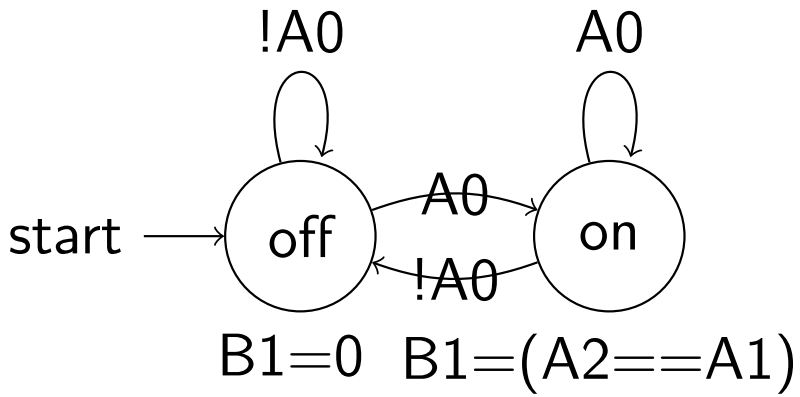
CS122A: Intermediate Embedded and Real Time Operating Systems

Jeffrey McDaniel

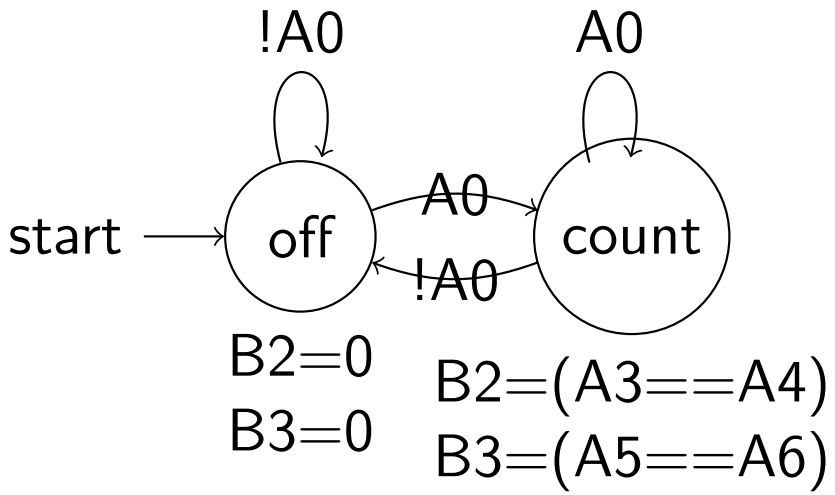
University of California, Riverside

Example

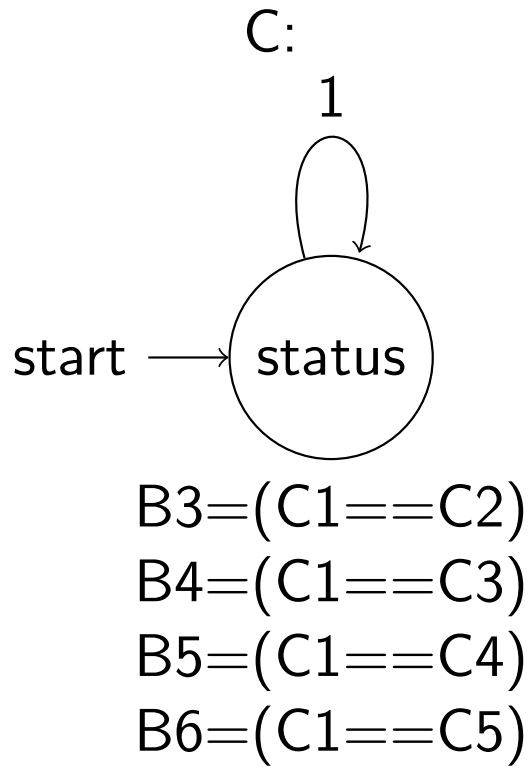
A:


!A0
A0
start
off
A0
!A0
on
B1=0
B1=(A2==A1)

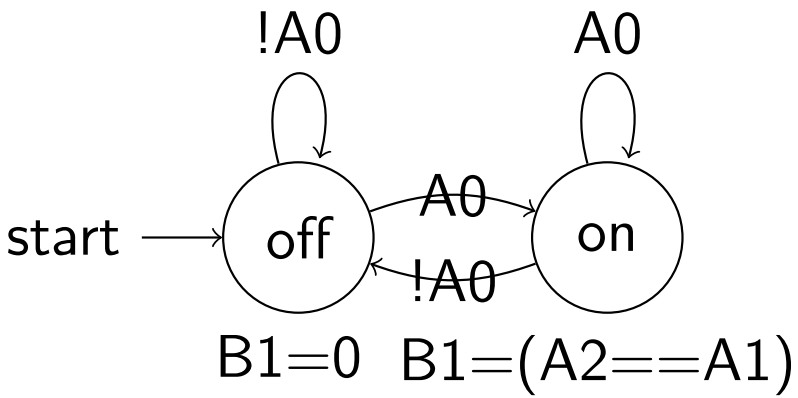
B:


!A0
A0
start
off
A0
!A0
count
B2=0
B3=0
B2=(A3==A4)
B3=(A5==A6)

C:

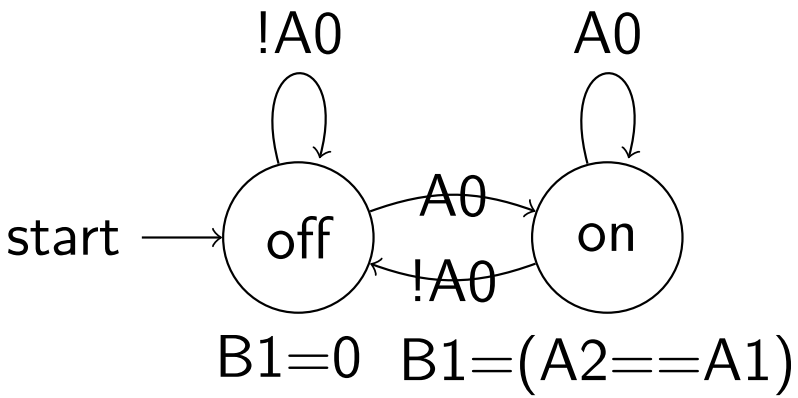

1
start
status
B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

A:



- B1 = 0
- 3

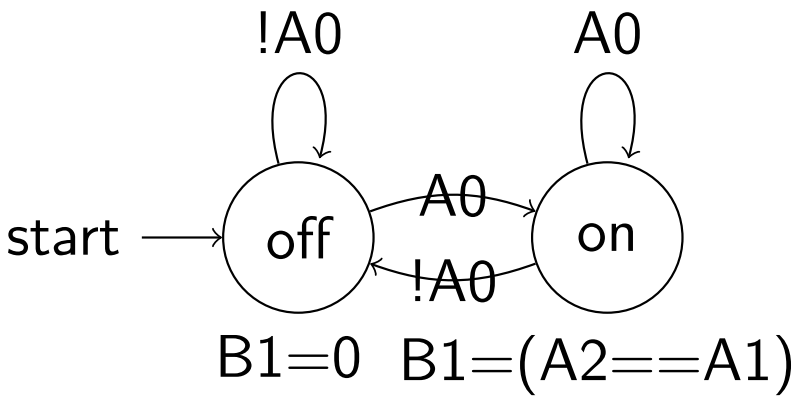
A:



- B1 = 0

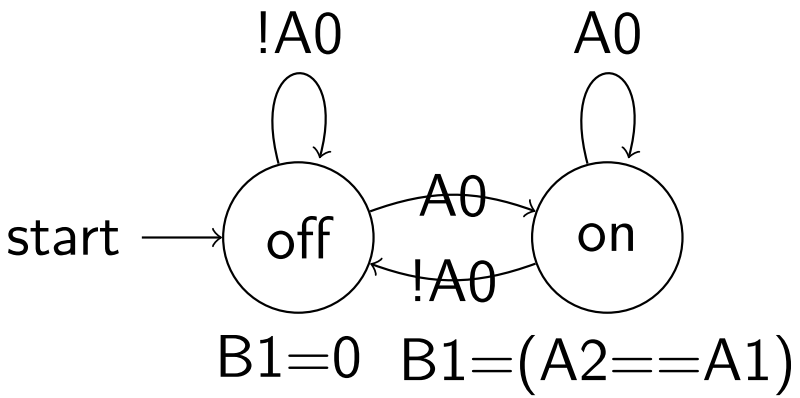
- 3
- Total: 3

A:



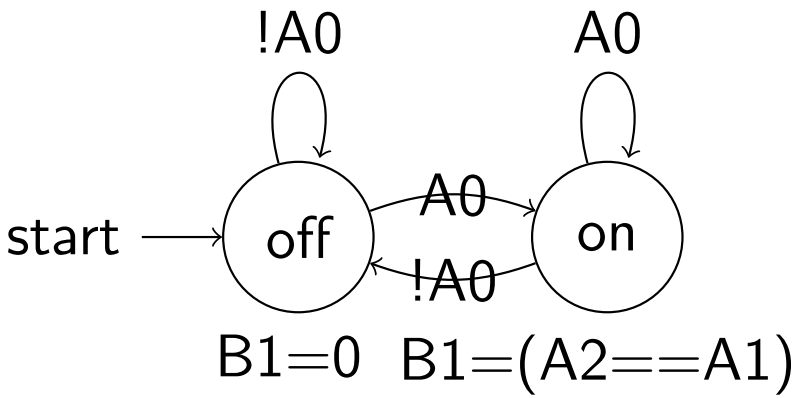
- B1 = (A2==A1)
- 3

A:



- B1 = (A2==A1)
- 3
- +2

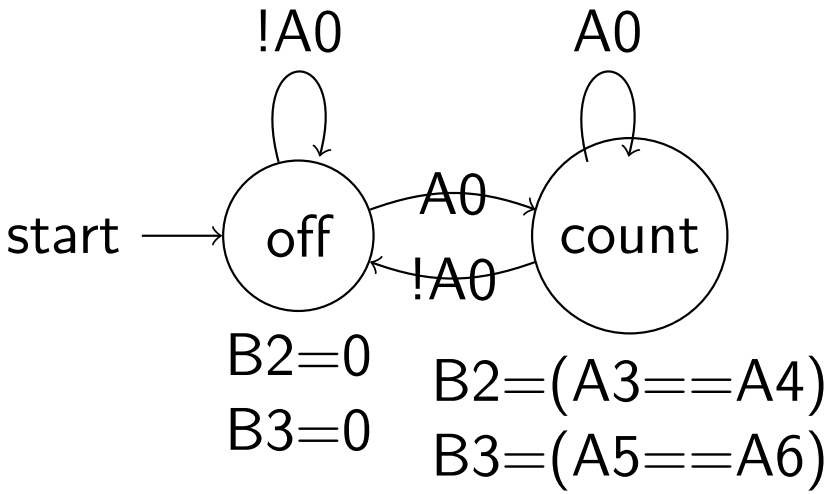
A:



- B1 = (A2==A1)

- 3
- +2
- Total: 5

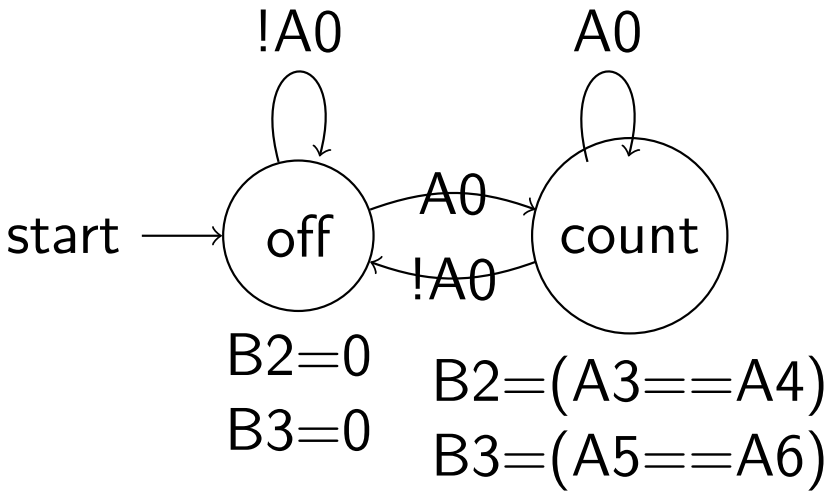
B:



- B2 = 0
- B3 = 0

- 3

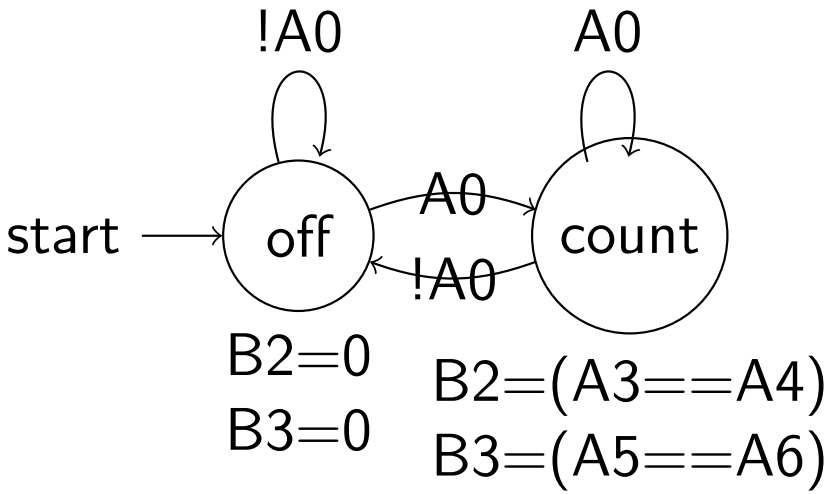
B:



- B2 = 0
- B3 = 0

- 3
- +3

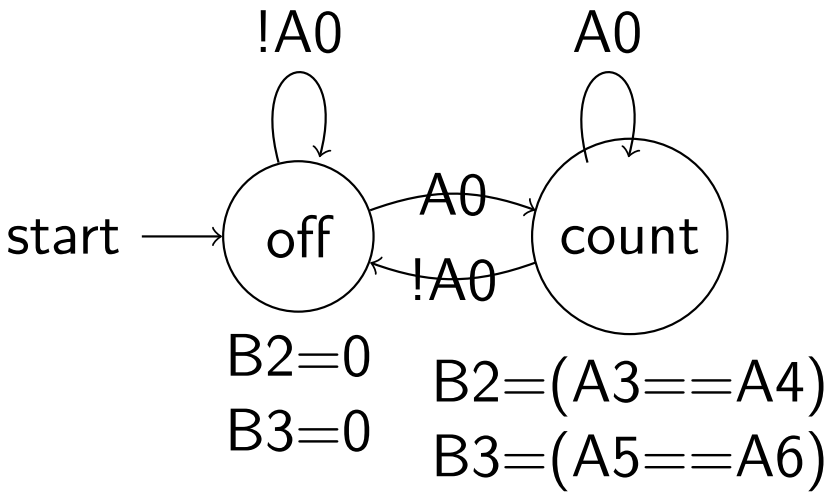
B:



- B2 = 0
- B3 = 0

- 3
- +3
- Total: 6

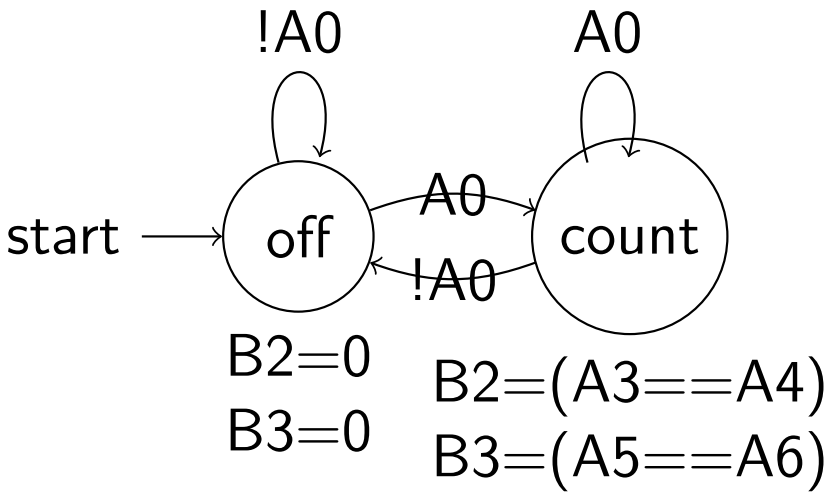
B:



