CS 3120 Quiz Day 1

This packet contains the quizzes for this quiz day. This **cover sheet** is here to provide instructions, and to cover the questions until the quiz begins. **do not remove this cover sheet** until your proctor instructs you to do so.

You will have the entire class period to complete these quizzes. Each quiz is two pages (front and back of one sheet of paper) worth of questions. Make sure to **write your name and computing id at the top of each individual quiz**.

When you are done, you will come to the front of the room and cut off the staple to this quiz booklet. Afterward, you will discard this cover sheet and submit each quiz separately in a different pile. The proctors will be available at the front of the room to clarify this if you have any questions.

This quiz is CLOSED text book, closed-notes, closed-calculator, closed-cell phone, closed-computer, closed-neighbor, etc. Questions are worth different amounts, so be sure to look over all the questions and plan your time accordingly. Please sign the honor pledge below.

In theory, there is no difference between theory and practice.
But, in practice, there is.

THIS COVER SHEET WILL NOT BE SUBMITTED. DO NOT PUT WORK YOU WANT GRADED ON THIS PAGE

Quiz - Module 1: Proofs, Computers, and Cardinality

Name ________________________________

1. [8 points] Answer the following True/False questions.

As defined in class, *Computers* take in various types of input (e.g., string, integer, double, etc.)	**True**	**False**
$\{0,1\}^* = \{0, 1, 00, 01, 10, 11, 000, ...\}$	**True**	**False**
The definition of a function's *co-domain* can have an effect on whether or not that function is *surjective*	**True**	**False**
Suppose you have infinite set I and finite set F. There exists a surjection from I to F but not from F to I	**True**	**False**
Given some natural $n \in \mathbb{N}$, $\left\| \bigcup_{0 \leq i \leq n} \{0,1\}^i \right\| \leq \|\mathbb{N}\|$	**True**	**False**
$\|\mathbb{Q}\| = \|\{0,1\}^\infty\|$	**True**	**False**
$\|\mathbb{Z}\| > \|\mathbb{N}\|$	**True**	**False**
Diagonalization is an example of *proof by contradiction*	**True**	**False**

2. [3 points] Suppose I have a proper, subset of the natural numbers $A \subset \mathbb{N}$ in which our universe of possible values is the natural numbers $\mathbb{N}$. Now consider the complement $\bar{A}$. Is $\bar{A}$ countable, not countable, or is it not possible to tell? Explain your answer.

3. [3 points] Now consider the same thing as the previous question, except this time the universe of possible values is the real numbers $\mathbb{R}$. Is $\bar{A}$ countable, not countable, or is it not possible to tell? Explain your answer.

For this question, you will prove that for any finite set S, $|\mathcal{P}(S)| = 2^{|S|}$. You will do this using two different methods.

4. [3 points] First, prove this by describing a bijection between $\mathcal{P}(S)$ and $\{0,1\}^{|S|}$. You can assume that you have already shown that $|\{0,1\}^{|S|}| = 2^{|S|}$

5. [3 points] Now, prove the same claim using induction. The beginning of the proof is done for you below:

   Base Case: When $|S| = 0$, $|\mathcal{P}(S)| = 1 = 2^0$.

   Inductive Hypothesis: Assume that for an arbitrary k, $|\mathcal{P}(S)| = 2^k$

   Inductive Step: