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CE1007/ CZ1007 DATA STRUCTURES

Lesson 7.4 Applying 1D Arrays to 2D Arrays in Functions

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OVERVIEW

The following are the coverage for 2D arrays:

- Multidimensional Arrays Declaration, Initialisation and Operations
- Multidimensional Arrays and Pointers
- Multidimensional Arrays as Function Arguments
- Applying 1-D Array to 2-D Arrays in Functions
- Sizeof Operator and Arrays

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The following are the coverage for 2
applying 1 arrays to 2

ARRAYS. this video focusses on
arrays IN FUNCTIONS

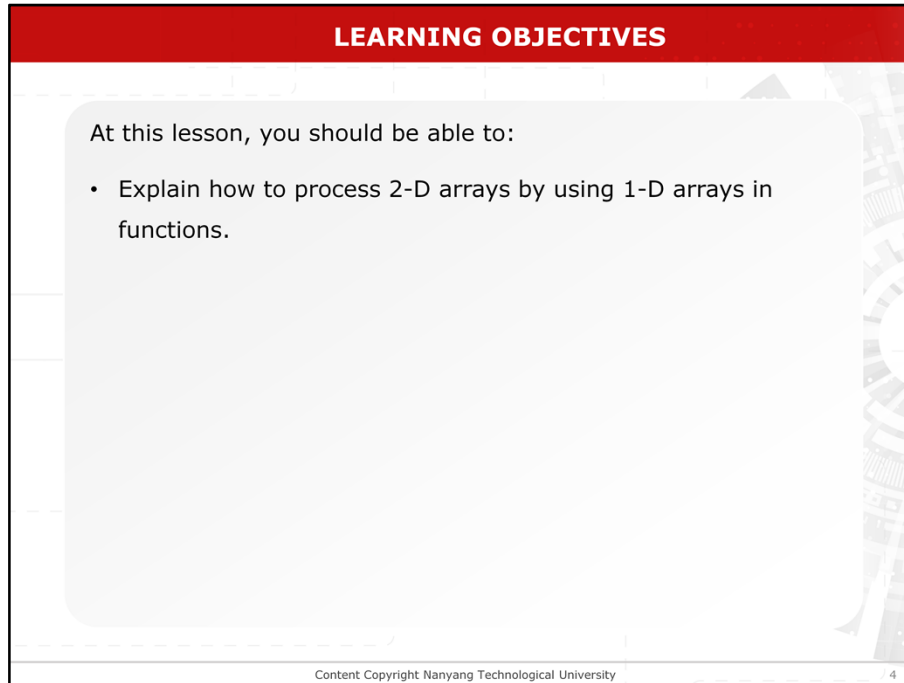
LEARNING OBJECTIVES

At this lesson, you should be able to:

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The slide features a red header with the title 'LEARNING OBJECTIVES'. Below the header is a large, light gray rectangular box with rounded corners, intended for the learning objectives. The text 'At this lesson, you should be able to:' is positioned at the top left of this box. The slide also includes a footer with the text 'Content Copyright Nanyang Technological University' and the page number '3'.

Learning Objectives: At this lesson, you should be able to:



LEARNING OBJECTIVES

At this lesson, you should be able to:

- Explain how to process 2-D arrays by using 1-D arrays in functions.

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- Explain how to process 2 DIMENSIONAL arrays by using 1 DIMENSIONAL arrays in functions.

LEARNING OBJECTIVES

At this lesson, you should be able to:

- Explain how to process 2-D arrays by using 1-D arrays in functions.
- Explain array processing to 2-D arrays in functions: using pointers.

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- Explain Array processing to 2 dimensional arrays in functions: using pointers.

LEARNING OBJECTIVES

At this lesson, you should be able to:

- Explain how to process 2-D arrays by using 1-D arrays in functions.
- Explain array processing to 2-D arrays in functions: using pointers.
- Explain array processing to 2-D arrays in functions: using indexes.