- B2 = (A3==A4)
- B3 = (A5==A6)

- 3

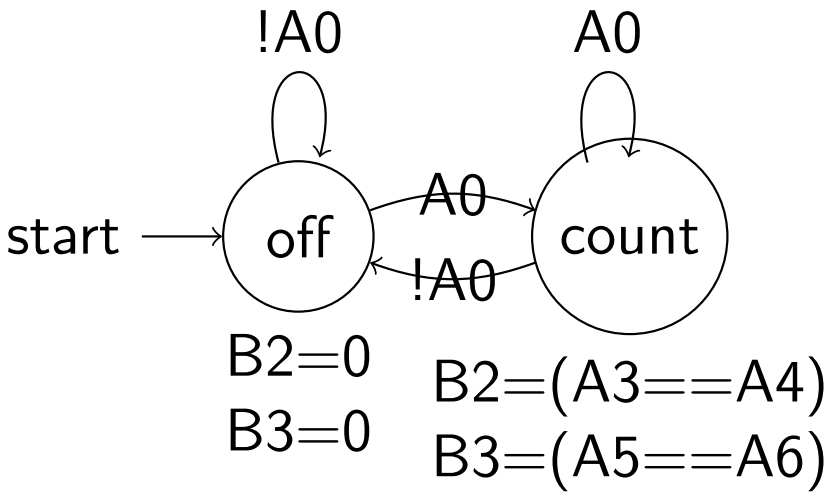
B:



- B2 = (A3==A4)
- B3 = (A5==A6)

- 3
- +2

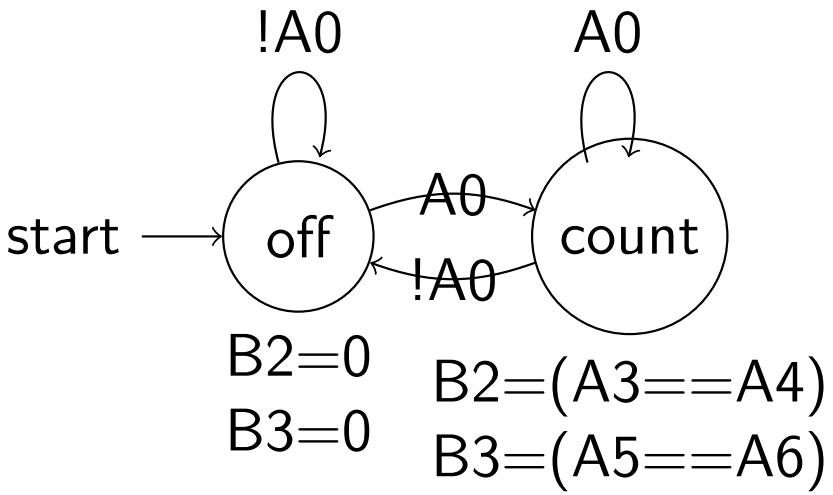
B:



- B2 = (A3==A4)
- B3 = (A5==A6)

- 3
- +2
- +3

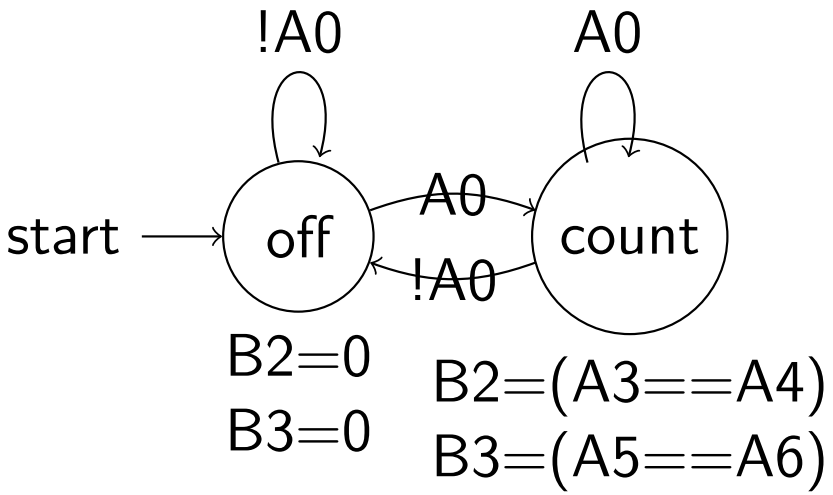
B:



- B2 = (A3==A4)
- B3 = (A5==A6)

- 3
- +2
- +3
- +2

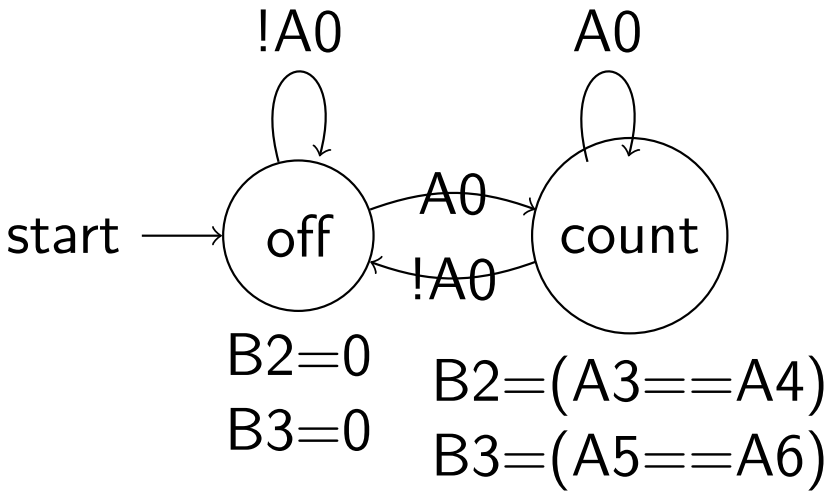
B:



- B2 = (A3==A4)
- B3 = (A5==A6)

- 3
- +2
- +3
- +2

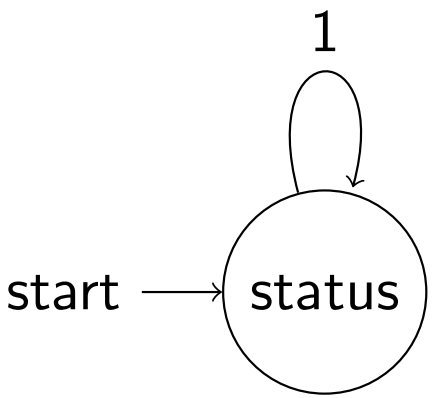
B:



- B2 = (A3==A4)
- B3 = (A5==A6)

- 3
- +2
- +3
- +2
- Total: 10

C:

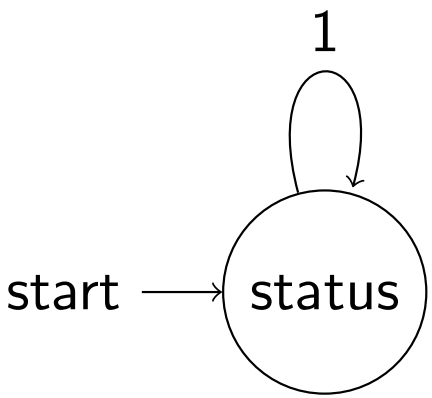


B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3

C:

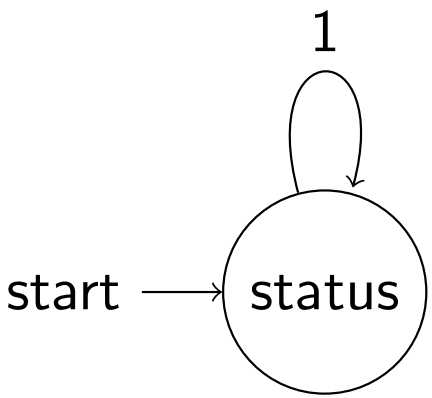


B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3
- +2

C:

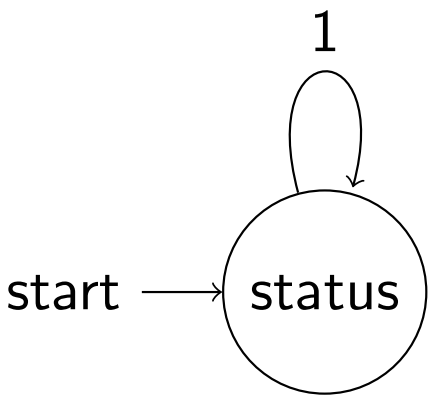


B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3
- +2
- 3

C:

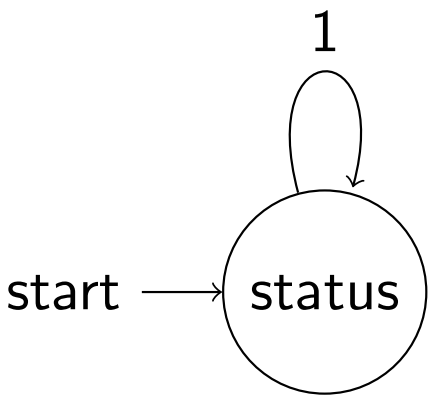


B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3
- +2
- 3
- +2

C:

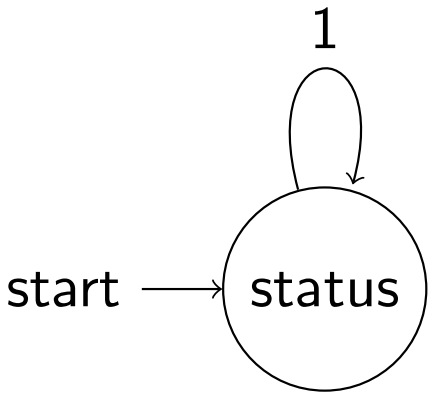


B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3
- +2
- 3
- +2
- 3

C:

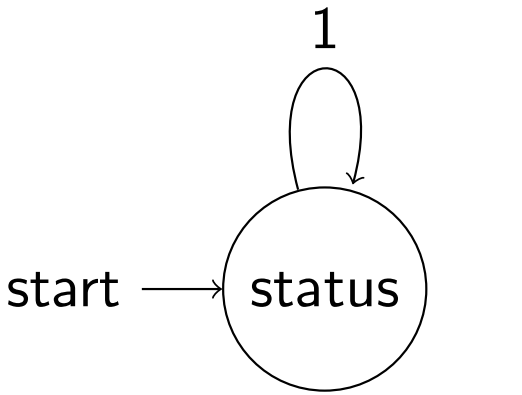


B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3
- +2
- 3
- +2
- 3
- +2

C:

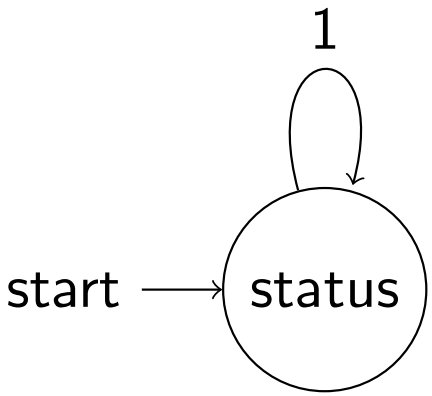


B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3
- +2
- 3
- +2
- 3
- +2
- 3

C:

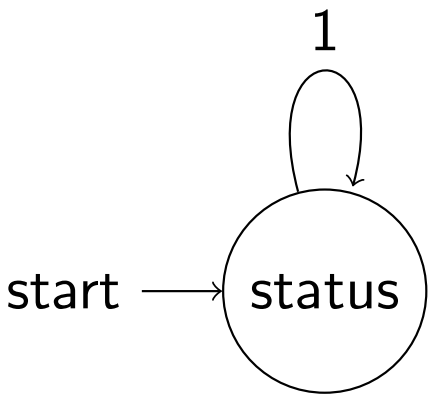


B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3
- +2
- 3
- +2
- 3
- +2
- 3
- +2

C:



B3=(C1==C2)
B4=(C1==C3)
B5=(C1==C4)
B6=(C1==C5)

- B3 = (C1==C2)
- B4 = (C1==C3)
- B5 = (C1==C4)
- B6 = (C1==C5)

- 3
- +2
- 3
- +2
- 3
- +2
- 3
- +2
- Total: 20

- 200 instr/sec

SM A:

$$WCET = 5instr * 0.005sec/instr \tag{1}$$

- 200 instr/sec
- 0.005 sec/instr

SM A:

$$\begin{aligned} WCET &= 5 instr * 0.005 sec/instr \\ &= 0.025 sec/instr \end{aligned} \tag{1}$$

- 200 instr/sec
- 0.005 sec/instr

SM A:

$$\begin{aligned} WCET &= 5 instr * 0.005 sec/instr \\ &= 0.025 sec/instr \\ &= 25 ms \end{aligned} \tag{1}$$

- 200 instr/sec
- 0.005 sec/instr

SM A: 25ms
SM B:

$$WCET = 10instr * 0.005sec/instr \tag{1}$$

- 200 instr/sec
- 0.005 sec/instr

SM A: 25ms
SM B:

$$\begin{aligned} WCET &= 10 instr * 0.005 sec/instr \\ &= 0.05 sec/instr \end{aligned} \tag{1}$$

- 200 instr/sec
- 0.005 sec/instr

SM A: 25ms
SM B:

$$\begin{aligned} WCET &= 10 instr * 0.005 sec/instr \\ &= 0.05 sec/instr \\ &= 50 ms \end{aligned} \tag{1}$$

- 200 instr/sec
- 0.005 sec/instr

SM A: 25ms
SM B: 50ms
SM C:

$$WCET = 20instr * 0.005sec/instr \tag{1}$$

- 200 instr/sec
- 0.005 sec/instr

SM A: 25ms
SM B: 50ms
SM C:

$$\begin{aligned} WCET &= 20 instr * 0.005 sec/instr \\ &= 0.1 sec/instr \end{aligned} \tag{1}$$

- 200 instr/sec
- 0.005 sec/instr

SM A: 25ms
SM B: 50ms
SM C:

$$\begin{aligned} WCET &= 20 instr * 0.005 sec/instr \\ &= 0.1 sec/instr \\ &= 100 ms \end{aligned} \tag{1}$$

SM A: 25ms
SM B: 50ms
SM C: 100ms

- Hyperperiod = LCM(100,200,250)

SM A: 25ms, 100ms
SM B: 50ms, 200ms
SM C: 100ms, 250ms

- Hyperperiod = LCM(100,200,250)
- Hyperperiod = 1000

SM A: 25ms, 100ms
SM B: 50ms, 200ms
SM C: 100ms, 250ms

- Hyperperiod = LCM(100,200,250)
- Hyperperiod = 1000

SM A: 25ms, 100ms, 10 executions
SM B: 50ms, 200ms, 5 executions
SM C: 100ms, 250ms, 4 executions

- Hyperperiod = LCM(100,200,250)
- Hyperperiod = 1000

SM A: 25ms, 100ms, 10 executions
SM B: 50ms, 200ms, 5 executions
SM C: 100ms, 250ms, 4 executions

$$Utilization = (25 * 10) + (50 * 5) + (100 * 4)/1000 \tag{1}$$

- Hyperperiod = LCM(100,200,250)
- Hyperperiod = 1000

SM A: 25ms, 100ms, 10 executions
SM B: 50ms, 200ms, 5 executions
SM C: 100ms, 250ms, 4 executions

$$\begin{aligned} \textit{Utilization} &= (25 * 10) + (50 * 5) + (100 * 4)/1000 \\ &= 250 + 250 + 400/1000 \end{aligned} \tag{1}$$

