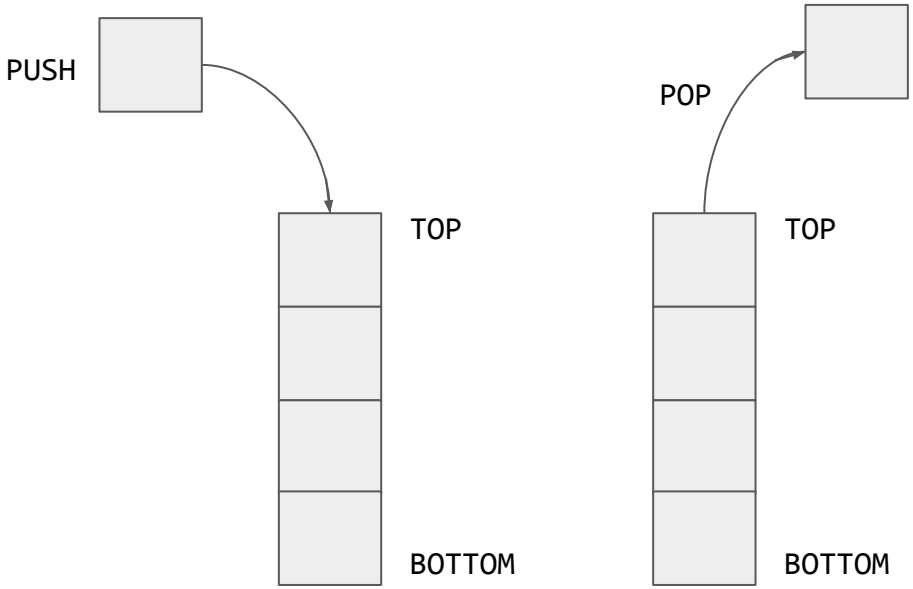
Q&A and M/D/1 Queues

Q&A

M/D/1 Queues

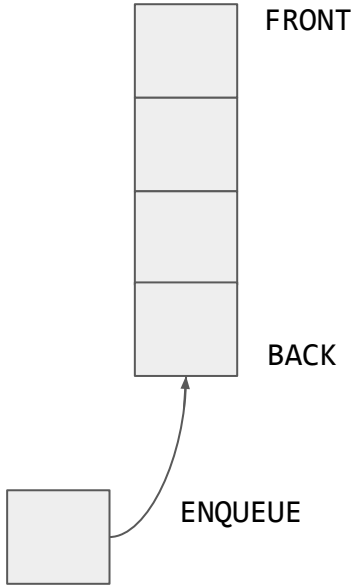
Stack data type

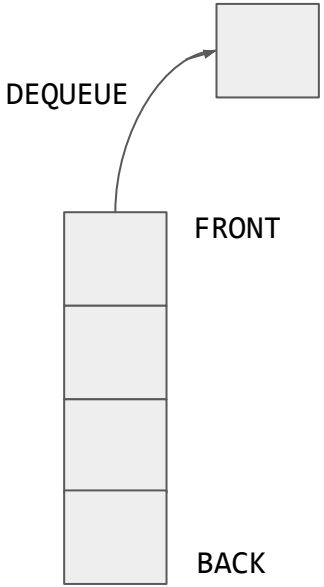
A stack is a sequence of items which are added (pushed) to the top of the stack and removed (popped) from the top.



Queue data type

A queue is a sequence of items which are added (enqueued) to the back of the queue and removed (dequeued) from the front.

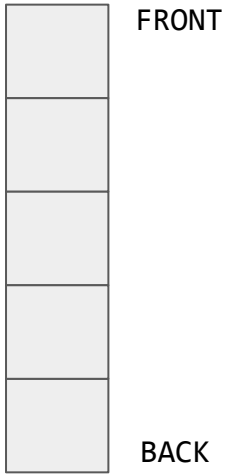




Queue data type

We can use queues to model many real-world processes, such as waiting in line to check in at the airport or waiting to vote at a polling station.

