

Hadassah Academic College

Department of Computer Science

Computer Architecture

Exercise 2

1. The formula for the SPEC score of a computer under test is:

$$\text{SPEC}_{\text{REF}}(\text{test}) = \left[\prod_{i=1}^n \frac{T_i^{\text{REF}}}{T_i^{\text{test}}} \right]^{1/n}$$

Given the SPEC scores for two computers, the test computer and computer A, prove that the score for computer test relative to computer A (using computer A instead of the reference computer REF) is given by

$$\text{SPEC}_A(\text{test}) = \frac{\text{SPEC}_{\text{REF}}(\text{test})}{\text{SPEC}_{\text{REF}}(A)}$$

2. The following are test results on SPEC CINT2017 for two Intel CPUs:
(<http://www.spec.org/cpu2017/results/cint2017.html>)

CPU	Clock Rate	Cores	Parallel Compilation	Cint2017
Xeon Gold 6146	3.40 GHZ	48	Yes	10.57
Xeon Platinum 8153	2.20 GHZ	64	Yes	7.70

- A. Which processor is faster? Explain.
B. Find the speedup of the 6146 relative to the 8153.
C. According to the formula

$$S = \frac{T^{\text{old}}}{T^{\text{new}}} = \frac{\text{program clock cycles}^{\text{old}}}{\text{program clock cycles}^{\text{new}}} \times \frac{\text{clock rate}^{\text{new}}}{\text{clock rate}^{\text{old}}}$$

Find the ratio of the clock cycles required to run a program on the 8153 relative to the 6146.

- D. If the clock rate for both CPUs were the same, which processor would be faster?
3. Translate the following instructions to the formal definition language, as in the example
- ADD R2, R9, (1001)** **Regs[R2] ← Regs[R9] + Mem[1001]**

1. **SUB R2, 12, 4(R4)**

2. **MULT R2, R3, 10(R4)**

3. **ADD R4, R5, (R2 + R3)**

4. **ADD (R2)+, R4, R5**

(d = 4)

5. **SUB 100(R6)[R4], R9, 12**

(d = 8)
4. Write the sequence of operations required to perform $Z = 5*W + 2*X - 4*Y$ for each of the four processor structures:

- A. stack
B. accumulator
C. register-memory
D. register-register