- Hyperperiod = LCM(100,200,250)
- Hyperperiod = 1000

SM A: 25ms, 100ms, 10 executions
SM B: 50ms, 200ms, 5 executions
SM C: 100ms, 250ms, 4 executions

$$\begin{aligned} \textit{Utilization} &= (25 * 10) + (50 * 5) + (100 * 4)/1000 \\ &= 250 + 250 + 400/1000 \\ &= 900/1000 \end{aligned} \tag{1}$$

- Hyperperiod = LCM(100,200,250)
- Hyperperiod = 1000

SM A: 25ms, 100ms, 10 executions
SM B: 50ms, 200ms, 5 executions
SM C: 100ms, 250ms, 4 executions

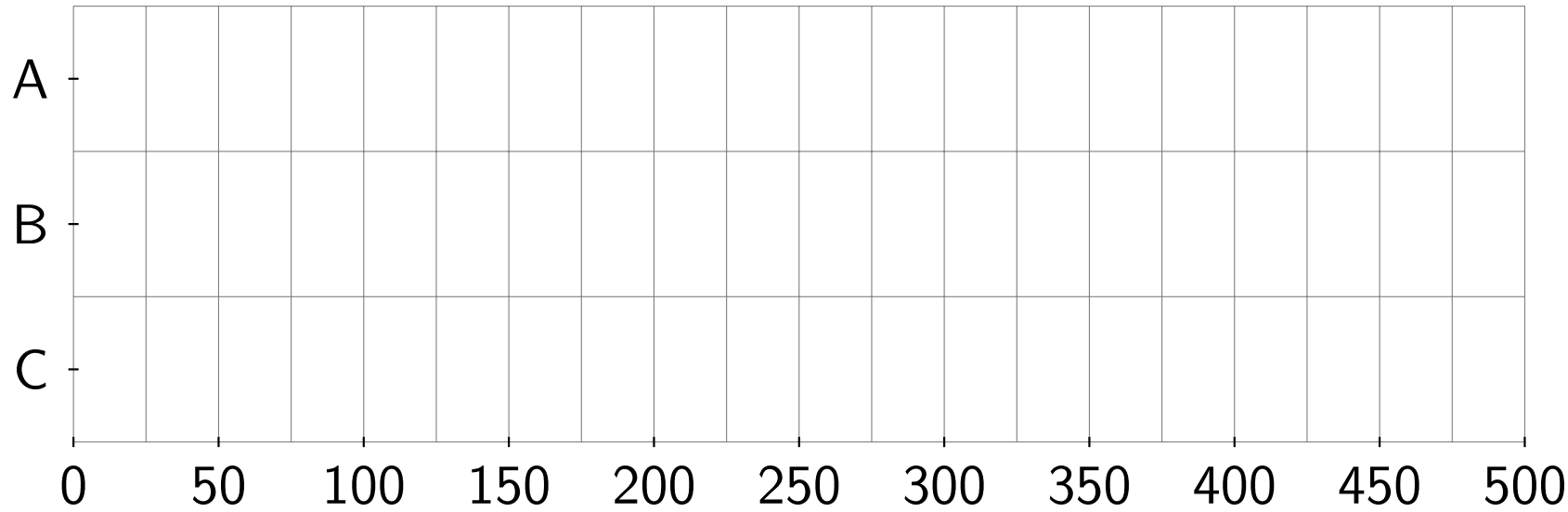
$$\begin{aligned} \textit{Utilization} &= (25 * 10) + (50 * 5) + (100 * 4)/1000 \\ &= 250 + 250 + 400/1000 \\ &= 900/1000 \\ &= .90 \end{aligned} \tag{1}$$

- Hyperperiod = LCM(100,200,250)
- Hyperperiod = 1000

SM A: 25ms, 100ms, 10 executions
SM B: 50ms, 200ms, 5 executions
SM C: 100ms, 250ms, 4 executions

$$
\begin{aligned}
\textit{Utilization} &= (25 * 10) + (50 * 5) + (100 * 4)/1000 \\
&= 250 + 250 + 400/1000 \\
&= 900/1000 \\
&= .90 \\
&= 90\%
\end{aligned}
\tag{1}
$$

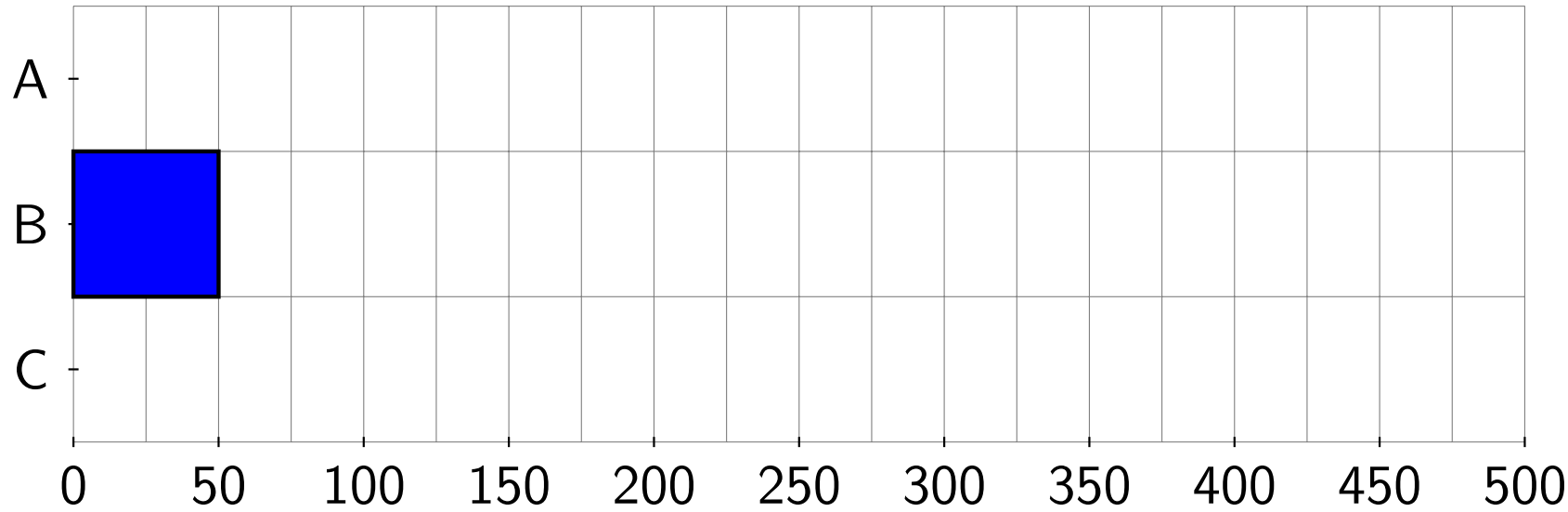
SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

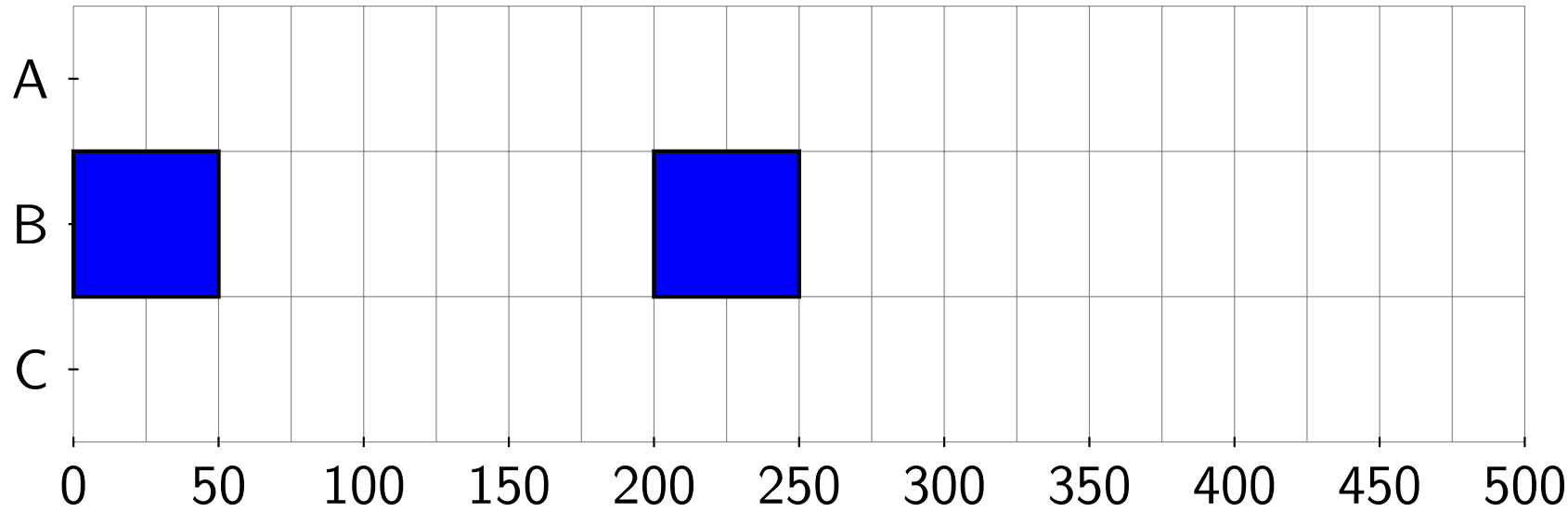
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

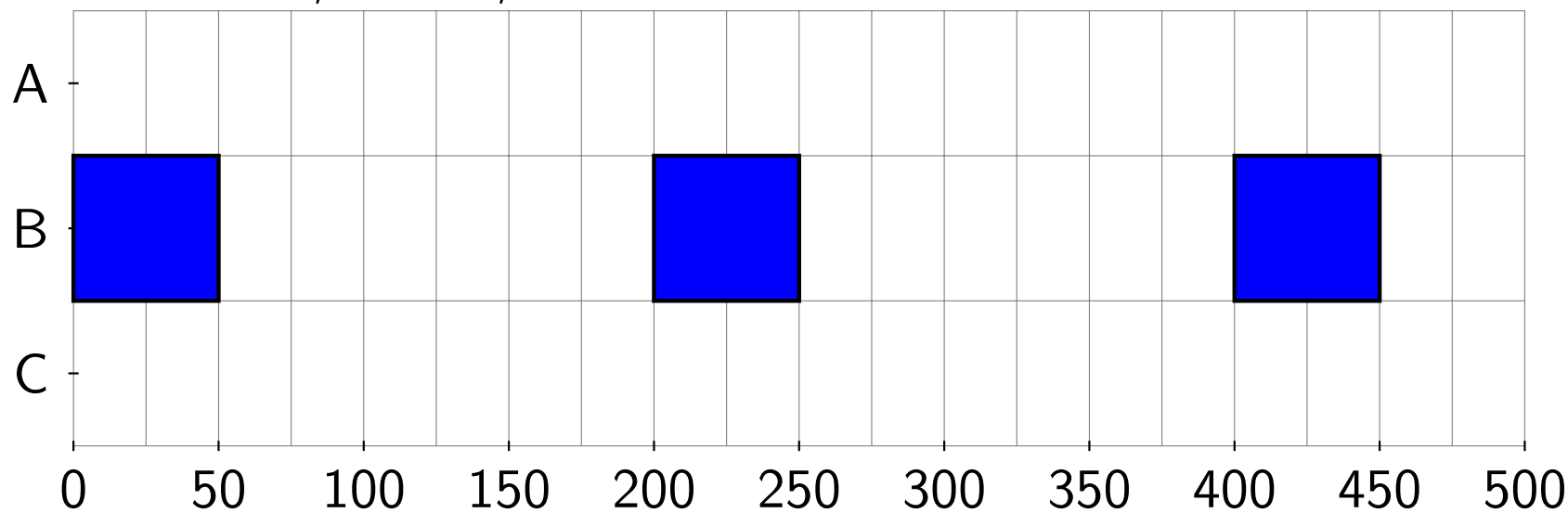
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

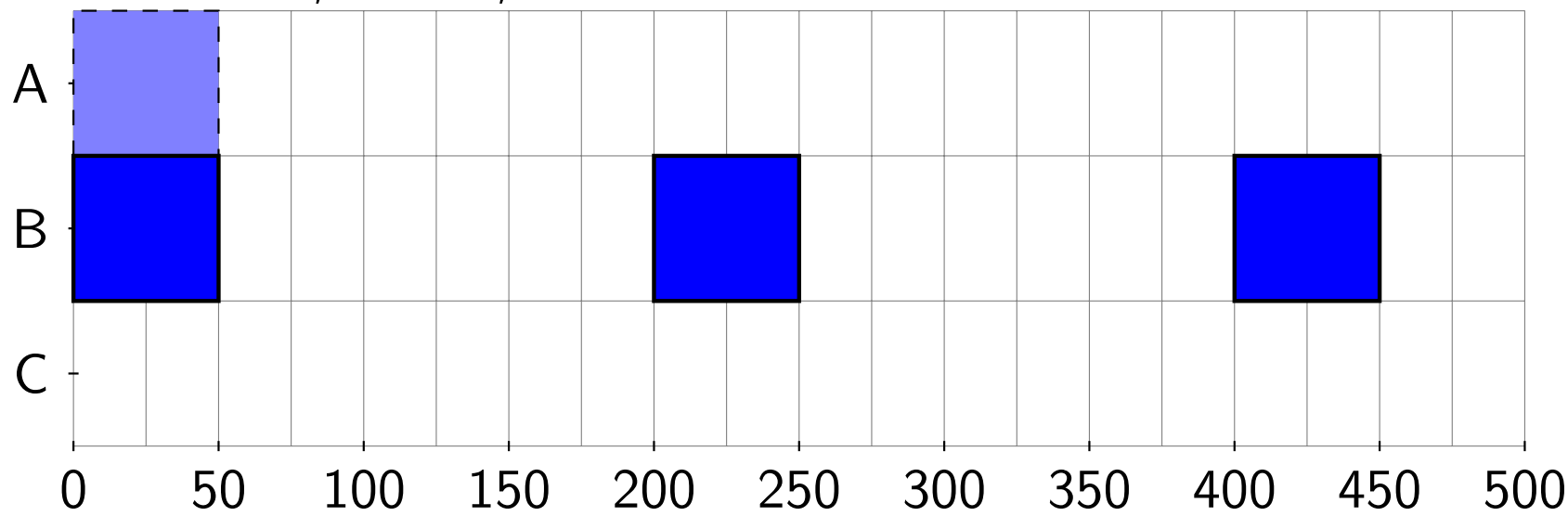
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

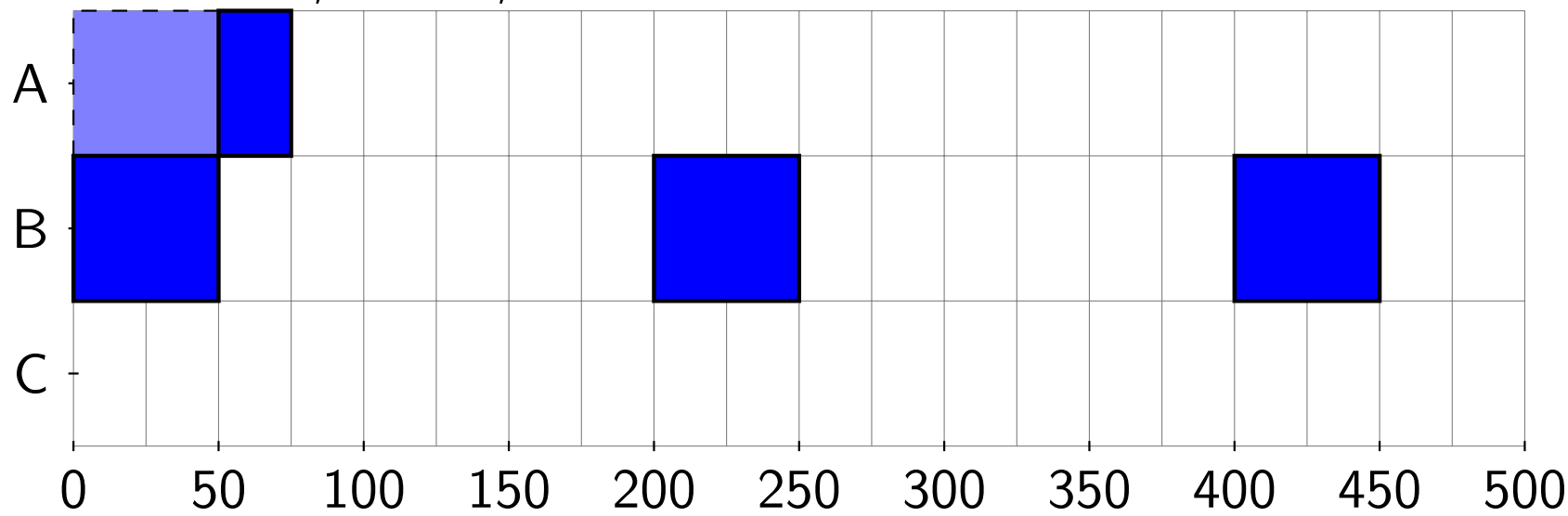
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