These processes often differ in the following aspects:

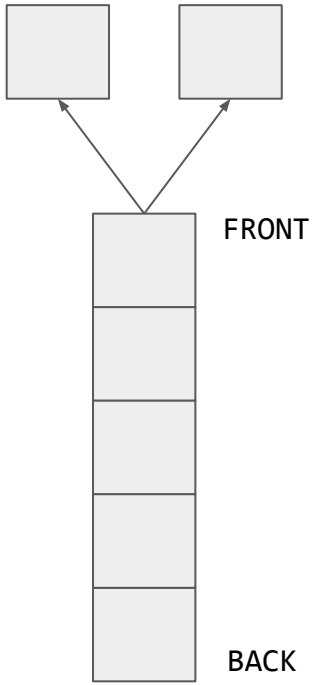


Queue data type

We can use queues to model many real-world processes, such as waiting in line to check in at the airport or waiting to vote at a polling station.

These processes often differ in the following aspects:

- The number of servers

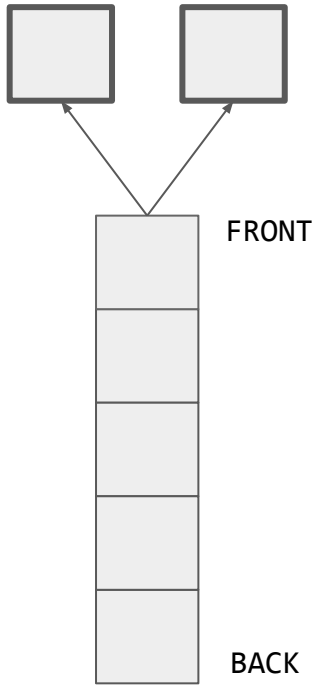


Queue data type

We can use queues to model many real-world processes, such as waiting in line to check in at the airport or waiting to vote at a polling station.

These processes often differ in the following aspects:

- The number of servers
- The service time

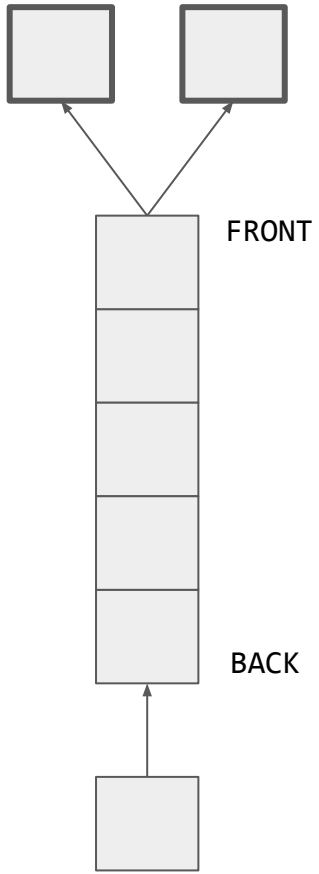


Queue data type

We can use queues to model many real-world processes, such as waiting in line to check in at the airport or waiting to vote at a polling station.

These processes often differ in the following aspects:

- The number of servers
- The service time
- The rate of arrival



M/D/1 queue

In this lecture, we're going to simulate the movement of customers through an M/D/1 queue.

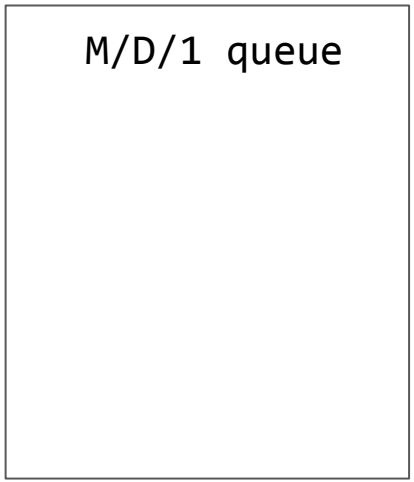
- Customer arrivals follow a Markov process (M) with parameter λ. We will draw customer interarrival times from an exponential distribution with parameter λ.
- The service time of each customer is deterministic (D) with parameter μ. Service will take time $1/\mu$ for every customer.
- There is only one (1) server.

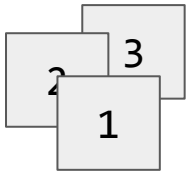
Example

Let’s say our probability distribution generates the interarrival times 2, 2, and 6. These are the time since last arrival, so we have three customers arriving at times 2, 4, and 10.

Let’s also say that service time is exactly 3.

