Mahidol University

ITCS113
Fundamentals of Programming

Lecture 5 - Advanced Repetition

Instructor: Asst. Prof. Dr. Akara Supratak

Contact: akara.sup@mahidol.edu

Agenda

- Nested Loop
- Multiple Inner Loops

Nested Loop

Nested Loops

for/while/do-while

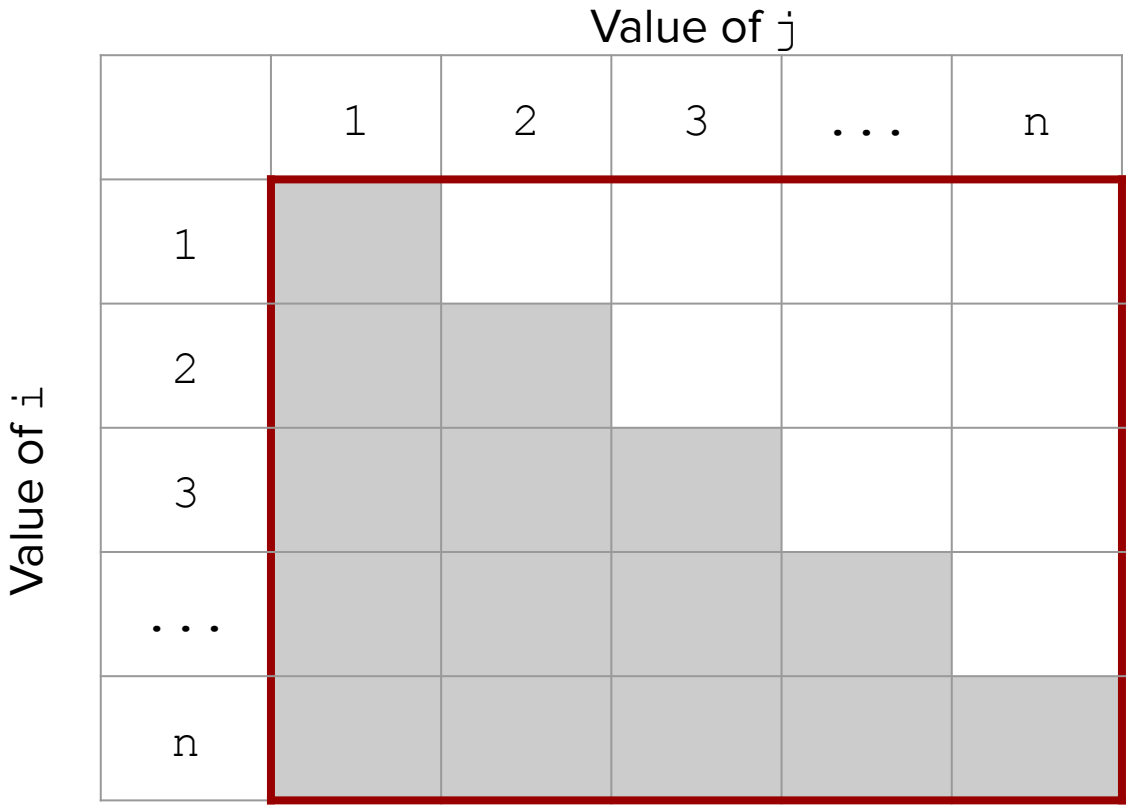
```
for/while/do-while

    for/while/do-while
```