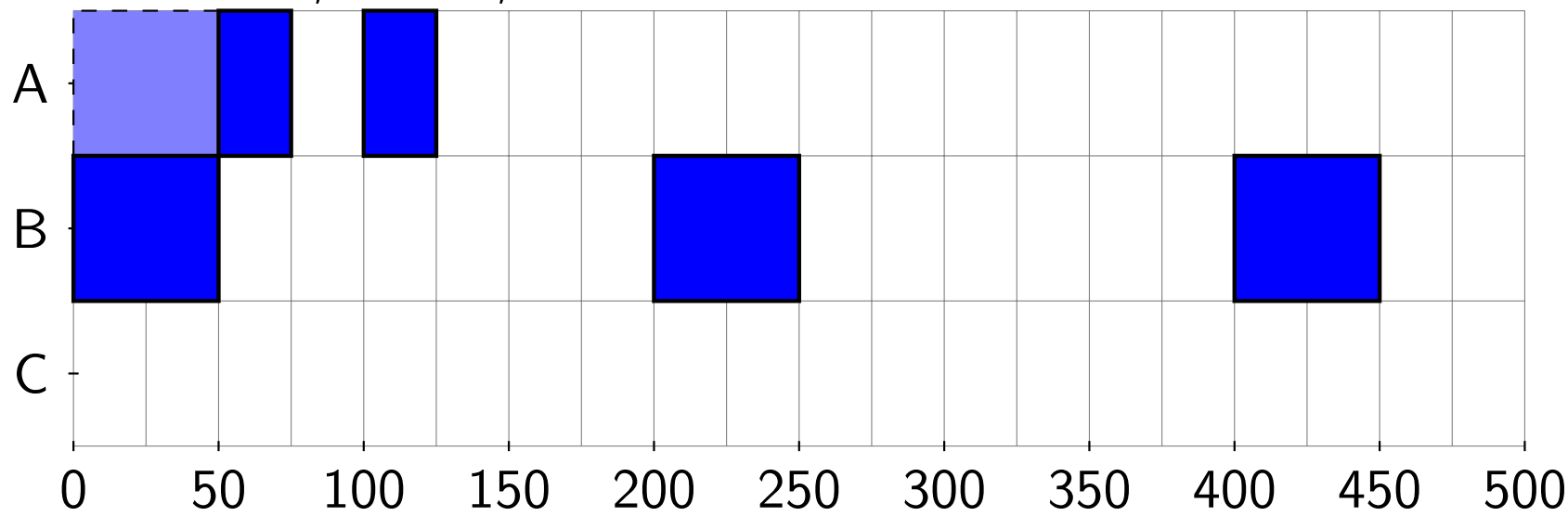
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

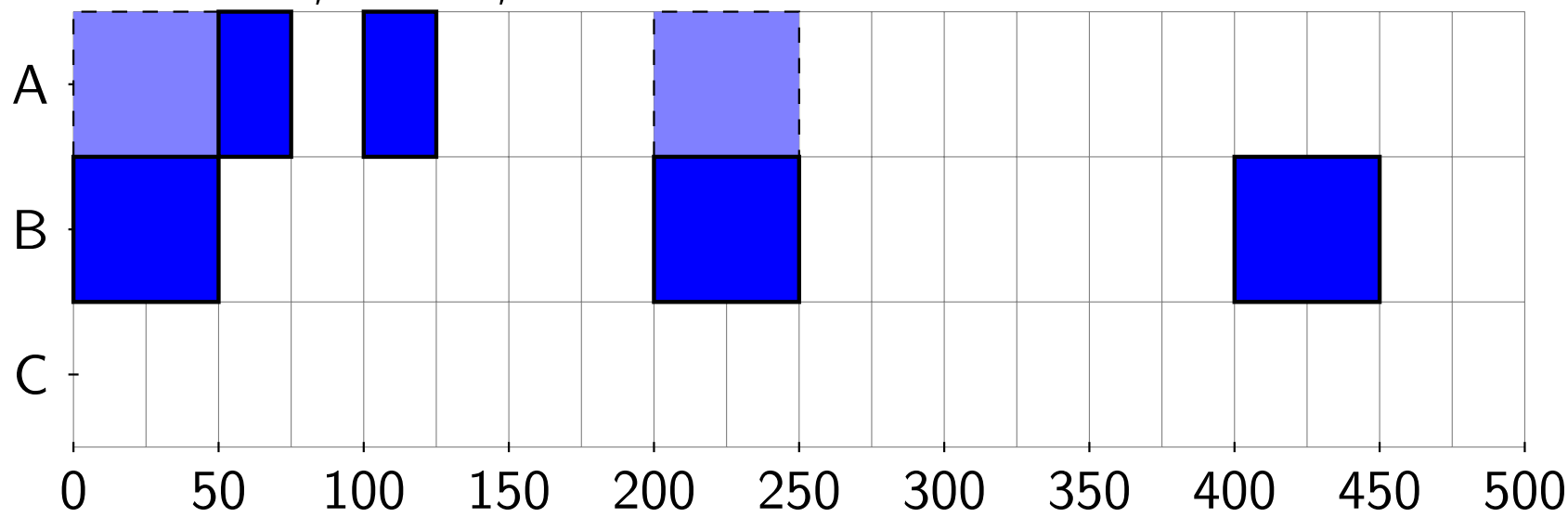
SM C: 100ms, 250ms, Low



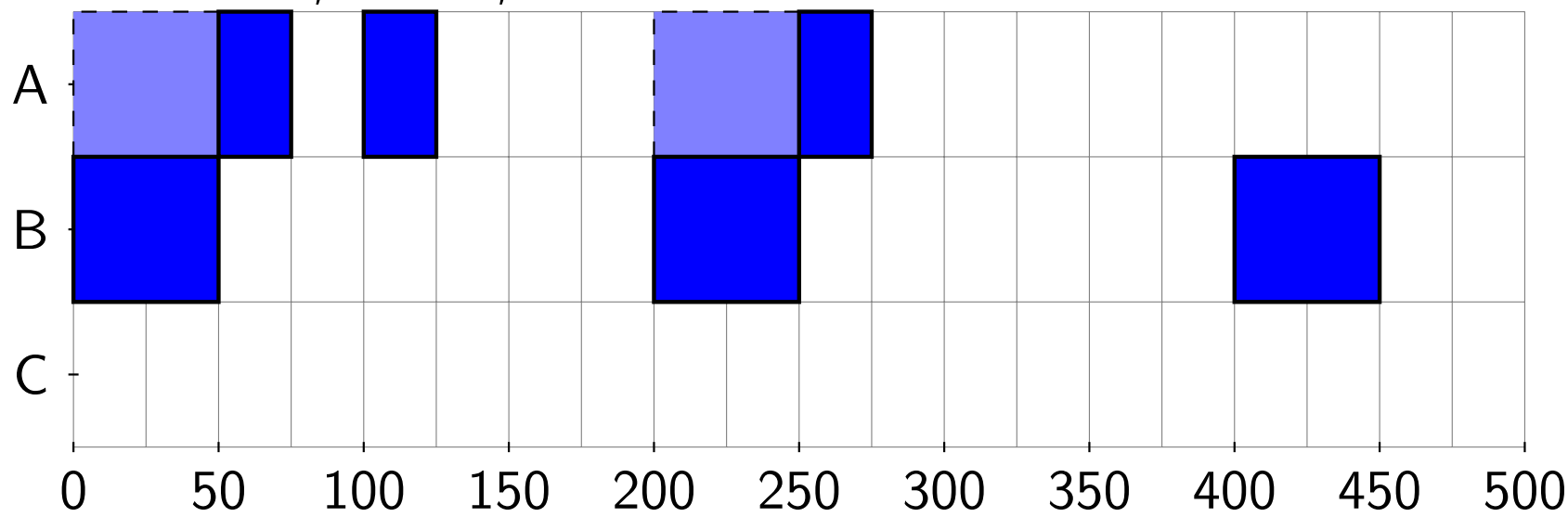
SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

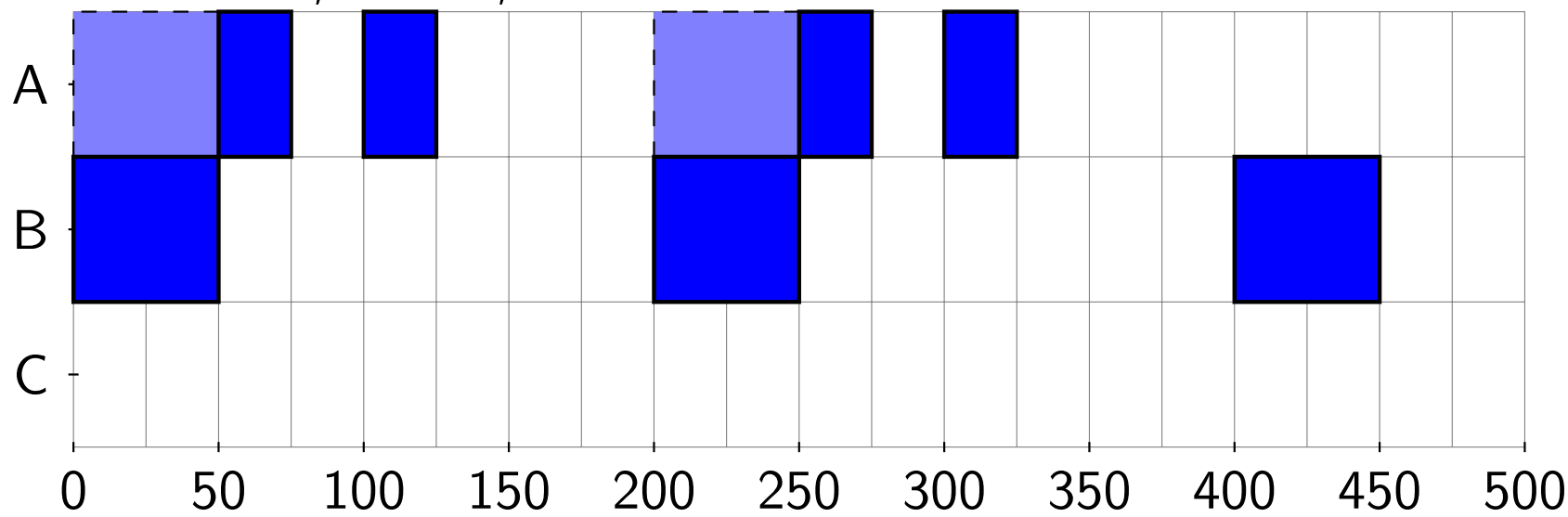
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



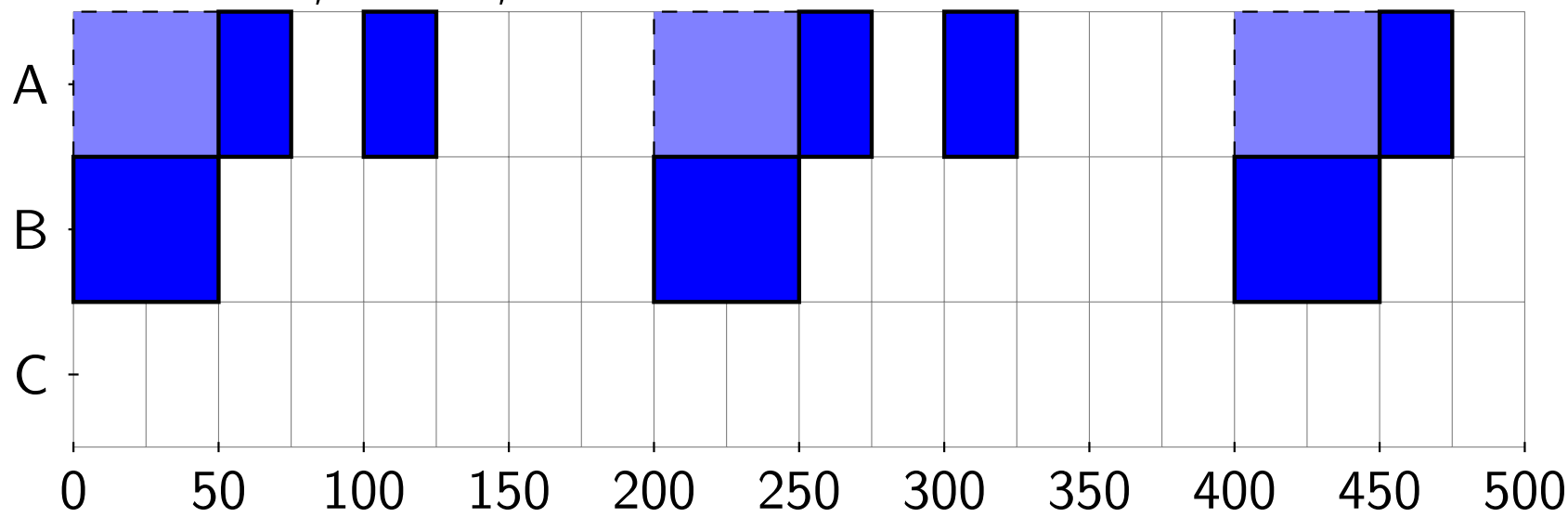
SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

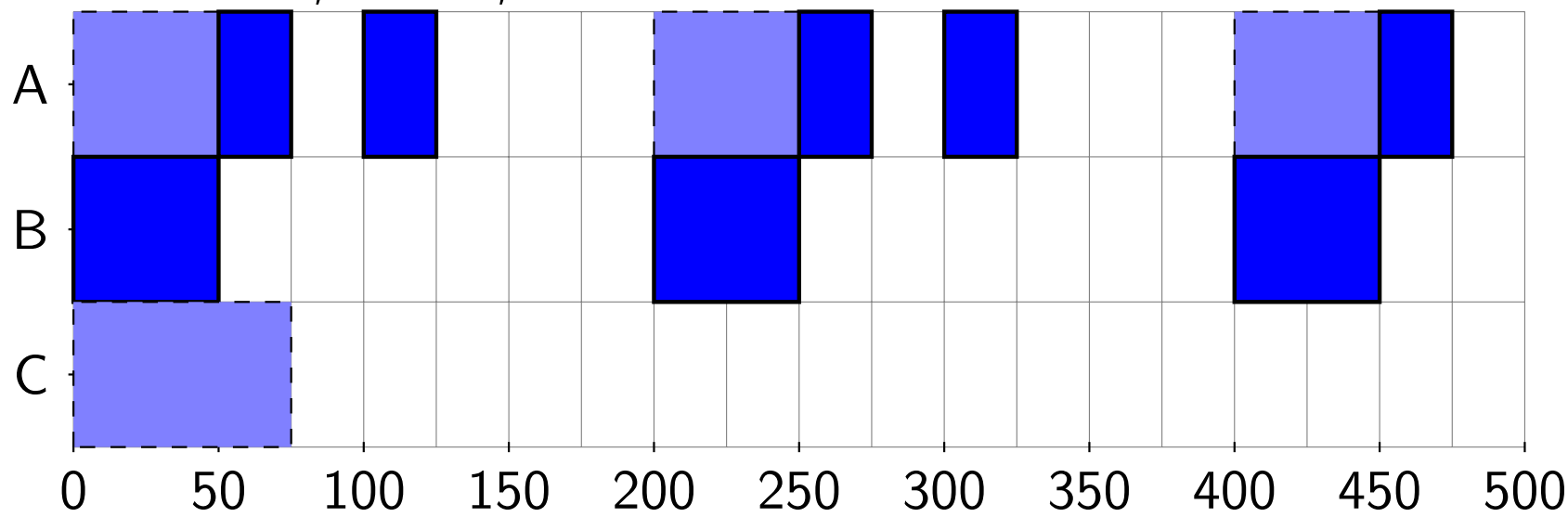
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

