CS 3.307

Performance Modeling for Computer Systems

Tejas Bodas

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Logistics

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- Feel free to contact me anytime at tejas.bodas@iiit.ac.in.
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- Book– Performance modeling and design of computer systems (Cambridge press) by Mor Harchol-Balter (Professor, CMU)
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- Assignment 1 : 15%. Midsem exam: 30%. Assignment 2: 15% Endsem 40 %.

Course Outline

- Module 1 (2 lectures)
  - Motivation, Probability refresher, Introduction to Stochastic Processes

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- Module 5 (3 lectures) Advanced Queues

Performance modeling for Computer systems

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  - blocking probability (screen freeze, no disk space, packet loss, buffer full)

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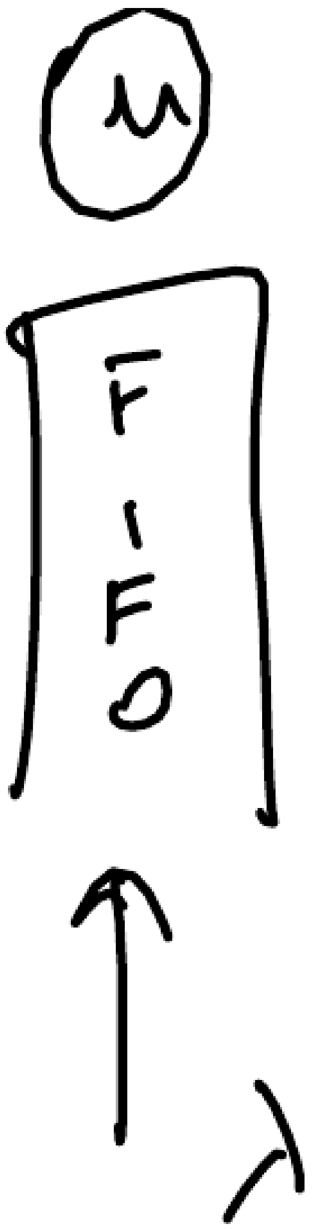
- Henceforth use the term Queueing system!

A single server queue



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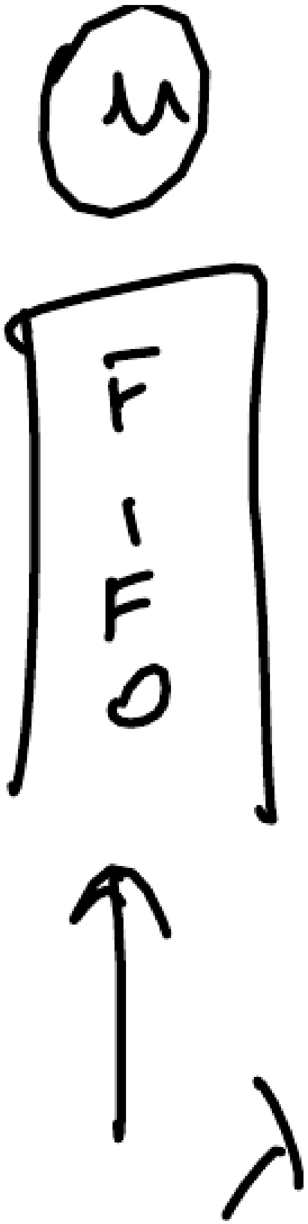

- One server, one FIFO queue for jobs to wait.

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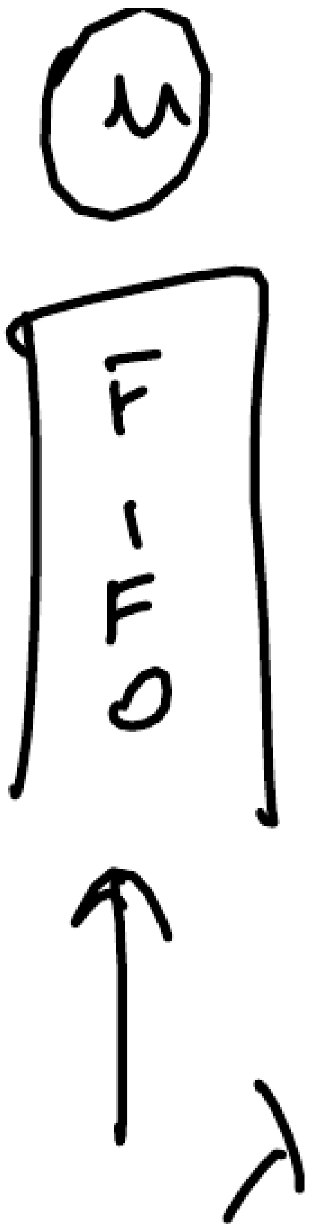

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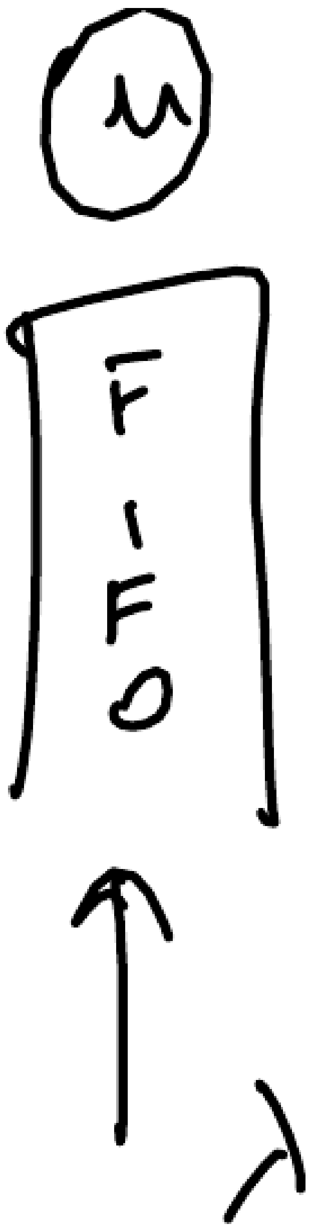

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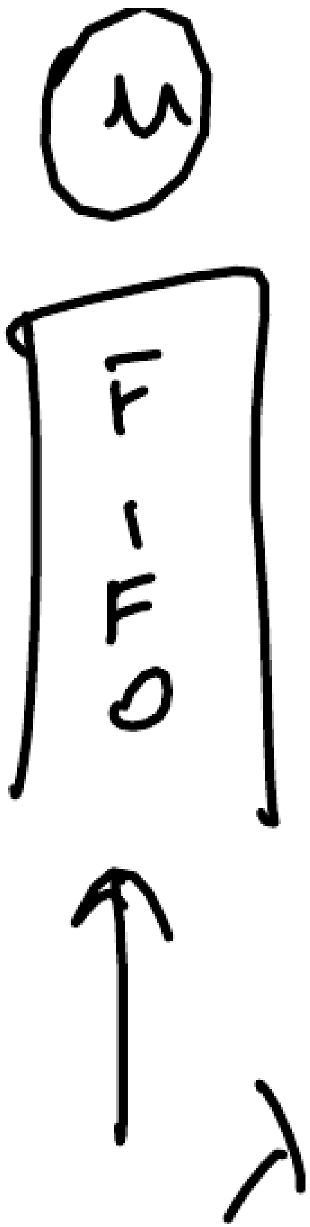

