Data Structures and Algorithms

XMUT-COMP 103 - 2026 T1

Introduction to Collections

Felix Yan

School of Engineering and Computer Science

Victoria University of Wellington

Some differences: COMP 103 vs COMP 102

- COMP 102 introduced ArrayLists.
- COMP 103 will be using Lists and other kinds of collections all the time.

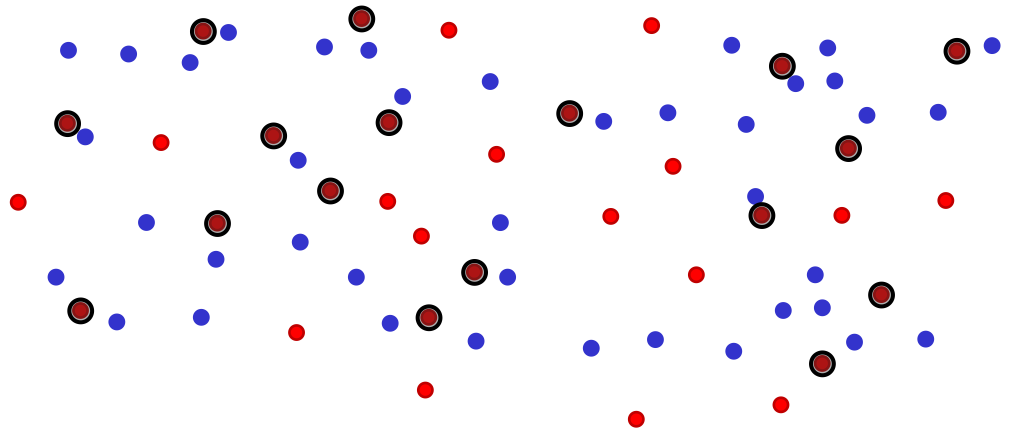
- In COMP 102, we just cared whether your program worked.
- In COMP 103, we will care how **well** your program works.
  - Especially, how efficient is it?
  - When a problem has lots of different solutions, how do we choose a good solution?

- Does it really matter? If the program works, isn't that good enough?

Example of why code quality matters

- A potential question in COMP 102
  - Dealing with Lists of City objects
    [Cities have locations, *double* distanceTo(*City* otherCity) computes the distance]

findAllCloseCities(…)
given a sources list, a targets list, and a distance.
Return a new list of the target cities that are closer than dist from some source city.



Course Structure

Topics:

- Programming with unstructured and linear collections
- Different Kinds of collections:
  - Lists, Sets, Bags, Maps, Stacks, Queues, Priority Queues
- Algorithms using collections.
- Complexity
- Recursion
- Programming with Linked collections
  - Building, traversing tree structured collections
  - Building, traversing graph/network structured collections
- More complex algorithms

Recurring Themes

- Good Design:
  - Which choices should you make?
  - Choosing appropriate implementations for collections
  - Making the right choice the first time

- Efficiency:
  - How fast is it?
  - How much memory does it take?
  - By analysis, and by benchmarking

- Testing:
  - Does it work right?

Programming with Libraries

- Modern programs (especially GUI and network) are too big to build from scratch.

  ⇒ Have to reuse code written by other people

- Libraries are collections of code designed for reuse.
  - Java has a huge collection of standard libraries….
  - Learning to use libraries is essential

Libraries for COMP 103

- ecs100 UI, etc
- java.io Classes for dealing with files
- java.util Collection classes (you've used ArrayList, now …….)
  Other utility classes

- We will use these libraries in almost every program
- We will use other libraries also, where appropriate.

Collections of information

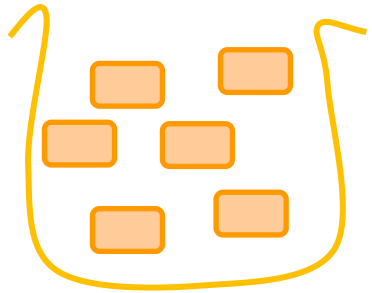
- Lots of information that computers deal with comes in **Collections** of data
  - Need to be able to store information in a way that reflects its structure
  - Need to be able to manipulate the information in lots of different ways

- Information about
  - earthquakes,
  - courses,
  - phone contacts,
  - documents
  - images, movies
  - people,
  - windows,
  - files,
  - network connections
  - …

