First Come First Serve (FCFS) Scheduling

Advance OS

1. Taking Input (Process Name, Arrival Time, CPU Time) form User

1.1 Enter Process Names

In [1]:

```
print("Enter Name of Processes as P0, P1, P2..... with space separted")

# This will Make the list of Processes Names entered by user
processList = list(map(str, input().split()))

processList
```

```
Enter Name of Processes as P0, P1, P2..... with space separted
```

Out[1]:

```
['P0', 'P1', 'P2', 'P3']
```

1.2 Enter Arrival Time

In [2]:

```
print("Enter Arrival Time for each Process mentioned above with space separted")

# This will Make the list of Processes arrival time entered by user
arrivalTime = list(map(float, input().split()))

arrivalTime
```

```
Enter Arrival Time for each Process mentioned above with space separted
```

Out[2]:

```
[2.0, 1.0, 0.0, 4.0]
```

1.3 Enter CPU Time

In [3]:

```
print("Enter CPU Time for each Process mentioned above with space separted")

# This will Make the list of Processes CPU time entered by user
CPUTime = list(map(float, input().split()))

CPUTime
```

```
Enter CPU Time for each Process mentioned above with space separted
```

Out[3]:

```
[20.0, 25.0, 14.0, 10.0]
```

1.4 Display in the form Table

In [4]:

```
import pandas as pd

data = {}

data["Process Name"] = processList
data["Arrival Time (AT)"] = arrivalTime
data["CPU Time / Burst Time"] = CPUTime

ECTMatrix = pd.DataFrame(data)

print("-----------------------------------------------------")
print("\t\t\tFCFS")
print("    Input Matirx with Arrival Time and CPU Time")
print("-----------------------------------------------------")
ECTMatrix
```

```
-----------------------------------------------------
   FCFS
    Input Matirx with Arrival Time and CPU Time
-----------------------------------------------------
```

Out[4]:

	Process Name	Arrival Time (AT)	CPU Time / Burst Time
0	**P0**	**2.0**	**20.0**
1	**P1**	**1.0**	**25.0**
2	**P2**	**0.0**	**14.0**
3	**P3**	**4.0**	**10.0**

2. Sort the Data frame on the basis of arrival time

In [5]:

```
sortedECTMatrix = ECTMatrix.sort_values('Arrival Time (AT)')

print("=====================================================")
print("\t\t\tFCFS")
print("\t\t    Sorted Matrix")
print("=====================================================")
sortedECTMatrix
```

```
=====================================================
   FCFS
      Sorted Matrix
=====================================================
```

Out[5]:

	Process Name	Arrival Time (AT)	CPU Time / Burst Time
2	**P2**	**0.0**	**14.0**
1	**P1**	**1.0**	**25.0**
0	**P0**	**2.0**	**20.0**
3	**P3**	**4.0**	**10.0**

2.1 Reset the index values

In [6]:

```
sortedECTMatrix.reset_index(drop=True, inplace=True)
sortedECTMatrix
```

Out[6]:

	Process Name	Arrival Time (AT)	CPU Time / Burst Time
0	P2	0.0	14.0
1	P1	1.0	25.0
2	P0	2.0	20.0
3	P3	4.0	10.0

3. Findng the start time and Completion time of each Process

In [7]:

```
currentTime = sortedECTMatrix["Arrival Time (AT)"][0]
gantChart = []

for p in range(len(sortedECTMatrix)):

    gantChart.append([currentTime, currentTime + sortedECTMatrix["CPU Time / Burst Time"
][p]])
    currentTime+= sortedECTMatrix["CPU Time / Burst Time"][p]

gantChart
```

Out[7]:

```
[[0.0, 14.0], [14.0, 39.0], [39.0, 59.0], [59.0, 69.0]]
```

3.1 Add start time and Completion time of each process in data frame

In [8]:

```
startTime = []
complTime = []

for i in range(0,len(sortedECTMatrix)):
    startTime.append(gantChart[i][0])
    complTime.append(gantChart[i][1])

sortedECTMatrix["Start Time"] = startTime
sortedECTMatrix["Completion Time"] = complTime

sortedECTMatrix
```