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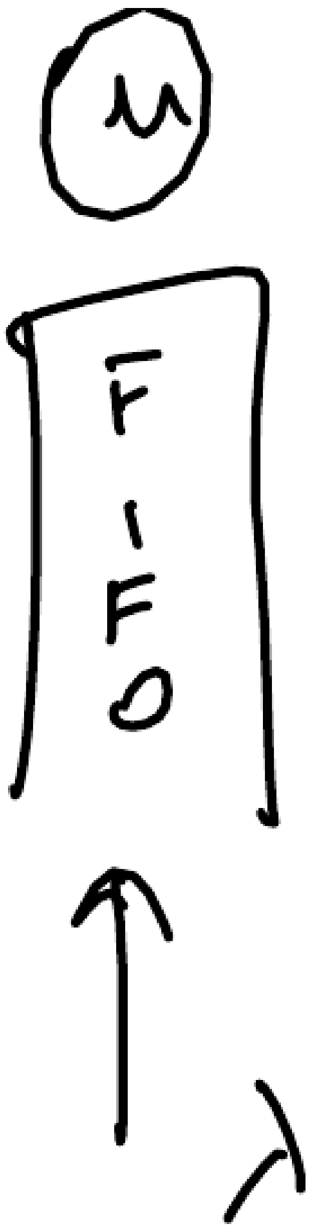

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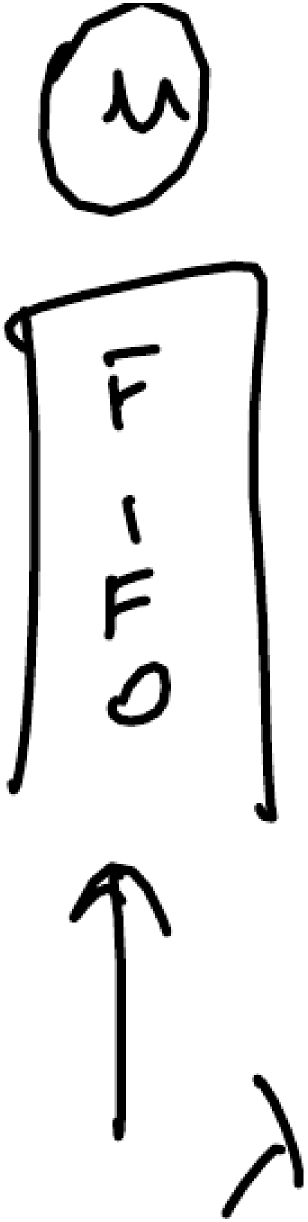

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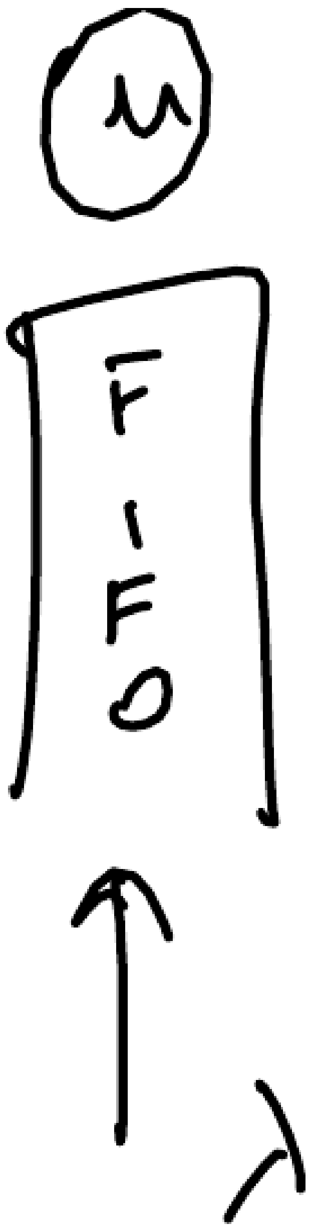

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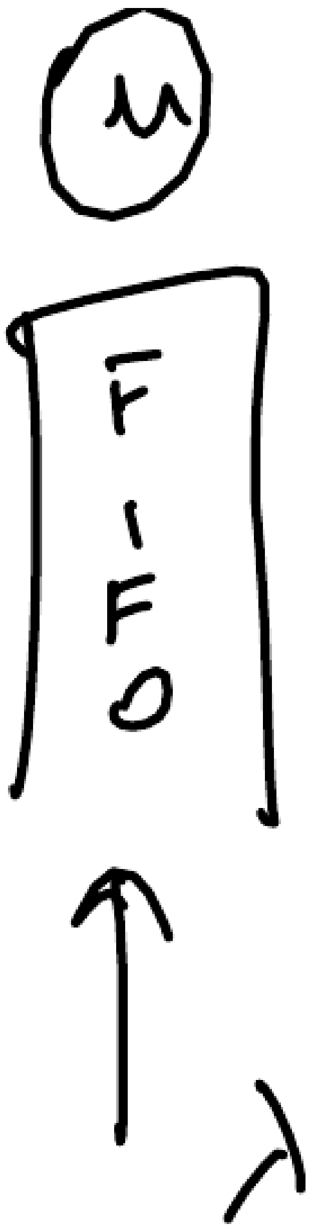

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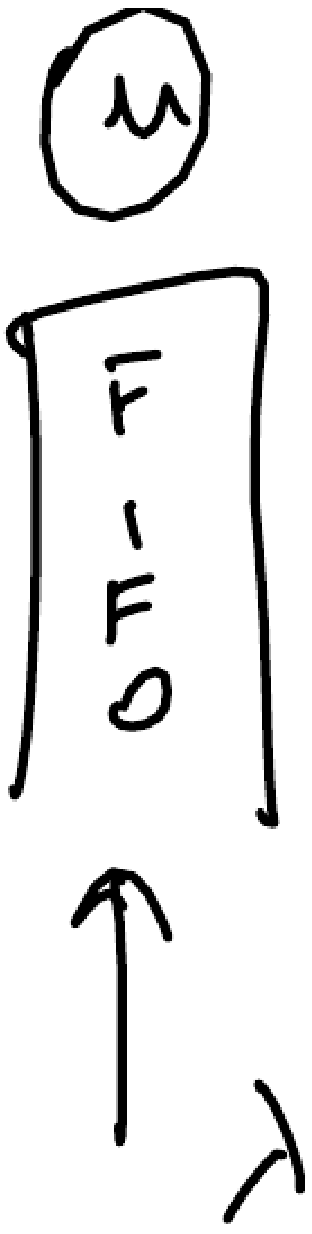

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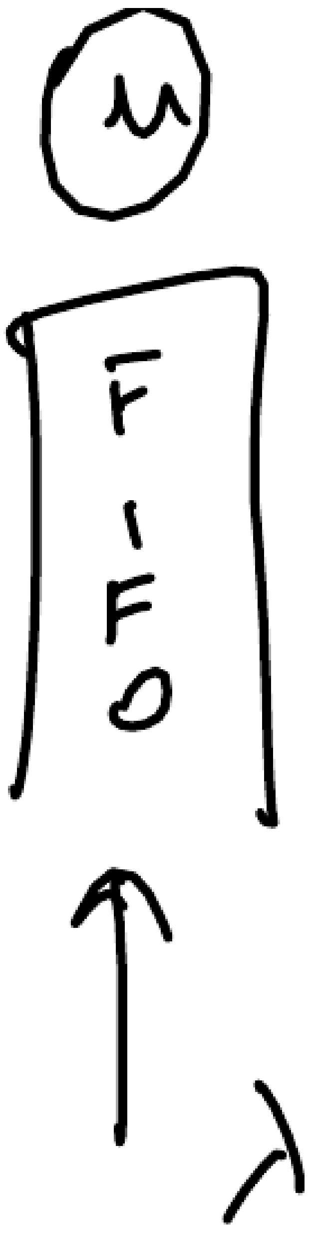

