

Problem Set 5
CSCE 440/640 Fall 2014

Due dates: Electronic submission of the pdf file of this homework is due on **11/03/2014 before 1:00pm** on ecampus.tamu.edu, a signed paper copy of the pdf file is due on **11/03/2014** at the beginning of class.

Name: (put your name here)

Resources. (All people, books, articles, web pages, etc. that have been consulted when producing your answers to this homework)

On my honor, as an Aggie, I have neither given nor received any unauthorized aid on any portion of the academic work included in this assignment. Furthermore, I have disclosed all resources (people, books, web sites, etc.) that have been used to prepare this homework.

Signature: _____

Read Chapter 8 in our textbook.

Problem 1. (40 points) Consider a Grover search on four quantum bits. Let's suppose that $s = 0110$ is the only string such that $O|s\rangle = -|s\rangle$, so $O|x\rangle = |x\rangle$ for all $x \in \{0, 1\}^4 \setminus \{s\}$. Illustrate the evolution of the probability amplitudes for 8 iterations. Make sure that you show the "mean" about which the reflection is done by a dashed line. [Hint: Write a program to generate the data. You can explore metapost as a nice option to visualize data.]

Solution.

Problem 2. (40 points) Exploration: What is known about exact quantum search, where the item is found with certainty? Search the literature and give an overview of the results that you have found. [Hint: google and arxiv.org are good places to start.]

Solution.

Problem 3. (20 points) In the analysis of the lower bound for quantum search, we defined the quantity

$$F_s = \sum_{s \in \{0,1\}^n} \||s\rangle - |\psi_k\rangle\|^2.$$

Show that $F_s \geq 2N - 2\sqrt{N}$, where $N = 2^n$. [Hint: Use the Cauchy Schwarz Inequality.]

Solution.

Discussions on piazza are always encouraged, especially to clarify concepts that were introduced in the lecture. However, discussions of homework problems on piazza should not contain spoilers. It is okay to ask for clarifications concerning homework questions if needed.

Checklist:

- Did you add your name?
- Did you disclose all resources that you have used?
(This includes all people, books, websites, etc. that you have consulted)
- Did you sign that you followed the Aggie honor code?
- Did you solve all problems?
- Did you submit the pdf file resulting from your latex source file on ecampus?
- Did you submit a hardcopy of the pdf file in class?