CMPE 110 Homework #1

John Allard
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ID : 1437547

1. Question #1 - Power

   (a) Question #1A : '...However, we discussed that nowadays power density and heat has become an issue preventing scaling of frequency. Discuss why power and temperature are becoming an issue'. **Answer :**

   (b) Question #1B : Given the rough formulations governing power and frequency for each voltage region, discuss which region (consider Near and Super-threshold only) is more energy efficient. **Answer :**
   To start, we will make the following assumptions.

$$\text{Given } k \in \mathbb{R}^+ :$$

$$\text{Near-threshold voltage } = V_{nth} = k, \text{ Super-threshold voltage } = V_{sth} = 2k : k \in \mathbb{R}^+$$

$$\text{Power} \propto V^3, \text{ Delay } \propto \frac{1}{V}, \text{ Energy } \propto \text{ Power } \times \text{ Delay}$$

$$\text{Energy Efficiency } \propto \text{ Energy } \times \text{ Delay } = \text{ Power } \times \text{ Delay}^2$$

   The energy efficiency can then be calculated for both the near and super threshold voltage levels, as shown below.

Near-Threshold	Super-Threshold
$P_{nth} = V_{nth}^3 = k^3$	$P_sth = V_{sth}^3 = (2k)^3 = 8k$
$D_{nth} = \frac{1}{V_{nth}} = \frac{1}{k}$	$D_{sth} = \frac{1}{2k}$
$E_{nth} = P_{nth} * D_{nth} = \frac{k^3}{k} = k^2$	$E_{sth} = P_{sth} * D_{sth} = \frac{8k^3}{2k} = 4k^2$
$EE_{nth} = E_{nth} * D_{nth} = \frac{k^2}{k} = k$	$EE_{sth} = E_{sth} * D_{sth} = \frac{4k^2}{2k} = 2k$

   Thus voltage levels that are near the threshold are more energy efficient.

2. Question #2 Computing ISA's

   (a) Question #2A x86 CISC ISA
   Fill out the first row of the above table (from the handout), but assume 32-bit data values.
   Answer :

   (b)

3. Provide the output for each of the following code statements.

4. For each of the following items, identify whether the caller fucntion or the callee function performs the actions.

5. TODO

6. Write a C program that computes the pig-latin translation of an english word.