

# UESTC 1005 - Introductory Programming

Lecture 4 - Operators and Program Control

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# About Me

- IP Course Coordinator since 2019
- Research Interests in Numerical Electromagnetics
- Fascinated by Nanoscale Physics
- Also dabbles in Artificial Intelligence 🧠 and Healthcare Technologies 🏥



# Lecture Outline

- Dive deeper into operators (运算符)
- Make Decisions
- Introduce program control

# Operators

In the last lecture, we looked at a number of operators available in C. C has in fact many more, and mastering all of them takes time.

- Interestingly, the results of operators as sometimes hardware dependent.
- Let's look at some interesting observations.

# Some Side Effects

Some unexpected results:

```
int i;  
float pi;  
pi = i = 3.1416f;
```

The `float` variable `f` is assigned a value of `3.0` (as opposed to `3.1416`).

better to use multiple statements to avoid unexpected behaviour

## Example - Operators

Write a C program where you are going to enter a *three-digit* number which is then printed on the screen.

Task is to reverse the number. Example output of the program:

```
Enter a three-digit number: 123  
Reversed number is: 321
```

# Example - Operators

## Method

- We need to extract the three digits from the number
- Split the number `n` into units, tens and hundreds
- Units -- `n % 10` gives us the right-most digit
- Hundreds -- `n % 100` gives us the hundreds
- For tens, we need to do two steps, first remove the hundred `temp = n % 100` and then get the tens part, `ten = temp % 10` gives us the tens in the number

For swapping, we can simply display the number in the reverse order ( `unit` , `tens` and `hundred` ).

# Example - Operators

```
#include <stdio.h>
int main(void)
{
    int input, unit, ten, hundred;
    int temp; // for temporarily storing a value

    printf("\nEnter a three-digit number: ");
    scanf("%d", &input);

    hundred = input / 100; // Get the hundred
    temp = input % 100;    // remove the hundred
    ten = temp / 10;       // Get the ten
    unit = input % 10;     // Get the unit

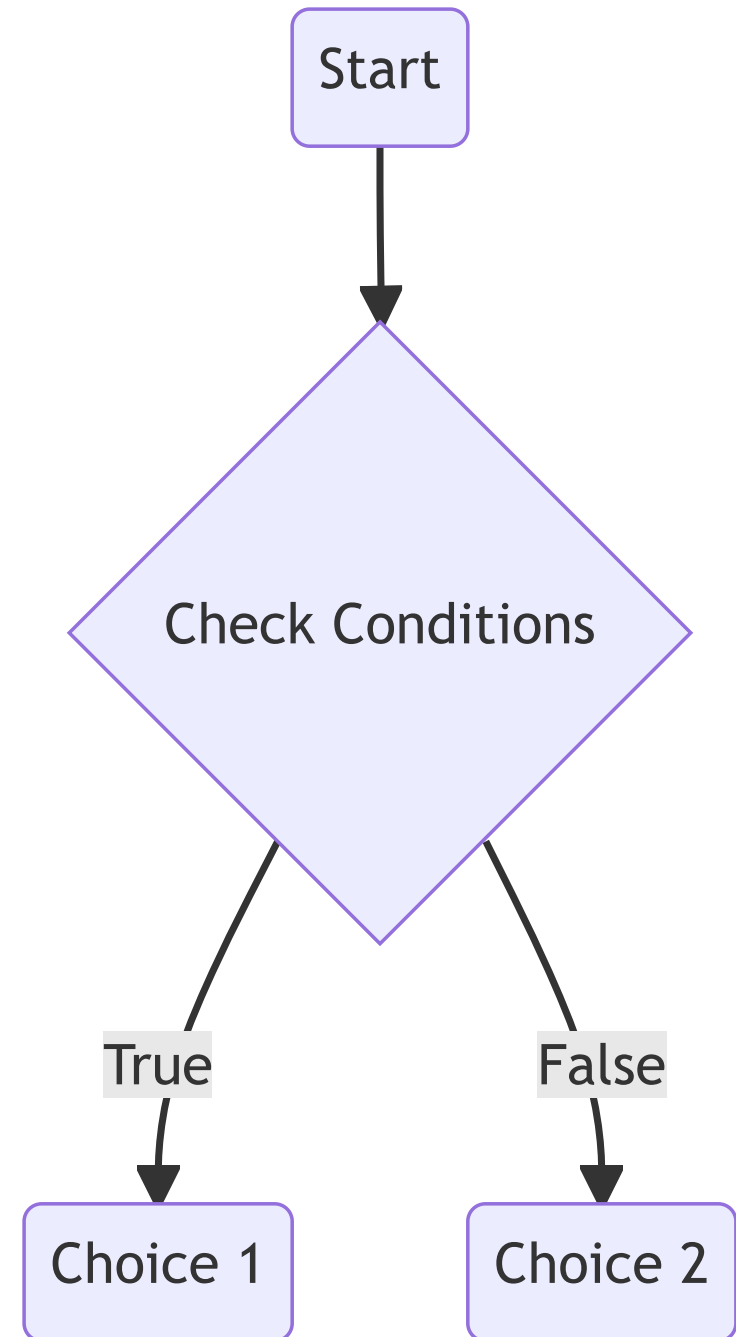
    printf("\n\nThe reversal is %d%d%d\n\n", unit, ten, hundred);
    return 0;
}
```



