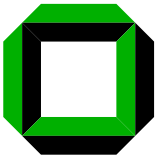

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System Architecture 2008/09
Assignment 11

Question 11.1: Dealing with Priority Inversion

1. Recall the four different protocols to deal with priority inversion that were introduced in the lecture. Describe roughly how each protocol works, and enumerate the advantages and disadvantages of each.
2. Give an example for the occurance of a deadlock when priority inheritance is used.
3. What would happen in this example if the priority ceiling protocol was used instead of priority inheritance?

Question 11.2: Deadlock Immunity

Read the paper [1], and/or have a look at the according slides on the course website.

1. Try to explain the basic idea of *deadlock immunity*, and how *Dimmunix* tries to achieve it.
2. Is a system such as Dimmunix a solution to all deadlock problems?

Question 11.3: Memory Managers

1. Discuss as short as possible but as precisely as necessary the difference between *internal* and *external* fragmentation. Analyze whether the *five specific memory managers* of the lecture exhibit one or even both types of fragmentation.
2. What is the minimal block size you would offer in each of the five specific memory managers?
3. Discuss the difference between a *logical* and a *physical* address.
4. What are the two main disadvantages of a DRAM type main memory?
5. There are some embedded systems without a rotating storage system. However, some of these systems need stable storage. How can you solve this problem?
6. How long does it take to fill up the maximal physical address space of a 64 bit machine if 16 MB can be filled within 1 ms? Guess first, calculate afterwards!

Question 11.4: Memory Allocation Policies

Given a system with 4200 memory cells and the following allocation of blocks in main memory: 1000 blocks starting at 1000, 500 blocks starting at 2900, and 800 blocks starting at 3400.

1. Allocate additional blocks of memory of lengths 500, 1200, and 200 (in that order) according the the *best fit* policy. Show the memory pattern of allocated blocks and remaining holes after each allocation.

2. If the above does not succeed, try to create a sufficiently large hole by compacting allocated blocks towards address 0. Move allocated blocks in ascending order of their starting addresses and continue until the resulting hole is large enough.

Question 11.5: Memory Management Data Structures

Determine the storage space needed to keep track of allocated and free memory using a bitmap as compared to using a (singly or doubly) linked list.
Suppose your system had 128 MB memory, managed in units of n bytes. Assume that each node in the linked list needs a memory address, a length field, and one or two next/prev fields (all 32 bit words). How many bytes of storage are required for the three methods assuming typical use-cases (no memory allocated, all memory allocated, worst case)? Which one is better?

References

[1] Horatiu Jula, Daniel Tralamazza, Cristian Zamfir, and George Candea. Deadlock Immunity: Enabling Systems To Defend Against Deadlocks. In *Proceedings of the 8th USENIX Symposium on Operating Systems Design and Implementation (OSDI)*, 2008.