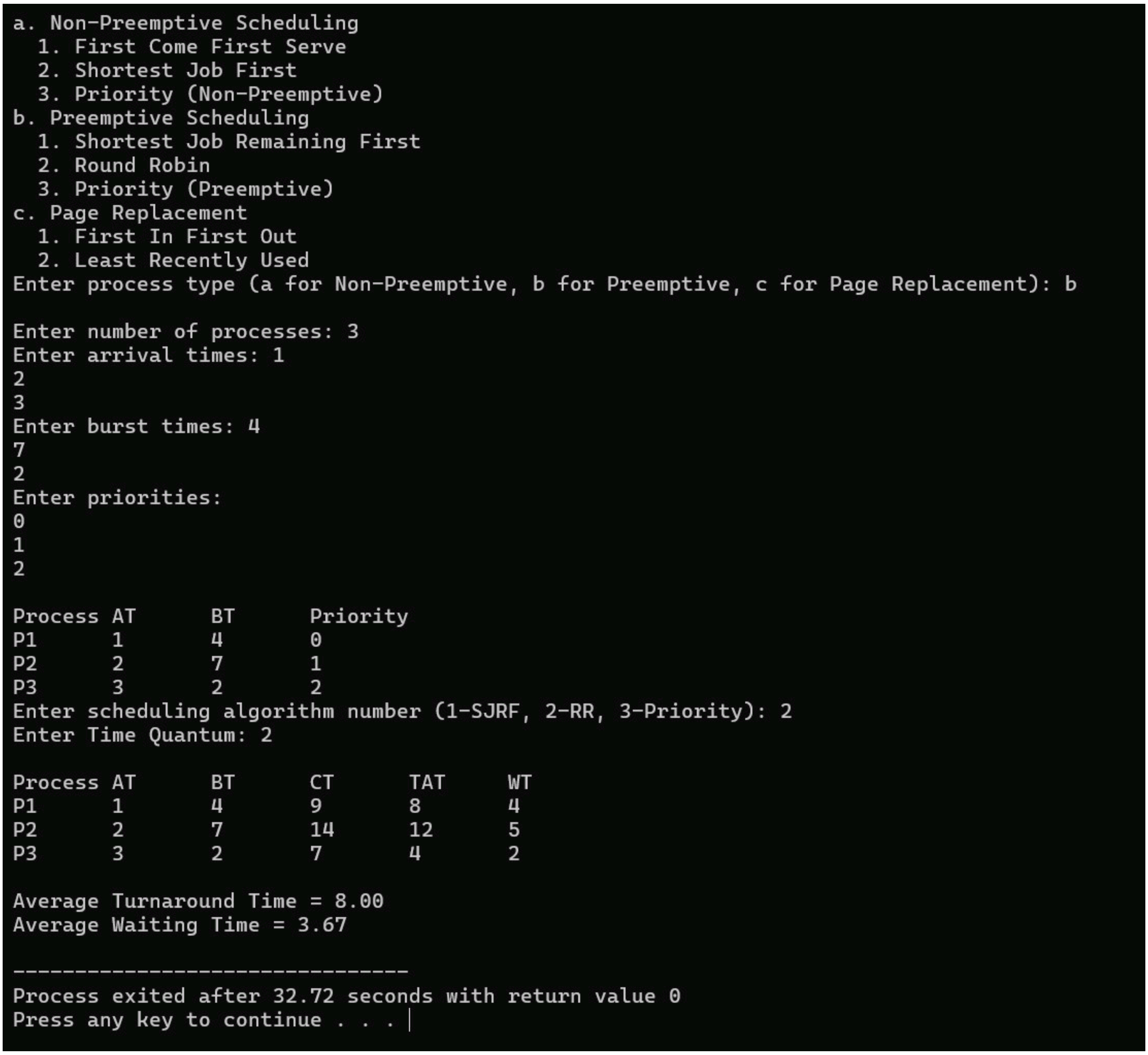
```
a. Non-Preemptive Scheduling
  1. First Come First Serve
  2. Shortest Job First
  3. Priority (Non-Preemptive)
b. Preemptive Scheduling
  1. Shortest Job Remaining First
  2. Round Robin
  3. Priority (Preemptive)
c. Page Replacement
  1. First In First Out
  2. Least Recently Used
Enter process type (a for Non-Preemptive, b for Preemptive, c for Page Replacement): a

Enter number of processes: 3
Enter arrival times: 1
2
3
Enter burst times: 4
7
2
Enter priorities: 0
1
2

Process AT      BT      Priority
P1      1       4       0
P2      2       7       1
P3      3       2       2
Enter scheduling algorithm number (1-FCFS, 2-SJF, 3-Priority): 2

Process AT      BT      CT      TAT     WT
P1      1       4       5       4       0
P2      2       7       14      12      5
P3      3       2       7       4       2

Average Turnaround Time = 6.67
Average Waiting Time = 2.33

--------------------------------
Process exited after 16.29 seconds with return value 0
Press any key to continue . . .