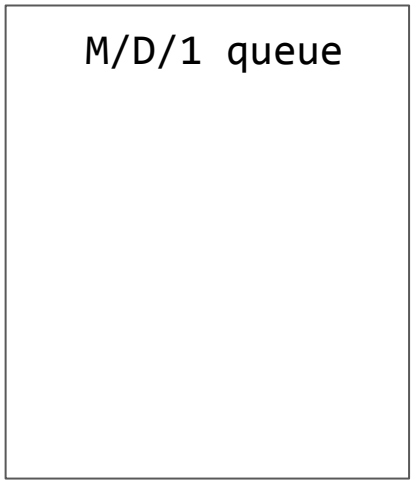
Example

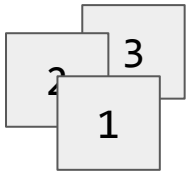




Time	
0	

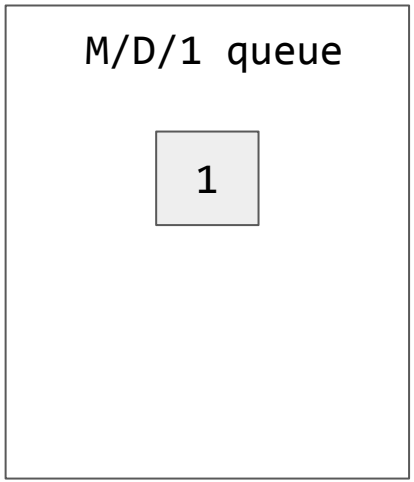
Example

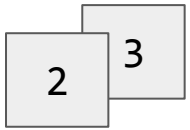




Time	
0	
1	

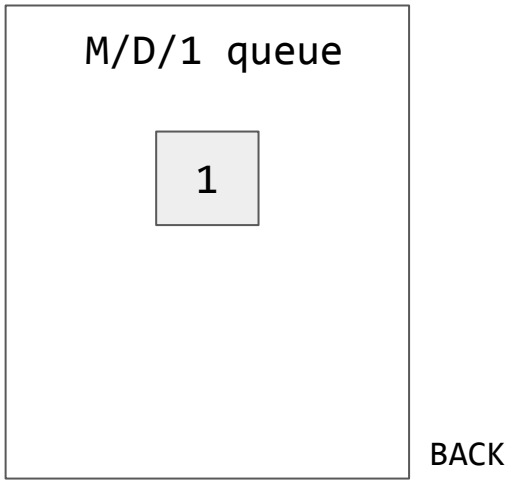
Example

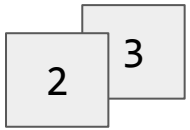




Time	
0	
1	
2	Customer 1 arrives, starts service

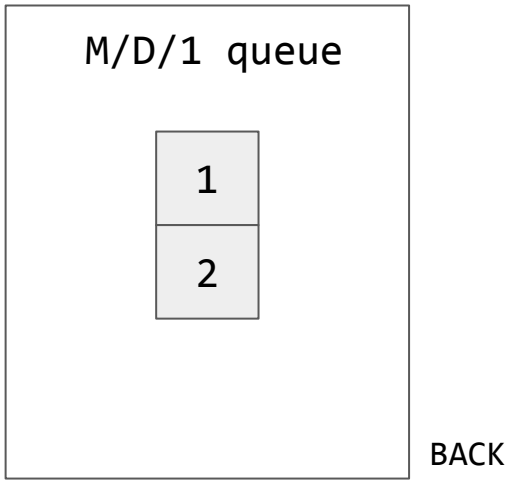
Example





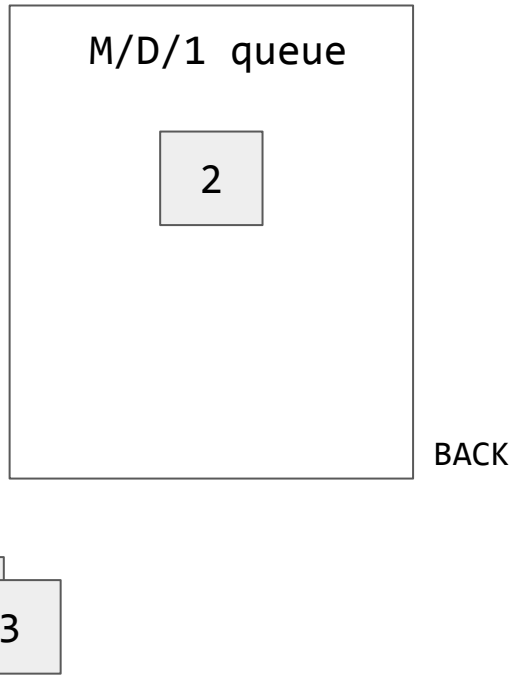
Time	
0	
1	
2	Customer 1 arrives, starts service
3	

