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Subject: Re: Quals Questions
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EE Quals - Winter 1995 - Mendel Rosenblum

1)
One of the things that operating systems do is manage the hardware
resources of a computer system. Examples of resources include
storage space (memory, disks), processing elements (CPU, I/O devices),
higher level abstractions (open files, network connections, etc).

There are two related techniques used to control resources:
scheduling and allocation.

(a) What's the difference between these techniques?

It is important for the OS not to "lose" track when allocating
storage. Two different techniques are used. One is to have the
OS explicitly track of storage allocation and deallocation. The
other is for the OS not to explicit track but it might need to search
around and find requests when needed.

(b) Describe the tradeoffs between these techniques. Give examples
    when one is better. When would you use each.

ANSWER #1
   (a)
   We usually used scheduling when talking about preemptable resources and
   allocation when talking about non-preemptable resources. Scheduling implies
   "How long" while allocation is "Too whom".

   (b)
   This is basically asking you to compare explicit resource management
   such as reference counting with garbage collection. If you have
   plenty of resources so that you rarely run out, garbage collection can
   result in a lower overhead than explicitly tracking storage. Explicit
   is good when tight controls are needed.

2)
The OS defines the interface to resources and services. This can be thought of
as an user interface for application programmers. It allows user access and
control of resources. Describe issues (tradeoffs) in what should go into
interfaces. What do we look for in such a interface. (goals?)

(Example: Subsystem FS)

(b) Are the differences between interfaces for multiprogramming system and
    personal computers? What? (Optimizations?)

ANSWER #2
   When designing such an interface you need to tradeoff ease of use with
   providing information for optimizations. More information can make
   the OSes job easier but the programmers harder.

   (b)
   Typically, more information is needed in a multiprogramming system to
   handle balancing the system between the users.

Mendel Rosenblum 2005 EE qualifying exam questions:

1) Pipelining
    a) Explain how pipelining allow a CPU to execute faster?
    b) What happens when an instruction executing in a pipeline has an error (e.g. Illegal instruction, Page Fault)?
    c) What can be done to speedup exception processing?
    d) What changes would be needed to a pipeline to support very low overhead exceptions?

2) Translation lookaside buffer (TLB)
    a) What does a TLB do?
    b) Is the TLB typically visible to the software?
    c) How would you design a TLB so that it was invisible to the software including the operating system?
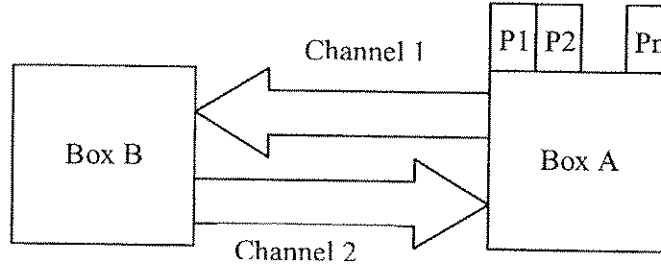
Observation Points:
1) CPU-A Utilization
2) CPU-B Utilization
3) Channel 1 Utilization
4) Channel 2 Utilization

I assume you have given a system with to boxes (Box A and Box B) with communication channels between them. Channel 1 allows Box A to talk to Box B while Channel 2 allows Box B to talk to Box A. Processes (P1 ... Pn) run on Box A send small request to Box B over Channel 1 and get replies back over Channel 2. A process blocks while waiting for the request to return. The system has 4 observation points where the utilizations of CPUs in Box A and Box B and the utilizations of the communication channels can be seen.

Questions
1) Someone studying the system claims that there is a bandwidth problem on Channel 2 that is causing the system to run slow. What would you expect to observe at each of the Observation points?

2) What if the claim was a latency problem on Channel 1? What would be seen at the observation points.

3) Suggest how you could fix a bandwidth problem by adding software to either box A or B. State what assumptions you fix requires.

4) Could increasing the value of n (the number of processes on Box A) help with a bandwidth problem? How about a latency problem?