

# C Course

IIT Kanpur

Lecture 3

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# Recap

- Signed and Unsigned data types in C
  - Let's consider `signed int` and `unsigned int` in C. C allocates 2 bytes (can vary from one compiler to another)
  - For `unsigned int`,  
All bits are used to represent the magnitude.  
Thus 0 to  $2^{16} - 1$  can be represented.
  - For `signed int`,  
1 bit is reserved for sign. ( 0 for +ve and 1 for -ve)  
Thus +ve numbers range from 0 to  $2^{15} - 1$   
For -ve numbers we use 2's complements.  
**What's 2's complement?**

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Thus 0 to  $2^{16} - 1$  can be represented.
  - For `signed int`,  
1 bit is reserved for sign. ( 0 for +ve and 1 for -ve)  
Thus +ve numbers range from 0 to  $2^{15} - 1$   
For -ve numbers we use 2's complements.  
**What's 2's complement?**  
In 2's complement to represent a -ve number (say -x) in n bits
    - Compute  $2^n - x$ . Represent this magnitude as unsigned int in n bits.
    - The range is 0 to  $-2^{15}$ . **How?**

# Logical Expressions

- Formed using
  - 4 relational operators: `<`, `<=`, `>`, `>=`
  - 2 equality operators: `==`, `!=`
  - 3 logical connectives: `&&`, `||`, `!`
- `int` type: 1(true) or 0 (false)
- Some examples are
  - If `x = 8`, `y = 3`, `z = 2` what is the value of  
`x >= 10 && y < 5 || z == 2`

# Logical Expressions

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- `int` type: 1(true) or 0 (false)
- Some examples are
  - If `x = 8, y = 3, z = 2` the value of  
`x >= 10 && y < 5 || z == 2` is 1.
  - Precedence comes into picture. Remember last lecture?

# Conditional Operator [ ? : ]

- A conditional expression is of the form

`expr1 ? expr2 : expr3`

The expressions can recursively be conditional expressions.

- A substitute for `if-else`
- Example :

`(a < b) ? ( (a < c) ? a : c ) : ( (b < c) ? b : c )`

What does this expression evaluate to?

# Conditional Operator [ ? : ]

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- A substitute for `if-else`
- Example :

`(a < b) ? ( (a < c) ? a : c) : ( (b < c) ? b : c)`

This evaluates to `min(a,b,c)`

# if-else statement

- The syntax is

- `if(expr) stmt`

- `if(expr) stmt1 else stmt2`

Note that `stmt`, `stmt1`, `stmt2` can either be **simple** or **compound** or **control statements**.

- Simple statement is of the form `expr;`

- Compound statement is of the form

```
{  
    stmt1;  
    stmt2;  
    .....  
    stmtn;  
}
```

- Control Statement: will be discussed through this lecture.

involves `if-else`, `for`, `switch`, etc

e.g- `if(expr) stmt1 else stmt2`



# if-else : some examples

- ```
x = 1; y = 10;  
if(y < 0) if(y > 0) x = 3;  
else x = 5;  
printf("%d\n", x);
```

What is the output here?

- ```
if(z = y < 0) x = 10;  
printf("%d %d\n", x, z);
```

What is the output here?

# if-else : some examples

- ```
x = 1; y = 10;  
if(y < 0) if(y > 0) x = 3;  
else x = 5;  
printf("%d\n", x);
```

**Output is :** 1

**Dangling else:** else clause is always associated with the closest preceding unmatched if.

- ```
if(z = y < 0) x = 10;  
printf("%d %d\n", x, z);
```

The above code is equiv to the following one:

```
z = y < 0;  
if (z) x = 10;  
printf("%d %d\n", x , z);
```

**Output is:** 1 0

# While and do-while

- Syntax is
  - `while (expr) stmt`
    - As long as `expr` is true, keep on executing the `stmt` in loop
  - `do stmt while (expr)`
    - Same as before, except that the `stmt` is executed at least once.

- Example:

```
int i=0, x=0 ;
while (i<10) {
    if(i%3==0) {
        x += i;
        printf("%d ", x);
    }
    ++i;
}
```

What is the output here?

