

Due: Wednesday, September 24, 3PM EST

This assignment is worth 15% of the final grade. Each question is worth a multiple of 5 points. If you have no idea how to answer a question (or part of a question), you will receive 20% of the credit for that question (or subquestion) by leaving the question (or subquestion) blank. If your answer makes no sense, you will not receive any credit. Any answer that shows some understanding of the question will receive some credit.

1. This exercise pertains to a very simplified floating point representation. For simplicity we will pretend that we are working with decimal numbers. Similar to using binary numbers, let's say that a floating point word is represented as follows:

$$s\#s'\#e_{k-1}\dots e_0\#d_{\ell-1}\dots d_0$$

We use a sign bit s for the sign $(-1)^s$ of the number and a sign bit s' for the sign of the exponent. The $\#$ is used just for readability. For example with $k = 2$ and $\ell = 6$:

$$1\#0\#01\#083521$$

represents $-10^{+1} \times .083521 = .83521$.

- (5 points) Suppose $k = 2$ (ie. 2 exponent digits) and $\ell = 4$ (i.e., 4 significant digits), show how to represent the decimal number $+20.93$ as a simplified floating point number.
 - (5 points) Assume we have $k = 2$ and $\ell = 4$, what is the largest L positive number you can represent using this representation?
 - (5 points) What is the smallest positive number (not necessarily an integer) greater than 0 that you can represent?
 - (5 points) Can you represent the fraction $1/3$ in this representation? Explain your answer in one sentence.
2. (15 points)

We presented the ChatGPT response to the query “Will ChatGPT make Wikipedia obsolete?”

Which (if any) of the responses returned by ChatGPT do you think presents the most compelling argument for why Wikipedia will not be obsolete? Which (if any) of the responses do you feel are not compelling. Explain your answer in one or two paragraphs. A possible answer to this question can be “Wikipedia will be obsolete” but you still must provide an explanation. One way to help answer this question is to make up some examples of queries and see how Wikipedia and ChatGPT deal with this question now and envision how ChatGPT will reply to your queries in 5 years from now.

3. Consider a perfectly balanced binary search tree T with $n = 2^k - 1$. Think of k being reasonably large. We give a name for the location of the nodes in T as follows: Let the root be called node 1 so that the median value key is located at the root. The nodes at the next level are nodes 2,3 going left to right. More generally the nodes in the j^{th} level are $2^{j-1}, 2^{j-1} + 1, \dots, 2^j - 1$ going left to right. In terms of these tree names, where are the following nodes located?

- (5 points) The fourth smallest key in T .
- (5 points) The fourth largest key in T .