COMP9334
Capacity Planning for Computer Systems and Networks

Week 9b: Further applications of queueing

Applications of queueing

- There are plenty and we will look at a few examples
  - The technical papers can be downloaded from the course website (password required)

- Good resource:
  - Sigmetrics
    - http://www.sigmetrics.org
    - A leading conference on performance evaluation of computer systems and networks
  - The journal Performance Evaluation

Determining Multi-programming level

How to determine a good multi-programming level for external scheduling

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DB server – Multi-programming level

- Some database server management systems (DBMS) set an upper limit on the number of active transactions within the system
- This upper limit is called multi-programming level (MPL)

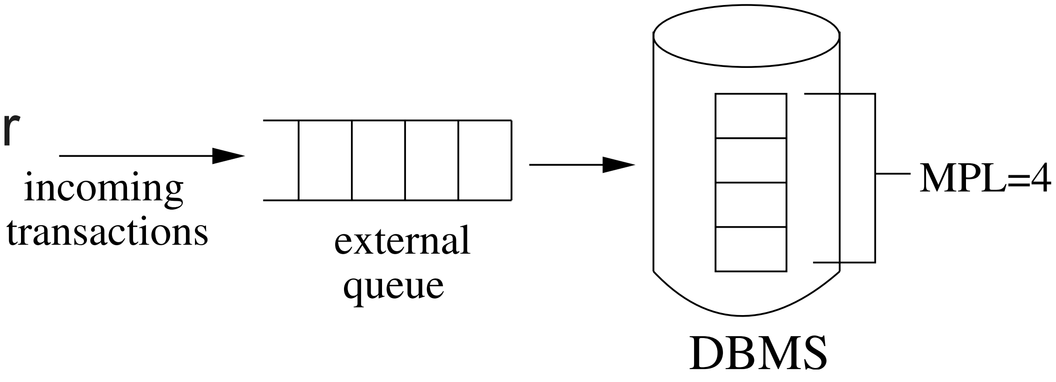
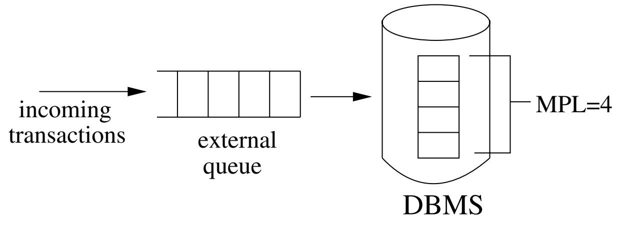


Figure 1. *Simplified view of the mechanism used in external scheduling. A fixed limited number of transactions (MPL=4) are allowed into the DBMS simultaneously. The remaining transactions are held back in an external queue. Response time is the time from when a transaction arrives until it completes, including time spent queueing externally to the DBMS.*

- A help page from SAP explaining MPL
- http://dcx.sap.com/1200/en/dbadmin_en12/running-s-3713576.html
- Picture from Schroder et al. "How to determine a good multi-programming level for external scheduling"

The problem



- To choose a good MPL means you want to determine the mean response time for different choices of MPL
  - If MPL = 1, what is the response time?
  - If MPL = 2, what is the response time?
  - …
- Question: Let us assume that the arrival is Poisson, can you suggest how we can determine the mean response time?
  - Method same as Question 2, Revision Problem of Week 8

Server farm power allocation:

Optimal Power Allocation in Server Farms

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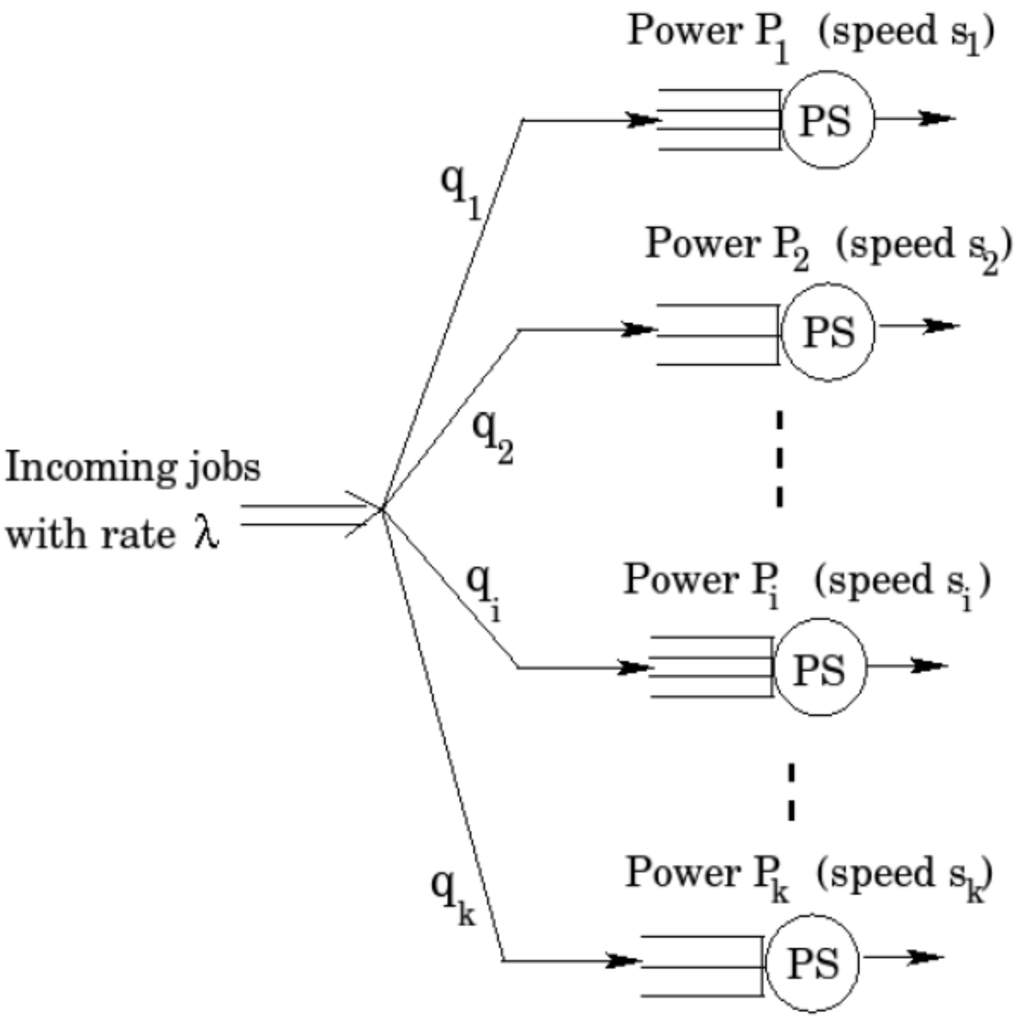
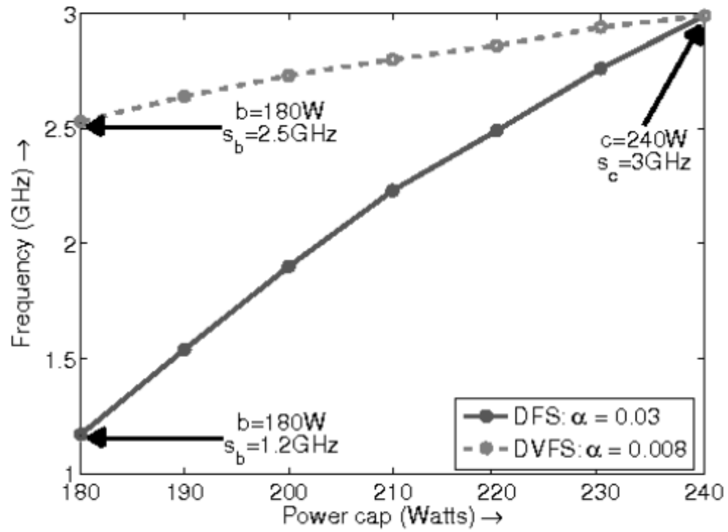
Server farm model

