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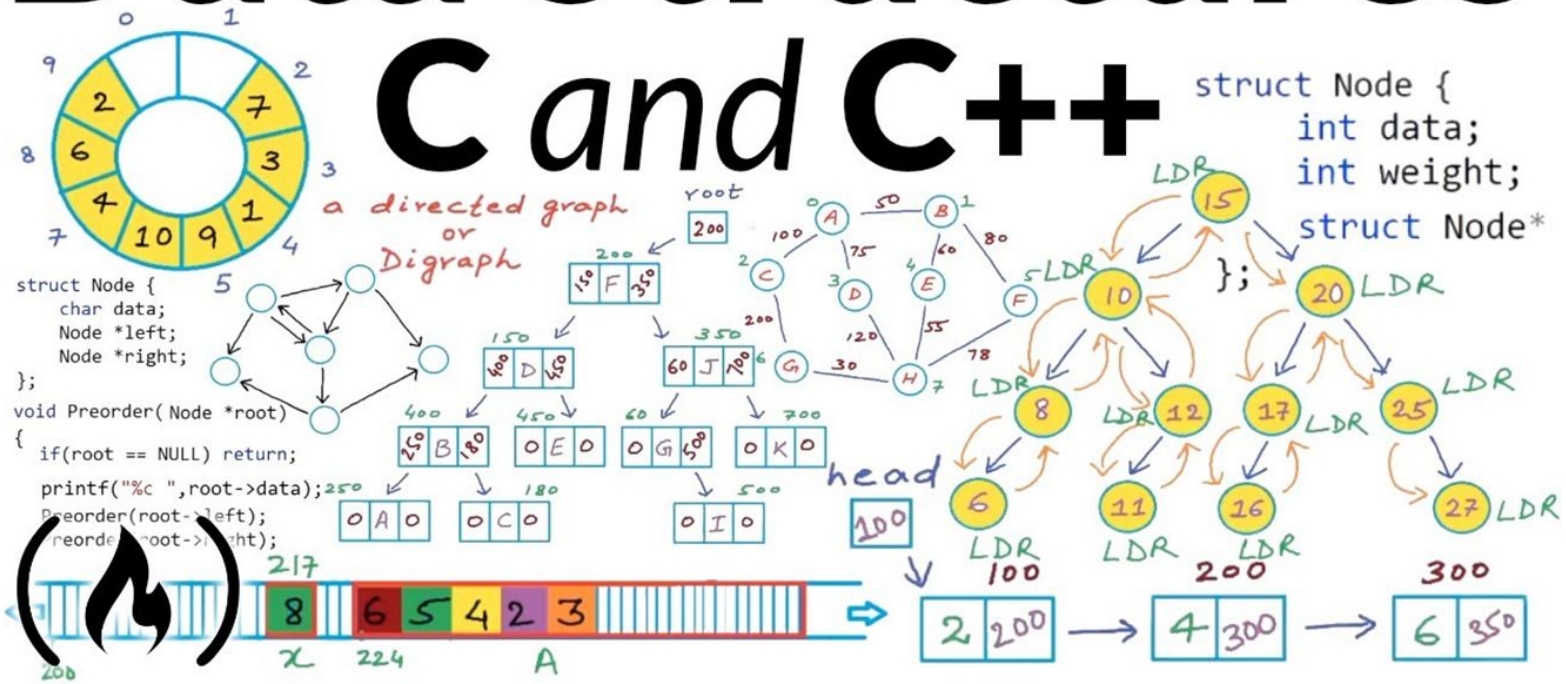
Data Structures C and C++