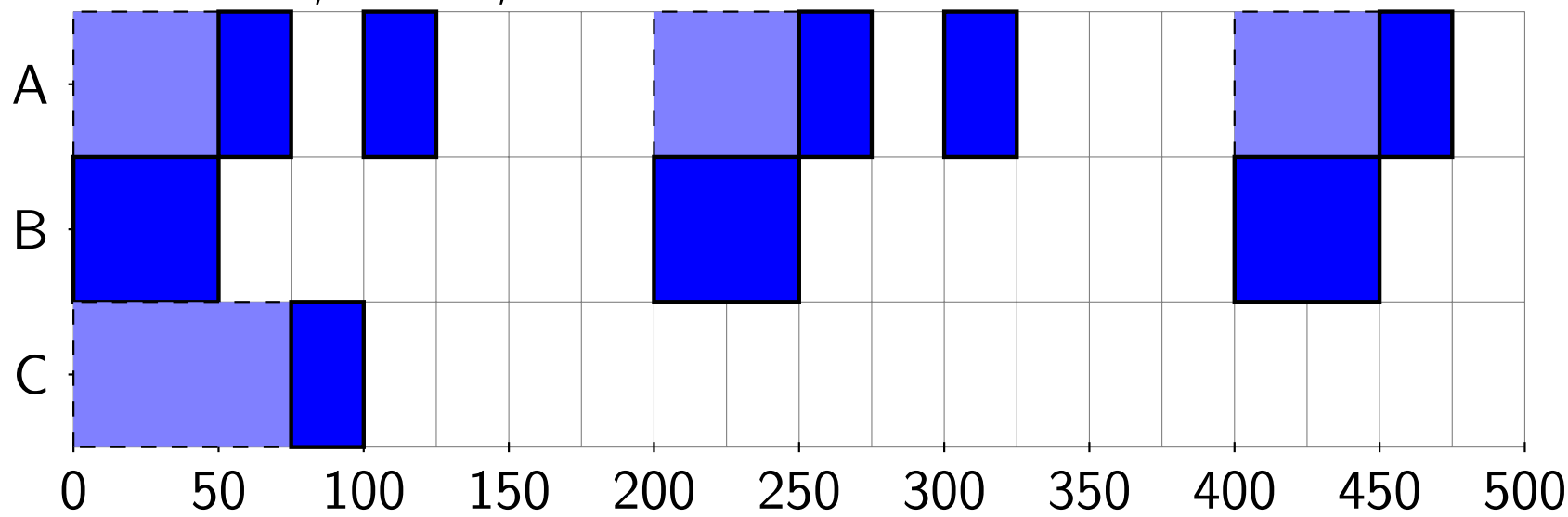
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

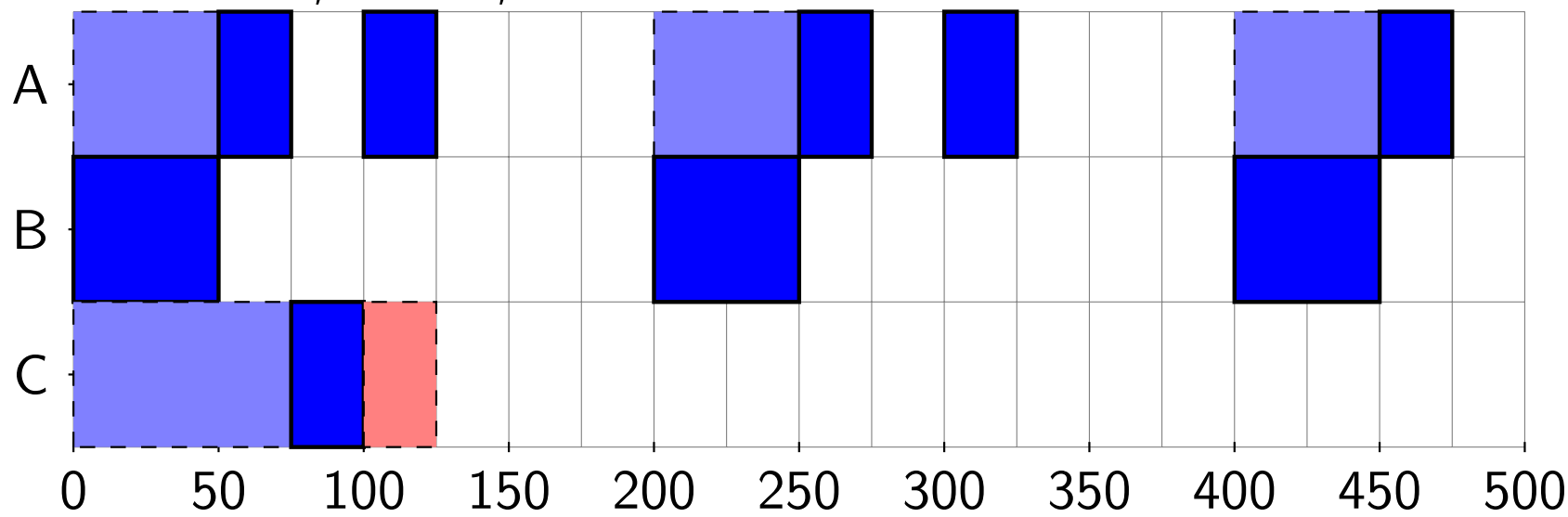
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

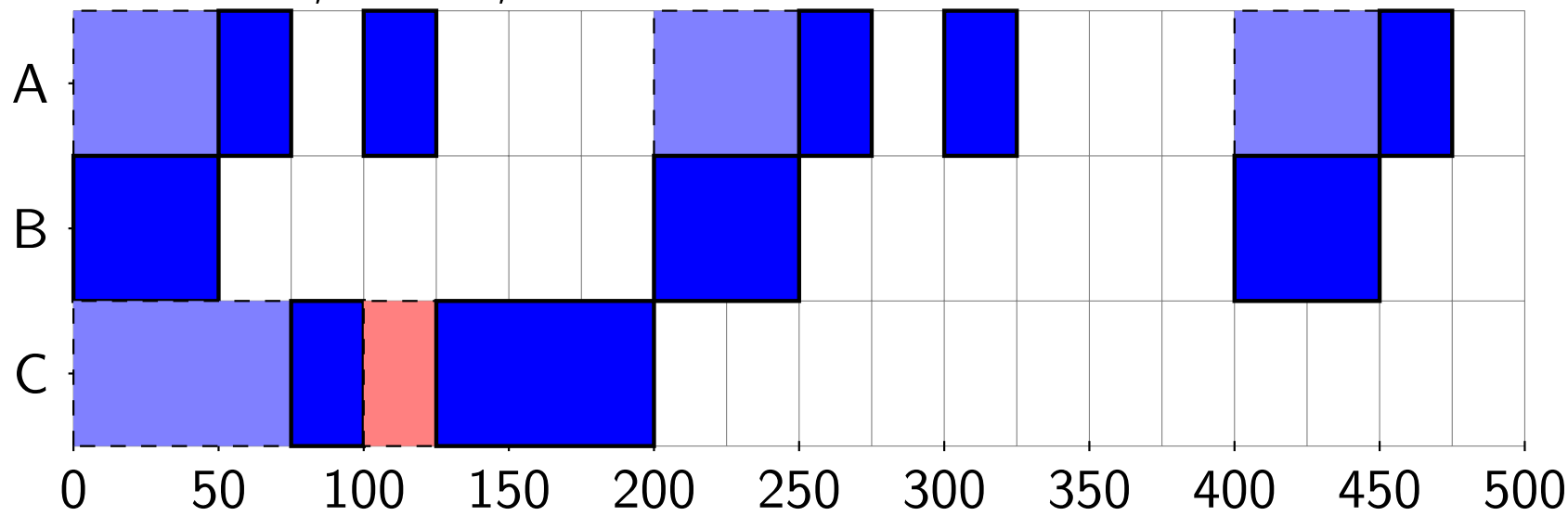
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

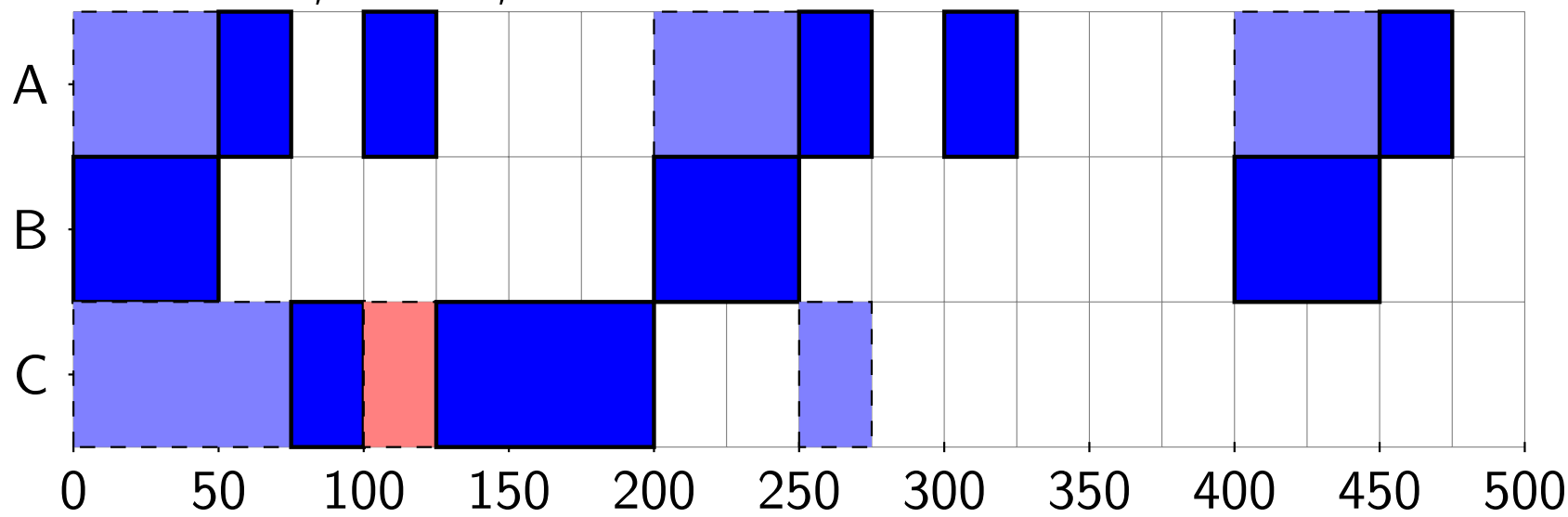
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

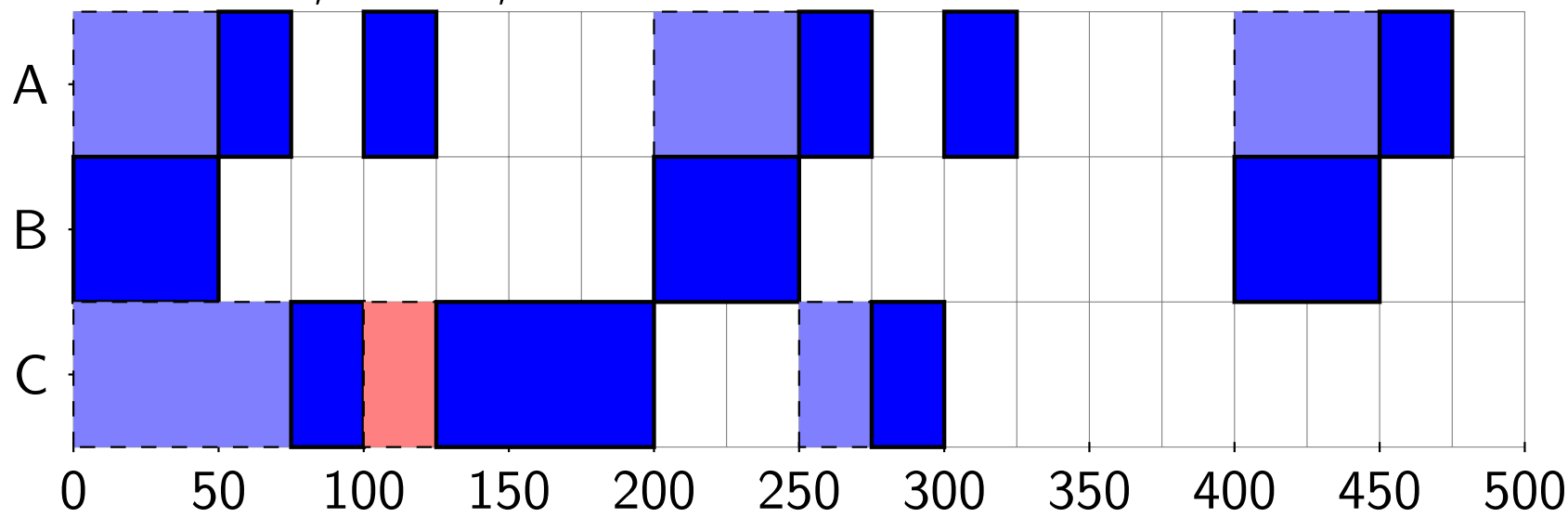
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