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- Explain Array processing to 2 dimensional arrays in functions: using indexes

APPLYING 1-D ARRAY PROCESSING TO 2-D ARRAYS IN FUNCTIONS: USING POINTERS

```

#include <stdio.h>
void display1(int *ptr, int size);
void display2(int ar[ ], int size);

int main()
{
    int array[2][4] = { 0, 1, 2, 3, 4, 5, 6, 7 };
    int i;

    for (i=0; i<2; i++) {
        /* as 2-D Array */
        display1(array[i], 4);
    }
    return 0;
}

```

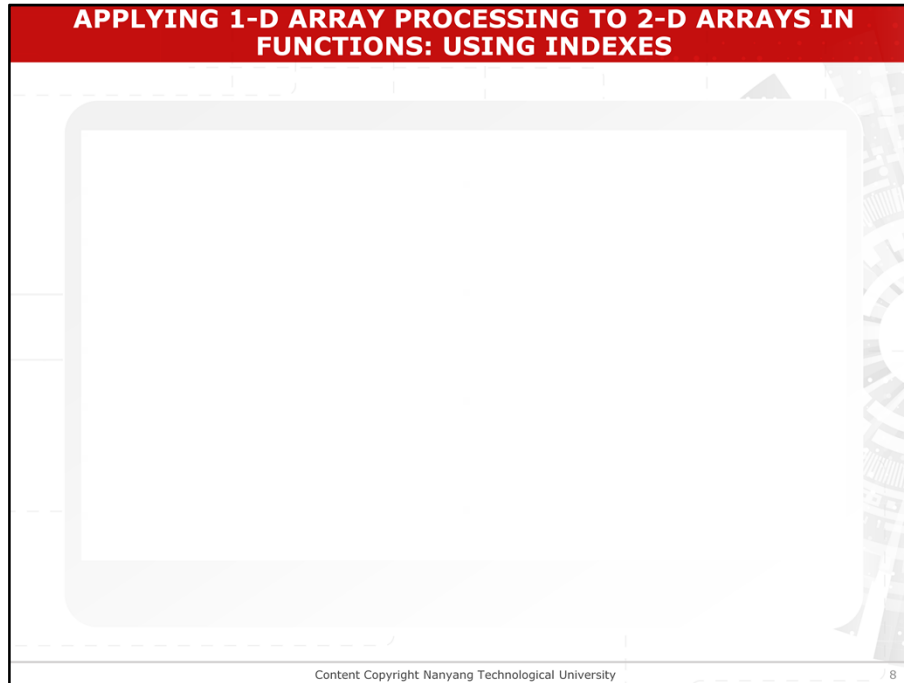
Output:

NB: There will have warning messages during compilation.

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A function that is written for processing one-dimensional arrays can be used to deal with two-dimensional arrays. In the program, **array** is an array of 2 by 4 integers. The function **display 1** is written to access the elements of the array with the specified **size** and prints the contents to the screen. In **display 1**, it accepts a pointer variable and accesses the elements of the array using the pointer variable.

In the **for** loop of the **main** function, when **i=0**, we pass **element of an array** to **display1**. Element of an **array** corresponds to the address of **array with 0 row and 0 column** (i.e. **&array with 0 row and 0 column**). The function then accesses the array starting from the location **array with 0 row and 0 column**, and prints the 4 elements out to the display as specified in the function. When **i=1**, **array of 1** is passed to **display1**. Now, **array of 1** corresponds to the address of **array with 1 row and 0 column** (i.e. **&array with 1 row and 0 column**). The function then accesses the 4 elements starting from **array with 1 row and 0 column**, and print the contents of the 4 elements.



Applying 1-D Array Processing to 2-D Arrays – using Indexes

In the program, **array** is an array of 2 by 4 integers. The function **display2()** is written to access the elements of the array with the specified **size** and prints the contents to the screen.

In **display2**, it accepts the array pointer and uses array index to access the elements of the array. In the **for** loop of the **main()** function, when **i=0**, we pass **Element of an array** to **display2**. **Element of an array** corresponds to the address of **array with 0 row and 0 column**. The function then accesses the 4 elements of the array starting from the location **array with 0 row and 0 column**, and prints the results to the display as specified in the function. When **i=1**, **array of 1** is passed to **display2**. Now, **array of 1** corresponds to the address of **array with 1 row and 0 column**. The function then accesses the 4 elements starting from **array with 1 row and 0 column**, and prints the results according to the function.

We can also view **array** as an array of 8 integers. When we pass **array** as an argument to the function **display 2** with **display 2(array, 8);**

the array **ar** in the function **display 2** is initialized to the address of **array with 0 row and 0 column**. As a result, **element of an array** corresponds to **array of 0 row and 0 column**, while **array of 1** corresponds to **array with 0 row and 1 column**. Similarly, **array** correspond to **array with 1 row and 0 column**, and so on. Therefore, all the elements of the two-dimensional array can be accessed and printed to the screen.