# Selection and Decisions

C has three kinds of statements (selection, iteration, jump) that can help make decisions and select choices.

Today we will look at `if` and `switch` statements along with relational and logical operators.



# Logical Expressions

We need to check an expression to see if it is `true` or `false` .

- Like, check whether `i < j` is `true` or `false`
- The above `(i < j)` is a logical expression.
- Result is an integer, `1` for true, and `0` for false
- We usually call it *Boolean* logic
- We can have relational operators such as `<`, `>`, `<=`, `>=` to *compare* two or more values

# Logical Operators

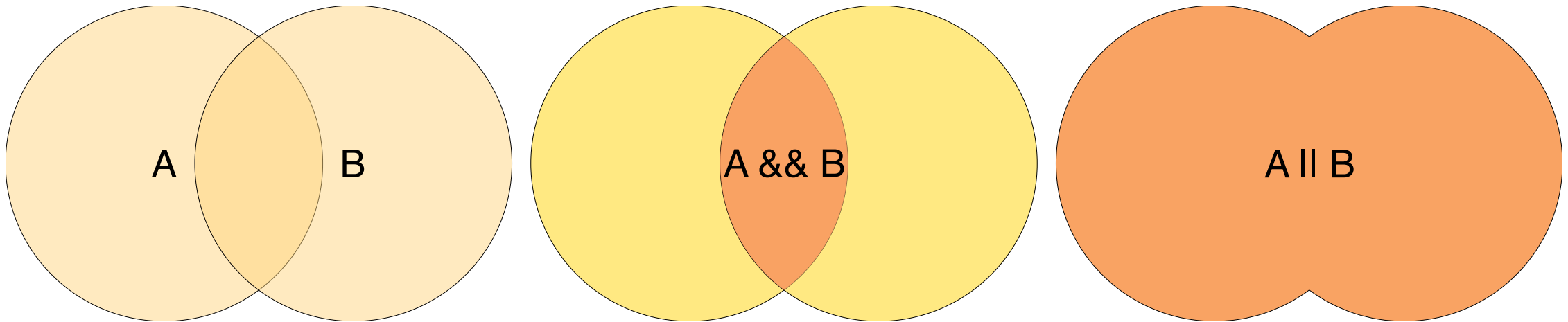
- Complex logical expressions built by combining simpler ones
- This is done using the *logical operators*

Symbol	Meaning
!	logical negation
&&	logical AND
	logical OR

As discussed in last lecture, the output of the logical expressions with logical operators is either `0` or `1`.

