Multidimensional Arrays in C

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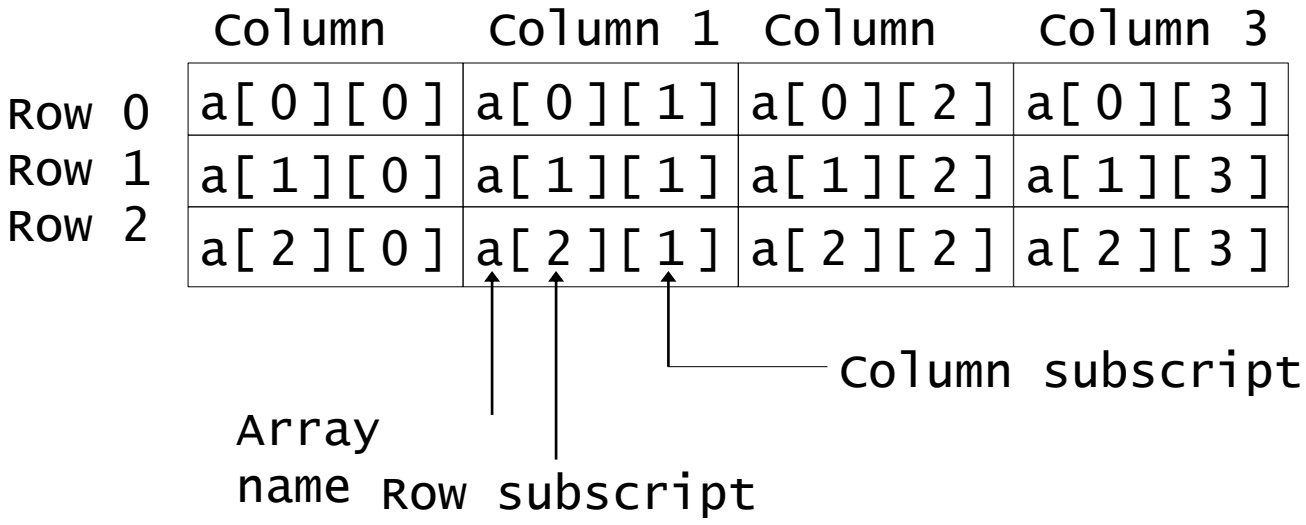
Multiple-Subscripted Arrays

- An array of arrays is called as multi dimensional array. In simple words, an array created with more than one dimension (size) is called as multi dimensional array. Multi dimensional array can be of **two dimensional array** or **three dimensional array** or **four dimensional array**...

  Most popular and commonly used multi dimensional array is **two dimensional array**. The 2-D arrays are used to store data in the form of table. We also use 2-D arrays to create mathematical **matrices**.

Multiple-Subscripted Arrays

- Multiple subscripted arrays
  - Tables with rows and columns (m by n array)
  - Like matrices: specify row, then column



Multiple-Subscripted Arrays (cont'd)

- Initialization
  - `int b[2][2] = {{1, 2}, {3, 4}};`
  - Initializers grouped by row in braces
  - If not enough, unspecified elements set to zero

    `int b[2][2] = {{1}, {3, 4}};`
- Referencing elements
  - Specify row, then column

    `printf("%d", b[0][1]);`

1	2
3	4

1	0
3	4

Multiple-Subscripted Arrays (cont'd)

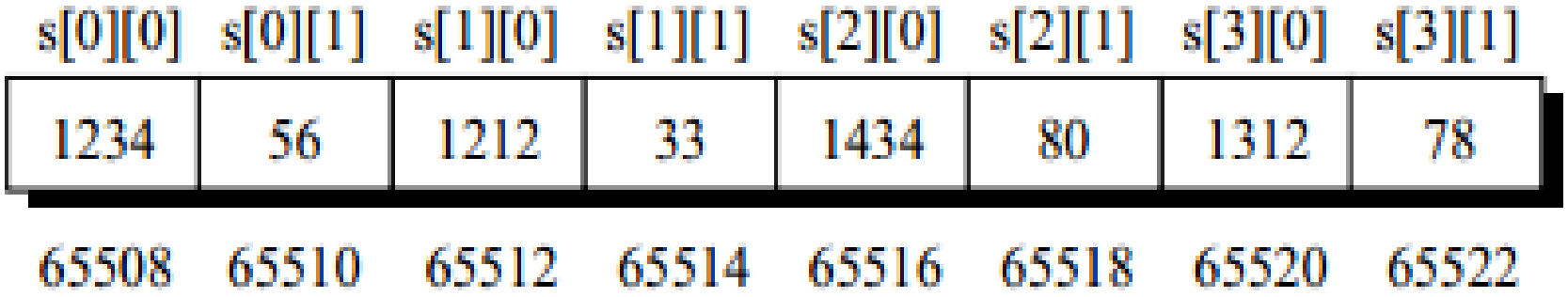
The 2-D array arrangement is shown below.
Remember the counting of rows and columns begin with zero.

