

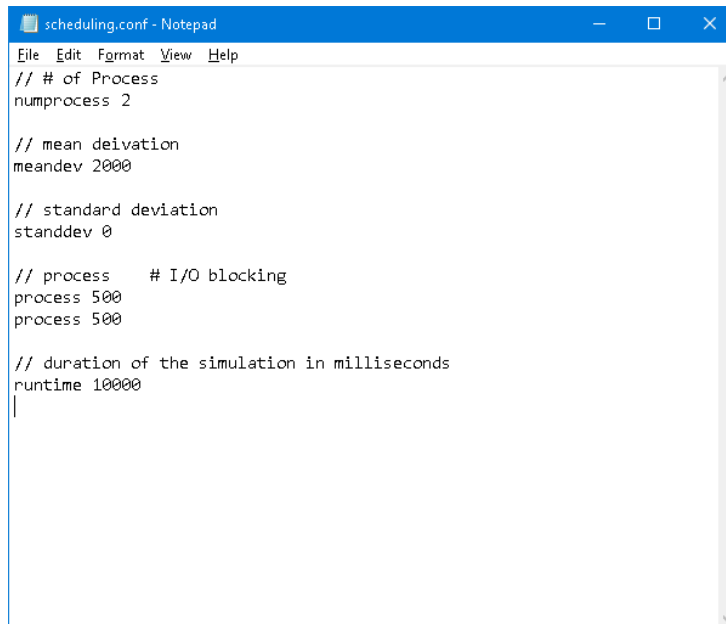
Task description.

Create a configuration file in which all processes run an average of 2000 milliseconds with a standard deviation of zero, and which are blocked for input or output every 500 milliseconds. Run the simulation for 10000 milliseconds with 2 processes. Examine the two output files. Try again for 5 processes. Try again for 10 processes. Explain what's happening.

Observations and explanations.

1) Simulation for 2 processes:

➤ Configuration:



```
scheduling.conf - Notepad
File Edit Format View Help
// # of Process
numprocess 2

// mean deviation
meandev 2000

// standard deviation
standdev 0

// process # I/O blocking
process 500
process 500

// duration of the simulation in milliseconds
runtime 10000
|
```

➤ Observation:

Summary results:

```
Summary-Results - Notepad
File Edit Format View Help
Scheduling Type: Batch (Nonpreemptive)
Scheduling Name: First-Come First-Served
Simulation Run Time: 4000
Mean: 2000
Standard Deviation: 0
Process #      CPU Time      IO Blocking      CPU Completed      CPU Blocked
0              2000 (ms)        500 (ms)          2000 (ms)          3 times
1              2000 (ms)        500 (ms)          2000 (ms)          3 times
```

Here,

Process # - is the number of processes;

CPU Time – time that distributed to work process;

IO Blocking – the amount of time process working and where after it the process is blocked;

CPU Completed – gives information about how much time spent on work process;

CPU Blocked – is the number of time process that was blocked for both, input and output.

Summary processes:

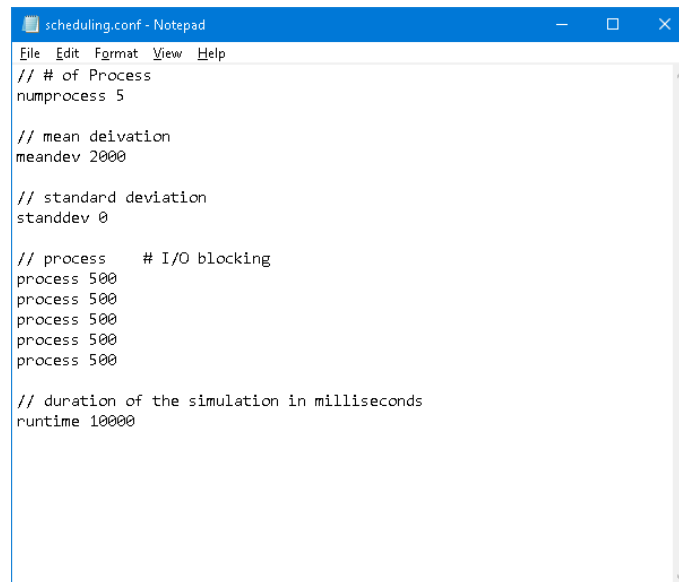
```
Summary-Processes - Notepad
File Edit Format View Help
Process: 0 registered... (2000 500 0 0)
Process: 0 I/O blocked... (2000 500 500 500)
Process: 1 registered... (2000 500 0 0)
Process: 1 I/O blocked... (2000 500 500 500)
Process: 0 registered... (2000 500 500 500)
Process: 0 I/O blocked... (2000 500 1000 1000)
Process: 1 registered... (2000 500 500 500)
Process: 1 I/O blocked... (2000 500 1000 1000)
Process: 0 registered... (2000 500 1000 1000)
Process: 0 I/O blocked... (2000 500 1500 1500)
Process: 1 registered... (2000 500 1000 1000)
Process: 1 I/O blocked... (2000 500 1500 1500)
Process: 0 registered... (2000 500 1500 1500)
Process: 0 completed... (2000 500 2000 2000)
Process: 1 registered... (2000 500 1500 1500)
Process: 1 completed... (2000 500 2000 2000)
```