Example



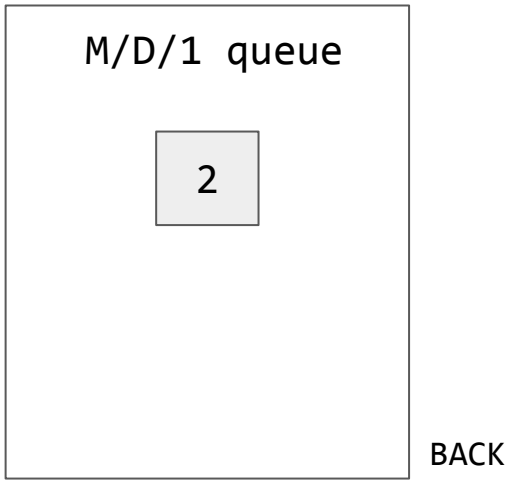
Time	
0	
1	
2	Customer 1 arrives, starts service
3	
4	Customer 2 arrives

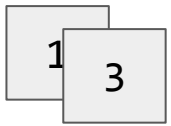
Example



Time	
0	
1	
2	Customer 1 arrives, starts service
3	
4	Customer 2 arrives
5	Customer 1 departs, Customer 2 starts service

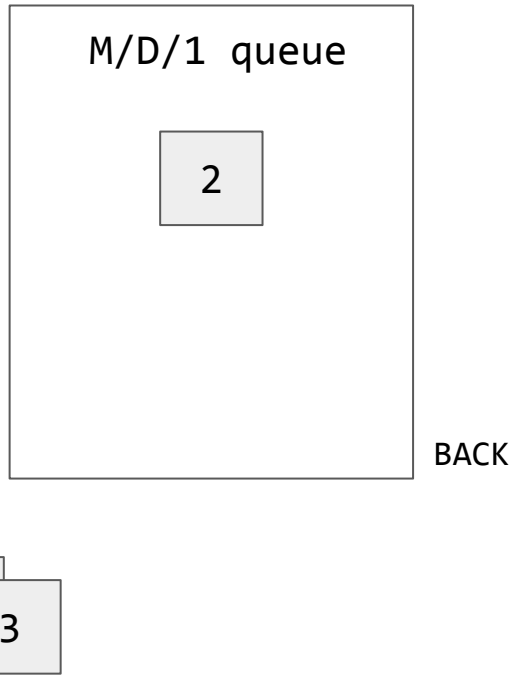
Example





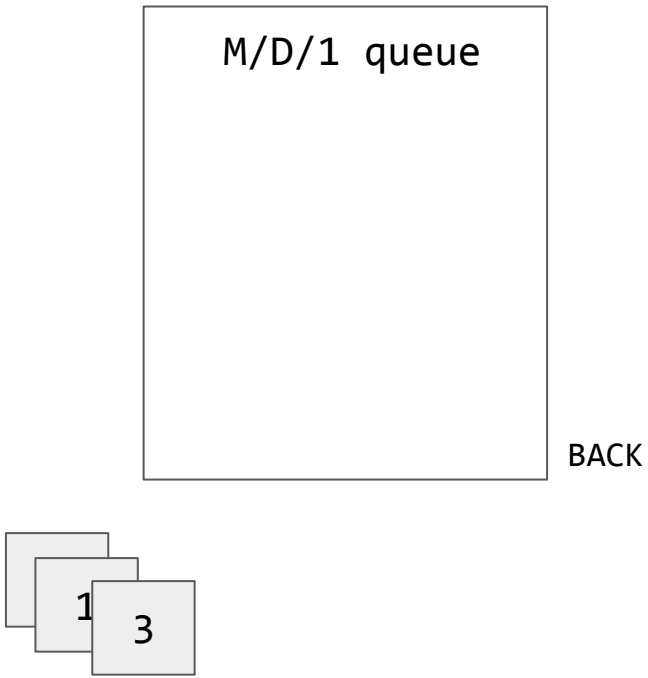
Time	
0	
1	
2	Customer 1 arrives, starts service
3	
4	Customer 2 arrives
5	Customer 1 departs, Customer 2 starts service
6	