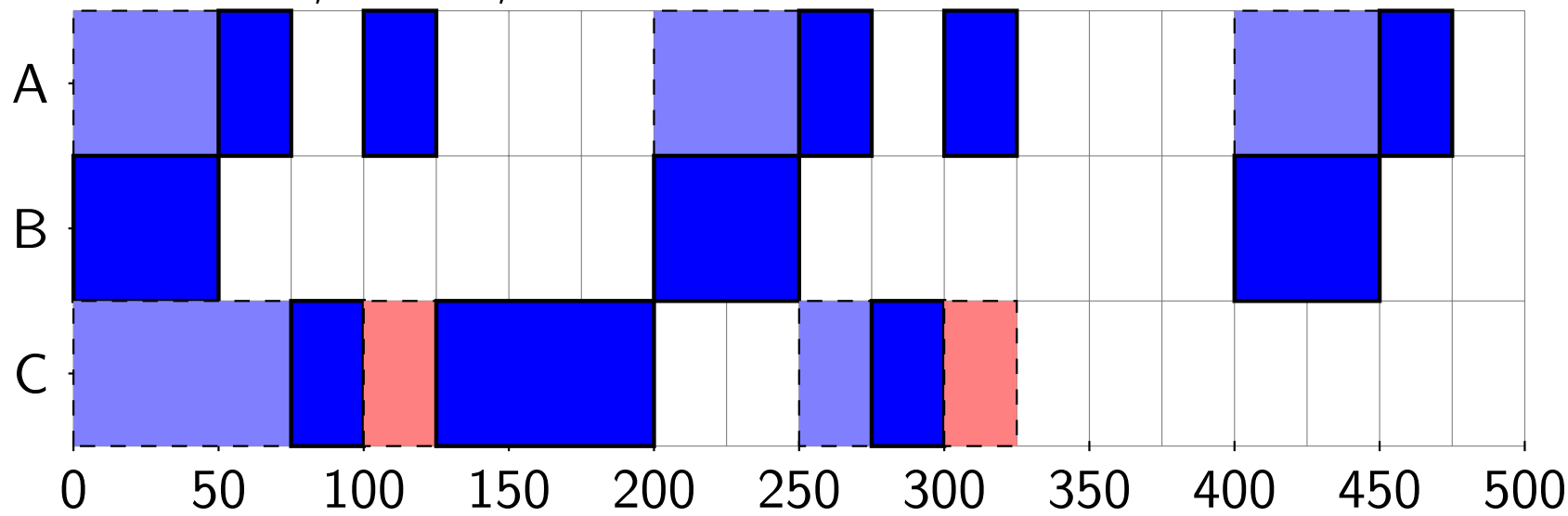
SM C: 100ms, 250ms, Low



SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

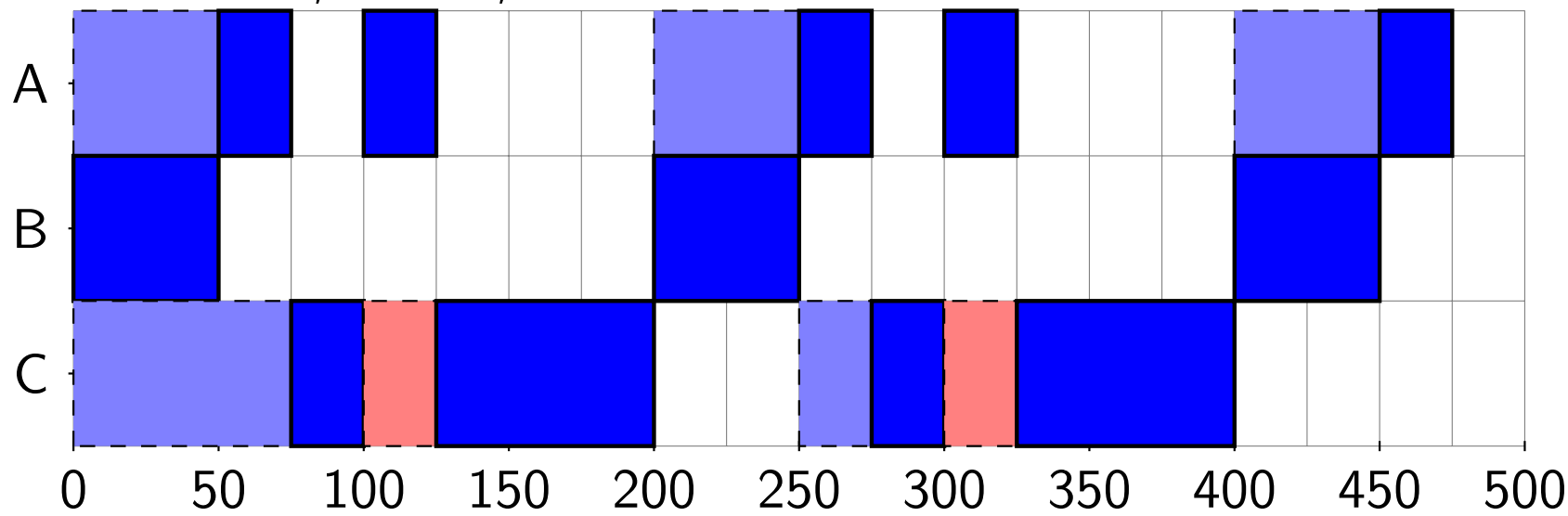
SM C: 100ms, 250ms, Low



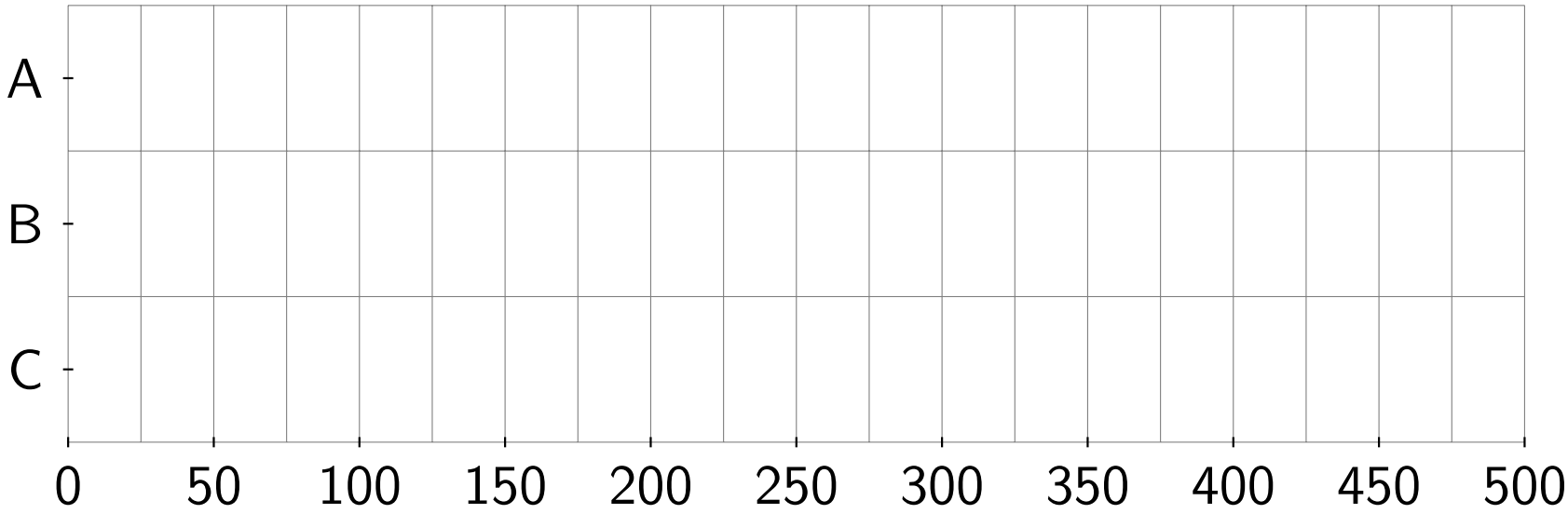
SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

SM C: 100ms, 250ms, Low

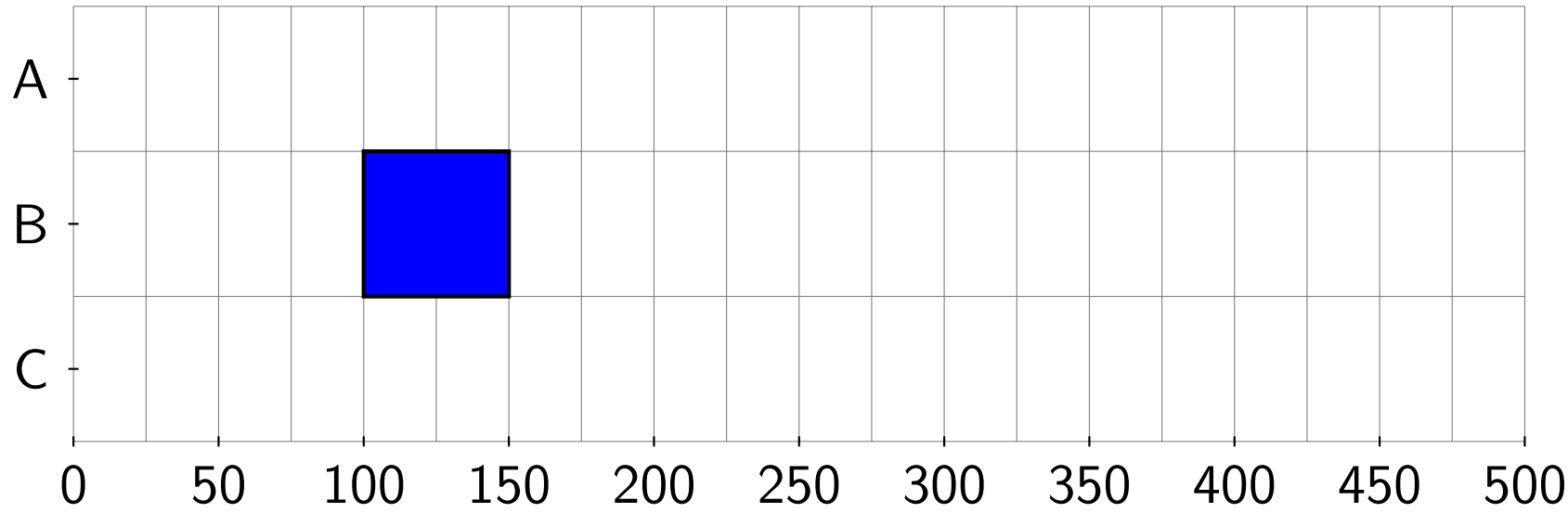


SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



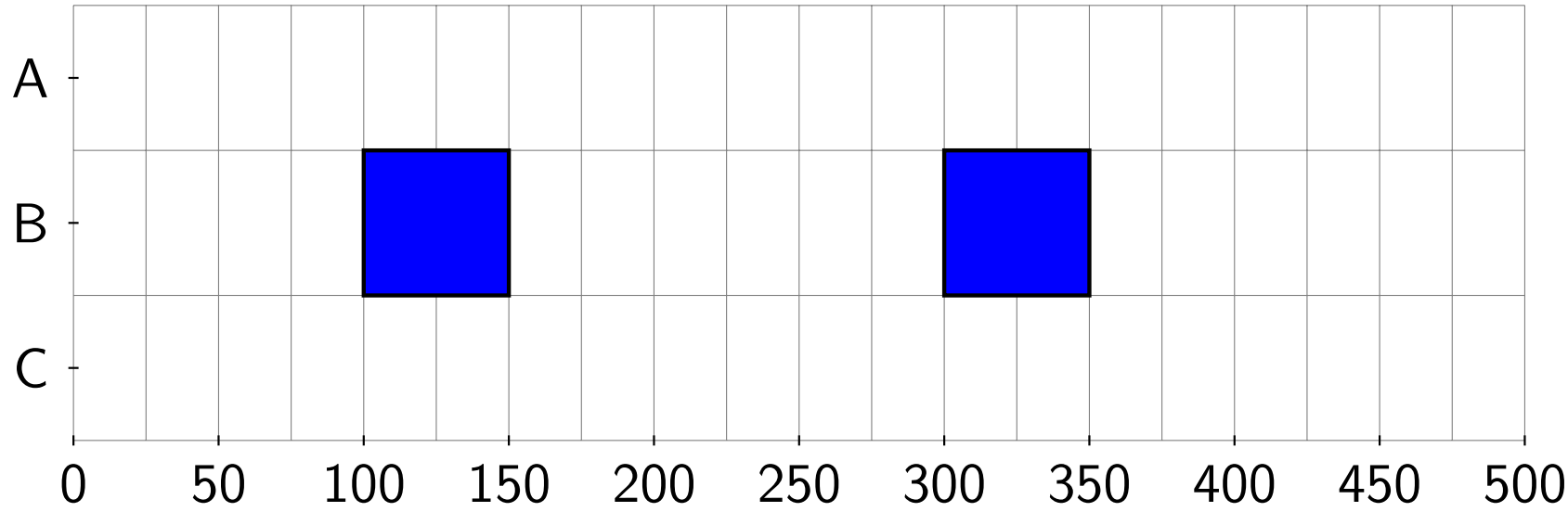
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



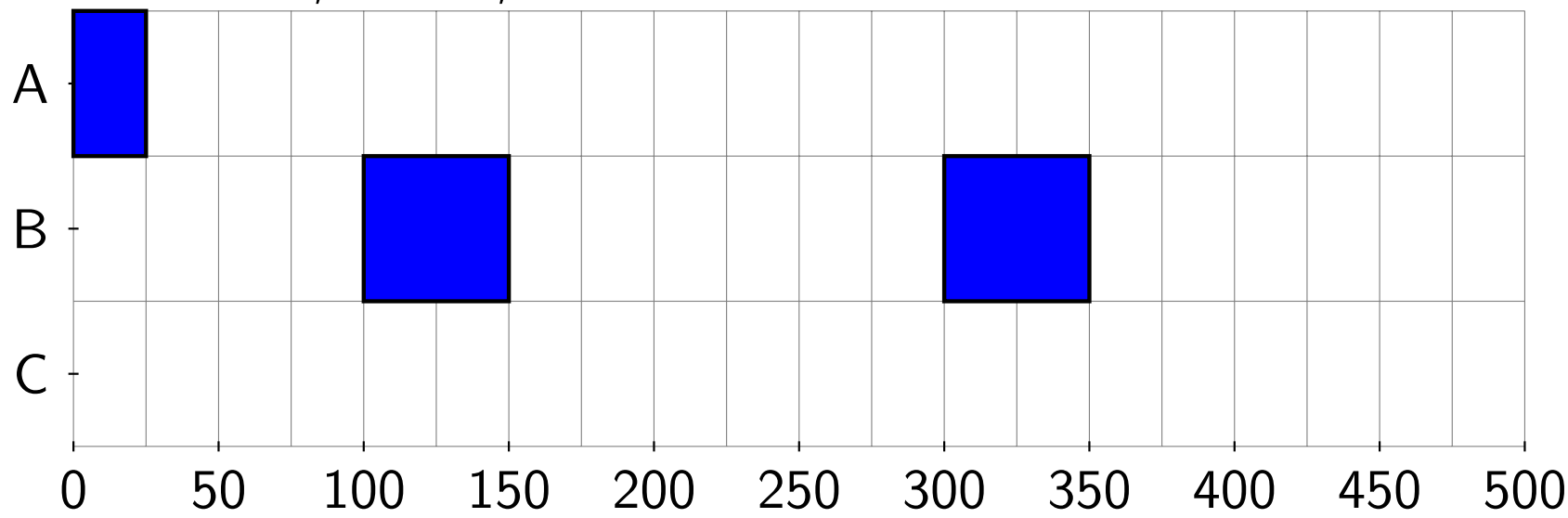
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



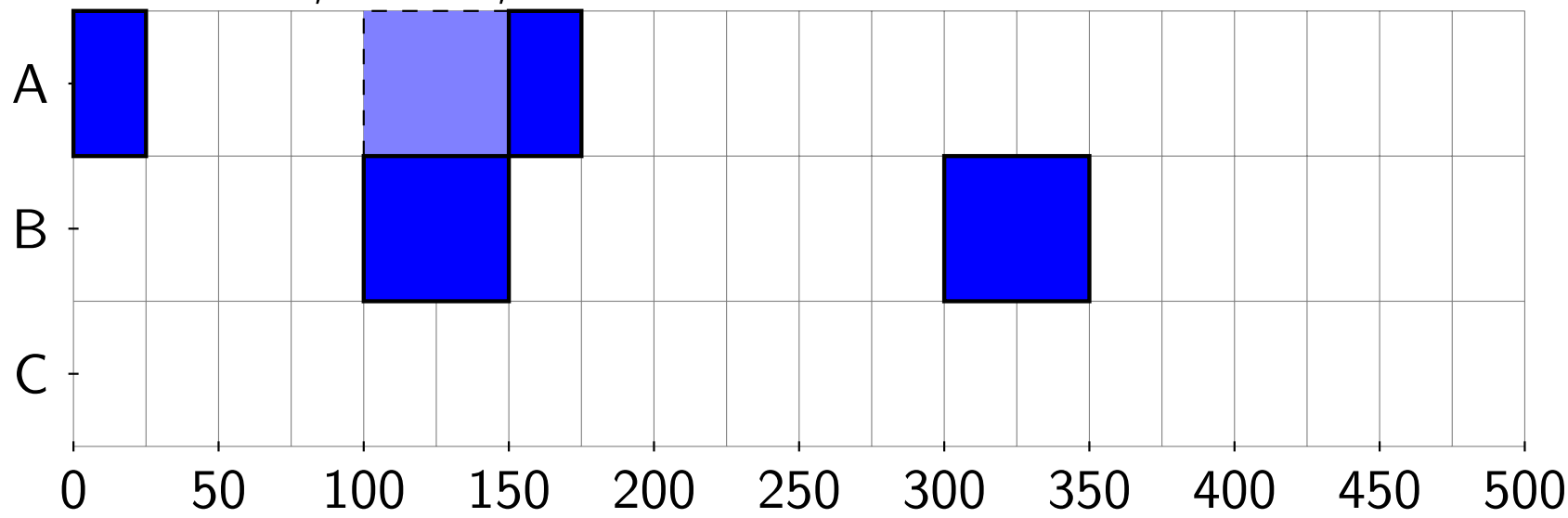
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