# Venn Diagram Visualisations

Logical operators are best understood using Venn diagrams



## Clearing some Confusion

We often confuse `==` with `=` operator

- `==` is used for *comparison*. For example, is `i` equal to `10` can be written as `i == 10`.
- `=` is used for *assignment*, eg. `i = 3;`.



# The `if` `else` Statement

- Allows to choose between *two* choices

```
if (expression)
    {statements1}
else
    {statements2}
```

# Example - Diagnosing Diabetes

We can use `if` selection statement whether a person is suffering from diabetes or not.

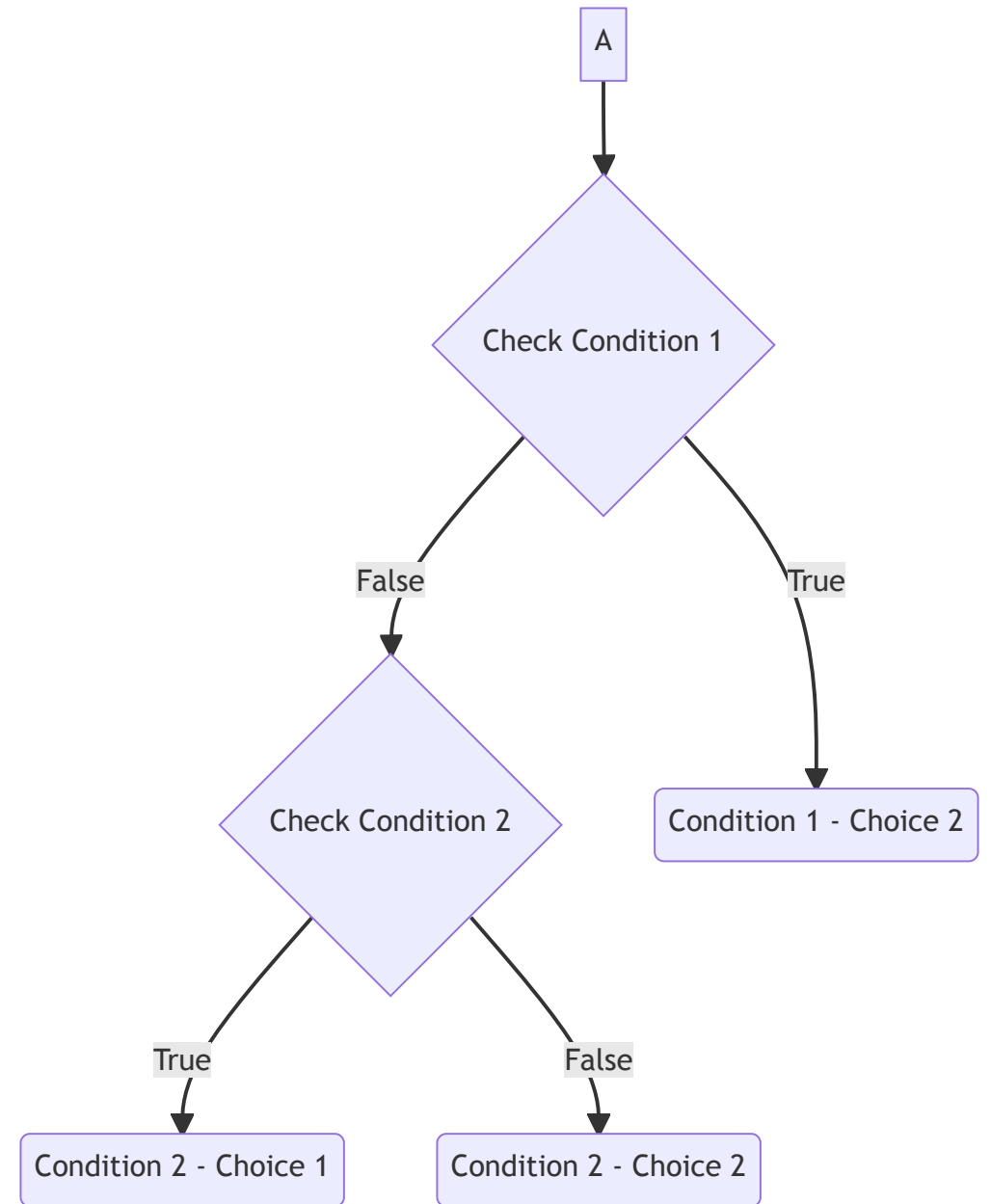
- Definition of diabetes according to World Health Organisation
- Fasting plasma  glucose (FPG)  $\geq 126$  mg/dL **OR**
- Oral glucose  tolerance test (OGTT) 2-hour glucose  $\geq 200$  mg/dL

```
if (fpg >= 126 || ogtt_2hpg >= 200)
    diabetes = TRUE;
else
    diabetes = FALSE;
```

