Fundamentals of Structured Programming

Lecture 3

Multi-Dimensional Array

Course Coordinator: Prof. Zaki Taha Fayed

Presented by: Dr. Sally Saad

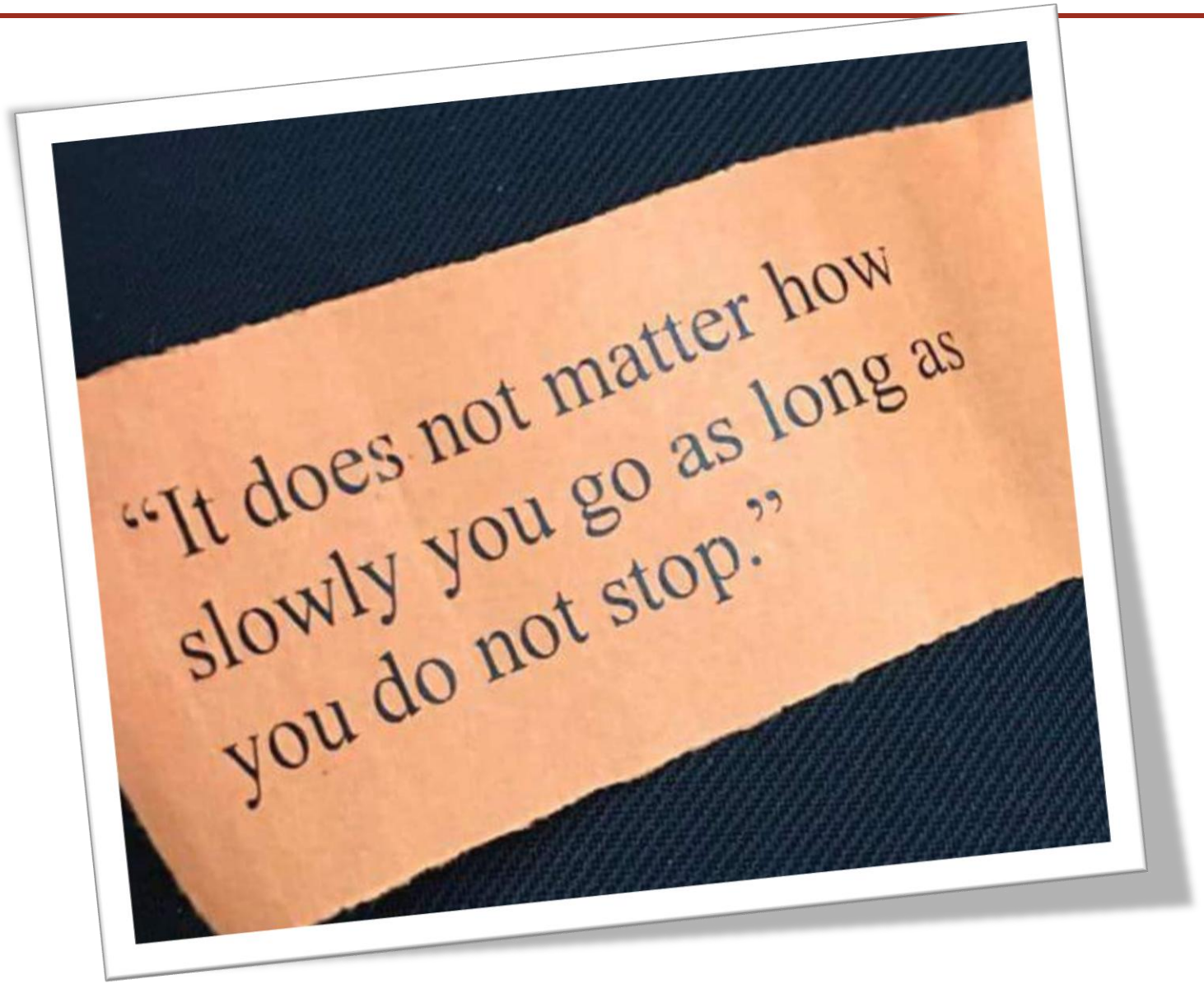
SallySaad@gmail.com

DropBox folder link

https://www.dropbox.com/sh/85vnrgkfqgrzhwn/AABdwKLJZqZs26a7u-y0AFwia?dl=0

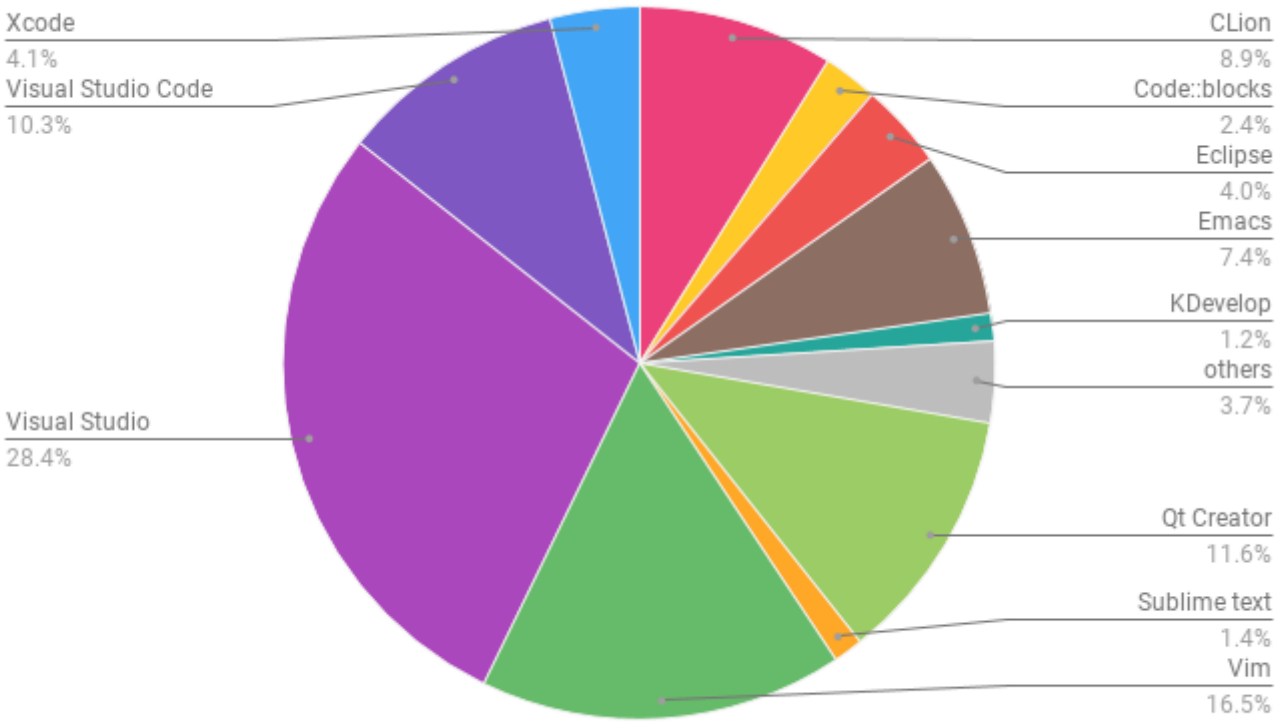
Credits to Dr.Salma Hamdy for Content Preparation

Quote of the Day!



Information of the Day ☺ (2018 most used C++ IDEs)

The full results including all the entries with at least 1% of votes are showed in this pie chart:



In this chart "others" includes all the entries with less than 1% of votes. Some notable IDEs in this group

http://blog.davidecoppola.com/2018/02/market-share-most-used-c-cpp-ides-in-2018-statistics-estimates/

Class Accumulative Project: Employees Salary for Companies

***Task1 ***

7. An employee is paid at a rate of $16.78 per hour for the first 40 hours worked in a week. Any hours over that are paid at the overtime rate of one and one half times that. From the worker's gross pay, 6% is withheld for social security tax, 14% is withheld for federal income tax, 5% is withheld for state income tax, and $10 per week is withheld for union dues. If the worker has three or more dependents, then an additional $35 is withheld to cover the extra cost of health insurance beyond what the employer pays. Write a program that will read in the number of hours worked in a week and the number of dependents as input, and will then output the worker's gross pay, each withholding amount, and the net take-home pay for the week. For a harder version, write your program so that it allows the calculation to be repeated as often as the user wishes. If this is a class exercise, ask your instructor whether you should do this harder version.

