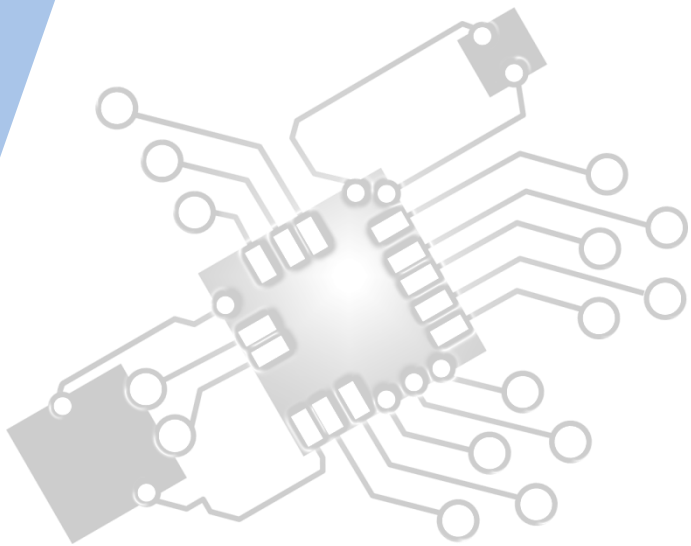
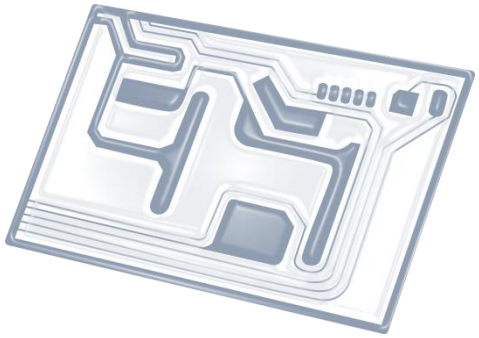
Abstract Data Structures

IB Computer Science



Content developed by
Dartford Grammar School
Computer Science Department

HL Topics 1-7, D1-4



1: System design

2: Computer Organisation

3: Networks

4: Computational thinking

5: Abstract data structures

6: Resource management

7: Control

D: OOP

HL only 5 Overview

Thinking recursively
5.1.1 Identify a situation that requires the use of recursive thinking
5.1.2 Identify recursive thinking in a specified problem solution
5.1.3 Trace a recursive algorithm to express a solution to a problem
Abstract data structures
5.1.4 Describe the characteristics of a two-dimensional array
5.1.5 Construct algorithms using two-dimensional arrays
5.1.6 Describe the characteristics and applications of a stack
5.1.7 Construct algorithms using the access methods of a stack
5.1.8 Describe the characteristics and applications of a queue
5.1.9 Construct algorithms using the access methods of a queue
5.1.10 Explain the use of arrays as static stacks and queues
Linked lists
5.1.11 Describe the features and characteristics of a dynamic data structure
5.1.12 Describe how linked lists operate logically
5.1.13 Sketch linked lists (single, double and circular)
Trees
5.1.14 Describe how trees operate logically (both binary and non-binary)
5.1.15 Define the terms: parent, left-child, right-child, subtree, root and leaf
5.1.16 State the result of inorder, postorder and preorder tree traversal
5.1.17 Sketch binary trees
Applications
5.1.18 Define the term dynamic data structure
5.1.19 Compare the use of static and dynamic data structures
5.1.20 Suggest a suitable structure for a given situation