# Cascaded **if** Statements

- We often need to check a series of conditions, seeking *one* of them to be true

```
if (expresssion)
    {statements1}
else if
    {statements2}
...
else
    {statementsN}
```





## Cascaded `if` - Example

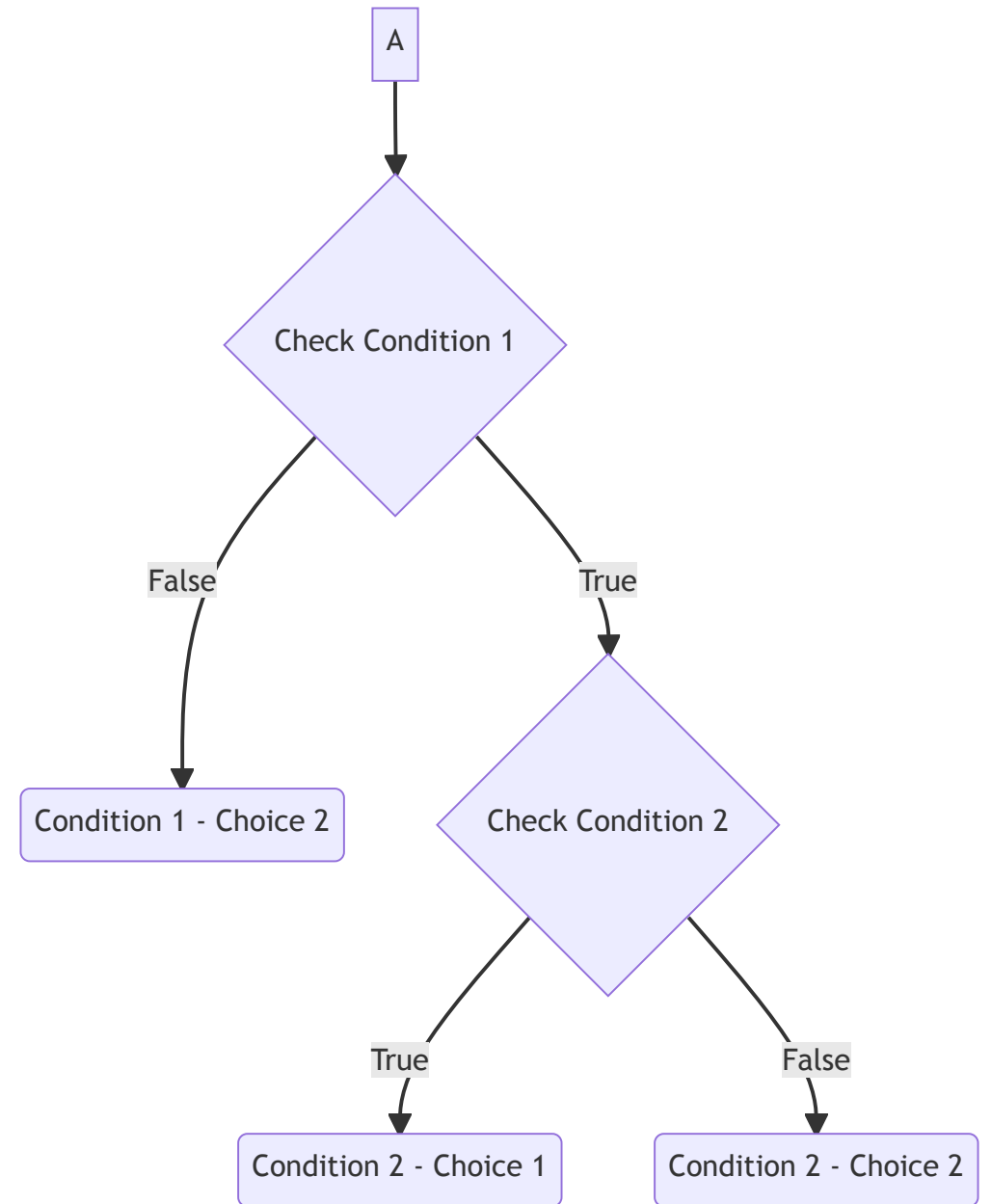
Check whether a number is positive, negative, or zero.

```
if (n<0)
    printf("n is less than 0 \n");
else if (n==0)
    printf("n is equal to 0 \n");
else
    printf("n is greater than 0 \n ");
```

