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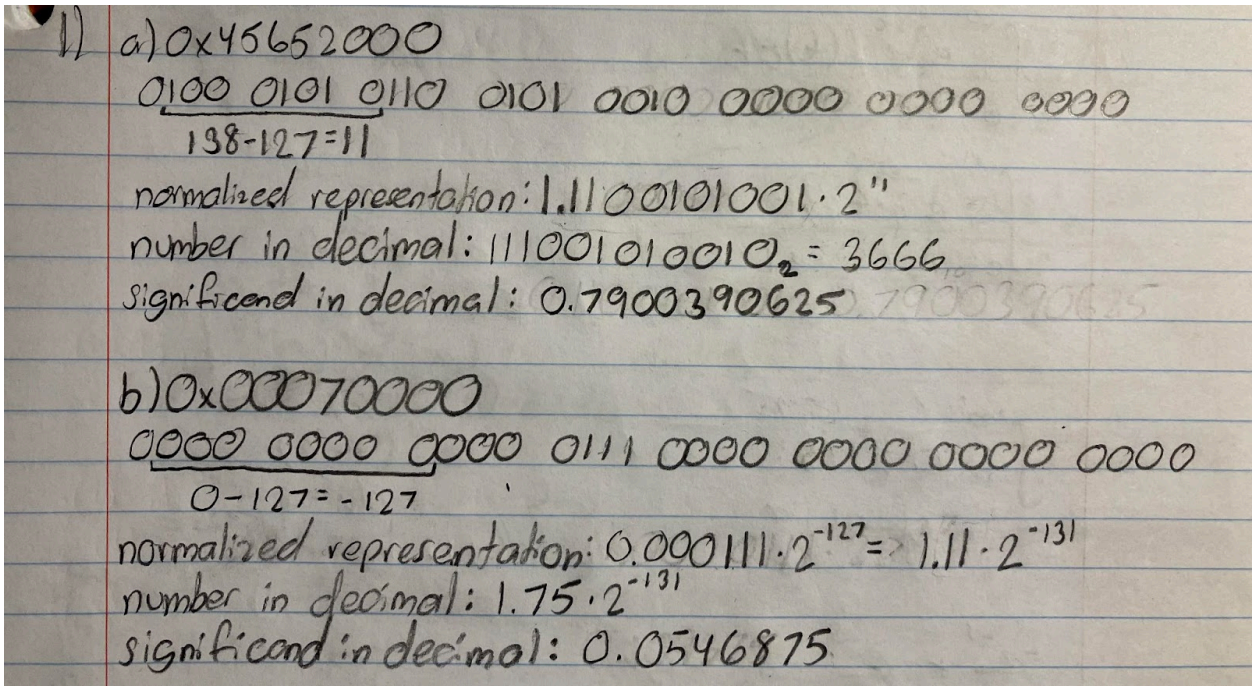
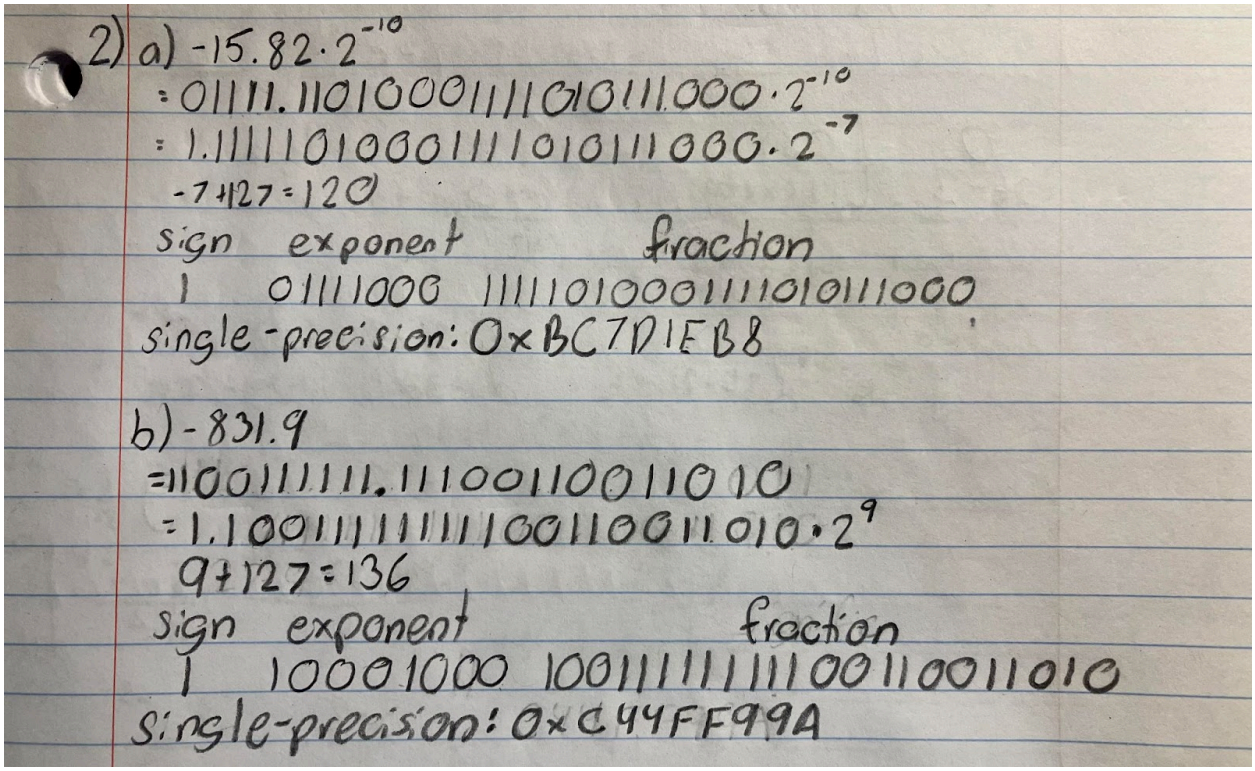
CSE 3666
23 March, 2024

