
Data Structures and Algorithms

XMUT-COMP 103 - 2025 T1

Introduction to Collections

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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?

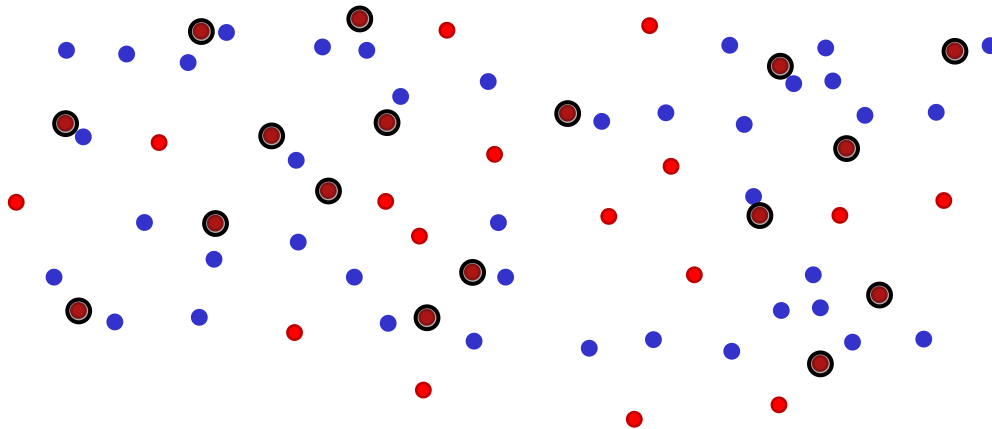
Example of why code quality matters

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

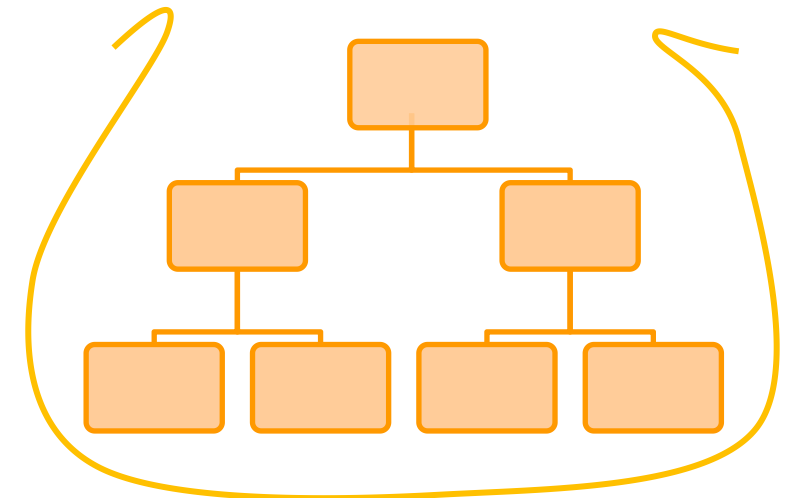
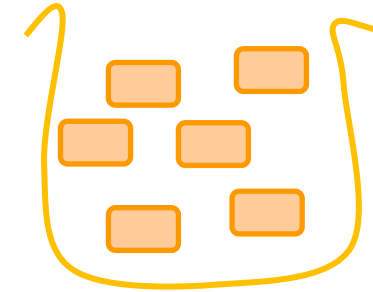
Collections of information

- 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
 - ...

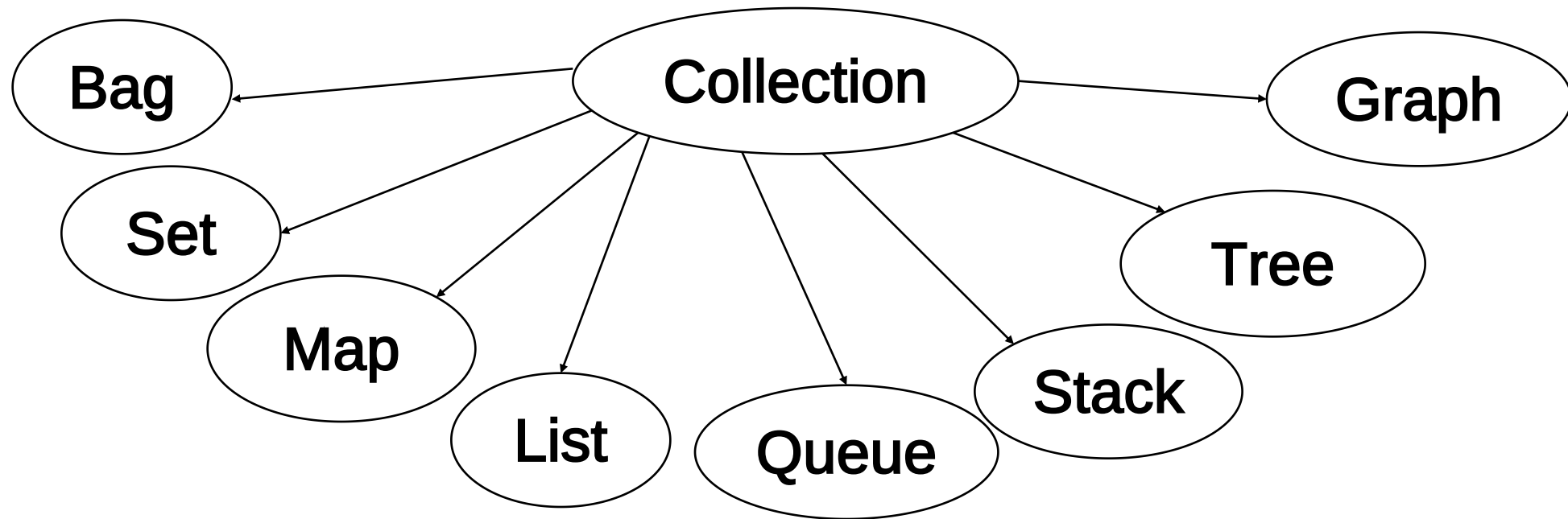
Collections in Java

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