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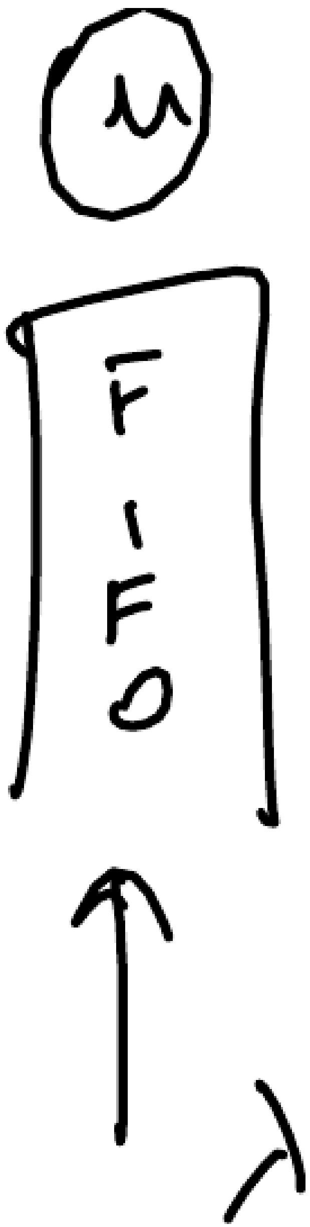

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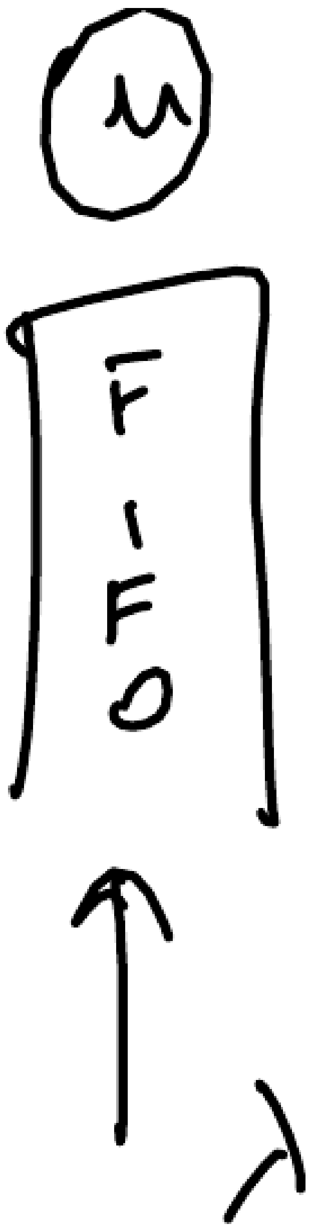

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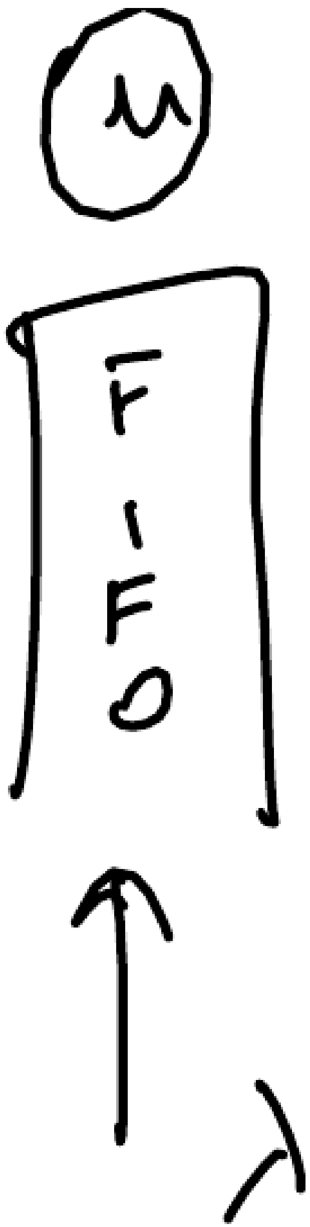

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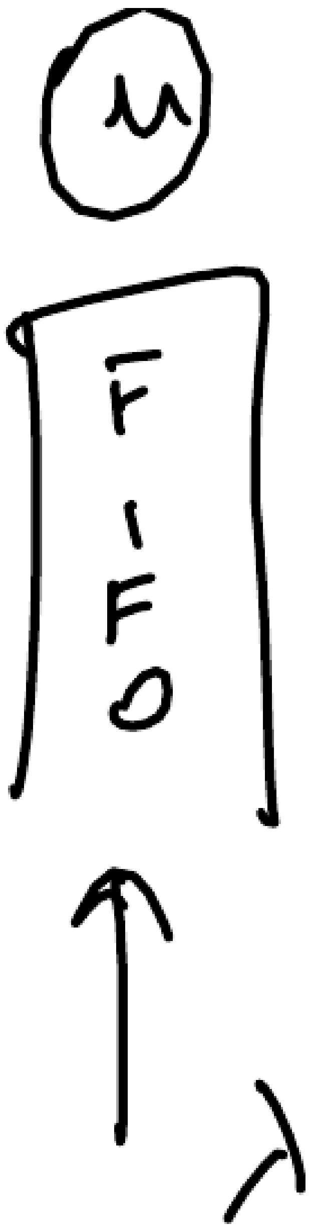

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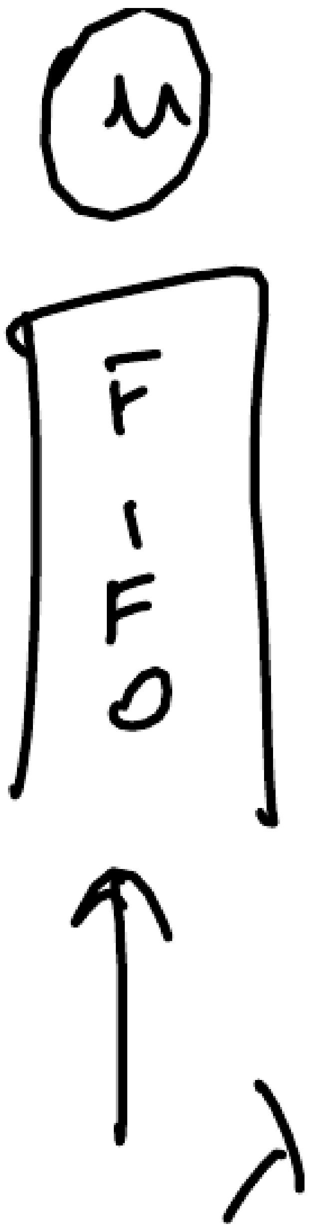
- This course is about Markov chain analysis to derive such formulas.

