SE120 - Discrete Structures II
Test 2 - Solutions
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1. Language acceptance (language recognition) problems are of interest to computer scientists because it is the most general form of computation. Every computation that a particular machine (finite automaton, pushdown automaton, Turing machine) can perform can be represented as a language that the machine can accept. Languages that the machine cannot accept correspond exactly to computations that that machine cannot perform.

2. The language consists of all pairs (a, b) where a is a list of integers, and b is list sorted in ascending order containing the exact same integers as in a. For example, the pair $((7, 55, 3, 23), (3, 7, 23, 55))$ would be in this language. If we can accept this language, then we can sort lists of integers.

3. The set X is countable because a bijection exists between the elements of X and $\mathbb{N}$. One such function that maps naturals to X is $f : \mathbb{N} \to X$, $f(a) = a \div 100$. This function is a bijection because its inverse $(f^{-1} : X \to \mathbb{N}$, $f(a) = a \times 100)$ maps X back to $\mathbb{N}$.

4. (a) Uncountable

   (b) Countably infinite