➤ Explanation:

Here, we observed that when one process is being executed, the other process is blocked. Every 500ms there is a change and the active process is being blocked and the process that previously was blocked carries on running. Parts of the process were executed sequentially, so the context switching mechanism is managing the processor's time. The simulation was run for 4000ms because each process, in total, was running for 2000ms. The processes were managed according to non-preemptive scheduling, namely a particular process is executed only after I/O blockade of the previously run process. In this case, the blockade lasts 500ms.

2) Simulation for 5 processes:

➤ Configuration:



```
File Edit Format View Help
// # of Process
numprocess 5

// mean deviation
meandev 2000

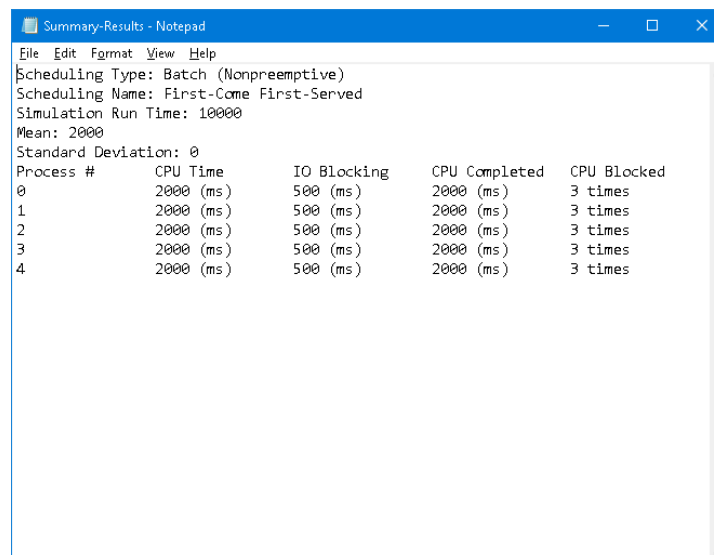
// standard deviation
standdev 0

// process # I/O blocking
process 500
process 500
process 500
process 500
process 500

// duration of the simulation in milliseconds
runtime 10000
```

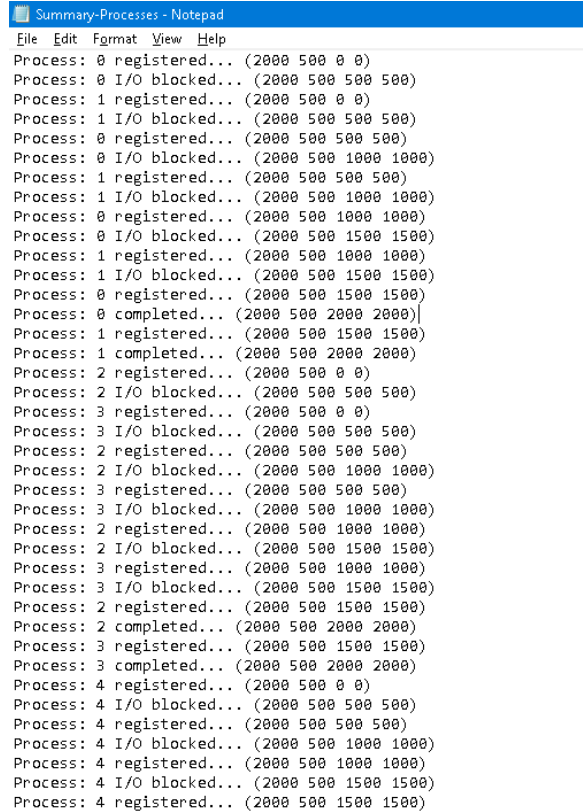
➤ Observation:

Summary Results:



```
File Edit Format View Help
Scheduling Type: Batch (Nonpreemptive)
Scheduling Name: First-Come First-Served
Simulation Run Time: 10000
Mean: 2000
Standard Deviation: 0
Process #    CPU Time    IO Blocking    CPU Completed    CPU Blocked
0            2000 (ms)    500 (ms)       2000 (ms)        3 times
1            2000 (ms)    500 (ms)       2000 (ms)        3 times
2            2000 (ms)    500 (ms)       2000 (ms)        3 times
3            2000 (ms)    500 (ms)       2000 (ms)        3 times
4            2000 (ms)    500 (ms)       2000 (ms)        3 times
```

Simulation Process:



```
Summary-Processes - Notepad
File Edit Format View Help
Process: 0 registered... (2000 500 0 0)
Process: 0 I/O blocked... (2000 500 500 500)
Process: 1 registered... (2000 500 0 0)
Process: 1 I/O blocked... (2000 500 500 500)
Process: 0 registered... (2000 500 500 500)
Process: 0 I/O blocked... (2000 500 1000 1000)
Process: 1 registered... (2000 500 500 500)
Process: 1 I/O blocked... (2000 500 1000 1000)
Process: 0 registered... (2000 500 1000 1000)
Process: 0 I/O blocked... (2000 500 1500 1500)
Process: 1 registered... (2000 500 1000 1000)
Process: 1 I/O blocked... (2000 500 1500 1500)
Process: 0 registered... (2000 500 1500 1500)
Process: 0 completed... (2000 500 2000 2000)
Process: 1 registered... (2000 500 1500 1500)
Process: 1 completed... (2000 500 2000 2000)
Process: 2 registered... (2000 500 0 0)
Process: 2 I/O blocked... (2000 500 500 500)
Process: 3 registered... (2000 500 0 0)
Process: 3 I/O blocked... (2000 500 500 500)
Process: 2 registered... (2000 500 500 500)
Process: 2 I/O blocked... (2000 500 1000 1000)
Process: 3 registered... (2000 500 500 500)
Process: 3 I/O blocked... (2000 500 1000 1000)
Process: 2 registered... (2000 500 1000 1000)
Process: 2 I/O blocked... (2000 500 1500 1500)
Process: 3 registered... (2000 500 1000 1000)
Process: 3 I/O blocked... (2000 500 1500 1500)
Process: 2 registered... (2000 500 1500 1500)
Process: 2 completed... (2000 500 2000 2000)
Process: 3 registered... (2000 500 1500 1500)
Process: 3 completed... (2000 500 2000 2000)
Process: 4 registered... (2000 500 0 0)
Process: 4 I/O blocked... (2000 500 500 500)
Process: 4 registered... (2000 500 500 500)
Process: 4 I/O blocked... (2000 500 1000 1000)
Process: 4 registered... (2000 500 1000 1000)
Process: 4 I/O blocked... (2000 500 1500 1500)
Process: 4 registered... (2000 500 1500 1500)
```

➤ Explanation:

In this case, the execution of all processes took whole time of the simulation:

$5 \text{ processes} * 2000\text{ms of each process} = 10000\text{ms of the simulation.}$

It is also noticed that the processes were executed and switched in pairs, namely after the completion of the first pair of the processes, the next pair started its execution and so on. In a pair, the processes were managed exactly as in the 1st case: parts of the process were executed sequentially every 500ms, every process was blocked 3 times. It is also the same, batch non-preemptive scheduling. The 5th process (number 4) is the only one that isn't executed in a pair because no more processes exist.