Example 1: Doubling the arrival rate



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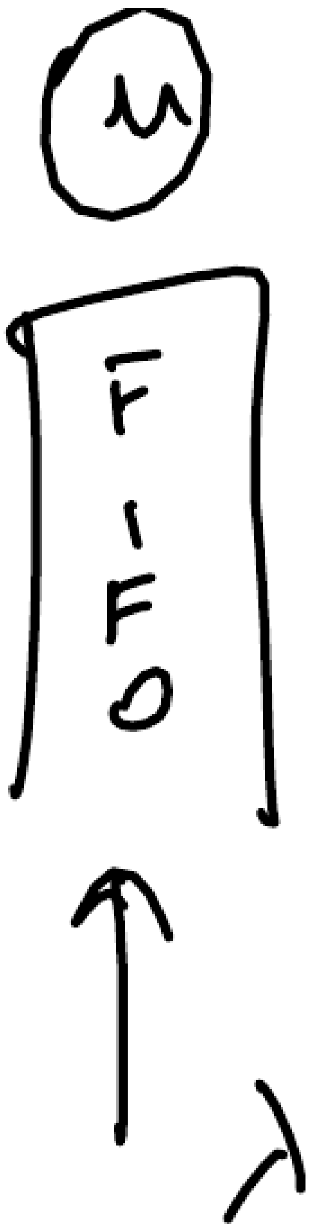

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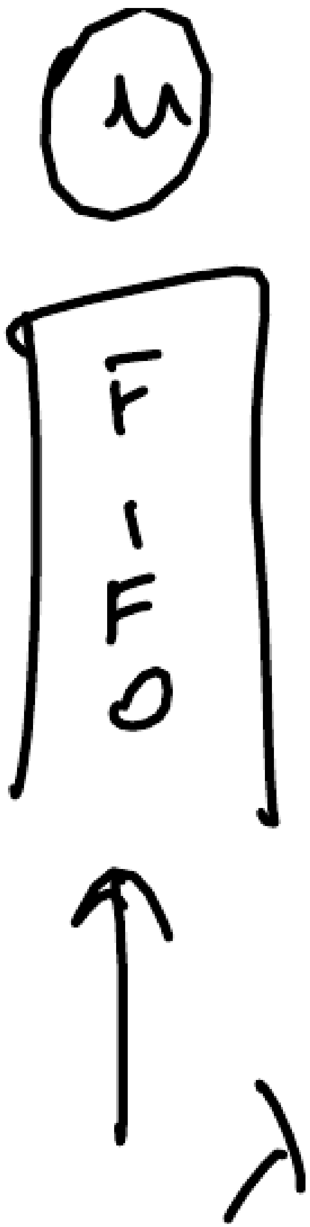

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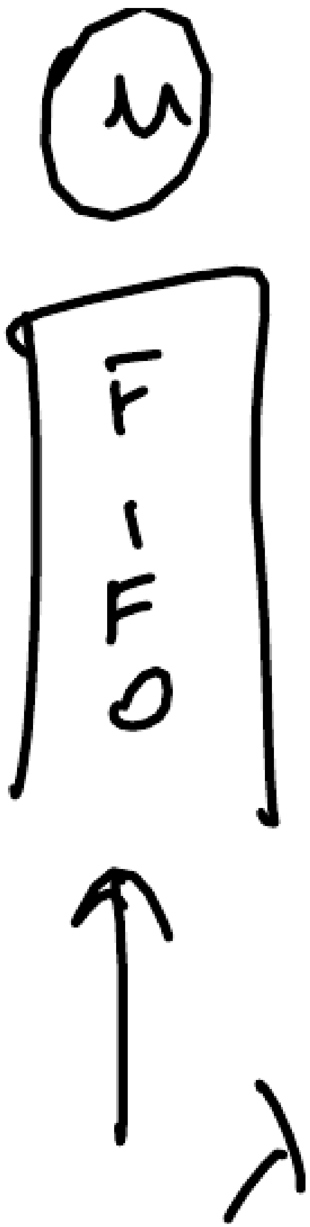

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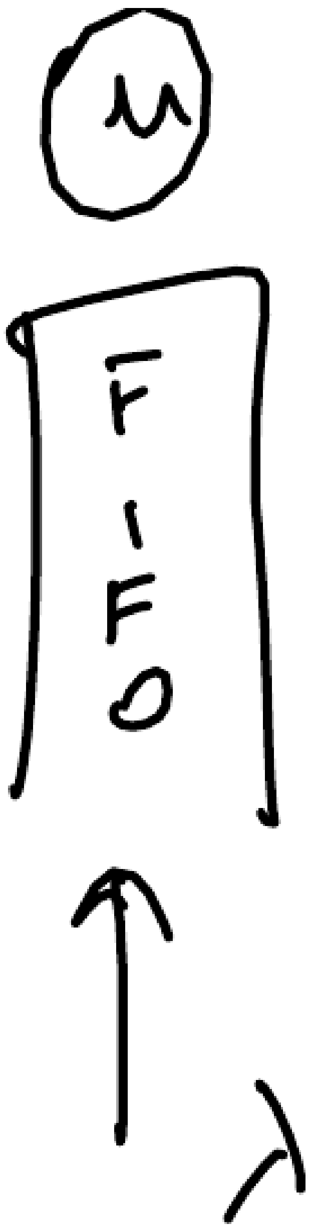

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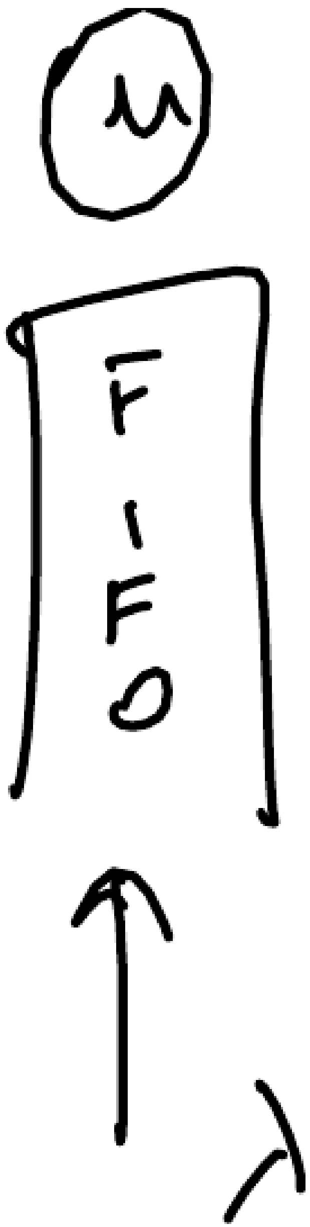

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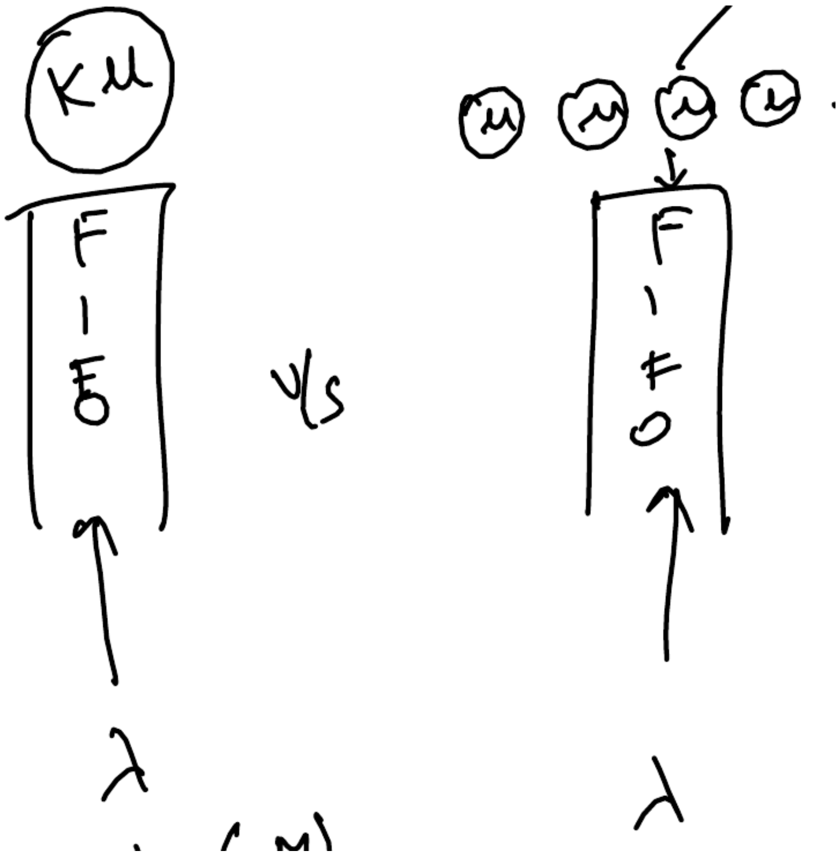
- This course is about making such design choices!