Examples

Step by Step to Analyze Patterns

1. Start from the square shape. What structure you want to print? Reco

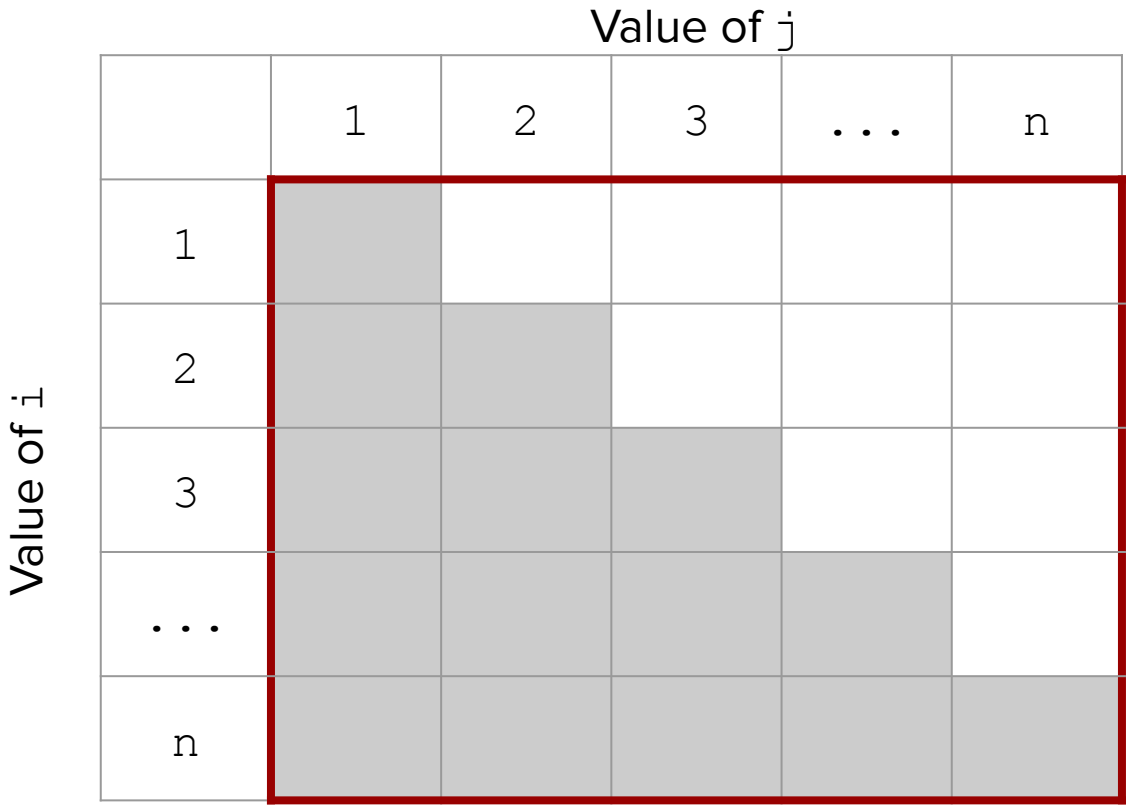
j



Row i = 1 : j = 1
Row i = 2: j = 1, 2
Row i = 3: j = 1, 2, 3
Row i = 4: j = 1, 2, 3, 4
Row i = 5: j = 1, 2, 3, 4, 5
...
Row i = n: j = 1, 2, 3, ..., n-1, n