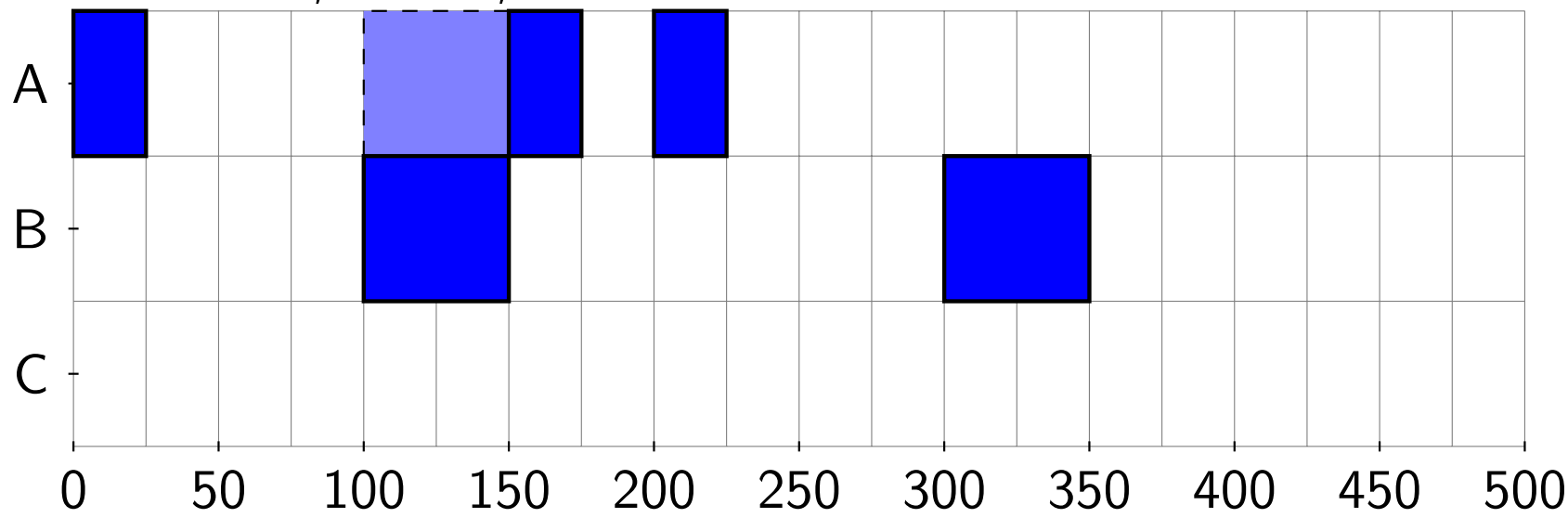
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low

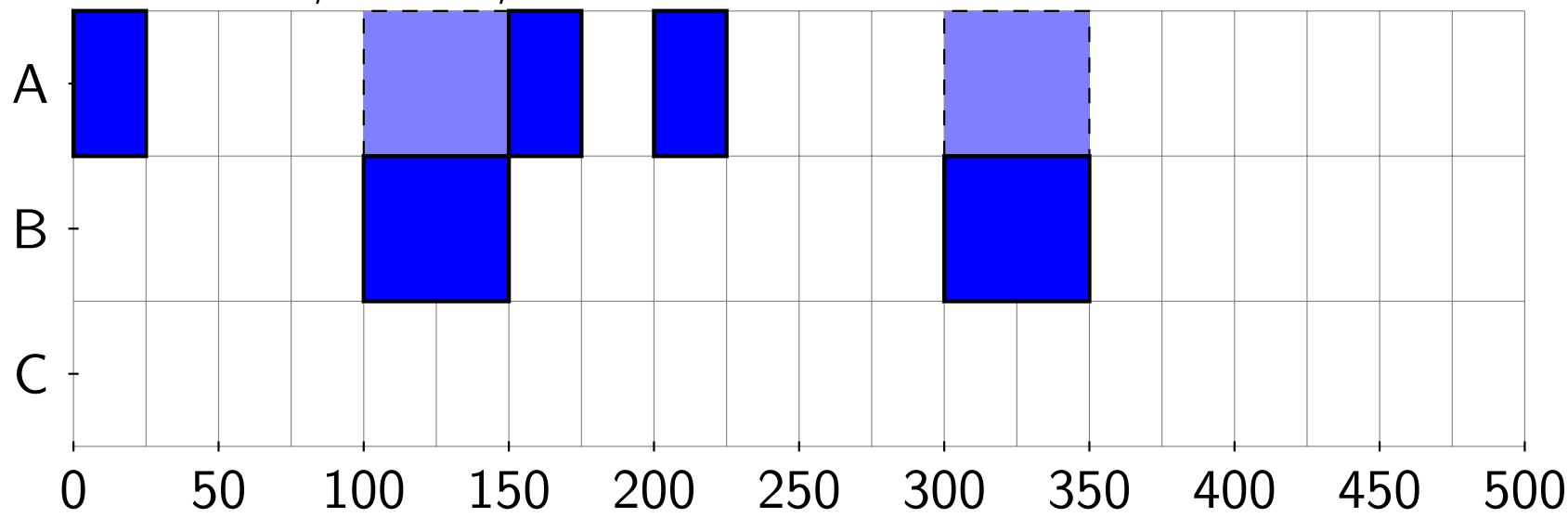


Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med

SM B: 50ms, 200ms, High

SM C: 100ms, 250ms, Low

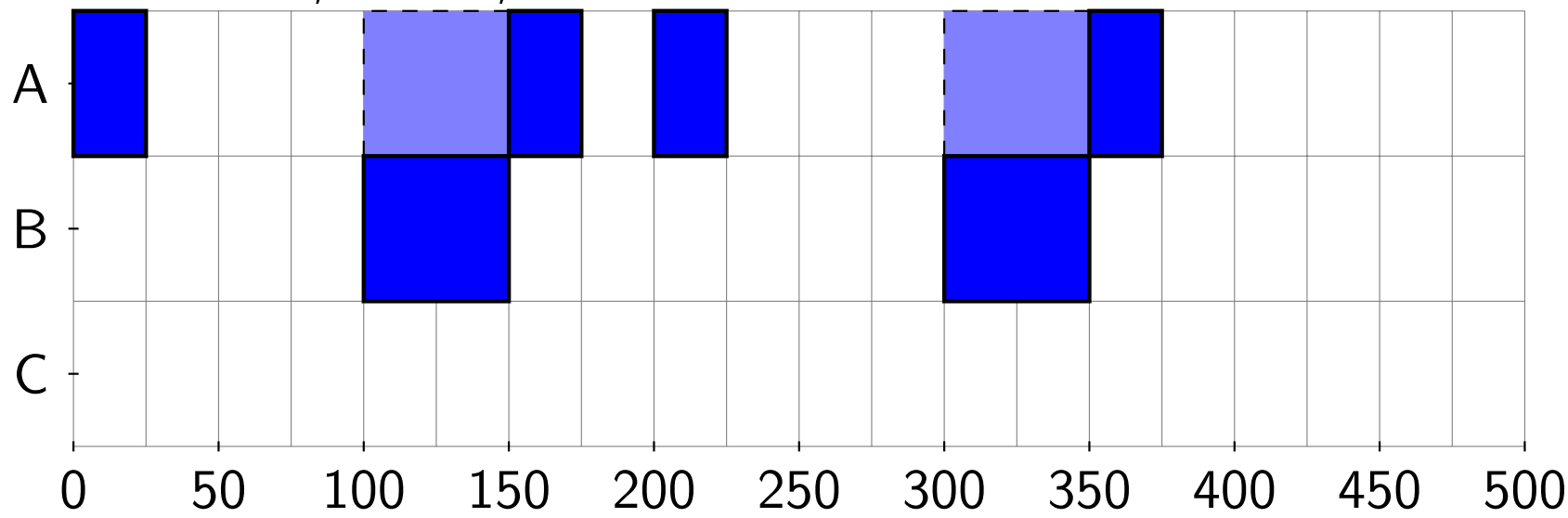


Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med

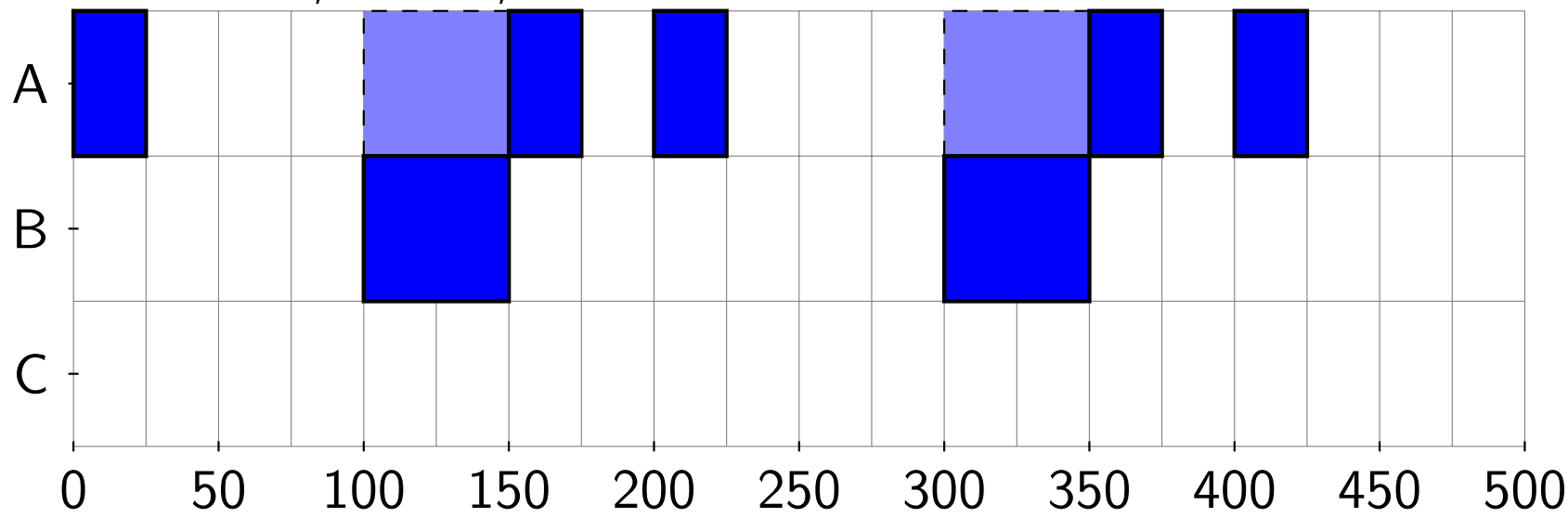
SM B: 50ms, 200ms, High

SM C: 100ms, 250ms, Low



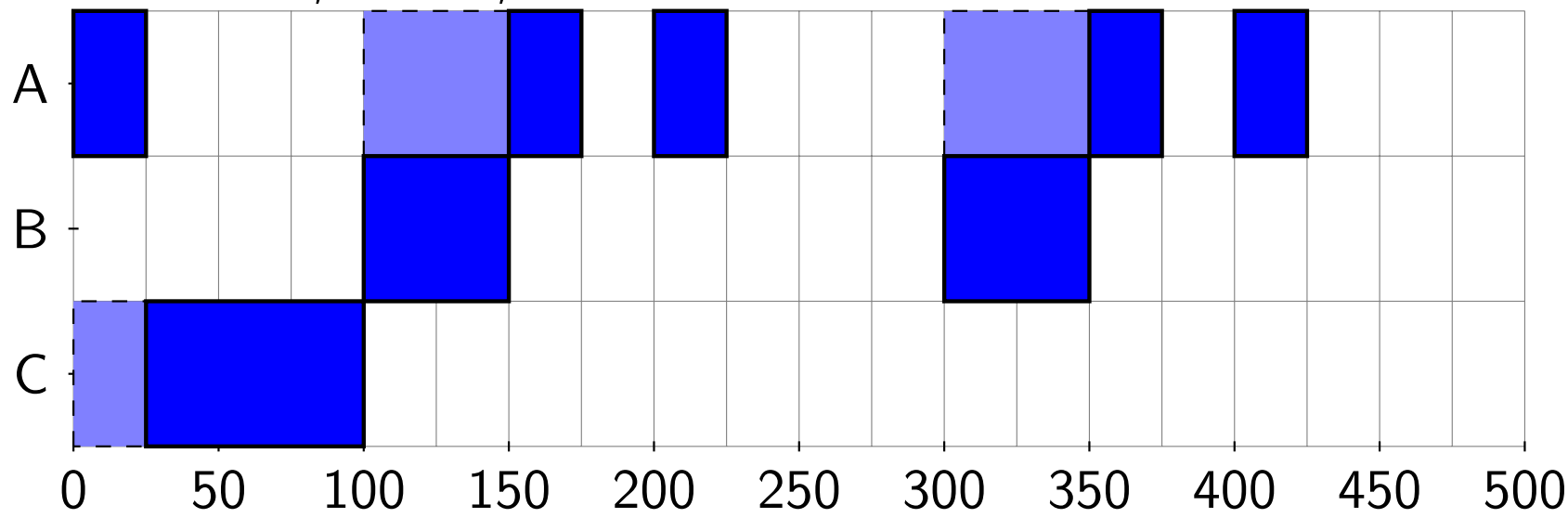
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



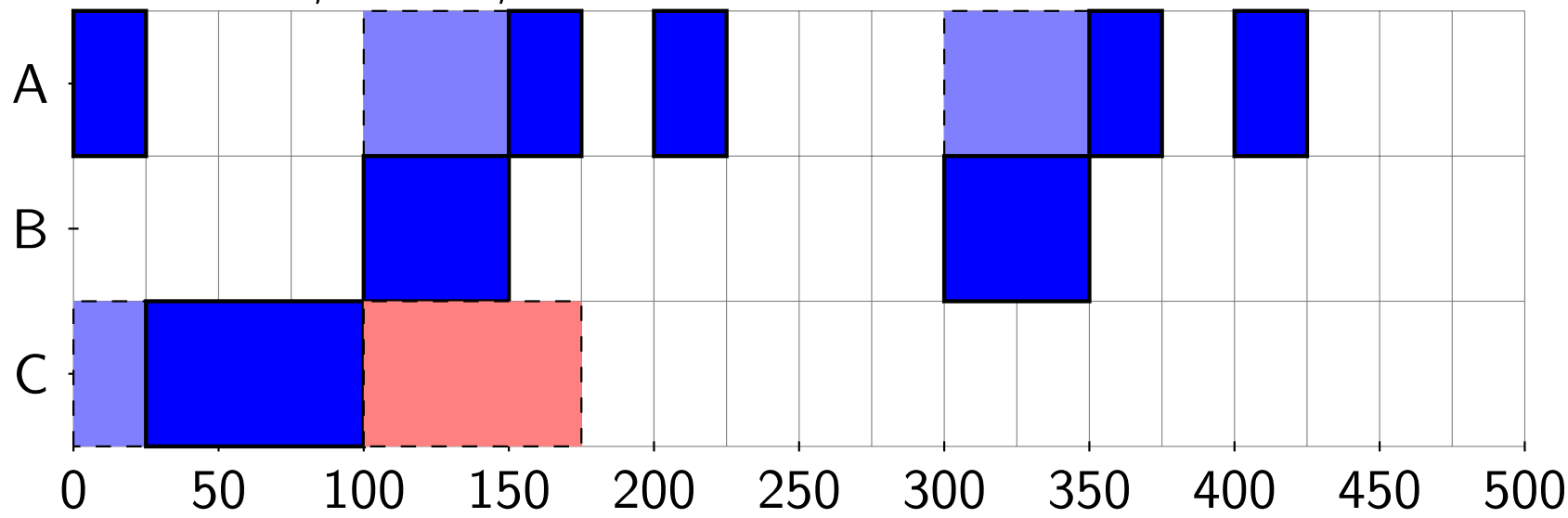
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