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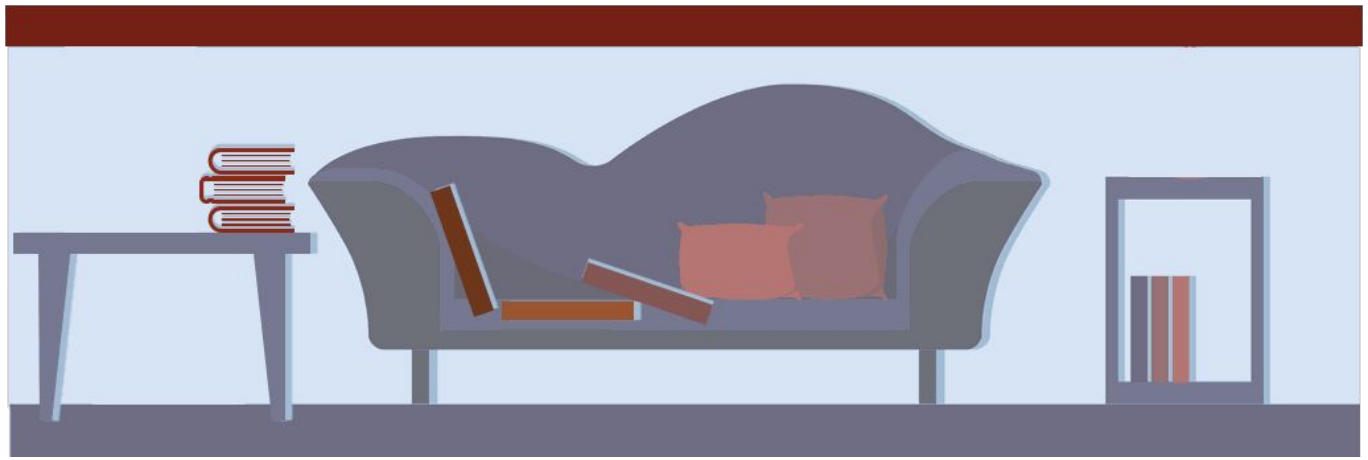
What is a Data Structure?

A data structure is a way we store and organize our data. For example, think about organizing books in a room, we can keep those books on a shelf, or make a stack of them on a table or even just put them randomly anywhere in the room.

Thus, we have different options to organize books in a room or in different words, we have different structures to keep books. In computers also, we have a similar scenario i.e., we can organize our data in the way we want and these different ways of organizing data are different data structures.



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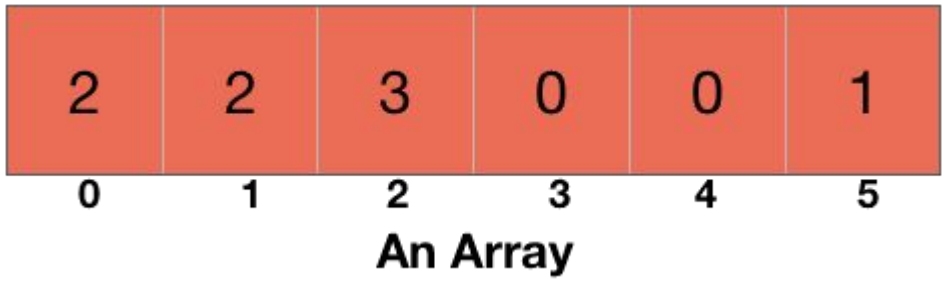
For example, an array is a type of data structure which we learn while learning basic programming languages. It is the most basic data structure and stores different data at different indices.



Do we really need to worry about how our data is stored?

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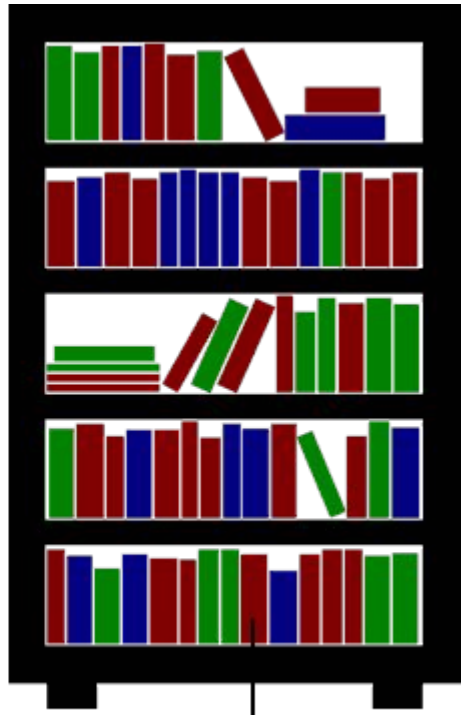
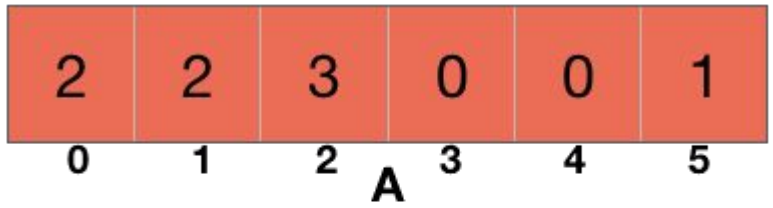
One can keep a frequently used book at the bottom of the pile of books and can access it with a little difficulty but it would make a lot more sense to keep frequently used books on the shelf to access them with ease.