Step by Step to Analyze Patterns

2. Find the relationship between `i` and `j`

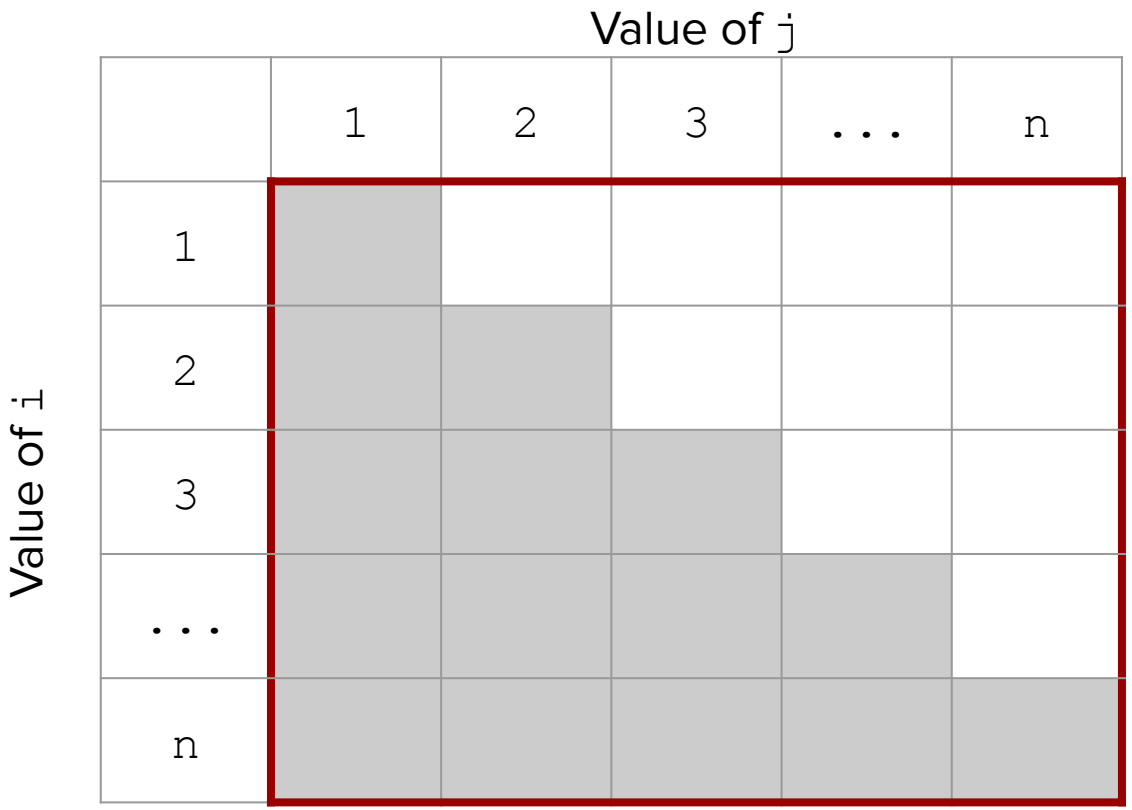


Row i = 1 : j = 1
Row i = 2: j = 1, 2
Row i = 3: j = 1, 2, 3
Row i = 4: j = 1, 2, 3, 4
Row i = 5: j = 1, 2, 3, 4, 5
...
Row i = n: j = 1, 2, 3, ..., n-1, n

The last value of `j` equals to `i`
`i` increase from `1` to `n`
`j` increase from `1` to `i`

Step by Step to Analyze Patterns

3. Write the structure of (`for`) loops with `i` and `j`

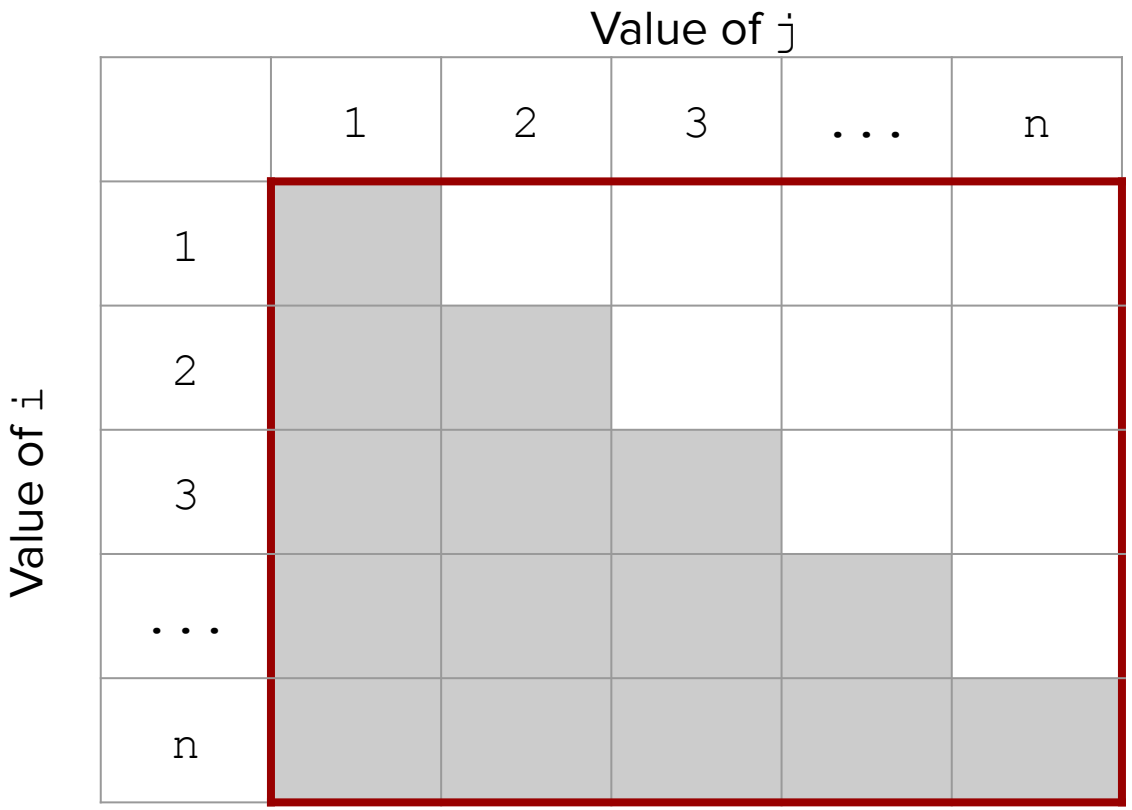


The last value of `j` equals to `i`
`i` increase from `1` to `n`
`j` increase from `1` to `i`

```
for (int i=1; i<=n; i++){
    for(int j=1; j<=i;j++){



    }
}
```

