difference. The speedup of 915 mV compared to 880mV is, $\frac{0.0075}{0.0043} \approx 1.74$ times faster.

4C) How much slower will it run at 2 GHz at 915 mV?

Step 1) Find new dynamic Power.

$? = K \cdot (915\,mV)^2 \cdot 2 \approx 25\,W$ // K = 0.000015 still?

Step 2) solve for seconds in the energy calculation

$0.128x = 25 \cdot S$

$\frac{0.128x}{25} = S$

$0.00512 = S = time_{new}$ (2.4 GHz at 915mV version)

and from previous problem $time_{old} \approx 0.0043$

So the 2 GHz is $\approx 0.00512 - 0.0043 = 0.00082$ seconds slower.

4D) For the new 2 GHz, 915mV configuration, Power consumption = 25 W. (see above calculation)

So it uses 5 W less than the 2.4 GHz version.

Brandon Williams

CS 351: HW 1

1A) A processor's clock runs at $2 \cdot 10^9$ (2,000,000,000) cycles per second. What is speed in GHz and MHz?

$1 \text{ GHz} = 10^9$ //note

So the processor runs at 2 GHz.

$1 \text{ GHz} = 1000 \text{ MHz}$ //note

Processor Speed in MHz $= 2 \cdot 1000 = 2000$ MHz

1B) For the same clock what is the period (aka cycle time) in p.s., n.s., μ.s.?

//note: 1 second $= 10^{-12}$ ps

$\frac{1 \text{ Second}}{2 \cdot 10^9} = \frac{10^{-12} \text{ps}}{2 \cdot 10^9} = 500\text{ps}$

//note: 1 second $= 10^{-9}$ ns

$\frac{1 \text{ second}}{2 \cdot 10^9} = \frac{10^{-9} \text{ns}}{2 \cdot 10^9} = 0.5 \text{ ns}$

//note: 1 second $= 10^{-6}$ μs

$\frac{1 \text{ Second}}{2 \cdot 10^9} = \frac{10^{-6} \mu s}{2 \cdot 10^9} = 0.0005 \mu s$

1C) $0xf = 15$ 1D) $2^7 = 128$ $\log_2 256 = 8$

$\log_2(256) = x$

$2^x = 256$

$2^x = 2^8$

$x = 8$

1E) 1111 1110 to Decimal:

8-bit two's complement signed number = flip bits and add 1...

0000 0001 (add 1) 0000 0010 So = -2

8-bit unsigned number: $2^1 + 2^2 + 2^3 + 2^4 + 2^5 + 2^6 + 2^7 = 254$

15 | 1111 | 0xf

2 2 8

1f) Convert −13 to an 8-bit two's compliment number.

step 1: write 13 in binary 0000 1101

step 2: invert bits: 1111 0010

step 3: add 1: 1111 0011

−13 in an 8-bit two's compliment binary is 1111 0011

1G) Both &*a and **a are invalid syntax in C++ since a is an integer value and the first * attemps to dereference it, which is impossible. (ran code)

2A) For sale Computer: newegg.com/Product/Product.aspx?Item=9SIA24G5PT6622

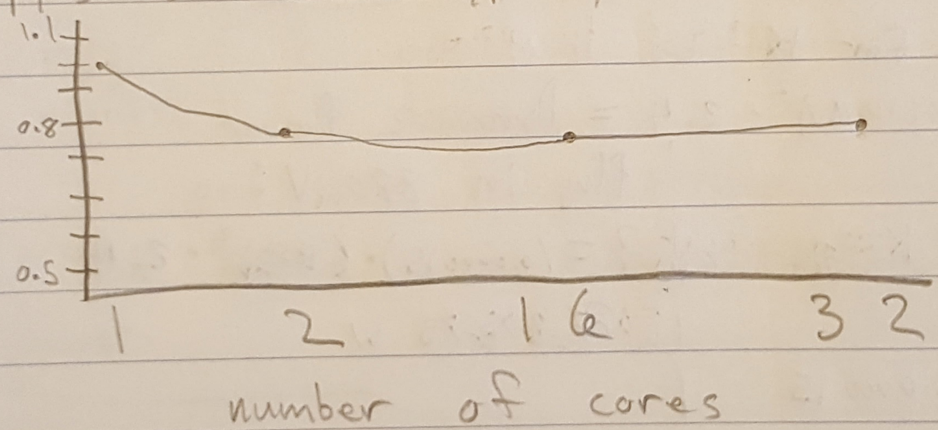
	NewEgg	Server in Paper
Processor model/manufacture	Intel core i7-7500	Intel Xeon E5-2697 V2
# of processors	1	1
Processor clock frequency & # of cores	3.4 GHz, 4 cores	2.7 GHz 24 cores
Size of processor cache	6 MB L3 cache	32 MB L3 Cache
amount and type (ddr4) of ram	8 GB DDR4 2400	256 GB D

2B) It has a mechanical hard disk.
1 TB 7200 RPM

2C) Intel HD Graphics 630

3A) The Karp - Flatt metric is similar to Amdahl's law, except that it solves for the fraction of the program we are speeding up; since that is typically unknown.

3B)



2 cores is $\frac{8}{5}$ times faster compared to 1

16 cores is $\frac{80}{25}$ times faster compared to 1

32 cores is $\frac{800}{225}$ times faster compared to 1

$F_{2cores} = \left(1-\left(\frac{1}{8/5}\right)\right)\left(1-\frac{1}{2}\right)^{-1} = 0.75$

$F_{16cores} = \left(1-\left(\frac{1}{\frac{16}{5}}\right)\right)\left(1-\frac{1}{16}\right)^{-1} \approx 0.73$

$F_{32cores} = \left(1-\left(\frac{1}{\frac{32}{9}}\right)\right)\left(1-\frac{1}{32}\right)^{-1} \approx 0.74$

3C) $P = \frac{16}{16}$, $S = \frac{80}{25} = \frac{16}{5}$ | $\frac{1}{(1-1) + \frac{1}{16/5}} = \frac{1}{\left(\frac{1}{16/5}\right)} = 3.2$

3D) Processor cycles used in the single-core version of ~~My~~ FaWe Bench Mark is

800 ms to execute. Processor in paper has 2.7 GHz = $\frac{1 \text{ second}}{2.7 \cdot 10^9 \text{ cycles}}$, Also note 800 ms = $\frac{4}{5}$ second

So to get cycles: $(2.7 \cdot 10^9 \text{ cycles}) \cdot \frac{4}{5} = 2.16 \cdot 10^9$ cycles

4A) Power consumption at 915 mV = 30w dynamic power.

Power consumption at 880mV = 27.75w

// Solve for K

$30_w = K \cdot (915 Mv)^2 \cdot 2.4$ = Dynamic Power

$\frac{\left(\frac{30}{2.4}\right)}{(915)^2} = K$

$K \approx 0.000015$

Plug in 880mV:

$? = (0.000015) \cdot (880_{mV})^2 \cdot 2.14$

≈ 27.75 W

4B)

Energy = W * S

Energy Savings 1: 12.8% (at the 915mV)

Energy Savings 2: 19.4% (at the 880mV

$0.128X = 30W \cdot S$

$\frac{0.128x}{30} = S$

$S \approx 0.0043$

$0.194X = 27.7W \cdot S$

$\frac{0.194x}{27.7} = S$

$S \approx 0.0075$

//note}
X = the energy at the higher voltage than 915mV, unknown?

As you can see above, there is a performance