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R Ritu Sibbal is presenting

Arrays and Strings

bcxzgslmls

People (63) Chat

- R ROSHAN SREEDHAR RE...
- S SATENDER
- S SHASHANK MISHRA
- S SHIRISHTI JAIN
- A SHOBHIT PRAKASH
- S SHREYA SINGH
- S SHUBHAM AGGARWAL
- S SHUBHAM SHARMA
- S SHYAMAL JAIN
- S SIMARJIT SINGH

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An array is a collection of variables of the same type that are referred to through a common name.

- A specific element in an array is accessed by an index. In C, all arrays consist of contiguous memory locations. The lowest address corresponds to the first element and the highest address to the last element.
- Arrays can have from one to several dimensions.
- The most common array is the *string*, which is simply an array of characters terminated by a null.

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Mute Microphone

Video Call

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Single dimension Arrays

- The general form for declaring a single-dimension array is
`type var_name[size];`
- Like other variables, arrays must be explicitly declared so that the compiler can allocate space for them in memory. Here, `type` declares the base type of the array, which is the type of each element in the array, and `size` defines how many elements the array will hold.
- For example a 100-element array called **balance** of type **double**, is declared using the statement :
`double balance[100];`

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A element is accessed by indexing the array name. For example,
balance[3] = 12.23;
assigns element number 3 in **balance** the value 12.23.
In C, all arrays have 0 as the index of their first element. Therefore, when you write
char p[10];
you are declaring a character array that has 10 elements, **p[0]** through **p[9]**.

The screenshot shows a Google Meet session. On the left, a presentation slide is displayed with a dark background and white text. The text discusses array indexing, mentioning that an element is accessed by indexing the array name, such as balance[3] = 12.23, which assigns element number 3 in the balance array the value 12.23. It also notes that in C, all arrays have 0 as the index of their first element. The slide includes code snippets for both C and Java. On the right, the Google Meet interface shows a list of participants. The participant list header is "bcxzgslmls". Below it, there are two tabs: "People (63)" (selected) and "Chat". The "People" tab lists 63 participants, each with a small profile picture, a letter indicator (R, A, S), and their names: ROSHAN SREEDHAR RE..., SATENDER, SHASHANK MISHRA, SHIRISHI JAIN, SHOBHIT PRAKASH, SHREYA SINGH, SHUBHAM AGGARWAL, SHUBHAM SHARMA, SHYAMAL JAIN, and SIMARJIT SINGH. Each participant entry also has a "Mute" icon and a three-dot menu icon.

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Microphone icon | Phone icon | Video icon

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Example

- The following program loads an integer array with the numbers 0 through 99

```
#include <stdio.h>
int main(void)
{
    int x[100]; /* this declares a 100-integer array */
    int t;
    /* load x with values 0 through 99 */
    for(t=0; t<100; ++t) x[t] = t;
    /* display contents of x */
    for(t=0; t<100; ++t) printf('%d ", x[t]);
    return 0;
}
```

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The screenshot shows a Google Meet session. On the left, a presentation slide displays the provided C code. On the right, the participant list is visible, showing 63 people. The participants are listed with their names and profile pictures. The names listed are: ROSHAN SREEDHAR RE..., SATENDER, SHASHANK MISHRA, SHIRISHTI JAIN, SHOBHIT PRAKASH, SHREYA SINGH, SHUBHAM AGGARWAL, SHUBHAM SHARMA, SHYAMAL JAIN, and SIMARJIT SINGH. Each participant has a small 'k' icon next to their name, indicating they are muted. The participant 'Ritu Sibbal' is at the top of the list, and her status is shown as 'is presenting'. The interface includes standard video conference controls at the bottom.

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People (63)

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- The amount of storage required to hold an array is directly related to its type and size.

For a single dimension m array, the total size in bytes is computed as shown here:

$$\text{Total bytes} = \text{sizeof(base type)} \times \text{length of array}$$

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has no bounds checking on arrays.

- You could overwrite either end of an array and write into some other variable's data or even into the program's code.
- For example, this code will compile without error, but it is incorrect because the **for** loop will cause the array **count** to be overrun.

```
int count[10], i;
/* this causes count to be overrun */
for(i=0; i<100; i++) count[i] = i;
```

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The screenshot shows a Google Meet session. On the left, a presentation slide is displayed with text about array bounds checking and a sample C code snippet. On the right, the participant list is shown, featuring a grid of user icons and names. The names listed are: ROSHAN SREEDHAR RE..., SATENDER, SHASHANK MISHRA, SHIRISHTI JAIN, SHOBHIT PRAKASH, SHREYA SINGH, SHUBHAM AGGARWAL, SHUBHAM SHARMA, SHYAMAL JAIN, and SIMARJIT SINGH. The participant Ritu Sibbal is currently presenting, as indicated by the 'is presenting' status at the bottom right of the participant list.

