

MANIPAL UNIVERSITY JAIPUR

Faculty of Engineering | School of Computing and Intelligent Systems

Department of IoT & IS

Session: Jan 2024 – May 2024 | Program: B. Tech. IoT & IS | Semester: IV

IS2201 Operating System

## Group Assignment 2

Pranav Karwa 229311052, IOT - B

Aniruddha Bolakhe 229303199,

Hitesh Sangra 229302611,

Nabhya Sharma 229311118

## Process Scheduling

Consider the following source codes:

**program looptest**

**read(i) for n = 1 to 15 x = i + n next**

**end**

Compile the above source code using **CPU-OS Simulator** and load it in the main memory and run this code. To enter the OS simulator:

1. Click on the OS O... button in the current window. The OS window opens.
2. You should see an entry titled as the program name given above, in the PROGRAM LIST view.
3. Now that this program is available to the OS simulator, we can create as many instances, i.e. processes, of it as we like. You do this by clicking on the CREATE NEW PROCESS button.

### PART-A

- Select the **First-Come-First-Served (FCFS)** option in the SCHEDULER/Policies view
- Time slice should be considered as **seconds**.
- Create four processes P1, P2, P3 and P4 from source code respectively (Use the

Priority drop-down list in the PROGRAM LIST / Process View): **3, 2, 4, 1** ➤ Slide the Speed selector half-way down and then hit the START button.

- **Arrival delay** should be considered in **seconds** in the OS simulator **Now, give answer for the following:**

1. What is the order in which processes are executed?

P1-P2-P3-P4

1. What is the **Elapsed time**, **Average Process Waiting Time** and **Average Burst Period** and of each process? (To see this, Click on VIEWS button available on the left of your OS control, the click VIEW LOG)

Process	Arrival Time/Delay (sec)	Elapsed Time	Average Process Waiting Time (sec)	Average Burst Period
P1	0	40.138	0.32	125
P2	0	38.130	160.71	125
P3	0	38.381	319.09	125
P4	0	38.381	477.72	125
Avg. Process Waiting Time				239.46

## PART-B

- Select the **Shortest Job First (SJF)** option in the SCHEDULER/Policies view
- Select the Priority (static) as **Pre-emptive** option in the SCHEDULER/Policies view ➤ Time slice should be considered as **seconds**.
- Create four processes P1, P2, P3 and P4 from source codes respectively (Use the

Priority drop-down list in the PROGRAM LIST / Process View): **3, 2, 4, 1** ➤ Slide the Speed selector half-way down and then hit the START button.

- **Arrival delay** should be considered in **seconds** in the OS simulator **Now, give answer for the following:**

1. What is the order in which processes are executed?

P1-P2-P3-p4

1. What is the **Elapsed time**, **Average Process Waiting Time** and **Average Burst Period** and of each process? (To see this, Click on VIEWS button available on the left of your

OS control, the click VIEW LOG)

Process	Arrival Time/Delay (sec)	Elapsed Time	Average Process Waiting Time (sec)	Average Burst Period
P1	0	31.917	0.31	125
P2	0	29.310	152.46	125
P3	0	29.310	302.01	125
P4	0	29.310	451.55	125
Avg. Process Waiting Time =			226.58	

## PART-C

- Select the **Round Robin (RR) with 5 seconds as time slice** option in the SCHEDULER/Policies view.
- Select the Priority (static) as **Pre-emptive** option in the SCHEDULER/Policies view
- Time slice should be taken in terms of **seconds** instead of **ticks**
- Create four processes P1, P2, P3 and P4 from source codes respectively (Use the

Priority drop-down list in the PROGRAM LIST / Process View): **3, 2, 4, 1** ➤ Slide the Speed selector half-way down and then hit the START button.

