CS5352 Advanced Operating Systems
Example questions

Question 1: **(7 points)** Suppose that processes have 50% of I/O wait of the total time, each of them needs 10 seconds to complete (including CPU and I/O times), and they start simultaneously. We have a **single** CPU.

   a) Suppose that we have 3 processes. What is the CPU utilization in this case if they run in concurrently? How long will the last one take to complete these 3 processes in the best case, average case, and worst case? Assume that they perform different types of I/0 (no conflicts) *(2 points)*

   b) To obtain the CPU utilization >=0.95 when running simultaneously, what is the minimum number of processes do we need? What is the CPU utilization in this case? *(1 points)*

   c) How many processes can complete in 1 minute in **the best case** if they run in parallel (assuming that there is no I/O conflicts)? Please draw your solution *(1 point)*
   What is the CPU utilization in this case? *(1 point)*

   d) How many processes can complete in 1 minute in **the worst case** if they run in parallel (assuming that there is no I/O conflicts)? Please draw your solution *(1 point)*
   What is the CPU utilization in this case? *(1 point)*

Question 2: **(2 points)** A computer has 16-MB virtual memory and 2-KB pages.

   a) How many entries are needed in the page table if traditional (one-level) paging is used? *(1 point)*

   b) If the physical memory is half size of virtual memory, many page frames are there in the physical memory? *(1 point)*

Question 3: **(3 points)** A computer provides each process with 64KB of address space divided into pages of 4KB. A particular program has a text size of 31 KB, a data size of 17 KB, and a stack size of 15KB bytes.
Each page must contain either text, data, or stack, not a mixture of two or three of them.
Please explain your answers.

   a) Will this program fit in the address space? *(1 point)*

   b) If the page size were 2KB, would it fit? *(1 point)*

   c) If the page size were 1KB, would it fit? *(1 point)*

Question 4: *(1 point)* Contiguous allocation can lead to disk external fragmentation, as mentioned in the text. Please explain why.
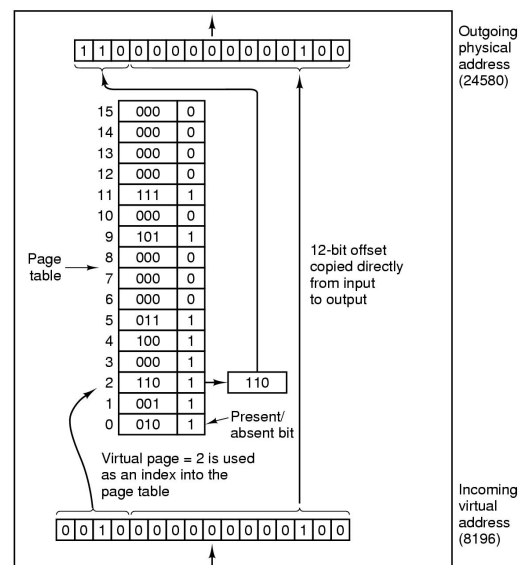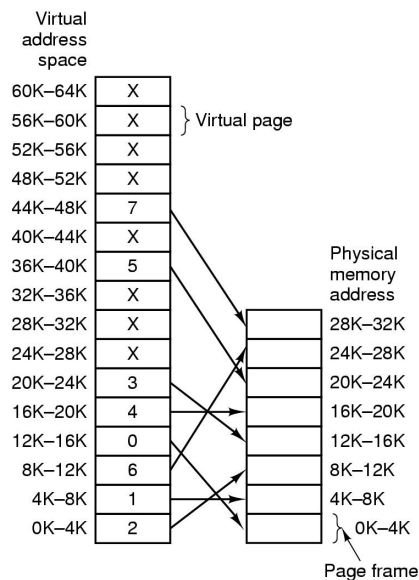
Question 5: *(1 point)* What are the differences between external vs internal fragmentation.

Question 6: *(1 point)* What is Thrashing in operating system.

Question 7: *(1 point)* When does page fault happen? Why does page fault consume a lots of CPU cycles?

Question 8: *(2 points)* In the following figure, we have the relation between virtual addresses and physical memory addresses given by page table.
   a) What is the physical address of #9A24? *(1 point)*
   b) What is the physical address of #EDBC? *(1 point)*

Question 9: *(1 point)*
What is the difference between point-based vs region-based Reinforcement Learning described in the paper: "Swift Machine Learning Model Serving Scheduling: A Region Based Reinforcement Learning Approach"?

Question 10: *(1 point)*
What does Ryoan provide?

Question 11: *(1 point)*
In Sapphire architecture, what are the differences between Deployment Kernel vs. Deployment Manager?

Question 12: *(1 point)*
How does GService handle exceptions (page faults)?

Question 13: *(1 point)*
Can users overwrite the functions controlled by the GServive?

Question 14: *(1 point)*
What is Spark? and how does it work? Explain it in 2-3 sentences.

Question 15: *(1 point)*
What are the requirements (or assumptions) to use Weighted Latest Arrival Processors Sharing with Energy?

Question 16: *(1 point)*
What are the basic differences between Amazon DynamoDB vs. Relational Databases?

Question 17: *(1 point)*
What is Aracme? What does Aracme do?

Question 18: *(1 point)*
Can you compare Static vs. Dynamic Task Scheduling? Pros and cons?

Question 19: *(1 point)*
Why do we need Nori over Existing data-flow systems

Question 20: *(1 point)*
What are the challenges that REPT face? Explain each of them in 1-2 sentences.

Question 21: *(1 point)*
In the paper "Automated Performance Modeling of HPC Applications Using Machine Learning", what machine learning techniques that the authors used to automatic performance modeling of HPC applications?
What are the advantages of the selected machine learning technique?

Question 22: **(1 point)**
Why do we need to perform graph partitioning algorithm for distributed graph storage systems? What are the main criteria/considerations for evaluating the performance of graph partitioning algorithms for distributed graph storage systems?

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