Step by Step to Analyze Patterns

4. Analyze in the pattern (what should be inside each grey box)




```
for (int i=1; i<=n; i++){
    for(int j=1; j<=i;j++){



    }
}
```

```
0
1 1
2 2 2
3 3 3 3
4 4 4 4 4
5 5 5 5 5 5
6 6 6 6 6 6 6
7 7 7 7 7 7 7 7
8 8 8 8 8 8 8 8 8
9 9 9 9 9 9 9 9 9 9
```

Step by Step to Analyze Patterns

4. Analyze in the pattern
   What is **n** for rows and pattern? `n=10`

```
0
1 1
2 2 2
3 3 3 3
4 4 4 4 4
5 5 5 5 5 5
6 6 6 6 6 6 6
7 7 7 7 7 7 7 7
8 8 8 8 8 8 8 8 8
9 9 9 9 9 9 9 9 9 9
```

Row `i=1` : Print `'0'`
Row `i=2` : Print `'1'`
Row `i=3` : Print `'2'`
Row `i=4` : Print `'3'`
Row `i=5` : Print `'4'`
Row `i=6` : Print `'5'`
Row `i=7` : Print `'6'`
Row `i=8` : Print `'7'`
Row `i=9` : Print `'8'`
Row `i=10` : Print `'9'`

Pattern: Row `i=n` : Print `n-1`

Step by Step to Analyze Patterns

5. Write the designed pattern in the loop

Value of j

Value of i	1	2	3	...	10
1	0				
2	1	1			
3	2	2	2		
...					
10	9	9	9	...	9

```
int n=10;

for (int i=1; i<=n; i++)
{
    for(int j=1; j<=i;j++)
    {
        printf("%d ", i-1);
    }
    printf("\n");
}
```