- **Arrival delay** should be considered in **seconds** in the OS simulator **Now, give answer for the following:**

1. What is the order in which processes are executed?

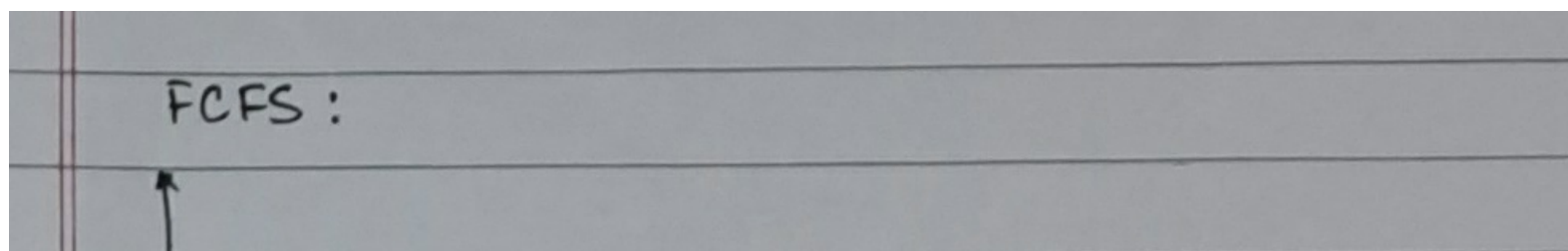
P4-P2-P1-P3

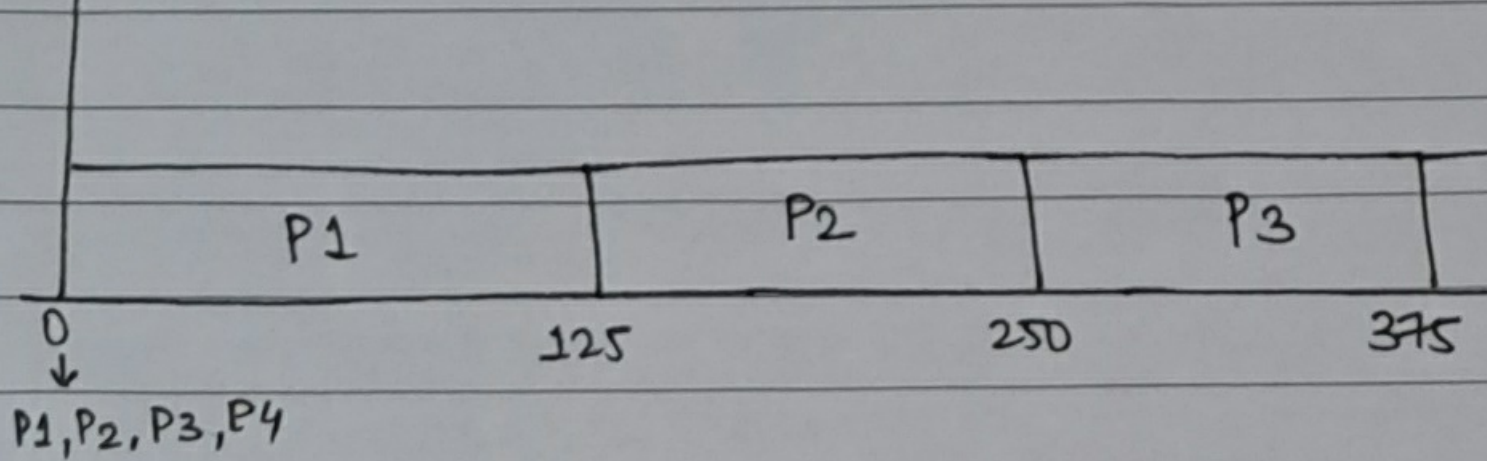
1. What is the **Elapsed time**, **Average Process Waiting Time** and **Average Burst Period** and of each process? (To see this, Click on VIEWS button available on the left of your OS control, the click VIEW LOG)

Process	Arrival Time/Delay (sec)	Elapsed Time	Average Process Waiting Time (sec)	Average Burst Period
P1	0	36.657	10.15	3
P2	0	36.894	5.09	3
P3	0	29.311	474.31	125
P4	0	39.739	0.24	3
Avg. Process Waiting Time =			166.23	