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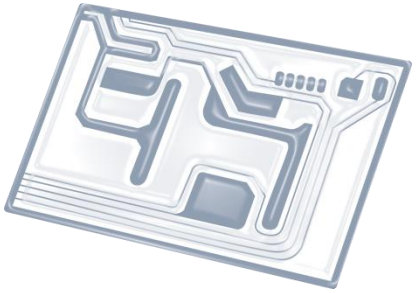
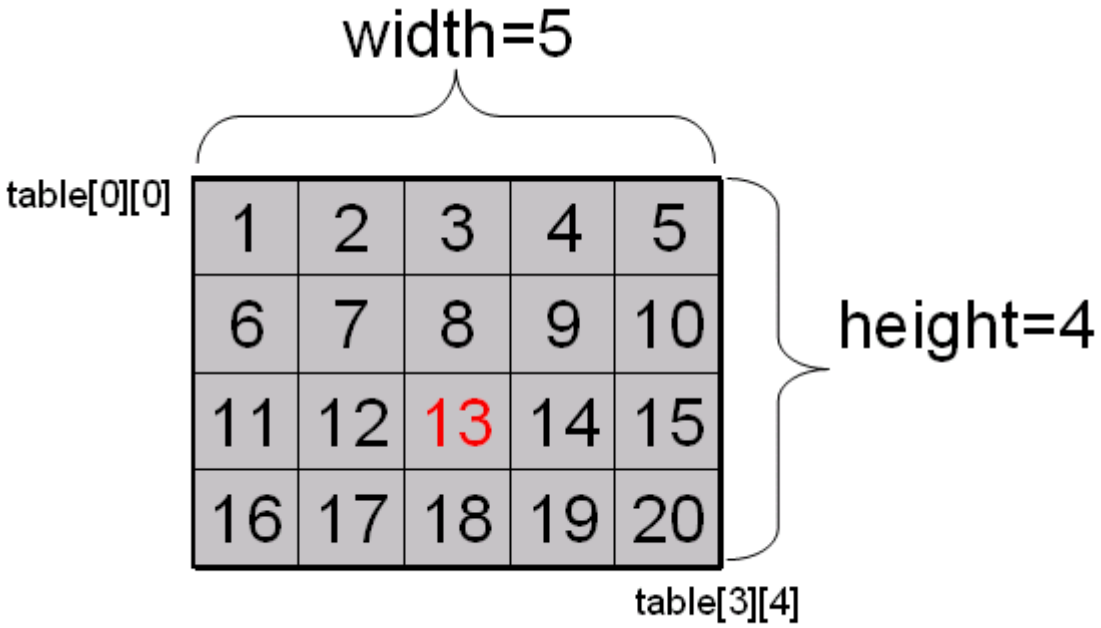


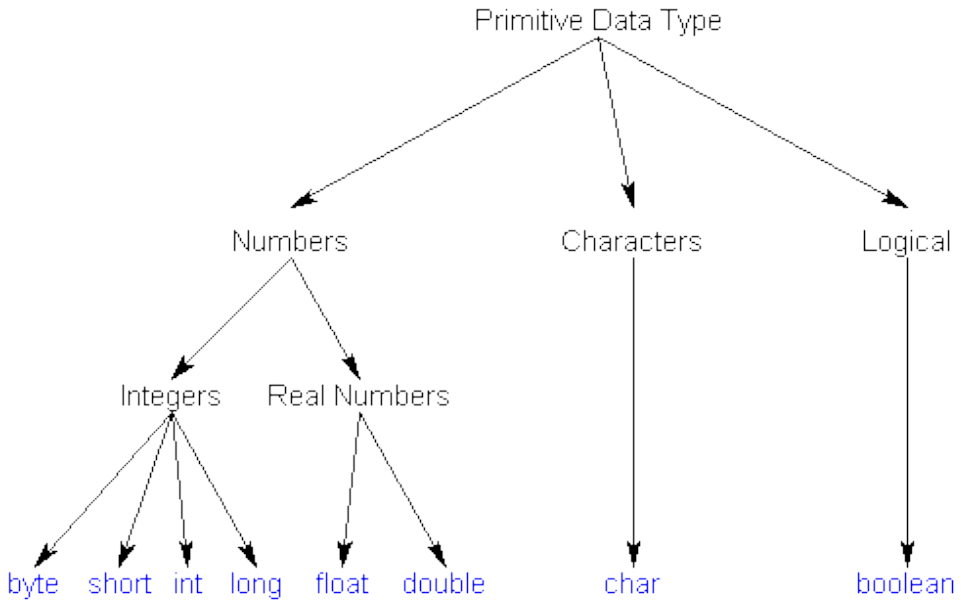
Topic 5.1.4

Describe the **characteristics** of a **two-dimensional array**



Abstract Data Structures (ADTs)

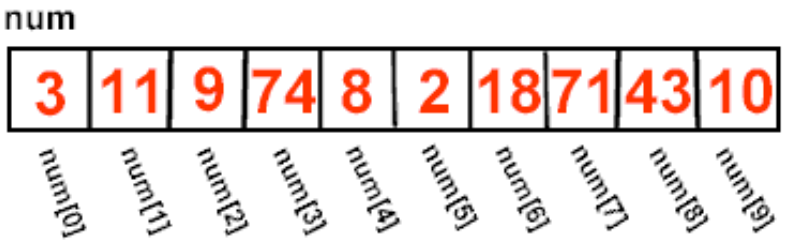
- **2D array**
- Stack
- Queue
- Linked List
- (Binary) Tree
- Recursion



Arrays in general (1D/linear)