# Nested `if` Statements

There is also an option to use an `if` statement *inside* another one

```
if (expression)
    if
    {statements1}
    else
    {statements2}
else
    {statements3}
```



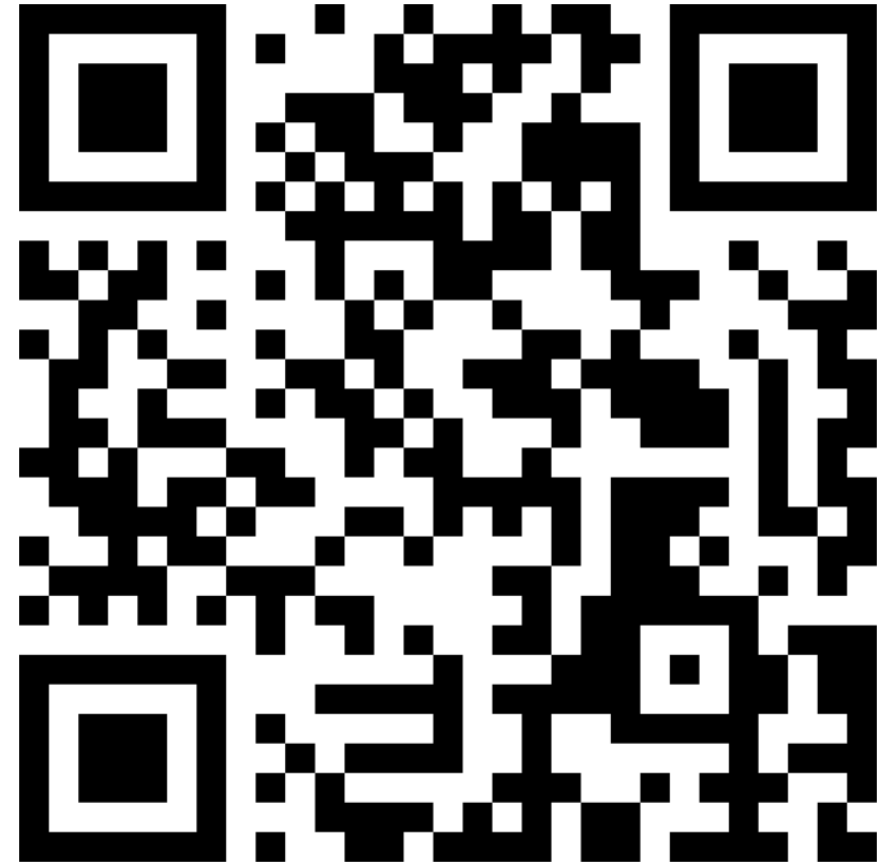
# Question ?