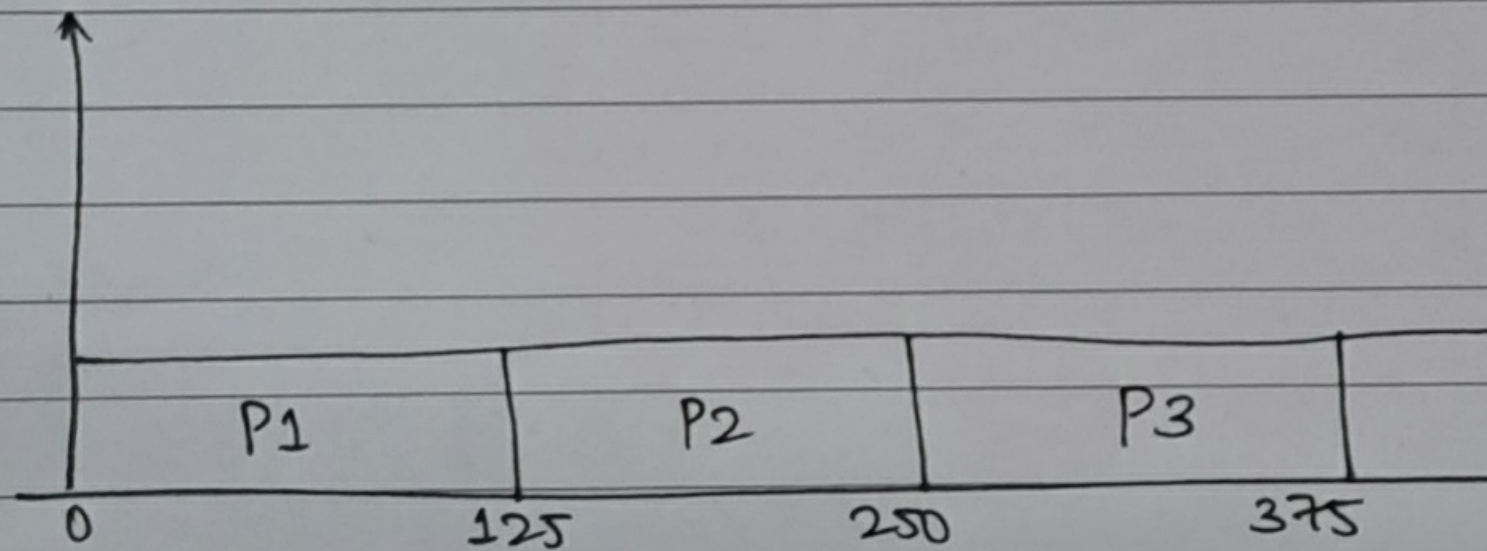
## PART-D

1. Plot a graph from the results obtained by FCFS, SJF and Round Robin scheduling and explain which algorithm is better among these with proper justification.

