

*In The Name of God*

# Computer Architecture Homework 1

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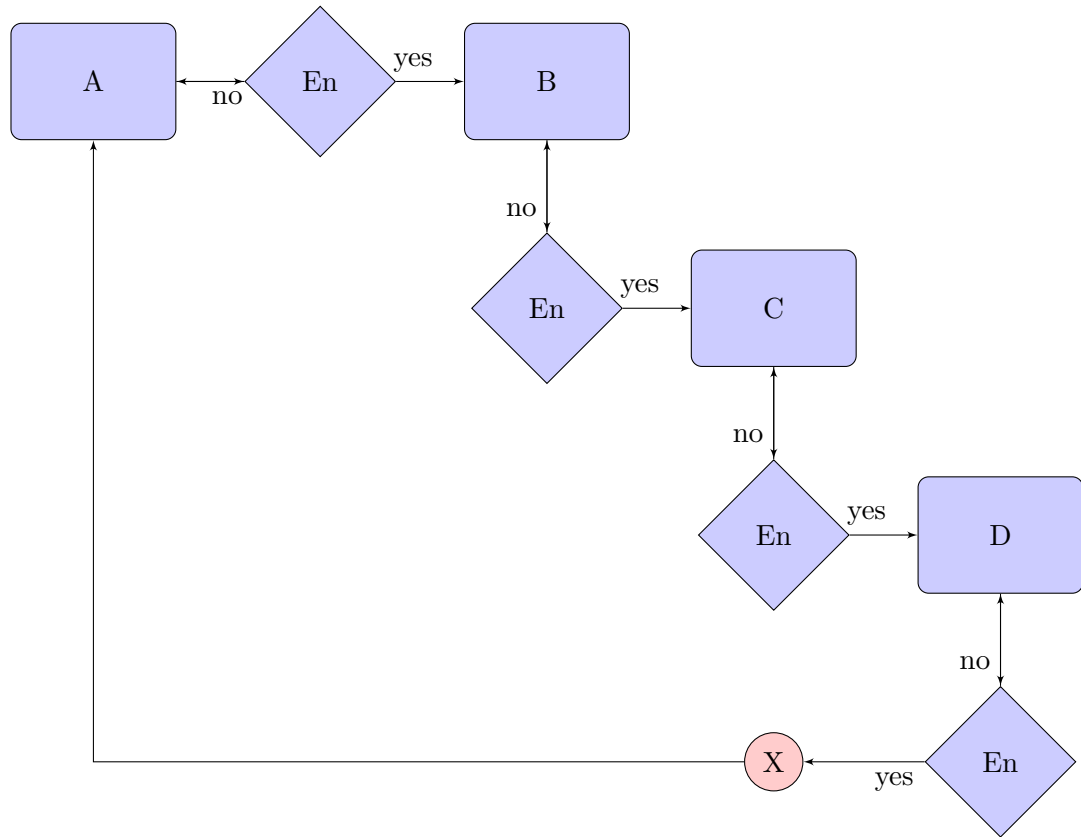
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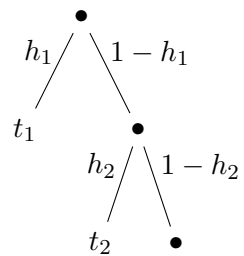
## 1 Problem 1



## 2 Problem 2

1

2 According to following diagram :



- Average Memory Access Time, the exact formula

$$t_1 + (1 - h_1) * [t_2 + (1 - h_2) * [\dots]] \quad (1)$$

- Average Memory Access Time, an approximate formula

$$h_1 * t_1 + (1 - h_1)[h_2 * t_2 + (1 - h_2) * [\dots]] \quad (2)$$

### 3

- Average Memory Access Time, the exact formula

$$t_1 + (1 - h_1) * t_2 + (1 - h_1) * (1 - h_2) * t_3 + (1 - h_1) * (1 - h_2) * (1 - h_3) * t_4 \quad (3)$$