Class Accumulative Project: Employees Salary for Companies

- Refer to Bonus Exercise in Dropbox folder under folder Lecture1 and Lecture 2.
- View code **(Task1)**
- Updated code with Arrays **(Task2)**
- **Task 3 :** at the end of the slides ☺

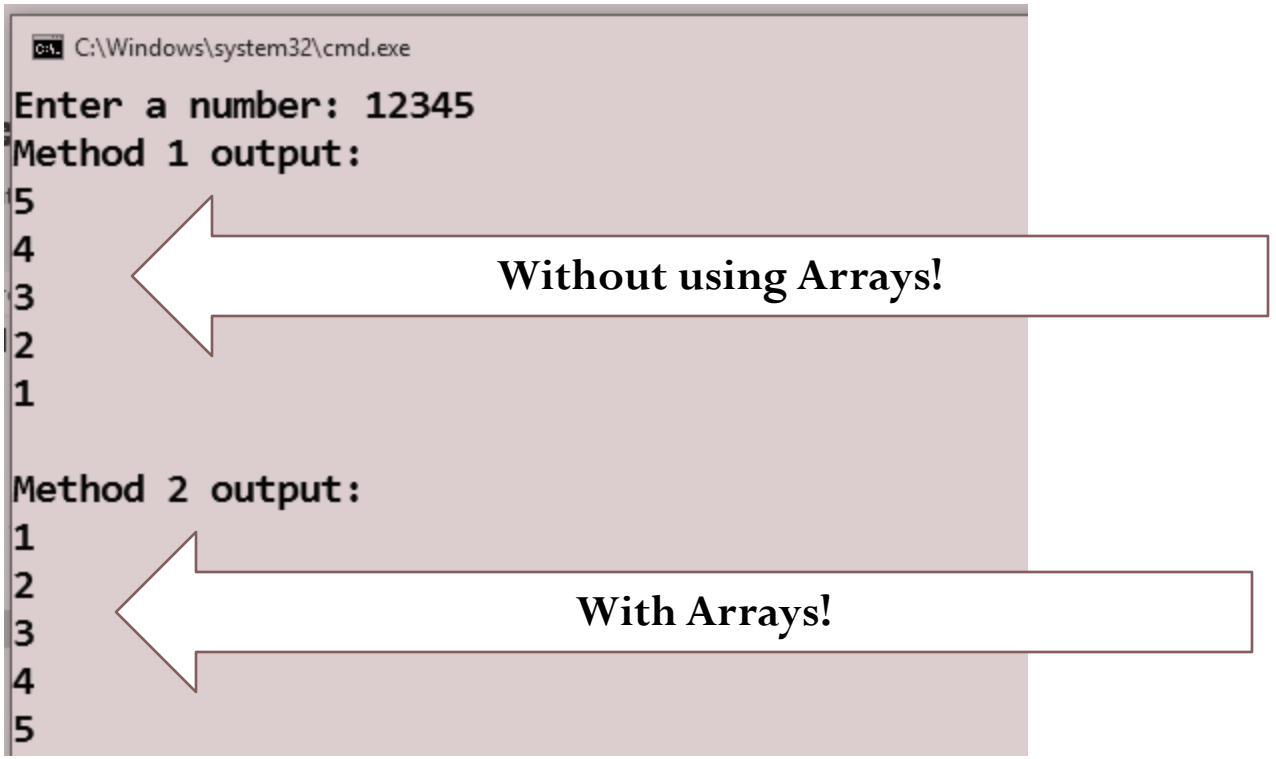
Remarks from Previous Lect

SMART ENOUGH..HA ? ☺

Example 1

- Write a program to accept an integer from the user and display each digit on a separate line.