Difficult to access



Easy to access

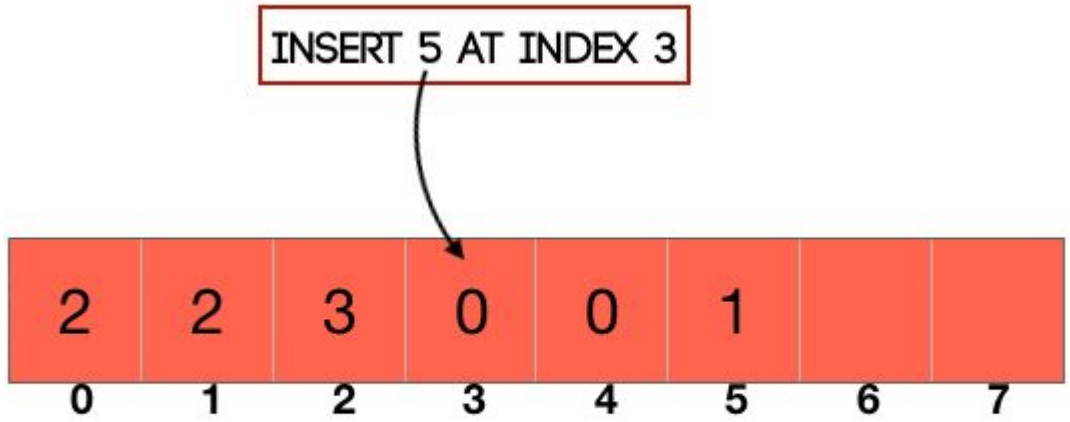
In computers also, the choice of the data structure depends upon the task we are going to perform. For example, if we have a constant number of data and accessing the data in the least time is our priority, then an array is a suitable data structure because it can return the data at an index in constant time (O(1))



A[0] – 2
A[1] – 2
A[2] – 3
A[3] – 0

→ Each element can be accessed in constant time

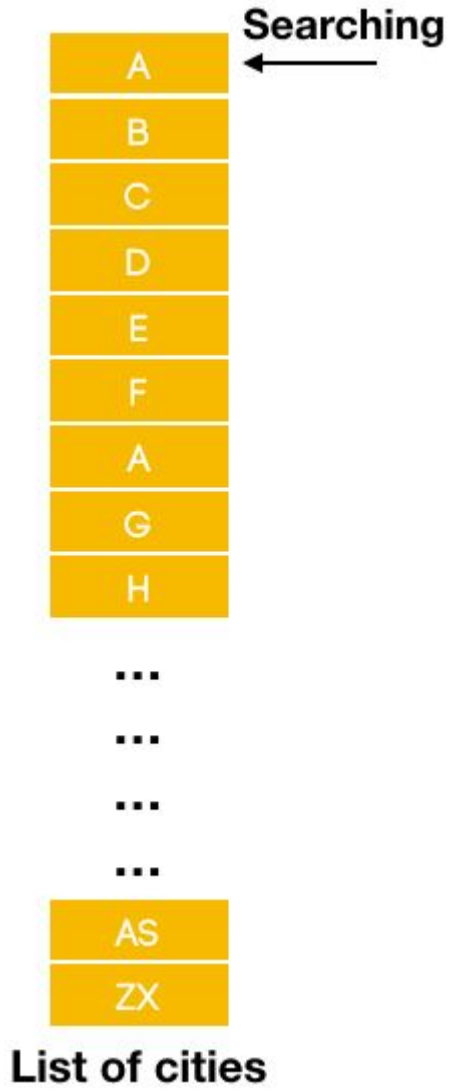
But imagine a task in which we need to frequently insert some new data between two data. In that case, using an array will lead to shifting the elements of the array or even making a new array of different size if the array is not large enough.



