

## Chapter 1 outline:

- ▶ Introduction, sets and elements (last week Wednesday)
- ▶ Set operations; visual verification of set propositions (last week Friday)
- ▶ Introduction to SML; cardinality and Cartesian products (Today)
- ▶ Making types and functions in SML (Wednesday)
- ▶ More about functions in SML; introduction to lists [Chapter 2] (Friday)

## Today (full agenda):

- ▶ **[Programming]** Introduction to the SML interpreter
- ▶ **[Programming]** Basic programming terminology
- ▶ **[Programming]** Types
- ▶ **[Sets]** Cardinality, disjointedness, partitions
- ▶ **[Sets and Programming]** Tuples and Cartesian products
- ▶ **[Programming]** Type analysis (“afterclass” video)

Which are valid ML types?

`int`

`double`

`char`

`val`

`string`

`real`

`int * int`

`int * char`

Compute the cardinality:

$$|\{1, 2, 3, 4, 5\} \cup \{3, 4, 5, 6\}|$$

$$|[0, \pi) \cap \mathbb{Z}|$$

$$|\textit{FacultyInThisRoom} - \textit{StudentsInThisRoom}|$$

Which are disjoint?

$\mathbb{Z}$  and  $\mathbb{R}$

$\mathbb{Z}$  and  $\mathbb{R}^-$

$[0, 5)$  and  $[5, 10)$

*Plants* and *Fungi*

*MathClasses* and *CSCIClasses*

*DeciduousTrees* and *ConiferousTrees*

**1.8.1** What is the cardinality of  $\{0, 1, 2, \dots, n\}$ ?

**1.8.3** One might be tempted to think  $|A \cup B| = |A| + |B|$ , but this is not true in general. Why not? (Assume  $A$  and  $B$  are finite.)

**1.8.6** Describe three distinct partitions of the set  $\mathbb{Z}$ .

**1.9.5** Based on our description of the real number plane as a Cartesian product, explain how a line can be interpreted as a set.

**1.9.6** Explain how  $\mathbb{C}$ , the set of complex numbers, can be thought of as a Cartesian product.

**1.9.7** Any rational number (an element of set  $\mathbb{Q}$ ) has two integers as components. Why not rewrite fractions as ordered pairs (for example,  $\frac{1}{2}$  as  $(1, 2)$  and  $\frac{3}{4}$  as  $(3, 4)$ ) and claim that  $\mathbb{Q}$  can be thought of as  $\mathbb{Z} \times \mathbb{Z}$ ? Explain why these two sets *cannot* be thought of as two different ways to write the same set. (There are at least two reasons.)

```
#1(5, 4) + int(4.0 / 3.1)
```

```
(5 + 7, String.sub("hello", 2))
```



`((1, 2), 5.7, ("A", "x")), 8, "bye")`

**For next time:**

*Watch “afterclass” video about type analysis (pandemic-era)*

*Pg 26: 1.6.(1-5)*

*Pg 32: 1.8.(2, 4, 5)*

*Pg 36: 1.9.(3, 4, 8, 9, 10)*

*Note that the ML problems should be submitted as a pdf through Schoology or on paper with the rest of the assignment. Submission to the automated grader starts with the assignment due Sept 8.*

*Skim 1.(10 & 11)*