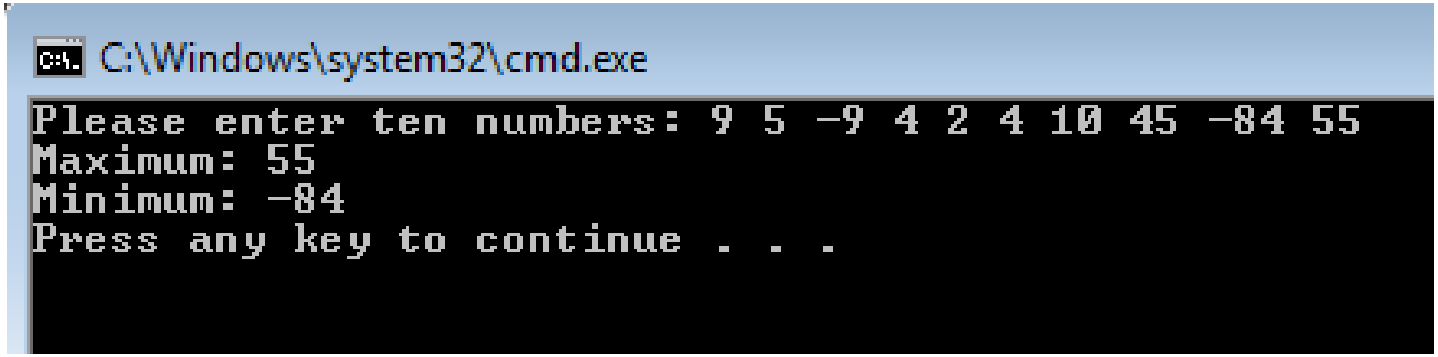
- Code



Remarks from Previous Lecture

Example 2

- **Write a program to take ten integers from the user and display the minimum of them. (initial value vs. first element)**
- ***Maximum value will be practiced in the lab.***



Remarks from Previous Lecture

Example 3 (*Take-HOME-Exercise*)

- **Write a program to find the second maximum of an array of 5 integers.**

(Sort Vs. Search)