Example 2: A fast server versus many slow servers



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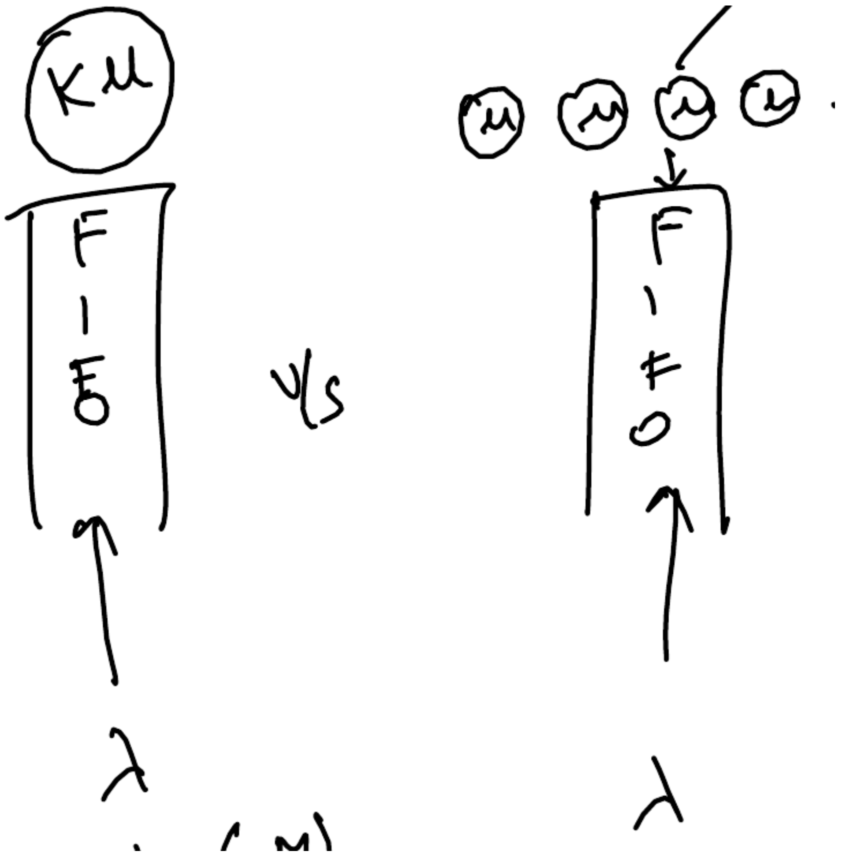

- Which system will have lower $E[T]$?
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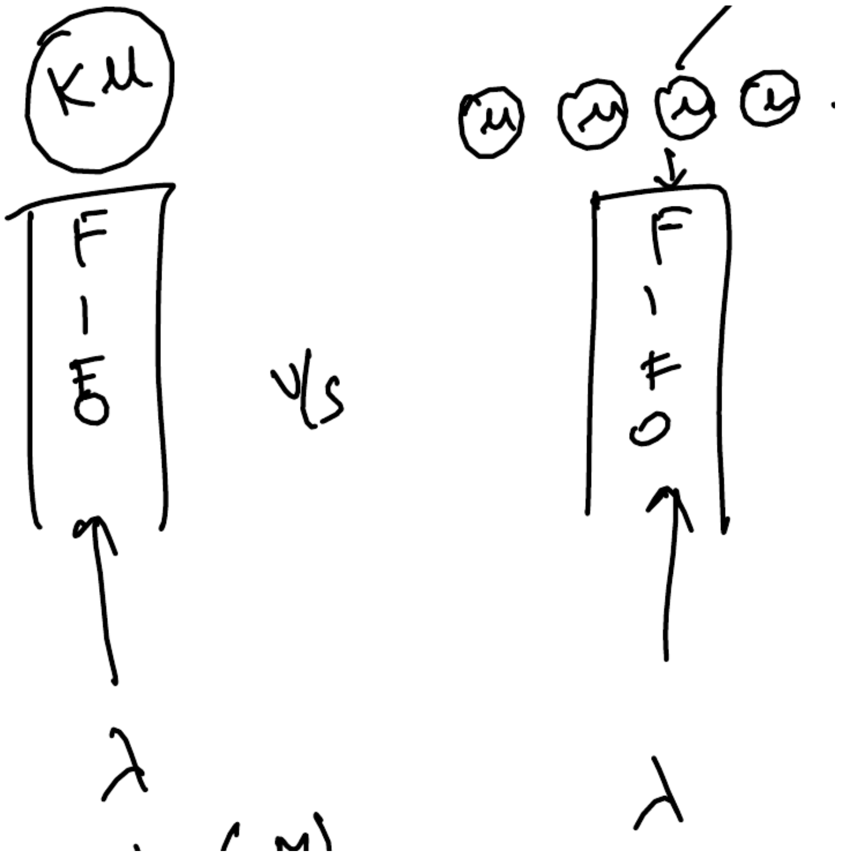

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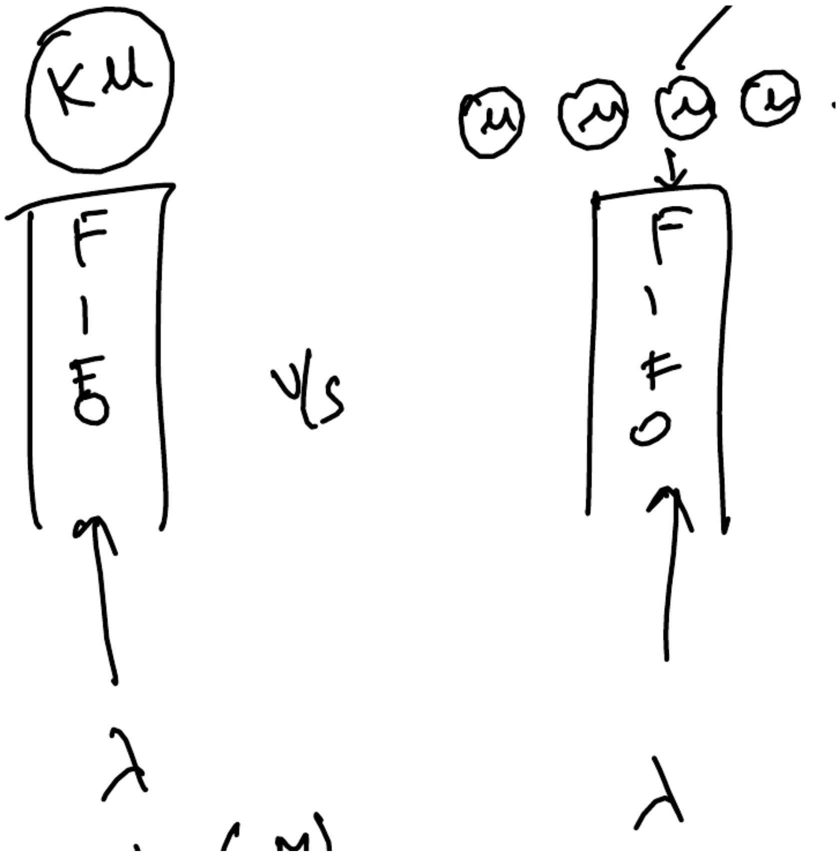

