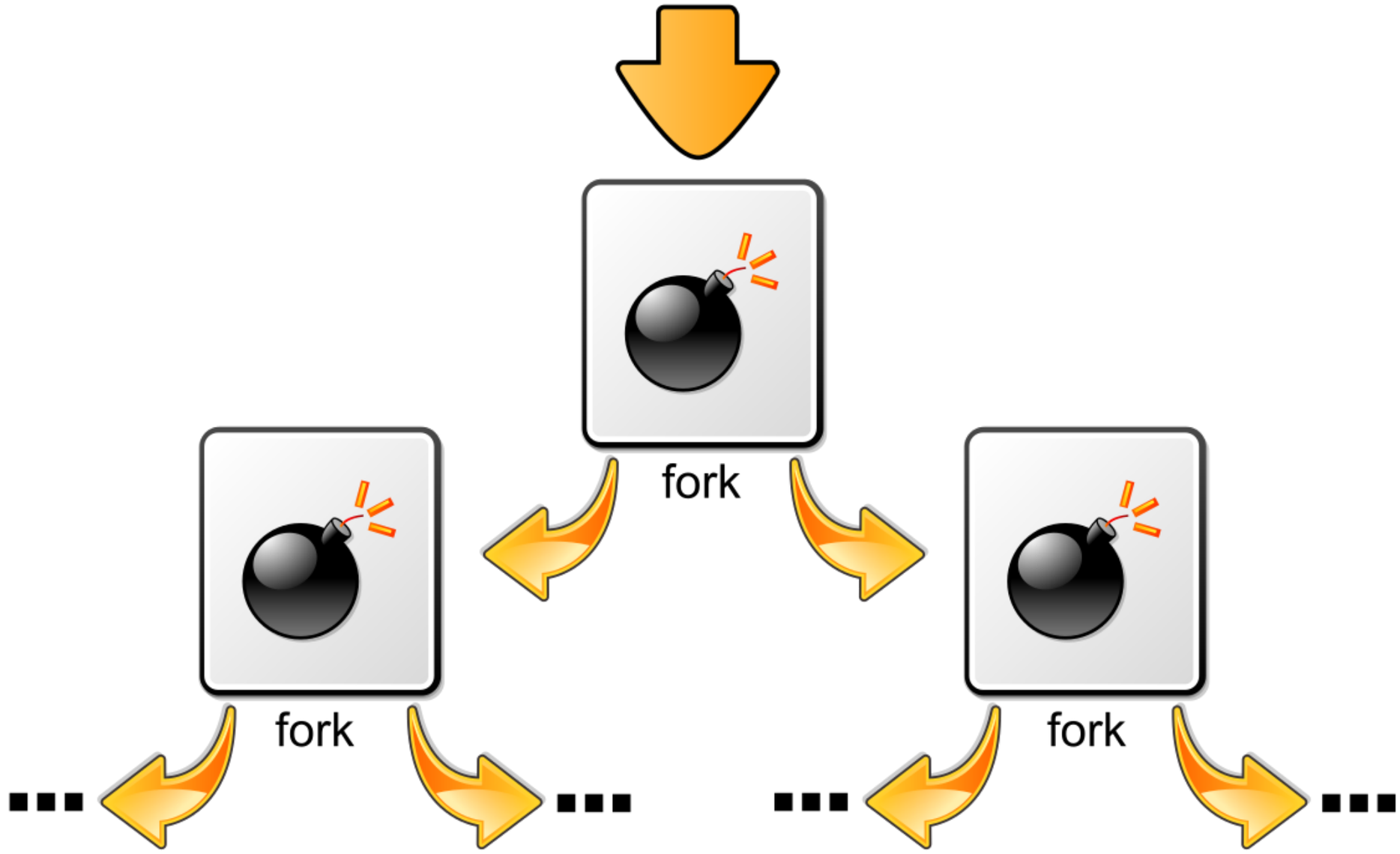
Administrative

- VM; Video of last lecture up on website

Shell Fun -I (Fork Bomb)



Shell Fun -II

Bq command

Operating Systems
Lecture 5: CPU Scheduling Policies

Nipun Batra
Aug 10, 2018

CPU Virtualisation Revisited

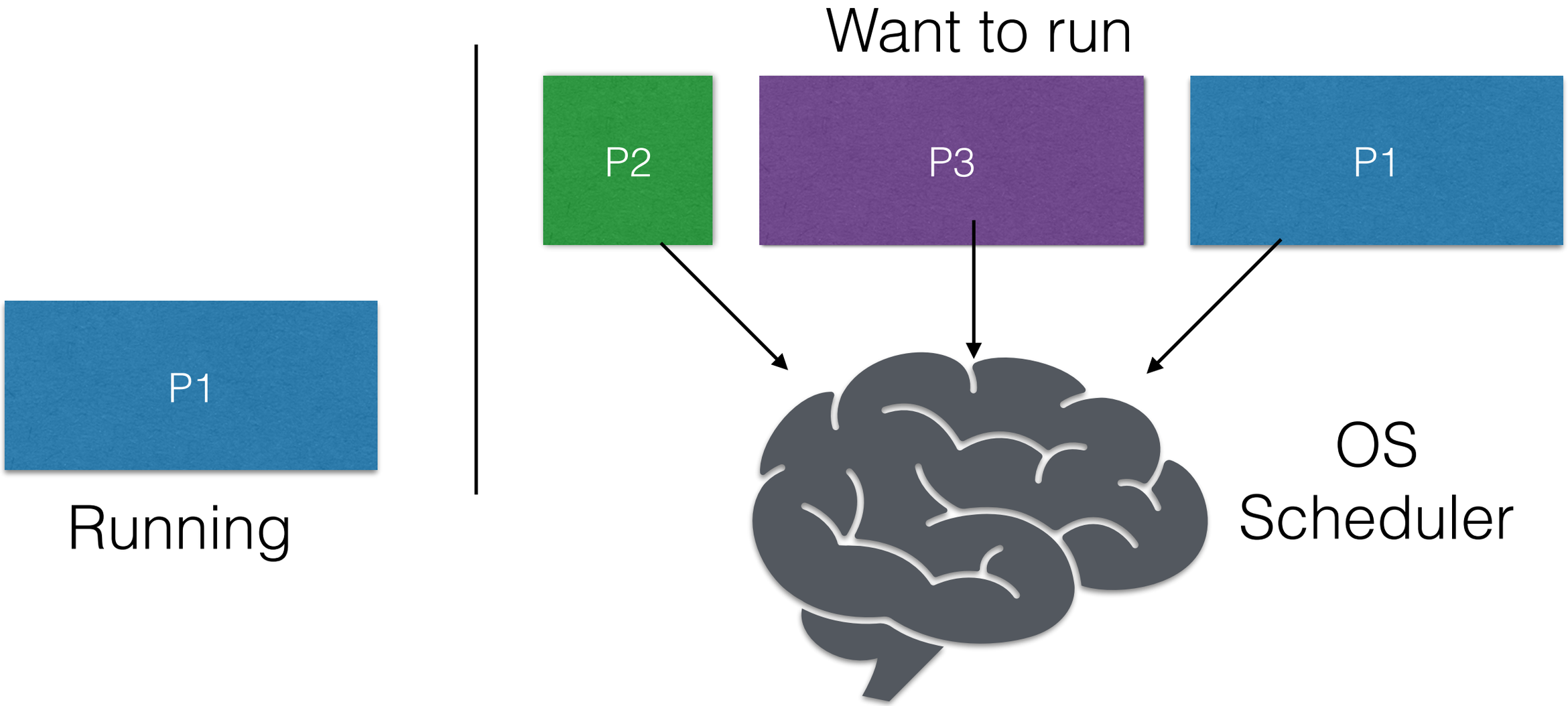
Running

CPU Virtualisation Revisited

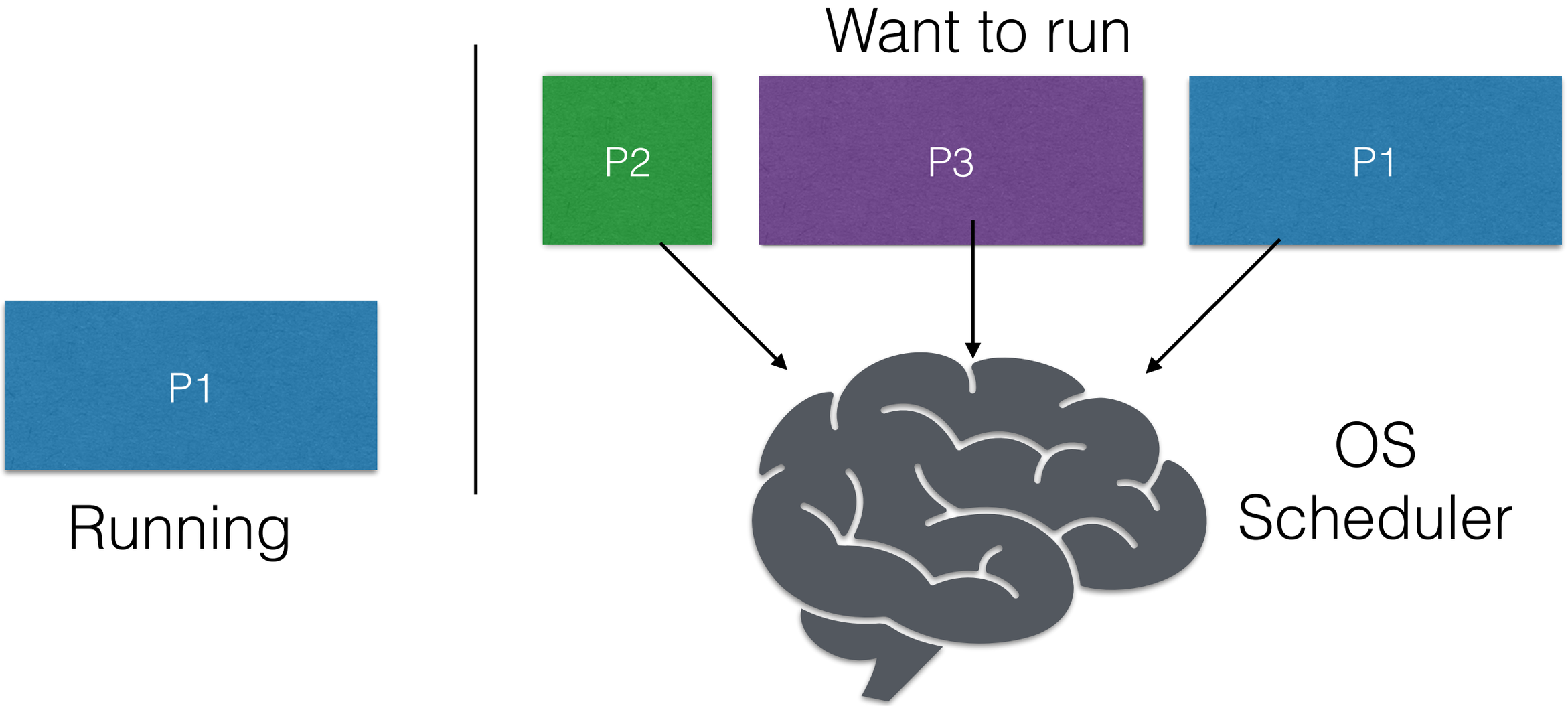
Want to run

Running

CPU Virtualisation Revisited

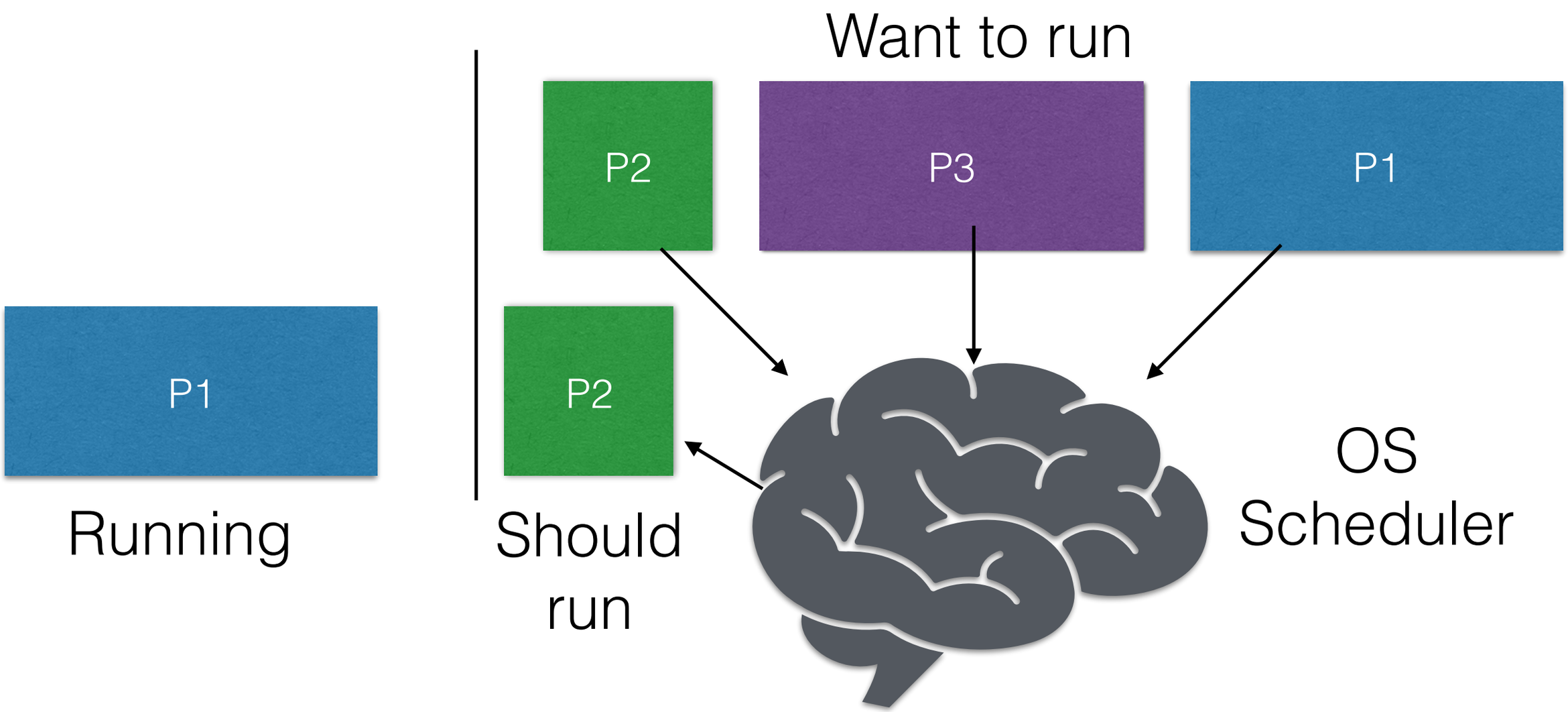


CPU Virtualisation Revisited

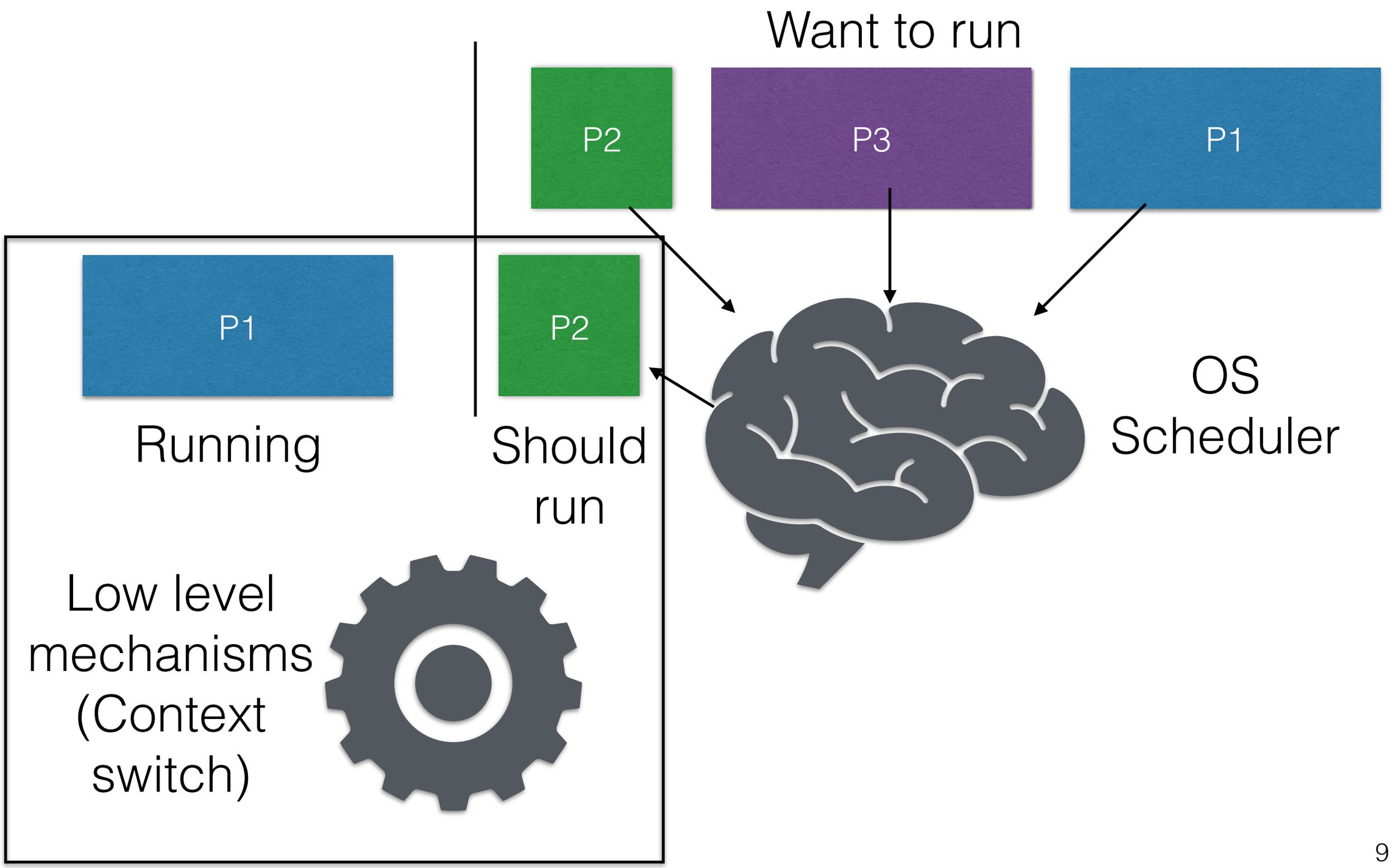


Next P = f(run time, metric, type of process, …)

