CS202 Homework1

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1.9.1

One processor: Clock cycles $= 1 \times 2.56 \times 10^9 + 12 \times 1.28 \times 10^9 + 5 \times 256 \times 10^6$

$= 1.92 \times 10^{10}$

execution time 1 processor $= \dfrac{1.92 \times 10^{10}}{2 \times 10^9}$

$= \underline{9.6\,S}$

multiple processors: clock cycles $= 1 \times \dfrac{2.56 \times 10^9}{0.7p} + 12 \times \dfrac{1.28 \times 10^9}{0.7p} + 5 \times 256 \times 10^6$

$= \dfrac{2.56 \times 10^{10}}{p} + 1.28 \times 10^9$

execution time $= \dfrac{2.56 \times 10^{10}}{p \times 2 \times 10^9} + \dfrac{1.28 \times 10^9}{2 \times 10^9}$

$= \dfrac{12.8}{p} + 0.64$

2 processors: execution time 7.04 S speedup 1.36

4 processors: execution time 3.84 S speedup 2.5

8 processors: execution time 2.24 S speedup 4.29

1.9.2

one processor: clock cycles $= 2 \times 2.56 \times 10^9 + 12 \times 1.28 \times 10^9 + 5 \times 256 \times 10^6$

$= 2.716 \times 10^{10}$

execution time for one processor: $\dfrac{2.716 \times 10^{10}}{2 \times 10^9}$

$= \underline{10.88\,S}$

multiple processors: clock cycles: $2 \times \dfrac{2.56 \times 10^9}{0.7p} + 12 \times \dfrac{1.28 \times 10^9}{0.7p} + 5 \times 256 \times 10^6$

$= \dfrac{2.93 \times 10^{10}}{p} + 1.28 \times 10^9$

execution time: $\dfrac{2.93 \times 10^{10}}{2 \times 10^9 \times p} + \dfrac{1.28 \times 10^9}{2 \times 10^9}$

$= \dfrac{14.65}{p} + 0.64$

2 processors: execution time: 7.965 S

4 processors: execution time: 4.3025 S

8 processors: execution time: 2.47125 S

1.9.3

The execution time would be 3.84 S

clock cycles: $3.84 \times 2 \times 10^9 = 7.68 \times 10^9$

CPI of load/store: $\dfrac{7.68 \times 10^9 - 1 \times 2.56 \times 10^9 - 5 \times 256 \times 10^6}{1.28 \times 10^9}$

$= 3$

1.11

1.11.1 $CPI = \dfrac{750}{0.333 \times 10^{-9} \cdot 2.389 \times 10^{12}}$

$= \underline{0.943}$

1.11.2 SPEC ratio $= \dfrac{9650}{750} = 12.87$

1.11.3 Increase CPU time: $750 \times 10\% = \underline{75\,S}$

1.11.4 Increase CPU time: $750 \times (10\% + 5\%) = \underline{112.5\,S}$

1.11.5 SPEC ratio $= \dfrac{9650}{750 + 112.5} = \underline{11.19}$

1.11.6 $CPI = \dfrac{700 \times 4 \times 10^9}{2.389 \times 10^{12} \times (1 - 15\%)} = \underline{1.379}$

1.11.7 increase in CPI: $\dfrac{1.379}{0.943} = \underline{1.462}$

increase in clock rate $= \dfrac{4}{3} = \underline{1.333}$

They are different because the number of instructions has also been readuced.

1.11.8 $750 - 700 = \underline{50\,S}$

$\dfrac{50}{750} \times 100\% = \underline{6.67\%}$

1.11.9 numbers of instructions: $\dfrac{0.9 \times 960 \times 10^{-9} \times 4 \times 10^9}{1.61} = \underline{2147}$

1.11.10 clock rate: $\dfrac{1.61 \times 2147}{0.9 \times 0.9 \times 960 \times 10^{-9}} = \underline{4.445\,GHz}$

1.11.11 clock rate: $\dfrac{1.61 \times 0.85 \times 2147}{0.8 \times 960 \times 10^{-9}} = \underline{3.826\,GHz}$