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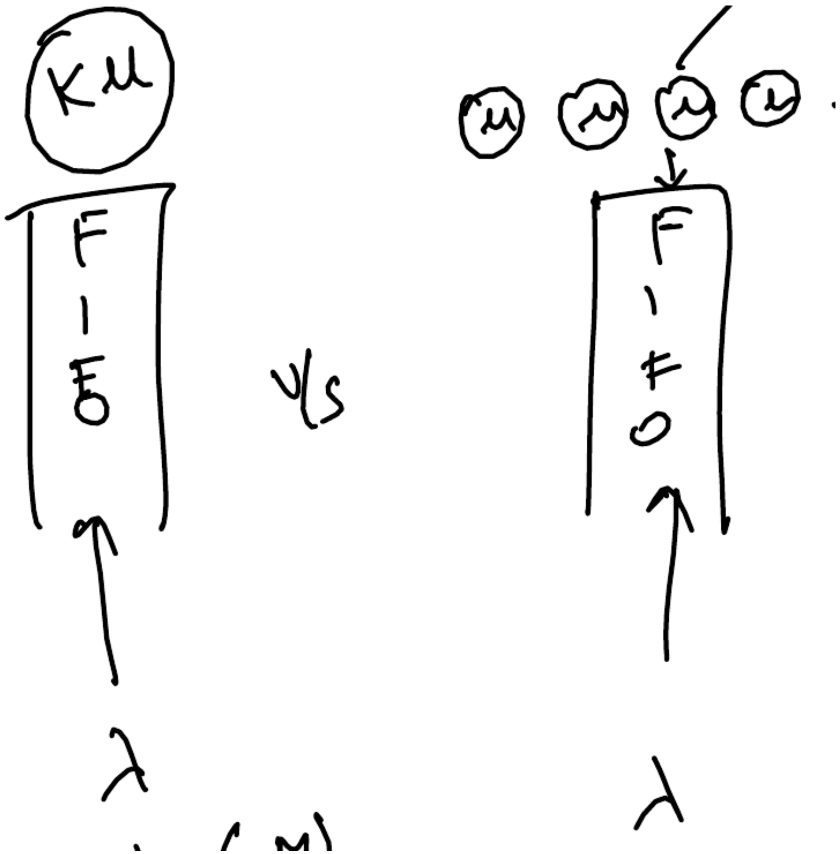

- Which system will have lower $E[T]$?
- Is a fast server ($K\mu$) better that K normal servers (μ)?
- Does job variability impact this decision? Suppose job sizes were XS, S, M, L, XL.
- In the first model, an S, or M job has to possibly wait behind XL. This is avoided in the second scenario.

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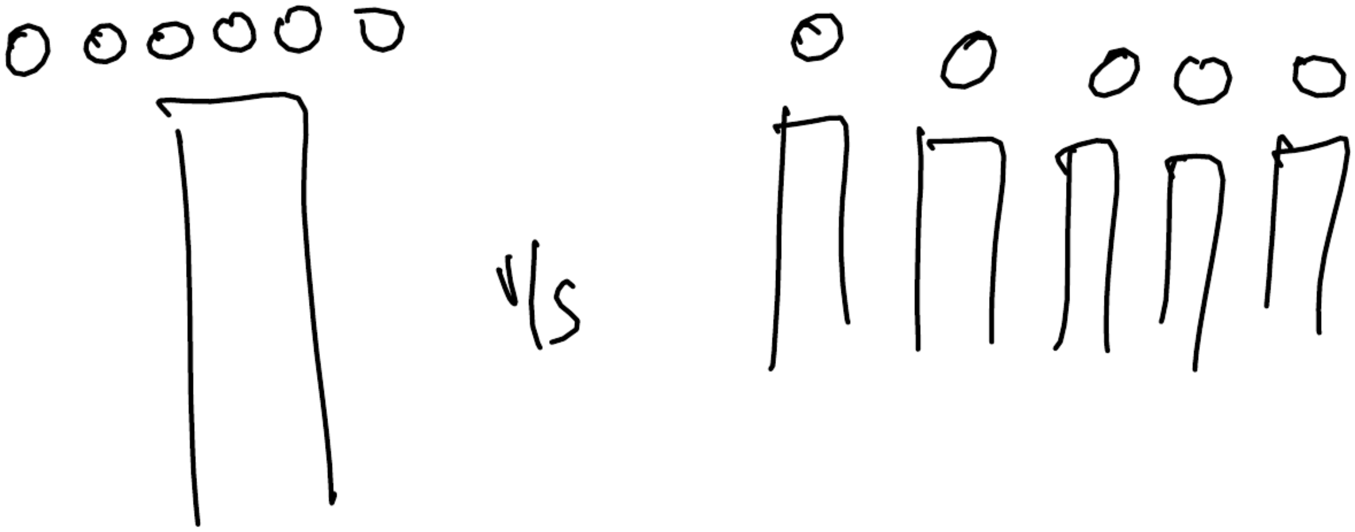

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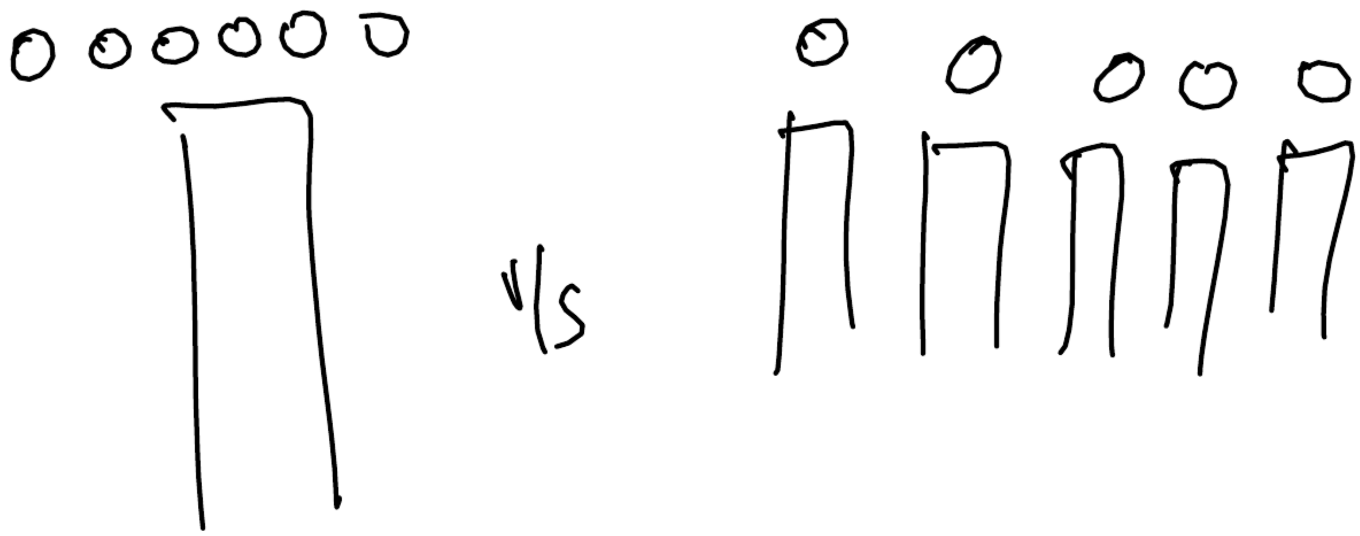

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- Which setting has a lower $E[T]$?