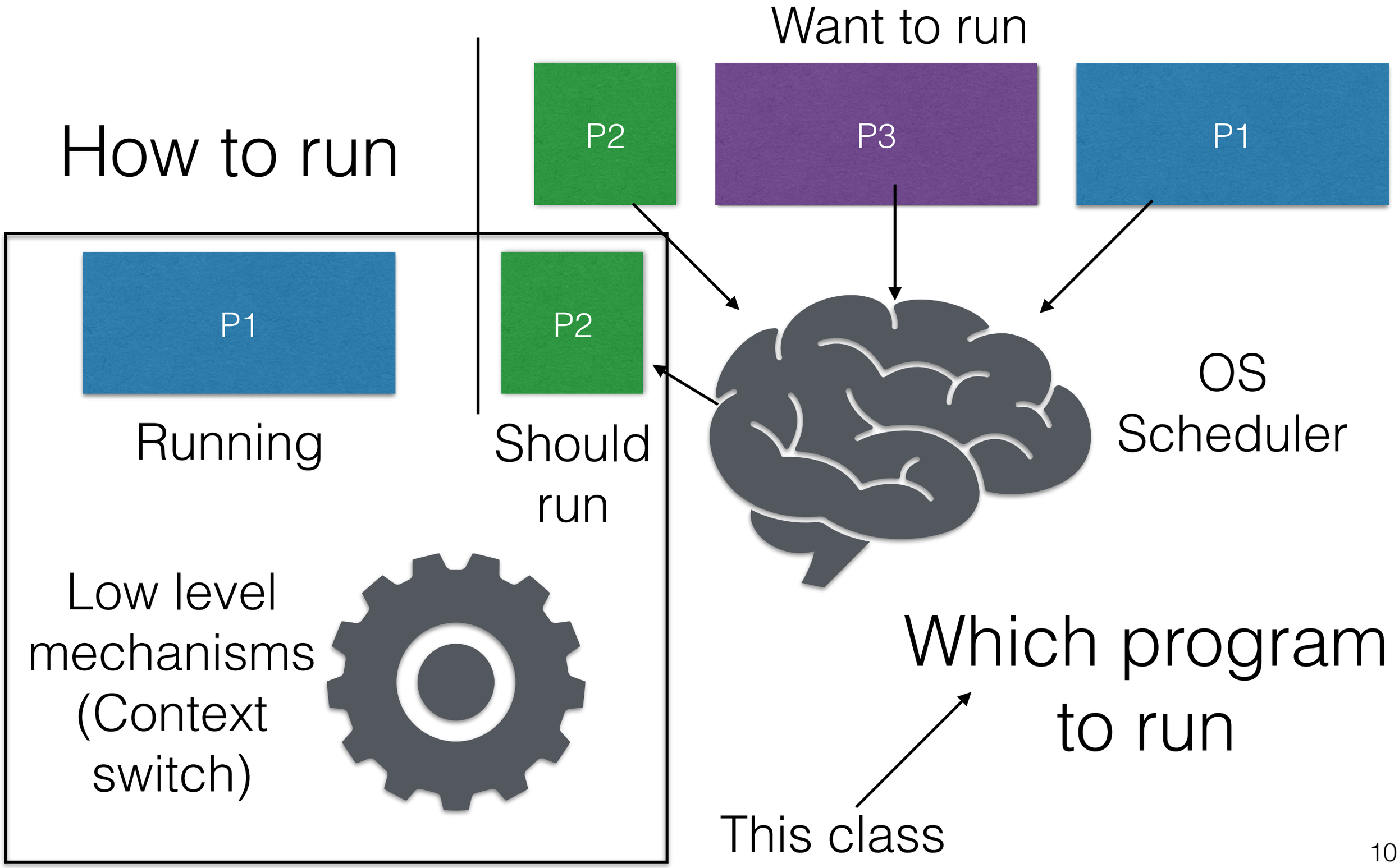
CPU Virtualisation Revisited



CPU Virtualisation Revisited



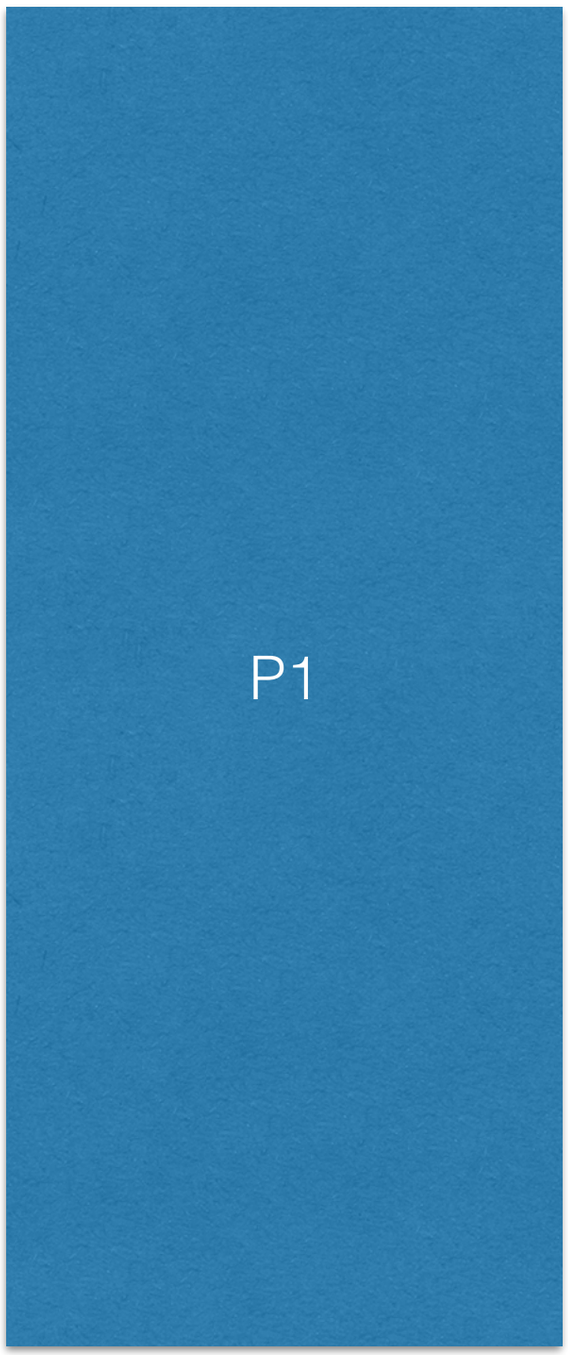
CPU Virtualisation Revisited



Workload

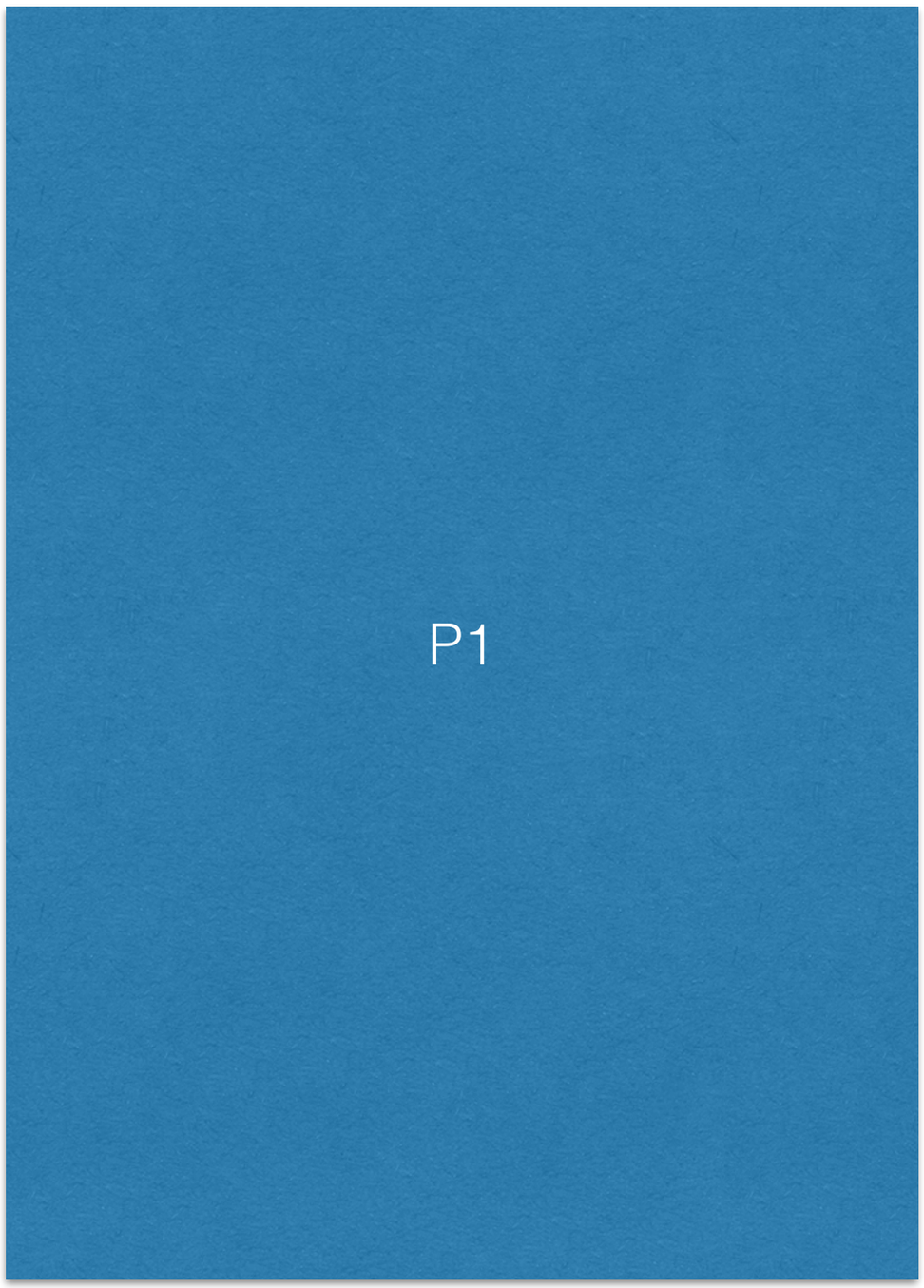
Set of processes

Workload



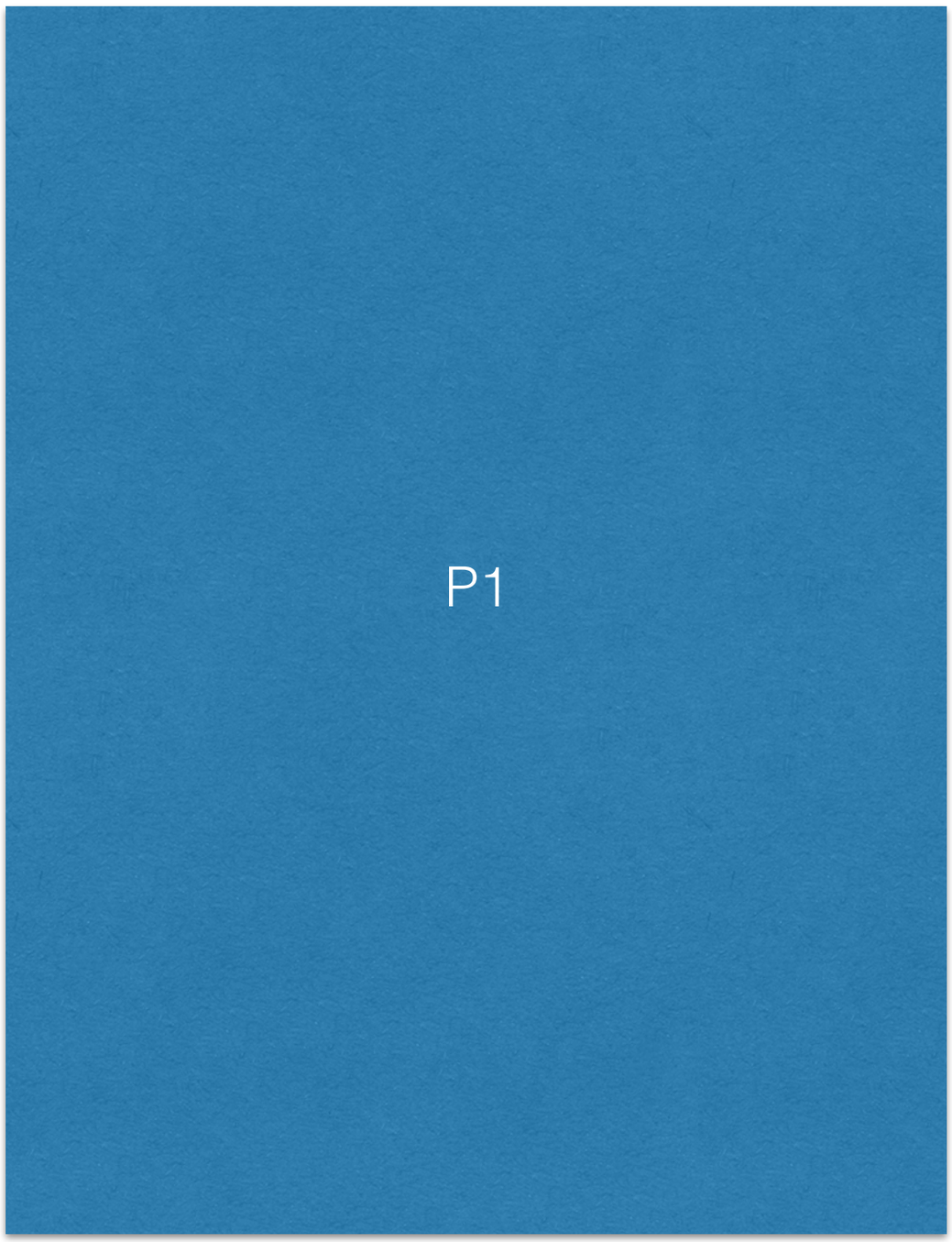
Set of processes

Workload



Set of processes

Workload



Set of processes

Workload

P1

1. Time at which P is created

P2

P3

Set of processes

Workload

P1

1. Time at which P is created
2. Length of job P

P2

P3

Set of processes

Workload

P1

1. Time at which P is created
2. Length of job P
3. Is P interruptible?

P2

P3

Set of processes

Workload

P1

1. Time at which P is created
2. Length of job P
3. Is P interruptible?
4. Is it only CPU? Or CPU & IO?

P2

P3

Set of processes

Workload Assumptions

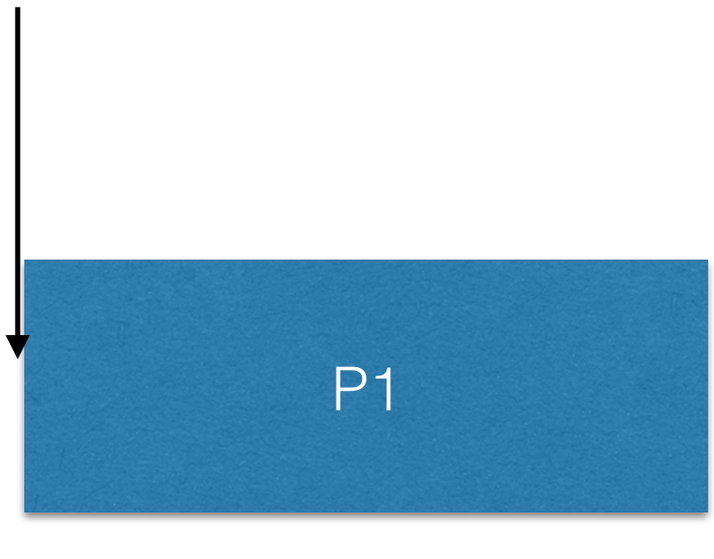
1. Each job runs for the same time
2. All jobs arrive at the same time
3. Once started, each job runs to completion
4. All jobs use only the CPU
5. Run time of each job is known