Out[8]:

	Process Name	Arrival Time (AT)	CPU Time / Burst Time	Start Time	Completion Time
0	P2	0.0	14.0	0.0	14.0
1	P1	1.0	25.0	14.0	39.0
2	P0	2.0	20.0	39.0	59.0
3	P3	4.0	10.0	59.0	69.0

4. Find Turn Around time for each process and average Turn Around Time

```
Turn around Time  = Completion Time - Arrival Time
```

In [9]:

```
TurnAroundTime = []

for i in range(0,len(sortedECTMatrix)):
```

```
    TurnAroundTime.append(sortedECTMatrix["Completion Time"][i] - sortedECTMatrix["Arriv
al Time (AT)"][i])

TurnAroundTime
```

Out[9]:

```
[14.0, 38.0, 57.0, 65.0]
```

4.1 Add Turn Around column in current data frame

In [10]:

```
sortedECTMatrix["Turnaround Time"] = TurnAroundTime

sortedECTMatrix
```

Out[10]:

	Process Name	Arrival Time (AT)	CPU Time / Burst Time	Start Time	Completion Time	Turnaround Time
0	**P2**	**0.0**	**14.0**	**0.0**	**14.0**	**14.0**
1	**P1**	**1.0**	**25.0**	**14.0**	**39.0**	**38.0**
2	**P0**	**2.0**	**20.0**	**39.0**	**59.0**	**57.0**
3	**P3**	**4.0**	**10.0**	**59.0**	**69.0**	**65.0**

4.2 Finding Average Turn Around Time and Maskespan

```
Average Turn Around Time = Sum of Turn around Time / Total no. of Process
Makespan = Maximum of Turn around Time
```

In [11]:

```
averageTurnAroundTime = sortedECTMatrix["Turnaround Time"].sum()/len(sortedECTMatrix)
makespan = max(sortedECTMatrix["Turnaround Time"])

print(f"The average turn around time: {averageTurnAroundTime}")
print(f"The Makespan is: {makespan}")
```

```
The average turn around time: 43.5
The Makespan is: 65.0
```

5. Finding the Waiting Time for each Process

```
Waiting Time = Turn Around Time - CPU Time
```

In [12]:

```
WeightingTime = []

for i in range(0,len(sortedECTMatrix)):

    WeightingTime.append(sortedECTMatrix["Turnaround Time"][i] - sortedECTMatrix["CPU Ti
me / Burst Time"][i])

WeightingTime
```

Out[12]:

```
[0.0, 13.0, 37.0, 55.0]
```

5.1 Add Waiting Time column in current Data Frame

In [13]:

```
sortedECTMatrix["Waiting Time"] = WeightingTime

sortedECTMatrix
```

Out[13]:

	Process Name	Arrival Time (AT)	CPU Time / Burst Time	Start Time	Completion Time	Turnaround Time	Waiting Time
0	**P2**	**0.0**	**14.0**	**0.0**	**14.0**	**14.0**	**0.0**
1	**P1**	**1.0**	**25.0**	**14.0**	**39.0**	**38.0**	**13.0**
2	**P0**	**2.0**	**20.0**	**39.0**	**59.0**	**57.0**	**37.0**
3	**P3**	**4.0**	**10.0**	**59.0**	**69.0**	**65.0**	**55.0**

5.2 Average Waiting Time

In [14]:

```
averageWeightingTime= sortedECTMatrix["Waiting Time"].sum()/len(sortedECTMatrix)

print(f"The average waiting time: {averageWeightingTime}")
```

