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COEN 241
B4

**1) A typical BCube3 uses 8-port mini-switches, how many servers it can it support? How many total switches it needs?**

$n = 8$
$k = 3$

number of servers supported: $8^{3+1} = 4096$
number of total switches: $(3 + 1) * 8^3 = 2048$

The number of 8-port switches needed is **4096**
The number of total servers that it can support is **2048 (512 switches at each layer for 4 layers)**

**2) Consider a multicore processor with four heterogeneous cores labeled A, B, C, and D. Assume core A and D have the same speed. Core B runs twice as fast as core A, and core C runs three times faster than core A. Assume that all 4 cores start executing the following application at the same time and no cache misses are encountered in all core operations. Suppose an application needs to compute the square of each element of an array of 256 elements. Assume 1 unit of time for core A and D to compute the square of an element. Thus core B takes 1⁄2 unit time and core C takes 1/3 unit time to compute the square of an element. Given the following division of labor in four cores: core A 32 elements, core B 128 elements, core C 64 elements, core D 32 elements.**

**a) Compute the total execution time (in time units) for using the 4- core processor to compute the square of 256 elements in parallel. The four cores have different speed. Some after cores finish the job and may become idle, while others are still busy computing until all squares are computed.**

| Core | Number of elements | Time units to complete task |
|:---:|:---:|:---:|
| A | 32 | 32 |
| B | 128 | 64 |
| C | 64 | 21.333 |
| D | 32 | 32 |

As we can see, the core which takes the longest to complete is core B which takes 64 time units.  Therefore, the total execution time  for this 4-core processor in parallel is **64 time units**.

**b) Calculate the processor utilization rate, which is the total amount of time the cores are busy (not idle) divided by the total execution time they are using all cores in the processor to execute the above application.**

The total time the cores are busy is $32 + 64 + 21.333 + 32 = 149.33$
The total execution time all cores are using is $64 * 4 = 256$

$$\frac{149.33}{256} = 0.583$$

Therefore, the processor utilization rate is **0.583**