Scheduling Metrics

Scheduling Metrics

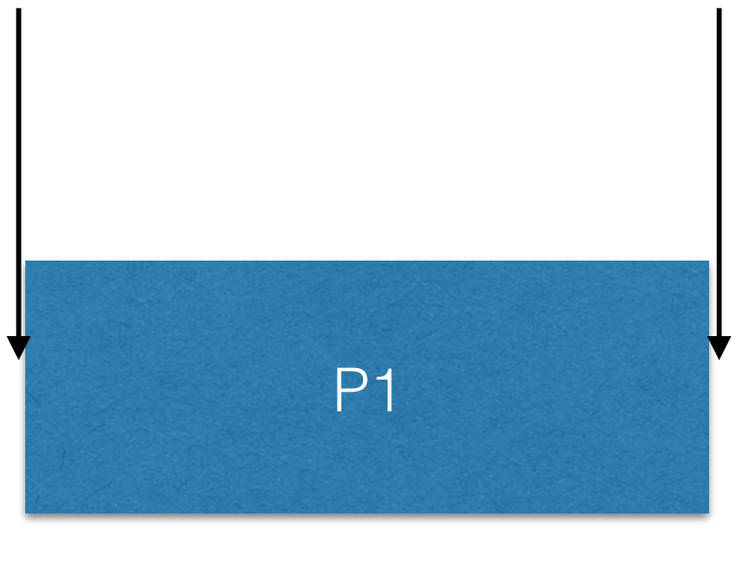
Scheduling Metrics

Arrived at t1

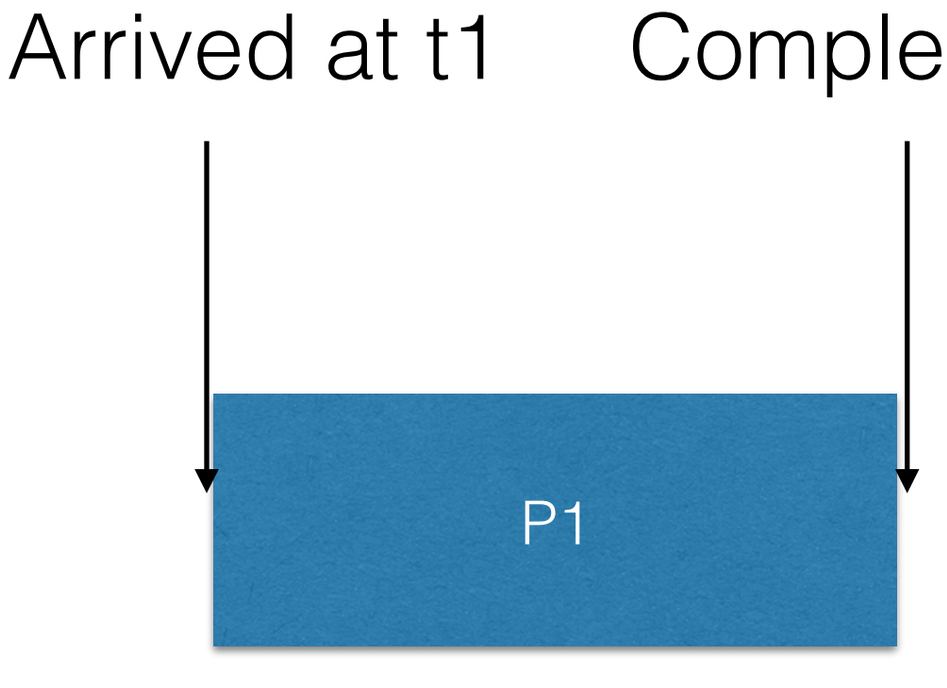


Scheduling Metrics

Arrived at t1 Completed at t2



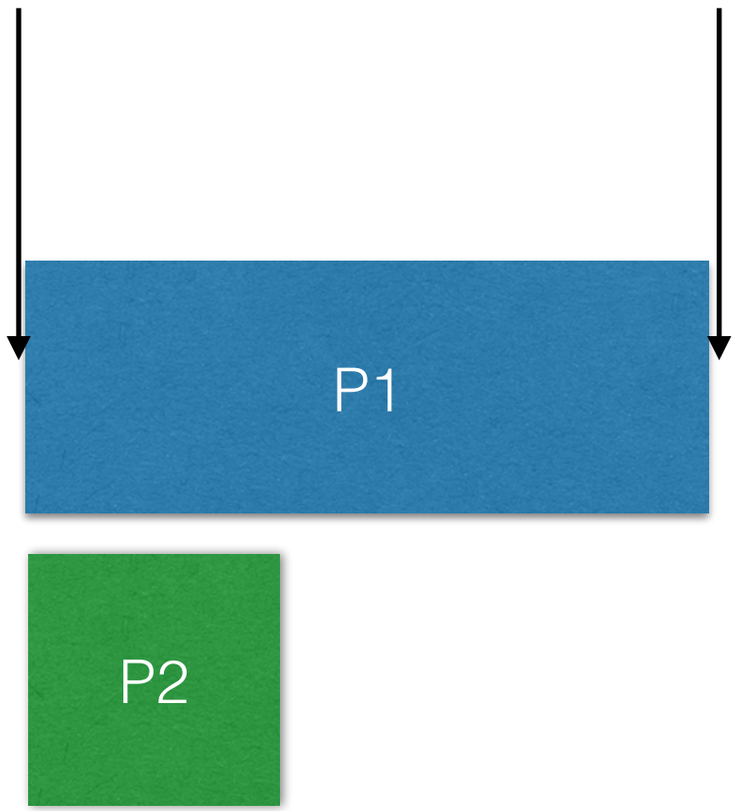
Scheduling Metrics



Turnaround time (P1) = t2-t1

Scheduling Metrics

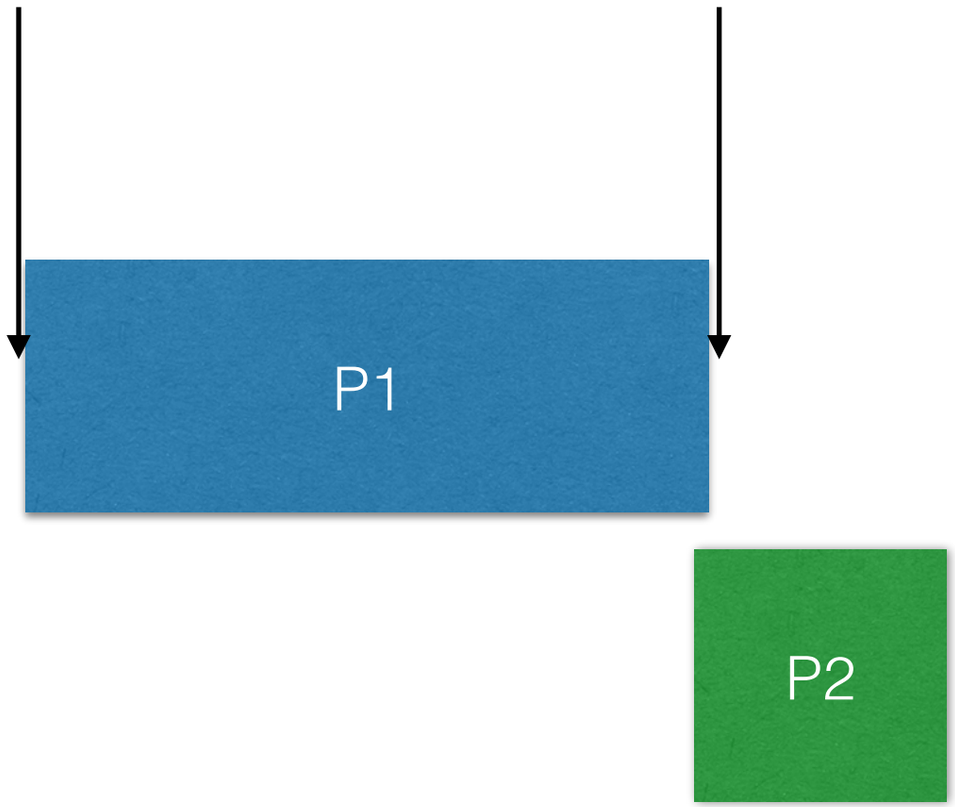
Arrived at t1 Completed at t2



Turnaround time (P1) = t2-t1

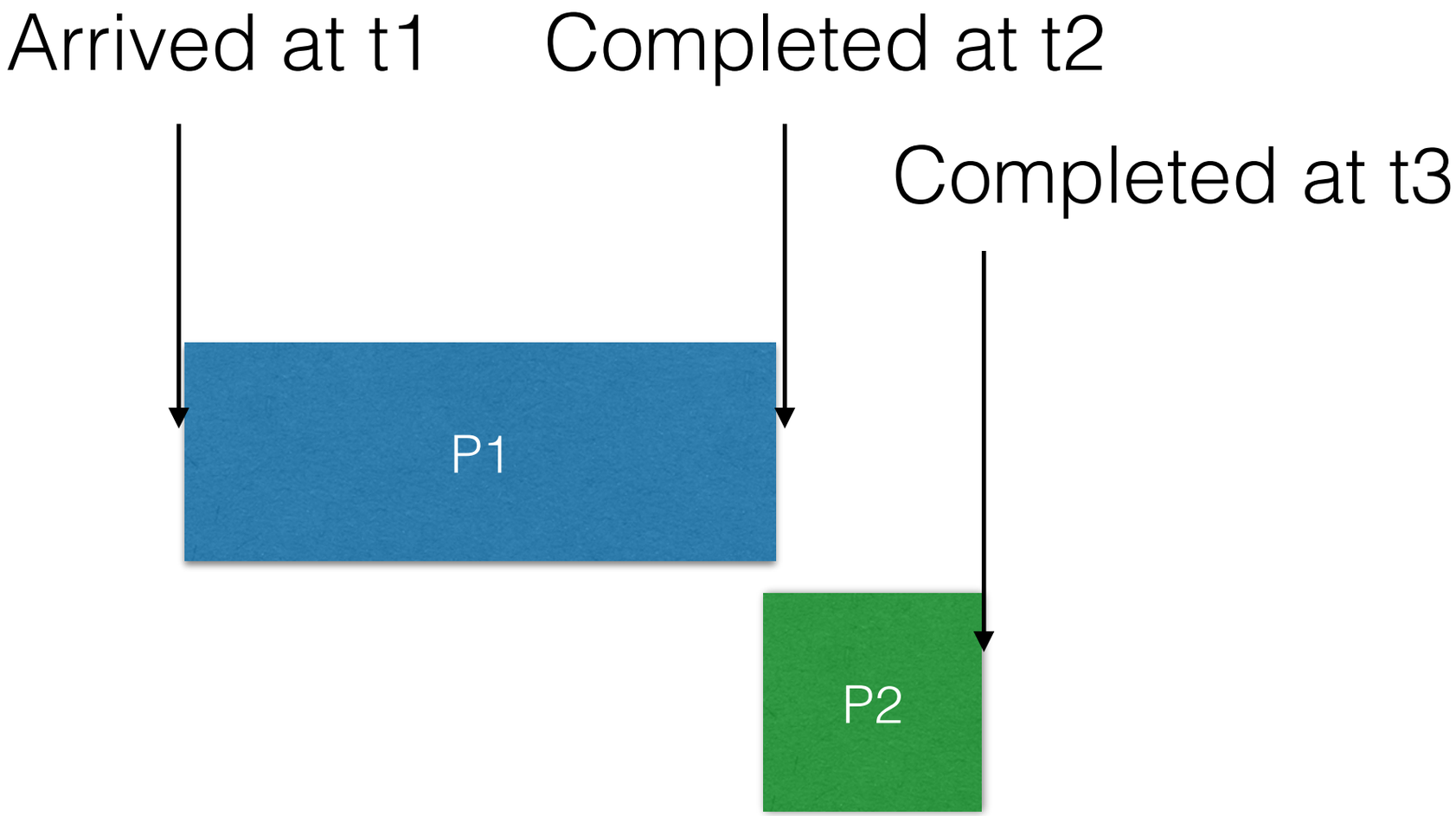
Scheduling Metrics

Arrived at t1 Completed at t2



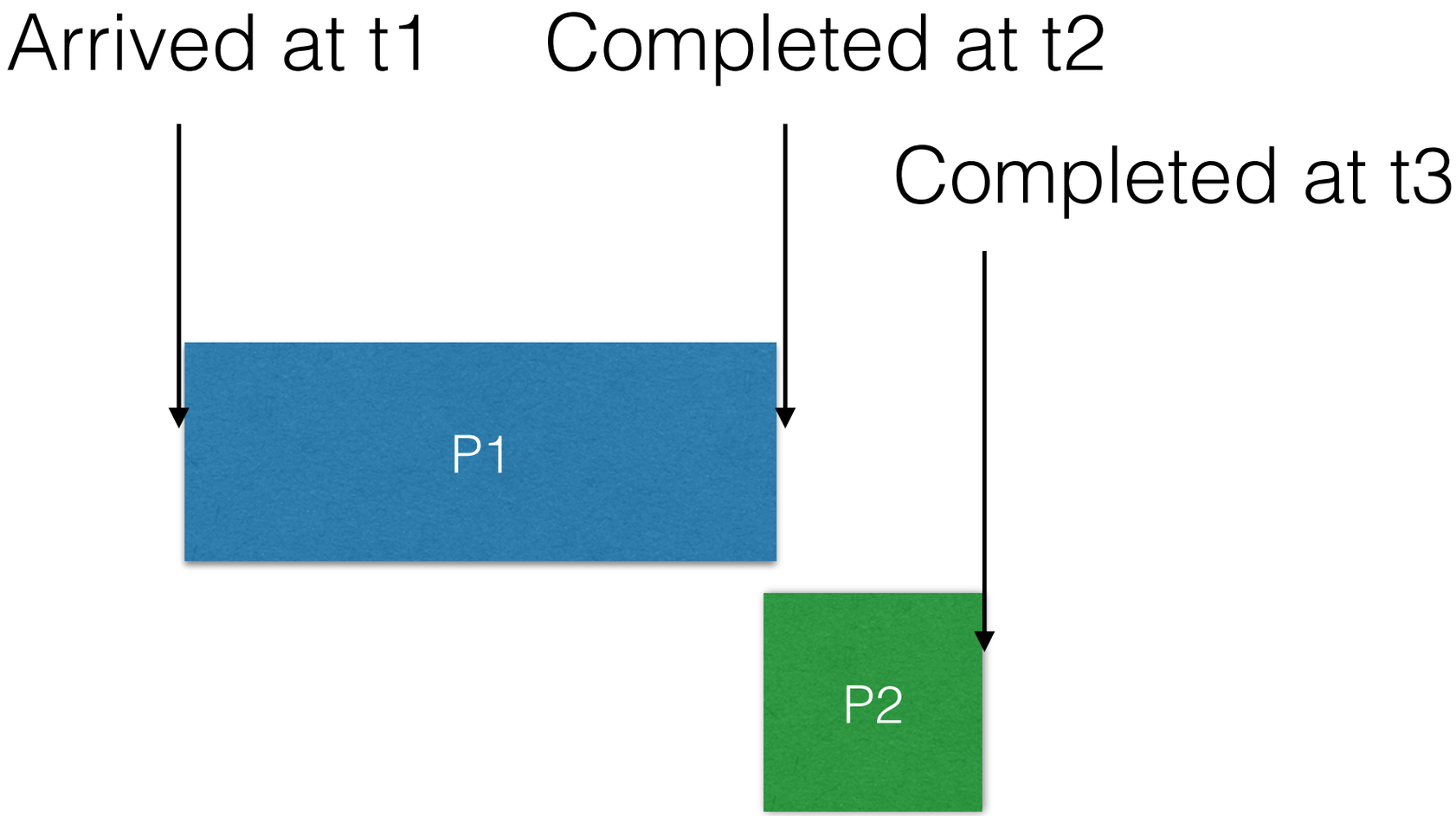
Turnaround time (P1) = t2-t1

Scheduling Metrics



Turnaround time (P1) = t2-t1

Scheduling Metrics



Turnaround time (P1) = t2-t1

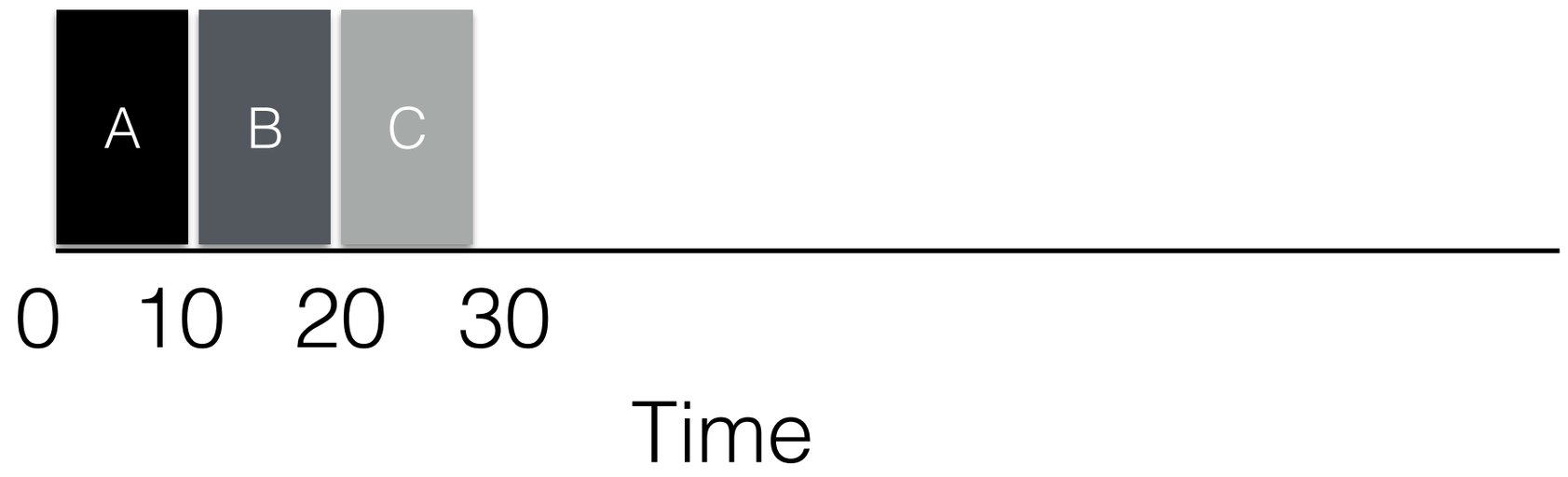
Turnaround time (P2) = t3-t1

FIFO scheduling

A, B and C come at T= 0, 0 + Delta, 0 +2 Delta

FIFO scheduling

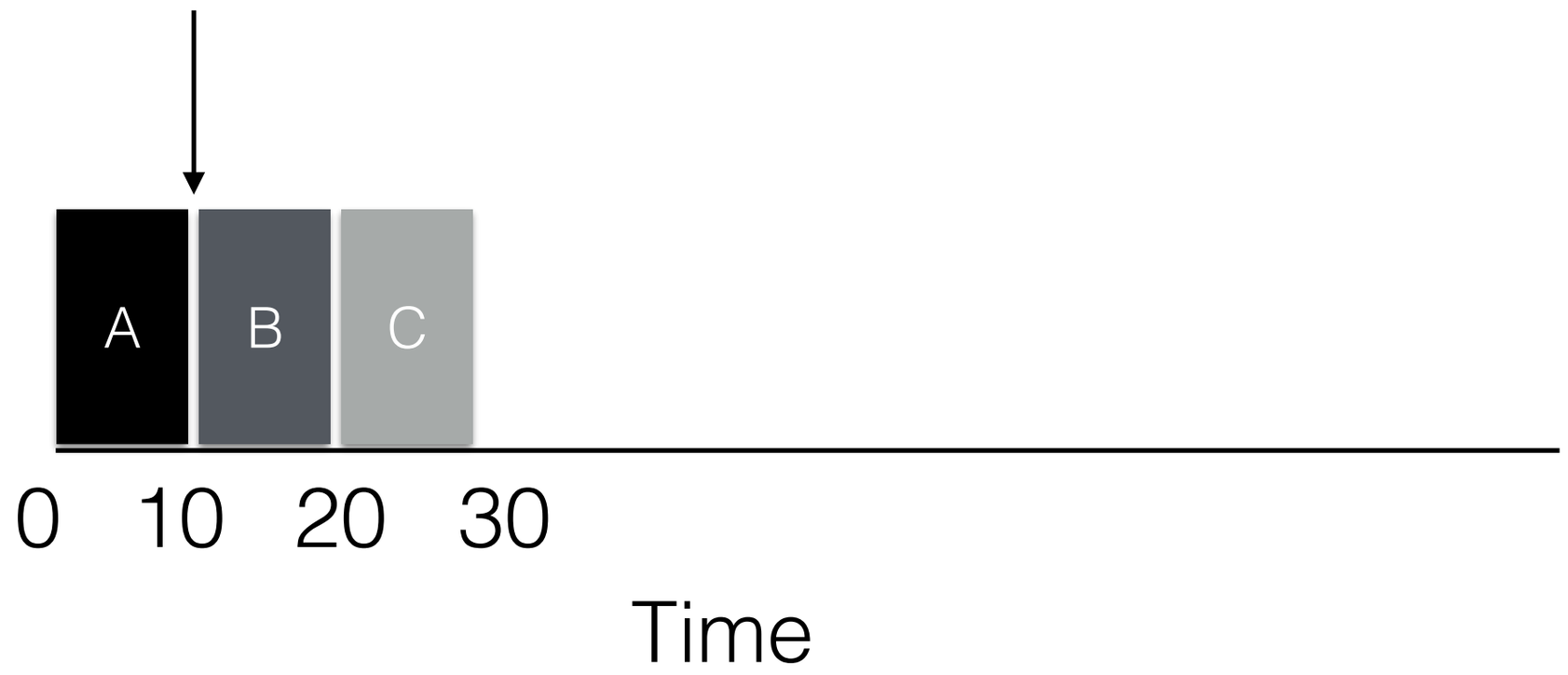
A, B and C come at T= 0, 0 + Delta, 0 +2 Delta



FIFO scheduling

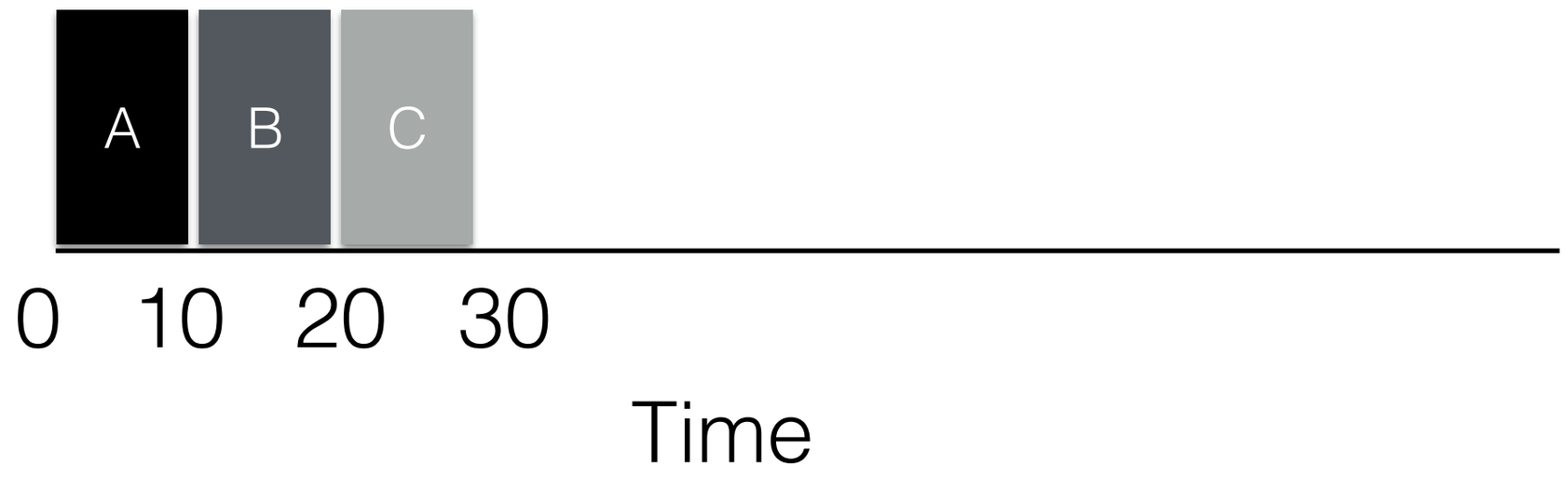
A, B and C come at T= 0, 0 + Delta, 0 +2 Delta

- $T_{completion}(A) = 10$
- Turnaround(A) = 10-0=0



FIFO scheduling

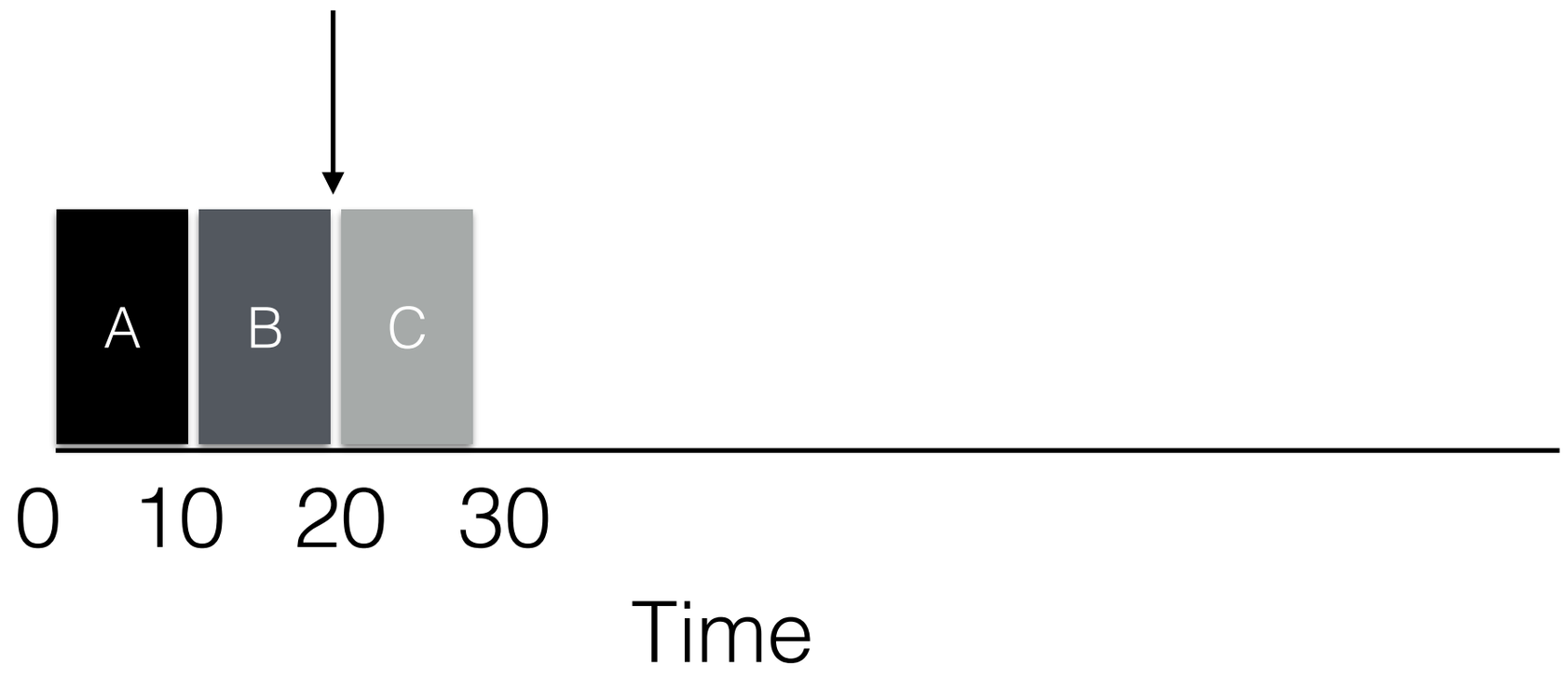
A, B and C come at T= 0, 0 + Delta, 0 +2 Delta



FIFO scheduling

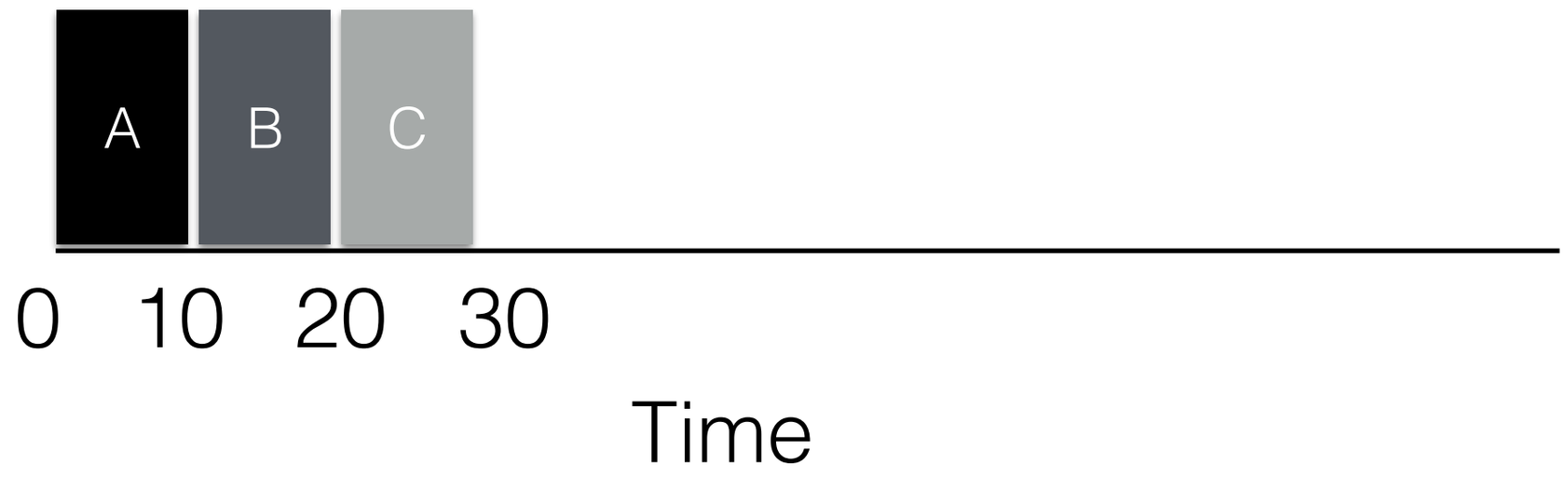
A, B and C come at T= 0, 0 + Delta, 0 +2 Delta

- $T_{completion}(B) = 20$
- Turnaround(B) = 20-0=20



FIFO scheduling

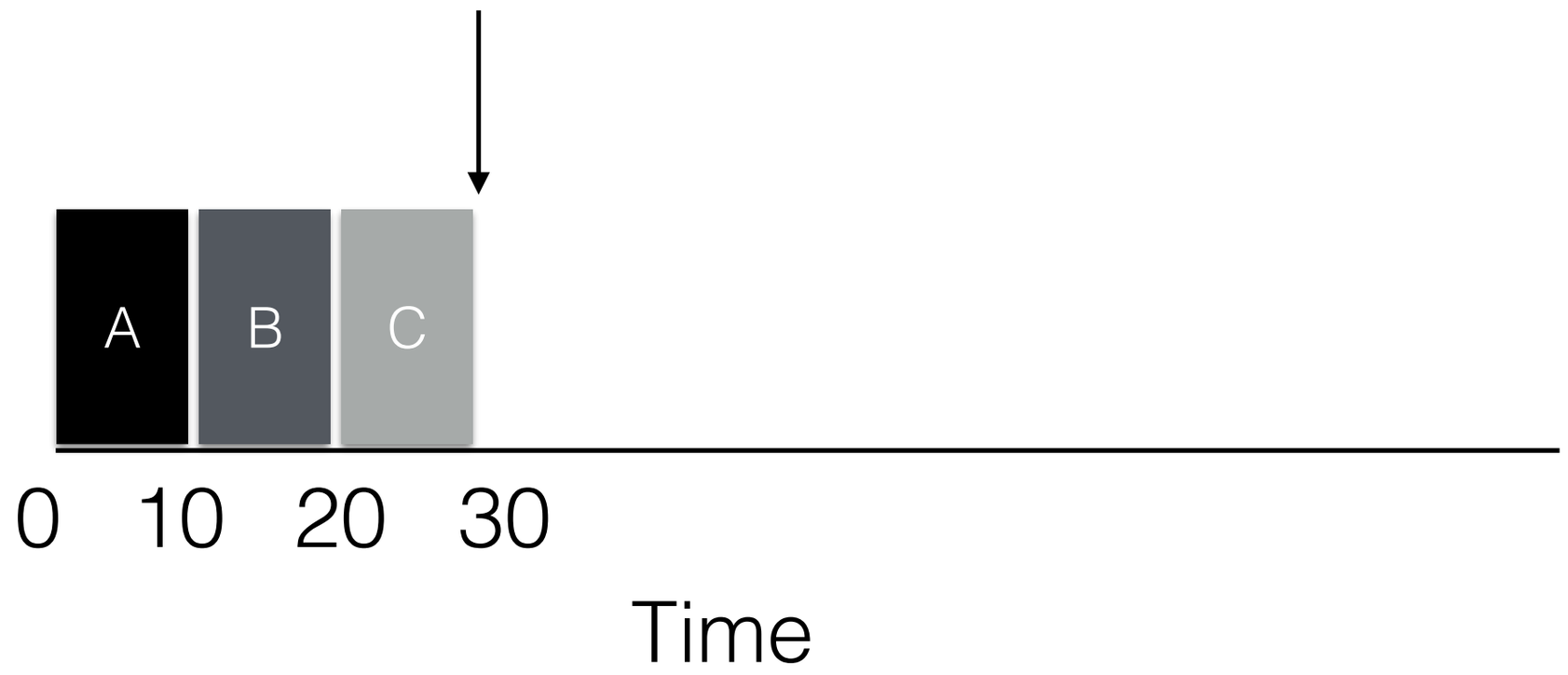
A, B and C come at T= 0, 0 + Delta, 0 +2 Delta



FIFO scheduling

A, B and C come at T= 0, 0 + Delta, 0 +2 Delta

- $T_{completion}(C) = 30$
- Turnaround(C) = 30-0=30



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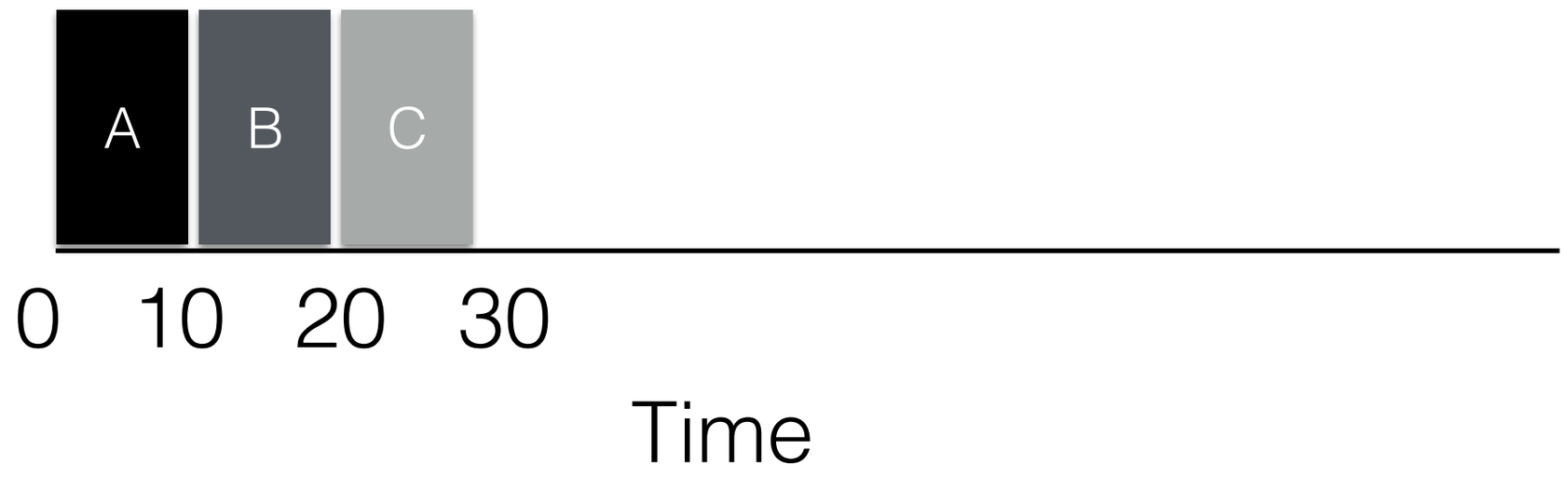
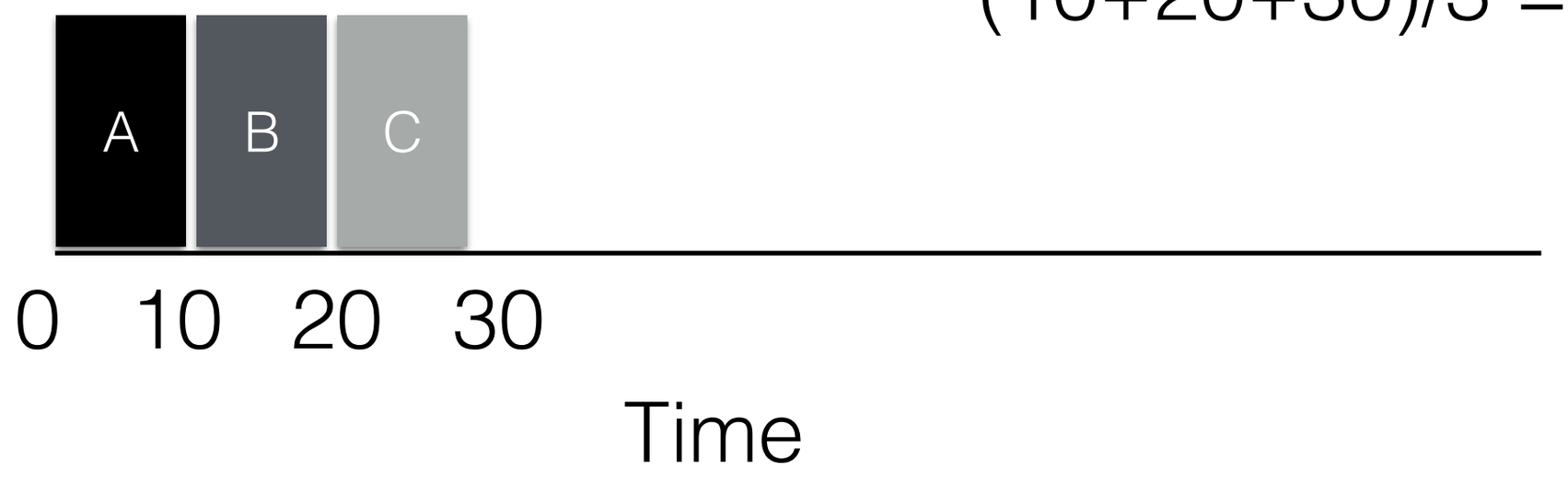
A, B and C come at T= 0, 0 + Delta, 0 +2 Delta



FIFO scheduling

A, B and C come at T= 0, 0 + Delta, 0 +2 Delta

Avg. Turnaround Time =
(10+20+30)/3 = 20



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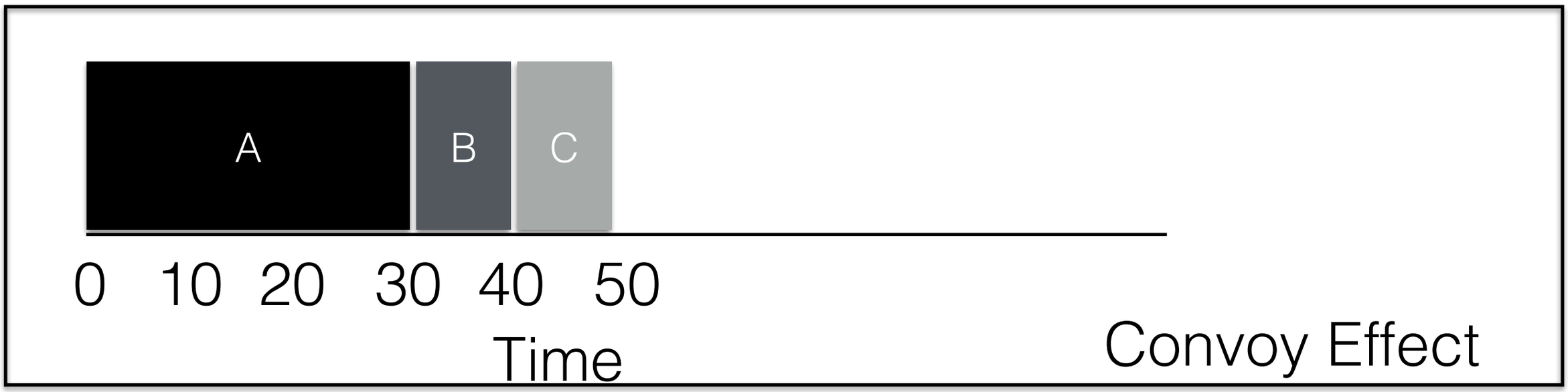

