Exercise 1

1.1 Reading

1.2 Moore's Law

1.2.1

1.3 Amdahl's Law

1.3.1

- new CPU 10 times faster
- old CPU spent 40% of execution time on calculations
- remaining time was for IO

$$S := 60\% \tag{1}$$
$$P := 40\% \tag{2}$$
$$N := 10 \tag{3}$$

$$Speedup = \frac{1}{.6 + \frac{.4}{10}} = 1.563 \tag{4}$$

⇒ We would expect a 56% performance improvement from the new CPU.

1.3.2

- 20% of compute time is used for squaere roots
- possibilities:
  - improve floating point square root calculations by factor of 10
  - improve all fp operations by 1.6
- 50% of operation is spent on FP

$$S_1 = \frac{1}{(1 - (0.5 \cdot 0.2)) + \frac{0.5 \cdot 0.2}{10}} \tag{5}$$
$$= 1.099 \tag{6}$$

$$S_2 = \frac{1}{(1 - 0.5) + \frac{0.5}{1.6}} \tag{7}$$
$$= 1.231 \tag{8}$$

⇒ By accelerating all FP operations by a facctor of 1.6 a speedup of 23% can be observed and therefore is the optimal solution (in contrast to only 9.9% when only speeding up FPSQRT).

1.3.3

$$100 = \frac{1}{(1-P) + \frac{P}{128}} \tag{9}$$

$$\Leftrightarrow P = 0.9978 \tag{10}$$

$$\Rightarrow S \leq 0.22\% \tag{11}$$