

Let's get started: A Hand Simulation

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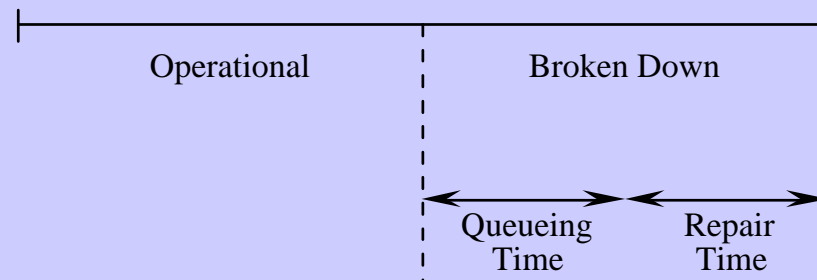
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The machine repairman problem

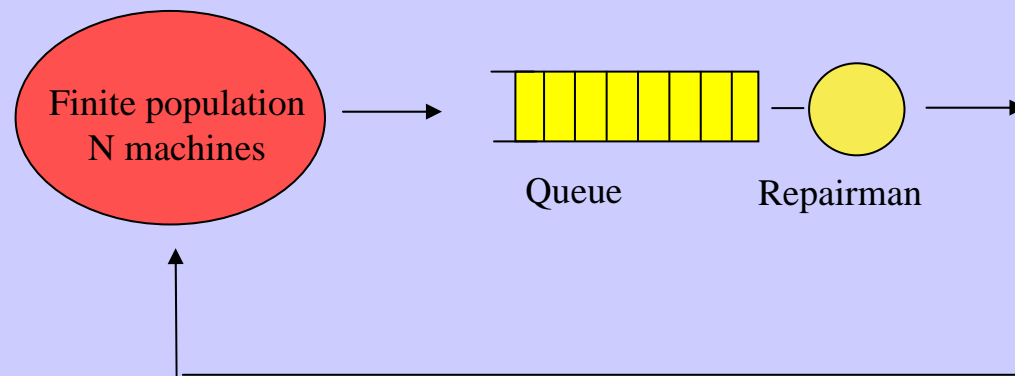
- There are N machines and a one repairman.
- Machines are repaired in FIFO.
- A machine has the following cycle:



- Operational and repair time are known. What is the queueing time in the repairman's queue?

The queueing system

- The repairman's queue is a single server queue fed by a finite population.



Building the model

- The first and most important step in building a simulation model is to identify the basic *events* whose occurrence will alter the *status* of the system
- *System status* - this is depicted by a set of variables that describe the state of the system.

- The system status: Machine repairman

Number n of broken down machines (queueing plus the one being repaired) = *Number of operational machines*

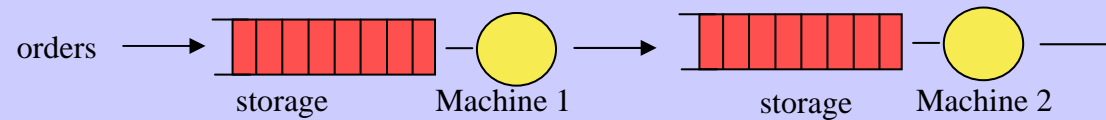
- $n=0$: repairman's queue is empty, repairman is idle.
Number of operational machines is N
- $n=1$, repairman's queue is empty, repairman is busy.
Number of operational machines is $N-1$
- $n>1$, repairman is busy, $n-1$ broken down machines in the queue. Number of operational machines is $N-n$

- Events:

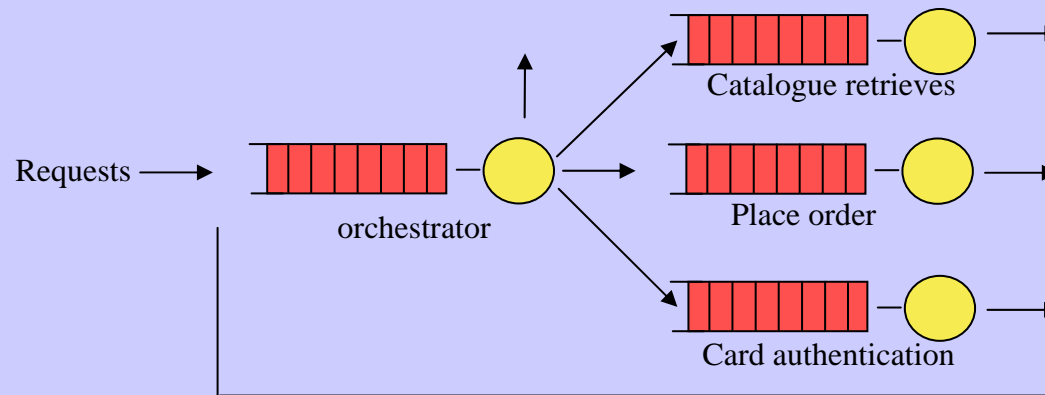
- *A machine breaks down* (arrival occurs at the queue).
- *A machine is fixed* (departure occurs from the queue).

