

Due: Friday, November 19, 8AM EST

This assignment is worth 15% of final grade. Each question is worth 10 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) 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. [20 points]

Note: I believe most students should be able to obtain full credit for this question as it is based on your experience. But you do have to articulate your answers clearly.

[15 points] We want to consider three of your recent search experiences, for each of which you will create a record of your search experience as will be explained. In all examples do not search for something that would be considered personal.

Create an “information need” for which you believe that the desired information exists in a single document but where you are not sure how to create an appropriate query. Create an initial query and detail your search experience. Namely, record that query, the time you issued the query, the titles of the $k \leq 10$ (if only k documents are returned) highest ranked documents returned, and whether or not you obtained the desired information. If the desired information was obtained then indicate the rank of the relevant document. If you didn’t find the desired information, refine your query and try searching again using your refined query. Try explaining as best you can how your thinking led to the refined query. Indicate if you were successful or not in your refined search and if successful what was the rank of the relevant document. Wait one day and repeat the same search for your information need using the same initial query. Now just indicate whether or not you obtained the same set of the top 10 (or less) ranked documents. If different why do you think the results were different?

[5 points] Suppose that the precision of a document (relative to an information need) is given as a value in $[0, 1]$ with 0 meaning the document is irrelevant and 1 meaning that the document is exactly what was needed. Provide a precise definition for the precision of a top 10 set of returned documents.

Note: There is not necessarily one correct answer. It is how you feel precision for the top 10 should be defined. Also note that this part of the question does not concern part (a).

2. [10 points] Suppose tomorrow there is a new technology and programming language that allows us to compute decision problems in such a way that every program halts in at most time $15 \cdot 2^{2^n}$ where n is the length of the input. Could such a technology and programming language compute all computable functions? Explain your answer.
3. [10 points] Consider the example of cake-cutting on slide 7 of Nisarg Shah’s presentation. Find an allocation that is proportional and envy-free. Briefly argue why your allocation is envy-free and proportional.

4. [10 points] The following questions are reasonably easy facts following from the definitions.

[5 points] Consider the decision problem *FACTOR* on slide 7 of the Week 9 slides. Show that if $FACTOR \in P$, then in polynomial time we can compute the prime factorization of an integer.

[5 points] Consider polynomial time transformations \leq_{trans}^{poly} as defined on slide 12 of the Week 9 slides. Show that \leq_{trans}^{poly} is a transitive relation. That is, show

$A \leq_{trans}^{poly} B$ and $B \leq_{trans}^{poly} C$ implies $A \leq_{trans}^{poly} C$.