

- In the last lecture:
 - Introduction to Set Theory
 - Determining the elements of a set
 - Cardinality of sets, finite and infinite sets
 - Union and Intersection of sets
 - Cartesian product, relations, functions

- Characteristics of functions (the following are informal definitions):
 - *Injective function (one-to-one)*: each element of the codomain must appear at most once as the second element of an ordered pair.
 - *Surjective function (onto)*: each element of the codomain appears at least once as an element of an ordered pair.
 - *Bijjective function (one-to-one and onto)*: is both injective and surjective
- Give examples of each of these three types of functions. Remember you need to specify the domain and codomain

- Reminder: A function is a SET of ordered pairs
- Therefore a function's domain or codomain (or both) could also be a function)
 e.g. $f : A \rightarrow B$
 $g : (A \rightarrow B) \rightarrow C$
 $g_1 : (A \times B) \rightarrow C$
- What does $f : A \rightarrow B$ mean?
- What does $A \rightarrow B$ mean?

- Function composition: $f : A \rightarrow B$ and $g : B \rightarrow C$
 - $g \circ f : A \rightarrow C$
 - Applicable when f, g are one-to-one or onto

- Inverse of a one-to-one function:
 - $f : A \rightarrow B$
 - $Inv(f), f^{-1} : B \rightarrow Pow(A)$
 - Applicable when f is one-to-one

- Back to sets
 - The universal set
 - The complement of a set
- Discrepancies of definitions with Discrete Maths?

- Computer Representation of Sets(see book: Discrete Maths by Rosen)
- Storing sets in an unordered(unsorted) fashion (e.g. in an array)
- Advantages:
 - Direct representation
 - Easier to reason about

- Computer Representation of Sets
- Storing sets in an unordered fashion
- Disadvantages:
 - Manipulating an unsorted list (i.e. the set, stored in an array) is inefficient
 - Lots of searching for elements is necessary
- Suppose you have two sets:
 $A = \{1, 2, 3\}$ and $B = \{2, 3, 4, 5\}$.
Write a code segment which will store these two sets in two arrays of integers

- Computer Representation of Sets: Using bit strings
 - Need to know universal set, U and have some ordering for it
 - Suppose $U = \{a, b, c, \dots, z\}$ and $C = \{a, e, i, o, u\}$
 - Bit string representation of C is:
10 0010 0010 0000 1000 0010 0000
 - Suppose $U = \{0, 1, 2, \dots, 10\}$. Write a code segment which will store the bit string representation of A and B (from previous slide) as integer arrays of size 11, each entry being a 0 or a 1.

- Computer Representation of Sets:
 - Problem: Using each of the representations above, write a java function that will examine the arrays and output the union of the sets A and B .