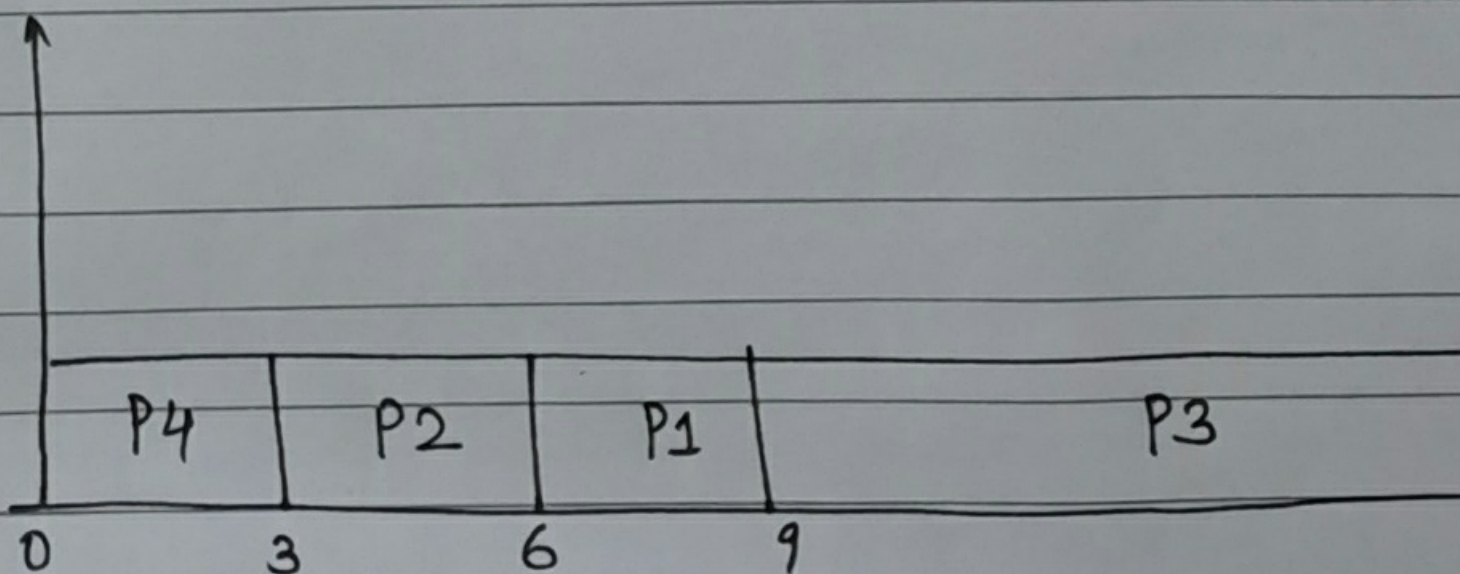




SJF :



RR :



## ScreenShots

OS Simulator: CPU 0 [YASMIN: CPU-OS Simulator, Version: 7.5.50, Copyright © 2006-2013, Besim Mustafa, Edge Hill University, UK]

RUNNING PROCESSES

Pid	Name	State	Memory	Priority	Burst	Swap	PName	CPU	PPid

WAIT

Period  
0 sec.

QUEUE

KILL

Force kill ☐

Suspend on state change ☐

Fault kill ☐

Suspend on pre-emption ☐

SHOW MEMORY...

SHOW PCB...

READY PROCESSES (Ready Queue)

Pid	Name	State	Memory	Priority	Burst	Swap	PName	CPU	PPid
<input type="checkbox"/> 1	LOOPTEST		1	3	0	No	P1	0	
<input type="checkbox"/> 2	LOOPTEST		1	3	0	No	P2	0	

Pid	Name	Delay	Memory	Priority	Burst	Swap	PName	CPU	PPid
<input type="checkbox"/> 3	LOOPTEST	1	1	3	0	Yes	P3	0	

CLEAR

REMOVE

Suspend on state change ☐

SHOW MEMORY...

SHOW PCB...

WAITING PROCESSES (Waiting Queue)

Pid	Name	State	Memory	Priority	Burst	Swap	PName	CPU	PPid

CLEAR

REMOVE

RESUME

Suspend on state change ☐

SHOW MEMORY...

SHOW PCB...

SCHEDULER

Policies

☐ First-Come-First-Served
 ☐ Shortest-Job-First
 ☒ Round Robin

Round Robin Time  
☒ 5  
☐ 0.2

OS Control

START

STOP

SUSPEND

PROGRAM LIST

Program Name

LOOPTEST



[illegible]

The diagram illustrates the Cache - Pipeline Execution Unit. It is divided into two main sections: 'Cache - Pipeline' and 'Execution Unit'.

**Cache - Pipeline:**

- 1. FETCH:** The Instruction register contains 'IN 1, R03'.
- 2. DECODE:** The Op Code register contains 'IN'.

**Execution Unit:**

- Opnd1:** The register contains '1'. Below it are four radio button options: IMM (selected), RDIR, RIND, and MIND. There is also an unselected RJREL option.
- Opnd2:** The register contains '0'. Below it are four radio button options: IMM, MDIR (selected), RIND, and RJREL. There is also an unselected MIND option.

At the bottom, the **3. EXECUTE** stage is shown, but it is currently empty.

PROGRAM LIST				
Name	Base	Start	Type	
LOOPTEST	0000	0000	R	
LOOPTEST	0000	0000	S	
LOOPTEST	0000	0000	S	
LOOPTEST	0000	0000	S	

LOAD COMPILED CODE IN MEMORY

SHOW PROGRAM DATA MEMORY...

REMOVE PROGRAM

REMOVE ALL PROGRAMS

CREATE PROGRAM INSTANCE

DELETE PROGRAM INSTANCE

### SPECIAL CPU REGISTERS

PC	<input type="text" value="0"/>	SR	<input type="text" value=""/>
SP	<input type="text" value="8096"/>	BR	<input type="text" value=""/>
SR Status Flag		CPU Mode	
OV	<input type="checkbox"/>	Z	<input type="checkbox"/>
N	<input type="checkbox"/>	User	
		Kernel	
IR	<input type="text" value="IN 1, R03"/>		
MAR	<input type="text" value="255"/>		
MDR	<input type="text" value="0"/>		

[illegible]

Program

Instructions

Optimize - Assemble

New Program

Program Name

Base Address

Pages

1

ADD

Programs

SAVE...