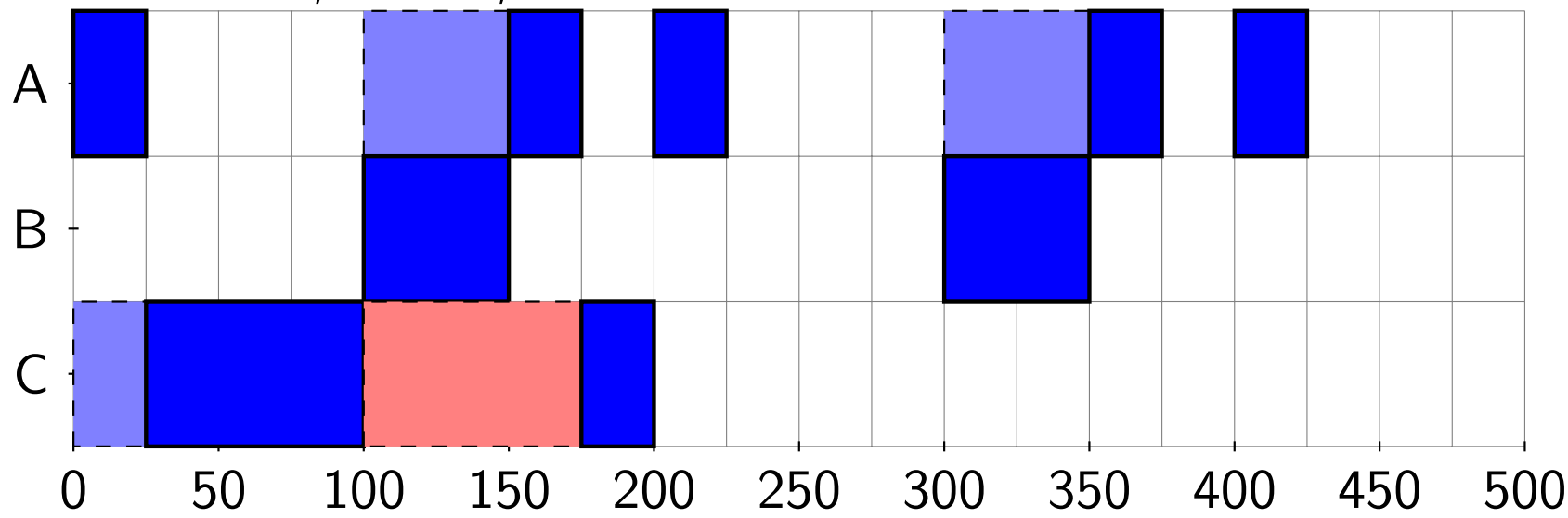
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



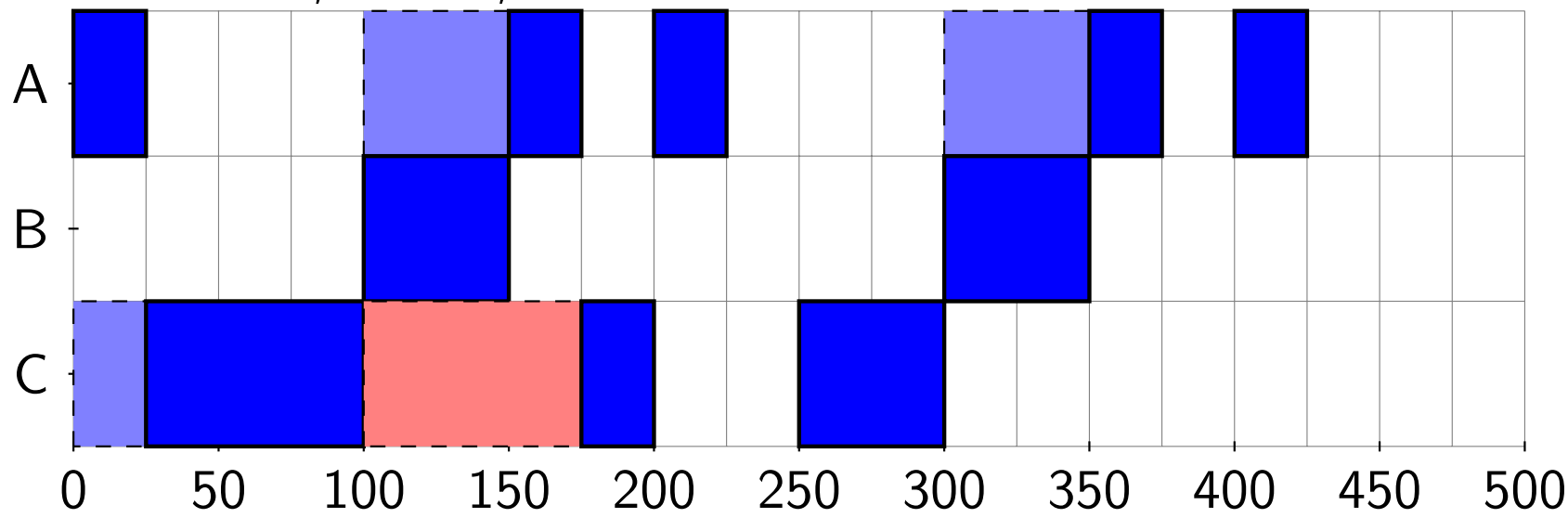
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



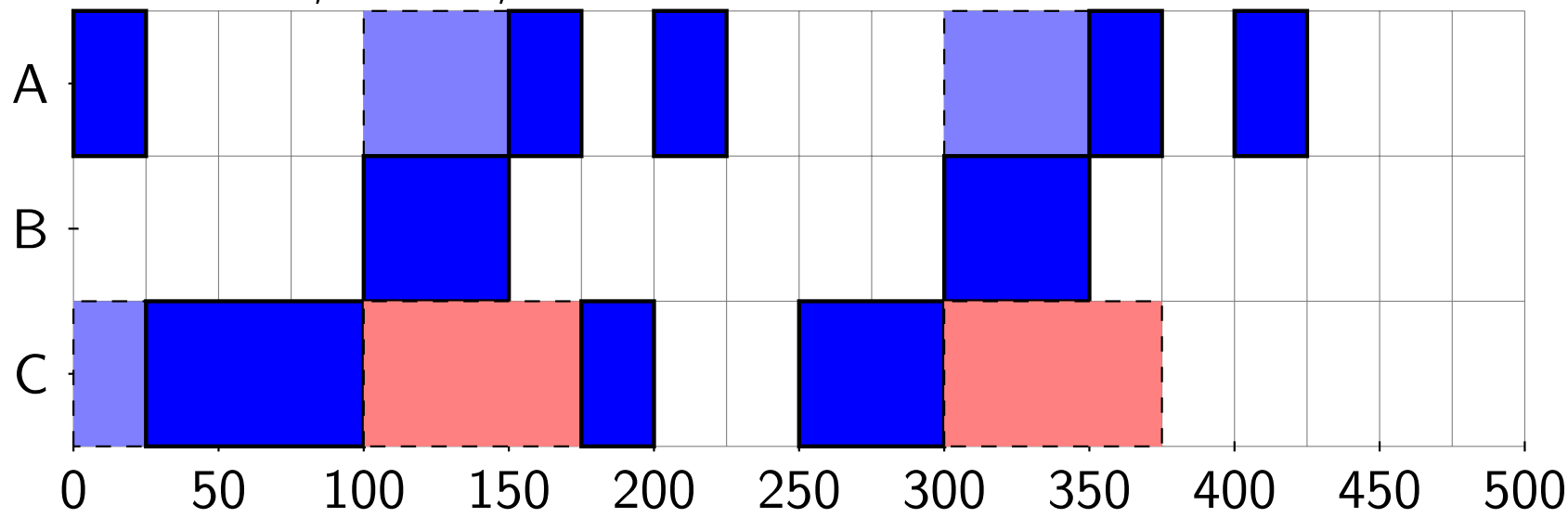
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



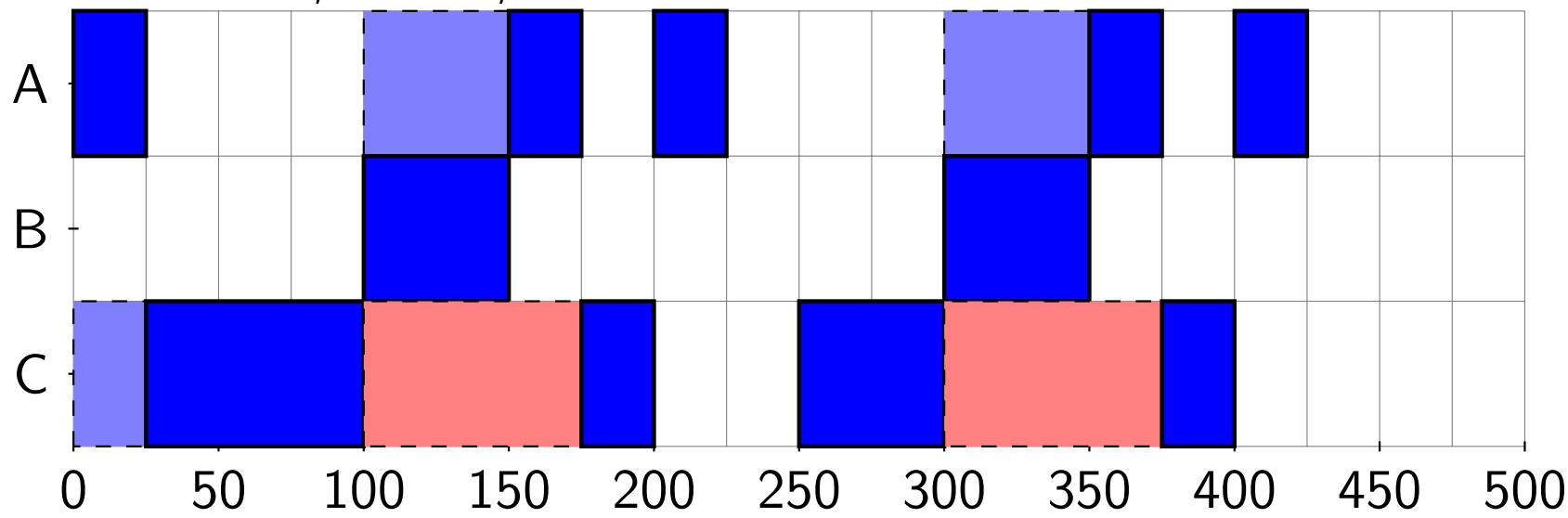
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



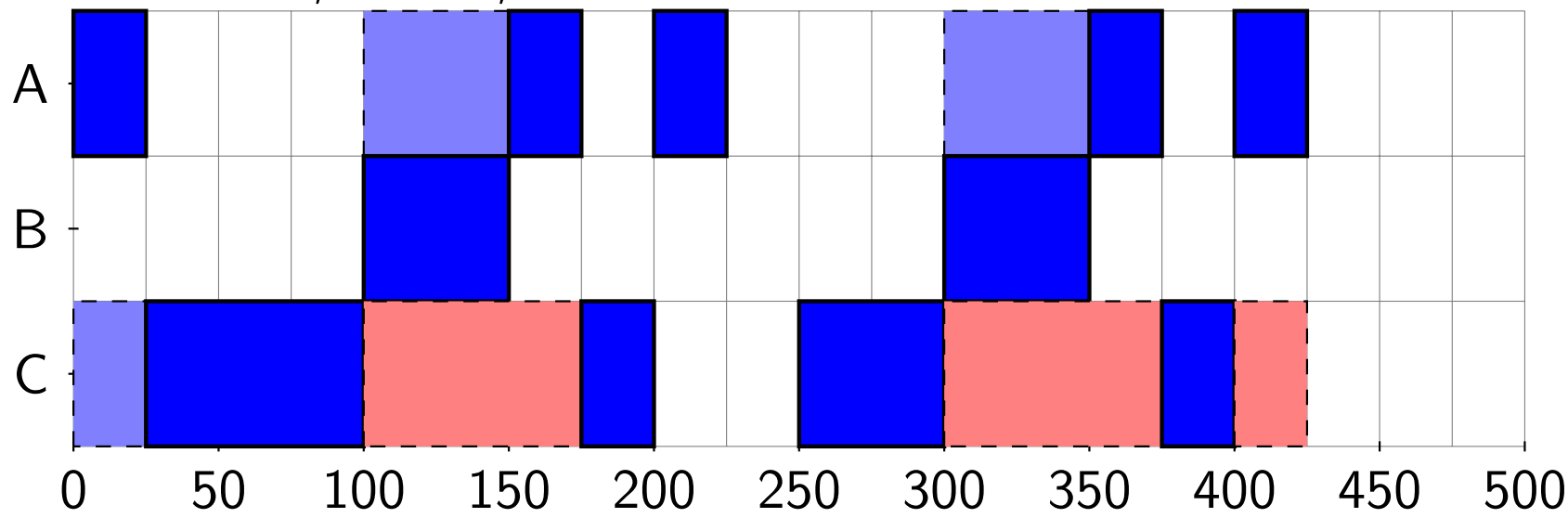
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



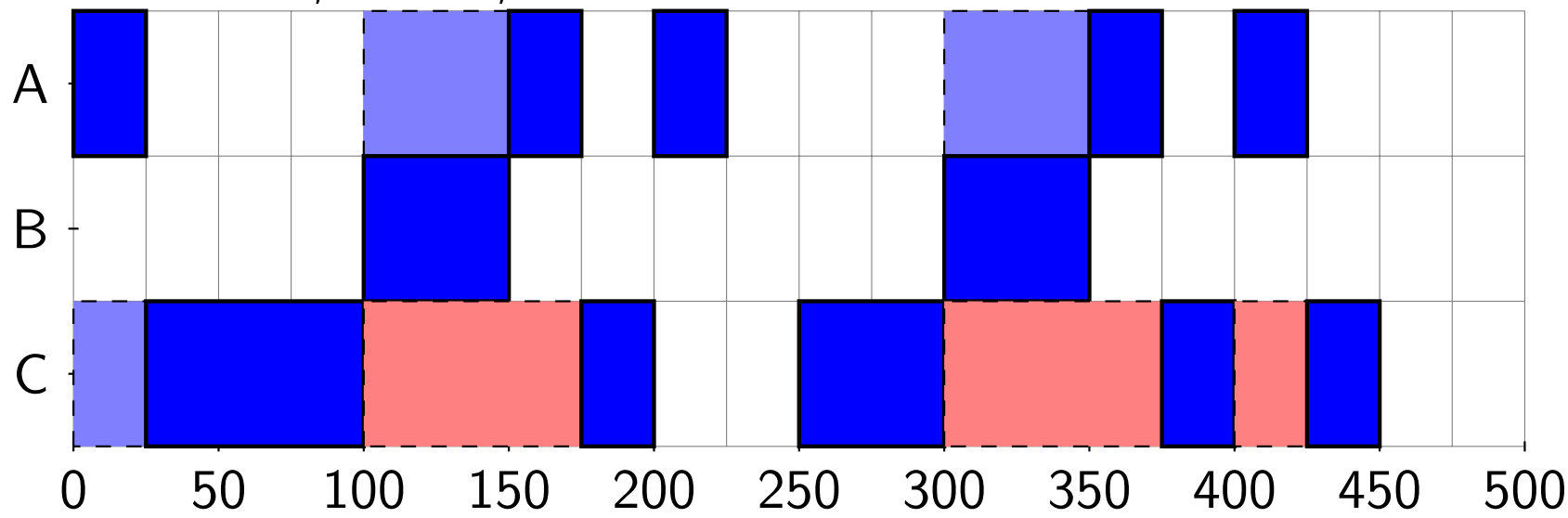
Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



Note: This schedule should be from 500 - 1000.

SM A: 25ms, 100ms, Med
SM B: 50ms, 200ms, High
SM C: 100ms, 250ms, Low



Note: This schedule should be from 500 - 1000.