

CPSC 320 2025S: Week 2 Tutorial Problems

Night at the Museum

Suppose that you're in charge of hiring security guards to protect priceless artifacts in a museum exhibit. You are given a line L that represents a long hallway in the show room. You are also given an unordered set $X = \{x_0, x_1, \dots, x_{n-1}\}$ of real numbers that represent the positions of artifacts in this hallway. Suppose that a single guard can protect all the objects within distance at most d of his or her position, on both sides.

1. Design a greedy algorithm for finding a placement of guards that uses the minimum number of guards to guard all the artifacts with positions in X .
2. Analyze the running time of your algorithm as a function of n , the number of objects that need guarding.
3. Give a “greedy stays ahead” lemma that you could use to prove your approach is optimal. You do not need to prove the lemma here (though you will need to do this in the next part of the question).

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4. Prove that your algorithm is optimal – i.e., that it guards all artifacts and does so using the fewest possible guards.