3) Simulation for 10 processes:

➤ Configuration:

```
scheduling.conf - Notepad
File Edit Format View Help
// # of Process
numprocess 10

// mean deviation
meandev 2000

// standard deviation
standdev 0

// process # I/O blocking
process 500
process 500
process 500
process 500
process 500
process 500
process 500
process 500
process 500
process 500

// duration of the simulation in milliseconds
runtime 10000
```

➤ Observation:

Summary results:

Summary-Results - Notepad				
File Edit Format View Help				
Scheduling Type: Batch (Nonpreemptive)				
Scheduling Name: First-Come First-Served				
Simulation Run Time: 10000				
Mean: 2000				
Standard Deviation: 0				
Process #	CPU Time	IO Blocking	CPU Completed	CPU Blocked
0	2000 (ms)	500 (ms)	2000 (ms)	3 times
1	2000 (ms)	500 (ms)	2000 (ms)	3 times
2	2000 (ms)	500 (ms)	2000 (ms)	3 times
3	2000 (ms)	500 (ms)	2000 (ms)	3 times
4	2000 (ms)	500 (ms)	1000 (ms)	2 times
5	2000 (ms)	500 (ms)	1000 (ms)	1 times
6	2000 (ms)	500 (ms)	0 (ms)	0 times
7	2000 (ms)	500 (ms)	0 (ms)	0 times
8	2000 (ms)	500 (ms)	0 (ms)	0 times
9	2000 (ms)	500 (ms)	0 (ms)	0 times

Summary processes:

```
Summary-Processes - Notepad
File Edit Format View Help
Process: 0 registered... (2000 500 0 0)
Process: 0 I/O blocked... (2000 500 500 500)
Process: 1 registered... (2000 500 0 0)
Process: 1 I/O blocked... (2000 500 500 500)
Process: 0 registered... (2000 500 500 500)
Process: 0 I/O blocked... (2000 500 1000 1000)
Process: 1 registered... (2000 500 500 500)
Process: 1 I/O blocked... (2000 500 1000 1000)
Process: 0 registered... (2000 500 1000 1000)
Process: 0 I/O blocked... (2000 500 1500 1500)
Process: 1 registered... (2000 500 1000 1000)
Process: 1 I/O blocked... (2000 500 1500 1500)
Process: 0 registered... (2000 500 1500 1500)
Process: 0 completed... (2000 500 2000 2000)
Process: 1 registered... (2000 500 1500 1500)
Process: 1 completed... (2000 500 2000 2000)
Process: 2 registered... (2000 500 0 0)
Process: 2 I/O blocked... (2000 500 500 500)
Process: 3 registered... (2000 500 0 0)
Process: 3 I/O blocked... (2000 500 500 500)
Process: 2 registered... (2000 500 500 500)
Process: 2 I/O blocked... (2000 500 1000 1000)
Process: 3 registered... (2000 500 500 500)
Process: 3 I/O blocked... (2000 500 1000 1000)
Process: 2 registered... (2000 500 1000 1000)
Process: 2 I/O blocked... (2000 500 1500 1500)
Process: 3 registered... (2000 500 1000 1000)
Process: 3 I/O blocked... (2000 500 1500 1500)
Process: 2 registered... (2000 500 1500 1500)
Process: 2 completed... (2000 500 2000 2000)
Process: 3 registered... (2000 500 1500 1500)
Process: 3 completed... (2000 500 2000 2000)
Process: 4 registered... (2000 500 0 0)
Process: 4 I/O blocked... (2000 500 500 500)
Process: 5 registered... (2000 500 0 0)
Process: 5 I/O blocked... (2000 500 500 500)
Process: 4 registered... (2000 500 500 500)
Process: 4 I/O blocked... (2000 500 1000 1000)
```

➤ Explanation:

Finally, in the 3rd simulation time was not enough to execute all 10 configured processes because their total execution time is twice longer than the simulation time. The simulation was very similar to the previous cases: processes were switched in pairs and were managed by according to the batch non-preemptive scheduling. Only first 4 processes completed their execution, 5th and 6th were in progress, and the remaining ones did not even start.