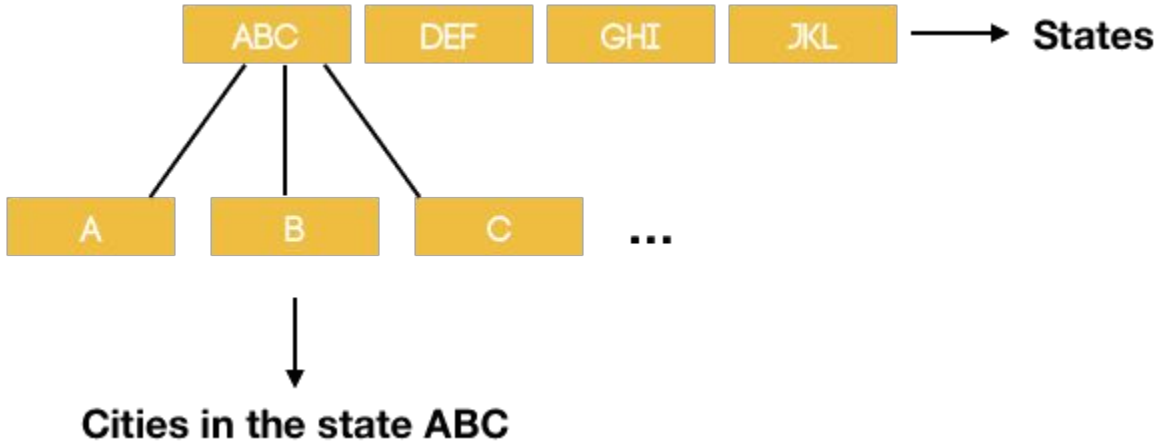
So, a data structure in which the task of inserting some new data between two data is done in the least time would be suitable for this purpose.

The point is that we can complete a task using any data structure but a suitable data structure for a task not only reduces the programmer's effort but also saves a lot of computational time and space.

For example, imagine searching for a city in the list of all the cities of a country. If the desired city is at the last of the list, we will end up iterating over the entire list.



But if we organize all the cities under the state in which they lie and we know the state, it would be a much quicker process to search the city.



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Let's say you have a book of 70000 pages, in which your roll no. is there.

Now, suppose you need to search your roll number. How will you actually do that most efficiently?

You will start searching from the very beginning and will keep on finding it. But in this way, it will take too much time to find your roll no, if let's say is on page 67000. To avoid this, you may use a Binary Search to find your roll number.

In this, you would go to page no. 35,000 and will see your roll no on that page, now if all the roll no. on the page are lesser than your roll no then you will go to page no. 35000+(35000/2). By continuing this way, you would be able to find the roll no. in a much shorter span of time. This is one of the most efficient ways of searching.

Can't I just use libraries instead of making a data structure from scratch?

The library provides exactly what the person needs, so, of course, a library can be used.

But, for understanding data structures, writing our own data structure from scratch will be more helpful to suit our need.

A more complex data structure is made using simpler data structures and existing libraries of them don't always provide exactly what we need.

Should I also be concerned with the choice of language for the implementation of data structure?

The implementation in a language like C is done with the help of structure, pointer, etc. Whereas in an object oriented language like Java, it is done with classes and objects and the idea remains the same as long as the language is an object-oriented one. So, the implementation will change with the "type" of the language we are using.

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What this course teaches me?

★ Basic concepts of different data structures, their applications and their implementation in C/C++.

★ Focus on the running time of different processes like inserting data, searching data, etc. in a data structure.

➔ Important subject for placements/interviews

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What this course teaches me?

★ At the end of this course, you will have knowledge of different data structures and you can use this knowledge to create a new data structure or modify an existing one according to your need.

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Data Structure in day to day life

Using Queue Data Structure as Boarding a Bus:

A queue is a data structure that is of linear type. In Queue, elements are arranged in FIFO manner.