	col. no. 0	col. no. 1
row no. 0	1234	56
row no. 1	1212	33
row no. 2	1434	80
row no. 3	1312	78

Multiple-Subscripted Arrays (cont'd)

Memory Map of a 2-Dimensional Array:

Let us reiterate the arrangement of array elements in a two-dimensional array of students, which contains roll nos. in one column and the marks in the other.
The arrangement of array elements of a two-dimensional array in memory is shown below:



Multiple-Subscripted Arrays (cont'd)

```c
#include <stdio.h>

int main () {

   /* an array with 5 rows and 2 columns*/
   int a[5][2] = { {0,0}, {1,2}, {2,4}, {3,6},{4,8}};
   int i, j;

   /* output each array element's value */
   for ( i = 0; i < 5; i++ ) {

      for ( j = 0; j < 2; j++ ) {
         printf("a[%d][%d] = %d\n", i,j, a[i][j] );
      }
   }

   return 0;
}
```

```
a[0][0]: 0
a[0][1]: 0
a[1][0]: 1
a[1][1]: 2
a[2][0]: 2
a[2][1]: 4
a[3][0]: 3
a[3][1]: 6
a[4][0]: 4
a[4][1]: 8
```

Multiple-Subscripted Arrays (cont'd)

Example: Addition of two matrices

```
#include <stdio.h>
int main() {
    int r, c, a[100][100], b[100][100], sum[100][100], i, j;
    printf("Enter the number of rows (between 1 and 100): ");
    scanf("%d", &r);
    printf("Enter the number of columns (between 1 and 100): ");
    scanf("%d", &c);

    printf("\nEnter elements of 1st matrix:\n");
    for (i = 0; i < r; ++i)
        for (j = 0; j < c; ++j) {
            printf("Enter element a%d%d: ", i + 1, j + 1);
            scanf("%d", &a[i][j]);
        }

    printf("Enter elements of 2nd matrix:\n");
    for (i = 0; i < r; ++i)
        for (j = 0; j < c; ++j) {
            printf("Enter element a%d%d: ", i + 1, j + 1);
            scanf("%d", &b[i][j]);
        }
```

Multiple-Subscripted Arrays (cont'd)

Example: Addition of two matrices

```
        // adding two matrices
        for (i = 0; i < r; ++i)
            for (j = 0; j < c; ++j) {
                sum[i][j] = a[i][j] + b[i][j];
            }

        // printing the result
        printf("\nSum of two matrices: \n");
        for (i = 0; i < r; ++i){

            for (j = 0; j < c; ++j) {
                printf("%d  ", sum[i][j]);
            }
                    printf("\n");
                }
        return 0;
}
```

Multiple-Subscripted Arrays (cont'd)

Online links videos for operations of 2-D Array

- 1D Array
https://www.youtube.com/watch?v=AT14lCXuMKI&list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuLl8LU

- 2-D Introduction
https://www.youtube.com/watch?v=vyOZcg4cPRY

https://www.youtube.com/watch?v=KDQXUysHLL8

- 2-D array Matrix Multiplication
https://www.youtube.com/watch?v=2K0nuYFGETM

- Sum of Diagonal Elements
https://www.youtube.com/watch?v=QCrBuYMqIwg

- Transpose of Matrix
https://www.youtube.com/watch?v=-arIesoWEoI

Multiple-Subscripted Arrays (cont'd)

Passing 2-D Array to Function

```c
#define ROWS 4
#define COLS 5

void func(int array[ROWS][COLS])
{
  int i, j;

  for (i=0; i<ROWS; i++)
  {
    for (j=0; j<COLS; j++)
    {
      array[i][j] = i*j;
    }
  }
}

void func_vla(int rows, int cols, int array[rows][cols])
{
  int i, j;

  for (i=0; i<rows; i++)
  {
    for (j=0; j<cols; j++)
    {
      array[i][j] = i*j;
    }
  }
}
```

```c
int main()
{
  int x[ROWS][COLS];

  func(x);
  func_vla(ROWS, COLS, x);
}
```

Array of Strings

A string is a 1-D array of characters, so an array of strings is a 2-D array of characters.