- Average Memory Access Time, an approximate formula

$$h_1 * t_1 + (1 - h_1) * h_2 * t_2 + (1 - h_1) * (1 - h_2) * h_3 * t_3 + (1 - h_1) * (1 - h_2) * (1 - h_3) * h_4 * t_4 \quad (4)$$

### 4

5 Substituting  $2ns$  for  $t_1$ ,  $0.25$  for  $h_1$ ,  $2ns$  for  $t_2$ ,  $0.36$  for  $h_2$ ,  $4ns$  for  $t_3$ ,  $0.54$  for  $h_3$ ,  $5ns$  for  $t_4$ ,  $0.76$  for  $h_4$ , in (??) gives us:

$$\begin{aligned} \bar{T} &= 0.25 * 2 + (1 - 0.25) * 0.36 * 2 + (1 - 0.25) * (1 - 0.36) * 0.54 * 4 + \\ &\quad (1 - 0.25) * (1 - 0.36) * (1 - 0.54) * 0.76 * 5 \\ &= 0.5 + 0.75 * 0.36 * 2 + 0.75 * 0.64 * 0.54 * 4 + 0.75 * 0.64 * 0.46 * 0.76 * 5 \\ &= 0.50 + 0.54 + 1.00 + 0.80 \\ &= 2.84ns \end{aligned}$$

## 3 Problem 3

The following is the avrage memory access time equlation for memory with 3 level:

$$\bar{T} = h_1 * t_1 + (1 - h_1) * h_2 * t_2 + (1 - h_1) * (1 - h_2) * h_3 * t_3 \quad (5)$$

Substituting  $1ns$  for  $t_1$ ,  $0.9$  for  $h_1$ ,  $10ns$  for  $t_2$ ,  $0.5$  for  $h_2$ ,  $1000ns$  for  $t_3$  and  $1$  for  $h_3$  in (??) gives us:

$$\begin{aligned}
 \bar{T} &= 0.9 * 1 + (1 - 0.9) * 0.5 * 10 + (1 - 0.9) * (1 - 0.5) * 1000 \\
 &= 0.9 + 0.1 * 0.5 * 10 + 0.1 * 0.5 * 1000 \\
 &= 0.9 + 0.5 * 10 + 0.5 * 1000 \\
 &= 0.9 + 5 + 500.00 \\
 &= 505.9ns
 \end{aligned}$$

#### 4 Problem 4

Substituting  $1ns$  for  $t_1$ ,  $0.9$  for  $h_1$ ,  $10ns$  for  $t_2$ ,  $0.5$  for  $h_2$ ,  $8ns$  for  $t_3$ ,  $0.63$  for  $h_3$ ,  $1000ns$  for  $t_4$ ,  $1$  for  $h_3$ , in (??) gives us:

$$\begin{aligned}
 \bar{T} &= 0.9 * 1 + (1 - 0.9) * 0.5 * 10 + (1 - 0.9) * (1 - 0.5) * 0.63 * 8 + \\
 &\quad (1 - 0.9) * (1 - 0.5) * (1 - 0.63) * 1000 \\
 &= 0.9 * 1 + 0.1 * 0.5 * 10 + 0.1 * 0.5 * 0.63 * 8 + 0.1 * 0.5 * 0.37 * 1000 \\
 &= 0.90 + 0.50 * 10 + 0.31 * 8 + 0.18 * 1000 \\
 &= 0.90 + 5.00 + 2.48 + 180.00 \\
 &= 188.38ns
 \end{aligned}$$

#### 5 Problem 5

**1** Address bits = 14 bits,      Length = 2 bytes,      Width =  $2^{14}$  words,  
The smallest unit available = 16 bits.

**2** Address bits = 15 bits,      Length = 2 bytes,      Width =  $2^{15}$  words,  
The smallest unit available = 16 bits.

**3** Address bits = 15 bits,      Length = 1 bytes,      Width =  $2^{15}$  words,  
The smallest unit available = 8 bits.

**4** Address bits = 13 bits,      Length = 4 bytes,      Width =  $2^{13}$  words,  
The smallest unit available = 32 bits.