```



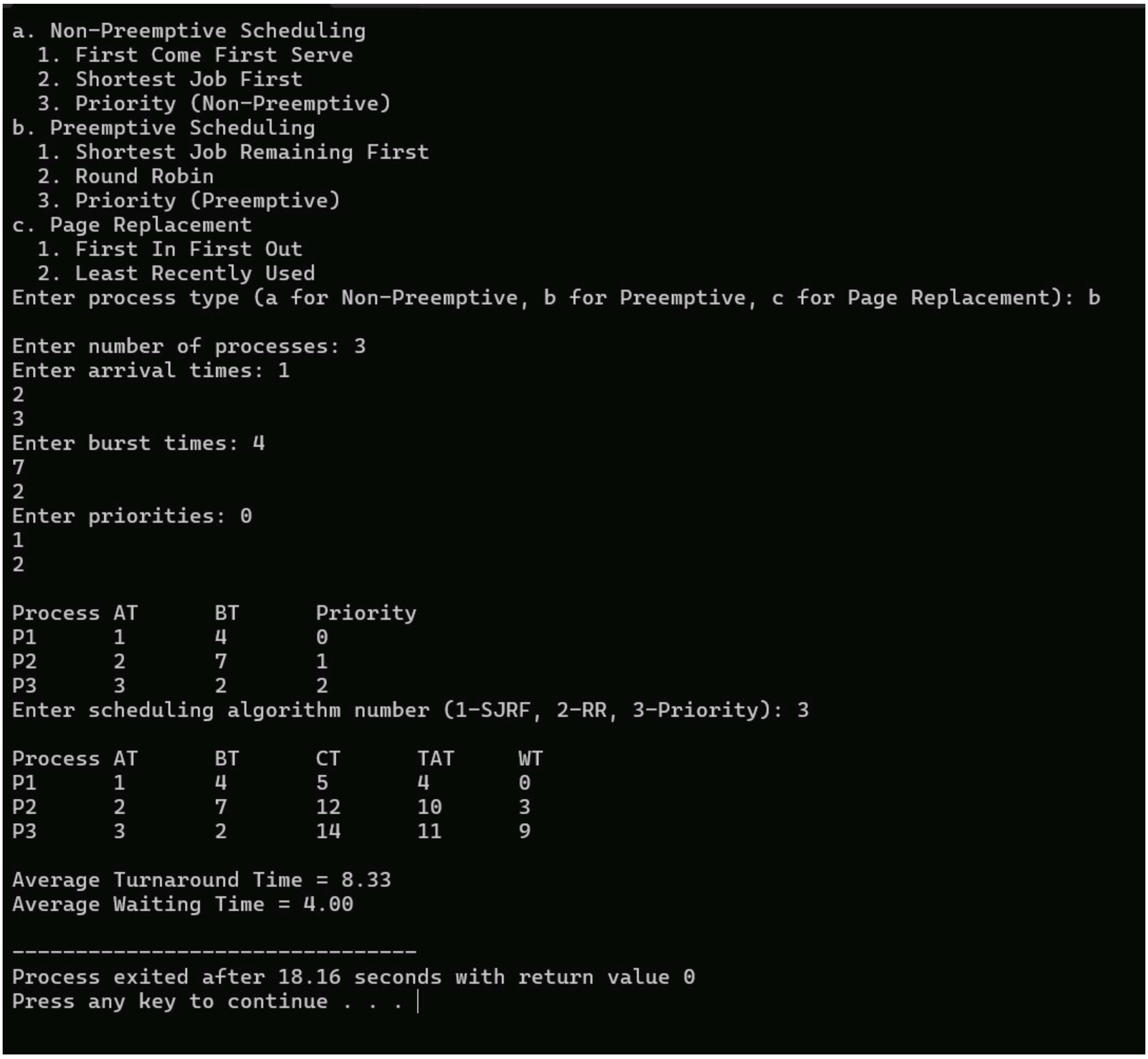
```
a. Non-Preemptive Scheduling
  1. First Come First Serve
  2. Shortest Job First
  3. Priority (Non-Preemptive)
b. Preemptive Scheduling
  1. Shortest Job Remaining First
  2. Round Robin
  3. Priority (Preemptive)
c. Page Replacement
  1. First In First Out
  2. Least Recently Used
Enter process type (a for Non-Preemptive, b for Preemptive, c for Page Replacement): a

Enter number of processes: 3
Enter arrival times: 1
2
3
Enter burst times: 4
7
2
Enter priorities: 0
1
2

Process AT      BT      Priority
P1      1       4       0
P2      2       7       1
P3      3       2       2
Enter scheduling algorithm number (1-FCFS, 2-SJF, 3-Priority): 3

Process AT      BT      CT      TAT     WT
P1      1       4       5       4       0
P2      2       7       12      10      3
P3      3       2       14      11      9

Average Turnaround Time = 8.33
Average Waiting Time = 4.00

--------------------------------
Process exited after 18.54 seconds with return value 0
Press any key to continue . . .