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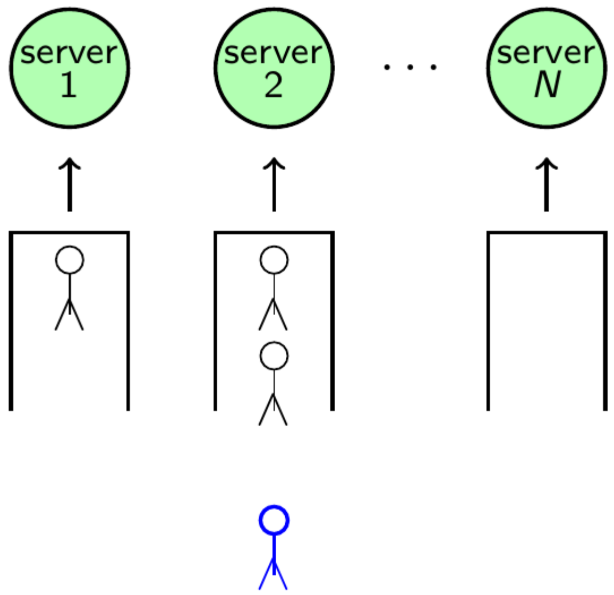
- This course will help you answer such performance modeling questions.

Example 4: Supermarket queue and load balancing



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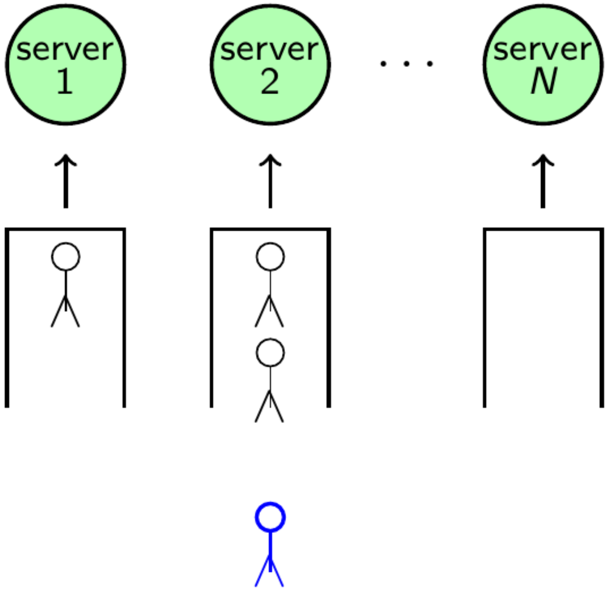

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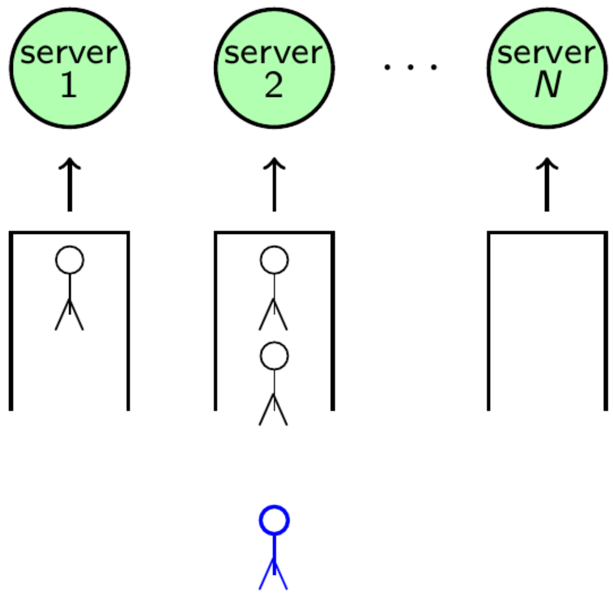

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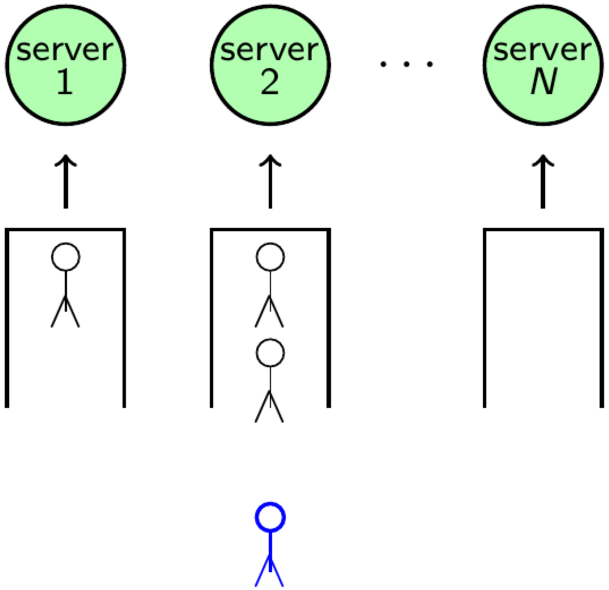

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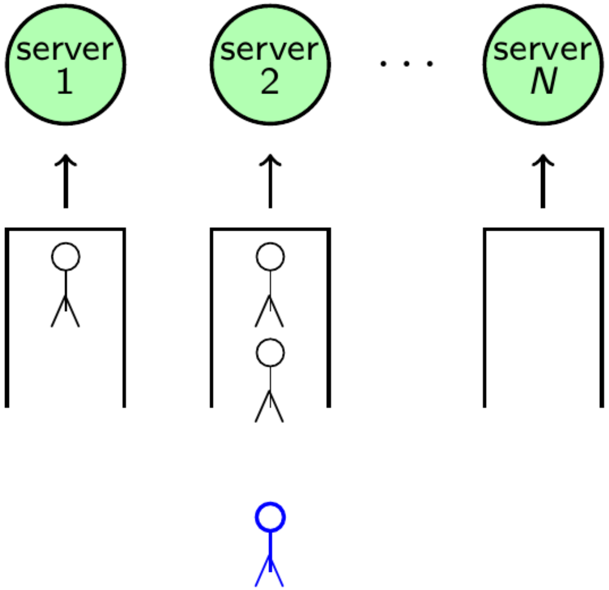

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- Popular policy is Join shortest Queue (JSQ).
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- N is typically large and the overhead in obtaining queue length information is huge ($2N$).

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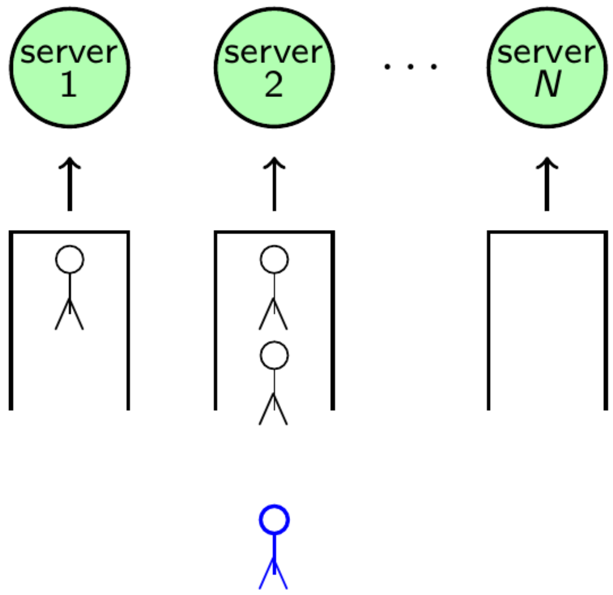