LOAD...

COPY TO CLIPBOARD

Program List

LOOPTEST

Base Address

-1

The screenshot shows the 'Program Control' window in Proteus. The 'STEP' button is highlighted. The 'by instruction' radio button is selected. The 'Fast' speed setting is chosen. The 'RESET PROGRAM' and 'SHOW PCB...' buttons are visible.



PROGRAM SOURCE (INPUT)

looptest.bt

```
program looptest
read(i)
for n = 1 to 15 x = i + n
next
end
```

COMPILER PROGRESS

Code generation completed...  
Displaying generated code  
Display completed...  
  
\*\*\* NOTE: Click on numbers in brackets to highlight corresponding source  
  
Uploading code to code memory of CPU 0...Please wait  
Completed...

COMPILER

Edit Source **Compile** Optimize Options Compiler Help

COMPILE

RUN

SHOW SYMBOL TABLE...

SHOW CLASS  
MAP...

CANCEL

SHOW SUBROUTINE LIST...

SHOW AST...

SOURCE

LOAD...

SAVE...

PRINT...

Auto save source files

PROGRAM CODE (OUTPUT)

looptest.bt

LAdd	CPU Instruction	Binary Code	Lin
****	CODE:		
****	MAIN PROG...		
0000	MOV R01, R03	0001010103	000
0005	IN 1, R03	320200010103	000
0011	MOV R03, R01	0001030101	000
0016	MOV #1, R04	000000010104	000
0022	MOV R04, R02	0001040102	000
0027	MOV #15, R04	0000000F0104	000
0033	CMP R04, R02	3001040102	000
0038	JGT 72	20020048	000
0042	MOV R01, R05	0001010105	000
0047	ADD R02, R05	1101020105	000
0052	MOV R05, R06	0001050106	000
0057	MOV R06, R03	0001060103	000
0062	ADD #1, R02	110000010102	000
0068	JMP 33	1D020021	000
0072	HLT	2F	000
****	DATA:		

Upload ok...

ASSEMBLY CODE

Start Address:

0

Code

Size

73

Select CPU

0

LOAD IN MEMORY...

SHOW OS 0...

SHOW CPU 0...



RUNNING PROCESSES

Pid

WA

READY I

Pid

OS Activity Log

00:13:33 (33.313) [OS0: 00000000]: P1(1) loaded into the READY queue [Memory=1 pages, Pri

00:14:55 (54.534) [OS0: 00000000]: P2(2) loaded into the READY queue [Memory=1 pages, Pri

00:19:45 (44.922) [OS0: 00000000]:

00:19:45 (44.922) [OS0: 00000000]: NEW SCHEDULER SESSION STARTED

00:19:45 (44.922) [OS0: 00000000]: Scheduling scheme is Round Robin using Static Priority

00:19:45 (44.922) [OS0: 00000000]: Memory allocation policy is First Fit

00:19:45 (45.381) [OS0: 00000000]: P1(1) moved from READY to RUNNING state on CPU 0

00:19:48 (48.194) [OS0: 00000001]: P3(3) loaded into the READY queue [Memory=1 pages, Pri

00:19:48 (48.194) [OS0: 00000001]: P1(1) moved from RUNNING to READY state

00:19:49 (48.597) [OS0: 00000001]: P2(2) moved from READY to RUNNING state on CPU 0

00:19:51 (50.606) [OS0: 00000002]: P2(2) moved from RUNNING to READY state

00:19:51 (51.014) [OS0: 00000002]: P3(3) moved from READY to RUNNING state on CPU 0

00:19:53 (53.024) [OS0: 00000003]: P3(3) moved from RUNNING to READY state

00:19:53 (53.421) [OS0: 00000003]: P1(1) moved from READY to RUNNING state on CPU 0

00:19:55 (55.029) [OS0: 00000003]: P1(1) moved from RUNNING to WAITING state

00:19:55 (55.430) [OS0: 00000003]: P2(2) moved from READY to RUNNING state on CPU 0

00:19:57 (57.038) [OS0: 00000003]: P2(2) moved from RUNNING to WAITING state

00:19:57 (57.441) [OS0: 00000003]: P3(3) moved from READY to RUNNING state on CPU 0

00:19:59 (59.048) [OS0: 00000003]: P3(3) moved from RUNNING to WAITING state

CLEAR

SAVE...