Homework 5

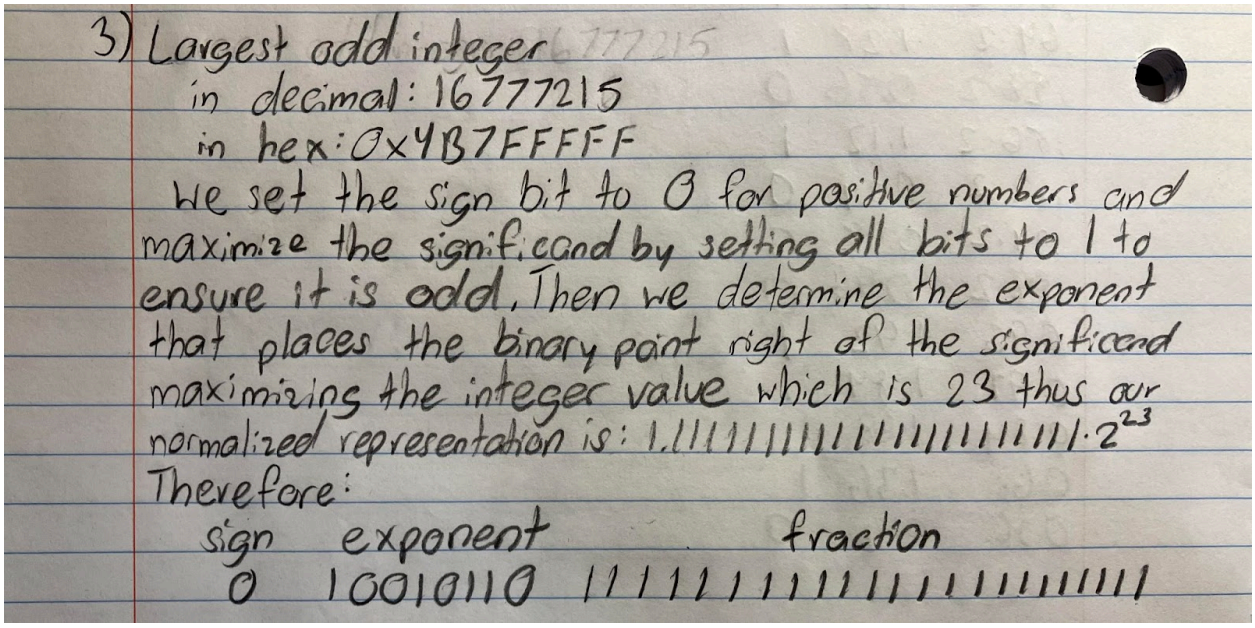
1)



2)


2) a) $-15.82 \cdot 2^{-10}$
$= 01111.1101000111101011100 \cdot 2^{-10}$
$= 1.11111010001111010111000 \cdot 2^{-7}$
$-7+127 = 120$
sign exponent fraction
1 01111000 11111010001111010111000
single-precision: 0xBC7D1EB8
b) -831.9
$= 1100111111.1110011001100 \cdot 2^{9}$
$9+127 = 136$
sign exponent fraction
1 10001000 10011111111100110011010
single-precision: 0xC44FF99A

3)



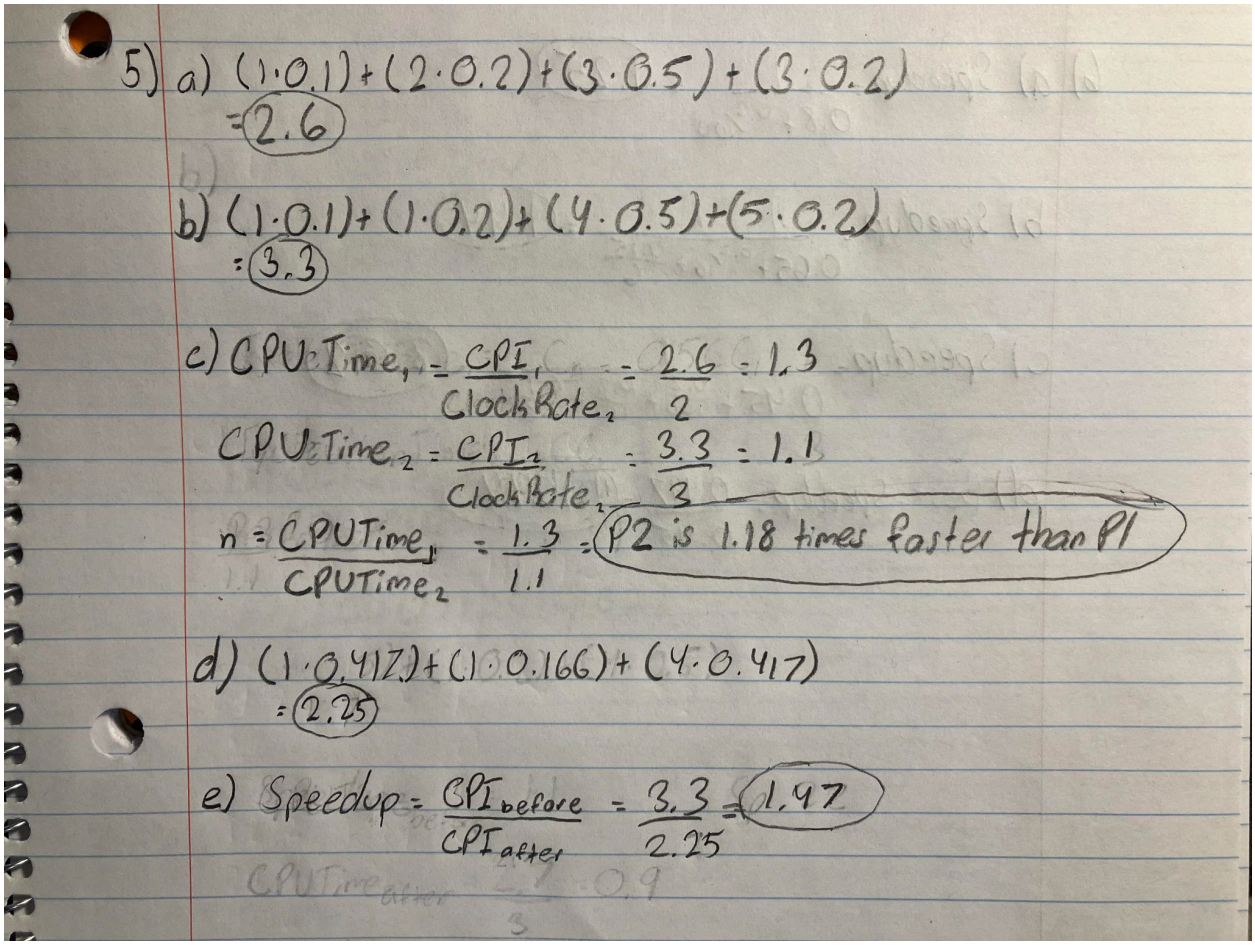
3) Largest odd integer
in decimal: 16777215
in hex: 0x4B7FFFFF
We set the sign bit to 0 for positive numbers and maximize the significand by setting all bits to 1 to ensure it is odd. Then we determine the exponent that places the binary point right of the significand maximizing the integer value which is 23 thus our normalized representation is: $1.11111111111111111111111 \cdot 2^{23}$
Therefore:

sign	exponent	fraction
0	10010110	11111111111111111111111

4)

```
67  dot_product:
68          # TODO
69          # use one of the fcvt instructions to convert
70          # integer 0 to SP 0
71          fcvt.s.w ft0, t0          # ft0 = 0.0
72          fcvt.s.w fs0, t0          # fs0 = 0.0
73  loop:
74          bge      t0, a2, f_exit   # if(i >= n) goto f_exit
75
76          slli     t1, t0, 2        # t1 = i * 4
77          add      t2, t1, a0       # t2 = x[i]
78          add      t3, t1, a1       # t3 = y[i]
79
80          flw      ft1, 0(t2)       # load value at x[i] to ft1
81          flw      ft2, 0(t3)       # load value at y[i] to ft2
82
83          fmul.s   ft3, ft1, ft2
84          fadd.s   fs0, fs0, ft3    # sum += x[i] * y[i]
85
86          addi     t0, t0, 1        # i += 1
87          beq      x0, x0, loop     # goto loop
88  f_exit:
89          fadd.s   fa0, ft0, fs0    # set return value to fs0
90          jalr     x0, ra, 0        # return
```

5)



5) a) $(1 \cdot 0.1) + (2 \cdot 0.2) + (3 \cdot 0.5) + (3 \cdot 0.2)$
$= 2.6$

b) $(1 \cdot 0.1) + (1 \cdot 0.2) + (4 \cdot 0.5) + (5 \cdot 0.2)$
$= 3.3$

c) $CPU\ Time_1 = \frac{CPI_1}{Clock\ Rate_2} = \frac{2.6}{2} = 1.3$

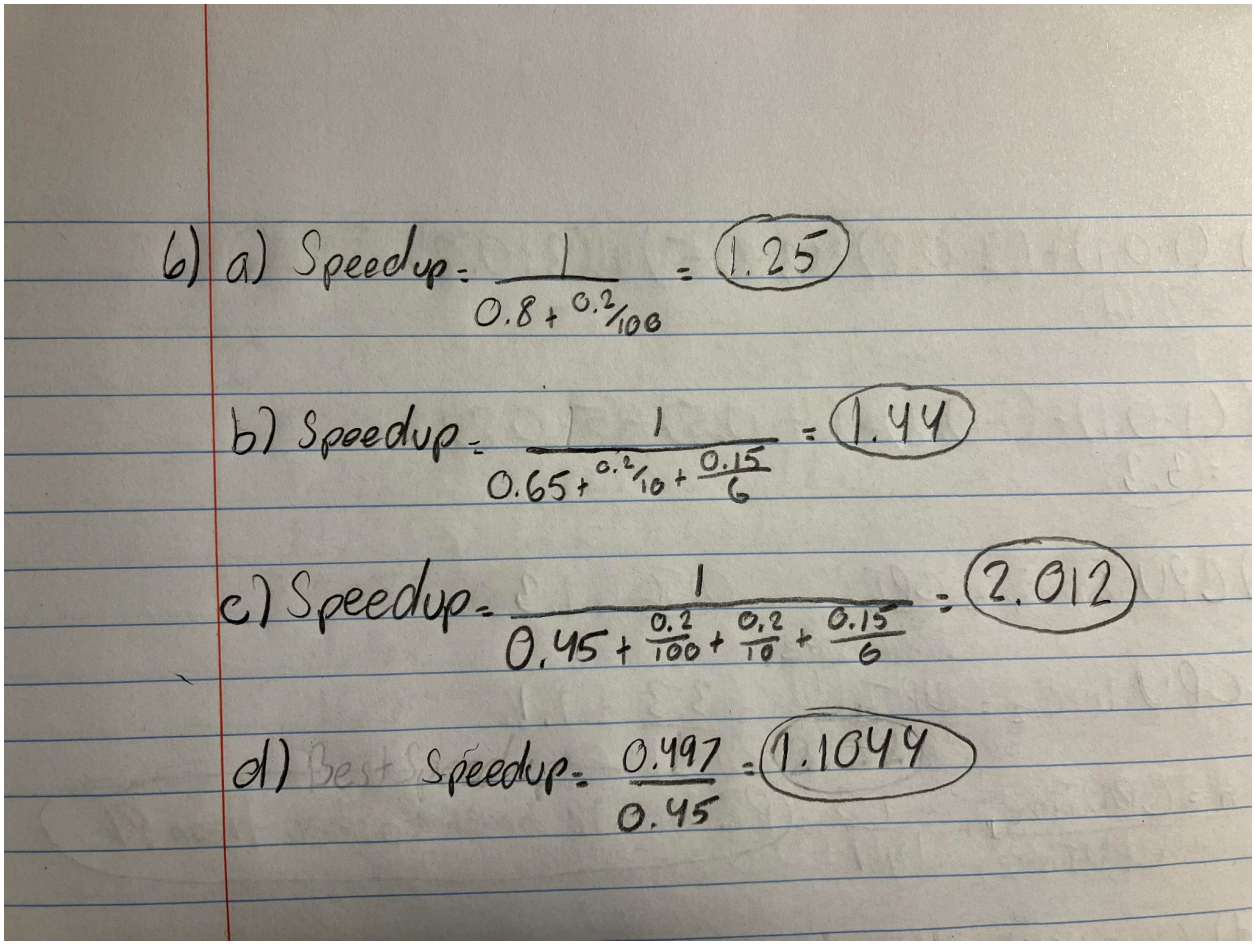
$CPU\ Time_2 = \frac{CPI_2}{Clock\ Rate_2} = \frac{3.3}{3} = 1.1$

$n = \frac{CPU\ Time_1}{CPU\ Time_2} = \frac{1.3}{1.1} =$ P2 is 1.18 times faster than P1

d) $(1 \cdot 0.417) + (1 \cdot 0.166) + (4 \cdot 0.417)$
$= 2.25$

e) $Speedup = \frac{CPI_{before}}{CPI_{after}} = \frac{3.3}{2.25} = 1.47$

6)



6) a) Speedup $= \frac{1}{0.8 + 0.2/100} = 1.25$

b) Speedup $= \frac{1}{0.65 + 0.2/10 + \frac{0.15}{6}} = 1.44$

c) Speedup $= \frac{1}{0.45 + \frac{0.2}{100} + \frac{0.2}{10} + \frac{0.15}{6}} = 2.012$

d) Best Speedup $= \frac{0.497}{0.45} = 1.1044$