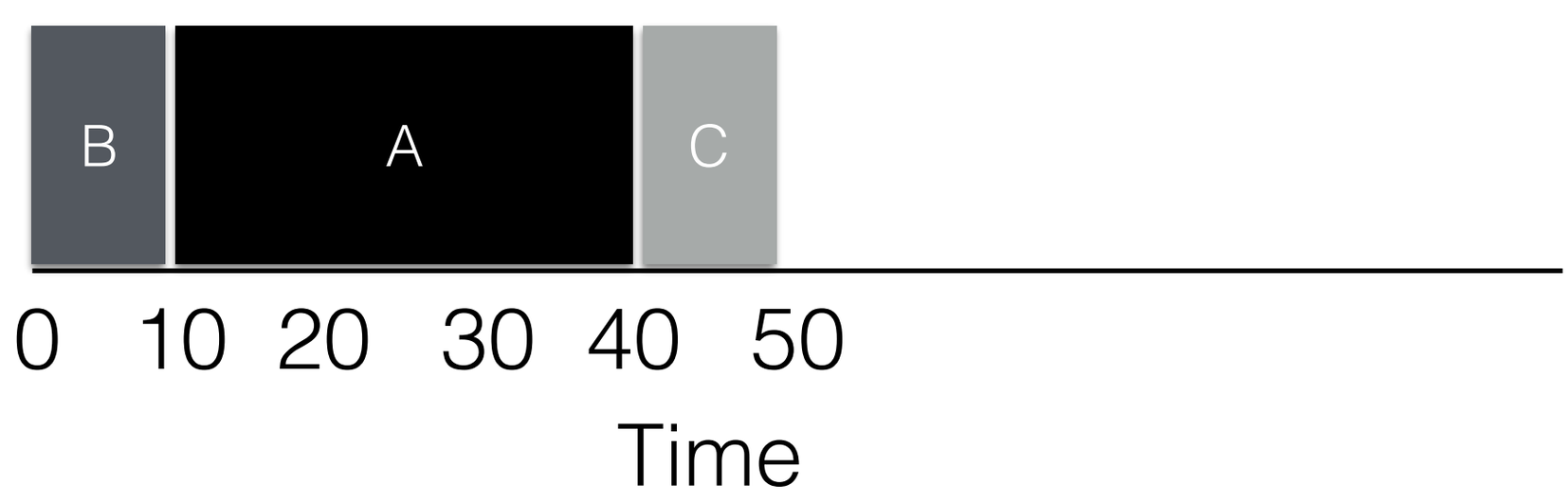

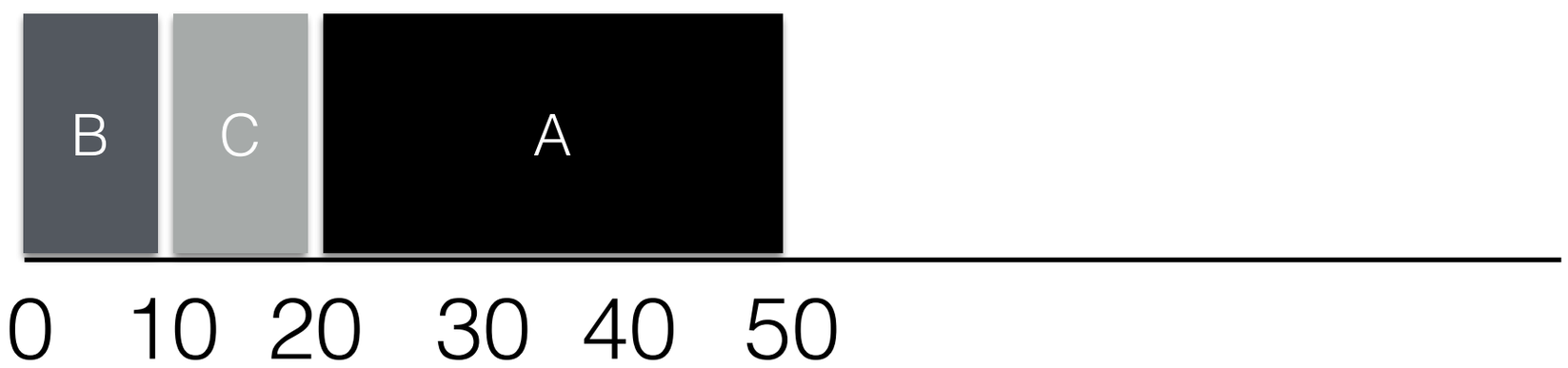

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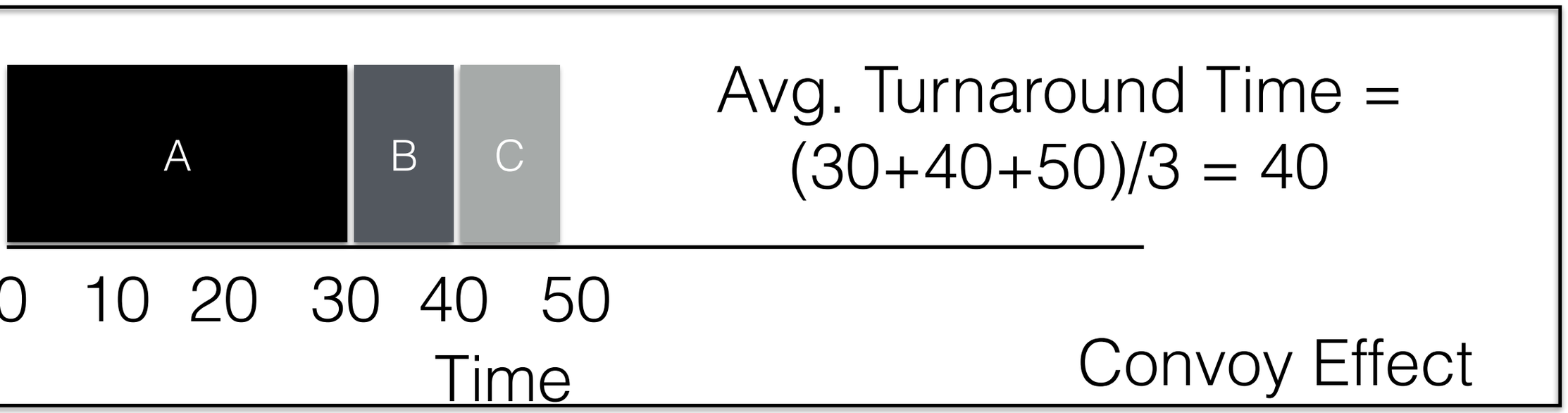

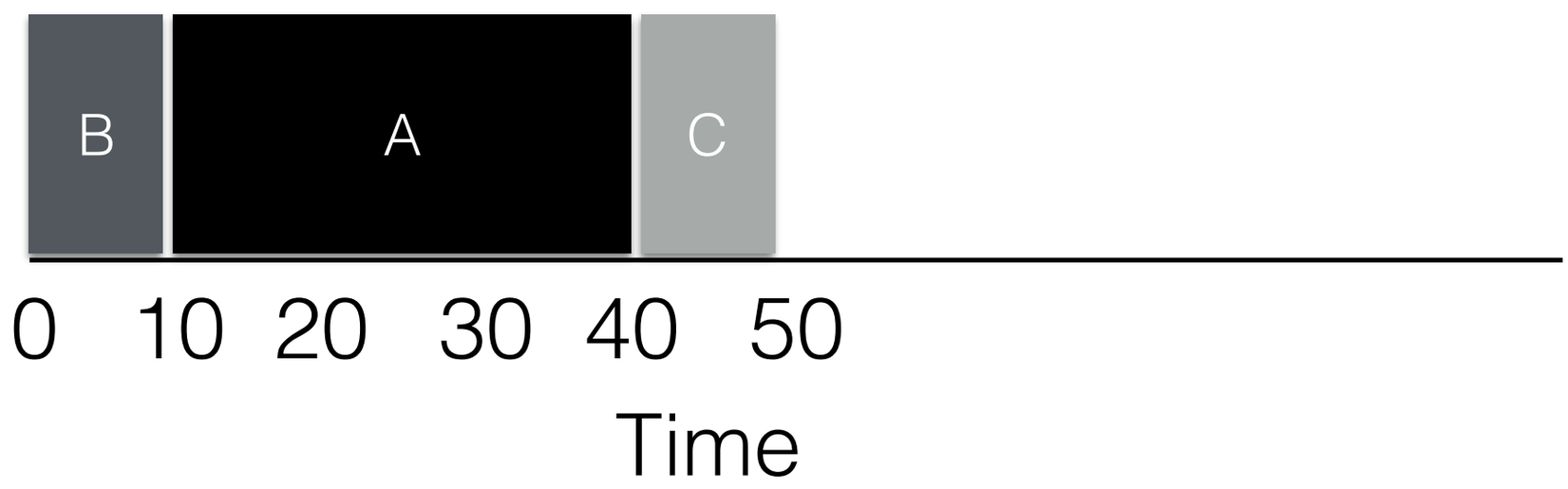

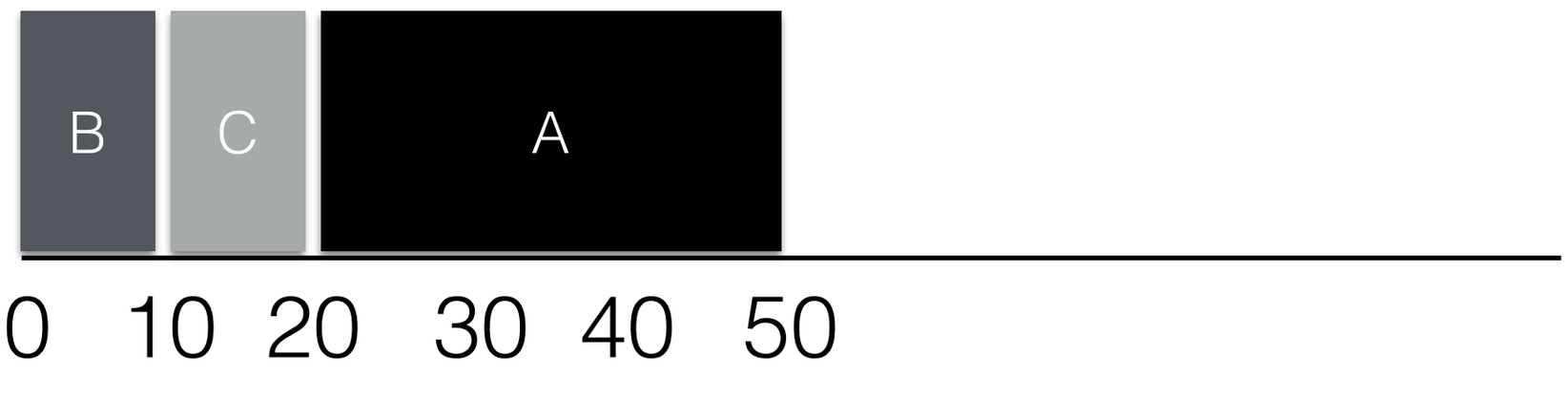

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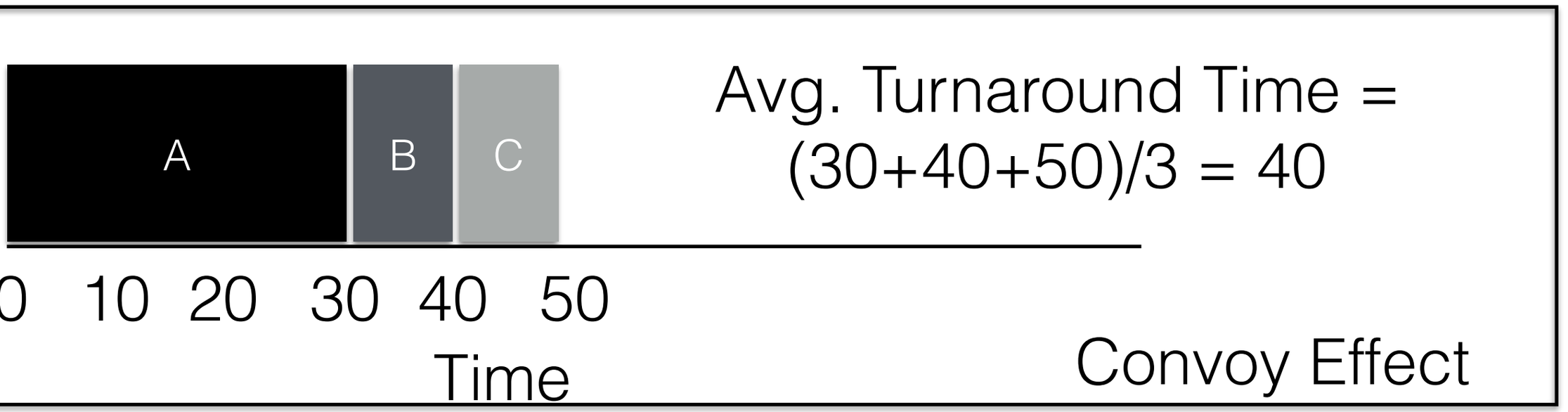
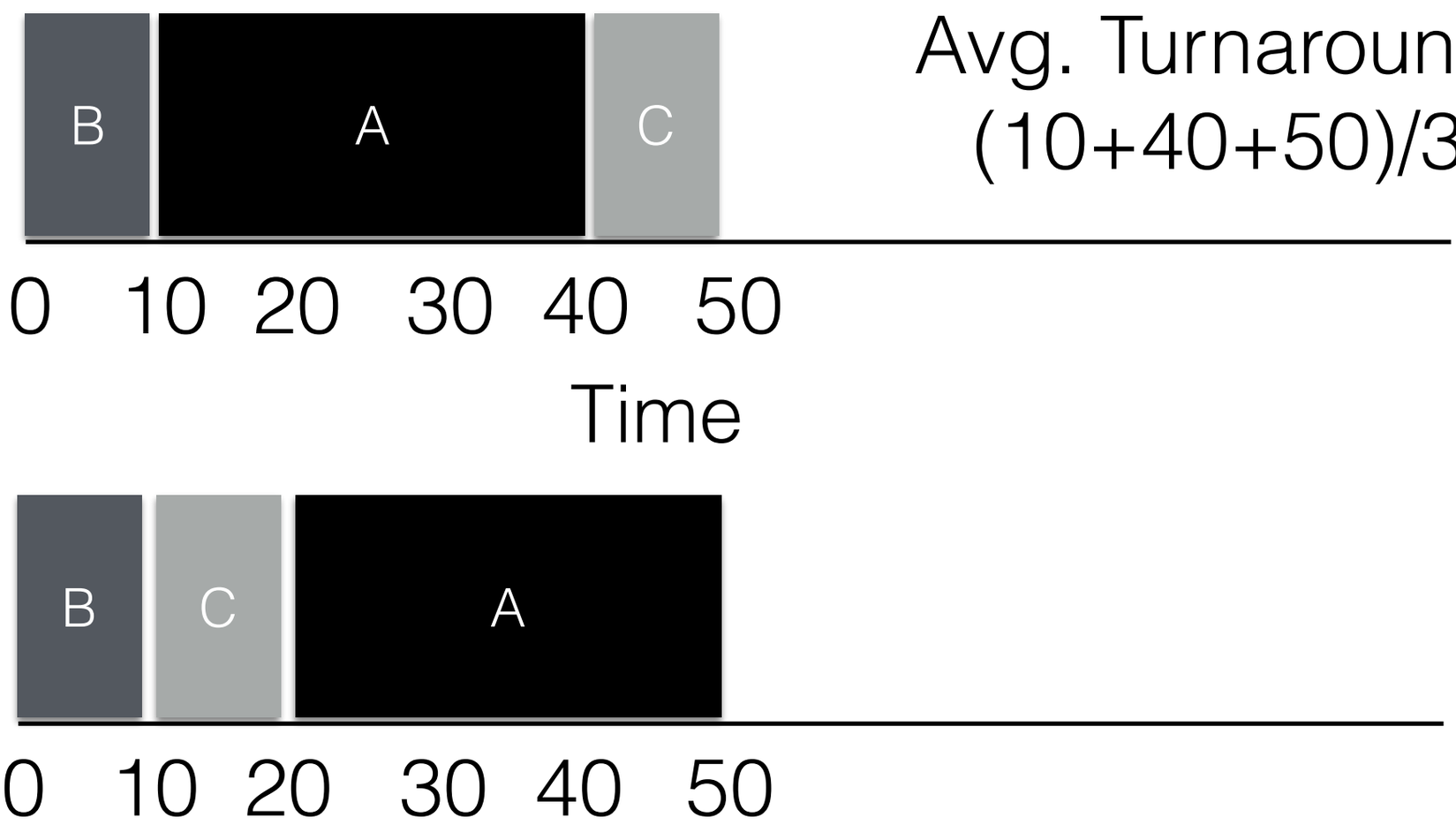
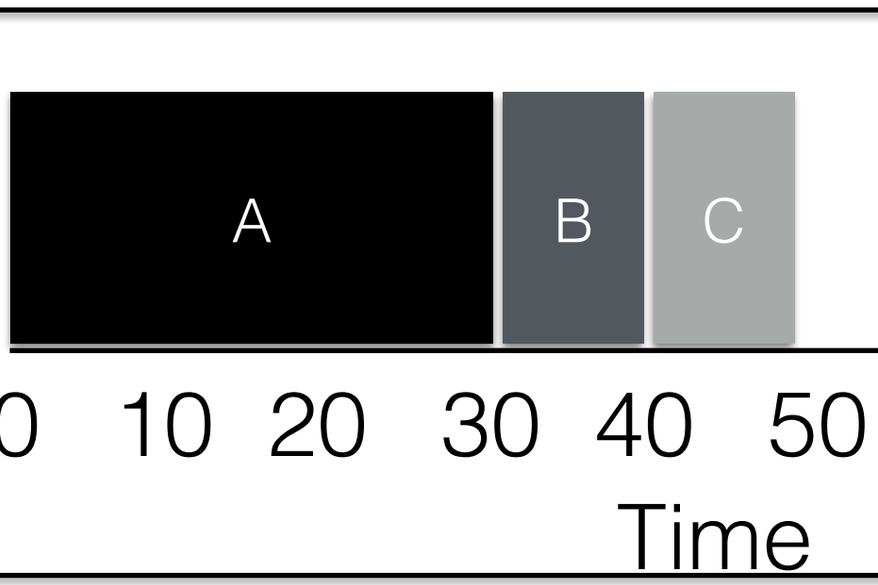


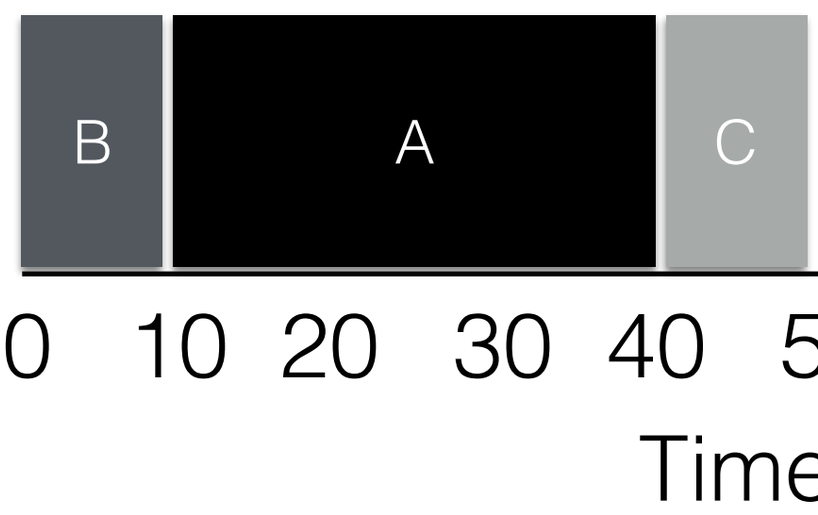


FIFO scheduling



Avg. Turnaround Time =
(30+40+50)/3 = 40

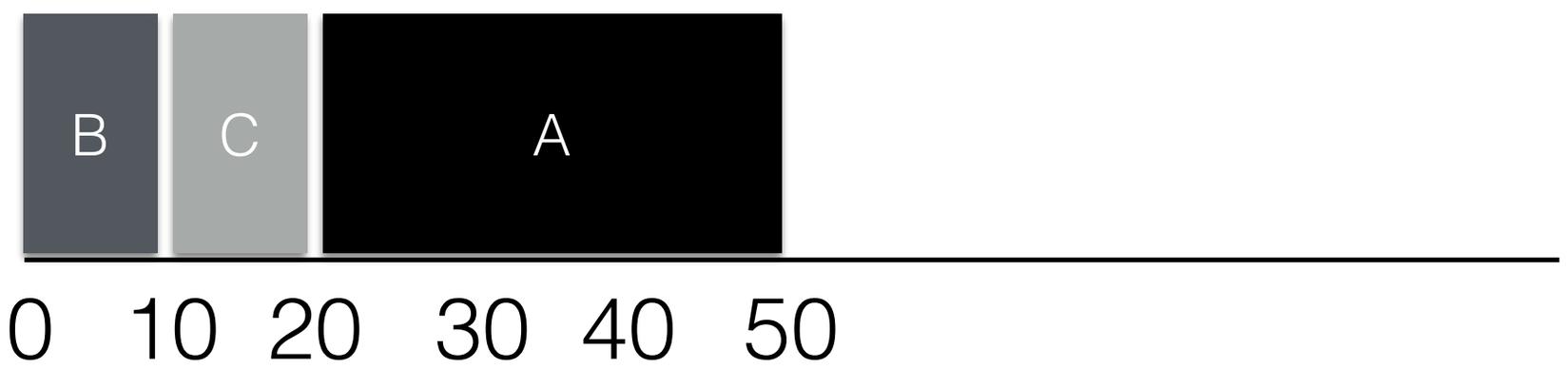
Convoy Effect



Avg. Turnaround Time =
(10+40+50)/3 = 33.3

Avg. Turnaround Time =
(10+20+50)/3 ~27

Shortest Job First (SJF) scheduling



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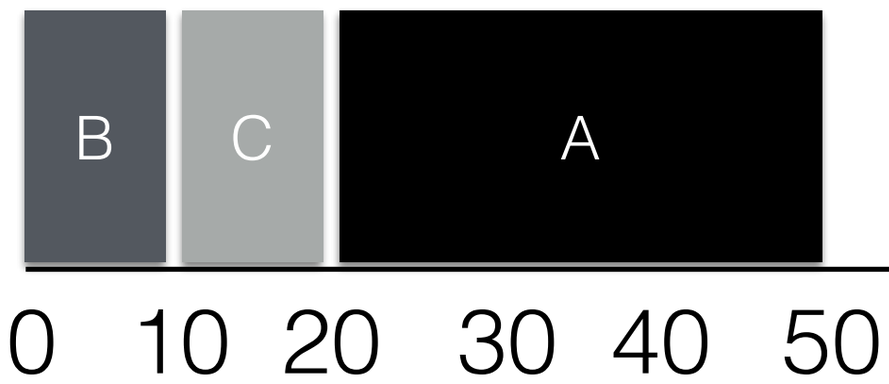

Avg. Turnaround Time =
(10+20+50)/3 ~27

Workload Assumptions

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3. Once started, each job runs to completion
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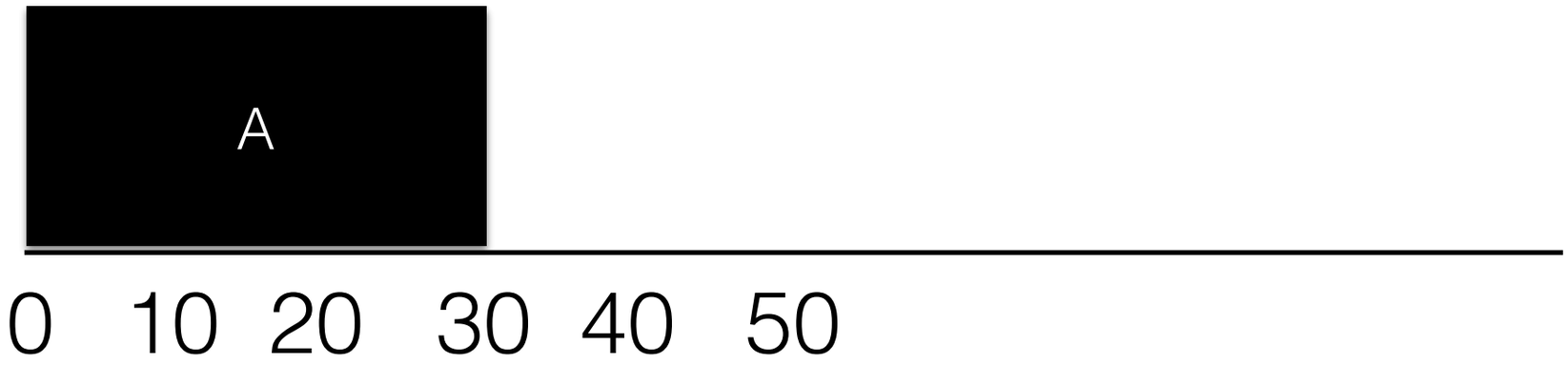