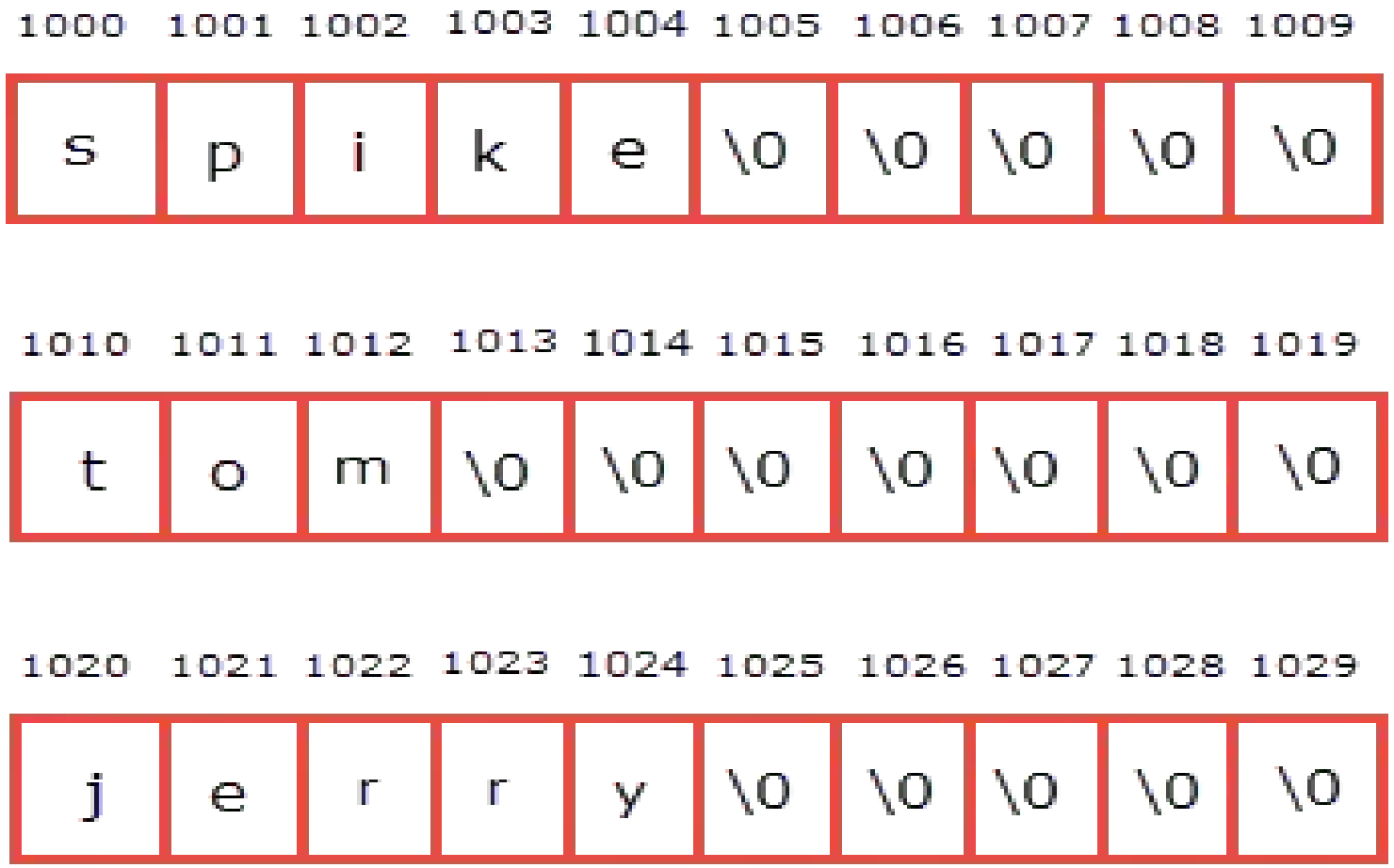
Just like we can create a 2-D array of int, float etc; we can also create a 2-D array of character or array of strings. Here is how we can declare a 2-D array of characters.

```
char ch_arr[3][10] = {
                        {'s', 'p', 'i', 'k', 'e', '\0'},
                        {'t', 'o', 'm','\0'},
                        {'j', 'e', 'r', 'r', 'y','\0'}
                    };
```

```
char ch_arr[3][10] = {
                        "spike",
                        "tom",
                        "jerry"
                    };
```

Array of Strings

In memory allocation:



Array of Strings

In memory allocation:

```c
#include<stdio.h>
int main()
{
	char name[10][20];
	int i,n;

	printf("Enter the number of names (<10): ");
	scanf("%d",&n);

	//reading string from user
	printf("Enter %d names:\n",n);
	for(i=0;i<n;i++)
	scanf("%s",name[i]);

	//Dispaying names
	printf("\nEntered names are:\n");
	for(i=0;i<n;i++)
	puts(name[i]);

	return 0;
}
```

Exercise

- Write a C program to read through an array of any type. Write a C program to scan through this array to find a particular value.
- Write a program to copy the contents of one array into another in the reverse order.
- Write a program to pick up the largest number from any 5 row by 5 column matrix.
- Write a program to add two 6 * 6 matrices.