CS 70 Discrete Mathematics and Probability Theory
Summer 2019 Course Notes **Note -1**

1 Welcome to CS 70!

Welcome to Discrete Math and Probability Theory! You might be wondering what you've gotten yourself into — we're delighted to tell you that the answer is something quite remarkable. For as you will find in this course, computer science is a unique field which straddles the fine line between a wealth of research areas: natural sciences such as physics and chemistry, applied fields such as engineering, and abstract areas such as mathematics. It is precisely this pervasive diversity that not only allows computer science to have something to offer for everyone, but also makes it a driving force of life as we know it today. Before diving into the material proper, we'd like to take a moment to dispel a few common myths.

1.1 What is Math?

From high school classes, many of you may be familiar with math as simply "plug-and-chug", memorizing formulae and plugging in appropriate values in order to get out the answer. But this is not truly what math is. Indeed, in this class (and in any upper division math courses you take in the future), the focus is on the thought process used to get to the answer and the justification for why it is correct, rather than just the answer itself. For those of you less accustomed to (or comfortable with) proof writing, we highly recommend you practice writing out full justifications for problems even when just solving them on your own; like writing an essay, writing a proof has its own style, and it takes practice to find what yours is.

1.2 Why Math?

A common question students have coming into 70 is why they're required to take this course, seemingly so distant from the (programming-focused) 61 series. The first answer to this is that mathematics is as integral[1] to computer science as programming itself is, as it allows us to answer questions such as "how can we make a robot learn?", "how can we find the fastest route to this destination?", and many others. In other words, math underlies programming, as it allows us to determine *how* to write a program that solves the problem at hand. The second answer to this question is that, even if you are only interested in writing code, you cannot program in a vacuum. You will at some point need to convince someone else (or even yourself!) that your program works — you will have to *prove* its correctness. This course aims to give you the tools to think critically and argue clearly in a computer science context, skills which are invaluable no matter what field you are in.

2 A High-Level Overview of the Course

As the course title suggests, this course can be roughly divided into two halves: discrete math and probability theory. The first half starts by introducing logic and proofs, which are the bedrock of mathematics and will be used throughout the rest of the course — and indeed throughout your whole career here at Berkeley and beyond, as discussed above. We then use these foundations to take glimpses into various

[1]Pun most certainly intended.

fields important to computer scientists, such as graph theory (used to model networks), modular arithmetic (used for cryptography and error correction), and uncomputability (showing computers can't do everything).

The latter half of the course then takes us through various topics in probability, which are critical to many subfields of computer science, from parallel computing to artificial intelligence to quantum computation. These concepts can also have many applications in your day-to-day life, allowing you to weigh different options by comparing at their chances of success or their expected values.

3 A Final Note

One final note before we dive into the material proper: don't be afraid to ask for help. This class can be challenging at times for everyone, but do always keep in mind that as trite as the saying is, there really isn't such a thing as a "math person" or a "non-math person". No matter how difficult a concept or problem might seem at the outset, you can solve it if you put your mind to it — and we the course staff are here to help you whenever you need it!