CSE3666

Homework 5 (100 points)

Due Date: By the end of Friday, 4/1/2022.

Enter your answers in HW5-test in HuskyCT.

1. Convert the following binary numbers to decimal.

   a. `0b1011.1101`
   b. `0b0.00111`

2. Write the normalized (binary) representation of the binary numbers in Problem 1. Note that the exponents are in decimal.

3. Find the value of the following single-precision floating point numbers.
   For a., write a real number in decimal.
   For b., write the answer in the form of $x \times 2^e$, where both x and e are in decimal. x is a real number in interval [1, 2), and e is an integer.

   a. `0x45652000`
   b. `0x00070000`

4. Find the single-precision representation of the following values/numbers. HuskyCT questions only ask for the higher four hexadecimal digits.

   a. -15.82×2^{-10}
   b. – 831.9
   c. The largest odd integer that can be represented in single-precision format

Example:

	S	Exponent	Fraction	Single-precision
2.32	0	1000 0000	001 0100 0111 1010 1110 0001	0x40147AE1
-15.82*2^-10				
-831.9				

5. Consider two processors P1 and P2 that have the same ISA but different implementations. The ISA has four classes of instructions: class A, B, C, and D. The clock rate of two processors and the number of clock cycles required for each class on the processors are listed in the following table.

Processor	Clock Rate	Class A	Class B	Class C	Class D
P1	2 GHz	1	2	3	3
P2	3 GHz	1	1	4	5

   Suppose the breakdown of instructions executed in a program is as follows: 10% class A, 20% class B, 50% class C, and 20% class D.

   When entering answers in HuskyCT, round the numbers to the nearest hundredth if necessary. For example, enter 0.5 for 1/2, 0.67 for 2/3.

   a. What is the overall CPI of the program on P1?
   b. What is the overall CPI of the program on P2?
   c. How many times faster is the program on P2 than on P1? Note that the clock rate is different on P1 and P2.
   d. Suppose a compiler can optimize the program, replacing all class D instructions with class A instructions. Each class D instruction requires two class A instructions. What is the average CPI of the program on P2 after the optimization?
   e. What is the speedup the compiler in d) can achieve on processor P2?

6. Suppose you have two different methods to accelerate a program. Method 1 can accelerate 20% of the program 100 times. Method 2 can accelerate 20% of the program 10 times and 15% of the program 6 times. The part of code enhanced by each method does not overlap.

   When entering answers in HuskyCT, round the numbers to the nearest hundredth if necessary. For example, enter 0.5 for 1/2, 0.67 for 2/3.

   a. What is the speedup Method 1 can achieve on the entire application?
   b. What is the speedup Method 2 can achieve on the entire application?
   c. What is the speedup if both methods are applied?