PRINT...

☐ Stay on top

Log detail level  
Low

WAITING PROCESSES (Waiting Queue)

Pid	Name	State	Memory	Priority	Burst	Swap	PName	CPU	PPid
<input type="checkbox"/> I 1	LOOPTEST		1	3	0	No	P1		0
<input type="checkbox"/> I 2	LOOPTEST		1	3	0	No	P2		0
<input type="checkbox"/> I 3	LOOPTEST		1	3	0	No	P3		0

CLEAR

REMOVE

RESUME

Suspend on state change ☐

OUTPUTS

1] First Come First Serve



&amp;lt

CLEAR

CASE

PRINT

☐

## Stay on top



```
00:02:33(33.324) [OS0: 00000000]: P2(2) loaded into the READY queue [Memory=1 pages, Priority=2]
00:02:45(44.822) [OS0: 00000000]: P3(3) loaded into the READY queue [Memory=1 pages, Priority=4]
00:02:56(56.313) [OS0: 00000000]: P4(4) loaded into the READY queue [Memory=1 pages, Priority=1]
00:04:21(20.715) [OS0: 00000000]:
00:04:21(20.715) [OS0: 00000000]: NEW SCHEDULER SESSION STARTED
00:04:21(20.715) [OS0: 00000000]: Scheduling scheme is Shortest-Job-First with Pre-emptive prior
00:04:21(20.715) [OS0: 00000000]: Memory allocation policy is First Fit
00:04:21(21.020) [OS0: 00000000]: P1(1) moved from READY to RUNNING state on CPU 0
00:06:53(52.937) [OS0: 00000125]: P1(1) terminated normally
00:06:53(52.937) [OS0: 00000125]: *** STATS FOR PROCESS P1(1) ***
00:06:53(52.937) [OS0: 00000125]: Elapsed Time = 00:02:32(31.917)
00:06:53(52.937) [OS0: 00000125]: Avg. Waiting Time = 0.31 sec
00:06:53(52.937) [OS0: 00000125]: Avg. Burst Period = 125
00:06:53(52.937) [OS0: 00000125]: Tick Count = 125
00:06:53(52.937) [OS0: 00000125]: Memory Swap Count = 0
00:06:53(53.174) [OS0: 00000126]: P2(2) moved from READY to RUNNING state on CPU 0
00:09:22(22.484) [OS0: 00000251]: P2(2) terminated normally
00:09:22(22.484) [OS0: 00000251]: *** STATS FOR PROCESS P2(2) ***
00:09:22(22.484) [OS0: 00000251]: Elapsed Time = 00:02:29(29.310)
00:09:22(22.484) [OS0: 00000251]: Avg. Waiting Time = 152.46 sec
00:09:22(22.484) [OS0: 00000251]: Avg. Burst Period = 125
00:09:22(22.484) [OS0: 00000251]: Tick Count = 125
00:09:22(22.484) [OS0: 00000251]: Memory Swap Count = 0
00:09:23(22.721) [OS0: 00000252]: P3(3) moved from READY to RUNNING state on CPU 0
00:11:52(52.031) [OS0: 00000377]: P3(3) terminated normally
00:11:52(52.031) [OS0: 00000377]: *** STATS FOR PROCESS P3(3) ***
00:11:52(52.031) [OS0: 00000377]: Elapsed Time = 00:02:29(29.310)
00:11:52(52.031) [OS0: 00000377]: Avg. Waiting Time = 302.01 sec
00:11:52(52.031) [OS0: 00000377]: Avg. Burst Period = 125
00:11:52(52.031) [OS0: 00000377]: Tick Count = 125
00:11:52(52.031) [OS0: 00000377]: Memory Swap Count = 0
00:11:52(52.268) [OS0: 00000378]: P4(4) moved from READY to RUNNING state on CPU 0
00:14:22(21.578) [OS0: 00000503]: P4(4) terminated normally
00:14:22(21.578) [OS0: 00000503]: *** STATS FOR PROCESS P4(4) ***
00:14:22(21.578) [OS0: 00000503]: Elapsed Time = 00:02:29(29.310)
00:14:22(21.578) [OS0: 00000503]: Avg. Waiting Time = 451.55 sec
00:14:22(21.578) [OS0: 00000503]: Avg. Burst Period = 125
00:14:22(21.578) [OS0: 00000503]: Tick Count = 125
00:14:22(21.578) [OS0: 00000503]: Memory Swap Count = 0
00:14:22(21.726) [OS0: 00000504]: Avg. Process Waiting Time = 226.58 sec
```