# While and do-while

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    - Same as before, except that the `stmt` is executed at least once.

- Example:

```
int i=0, x=0 ;
while (i<10) {
    if(i%3==0) {
        x += i;
        printf("%d ", x);
    }
    ++i;
}
```

**Output is:** 0 3 9 18

# for statement

- Syntax is
  - `for (expr1; expr2; expr3) stmt`
    - `expr1` is used to initialize some parameters
    - `expr2` represents a condition that must be true for the loop to continue
    - `expr3` is used to modify the values of some parameters.
  - It is equiv to

```
expr1;
while (expr2) {
    stmt
    expr3;
}
```

# for statement

- This piece of code has equivalent `for` statement as follows:

```
expr1a;  
expr1b;  
while (expr2) {  
    stmt  
    expr3a;  
    expr3b;  
}
```

```
for ( expr1a, expr1b; expr2; expr3a, expr3b) stmt
```

- Note that in the `for` statement `expr1`, `expr2`, `expr3` need not necessarily be present. If `expr2` is not there, then the loop will go forever.

# for statement: some examples

- ```
int i, j, x;
for(i=0, x=0; i<5; ++i)
    for(j=0; j<i; ++j) {
        x += (i+j-1);
        printf("%d ", x);
    }
```

What is the output here?

# for statement: some examples

- ```
int i, j, x;
for(i=0, x=0; i<5; ++i)
    for(j=0; j<i; ++j) {
        x += (i+j-1);
        printf("%d ", x);
    }
```
- **Output is:** 0 1 3 5 8 12 15 19 24 30



# switch statement

- Syntax is

- `switch (expr) stmt`
- `expr` must result in integer value; `char` can be used(ASCII integer value A-Z: 65-90, a-z: 97-122)
- `stmt` specifies alternate courses of action
  - `case` prefixes identify different groups of alternatives.
  - Each group of alternatives has the syntax

```
case  expr:
    stmt1
    stmt2
    .....
    stmtn
```

Note that parentheses `{ }` are not needed in case block

- Multiple case labels

```
case expr1:case expr2 :... ..: case exprn:
    stmt1
    stmt2
    .....
    stmtm
```

# switch statement: example

```
switch (letter = getchar()) {  
    case 'a': case 'A': case 'e' : case 'E':  
    case 'i': case 'I': case 'o' : case 'O':  
    case 'u': case 'U':  
        printf("Vowel"); break;  
    default: printf("Consonant");  
}
```

- Note the use of multiple cases for one group of alternative. Also note the use of `default`. Statement corresponding to `default` is always executed.  
`break` to be discussed soon.

# Power of `break`

- Syntax is
  - `break;`
- used to terminate loop or exit from a `switch`.
- In case of several nested `while`, `do-while`, `for` or `switch` statements, a `break` statement will cause a transfer of control out of the immediate enclosing statement.

# break statement: Example

```
int count =0;
while (count <=n) {
    while( c=getchar() != '\n' )
    {
        if ( c == '@' ) break;
        ...    ...    ...
    }
    ++count;
}
```

# continue statement

- Used to bypass the *remainder* of the *current pass* through a loop.
- Computation proceeds directly to the *next* pass through the loop.
- Example:

```
for( count=1; x <=100; ++count) {  
    scanf ( "%f " , &x);  
    if (x < 0) {  
        printf(" it's a negative no\n")  
        continue;  
    }  
    /*computation for non-negative  
    numbers here*/  
}
```

# goto statement

- Note that you can *tag* any statement in C with an identifier.
- And then, can use `goto` to directly transfer the program control to that statement .

- Example:

```
while ( x <= 10) {  
    ... ..  
    if (x<0)    goto chkErr;  
    ... ..  
    scanf ("%f", &x) ;  
}  
chkErr: {  
    printf ("found a negative value!\n");  
    ... ..  
}
```

- Note that use of `goto` is discouraged. It encourages logic that skips all over the program . Difficult to track the code. Hard to debug.

# Questions!!