Example



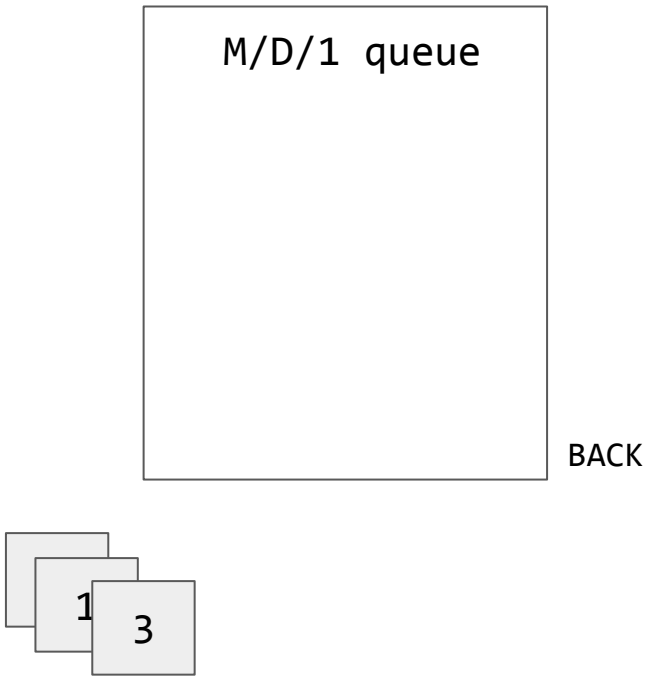
Time	
0	
1	
2	Customer 1 arrives, starts service
3	
4	Customer 2 arrives
5	Customer 1 departs, Customer 2 starts service
6	
7	

Example



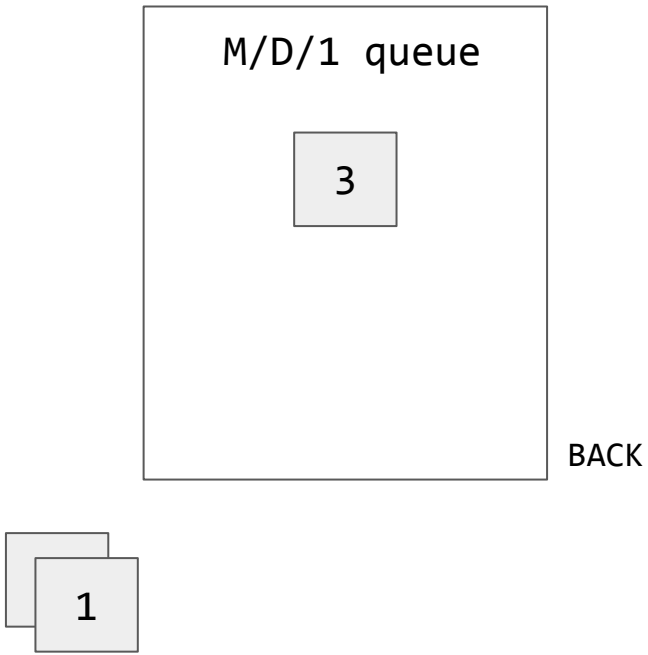
Time	
0	
1	
2	Customer 1 arrives, starts service
3	
4	Customer 2 arrives
5	Customer 1 departs, Customer 2 starts service
6	
7	
8	Customer 2 departs

Example



Time	
0	
1	
2	Customer 1 arrives, starts service
3	
4	Customer 2 arrives
5	Customer 1 departs, Customer 2 starts service
6	
7	
8	Customer 2 departs
9	

Example



Time	
0	
1	
2	Customer 1 arrives, starts service
3	
4	Customer 2 arrives
5	Customer 1 departs, Customer 2 starts service
6	
7	
8	Customer 2 departs
9	
10	Customer 3 arrives, starts service