Pattern: Row `i=n` : Print `n-1`

Multiple Inner Loops

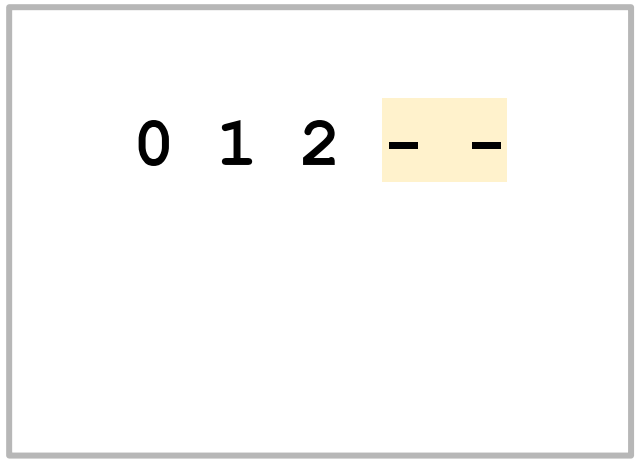
Multiple Inner Loops

Examples

Step to Analyze Multiple Patterns

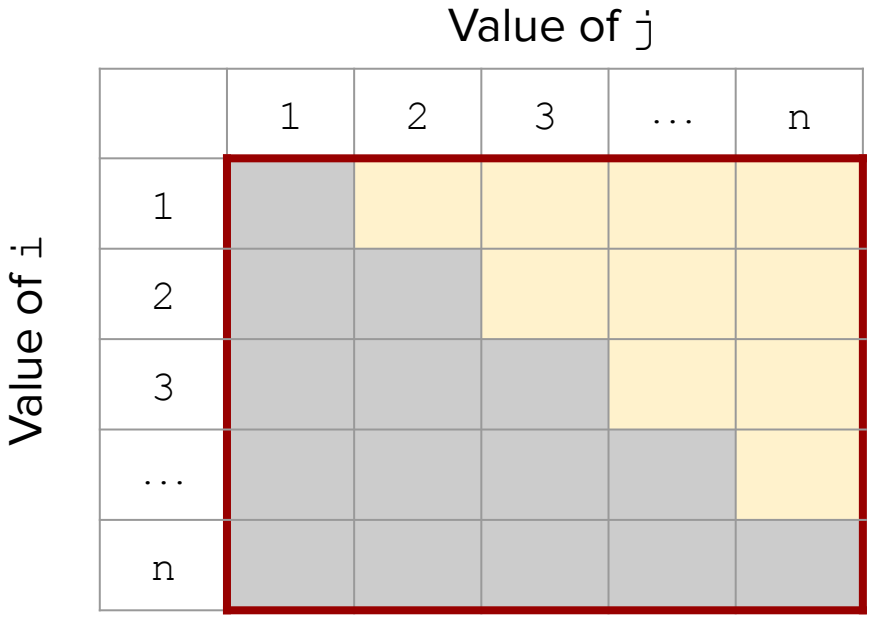
1. Check the structure of the pattern

2. Identify the pattern in <u>each row</u>



Step to Analyze Multiple Patterns

1. Check the structure of the pattern



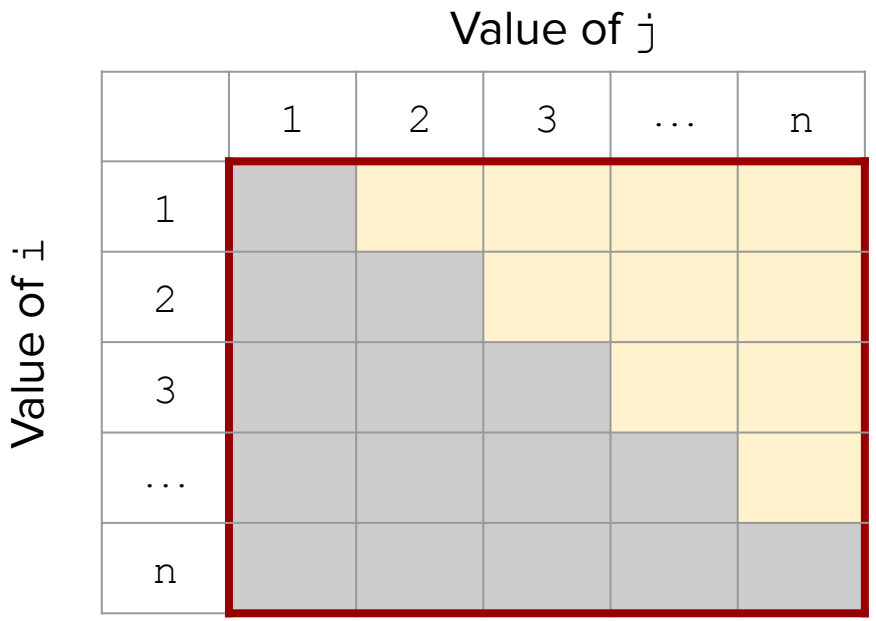

```
0 - - - -
0 1 - - -
0 1 2 - -
0 1 2 3 -
0 1 2 3 4
```

Structure: SQUARE size `n`

- Numbers : triangle
- `'-'`: upside down triangle

Step to Analyze Multiple Patterns

1. Check the structure of the pattern



Structure: SQUARE size `n`

- Numbers: triangle
- `'-'`: upside down triangle

```
int n=5, i, j, k;
for(i=1; i<=n; i++){

    // Print sequence numbers
    for (j=1 ; j<=i ; j++)
    {

    }

    // Print -
    for (k=n-i ; k>=1 ; k--)
    {

    }
    printf("\n");
}
```

Step to Analyze Multiple Patterns (cont.)

1. Check the structure of the pattern

2. Identify the pattern in <u>each row</u>

```
0 - - - -
0 1 - - -
0 1 2 - -
0 1 2 3 -
0 1 2 3 4
```

Step to Analyze Multiple Patterns

2. Identify the pattern in each row

Value of `j`

Value of `i`	1	2	3	4	5
1	**0**				
2	**0**	**1**			
3	**0**	**1**	**2**		
4	**0**	**1**	**2**	**3**	
5	**0**	**1**	**2**	**3**	**4**

Structure: SQUARE size `n`

- Numbers: triangle
- `'-'`: upside down triangle

```
int n=5, i, j, k;
for(i=1; i<=n; i++){

    // Print sequence numbers
    for (j=1 ; j<=i ; j++)
    {
        printf("%d ", i-1);
    }

    // Print -
    for (k=n-i ; k>=1 ; k--)
    {

    }
    printf("\n");
}
```

Step to Analyze Multiple Patterns

2. Identify the pattern in each row

Value of `j`

Value of `i`	1	2	3	4	5
1	**0**	**-**	**-**	**-**	**-**
2	**0**	**1**	**-**	**-**	**-**
3	**0**	**1**	**2**	**-**	**-**
4	**0**	**1**	**2**	**3**	**-**
5	**0**	**1**	**2**	**3**	**4**

Structure: SQUARE size `n`

- Numbers: triangle
- `'-'`: upside down triangle

```
int n=5, i, j, k;
for(i=1; i<=n; i++){

    // Print sequence numbers
    for (j=1 ; j<=i ; j++)
    {
        printf("%d ", i-1);
    }

    // Print -
    for (k=n-i ; k>=1 ; k--)
    {
        printf("- ");
    }
    printf("\n");
}
```

Lab Exercises