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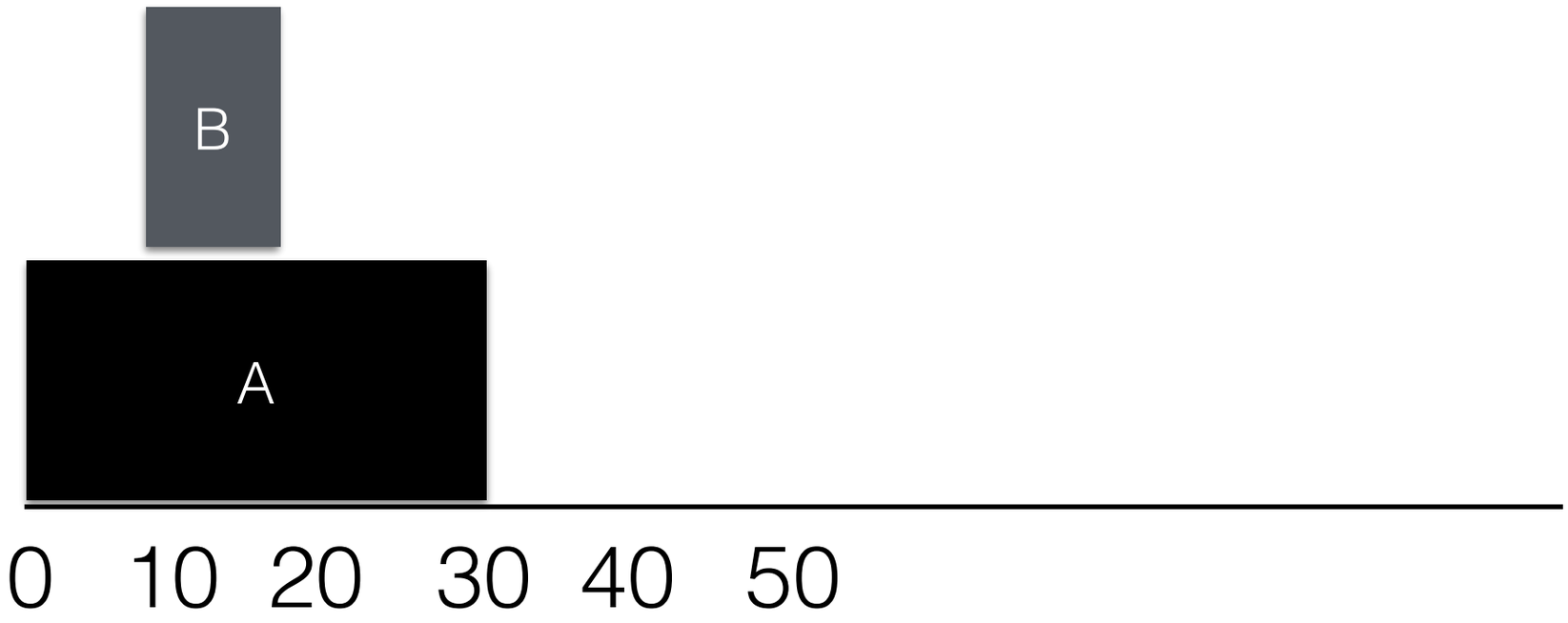

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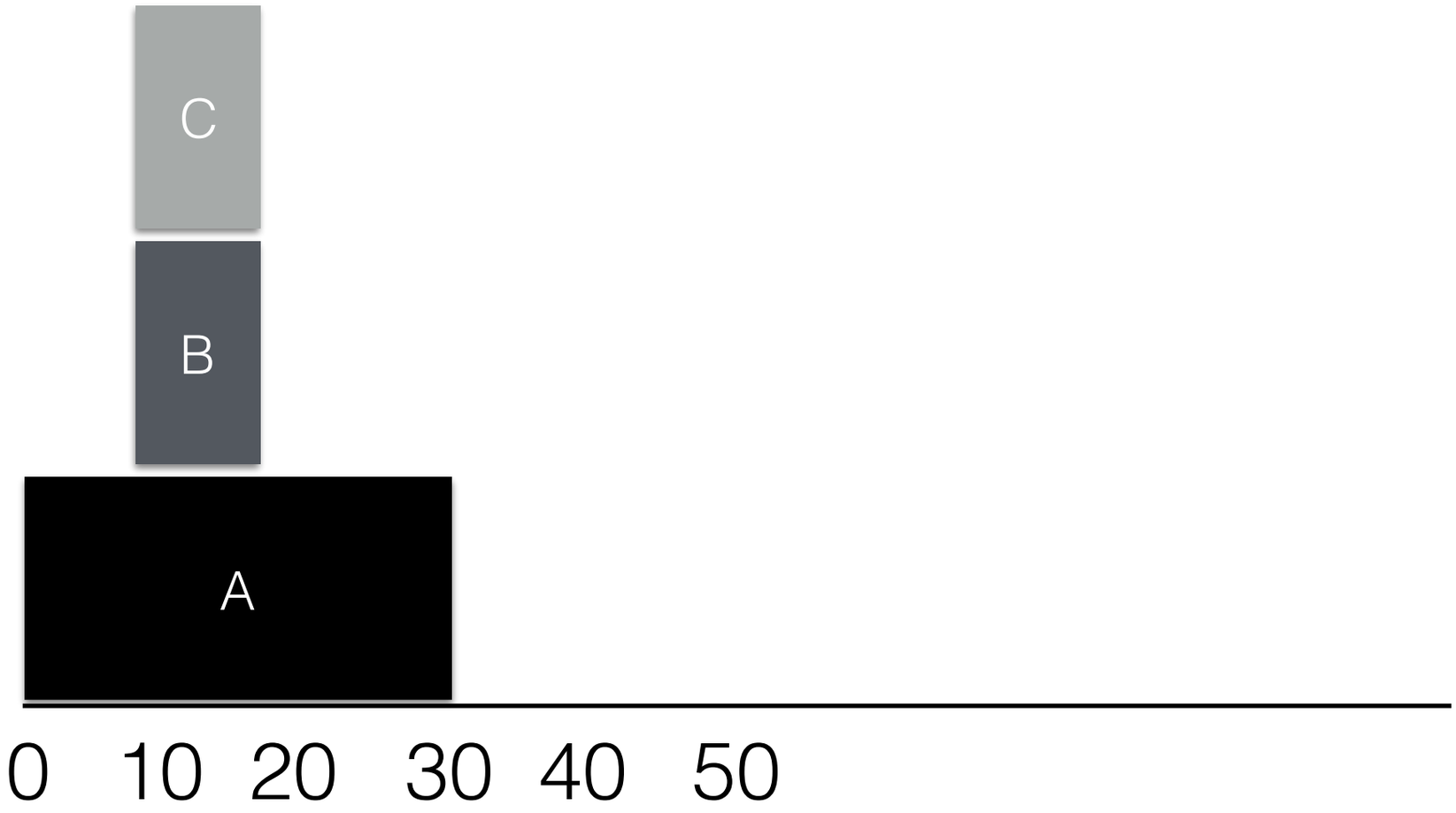

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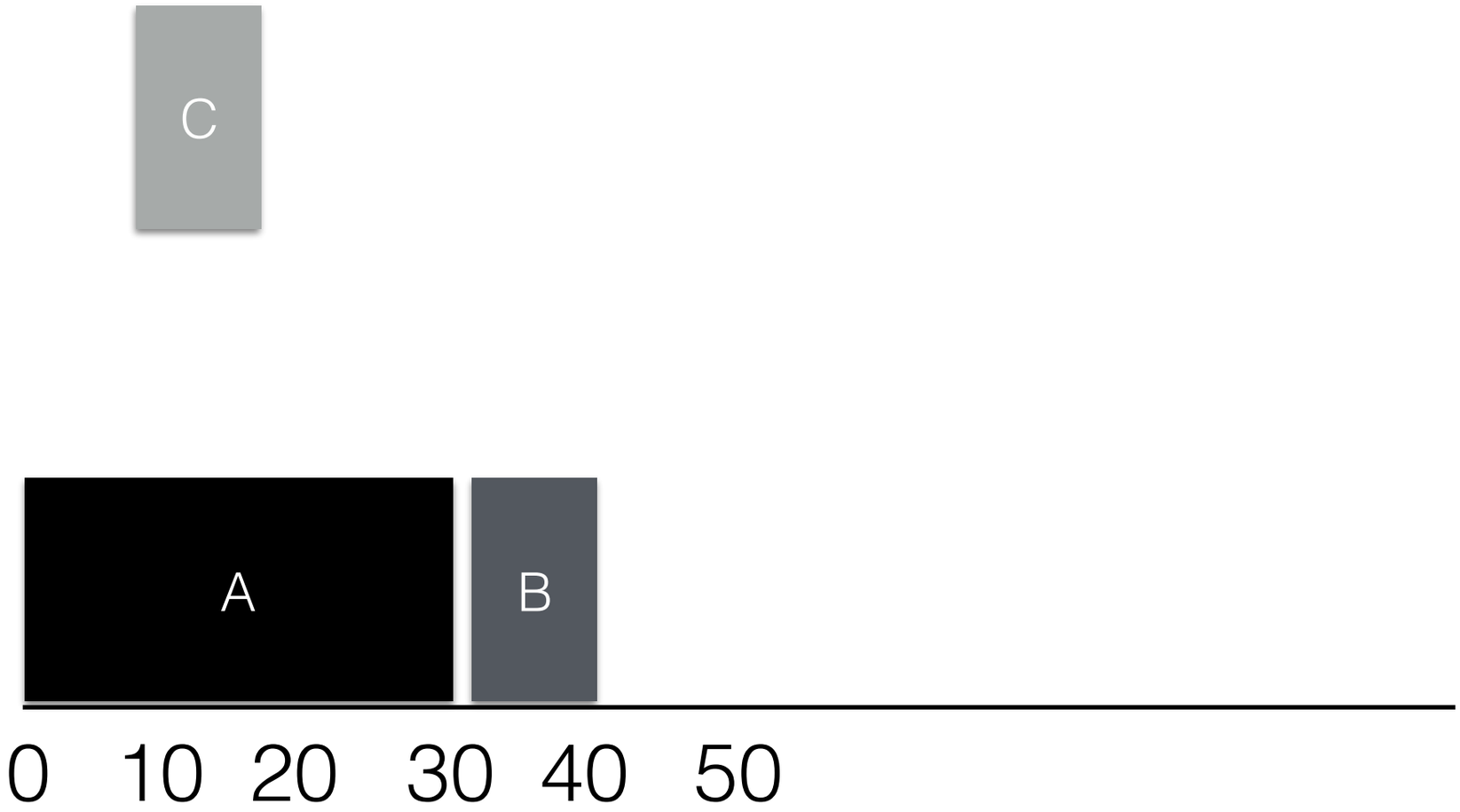

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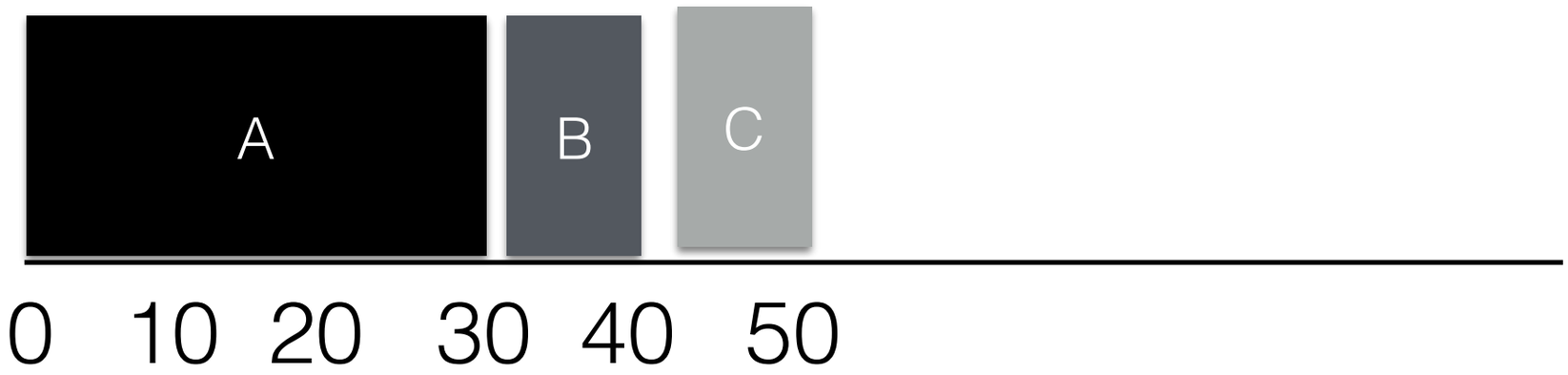

Shortest Job First (SJF) scheduling

Avg. Turnaround Time =
(30+(40-10)+(50-10))/3 ~33

Workload Assumptions

1. ~~Each job runs for the same time~~
2. ~~All jobs arrive at the same time~~
3. Once started, each job runs to completion (Pre-emptible)
4. All jobs use only the CPU
5. Run time of each job is known

Workload Assumptions

1. ~~Each job runs for the same time~~
2. ~~All jobs arrive at the same time~~
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Shortest Time to Completion (SCTF) scheduling

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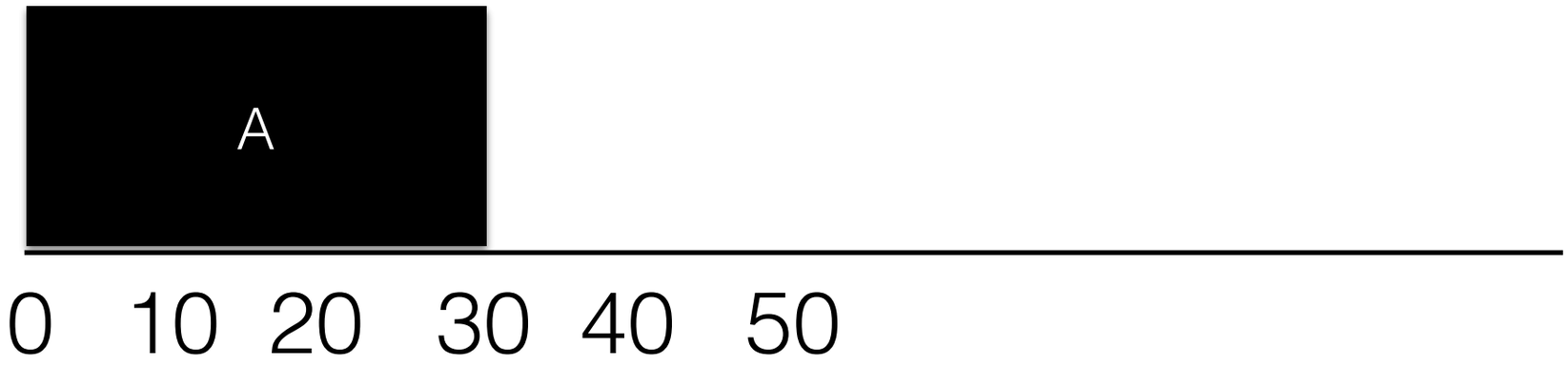
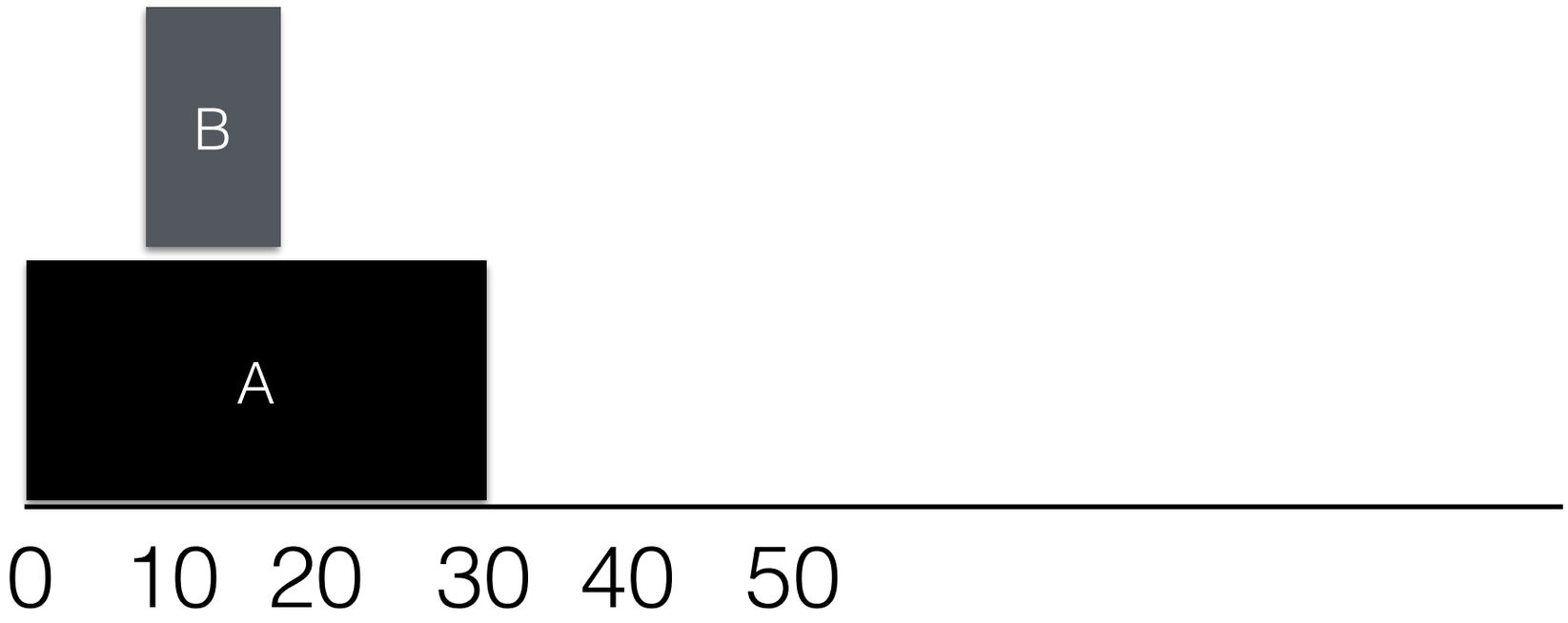
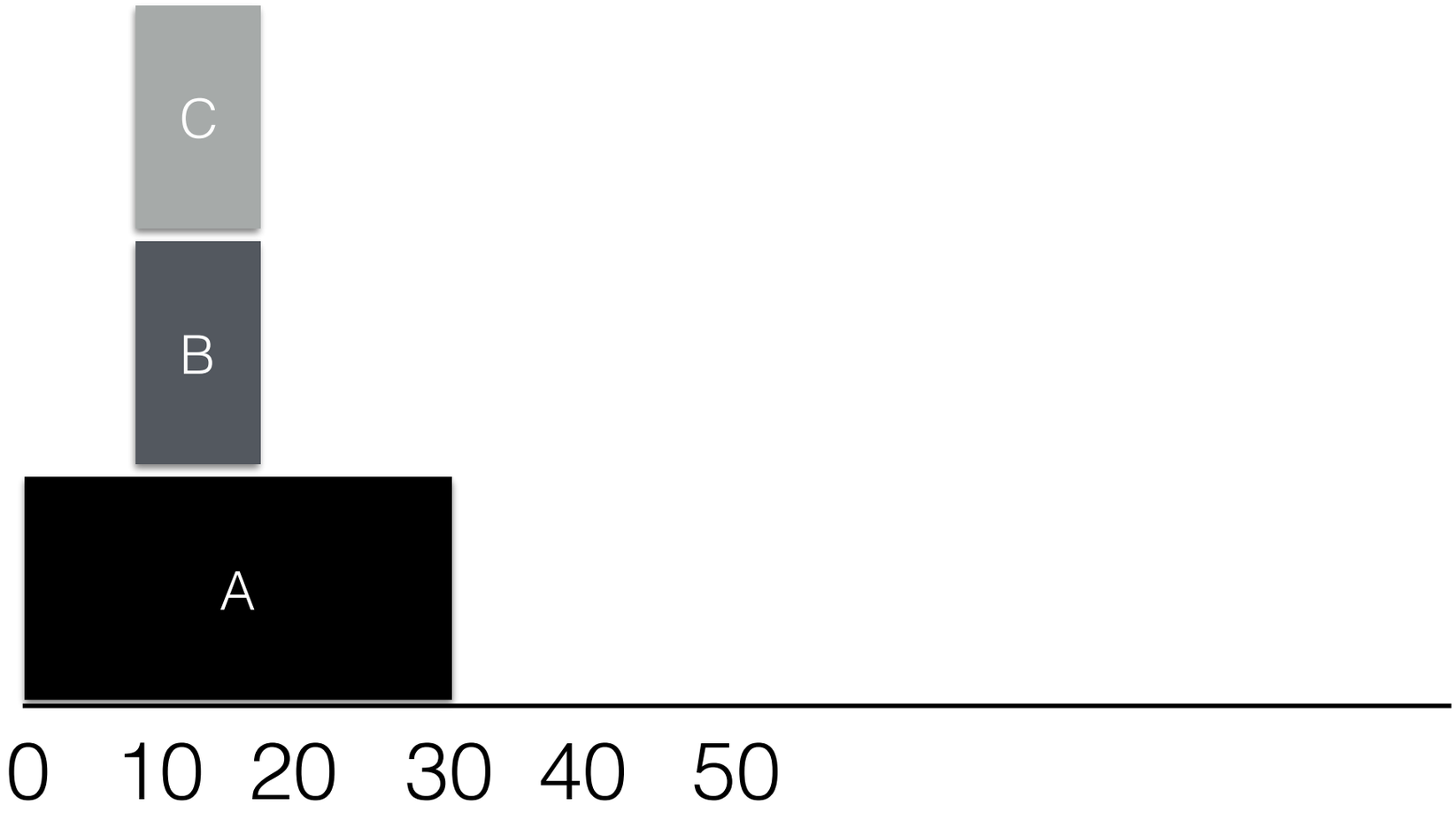