```



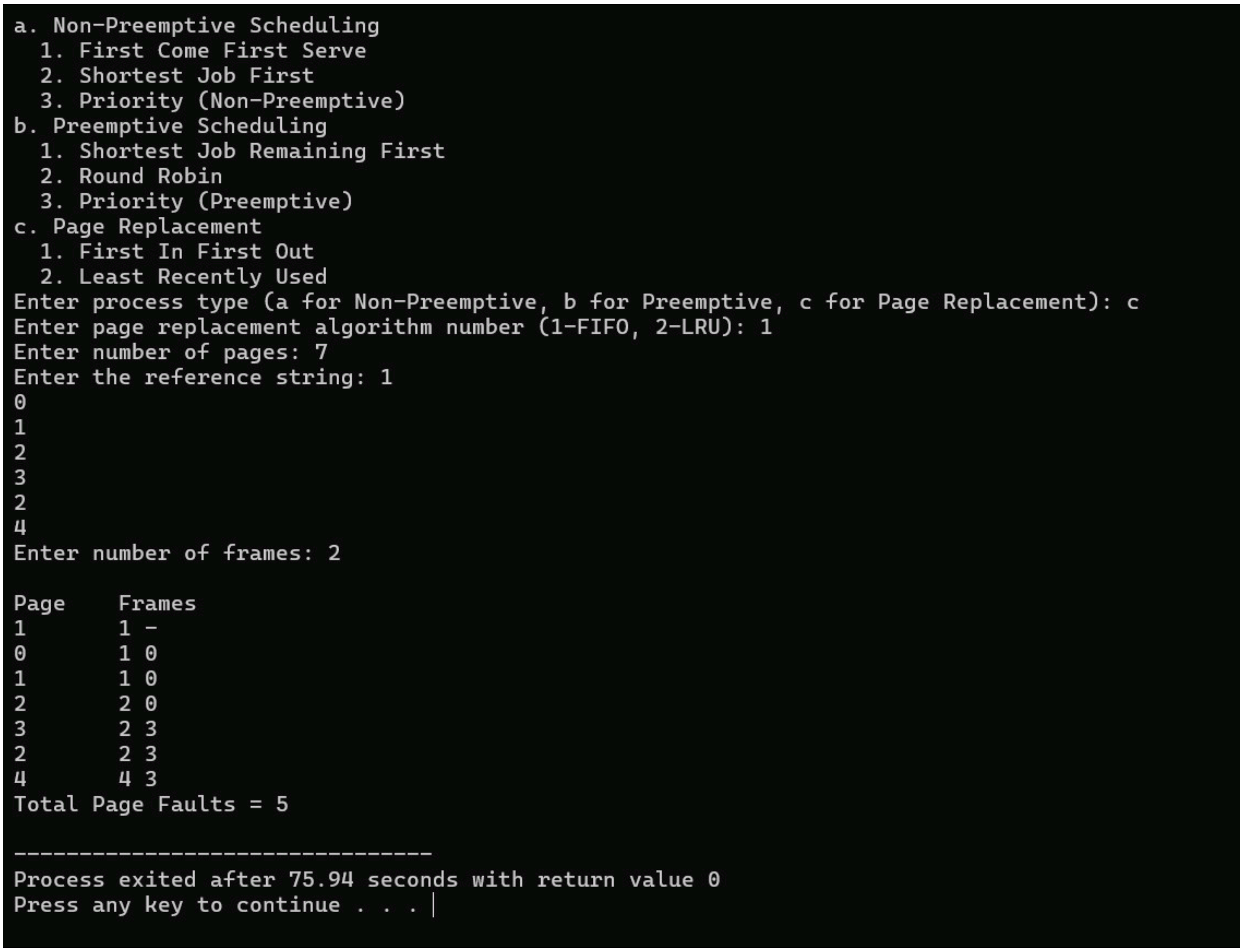
```
a. Non-Preemptive Scheduling
  1. First Come First Serve
  2. Shortest Job First
  3. Priority (Non-Preemptive)
b. Preemptive Scheduling
  1. Shortest Job Remaining First
  2. Round Robin
  3. Priority (Preemptive)
c. Page Replacement
  1. First In First Out
  2. Least Recently Used
Enter process type (a for Non-Preemptive, b for Preemptive, c for Page Replacement): b

Enter number of processes: 3
Enter arrival times: 1
2
3
Enter burst times: 4
7
2
Enter priorities: 0
1
2

Process AT      BT      Priority
P1      1       4       0
P2      2       7       1
P3      3       2       2
Enter scheduling algorithm number (1-SJRF, 2-RR, 3-Priority): 1

Process AT      BT      CT      TAT     WT
P1      1       4       5       4       0
P2      2       7       14      12      5
P3      3       2       7       4       2

Average Turnaround Time = 6.67
Average Waiting Time = 2.33

--------------------------------
Process exited after 18.36 seconds with return value 0
Press any key to continue . . .