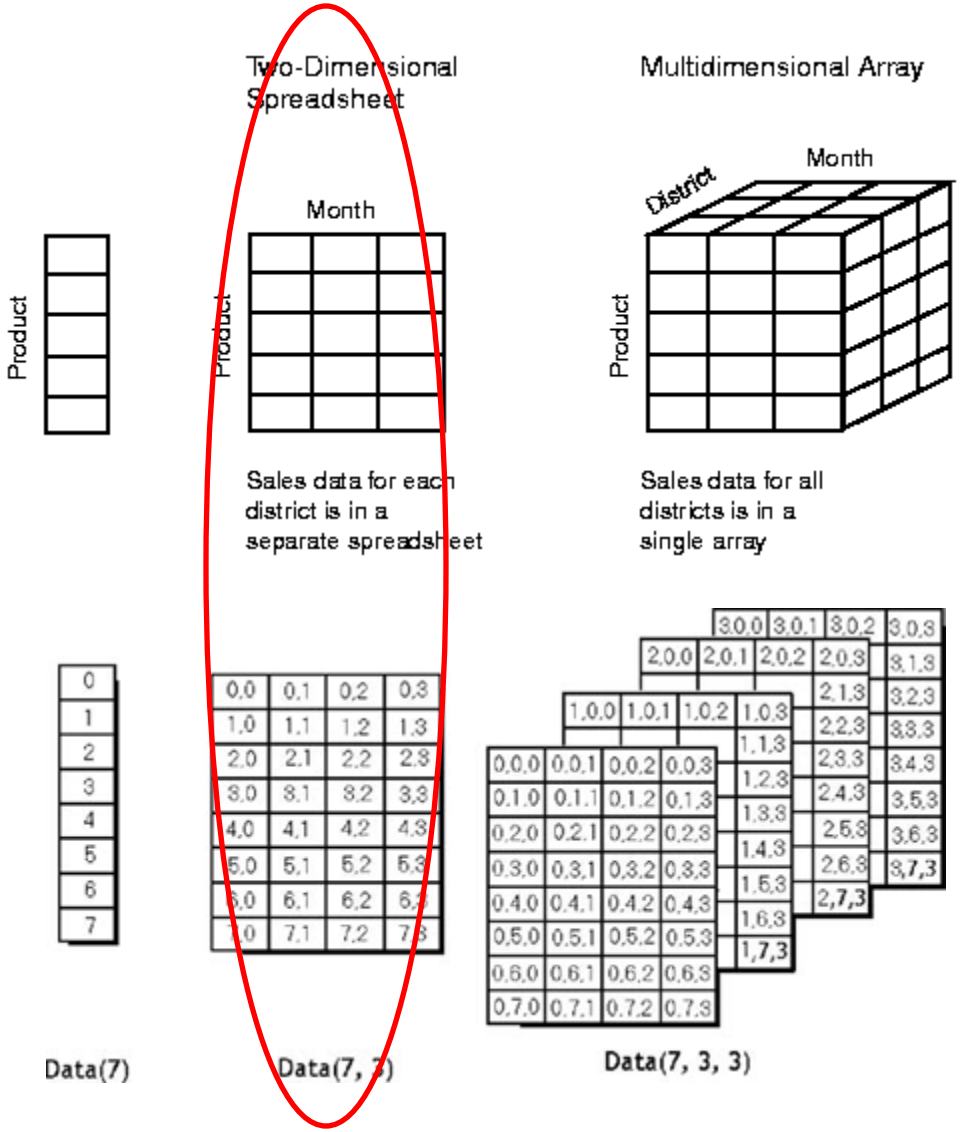

Break

Multi-Dimensional Array

Multidimensional Arrays

What is a dimension?

two dimensional arrays



Multidimensional Arrays

Declaration

type var_name[size1][size2]; → **allocates memory**

```
int income[12][5];

const int MONTHS = 12, PRODUCT = 5;
int income[MONTHS][PRODUCT]
```

Value or Constant or Expression → constant NOT variable

0,0	0,1	0,2	0,3
1,0	1,1	1,2	1,3
2,0	2,1	2,2	2,3
3,0	3,1	3,2	3,3
4,0	4,1	4,2	4,3
5,0	5,1	5,2	5,3
6,0	6,1	6,2	6,3
7,0	7,1	7,2	7,3

Data(7, 3)

Multidimensional Arrays

Initialization

```
const int STUD = 2, SCORE = 3;
int score[STUD][SCORE] = {{50, 60, 80}, {100, 50, 45}};
```

```
int score[STUD][SCORE] = {{50, 60, 80}, {100, 50, 45}, {40, 50, 70}};
```

```
int score[STUD][SCORE] = {{50, 60, 80}};
```

Will zero the rest

Multidimensional Arrays

Initialization

- **What if undefined size? → Auto-initialization**

BUT MUST GIVE AT LEAST SIZE 2

```
int score[][] = {{50, 60, 80}, {100, 50, 45}, {40, 50, 70}};
```

```
int score[][SCORE] = {{50, 60, 80}, {100, 50, 45}, {40, 50, 70}};
```

Multidimensional Arrays

Accessing Array Elements

- *type name[rows][cols];*

Element

subscripts/indices

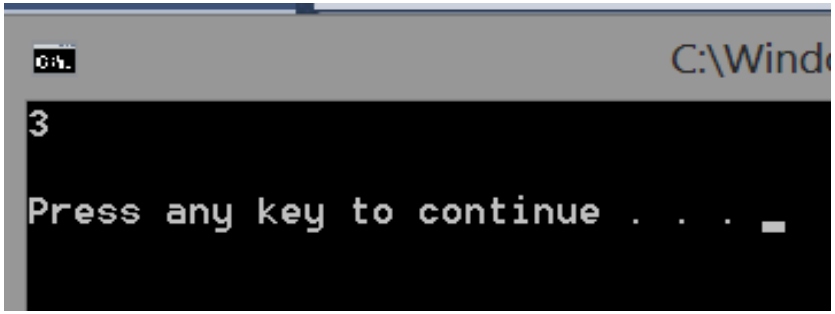
- **Subscripts start at 0 to *rows-1* and *cols*-1.**
- **Recall INDEX OUT OF RANGE ERROR.**