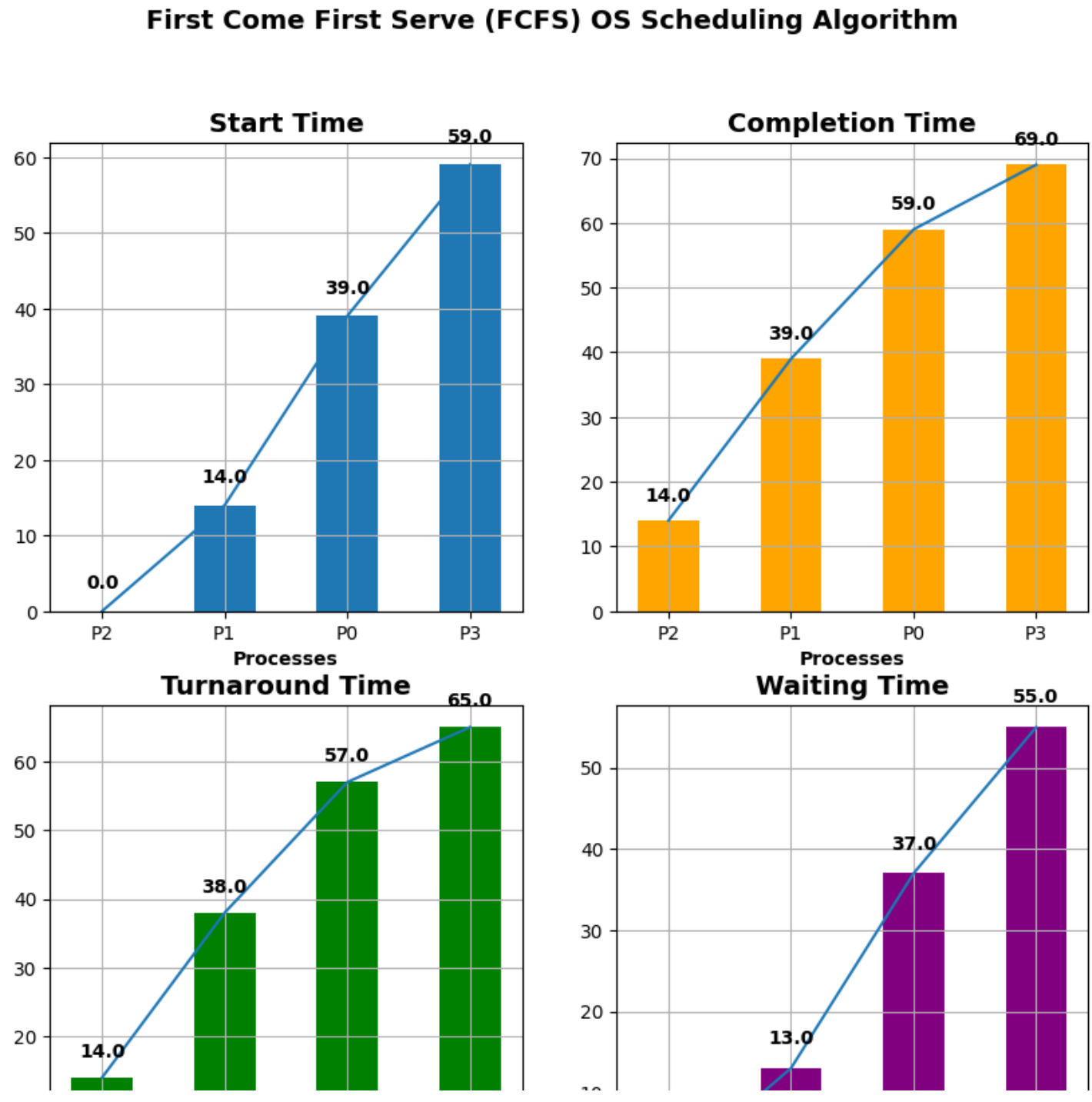
```
The average waiting time: 26.25
```

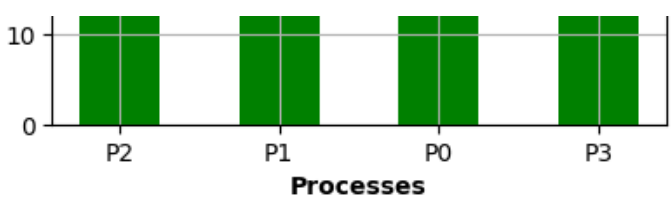
6. Draw Start Time, Completion Time, Turnaround Time, and Waiting Time for each Process

