Computer Architecture: tutorial exercise answers

Exercise 1.1

(a) executions per second per pound = executions per second / cost
= 1 / (execution time $\times$ cost)

for S1: 1 / (10 $\times$ 10,000) = 1 / 100,000
for S2: 1 / (5 $\times$ 15,000) = 1 / 75,000

So S2 is more cost effective by a ratio of 100 / 75 ($\approx$ 1.3).

(b) The performance is inversely proportional to the time taken for the programs. This is 13 seconds for S1, and 9 seconds for S2. S2 therefore outperforms S1 by 13/9 ($\approx$ 1.4) times.

Cost effectiveness is computed in the same way as the previous question:

for S1: 1 / (13 $\times$ 10,000) = 1 / 130,000
for S2: 1 / (9 $\times$ 15,000) = 1 / 135,000

S1 is more cost effective by 135 / 130 ($\approx$ 1.04) times.

(c) Both machines run P1 the required number of times; the performance is therefore measured by the *number of executions per hour of P2*.

	Time for 200 executions of P1	Time remaining for P2	Number of executions of P2
S1	2000 seconds	1600 seconds	1600 / 3 = 533
S2	1000 seconds	2600 seconds	2600 / 4 = 650

S2 is faster by 650 / 533 ($\approx$ 1.22) times.

Cost effectiveness in executions per hour per pound:

for S1: 533 / 10,000 = 0.0533
for S2: 650 / 15,000 $\approx$ 0.043

S1 is more cost effective by 1.24 times.

Exercise 1.2

(a) MIPS = Number of instructions / (time taken $\times 10^6$)

for S1: 20×10^6 / 10×10^6 = 20 / 10 = 2 MIPS
for S2: 16×10^6 / 5×10^6 = 16 / 5 = 3.2 MIPS

(b) CPI = cycles per instruction
= number of cycles / number of instructions
= cycles per second / instructions per second
= clock rate / IPS
= clock rate / (MIPS $\times 10^6$)

for S1: 20×10^6 / 2×10^6 = 10
for S2: 30×10^6 / 3.2×10^6 = 9.4

(c) CPI = number of cycles / number of instructions
= time taken $\times$ clock rate / number of instructions

number of instructions = time taken (seconds) $\times$ clock rate (Hz) / CPI

for S1: $3 \times 20 \times 10^6$ / 10 = 6×10^6
for S2: $4 \times 30 \times 10^6$ / 9.4 = 12.8×10^6