

Introduction to Number Systems

Reading

Sections 1.1, 1.2

Practice Problems

1.1 5, 8, 9, 10, 11

1.2 1, 2, 3, 9

Notes

First a short survey of number systems.

- We all know the *natural numbers*: 1, 2, 3, 4, ... Start from 1, and add it into itself over and over. These will be the main focus of this course.
- By including a zero and additive inverses, we get *negative integers*: -1, -2, 0
- By taking quotients of those we form *rational numbers*: $2/3$, $-42/11$
- In Calculus we learn about the *real numbers*: e , π , $\sqrt{2}$
- One of the fundamental results is that there are many real numbers that are not rational (*irrational numbers*). In fact almost every real number is not rational.
- *Complex numbers* have the form: $a + bi$ where $i = \sqrt{-1}$ represents a “square root of -1”. They are an extension of the reals.
 - We can define addition and multiplication of complex numbers by extending the properties for reals.
 - There is a zero, $0 + 0i$.
 - Cool fact: Every polynomial equation has solutions in the complex numbers. For example $x^2 + 1 = 0$ has solutions i and $-i$.
- The standard number systems:
 - \mathbb{N} The natural numbers: $\mathbb{N} = \{1, 2, 3, \dots\}$
 - \mathbb{Z} The integers: $\mathbb{Z} = \{\dots, -2, -1, 0, 1, 2, 3, \dots\}$
 - \mathbb{Q} The rational numbers: $\mathbb{Q} = \{\frac{a}{b} \mid a, b \in \mathbb{Z}, b \neq 0\}$
 - \mathbb{R} The real numbers. Precisely defining them is more difficult.
 - \mathbb{C} The complex numbers: $\mathbb{C} = \{a + bi \mid a, b \in \mathbb{R}\}$