# Reductions

**Warning:** The hard deadline has passed. You can attempt it, but **you will not get credit for it**. You are welcome to try it as a learning exercise.

To specify an array or sequence of values in an answer, you must separate the values by a single space character (with no punctuation and with no leading or trailing whitespace). For example, if the question asks for the first ten powers of two (starting at 1), the only accepted answer is:

1 2 4 8 16 32 64 128 256 512

If you wish to discuss a particular question and answer in the forums, please post the entire question and answer, including the seed (which is used by the course staff to uniquely identify the question) and the explanation (which contains the correct answer).

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## Question 1

(seed = 771656)
Which of the following problems can be linear-time reduced *to* the standard shortest-paths problem in digraphs with nonnegative weights? Check all that apply.

- ☐ Given a digraph with positve *vertex* weights and two vertices s and t, find a shortest path from s to t (where the length of the path is the sum of the vertex weights).
- ☐ Given a digraph with positive edge weights and two vertices s and t, find the shortest path from s to t where you can change the weight of any one edge to 0.
- ☐ Given a digraph with positive edge weights and two vertices s and t, find a shortest path from s to t that uses the fewest number of edges.
- ☐ Given a digraph with positive edge weights, find the shortest simple cycle.
- ☐ Given an undirected graph with arbitrary edge weights, find a negative cycle.

## Question 2

(seed = 682713)
Which problems are known to have the same asymptotic complexity as sorting an array of N comparable elements? Check all that apply.

- ☐ Given an array of N comparable elements, find one that occurs most frequently.
- ☐ Given an array of N comparable elements, determine if any two are equal.
- ☐ Given an array of N numbers, determine if any three sum to zero.
- ☐ Given an array of N 64-bit integers, determine if any two are equal.

- [ ] Given an array of N 64-bit integers, sort them.

## Question 3

(seed = 535177)
Suppose that problem A linear-time reduces to problem B. Which of the following can you infer? Check all that apply.

- [ ] If A can be solved in linear time, then B can be solved in poly-time.
- [ ] A can be solved in poly-time.
- [ ] If B can be solved in quadratic time, then so can A.
- [ ] If A can be solved in quadratic time, then B can be solved in poly-time.
- [ ] If A can be solved in poly-time, then so can B.

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You cannot submit your work until you agree to the Honor Code. Thanks!