```



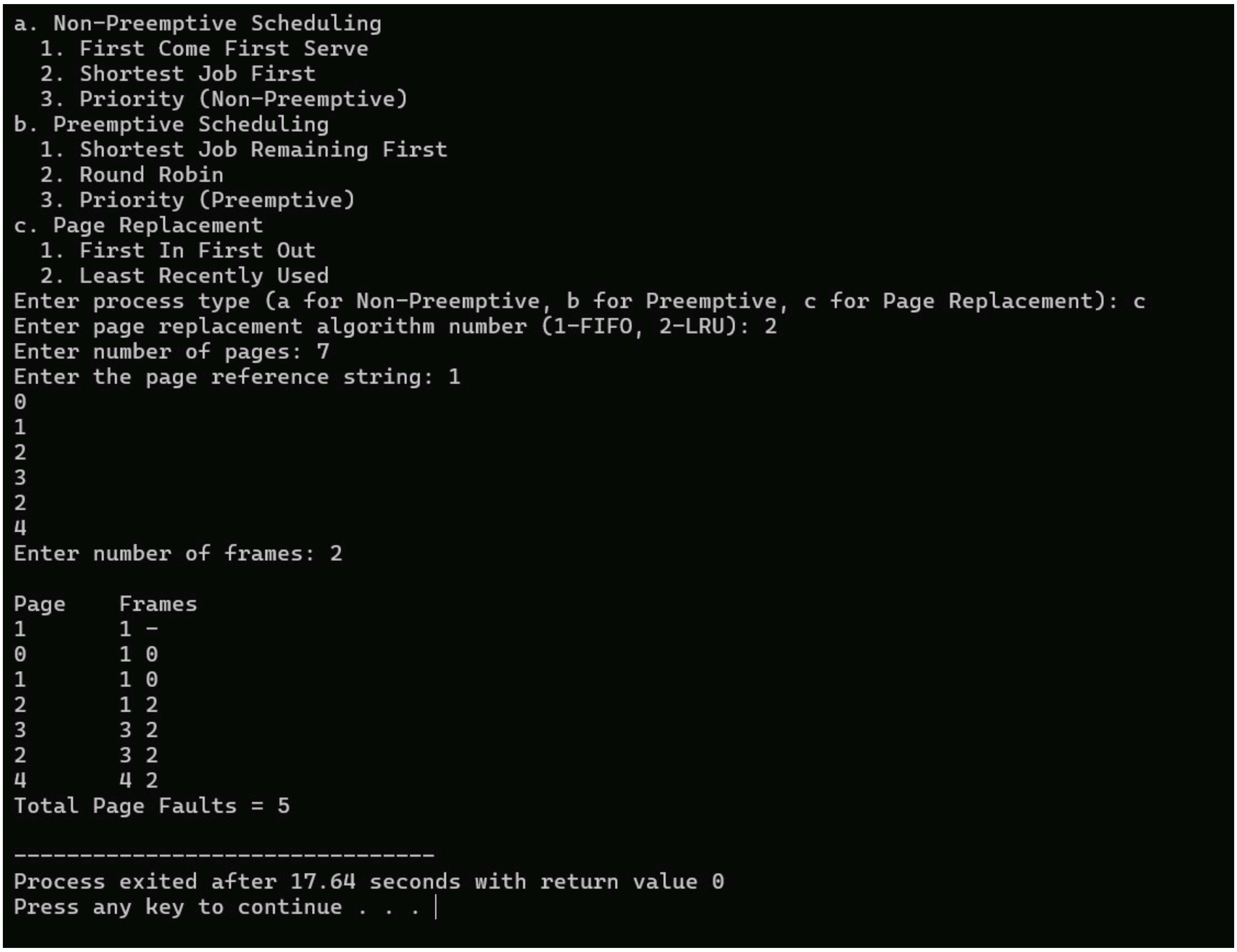
```
a. Non-Preemptive Scheduling
  1. First Come First Serve
  2. Shortest Job First
  3. Priority (Non-Preemptive)
b. Preemptive Scheduling
  1. Shortest Job Remaining First
  2. Round Robin
  3. Priority (Preemptive)
c. Page Replacement
  1. First In First Out
  2. Least Recently Used
Enter process type (a for Non-Preemptive, b for Preemptive, c for Page Replacement): b

Enter number of processes: 3
Enter arrival times: 1
2
3
Enter burst times: 4
7
2
Enter priorities:
0
1
2

Process AT      BT      Priority
P1      1       4       0
P2      2       7       1
P3      3       2       2
Enter scheduling algorithm number (1-SJRF, 2-RR, 3-Priority): 2
Enter Time Quantum: 2

Process AT      BT      CT      TAT     WT
P1      1       4       9       8       4
P2      2       7       14      12      5
P3      3       2       7       4       2

Average Turnaround Time = 8.00
Average Waiting Time = 3.67

--------------------------------
Process exited after 32.72 seconds with return value 0
Press any key to continue . . .
```



```
a. Non-Preemptive Scheduling
  1. First Come First Serve
  2. Shortest Job First
  3. Priority (Non-Preemptive)
b. Preemptive Scheduling
  1. Shortest Job Remaining First
  2. Round Robin
  3. Priority (Preemptive)
c. Page Replacement
  1. First In First Out
  2. Least Recently Used
Enter process type (a for Non-Preemptive, b for Preemptive, c for Page Replacement): b

Enter number of processes: 3
Enter arrival times: 1
2
3
Enter burst times: 4
7
2
Enter priorities: 0
1
2

Process AT      BT      Priority
P1      1       4       0
P2      2       7       1
P3      3       2       2
Enter scheduling algorithm number (1-SJRF, 2-RR, 3-Priority): 3

Process AT      BT      CT      TAT     WT
P1      1       4       5       4       0
