



4.2.1 Data Structure & ADTs

1) Data structures can be static or dynamic.

a) Explain the differences between static and dynamic data structures.

[2 marks]

- Static data structures have storage size determined at compile-time / before program is run
// dynamic data structures can grow / shrink during execution / at run-time
// static data structures have fixed size
// size of dynamic data structures can change;
- Static data structures can waste storage space/memory if the number of data items stored is small relative to the size of the structure
// dynamic data structures only take up the amount of storage space required for the actual data;
- Dynamic data structures require memory to store pointers to the next item(s)
// static data structures do not need memory to store pointers;
- Static data structures store data in consecutive memory locations
// dynamic data structures do not store data in consecutive memory locations;

b) Discuss the advantages and disadvantages of dynamic data structures compared to static data structures.

[4 marks]

Advantages of dynamic (max 2)

- No wasted memory;
- Can grow as more data is added to the data structure
// no limit on number of items that can be added (up to hardware limitations);
- Resources only allocated as they are needed

Disadvantages of dynamic (max 2)

- Additional memory needed for pointers;
- Can result in a memory leak (if data that is no longer needed is not returned to the heap);
- Can take longer to access an item directly;

2) Complete Table 1 by stating whether each data structure is **static or dynamic**, and **mutable or immutable**.





Table 1

Data Structure	Static / Dynamic	Mutable / Immutable
Array	Static	Mutable
List	Dynamic	Mutable
Tuple	Static	Immutable

[6 marks]

3) A programmer needs to store a collection of values.

They must be stored where:

- the number of values may change while the program is running
- the values need to remain in order
- the values may be of different data types

a) Which of the following data structures would be most suitable? An Array, List or Tuple?

[1 mark]

- **List;**

b) Explain your choice.

[2 marks]

- **A list is dynamic, so its size can change while the program is running;**
- **A list is ordered and can contain values of different data types;**