Multidimensional Arrays

Elements Referencing (Accessing)

type var_name[size1][size2];

```
int score[][3] = {{1,2,3},{4,6}};
cout<<score[0][2]<<endl;
```



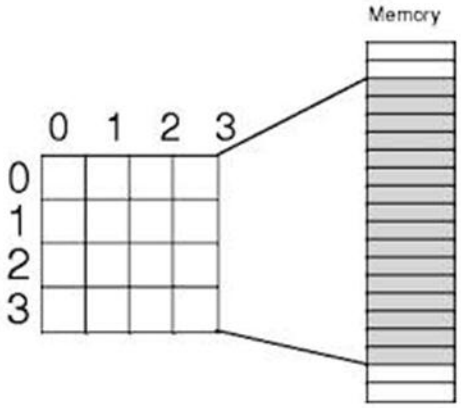
- **Indices start at 0 to *size1-1* and *size2-1*.**
- **So in the above example we have**
  - **Score[0][0] = 1**
  - **Score[0][2] = 3**
  - **Score[1] [1]= 6 the rest are all zeros.**

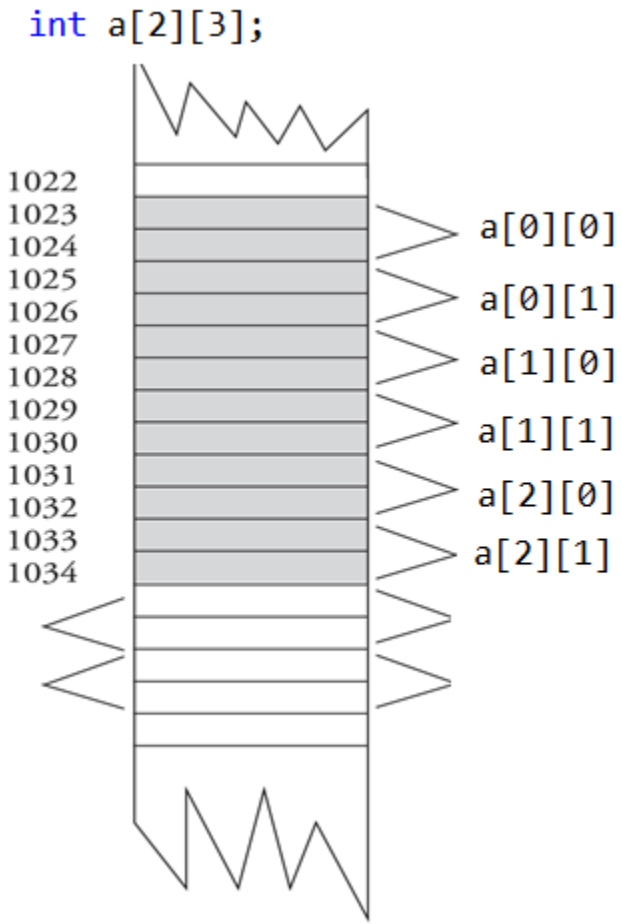
Multidimensional Arrays

- **Array elements are stored consecutively in memory.**

EVEN FOR THE 2D ARRAYS!

- **Only the address of first element is "memorized" and the rest are calculated.**





Multidimensional Arrays

Multidimensional arrays are not limited to two indices (i.e., two dimensions). They can contain as many indices as needed. But be careful! The amount of memory needed for an array rapidly increases with each dimension. For example:

```
char century [100][365][24][60][60];
```

declares an array with a `char` element for each second in a century, that is more than 3 billion chars. So this declaration would consume more than 3 gigabytes of memory!