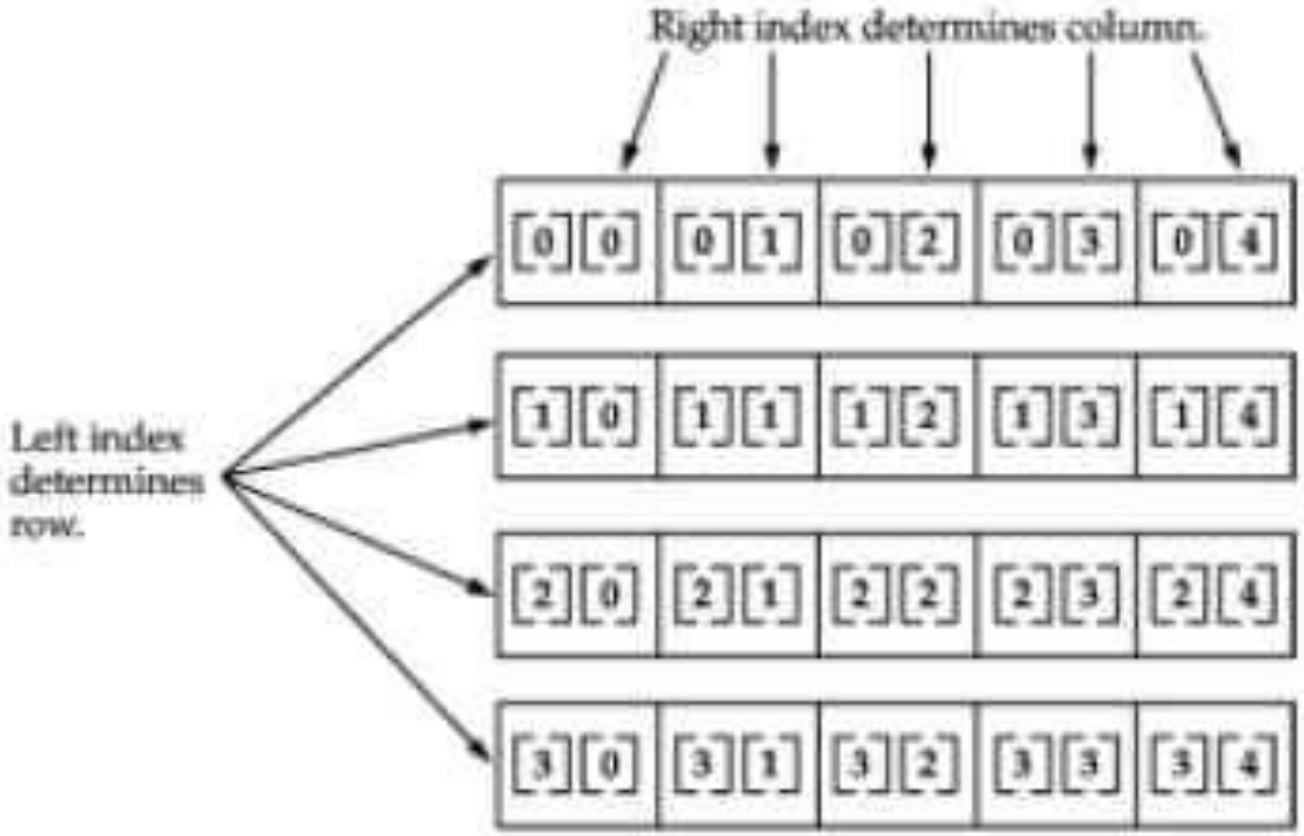
```
int [ ] num = new int [ 10 ];
```

- `int [ ]` — type of each element
- `num` — name of array
- `10` — subscript (integer or constant expression for number of elements.)



	What could go wrong?
`num [ 0 ]`	always OK
`num [ 9 ]`	OK (given the above declaration)
`num [ 10 ]`	illegal (no such cell from this declaration)
`num [ -1 ]`	always NO! (illegal)
`num [ 3.5 ]`	always NO! (illegal)

2D array (grids/tables)



Given: int twoD [ ] [ ] = new int [4] [5] ;

