CS61c Summer 2014 Discussion 6 – Floating Point and Performance

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1 Floating Point Numbers (IEEE Standard 754)

	Sign(S)	Exponent (E)	Fraction (F)
Single Precision	1 bit	8 bits	23 bits
Double Precision	1 bit	11 bits	52 bits

$$Floating\ Point\ value = (-1)^S \times (1 + F) \times 2^{E-bias}$$

- **Special values**

±Zero	E = 0, F = 0	**±Infinity**	E = 255, F = 0
NaN	E = 255, F $\neq$ 0	**Denormalized numbers**	E = 0, F $\neq$ 0

1.1 Exercises

1. Convert the following decimal numbers into binary : 1.0, 2.5, 0.125, 0.666...

2. Convert the following numbers into hex using single precision floating point : 2.0, -9.5, 15.333..., $+\infty$.

3. Convert the following numbers from hex into decimal using single precision floating point: 0x0, 0xff9abcde, 0x41040000, 0xC0B40000

2 Performance

To measure CPU performance, we use CPU Time which only considers processor time.

- CPU Time = Instructions $\times$ CPI $\times$ Clock Cycle Time.

2.1 Exercises

1. Suppose that you were developing a software that contains the following mix of instructions, which processor is the best choice?

Operation	Frequency	A's CPI	B's CPI	C's CPI
ALU	30%	1	1	1
Store	30%	3	5	3
Load	20%	2	3	4
Branch	20%	3	2	2

2. You then find out that the processors have different clock speeds. A is a 1 Ghz processor, B is a 1.5 Ghz processor, and C is a 750 Mhz processor. Which one is the best choice?

3. You contact the manufactures about each processor and found out that they have different instruction sets, so then running your software takes a different number of instructions on each. You find out that A averages 1000 instructions, B averages 800 instructions and C averages 1200 instructions. Which one is the best now?