Multidimensional arrays are just an abstraction for programmers, since we can obtain the same results with a simple array just by putting a factor between its indices:

```
int jimmy [3][5];   // is equivalent to
int jimmy [15];     // (3 * 5 = 15)
```

C++ Language Tutorial
Written by: **Juan Soulié**
Last revision: **June, 2007**
Available online at: http://www.cplusplus.com/doc/tutorial/
The online

Multidimensional Arrays

Example 1 (Search in 2D Array)

- **Write a program to accept a matrix of 4x3 numbers from the user and search for a value in the input matrix of numbers and output the row and column indices if found.**
- **Code**

```
C:\Windows\system32\cmd.exe
Enter 3x4 matrix:
1 2 3 4
7 9 8 10
12 -1 5 6
Enter key value you are searching for: 8
8 is found in the Matrix at row : 2 and column : 3
Search again (y/n)?
y
Enter key value you are searching for: -1
-1 is found in the Matrix at row : 3 and column : 2
Search again (y/n)?
n
Press any key to continue . . .
```

Multidimensional Arrays

Example 2 (Minimum in 2D Array)

- **Write a program to accept a matrix of 3x4 numbers from the user and display the minimum value in the matrix as well as the row and column indices of its position.**
- **Code**

Multidimensional Arrays

Example 3 (Minimum in 2D Array, by Row)

- **Write a program to accept a matrix of 3x4 numbers from the user and display the minimum value of each row in the matrix of as well as the row and column indices of them. Code.**

```
C:\Windows\system32\cmd.exe
Enter 3x4 matrix:
1 2 3 4
8 7 6 5
10 9 12 15
Minimum Value in Row 1 is : 1 found in column: 1
Minimum Value in Row 2 is : 5 found in column: 4
Minimum Value in Row 3 is : 9 found in column: 2
Continue (y/n)?
```

```
C:\Windows\system32\cmd.exe
Enter 3x4 matrix:
1 2 3 4
8 7 6 5
10 9 12 15
Matrix          Min
1 2 3 4         1
8 7 6 5         5
10 9 12 15      9
Continue (y/n)?
```

Class Accumulative Project: Employees Salary for Companies

Class Accumulative Project: Employees Salary for Companies

Task1 (DONE☺)

TASK 2:(DONE☺)

TASK 3 (NEW* BONUS):

- Update YOUR Code to **save** hours worked, number of dependents as well as the calculated total taxes and Net Pay Salaries for **10** employees in your company saving them in **2D Array**.
- **Display** them four information of the **10** employees in a tabular form.
- **Display** the salaries (and position in the array) of the most-paid employee and the least-paid one.

https://drive.google.com/open?id=1jn3G1DbDOfxPkqsGz_MO1hoL6nwx6VMzoZCJziwdTEM

- Submit your code as text in this form, **due Date Sunday 25/2/2018 at 11:59 pm**
- **IMPORTANT NOTE: Input YOUR SEAT NUMBER in the form.**

Roll of Honour

TASK 1

- Thanks for the following students for the Good Try of coding ☺

- **General (G1):**

1. **Ahmed ElErm (full Arabic name?)**
2. **Shehab Ashraf**
3. **Hossam Ahmed Mohamed**

Roll of Honour

TASK 1

- Thanks for the following students for the Good Try of coding ☺
- **Software Engineering Department :**

1. **Tasneem Kadous**
2. **Reem Osama**
3. **Ahmed Salama Ahmed**

Roll of Honour

TASK 1

- Thanks for the following students for the Good Try of coding ☺
- **Bio-Informatics Department:**

1. **Mohannad Mohammed**
2. **Salma Alaa**
3. **Demiana Emil**

Roll of Honour

TASK 1

- Thanks for the following students for the Good Try of coding ☺

- **General (G2):**
  1. **Youssef Halim Khouza...**
  2. **Hadeer Mahdy Zein ElAbdeen**
  3. **Tawfik Hesham**


Thank You