&lt;

CLEAR

SAVE...

PRINT...

☐ Stay on top



```
00:09:01(00.971) [OS0: 00000332]: P1(1) moved from RUNNING to READY state
00:09:01(01.208) [OS0: 00000332]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:06(05.948) [OS0: 00000336]: P1(1) moved from RUNNING to READY state
00:09:06(06.185) [OS0: 00000336]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:11(10.925) [OS0: 00000340]: P1(1) moved from RUNNING to READY state
00:09:11(11.162) [OS0: 00000340]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:16(15.902) [OS0: 00000344]: P1(1) moved from RUNNING to READY state
00:09:16(16.139) [OS0: 00000344]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:21(20.880) [OS0: 00000348]: P1(1) moved from RUNNING to READY state
00:09:21(21.116) [OS0: 00000348]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:26(25.856) [OS0: 00000352]: P1(1) moved from RUNNING to READY state
00:09:26(26.093) [OS0: 00000352]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:31(30.833) [OS0: 00000356]: P1(1) moved from RUNNING to READY state
00:09:31(31.070) [OS0: 00000356]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:36(35.810) [OS0: 00000360]: P1(1) moved from RUNNING to READY state
00:09:36(36.047) [OS0: 00000360]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:41(40.787) [OS0: 00000364]: P1(1) moved from RUNNING to READY state
00:09:41(41.024) [OS0: 00000364]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:46(45.764) [OS0: 00000368]: P1(1) moved from RUNNING to READY state
00:09:46(46.001) [OS0: 00000368]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:51(50.741) [OS0: 00000372]: P1(1) moved from RUNNING to READY state
00:09:51(50.978) [OS0: 00000372]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:56(55.718) [OS0: 00000376]: P1(1) moved from RUNNING to READY state
00:09:56(55.955) [OS0: 00000376]: P1(1) moved from READY to RUNNING state on CPU 0
00:09:58(58.325) [OS0: 00000377]: P1(1) terminated normally
00:09:58(58.325) [OS0: 00000377]: *** STATS FOR PROCESS P1(1) ***
00:09:58(58.325) [OS0: 00000377]: Elapsed Time = 00:02:37(36.657)
00:09:58(58.325) [OS0: 00000377]: Avg. Waiting Time = 10.15 sec
00:09:58(58.325) [OS0: 00000377]: Avg. Burst Period = 3
00:09:58(58.325) [OS0: 00000377]: Tick Count = 125
00:09:58(58.325) [OS0: 00000377]: Memory Swap Count = 0
00:09:59(58.562) [OS0: 00000378]: P3(3) moved from READY to RUNNING state on CPU 0
00:12:28(27.872) [OS0: 00000503]: P3(3) terminated normally
00:12:28(27.872) [OS0: 00000503]: *** STATS FOR PROCESS P3(3) ***
00:12:28(27.872) [OS0: 00000503]: Elapsed Time = 00:02:29(29.311)
00:12:28(27.872) [OS0: 00000503]: Avg. Waiting Time = 474.31 sec
00:12:28(27.872) [OS0: 00000503]: Avg. Burst Period = 125
00:12:28(27.872) [OS0: 00000503]: Tick Count = 125
00:12:28(27.872) [OS0: 00000503]: Memory Swap Count = 0
00:12:28(27.996) [OS0: 00000504]: Avg. Process Waiting Time = 166.23 sec
```

&lt;

CLEAR

SAVE...

PRINT...

☐ Stay on top