Introduction to Programming

Week – 5, Lecture – 2

Arrays in C – Part 2

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What if, we have to store marks for more students than one?

- One way to do so would be to increase the size of the array… in multiples of 5
- The first 5 indices could be used to store marks for the first student
- The next 5 indices could be used to store marks for the second student… and so on

Arrays and memory

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For example, if a C array is declared at starting address `1000` like this: `int arr[5];` then

- … address of `arr[0]` = `1000`, address of `arr[1]` = `1000` + `4` = `1004`…
- … address of `arr[2]` = `1000` + `8` = `1008`, and so on…

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- … address of `arr[2]` = `1000` + `8` = `1008`, and so on…
- **Basically, address of `arr[i]` = starting address of `arr` + (`i` * size of single element of `arr`)**

Adding more “dimensions” to an array

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- … so instead of creating `marks[`*`N`*`* 5]` we can also create something like `marks[`*`N`*`][5]`

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- … so instead of creating `marks[`*N*`* 5]` we can also create something like `marks[`*N*`][5]`
- The amount of memory allocated in both cases is the same, i.e. for (`5 *` *N*) elements

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One pair of brackets, essentially represent one *dimension* of the array

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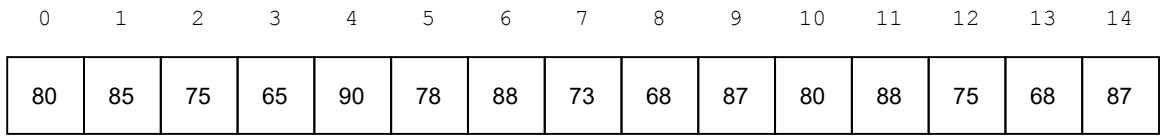
One pair of brackets, essentially represent one *dimension* of the array

- Thus, a 2-dimensional array can be visualised like “variables arranged in rows and columns of a matrix”

Visualising Arrays



A one-dimensional array with the indices,
can be visualized as a line of variables

Visualising Arrays

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
80	85	75	65	90	78	88	73	68	87	80	88	75	68	87

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1	78	88	73	68	87
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A one-dimensional array with the indices, can be visualized as a line of variables

This is the second index

	0	1	2	3	4
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1	78	88	73	68	87
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A two-dimensional array with the indices, can be visualized as a rows and columns of variables

In memory, though, they both look alike

1000	80
1004	85
1008	75
1012	65
1016	90
1020	78
1024	88
1028	73
1032	68
1036	87
1040	80
1044	88
1048	75
1052	68
1056	87

Nested loops for multidimensional arrays

Similar to how we usually use a for loop to access all elements of an array…

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For example an array declared like `int arr[M][N];` can be accessed as

```
for(i = 0; i < M; i++)
{
    for(j = 0; j < N; j++)
    {
        printf("%d\t", arr[i][j]);
        if(j == N-1)
            printf("\n");
    }
}
```

Marks summer for multiple students…

```c
int total_marks[N], total_maximum_marks[N];
int marks[N*5];
int max[N*5];
int i;

printf("Marks summer for %d student(s)\n", N);

for(i = 0; i < N*5; i++)
{
        if(i % 5 == 0)
        {
                printf("-------------------------------------------------------\n");
                printf("Enter marks for Student#%d\n", i/5+1); // Integer division ;)
                printf("Please provide marks for five subjects\n");
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                total_marks[i/5] = total_maximum_marks[i/5] = 0;
        }
        scanf("%d/%d", &marks[i], &max[i]);
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printf("Here are the sum of marks for all students:\n");

for(i = 0; i < N; i++)
        printf("Student#%d: %d/%d\n", i+1, total_marks[i], total_maximum_marks[i]);
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Here, we have a 1-dimensional array of size $N * 5$

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and here, we use a 2-dimensional array of size $N \ X \ 5$

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In particular, see the use of a single loop vs two loops with nesting

Convince yourself that these two code fragments are equivalent

Homework !!

The mechanism of storing values at addresses that we discussed is called the *Row-major* method

- Arrays in C are stored in row-major format
- There is another mechanism for storing arrays, called the *Column-major* method
- Read more about Column-major method, and try to think when it may be preferrable over row-major method