Shortest Time to Completion (SCTF) scheduling



Shortest Time to Completion (SCTF) scheduling



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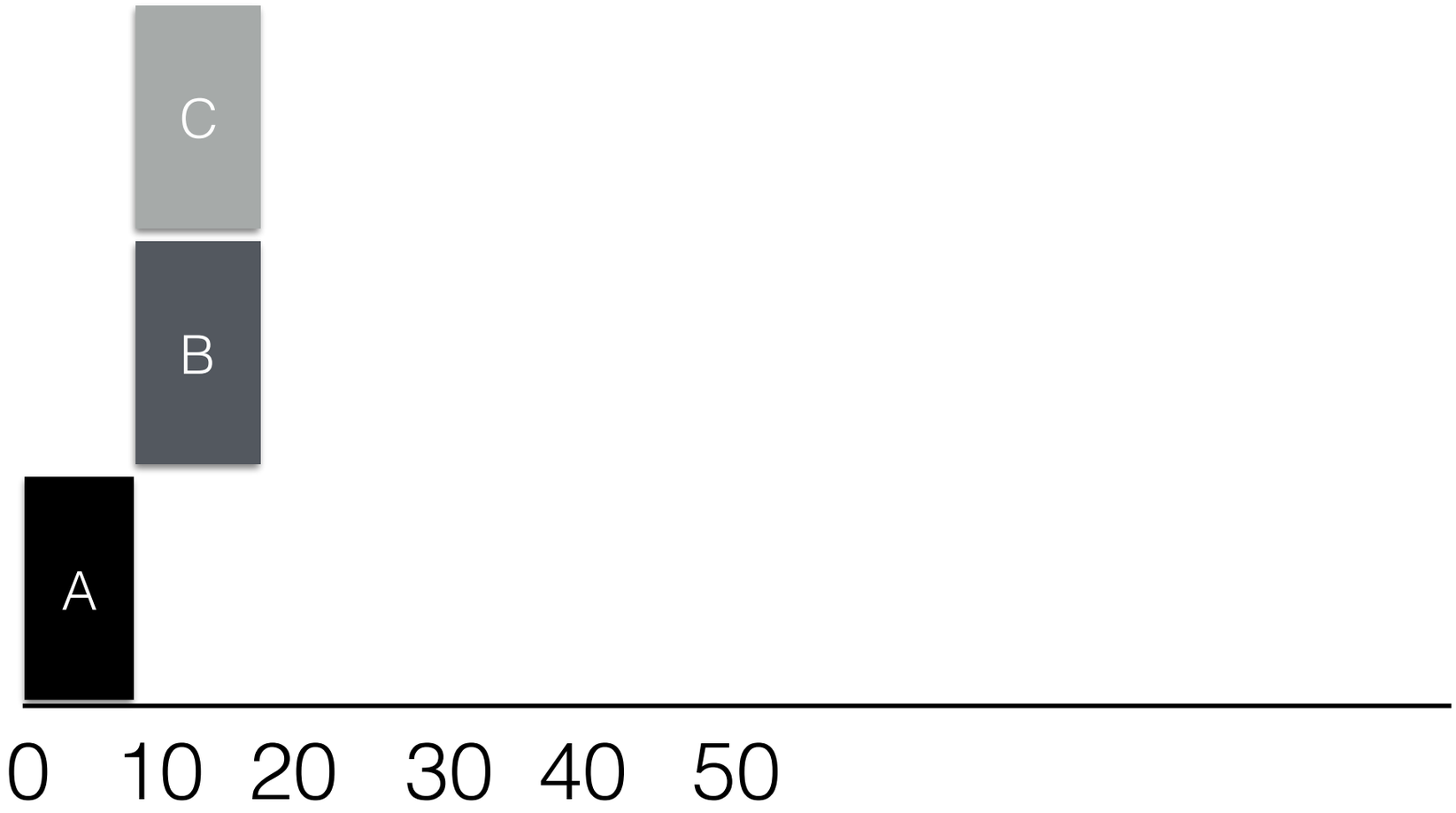
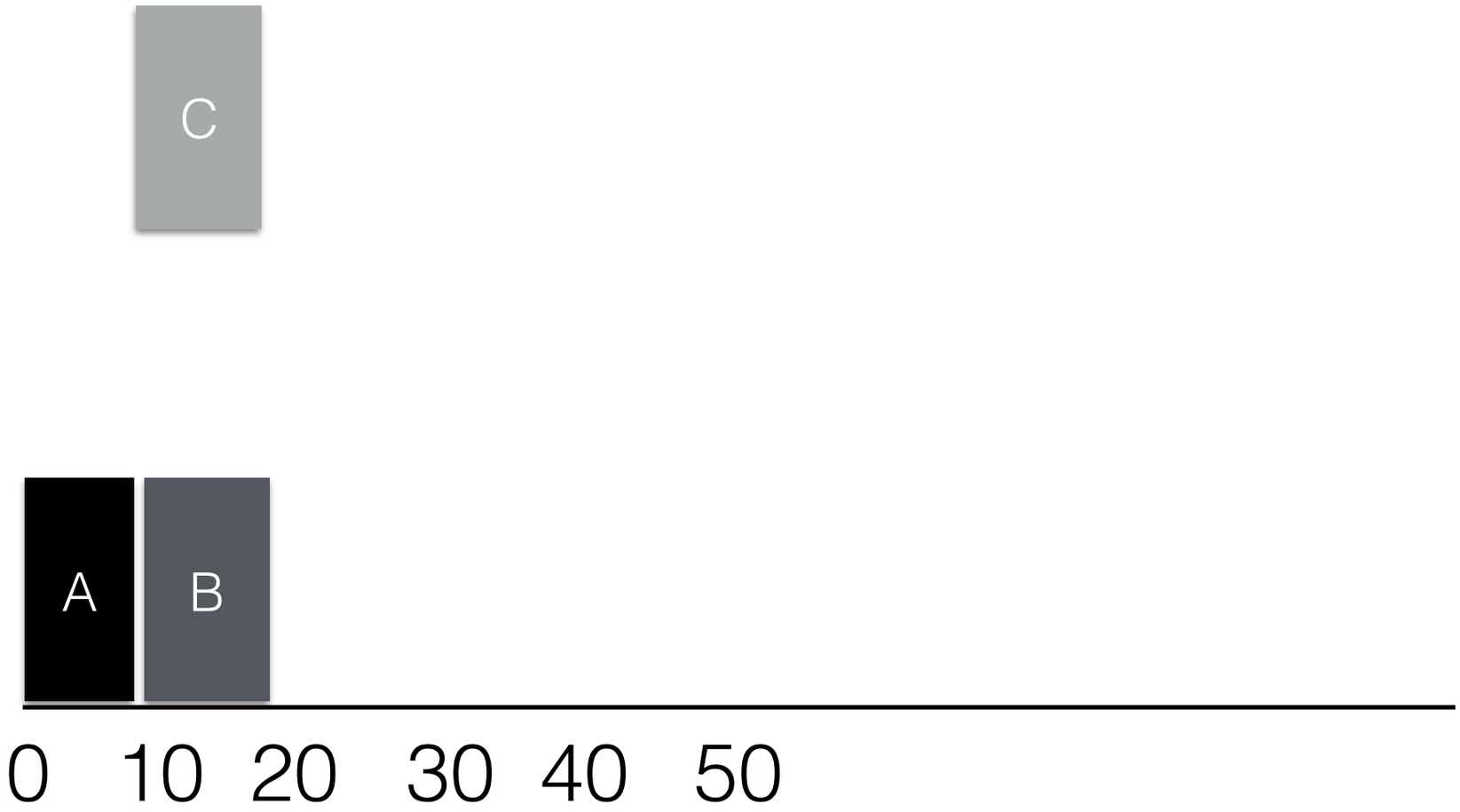
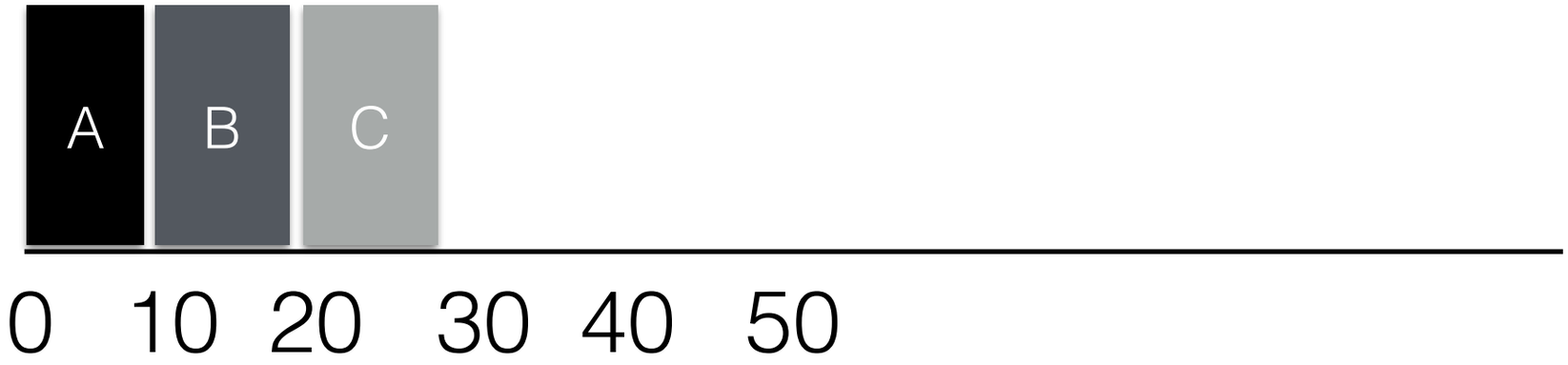


Shortest Time to Completion (SCTF) scheduling



Shortest Time to Completion (SCTF) scheduling



Shortest Time to Completion (SCTF) scheduling

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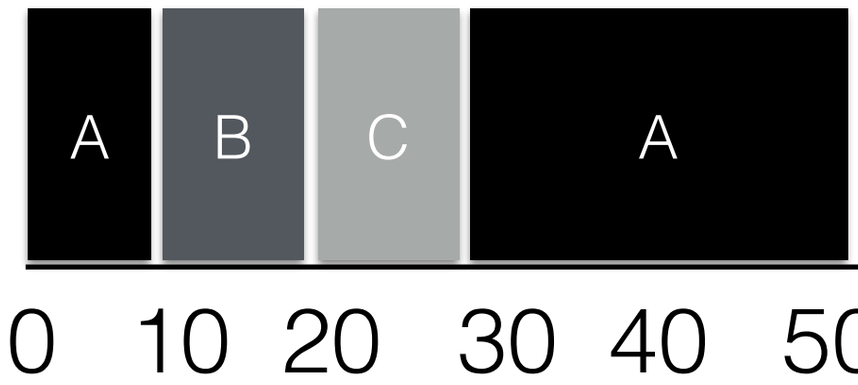
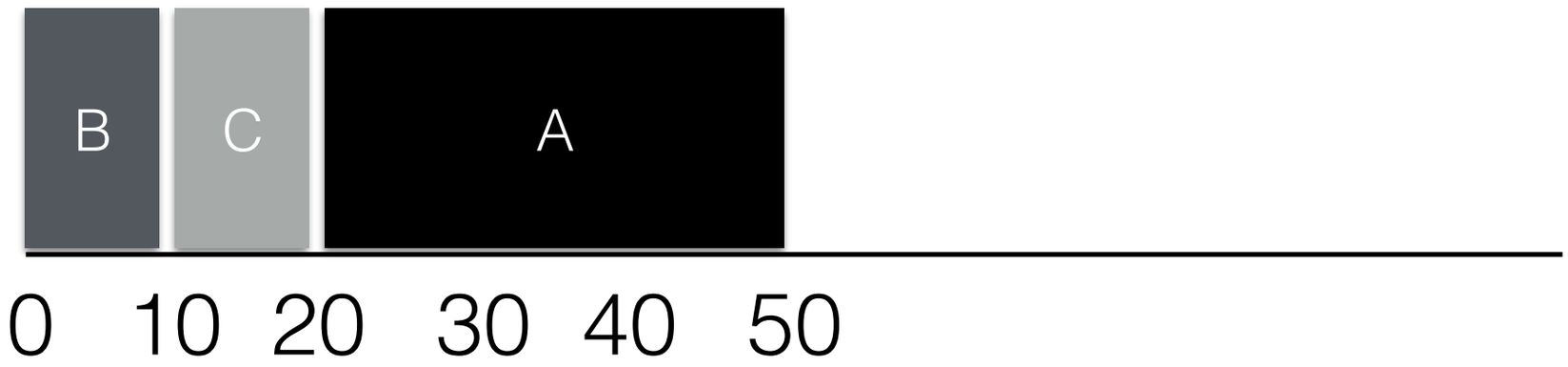


Avg. Turnaround Time = (50+(20-10)+(30-10))/3 ~27

Metric - Response Time



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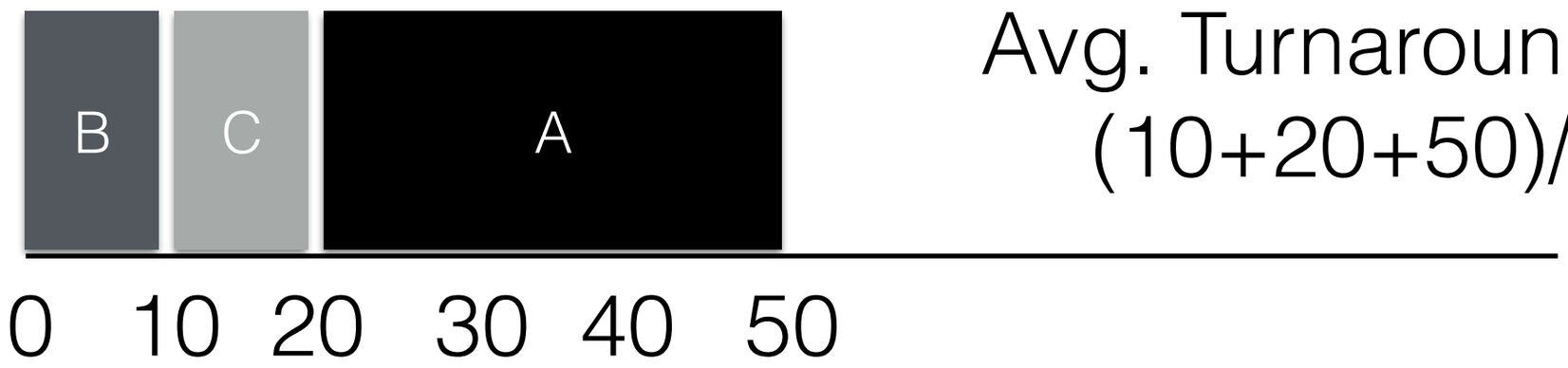
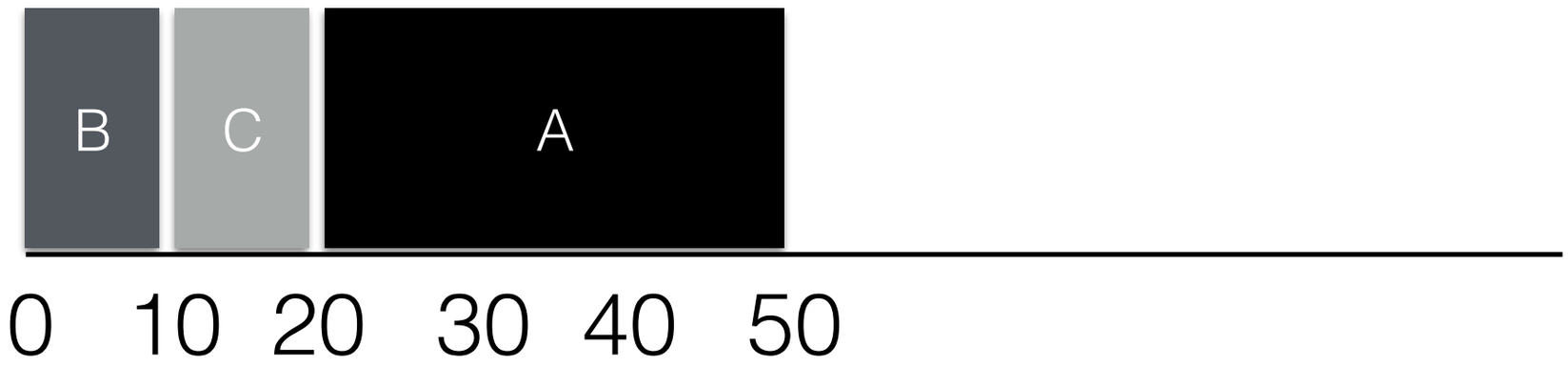
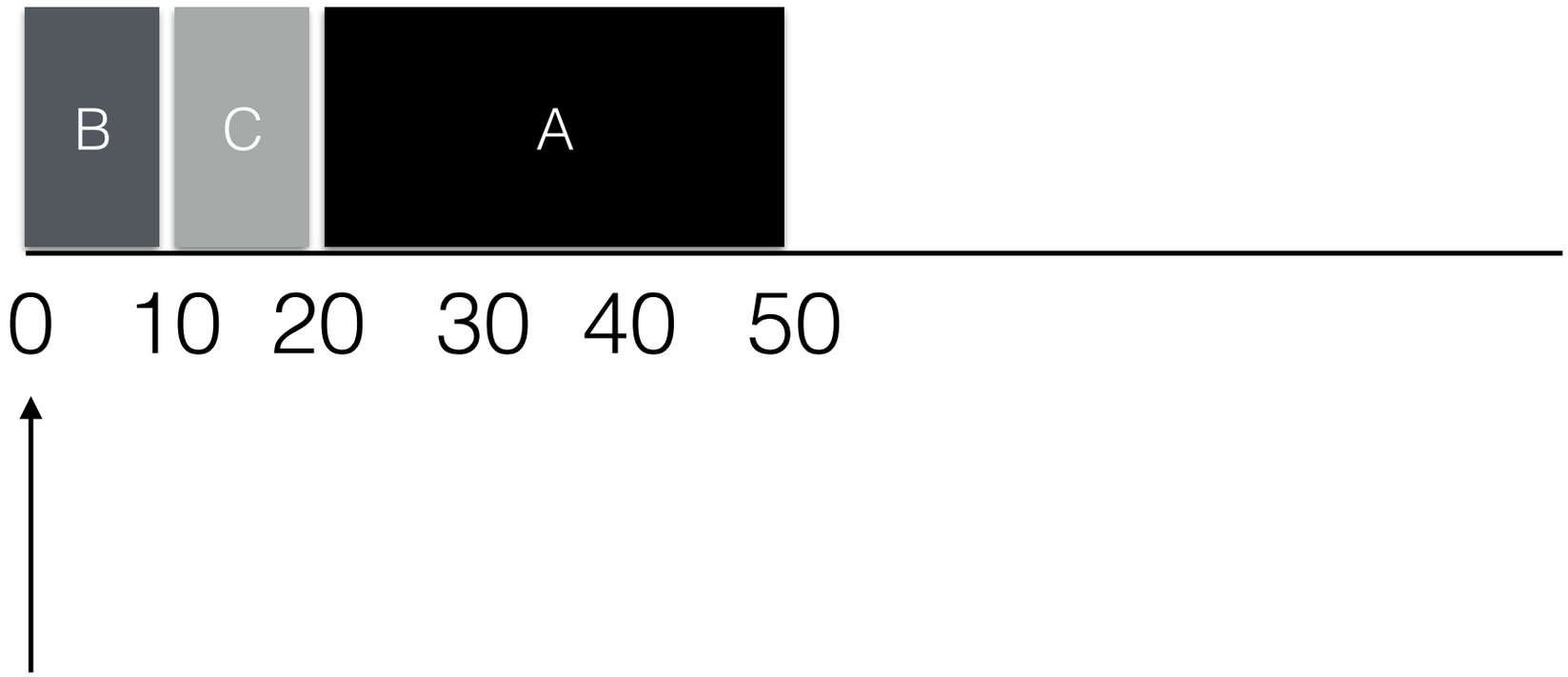


Avg. Turnaround Time =
(10+20+50)/3 ~27

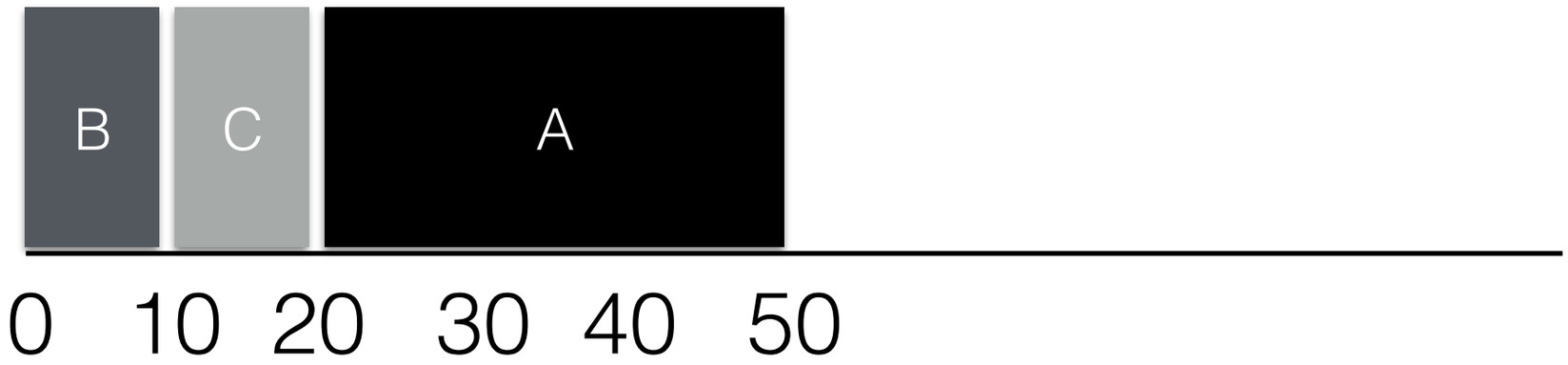
Metric - Response Time



Metric - Response Time

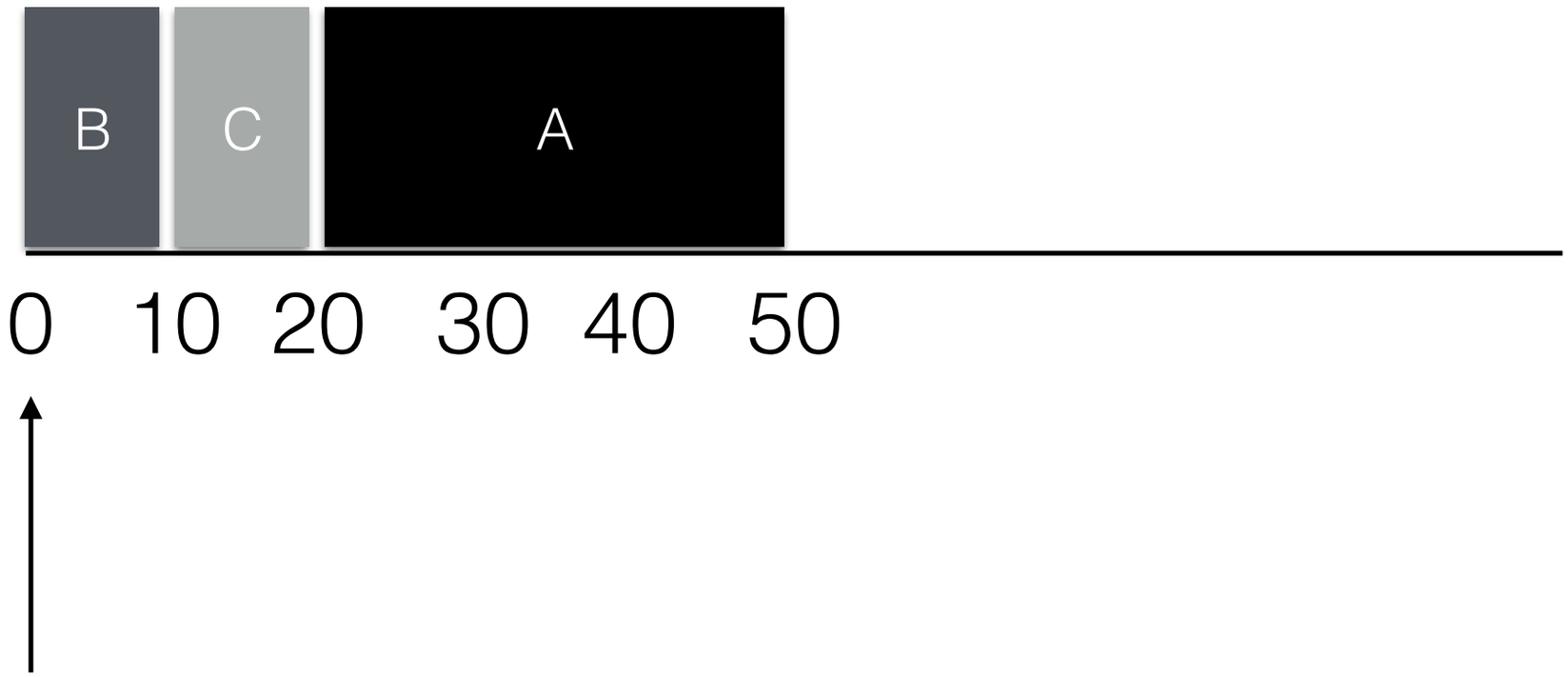


Metric - Response Time



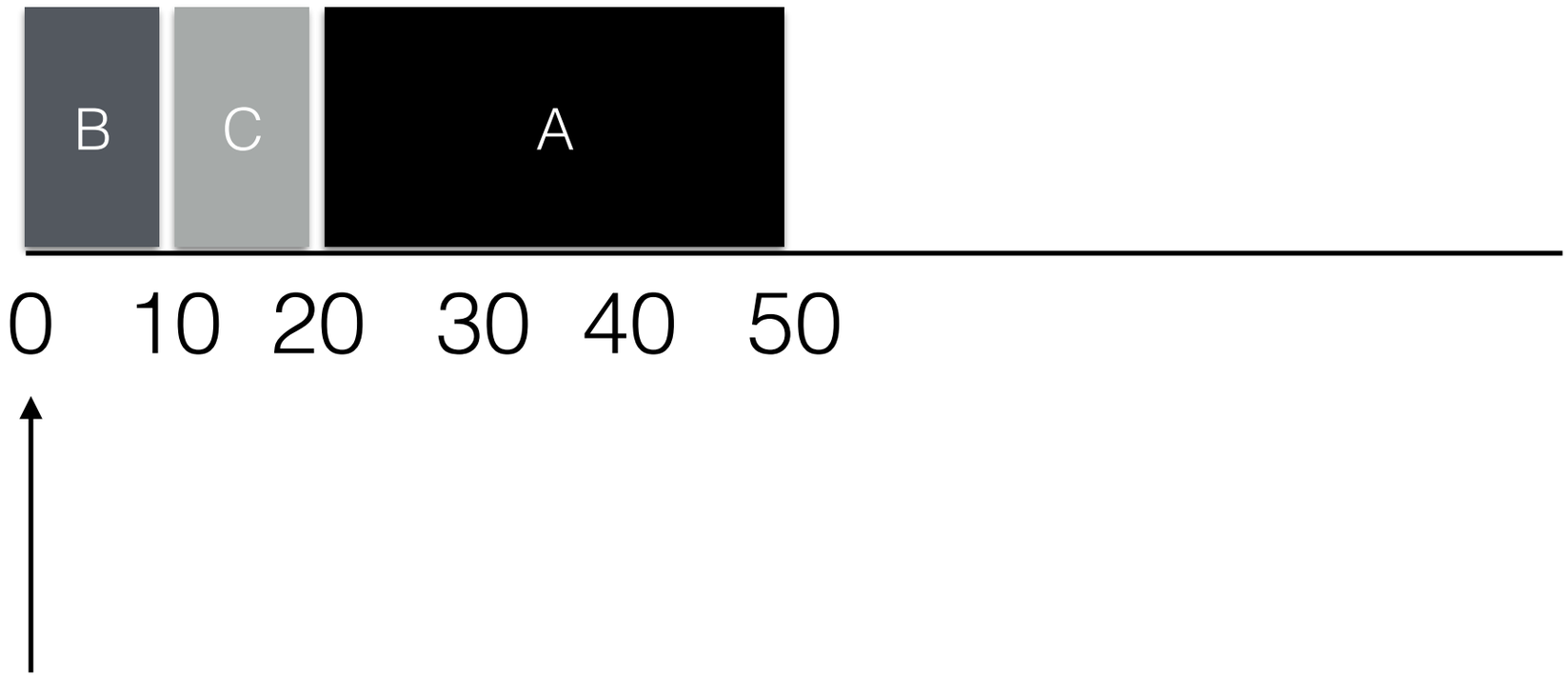
- Arrives at 0

Metric - Response Time



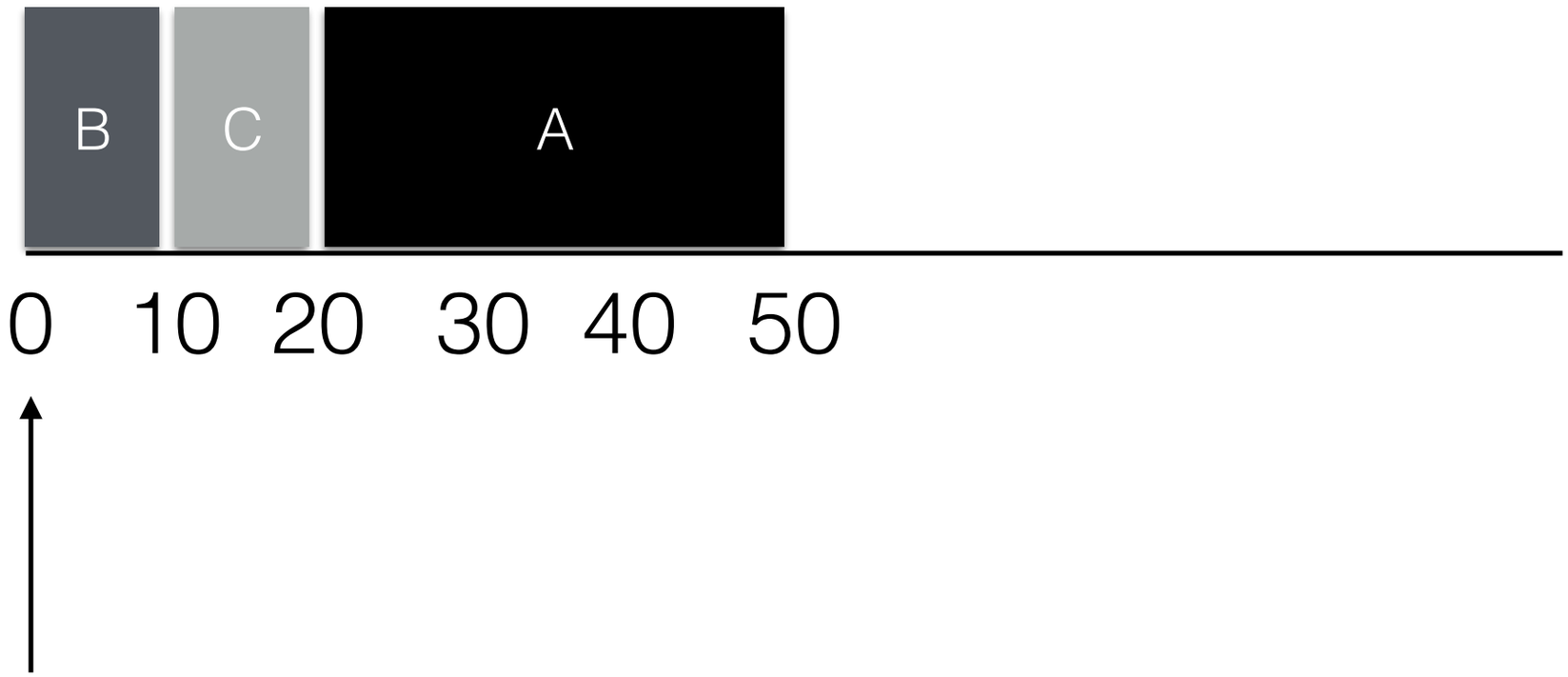
- Arrives at 0
- Runs for first time at 0