Writing nested `if` statements is a poor programming practice. Can you propose a better alternative?

- Check whether a number is odd **AND** divisible by 7.

```
if ( !(num %2 == 0))  
    if (num % 7 == 0)  
        printf("%d is odd and divisible by 7", num);  
    else  
        printf("%d is not odd or divisible by 7", num);
```

- *Hint:* Your answer is a single line



Go to the website link -

<https://www.menti.com/almp8abh7wkj> and

type the code 8625 1887 .

# A Terse form of selection Statement

Conditional expressions help us execute the function of `if else` statements in a brief manner.

Syntax:

```
expr1 ? expr2 : expr3
```

It reads as:

If `expr1` is `true` **THEN** execute `expr2`, **OTHERWISE** execute `expr3`.

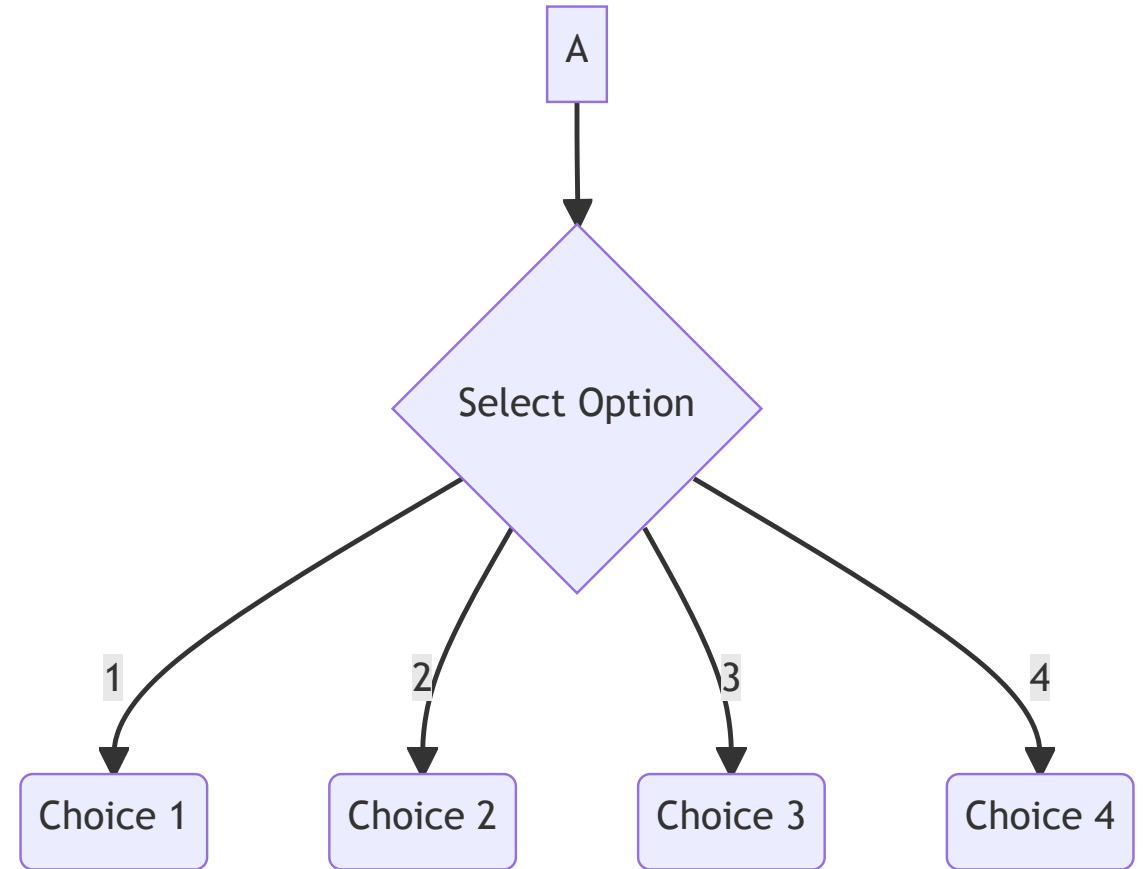
```
int i, j, k;  
i = 1, j = 2;  
k = i < j ? i : k; // Since i < j so k gets the value k = i = 1
```

# The `switch` statement

Imagine you call your mobile phone service helpline, and you are presented with a series of options

- Press `1` for billing
- Press `2` for text messages
- Press `3` for international roaming
- Press `4` to speak to an agent

In C, we can implement the same using the `switch` statement. Options are selected using the `case` labels.