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S SHASHANK MISHRA
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- Single-dimension arrays are essentially lists that are stored in contiguous memory locations in index order.
- For example,

- Element a[0] a[1] a[2] a[3] a[4] a[5] a[6]
- Address 1000 1001 1002 1003 1004 1005 1006
- Figure shows how array a appears in memory if it starts at memory location 1000 and is declared as shown here:
- `char a[7];`

The screenshot shows a Google Meet interface with a list of participants on the right. The participant list includes:

- ROSHAN SREEDHAR RE... (purple)
- SATENDER (blue)
- SHASHANK MISHRA (blue)
- SHIRISHTI JAIN (blue)
- SHOBHIT PRAKASH (yellow)
- SHREYA SINGH (red)
- SHUBHAM AGGARWAL (blue)
- SHUBHAM SHARMA (blue)
- SHYAMAL JAIN (red)
- SIMARJIT SINGH (blue)

At the bottom, there are controls for microphone, video, and sharing, along with options to raise hand, turn on captions, and a message indicating "Ritu Sibbal is presenting".

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Generating a Pointer to an Array

- You can generate a pointer to the first element of an array by simply specifying the array name, without any index. For example, given

```
int sample[10]
```
- you can generate a pointer to the first element by using the name **sample**. Thus, the following program fragment assigns **p** the address of the first element of **sample**:

```
int *p;  
int sample[10];  
p = sample;
```

Address of the first element of an array can be specified by using the & operator. For example, **sample** and **&sample[0]** both produce the same results.

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Passing Single-Dimension Arrays to Functions

- In C, you cannot pass an entire array as an argument to a function.
- Pass a pointer to an array by specifying the array's name without an index. For example, the following program fragment passes the address of `i` to `func1()`:

```
int main(void)
{
    int i[10];
    func1(i);
    /* . . . */
}
```

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If a function receives a pointer to a single-dimension array, you can declare its formal parameter in one of three ways: as a pointer, as a sized array, or as an unsized array. For example, to receive *i*, a function called `func1()` can be declared as

```
void func1(int *x) /* pointer */  
{  
    . . . /*/  
}
```

or

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The screenshot shows a Google Meet session. On the left, a presentation slide is displayed with text about pointers to arrays. The slide title is "R Ritu Sibbal is presenting". The text on the slide discusses three ways to declare a pointer to a single-dimension array in a function. Below the slide, there is some code for a function named `func1`. To the right of the slide, a participant grid shows several users, each with a circular profile picture and a letter (R, A, S) inside. To the right of the grid, a participant list titled "bcxzgslmls" shows 63 participants, each with a profile picture, name, and a microphone icon. At the bottom, there are standard Google Meet controls: a red mute button, a white video button, a red share button, a "Raise hand" button with a hand icon, a "Turn on captions" button, and a "Ritu Sibbal is presenting" status indicator.

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```
void func1(int x[10]) /* sized array */  
{  
/* . . . */  
}  
  
or finally as  
void func1 (int x[]) /* unsized array */  
{  
/* . . . */  
}
```

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The image shows a Google Meet session. On the left, a presentation slide displays C code for function prototypes. The right side shows a participant grid with 63 users. The host, Ritu Sibbal, is highlighted with a blue border and has a large circular icon with the letter 'R' above her video thumbnail. Other participants are represented by smaller circular icons with initials or letters (A, S, etc.). The participant list includes names like ROSHAN SREEDHAR RE..., SATENDER, SHASHANK MISHRA, SHIRISHI JAIN, SHOBHIT PRAKASH, SHREYA SINGH, SHUBHAM AGGARWAL, SHUBHAM SHARMA, SHYAMAL JAIN, and SIMARJIT SINGH. The interface includes standard Google Meet controls at the bottom: mute, video, share, raise hand, turn on captions, and a present indicator.

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- All three declaration methods produce similar results because each tells the compiler that an integer pointer is going to be received.
- The first declaration actually uses a pointer. The second employs the standard array declaration. In the final version, a modified version of an array declaration simply specifies that an array of type **int** of some length is to be received.

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The image shows a Google Meet interface. On the left, a presentation slide is displayed with a black background and white text. The text discusses three declaration methods for pointers and arrays. On the right, the participant list is shown with 63 participants. The list includes names like Roshan Sreedhar Re..., Satender, Shashank Mishra, Shirish Ti Jain, Shobhit Prakash, Shreya Singh, Shubham Aggarwal, Shubham Sharma, Shyamal Jain, and Simarjit Singh. Each participant has a small profile picture and a 'video off' icon. At the bottom, there are standard video call controls: a red microphone icon, a white video icon with a red outline, a red camera icon, a 'Raise hand' button with a hand icon, a 'Turn on captions' button with a document icon, and a 'Ritu Sibbal is presenting' message. The overall interface is dark-themed.

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Strings

- The most common use for the one-dimensional array is as a character string.
- In C, a *string* is a null-terminated character array. (A null is zero.)
- Thus, a string contains the characters that make up the string followed by a null.

The screenshot shows a Google Meet session. On the left, a presentation slide is displayed with the title 'Strings' and a bulleted list of points about strings in C. On the right, the participant list is shown with 63 people. The list includes names like ROSHAN SREEDHAR RE..., SATENDER, SHASHANK MISHRA, SHIRISHI JAIN, SHOBHIT PRAKASH, SHREYA SINGH, SHUBHAM AGGARWAL, SHUBHAM SHARMA, SHYAMAL JAIN, and SIMARJIT SINGH. Each participant has a small profile picture and a 'video off' icon. At the bottom, there are standard Google Meet controls for audio, video, and screen sharing, along with buttons for 'Raise hand', 'Turn on captions', and a message indicating 'Ritu Sibbal is presenting'.

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- SHUBHAM SHARMA
- SHYAMAL JAIN
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Microphone (red), Camera (white), Minimize, Close

Microphone (red), Camera (white), Hand icon, Turn on captions, Raise hand, Ritu Sibbal is presenting, More options

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Functions that Manipulate Strings

Name	Function
• <code>strcpy(s1, s2)</code>	Copies <i>s2</i> into <i>s1</i>
• <code>strcat(s1, s2)</code>	Concatenates <i>s2</i> onto the end of <i>s1</i>
• <code>strlen(s1)</code>	Returns the length of <i>s1</i>
• <code>strcmp(s1,s2)</code>	Returns 0 if <i>s1</i> and <i>s2</i> are the same; less than 0 if <i>s1</i> < <i>s2</i> ; greater than 0 if <i>s1</i> > <i>s2</i>
• <code>strchr(s1, ch)</code>	Returns a pointer to the first occurrence of <i>ch</i> in <i>s1</i>
• <code>strstr(s1, s2)</code>	Returns a pointer to the first occurrence of <i>s2</i> in <i>s1</i>

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Microphone Off | Call | Chat | Raise hand | Turn on captions | Ritu Sibbal is presenting | More

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- These functions use the standard header <string.h>. The following program illustrates the use of these string functions:

```
#include <stdio.h>
#include <string.h>
int main(void)

char s1[80], s2[80];
gets(s1);
gets (s2);
printf("lengths: %d %d\n", strlen(s1), s2);
if(!strcmp(s1, s2)) printf("The strings %s and %s are equal.\n");
strcat(s1, s2);
printf ('%s\n', s1);
strcpy(s1, "This is a test.\n");
printf(s1);
if(strchr("hello", 'e')) printf("e is in hello\n");
if(strstr("hi there", "hi")) printf("found hi");
return 0;
}
```

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Raise hand

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Two Dimensional Arrays

- C supports multidimensional arrays. The simplest form of the multidimensional array is the two dimensional array.
- A two -dimensional array is, essentially, an array of one-dimensional arrays.
- To declare a two-dimensional integer array **d** of size 10,20

```
int d[10][20];
```

- Similarly, to access point 1,2 of array **d**, you would use
• `d[1][2]`
- The following example loads a two-dimensional array with the numbers 1 through 12 and prints them row by row.

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S SHUBHAM SHA... and 60 more

63 4:32 PM You I ?

Pin to screen

Example

```
#include <stdio.h>
int main(void)
{
    int t, i, num[3][4];
    for(t=0; t<3; ++t)
        for(i=0; i<4; ++i)
            num[t][i] = (t*4)+i+1;
    /* now print them out */
    for(t=0; t<3; ++t) {
        for(i=0; i<4; ++i)
            printf("%3d ", num[t][i]);
        printf("\n");
    }
    return 0;
}
```

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Raise hand Turn on captions

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A screenshot of a Google Meet video call interface. The top bar shows three tabs: 'YouTube (17) Infinite Series - Raabe's Test', 'FCCS002 COE VI Section 3', and 'Meet - ejm-ujzd-eye?authuser=3'. The main video area displays a presentation slide titled 'Example' containing a C programming code. The code initializes a 3x4 matrix 'num' and prints its elements row by row. The participant 'Ritu Sibbal' is listed as 'presenting'. The bottom navigation bar includes icons for microphone, camera, and sharing, along with 'Raise hand', 'Turn on captions', and a participant list.

R Ritu Sibbal is presenting SHYAMAL JAIN and 60 more 4:32 PM You

num [t] [i]

	0	1	2	3
0	1	2	3	4
1	5	6	7	8
2	9	10	11	12

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SIMARJIT SINGH and 61 more

4:33 PM You

- Two-dimensional arrays are stored in a row-column matrix, where the left index indicates the row and the right indicates the column.
- This means that the rightmost index changes faster than the leftmost when accessing the elements in the array in the order in which they are actually stored in memory

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SIMARJIT SINGH and 61 more

4:33 PM You

Programming exercise 5

- Write a program in C that uses a two-dimensional array to store the numeric grade for each student in a teacher's classes. The program assumes that the teacher has three classes and a maximum of 30 students per class.

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