Other examples of system status and events

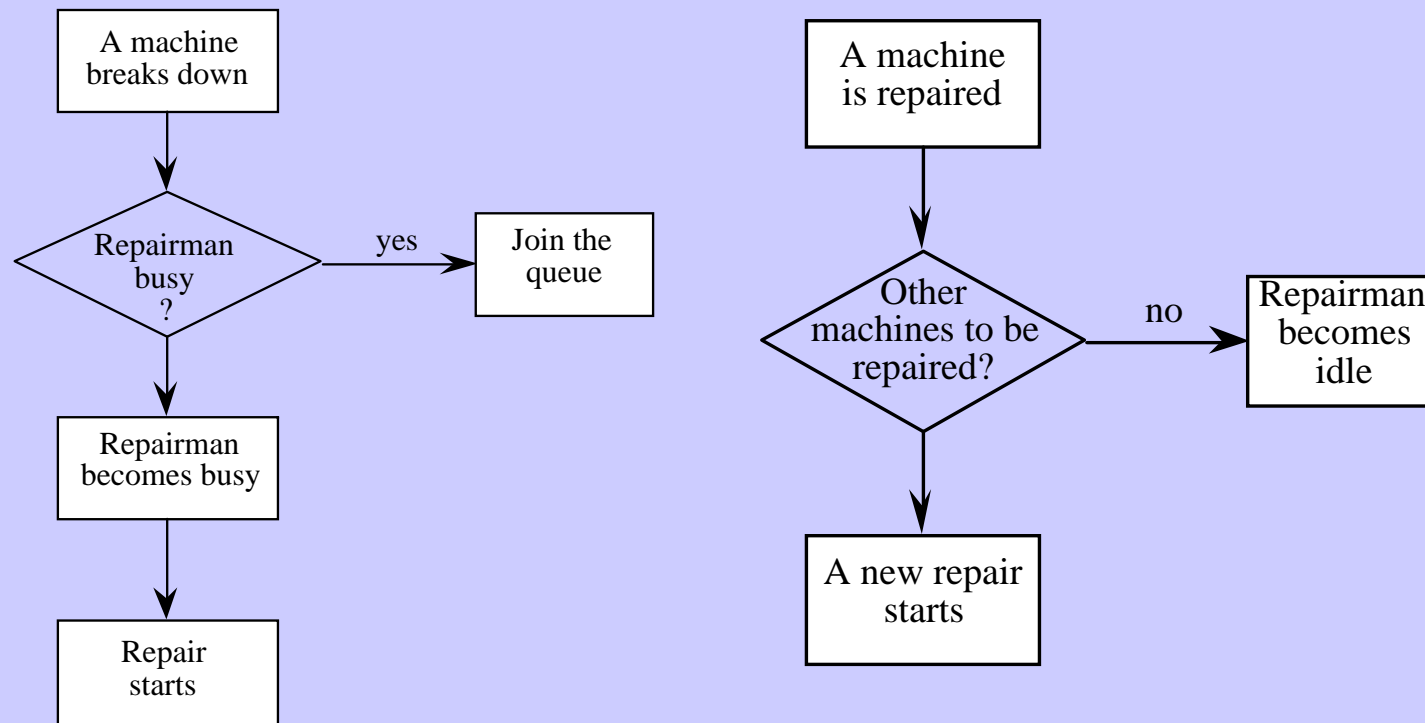
- Two stage production system



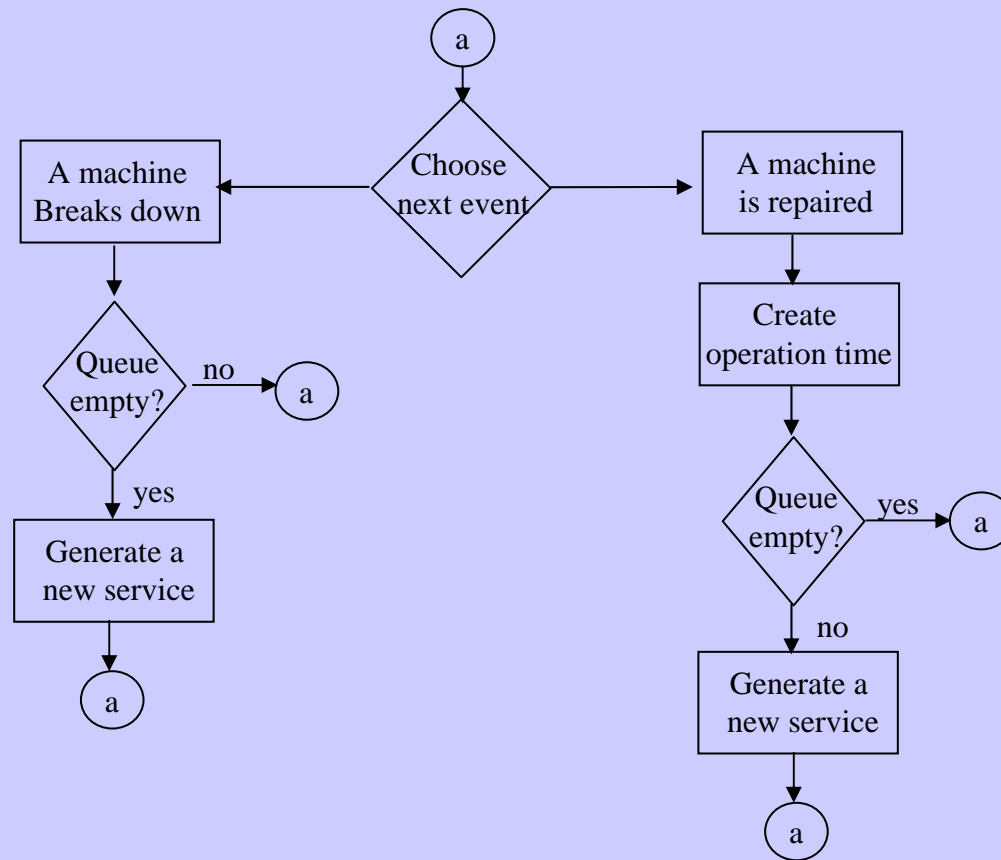
- Web service system



What happens when an event occurs



Event manipulation logic



Event clocks and master clock

- A clock is associated with each operational machine, to show the time instant at which the machine will break down.
- In addition another clock will be used to show the time instant at which a machine currently being repaired will become operational.
- A *master clock* is used to simply keep track of the simulated time.

- **A hand simulation - three machines**
 - Operational time = 10, and repair time = 5 units of time.
 - CL1, CL2, CL3 are associated with machines 1, 2, 3
 - CL4 repairman's completion time
 - At t=0 all three machines are operational, CL1=1, CL2=4, CL3=9

MC	CL1	CL2	CL3	CL4	n	
0	1	4	9	-	0	idle
1	-	4	9	6	1	busy
4	-	-	9	6	2	busy
6	16	-	9	11	1	busy
9	16	-	-	11	2	busy
11	16	21	-	16	1	busy
16	-	21	26	21	1	busy

Flow-chart for computer program