Suppose, there are 10 passengers standing in a row to board the bus. The passenger who comes first would get boarded first on the bus.

Whenever there is a new passenger, it can come through the backside only which means he/she can board the bus in the last only.

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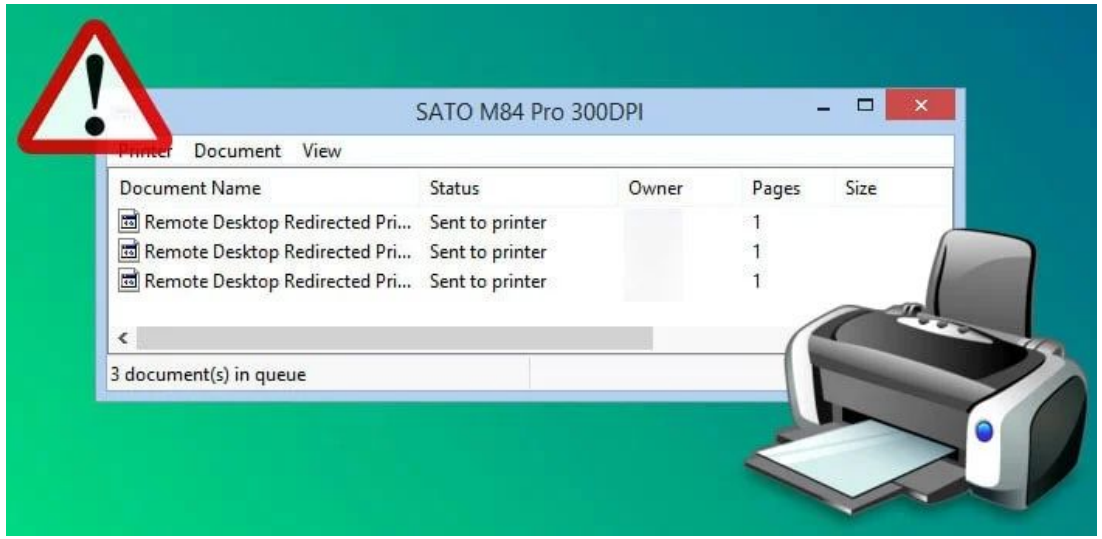
Data Structure in day to day life

Ex. Printing commands in a printer:



Let's say three commands are given to the printer to print the doc.

So, all 3 commands will be stored in the queue and they will be printed in FIFO order only. That means the second command will be printed only once the first command is executed.

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Data Structure in day to day life

Using Graph Data Structure For Google Maps:

Google Maps is one of the widely used and useful technologies developed by Google. According to Wikipedia, in 2020, over 1 billion people used google maps per month.

This google map uses Graph as the data Structure to predict the paths and the traffics shown.

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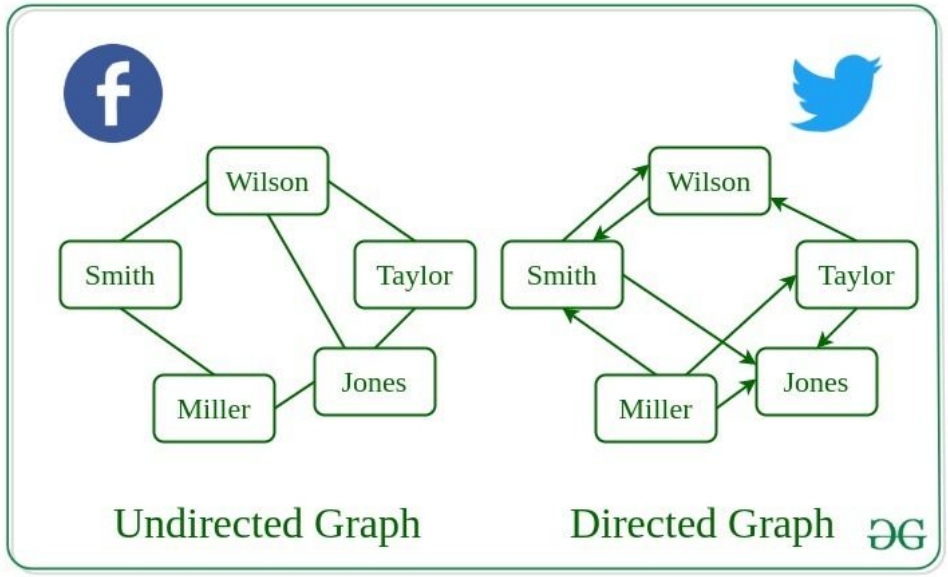
Data Structure in day to day life

Using Graph Data Structure
For Social Media:



A graph is considered to be an interconnected item and each item is basically a node and distance between two nodes is an edge.

