Hadassah Academic College
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Advanced Computer Architecture — Exercise 1

1. After some structural enhancement to a CPU, the run time of 85% of instructions in a typical program run 50% faster, and 10% of the program runs only half as fast. The run time of 5% of the program is unchanged. Find the overall speedup from Amdahl's equation.

2. The formula for the SPEC score of a CPU under test is

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

Show that by changing the reference CPU to CPU A the SPEC score for the CPU under test with respect to CPU A is

$$SPEC_{A}\left(test\right)=\frac{SPEC_{REF}\left(test\right)}{SPEC_{REF}\left(A\right)}$$

3. The following are SPEC scores for two Intel Xeon processors

CPU	Clock Rate	Threads	Auto-Parallel	Cint2017
Gold 6146	3.2 GHz	24	Yes	10.1
Platinum 8153	2.0 GHz	64	Yes	7.00

A. Which CPU is faster? Explain.

B. Find the SPEC score of the 6146 with respect to the 8153.

C. From the expression

$$S=\frac{T^{REF}}{T^{test}}=\frac{\text{program clock cycles}^{REF}}{\text{program clock cycles}^{test}}\times\frac{\text{clock rate}^{test}}{\text{clock rate}^{REF}}$$

find the ratio between the number of clock cycles required to run a typical program on the 6146 and the 8153. Is this result surprising? Explain.

D. Find the expected SPEC score for the 8153 if its clock rate were 3.2 GHz

4. A. Using the Amdahl equation for parallel processing $S=\frac{1}{1-F_p+\frac{F_p}{N}}$ explain the formula

$$\frac{C\text{int}^{6146@3.2GHz}}{C\text{int}^{8153@3.2GHz}}=\frac{\frac{1}{1-F_p+\frac{F_p}{24}}}{\frac{1}{1-F_p+\frac{F_p}{64}}}$$

B. Using this expression and the result of question 3.D, find F_p for this program.

C. Using this value for F_p find the expected score of the 6146 if just one core (thread) runs.