P2      2       7       12      10      3
P3      3       2       14      11      9

Average Turnaround Time = 8.33
Average Waiting Time = 4.00

--------------------------------
Process exited after 18.16 seconds with return value 0
Press any key to continue . . .
```



```
a. Non-Preemptive Scheduling
  1. First Come First Serve
  2. Shortest Job First
  3. Priority (Non-Preemptive)
b. Preemptive Scheduling
  1. Shortest Job Remaining First
  2. Round Robin
  3. Priority (Preemptive)
c. Page Replacement
  1. First In First Out
  2. Least Recently Used
Enter process type (a for Non-Preemptive, b for Preemptive, c for Page Replacement): c
Enter page replacement algorithm number (1-FIFO, 2-LRU): 1
Enter number of pages: 7
Enter the reference string: 1
0
1
2
3
2
4
Enter number of frames: 2

Page    Frames
1       1 -
0       1 0
1       1 0
2       2 0
3       2 3
2       2 3
4       4 3
Total Page Faults = 5

--------------------------------
Process exited after 75.94 seconds with return value 0
Press any key to continue . . .
```



```
a. Non-Preemptive Scheduling
  1. First Come First Serve
  2. Shortest Job First
  3. Priority (Non-Preemptive)
b. Preemptive Scheduling
  1. Shortest Job Remaining First
  2. Round Robin
  3. Priority (Preemptive)
c. Page Replacement
  1. First In First Out
  2. Least Recently Used
Enter process type (a for Non-Preemptive, b for Preemptive, c for Page Replacement): c
Enter page replacement algorithm number (1-FIFO, 2-LRU): 2
Enter number of pages: 7
Enter the page reference string: 1
0
1
2
3
2
4
Enter number of frames: 2

Page    Frames
1       1 -
0       1 0
1       1 0
2       1 2
3       3 2
2       3 2
4       4 2
Total Page Faults = 5

--------------------------------
Process exited after 17.64 seconds with return value 0
Press any key to continue . . .
```