We use Facebook, Instagram, etc. All these social media use graphs. Every user on these social media can be considered as the node and when we connect through the node it is called edge.

The more we connect with people, the more edges will be there and eventually, it will form a network something like Facebook we use.

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Data Structure in day to day life

Using Stack Data Structure For Pile of Plates:

A stack is the Data Structure which is used and can be related to the piles of plates. These follow the Last In First Out approach (LIFO).

It can be visualized how plates are put on over the other and the plate which we put at the last is the one which gets out first.

i.e., Insertion and removal can be done from the top only.

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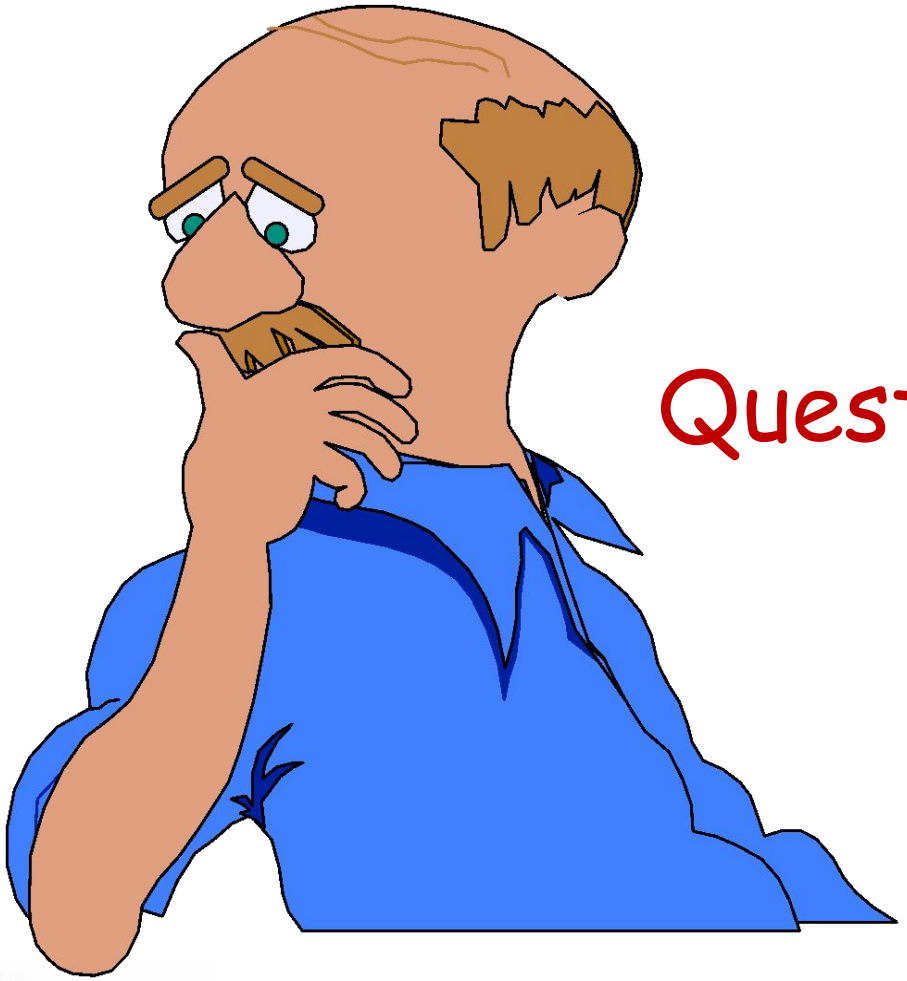

Questions?