

Mary Mitchell

COMP 4300

Midterm 1

March 3, 2022

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1)  $\frac{1}{3}$  time : jump

$S = 4$

$$\frac{1}{(1 - \frac{1}{3}) + (\frac{1}{3})/4} = \frac{4}{3}$$

$$\text{speedup} = \frac{\text{execution time w/o optim.}}{\text{execution time w/ optim.}} = \frac{(1-f) + f}{(1-f) + f/S}$$

$$\begin{aligned} \text{execution time with optimization} &= (1-f) + f/S \\ &= (1 - \frac{1}{3}) + \frac{\frac{1}{3}}{4} \\ &= \frac{3}{4} \end{aligned}$$

2)  $S = 0000\ 0000\ 0101$

sign magg =  $1000\ 0000\ 0101$

two's comp =  $1111\ 1111\ 1011$

3) CLA ~~0100~~  $11\ 010\ 000\ 000$

TAD  $001110\ 010\ 001$

TAD  $001110\ 010\ 010$

DCA  $011110\ 010\ 001$

HLT  $111\ 100\ 000\ 010$

data  $1111\ 1111\ 1011$

4) Code size with RISC is typically larger. This is because the instructions in RISC do much less than CISC instructions. CISC instructions are complicated but this means each instruction can do more than one of RISC's simpler instructions. This means that RISC programs will have to use more instructions to accomplish what just one CISC instruction can do. Therefore, RISC code size is bigger.

5) The IBM System/360. This was because it had backwards/forwards compatibility. ~~For~~ So future computers did not have an entirely new instruction set and were still compatible with past architectures.

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6) The 80x86 has a CISC design. While 80x86 processors recently have used hardware to translate instructions into a RISC-like design, it is still a CISC processor. It's instructions are variable length, and has complicated instruction decoding. Programs for 80x86 are also usually smaller than those for RISC-V because each instruction does more.

7) x after 15

z after 5

w after 30

$$20\text{ns} + 30\text{ns} = \cancel{50\text{ns}} \quad 50\text{ns}$$

8) 25 ns

$$9) \text{Avg. CPI} = (1 \times 0.30) + (4 \times 0.07) + (5 \times 0.25) + (3 \times 0.62) = 3.69$$

10) Optimization A:

$$\frac{IC \times CT \times CPI_{orig}}{IC \times (0.8) CT \times CPI_A}$$
$$CPI_A = (1 \times 0.30) + (4 \times 0.07) + (4 \times 0.25) + (3 \times 0.62) = 3.38$$
$$\frac{CPI_{orig}}{(0.8) CPI_A} = \frac{3.69}{(0.8)(3.38)} = 1.365$$

Optimization B:

$$\frac{IC \times CT \times CPI_{orig}}{IC \times (1.05) CT \times CPI_B}$$
$$CPI_B = (1 \times 0.30) + (3 \times 0.07) + (5 \times 0.25) + (3 \times 0.62) = 3.62$$
$$\frac{CPI_{orig}}{(1.05) CPI_B} = \frac{3.69}{3.801} = 0.97$$

Optimization A

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11) Since the 8080 can have variable length instructions it is probably harder to decode. Since the RISC-V and PDP 8 have fixed instruction lengths, finding and decoding each part of the instruction is easier.

12) fan MTF = 1 year

Power MTF = 5 years

$$\text{prob}_{\text{sys}} = \frac{1}{1 \text{ year}} + \frac{1}{5 \text{ years}} = \frac{6}{5 \text{ years}}$$

$$\text{MTF}_{\text{sys}} = \frac{1}{\text{prob}_{\text{sys}}} = \frac{1}{6 / 5 \text{ years}} = \boxed{\frac{5 \text{ years}}{6}}$$