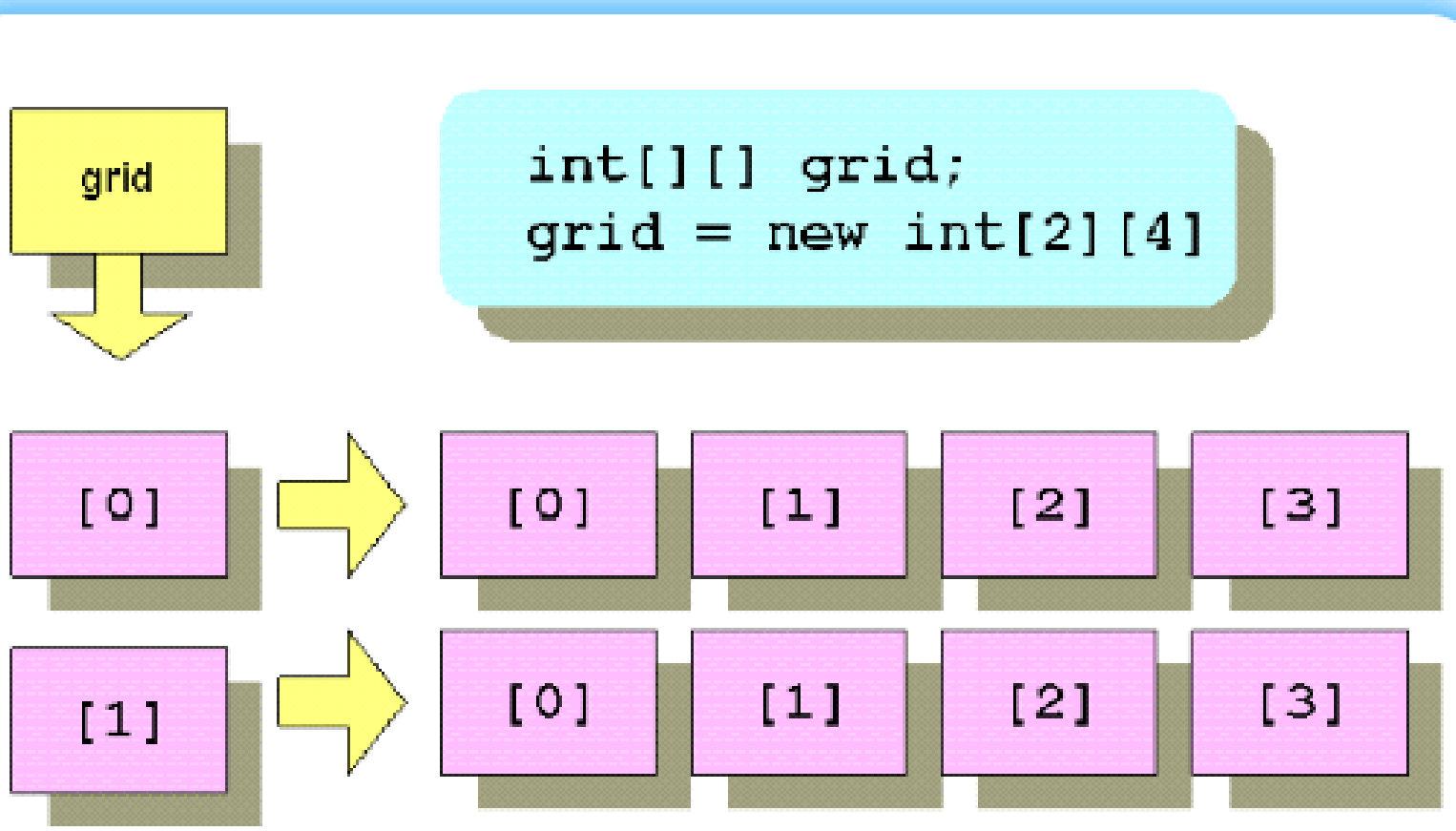
y = \ x =	0	1	2	3	4
0	1	0	0	0	0
1	0	0	2	0	0
2	1	1	0	0	1
3	2	1	1	1	0
4	1	2	1	2	2

Array.At(x,y) = value

Array.At(0,0) = 1

Array.At(2,3) = 1

Array.At(4, 4) = 2


grid
int[][] grid;
grid = new int[2][4]
[0]
[1]
[0]
[1]
[2]
[3]
[0]
[1]
[2]
[3]

Example of creating, filling and printing a 2D array in Java using dedicated methods

```
int main()
{
int array[5][5];

   fillArray(array, 5);
   printArray(array, 5);

    return 0;
}
void fillArray(int ar[][5], int numRows)
{
   srand(time(0));
   for(int row = 0; row < numRows; row++)
   {
      for(int col = 0; col < 5; col++)
      {
         ar[row][col] = rand() % 101;
      }
   }
}
void printArray(const int ar[][5], int numRows)
{
   for(int row = 0; row < numRows; row++)
   {
      for(int col = 0; col < 5; col++)
      {
         cout << ar[row][col] << "\t";
      }
      cout << endl;
   }

}
```