CST 334: Operating Systems

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# OSTEP Chapter 20: Multi-level paging

**Purpose**. We don't want the OS itself to consume lots of resources. A big problem with simple paging is that it consumes lots of memory. Multi-level paging helps a lot, but uses a more complicated data structure than simple paging. The purpose of this assignment is to help you get a solid grip on the mechanics of multi-level paging.

**Instructions**. Read Chapter 20 of the OSTEP text and answer the following questions by downloading and editing [chap20.txt](https://drive.google.com/file/d/1Z8FG_YI3LYTpqaQ7eMcUrcHZOWMJM4gd/view?usp=sharing). Assume that a virtual address is 24 bits: 14 bits for the virtual page number and 10 bits for the offset. Also assume that each page table entry is 4 bytes in size.

1. If we use simple paging, what is the size of a page table, in bytes? (Make sure you get this .right -- the following problems depend on it.)

16384 64kb

1. If we break the page table into page-sized chunks, how many chunks are there in the entire page table?

64

1. If only 25% of the page-sized chunks of the page table are used, what is the total size, in bytes, of all the chunks that are used?

32

1. Assume we move to multi-level paging, and split the VPN part of the virtual address into two parts of 6 bits and 8 bits, where the page directory index is the 6 bit part. Also assume that each page directory entry is 4 bytes in size. What is the total size of the page directory, in bytes?
2. Following on from the previous problems, how much memory is saved if we move from simple paging to multi-level paging? Express your answer as a decimal number between 0 and 1 that equals the number of bytes needed with multi-level paging divided by the number of bytes needed with simple paging. (Assume as before that only 25% of the page-sized chunks are used, and that each page table entry is 4 bytes in size.)

(hint: in the simple paging case we need a full page table; in the multi-level paging case we need a page directory plus any used chunks of the page table.)

**Submission**: Submit your edited chap20.txt on iLearn.

**Grading**: Each problem is worth 10 points.