Metric - Response Time

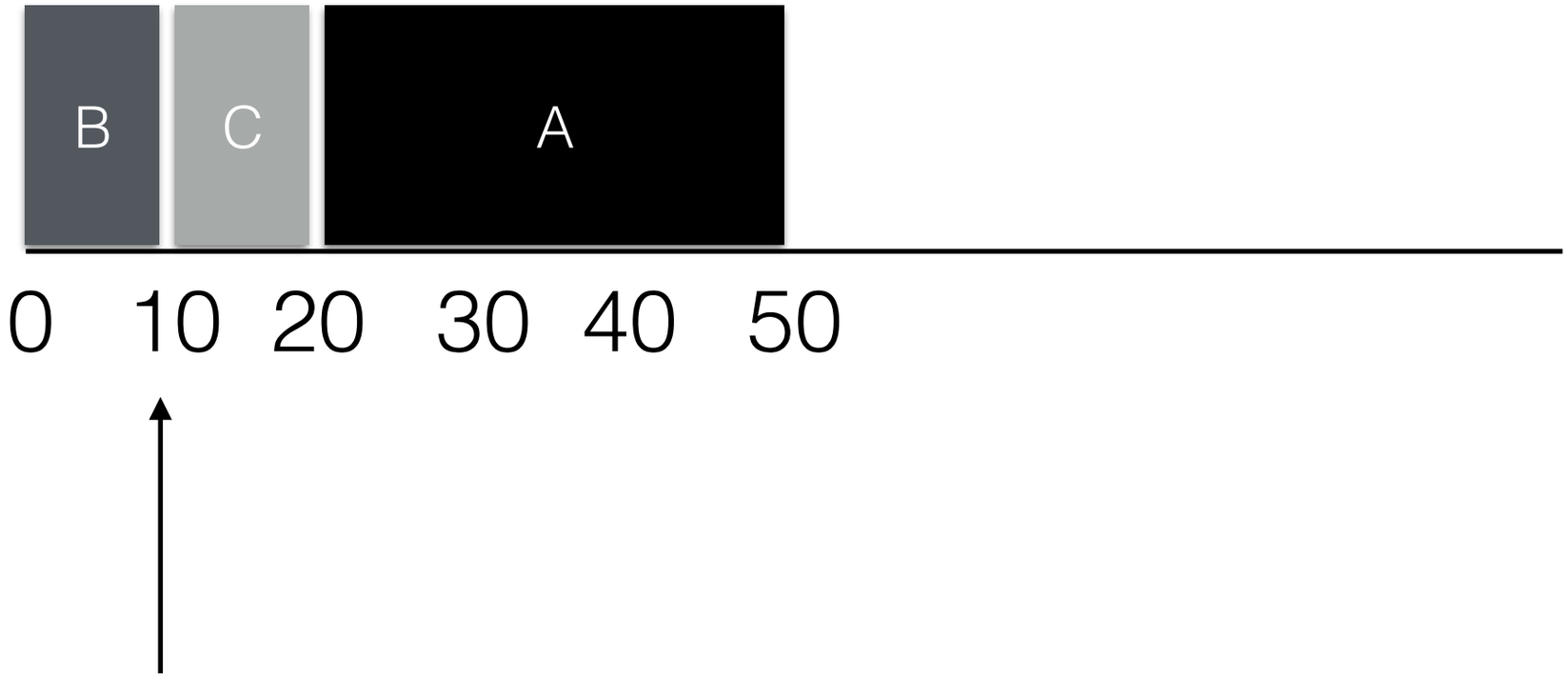


- Arrives at 0
- Runs for first time at 0
- Response time = 0

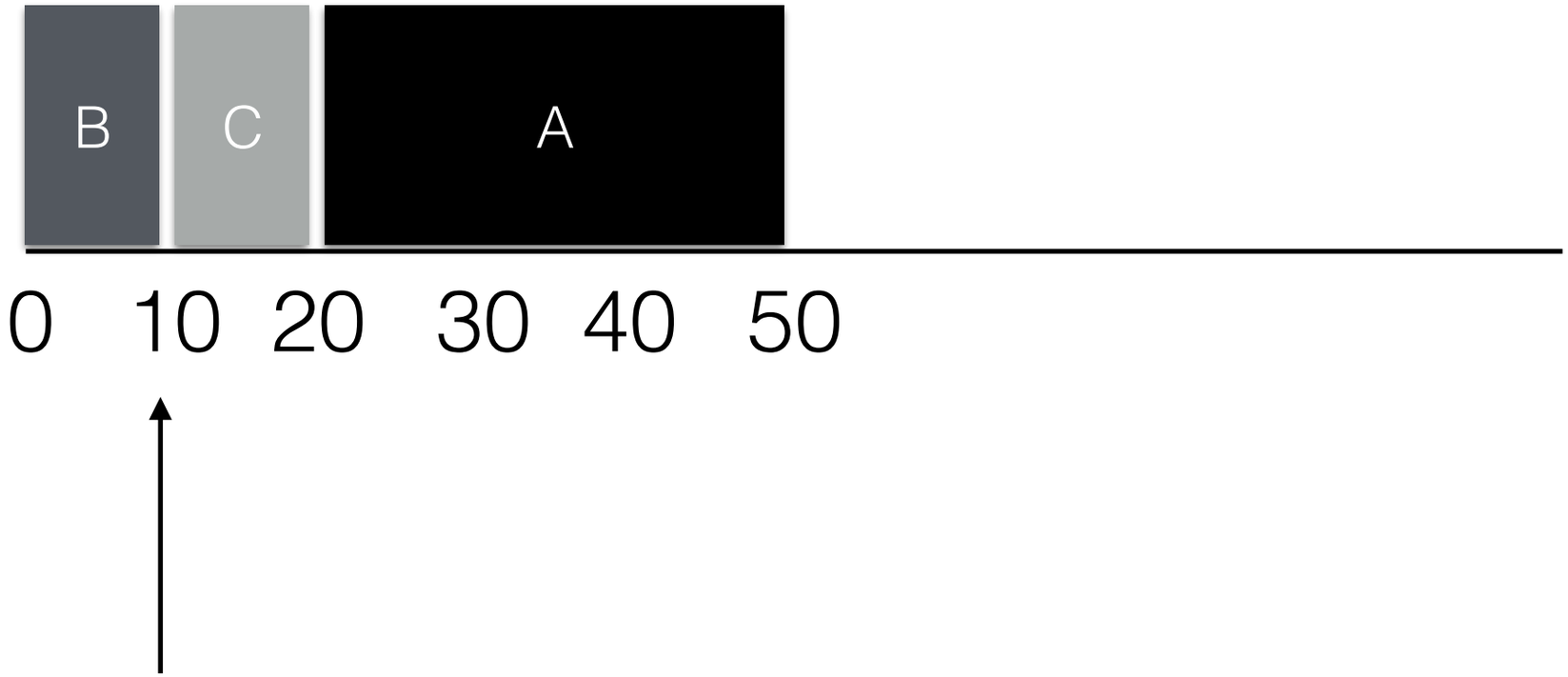
Metric - Response Time



Metric - Response Time

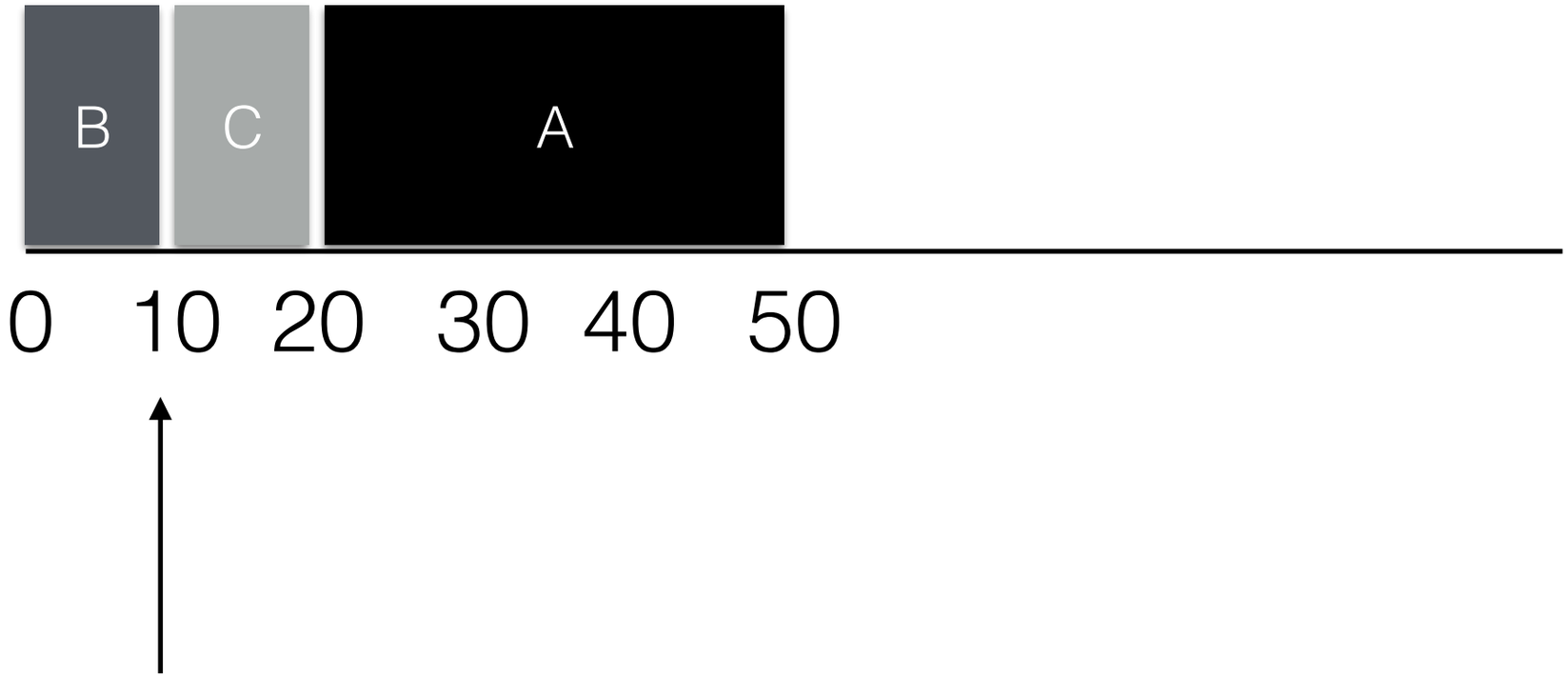


Metric - Response Time



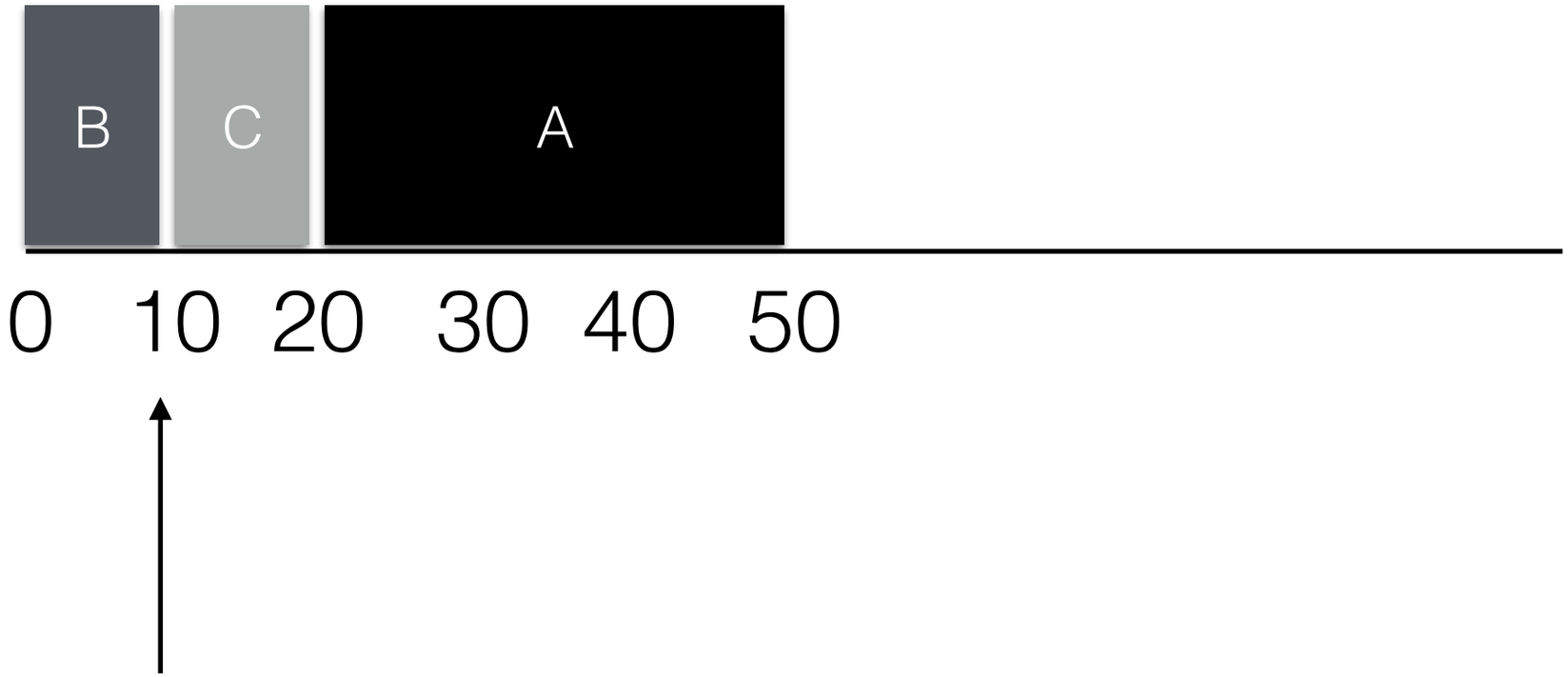
- Arrives at 0

Metric - Response Time



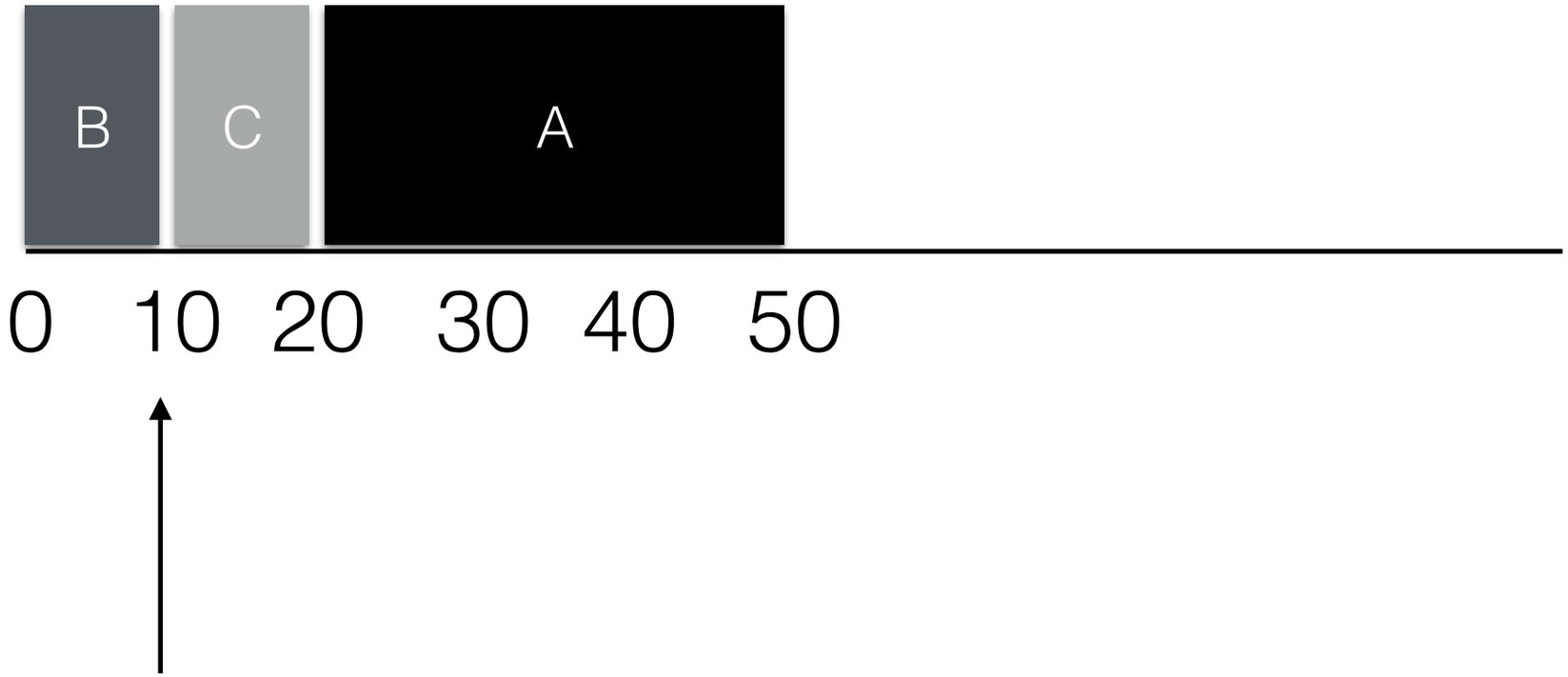
- Arrives at 0
- Runs for first time at 10