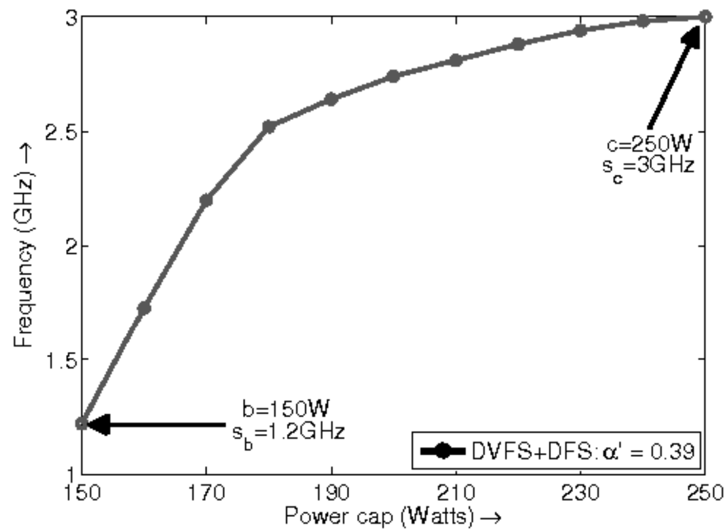


PS stands for processor sharing

Power-frequency curve



(a) DFS and DVFS



(b) DVFS+DFS

Power-to-frequency curves for DFS, DVFS, and DVFS+DFS for the CPU bound LINPACK workload. Fig.(a) illustrates our measurements for DFS and DVFS. In both these mechanisms, we see that the server frequency is linearly related to the power allocated to the server. Fig.(b) illustrates our measurements for DVFS+DFS, where the power-to-frequency curve is better approximated by a cubic relationship.

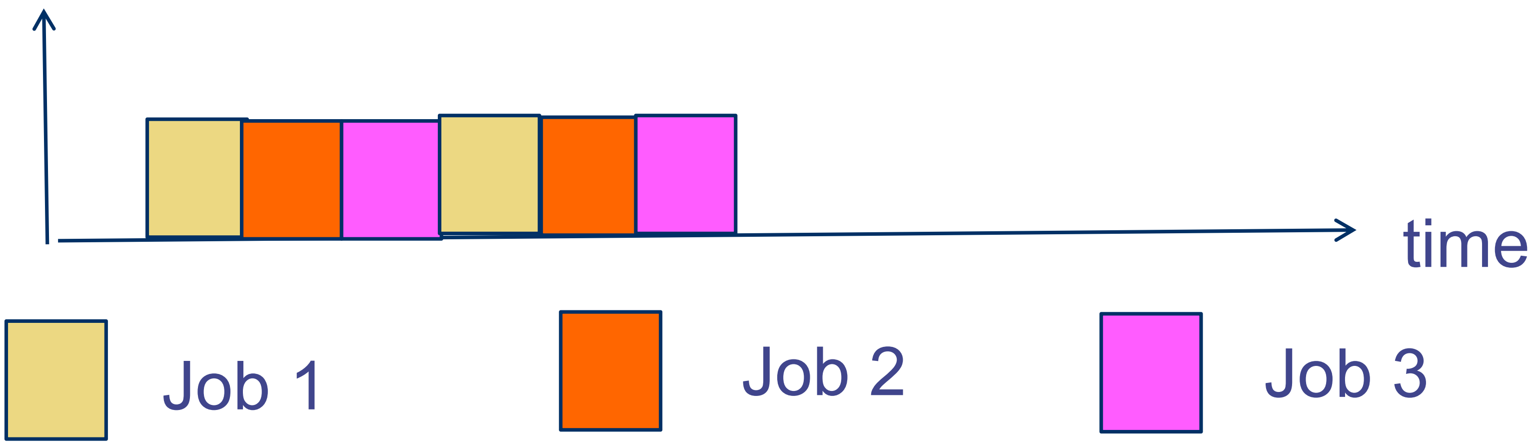
PS stands for processor sharing

The power allocation problem

- A server farm consists of multiple servers
- The servers can run at
  - Higher clock speed with higher power
  - Lower clock speed with lower power
- Ex: Given
  - Higher power = 250W, lower power = 150W
  - Power budget = 3000W
  - You can have
    - 12 servers at highest clock speed
    - 20 servers at lowest clock speed
    - Other combinations
  - Which combination is best?

Processor sharing (PS)

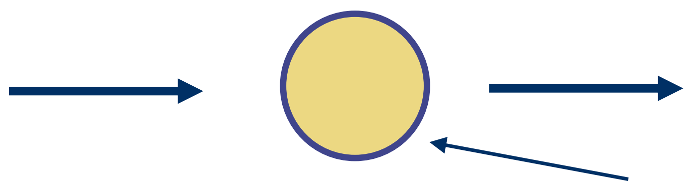
- For many operating systems, the processor works on a job for a quanta and then switch to another job for another quanta



M/G/1/PS

- Poisson arrivals with mean arrival rate λ
- General service time distribution with mean rate μ
- Processing sharing (PS)
- Mean response time

$$= \frac{1}{\mu - \lambda}$$



Processor sharing

Power allocation for 2 servers

- To be worked out during the lecture

Conclusions

- Queueing theory has many applications
- You have learnt the basics of analysis and simulation
- The are a lot of advanced theory and methods that we cannot cover but the basics will enable you to learn more