

Page Table Size

Given 32 bit addressing with a page size of 4KB:

How many bits are needed for the offset? In order to determine this, we need to calculate how many bits are required to index every byte of the 4KB page size. You can perform an incremental search in order to determine the number of bits that are required ($2^1 = 2$, $2^2 = 4$, ...) or just use calculator to determine $\log_2 4096$.

If 12 bits are used for the offset, that leaves 20 bits for page number.

- How many pages can be referenced with 20 bits?
 - Assuming each page entry is 4 bytes, how large will the page table be?
 - Assuming 50 processes are running and each has their own page table, how much memory will be used for all of the page tables?
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A possible solution that would allow for a more manageable page table would be a multi-level page table. The first table would index the second set of tables. A multi-level framework would allow for the second set of tables to be written to disk and not have to stay in memory. In order to introduce this concept, let's decrease the size of the address space in order to help our initial understanding.

Assuming an 8 bit address space where the page size is 16 bytes.

- How many bits must be used for the offset?
- How many bits will be used for the page number?
- How many total pages can be addressed?

Draw a small diagram to help you to understand.

Given the above example, implement a **multi-level framework** for the page table. Split the first 4 bits in half where the first 2 bits will represent the outer page table and the second 2 bits will represent the page table.

- How many bits will you use for the first level page table?
- How many bits will you use for the second level?
- How many second level tables will there be?
- How many total pages can be addressed?

Draw a diagram to help you to understand.

Now that we have a better understanding of a multi-level framework using an 8 bit address space, let's increase the number of addressing bits to 16. Assuming a page size of 256bytes:

- How many bits must be used for the offset?

- How many bits will be used for the first page table?
- How many bits will be used for the secondary page tables?
- How many total pages can be addressed?