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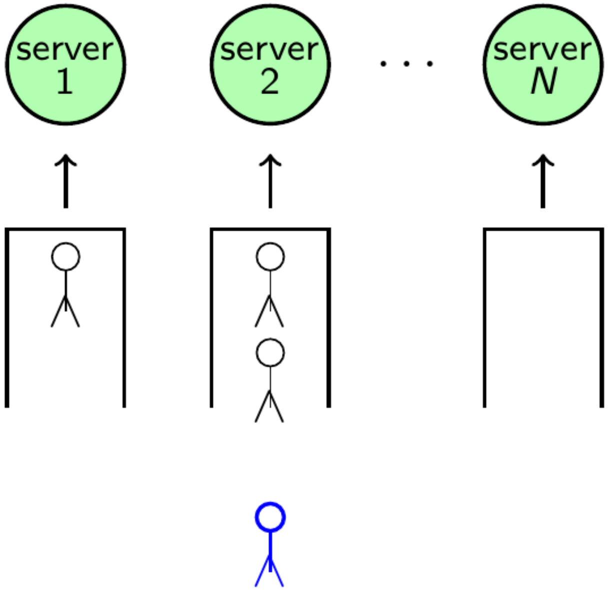

- In that case, sample d servers randomly and join appropriate queue using $JSQ(d)$ or $JSW(d)$.

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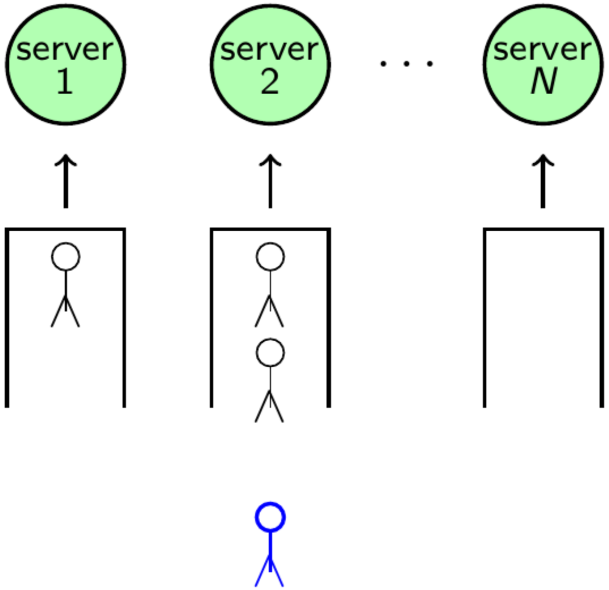

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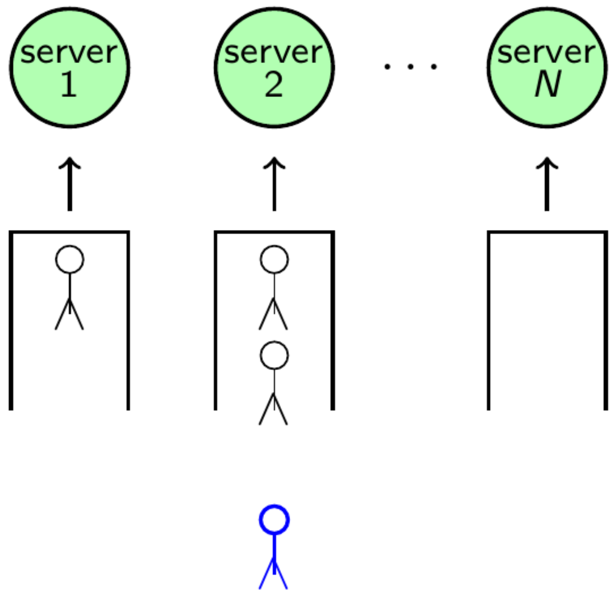

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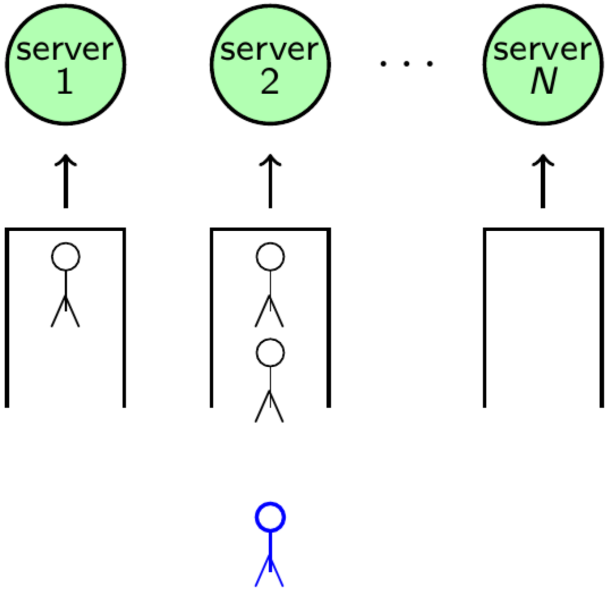

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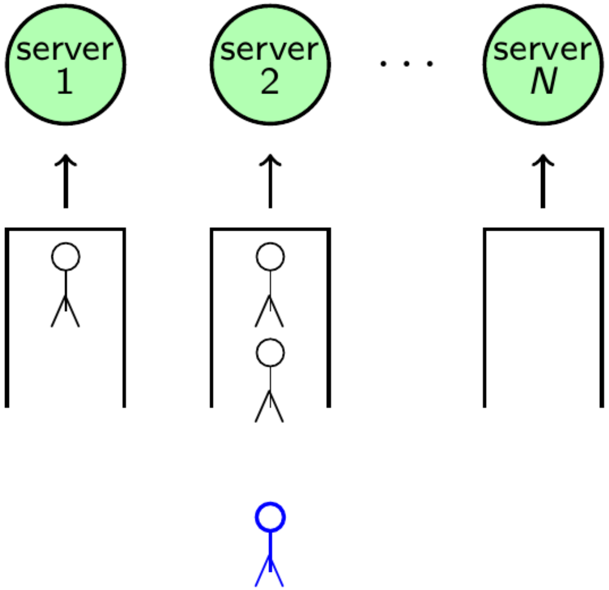

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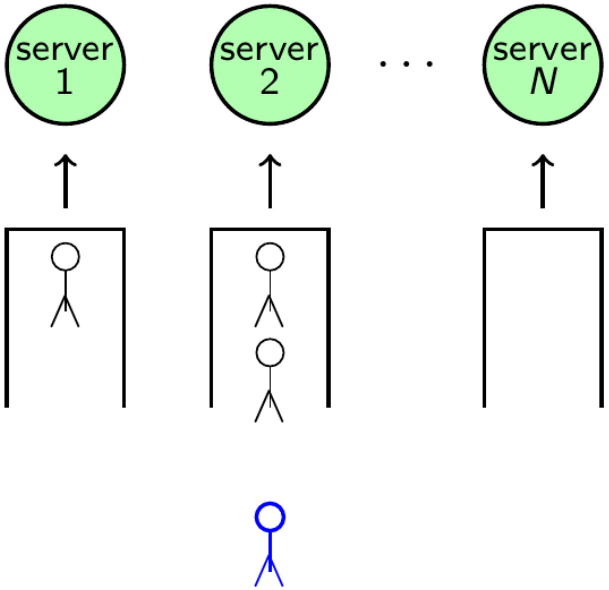

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- How about replicating jobs on d servers and cancelling copies when one copy starts service ?
- This is redundancy-d with cancel on start.
- We do this at super-markets all the time!