# switch - Example

```
int main(){
    char grade = 'B';
    switch(grade) {
        case 'A' :
            printf("Excellent!\n" );
            break;
        case 'B' :
        case 'C' :
            printf("Well done\n" );
            break;
        case 'D' :
            printf("You passed\n" );
            break;
        case 'F' :
            printf("Better try again\n" );
            break;
        default :
            printf("Invalid grade\n" );
    }
    return 0;
}
```

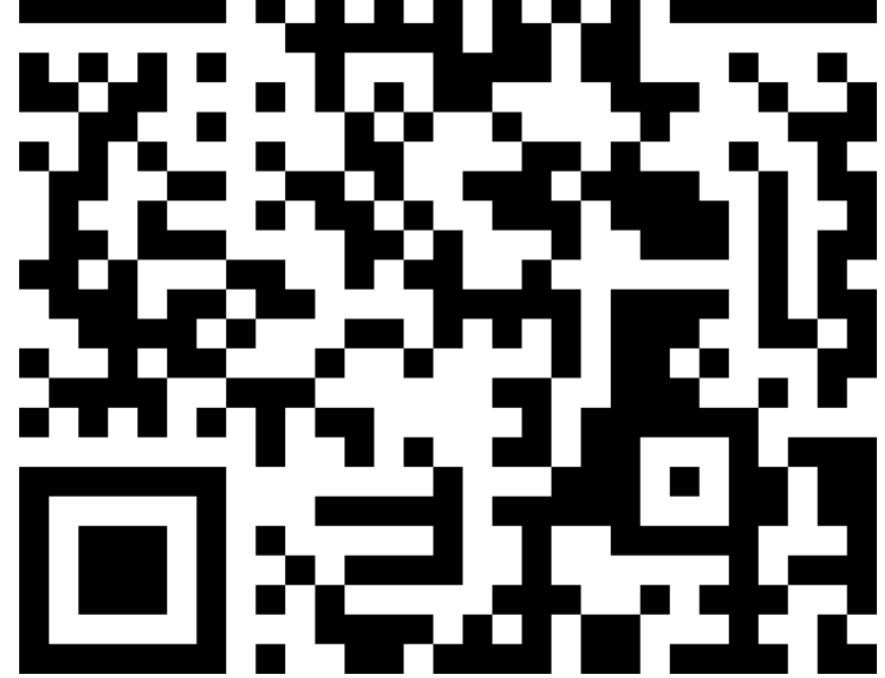
# Difference between `if` and `switch`

We can implement a given logic through either `if` or `switch` statements.

- Matter of personal choice/taste
- `if` checks for a *condition*
- `switch` checks the variable in the argument (between the parentheses `( )`) against a range of possible values.
- Code reads better if `switch` is used.

of the lines with `break` statements in there

```
int main(){
    char grade = 'B';
    switch(grade) {
        case 'A' :
            printf("Excellent " );
        case 'B' :
        case 'C' :
            printf("Good " );
        case 'D' :
            printf("Average " );
        default :
            printf("Invalid grade\n" );
    }
    return 0;
}
```



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and type the code `8625 1887` .

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## `break` statement

- `break` simply *breaks* the program flow to take out of the `switch`



# Today's Summary

- Using relational operators and logical operators to describe conditions
- Using `if-else` and `switch-case` statements in C to realise decision-making
- Flow charts to visualise program flow

## Next up

### Loops

- We will use `for` and `while` loops

# Questions ?

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