

## CS 50010 Assignment 4

Due Wednesday, July 6th. In class

### Greedy Algorithms

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1. Suppose that you are working in a country with coins of the following denominations- {1, 3, 7, 10, 20}. Prove that the cashiers algorithm is not optimal in this system.

### Randomized Algorithms

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1. Classify the following algorithms as either Las Vegas or Monte Carlo algorithms
  - a. To approximate pi to some number of digits, random points on a square are chosen. The number of points within  $\frac{1}{2}$  of the side length from the center are tallied and compared to the total number of points chosen. This fraction is then used to approximate pi
  - b. You are given a list that you know contains at least one pair of duplicate elements. To find this pair you continuously select random pairs and check if they are equal until you find the matching pair.

### Complexity Classes

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1. Classify the problems below as being either inNP or coNP. Note that problems can be in both of these classes at once!
  - a. Integer multiplication ( $a * b = c$ )
  - b. Graph Isomorphism (Given a graph A and a graph B, is it possible to rearrange the vertices of A so that it is now identical to B?)
  - c. Longest Path in a Graph

### Undecidability

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1. Prove that determining if a program runs through a specific loop more than 100 times is undecidable.