Lecture 3
Variables, Values, Assignment and Types

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Revision: Elements of a Program

- Main Procedure
- Procedure body
- Return statement
- Exit Status
- Statements
- Sequence of statements
- Keywords
- Identifiers

- Operators
- Syntax
- Meaning
- Grammar
- Libraries
- Input and Output (to be continued..)
Cout and cin

- Predefined identifiers
- Defined in library `iostream`
  - in namespace `std`
    - namespaces are used to organize entities
  - Cin and cout are names of input and output stream objects
    - These objects are connected to input and output devices
- Operators `<<` and `>>` can be used to perform input/output operations on these objects.
- Reading from cin: `cin >> x;`
- Writing to cout: `cout << x;`

(demo: linking input with output..try commenting the using namespace statement)
A Variable

- Variables hold objects used in the program
- A value can be assigned to a variable
- The assigned values can be changed through reassignment
- Variables occupy specific memory locations in the running program
- Assignment to a variable changes the content of its corresponding location
Assigning Values to Variables

- An example of Integer Values

```c
int i;
i = 212;
```
Let's execute this program step by step.

```cpp
int main () {
    int x;
    x = 10;
    cout << x * x ;
    x = 20;
    cout << x * x ;
    return 0;
}
```
int main () {
    int x;
    x = 10;
    cout << x * x ;
    x = 20;
    cout << x * x ;
    return 0;
}
An assignment has been made

```c++
int main () {
    int x;
    x = 10;
    cout << x * x ;
    x = 20;
    cout << x * x ;
    return 0;
}
```
int main () {
    int x;
    x = 10;
    cout << x * x ;
    x = 20;
    cout << x * x ;
    return 0;
}
Another assignment..the object remains but the previous value wiped out ..

```c
def main () {
    int x;
    x = 10;
    cout << x * x ;
    x = 20;
    cout << x * x ;
    return 0;
}
```

Output

```
100
```
int main () {
    int x;
    x = 10;
    cout << x * x ;
    x = 20;
    cout << x * x ;
    return 0;
}

Output
100400
Main procedure is completed.. memory allocated to this procedure is returned back to operating system... you may still see the output on screen.

```cpp
int main () {
    int x;
    x = 10;
    cout << x * x ;
    x = 20;
    cout << x * x ;
    return 0;
}
```

Output
100400
Types

- In a program, we need values of various kinds
  - ..-3, -2, -1, 0, 1, 2, 3, ....
  - 'A', 'B','C', ...., 'a', 'b', 'c', 'd', ..
    '1','2','3',...
    '!','@','<',
  - 12.34, 1.234, 3.142, ..
  - “Robin Hood”
  - { “Robin Hood”, 'M', 15, ”Mumbai” }
Restricting the set of values assignable to a given variable

- Declaring a Type of every variable
- A value of the declared type can be assigned to the variable
- A value not of the declared type cannot be assigned —> “Typing Error” (demo)
Use of Types

- Types are a means of organization of data
- Types are used to determine storage requirement for variables
- They are also used in “type checking”
  Check the Type of the value being assigned
- Standardized types enable easy exchange and use of stored information
Variable Declarations

```java
int main () {
    int x;  // A variable of type int
    int x, y, z;  // Many variables of type int
    int x = 10;  // An initialized variable of type int
}
```
The Assignment Statement

int x, y;
variables x and y of type int are declared

x = 124;
variable x is on the left hand side

y = 100;
variable y is on the left hand side

y = x;
variable x is on the right hand side

Variable y is on the left hand side
Values that occur on the left hand side and on the right hand side of an assignment

In expression \( e_1 = e_2 \), \( e_1 \) is lvalue and \( e_2 \) is rvalue

Is 30 a valid lvalue?

- Try it out

Location vs. value contained in the location
Using expressions in assignment statements

- \( x = x + 1 \)
- \( x = x + y \)
- \( X = 2 \times x \)
- \( x = (2 \times x) + (2 \times x) \)
Sizes of variables

- Binary Numbers
- Bit: 0s and 1s
  - Why do computers need to use binary numbers?
- A Byte: 8 bits
  - How many values?
- A variable with 2 Bytes storage:
  - how many values can it hold?
- For encoding all English characters, how many bits do you need?
How much storage for a variable?

Define a new type called Mountain

Given that it has 8 possible values all in all,

How much memory should a variable of type Mountain occupy?
Some Standard Types and their sizes

- char 1 byte
- int 4 bytes
- short int 2 bytes
- float 4 bytes
- double 8 bytes
- bool 1 byte

Demo
Standard Types Vs. Use Defined Types

• Commonly used types are predefined in the language
• They are added as keywords in the language
• Int, float, char, ..
• New types can be created by the user
  - composites from existing types
    • e.g. a record of a person's details