Metric - Response Time

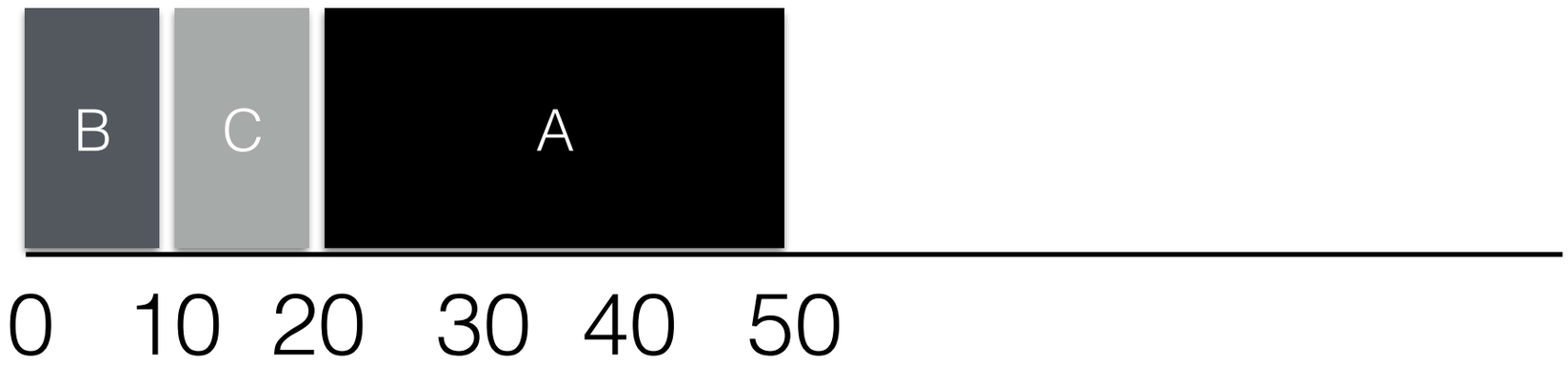


- Arrives at 0
- Runs for first time at 10
- Response time = 10

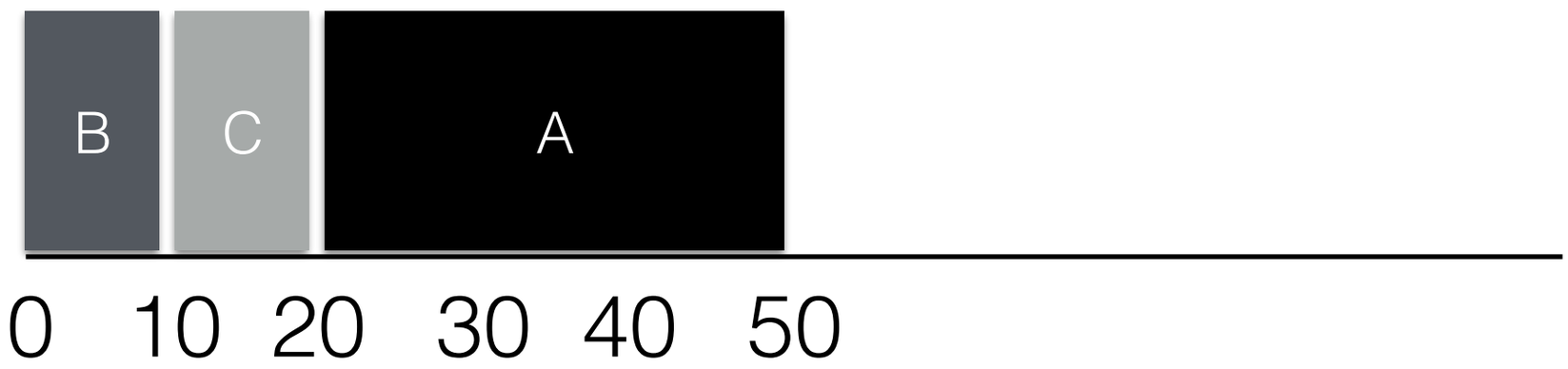
Metric - Response Time



Metric - Response Time

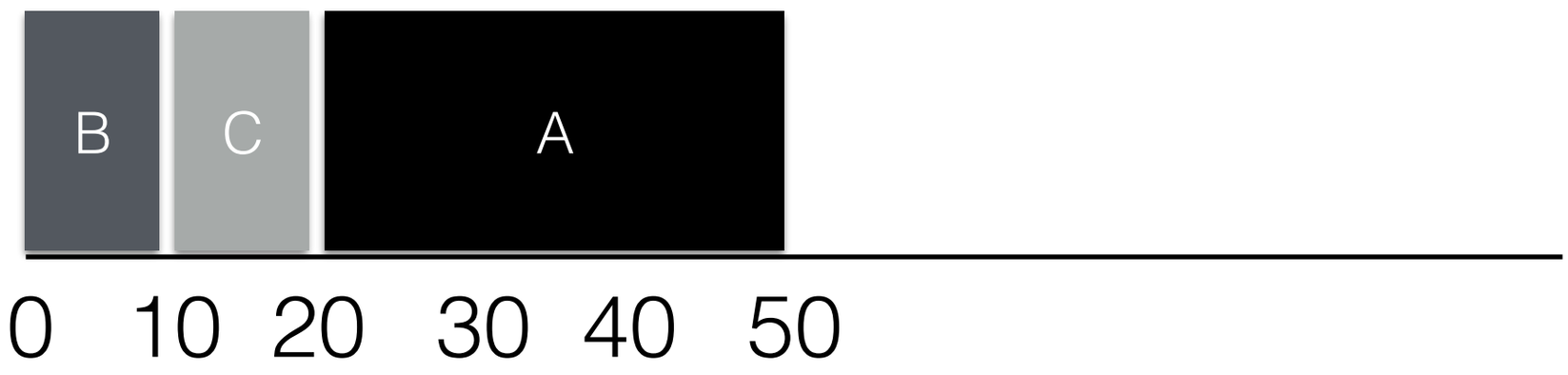


Metric - Response Time



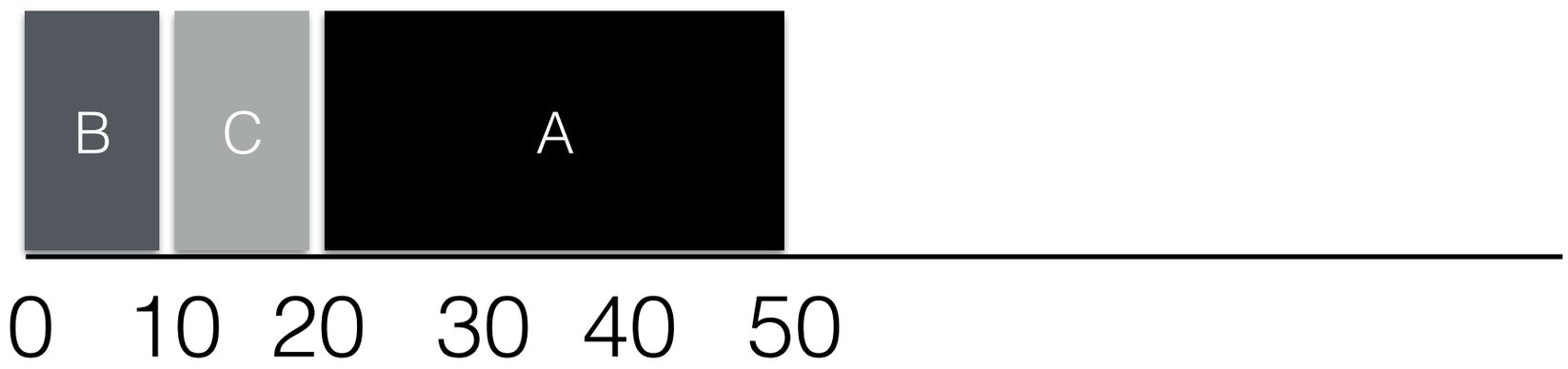
- Arrives at 0

Metric - Response Time



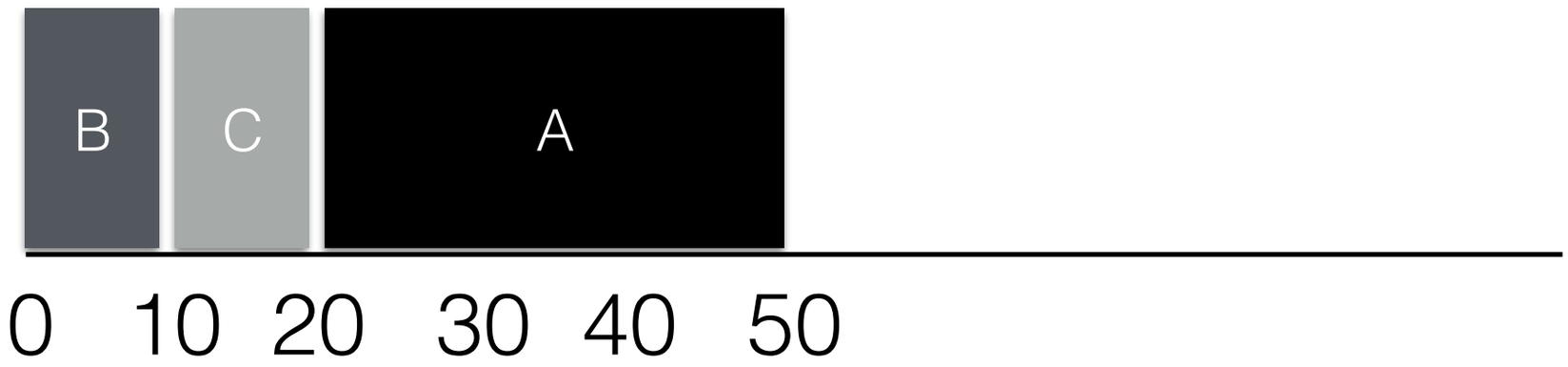
- Arrives at 0
- Runs for first time at 20

Metric - Response Time

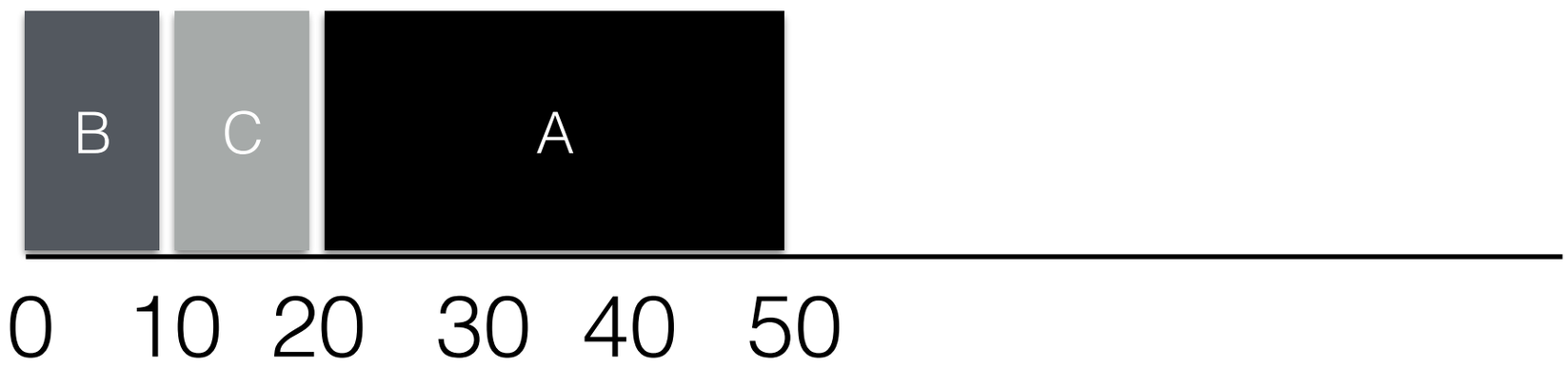


- Arrives at 0
- Runs for first time at 20
- Response time = 20

Metric - Response Time

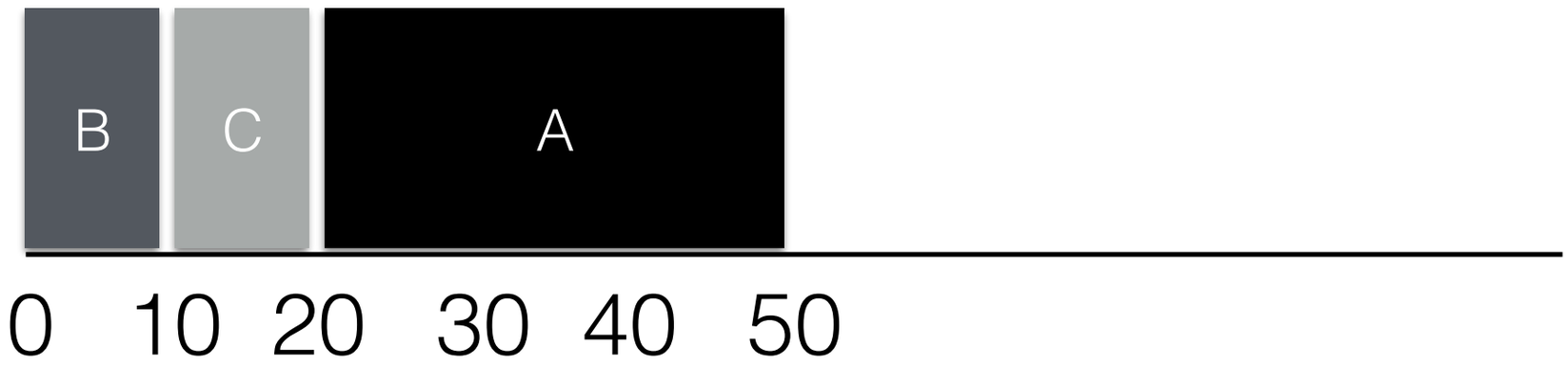


Metric - Response Time

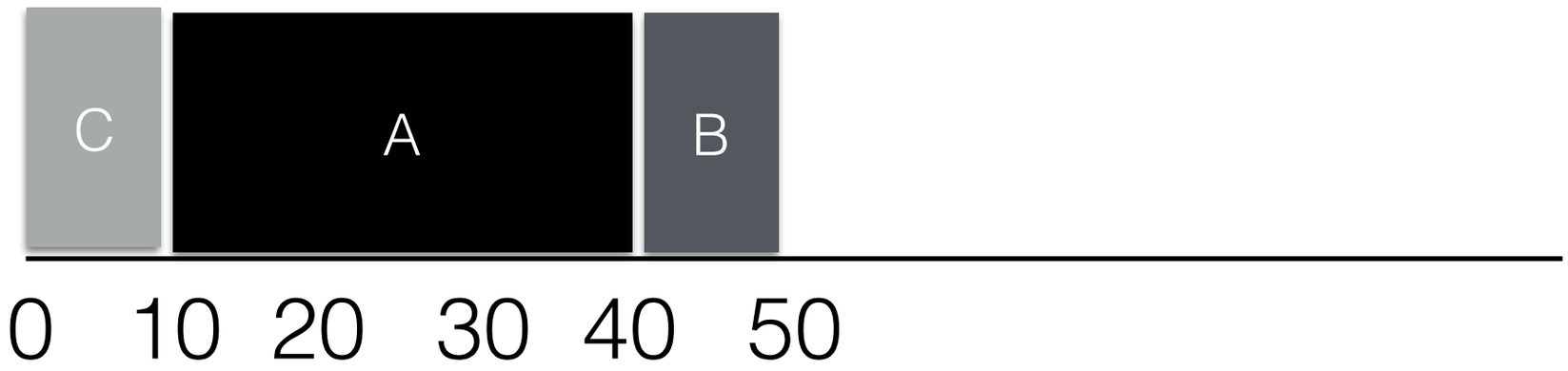


Avg. Response Time =
(0+10+20)/3 ~10

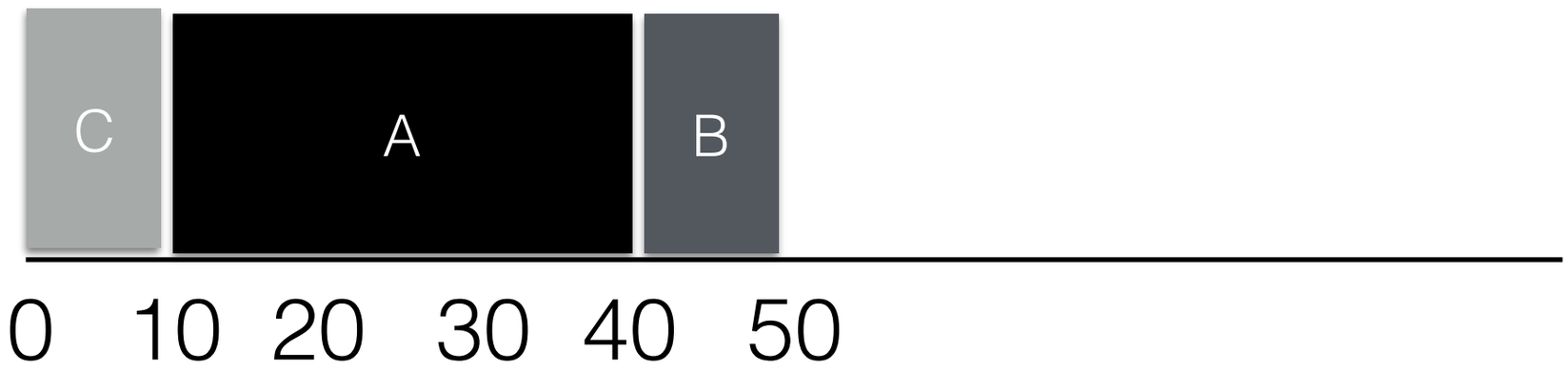
Metric - Response Time



Metric - Response Time

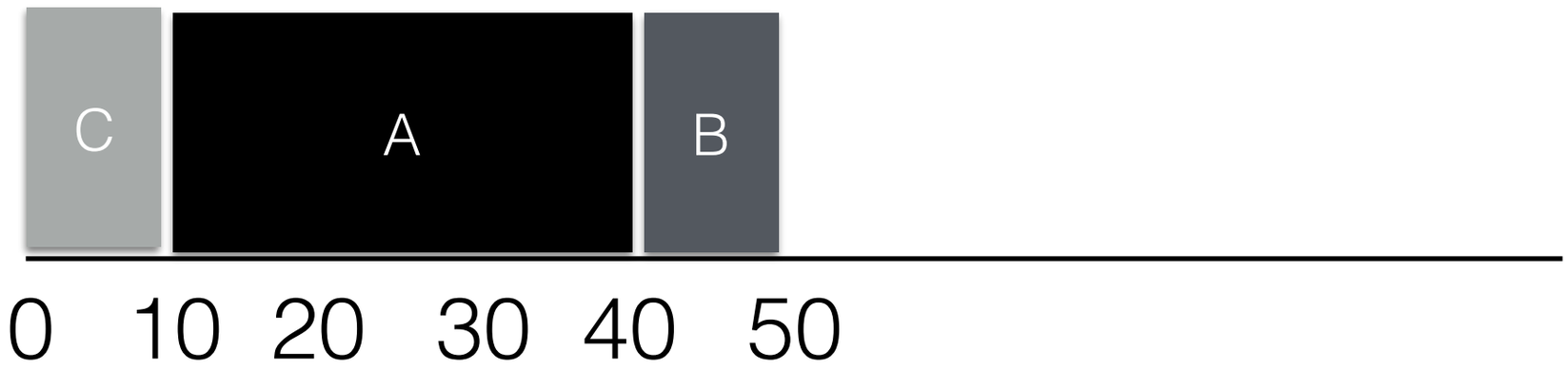


Metric - Response Time

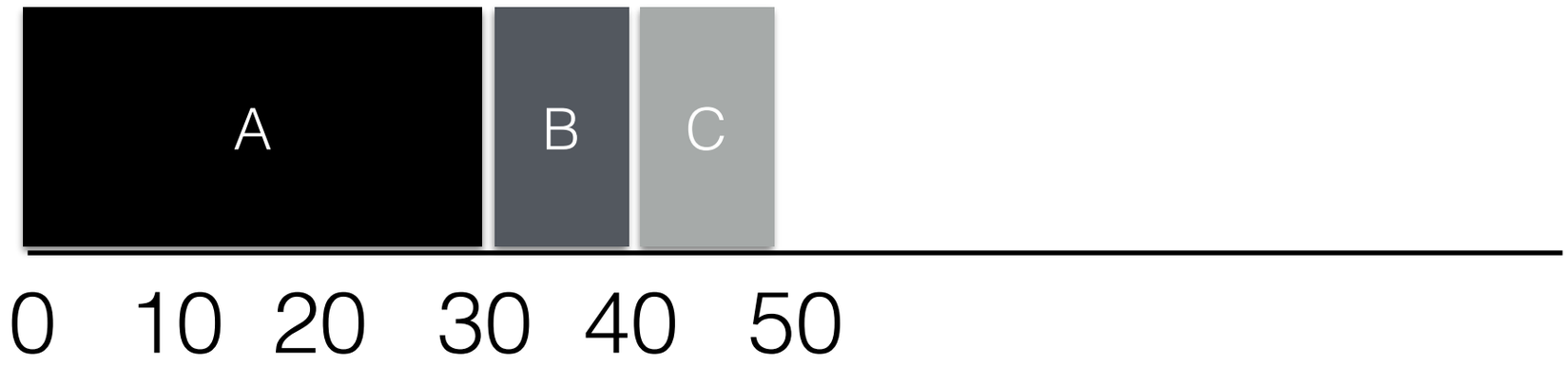


Avg. Response Time =
(0+10+40)/3 ~17

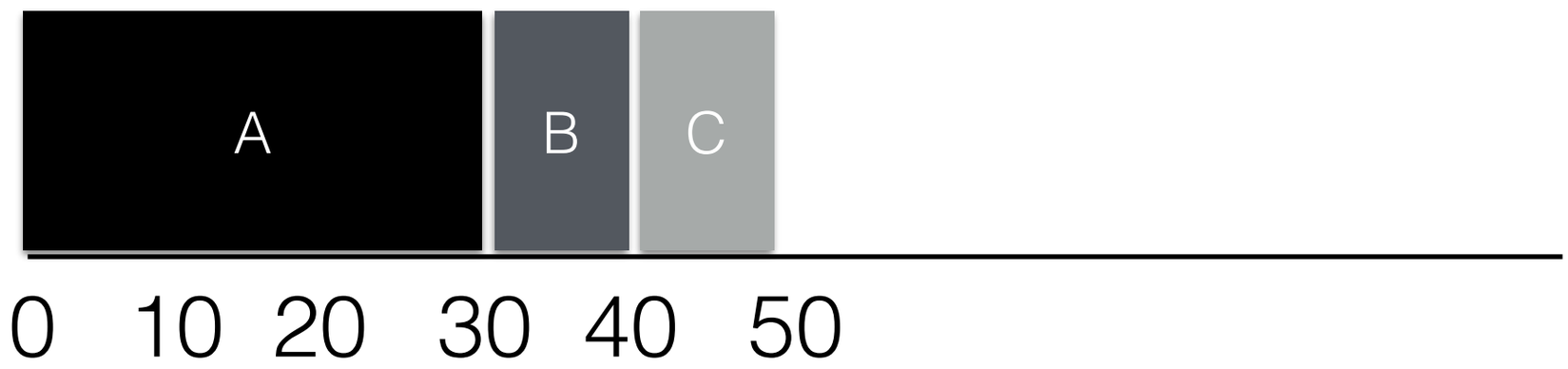
Metric - Response Time



Metric - Response Time

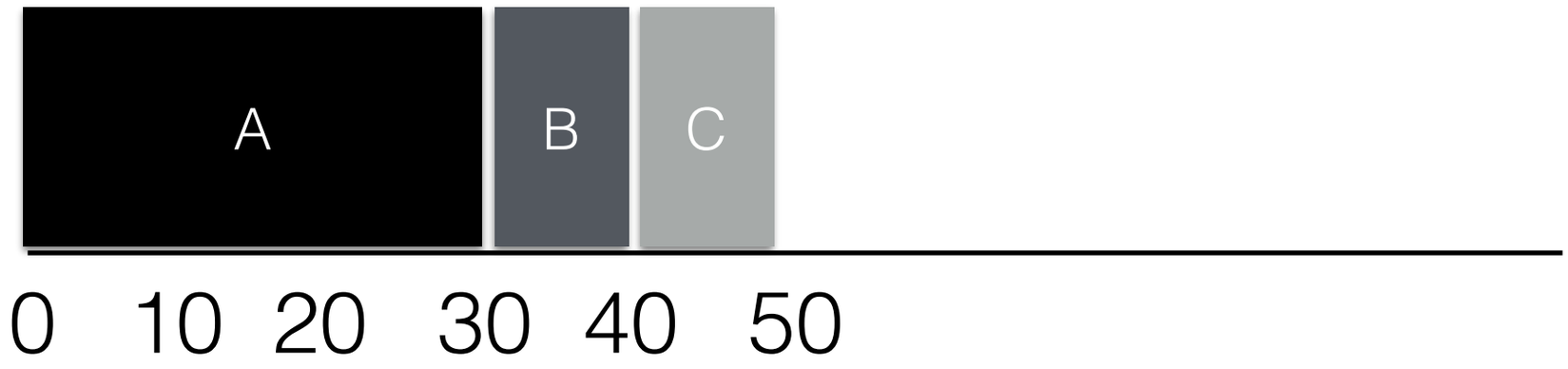


Metric - Response Time

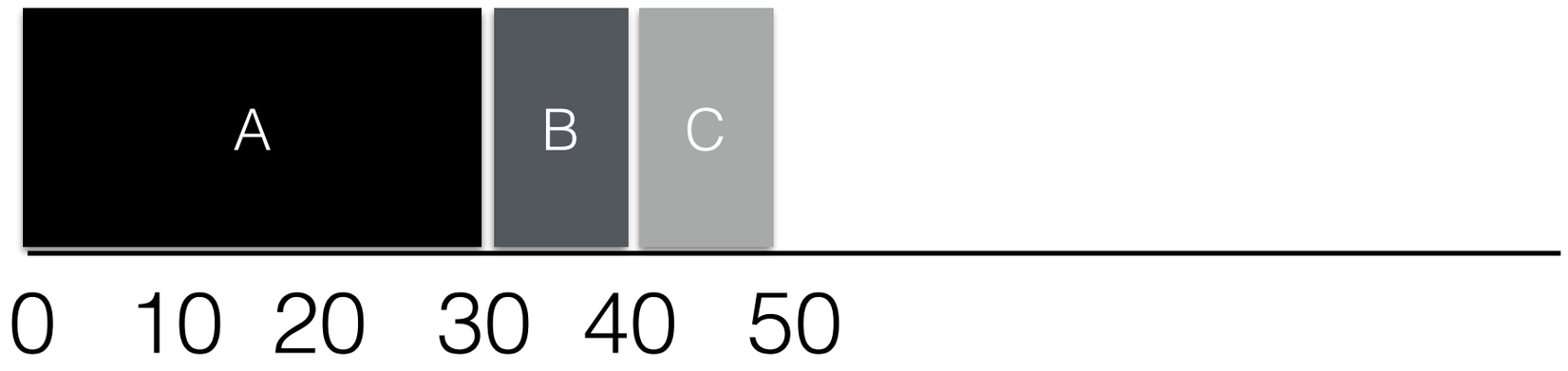


Avg. Response Time =
(0+30+40)/3 ~23

Metric - Response Time



Metric - Response Time



None of the previous policies particularly good for response time

Round Robin

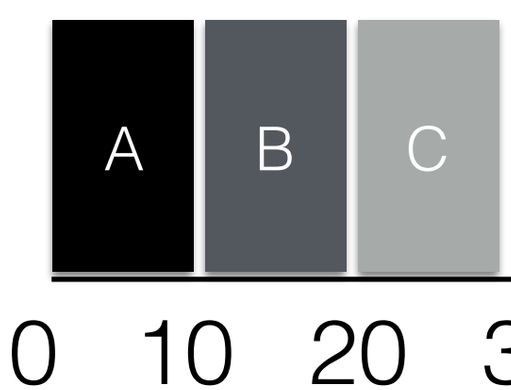
Response Time = (10+20+0)/3=10

Turnaround Time = (10+20+30)/3=20

Response Time = (0+5+10)/3=5

Turnaround Time = (20+25+30)/3=25

Round Robin



Response Time = (10+20+0)/3=10

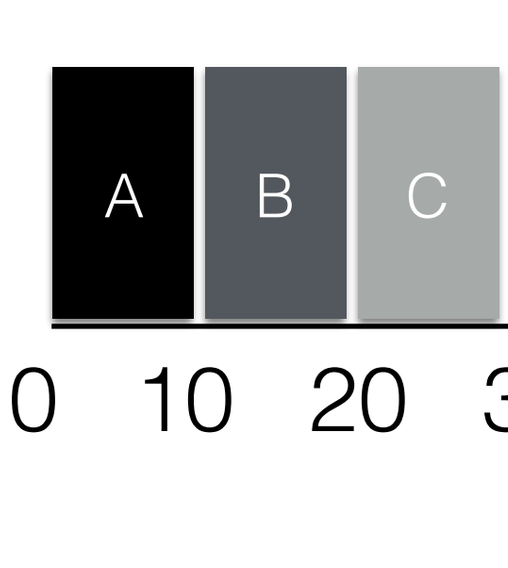
Turnaround Time = (10+20+30)/3=20

Time

Response Time = (0+5+10)/3=5

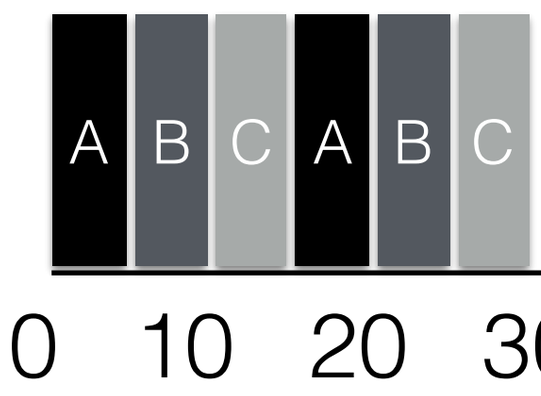
Turnaround Time = (20+25+30)/3=25

Round Robin



Response Time = (10+20+0)/3=10

Turnaround Time = (10+20+30)/3=20



Response Time = (0+5+10)/3=5

Turnaround Time = (20+25+30)/3=25