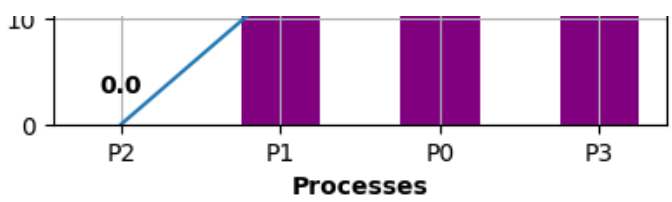
In [15]:

```
import matplotlib.pyplot as plt

# plt.figure(figsize=(5,5))

# plt.bar(sortedECTMatrix["Process Name"], sortedECTMatrix["Completion Time"])
# # plt.bar(sortedECTMatrix["Process Name"], sortedECTMatrix["Completion Time"])
# plt.show()

plt.figure(figsize=(10,10))
plt.subplot(221)
plt.plot(sortedECTMatrix["Process Name"], sortedECTMatrix["Start Time"])
plt.bar(sortedECTMatrix["Process Name"], sortedECTMatrix["Start Time"], width=0.5)

# Add labels to the bars
for i, v in enumerate(sortedECTMatrix["Start Time"]):
    plt.text(i, v + 3, str(v), ha='center', fontweight='bold')

plt.title("Start Time", fontweight = 'bold', fontsize = '14')
plt.xlabel("Processes", fontweight = 'bold', fontsize = '10')
plt.grid("on")
plt.subplot(222)
plt.plot(sortedECTMatrix["Process Name"], sortedECTMatrix["Completion Time"])
plt.bar(sortedECTMatrix["Process Name"], sortedECTMatrix["Completion Time"],
        width = 0.5, color = "orange")

# Add labels to the bars
for i, v in enumerate(sortedECTMatrix["Completion Time"]):
    plt.text(i, v + 3, str(v), ha='center', fontweight='bold')

plt.title("Completion Time", fontweight = 'bold', fontsize = '14')
plt.xlabel("Processes", fontweight = 'bold', fontsize = '10')
plt.grid("on")
plt.subplot(223)
plt.plot(sortedECTMatrix["Process Name"], sortedECTMatrix["Turnaround Time"])
plt.bar(sortedECTMatrix["Process Name"], sortedECTMatrix["Turnaround Time"],
        width=0.5, color = 'green')
```

```
# Add labels to the bars
for i, v in enumerate(sortedECTMatrix["Turnaround Time"]):
    plt.text(i, v + 3, str(v), ha='center', fontweight='bold')

plt.title("Turnaround Time", fontweight = 'bold', fontsize = '14')
plt.xlabel("Processes", fontweight = 'bold', fontsize = '10')
plt.grid("on")
plt.subplot(224)
plt.plot(sortedECTMatrix["Process Name"], sortedECTMatrix["Waiting Time"])
plt.bar(sortedECTMatrix["Process Name"], sortedECTMatrix["Waiting Time"],
        width=0.5, color = "purple")

# Add labels to the bars
for i, v in enumerate(sortedECTMatrix["Waiting Time"]):
    plt.text(i, v + 3, str(v), ha='center', fontweight='bold')

plt.title("Waiting Time", fontweight = 'bold', fontsize = '14')
plt.xlabel("Processes", fontweight = 'bold', fontsize = '10')
plt.grid("on")

plt.suptitle("First Come First Serve (FCFS) OS Scheduling Algorithm", fontweight = 'bold'
, fontsize = '14')
# Show the plot
plt.show()
```







In [17]:

```
forPlot = [averageTurnAroundTime, averageWeightingTime, makespan]
hBary = ["Average Turnaround Time", "Average Waiting Time", "Makespan"]

colors = ['BLUE', 'purple', 'green']

plt.figure(figsize=(5,5))
plt.barh(hBary,forPlot, color = colors, height=0.4)

for i, v in enumerate(forPlot):
    plt.text(v + 4, i , str(v), ha='center', fontweight='bold')

plt.title("FCFS OS Algorithm", fontweight = 'bold', fontsize = '14')
plt.grid("on")
      # set grid transparency to 0.5
plt.show()
```