EXAMPLE: MINMAX()

Write a C function `minMax()` that takes a 5x5 two-dimensional array of integers *a* as a parameter. The function returns the minimum and maximum numbers of the array back to the caller through the two parameters *min* and *max* respectively.
[using call by reference]

```
#include <stdio.h>
void minMax(int a[5][5], int *min, int *max);
int main()
{
    int A[5][5];
    int i, j;
    int min, max;
    printf("Enter your matrix data (5x5): \n");
    // nested loop
    for (i=0; i<5; i++)
        for (j=0; j<5; j++)
            scanf("%d", &A[i][j]);
    minMax(A, &min, &max);
    printf("min = %d; max = %d", min, max);
    return 0;
}
```

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In this application example, you are required to write a C function **minMax** that takes a 5x5 two-dimensional array of integers *a* as a parameter.

EXAMPLE: MINMAX()

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int main()
{
    int A[5][5];
    int i, j;
    int min, max;
    printf("Enter your matrix data (5x5): \n");
    // nested loop
    for (i=0; i<5; i++)
        for (j=0; j<5; j++)
            scanf("%d", &A[i][j]);
    minMax(A, &min, &max);
    printf("min = %d; max = %d", min, max);
    return 0;
}
```

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The function returns the minimum and maximum numbers of the array back to the caller through the two parameters *min* and *max* respectively. Call by reference is used for passing the results on maximum and minimum numbers to the calling function.

EXAMPLE: MINMAX()

Write a C function minMax() that takes a 5x5 two-dimensional array of integers *a* as a parameter. The function returns the minimum and maximum numbers of the array back to the caller through the two parameters *min* and *max* respectively.
[using call by reference]

```
#include <stdio.h>
void minMax(int a[5][5], int *min, int *max);
int main()
{
    int A[5][5];
    int i, j;
    int min, max;
    printf("Enter your matrix data (5x5): \n");
    // nested loop
    for (i=0; i<5; i++)
        for (j=0; j<5; j++)
            scanf("%d", &A[i][j]);
    minMax(A, &min, &max);
    printf("min = %d; max = %d", min, max);
    return 0;
}
```

```
void minMax(int a[5][5], int *min,
            int *max)
{
    int i, j;

    /* add your code here */

    Q: Using index?

    Q: Using pointer ?
}
```

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You may use the array index approach or pointer variable approach for processing the 2 array.

EXAMPLE: USING THE ARRAY INDEX APPROACH

Using indexes:

```

void minMax(int a[5][5],
            int *min,
            int *max)
{
    int i, j;

    *max = a[0][0];
    *min = a[0][0];
    for (i=0; i<5; i++)
        for (j=0; j<5; j++)
        {
            if (a[i][j] > *max)
                *max = a[i][j];
            else if (a[i][j] < *min)
                *min = a[i][j];
        }
}

```

int A[5][5] = {

	col
row	{5, 10, 15, 20, 25},
	{10, 20, 30, 40, 50},
	{20, 40, 60, 80, 100},
	{1, 3, 5, 7, 9},
	{2, 4, 6, 8, 10}

};

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Example: Using the Array Index Approach

In this implementation using the array index approach, a nested **for** loop is used to process the 2 array in the function.

EXAMPLE: USING THE ARRAY INDEX APPROACH

Using indexes:

```

void minMax(int a[5][5],
            int *min,
            int *max)
{
    int i, j;
    *max = a[0][0];
    *min = a[0][0];
    for (i=0; i<5; i++)
        for (j=0; j<5; j++)
        {
            if (a[i][j] > *max)
                *max = a[i][j];
            else if (a[i][j] < *min)
                *min = a[i][j];
        }
}

```

int A[5][5] = {

	col	→
	5, 10, 15, 20, 25,	
	10, 20, 30, 40, 50,	
	20, 40, 60, 80, 100,	
	1, 3, 5, 7, 9,	
	2, 4, 6, 8, 10}	

};

row ↓

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Example: Using the Array Index Approach

In this implementation using the array index approach, a nested **for** loop is used to process the 2D array in the function. It first initializes the **max** and **min** to contain the first array element number. The 2D array **eh** is processed using indexes to access and compare all the elements stored in the array with **max** and **min**.

EXAMPLE: USING THE ARRAY INDEX APPROACH

Using indexes:

```

void minMax(int a[5][5],
            int *min,
            int *max)
{
    int i, j;

    *max = a[0][0];
    *min = a[0][0];
    for (i=0; i<5; i++)
        for (j=0; j<5; j++)
        {
            if (a[i][j] > *max)
                *max = a[i][j];
            else if (a[i][j] < *min)
                *min = a[i][j];
        }
}

```

int A[5][5] = {

	col
row	{5, 10, 15, 20, 25},
	{10, 20, 30, 40, 50},
	{20, 40, 60, 80, 100},
	{1, 3, 5, 7, 9},
	{2, 4, 6, 8, 10}

};

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After the processing of the 2 array, the maximum and minimum numbers are determined and stored at **max** and **min** respectively. The implementation using indexes is quite straightforward.


EXAMPLE: USING POINTER VARIABLE APPROACH

Using Pointers:

```
void minMax2(int a[5][5], int *min, int *max)
{
    int i;
    int *p;
    p=a;

    *max = *p;
    *min = *p;
    for (i=0; i<25; i++) {
        if ( *p > *max )
            *max = *p;
        else if ( *p < *min )
            *min = *p;
        ++p;
    }
}
```

Consecutive & sequential memory

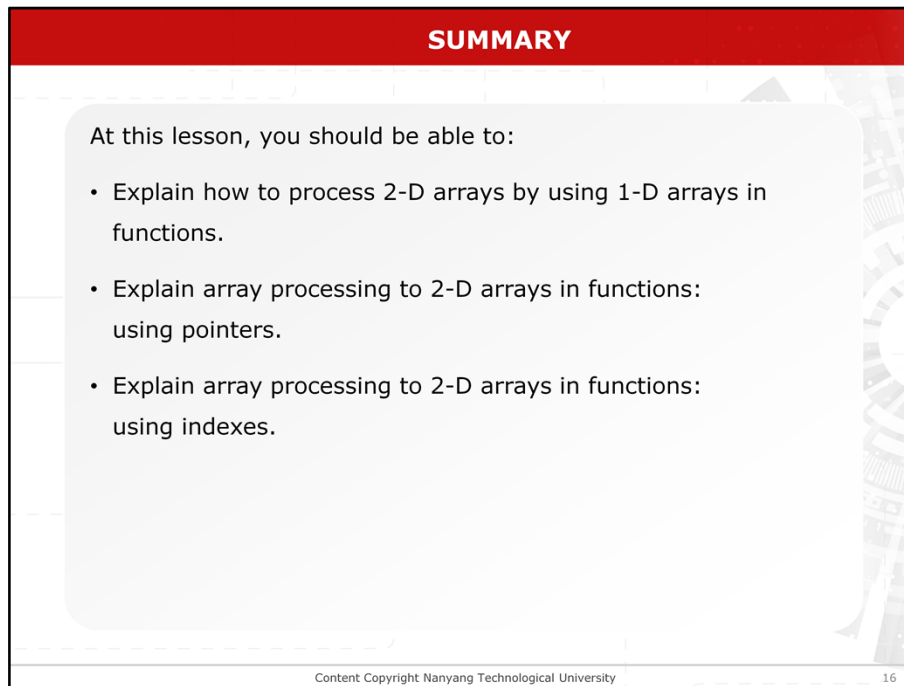


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Example: Using the Pointer Variable Approach

In this implementation, it uses the pointer variable approach. It first initializes the **max** and **min** to contain the first array element number. It is implemented using the pointer variable **p**. Then, assign the array **a** to the pointer variable **p**, and initializes the values for **max** and **min** by the first element of the array:

A **for** loop is used to traverse and process the 2-D array by treating it as a 1-D array. In this approach, we use the **base address** as the reference. The index variable **i** is used to update the pointer variable to the corresponding array memory location, and retrieves the array element content via **the memory location**. Each array element content will be compared with the **max** and **min** to determine the maximum and minimum numbers respectively. At the end of the processing, the maximum and minimum numbers are determined and stored at **max** and **min** respectively. The values are returned to the calling function via call by reference.



SUMMARY

At this lesson, you should be able to:

- Explain how to process 2-D arrays by using 1-D arrays in functions.
- Explain array processing to 2-D arrays in functions: using pointers.
- Explain array processing to 2-D arrays in functions: using indexes.

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In summary, after watching this video lesson, you should be able to do the listed.