Collections in Java

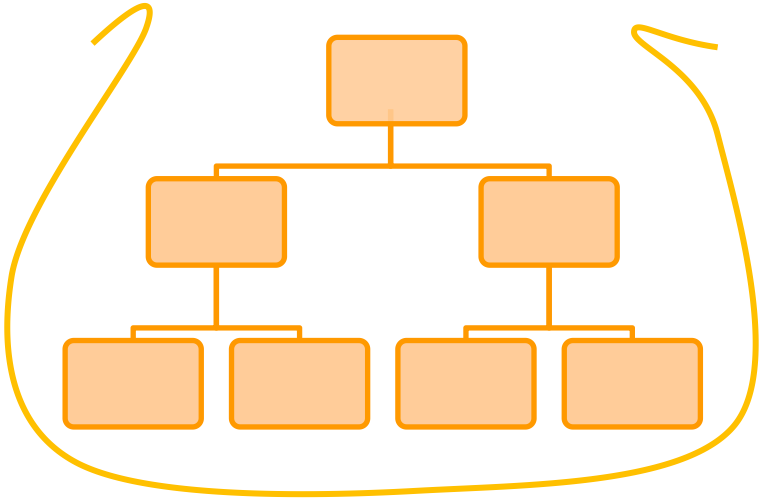
What is a Collection in Java?

- An object that contains other objects

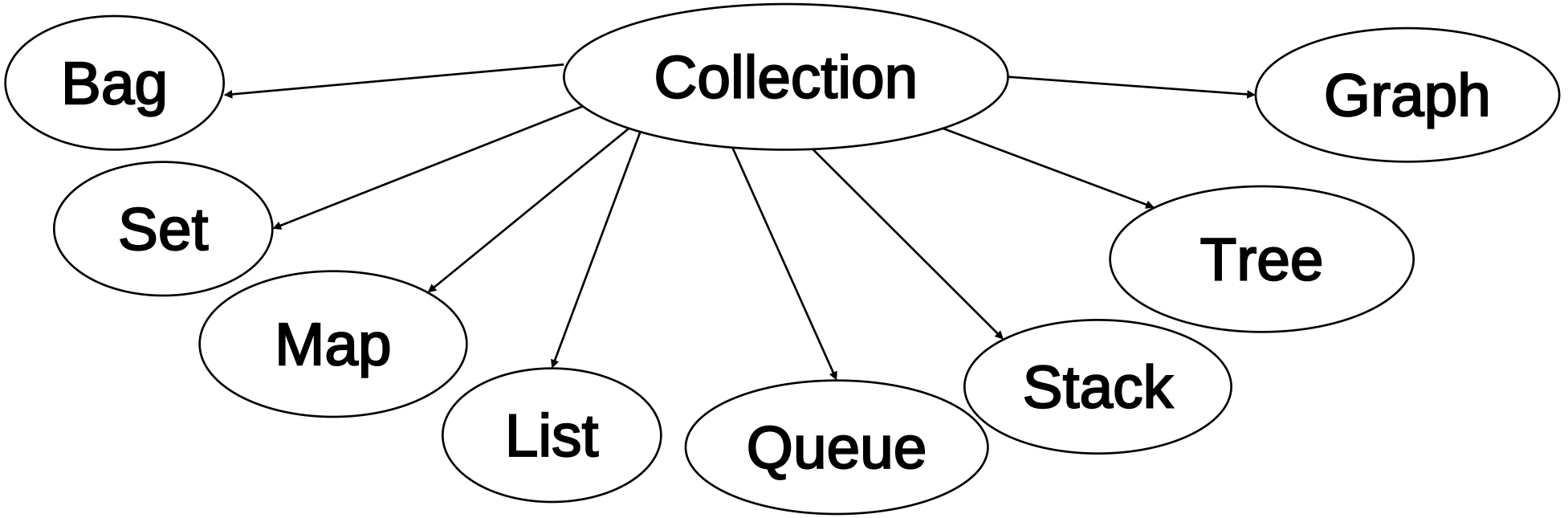


- What defines the collection type?
  - What you can do to it
  - What structure it imposes on its contents
  - What properties it ensures

- Mostly we won’t care much how it works inside:
  - As long as it has the right behaviour, the inside doesn't matter?
  - But we need to know what operations are expensive (and how expensive they are)
  - For trees, we will need to make our own!



“Standard” Collections



What's the difference?

Structure

Constraints