EGC442
Class Notes
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1. Voltage = 4 V, frequency = 1 GHz, and dynamic power = 3 W. Frequency is increased to 6 GHz. What is the new dynamic power?

$P_{total} = P_d + P_{static}$

$P_d = C V^2 f$

$3W = C \times 4^2 \times 1GHz \rightarrow C = \frac{3}{16}$

$18W = \frac{3}{16} \times 4^2 \times 6$

2. Voltage = 4 V, frequency = 1 GHz, and dynamic power = 3 W. Voltage is decreased to 2 V. What is the new dynamic power?

$$P = C V^2 f$$

$$\frac{3W}{P} = \frac{C \times 4^2 \times 1\,GHz}{C \times 2^2 \times 1\,GHz}$$

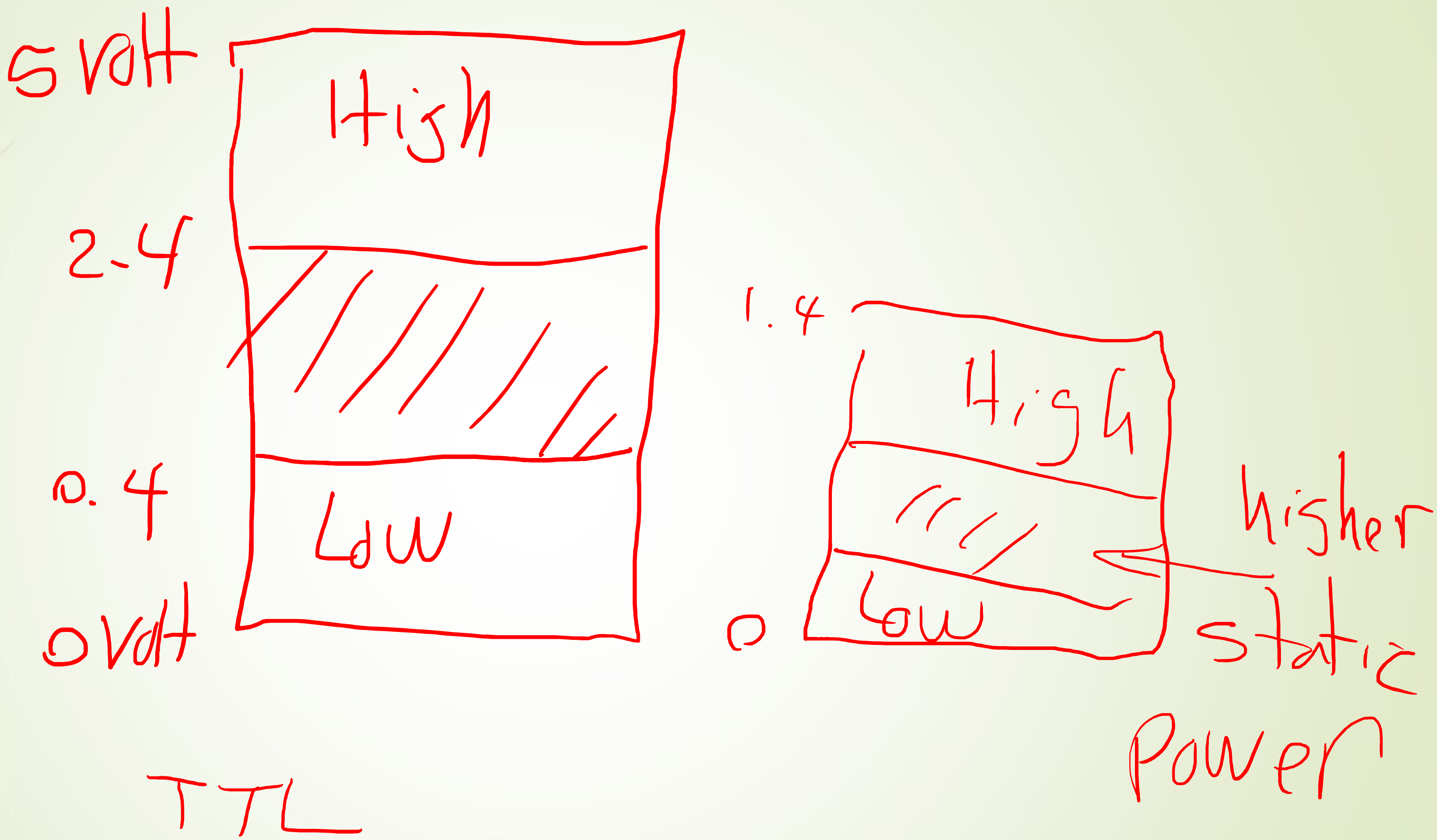
$$P = \frac{3}{4}\,W$$

3. Processor A has 75% of the capacitive load of processor B. Processor A also has a 20% voltage reduction and 10% shrink in frequency. What is the relative impact on dynamic power?

$$P_B = C_B V_B^2 f_B$$

$$P_A = .75 C_B (.8 V_B)^2 .9 f_B$$

$$= .75 * .8^2 * .9 \; P_B$$


5 volt
High
2.4
0.4
Low
0 volt
TTL
1.4
High
0
Low
higher
static
power

13. How should programmers write code to maximize the benefits of parallel programming? Divide a program into sub-tasks so all processors run about the same amount of time

15. A program runs in 100 seconds. Multiply operations are responsible for 30 of those seconds. If extensive designer effort is applied such that multiply operations are made to run 2 times faster, what is the program's new execution time?

20 sec Div.

$100 = 30 + 70$

total exec. | mult. | others

mult. ↓ 2x; others ↓ constant

$85 = 15 + 70$

M | D | rest

$100 = 30 + 20 + 50$

3X | 2X | Const

$70 = 10 + 10 + 50$

overall by factor of 2

$50 = 0 + 0 + 50$ No Way

Example: Suppose a program runs in 100 seconds on a machine, with multiply responsible for 80 seconds of this time. How much do we have to improve the speed of multiplication if we want the program to run 4 times faster?

$100 = 80 + 20$

mult. others

4X faster

16X

$25 = 5 + 20$

5X

$20 = \emptyset + 20$

Given: b = 2, c = 5, d = 1.

26. add a, b, c , Final value of a is ____.

dst. SRC 1 SRC 2

$a \leftarrow b+c$

$7 \leftarrow 2+5$

19. Consider the following performance measurements for a program:

Measurement	Computer A	Computer B
Instruction count	10 billion	8 billion
Clock rate	4 GHz	4 GHz
CPI	1.0	1.1

$$MIPS_A = \frac{10 \times 10^9}{1 \times 10^6 \times 2.5} = 4000$$

$$MIPS_B = \frac{8 \times 10^9}{1 \times 10^6 \times 2.2} = 3636$$

$$Tex_A = 10 \times 10^9 \times \frac{1}{4 \times 10^9} \times 1 = 2.5 \text{ sec}$$

$$Tex_B = 8 \times 10^9 \times 1.1 \times \frac{1}{4 \times 10^9} = 2.2 \text{ sec}$$

16. If some aspect of a computer accounts for 50% of program execution time, what is the limit on how many times faster programs can run if engineers focus on improving that aspect?

$t = t_{improv} + t_{same}$

$t = .5t + .5t$

most ↓

$t = \emptyset + .5t$

$\therefore$ At most 2x faster

30. For a given function, which programming language likely takes the most lines of source code?

- Java
- C
- **MIPS assembly language**

lw rt, (rs) d16

rs = 20000

d16 = 408

address → 20408

lw → load word → 32 bit

rt ← M[rs + d16]

rt ← 12345678

sw rt → M[rs + d16]