Expressions and User Input
Chap. 1.2 - 1.5
Odds and Ends

• Discuss Quiz #1
  – What will the variable declarations and assignments look like?
  – How are you going to directly compute the largest and smallest signed short numbers? (Assume a short is 2 bytes.)
Program Demo

```cpp
#include <iostream>
#include <limits>

using std::cout;
using std::endl;

int main(void) {
    unsigned short us_num;
    us_num = USHRT_MAX;
    cout << us_num << endl;
    return 0;
}
```
Program Demo

```cpp
#include <iostream>
#include <limits>

using std::cout;
using std::endl;

int main(void) {
    unsigned short us_num;
    us_num = USHRT_MAX;
    cout << us_num << endl;
    cout << (unsigned short) (us_num+1) << endl;
    //us_num = us_num + 1;
    //us_num += 1; //notice that this is the same as above
    //cout << us_num << endl;

    //You can use increment op
    cout << us_num++ << endl; //This will give value before incr
    cout << ++us_num << endl; //This will give value after incr
    return 0;
}
```

Expressions

• What is an expression?
  – Set of operations producing a value
    • Combining simple values
      12 * 4 + 6 * 10 vs. ((12 * 4) + 6) * 10
Expressions cont.

• Pieces of an Expression:
  – Operators
    • Indicate operation, e.g. +, *, /, -, %
  – Operands
    • Values in the expression
  – Evaluation
    • Process of obtaining results from operations on operands
Arithmetic Operators

• Add
  34 + 23
• Subtract
  34 - 23
• Multiply
  2 * 23
• Divide
  40 / 10
• Remainder/Mod
  34 % 5
Arithmetic

• Integer Arithmetic
  std::cout << 3/8;  /*prints 0*/
  std::cout << 34/5;  /*prints 6*/

• Floating Point Arithmetic
  std::cout << 34.0/5.0;  /*prints 6.8*/
  std::cout << 3.0/8;  /*prints .375*/
  std::cout << 3/8.0;  /*prints .375*/
Type Casting

• Casting

    std::cout << 34 / (int) 5.0; /*prints 6*/
    std::cout << (int) (34 / 5.0); /*prints 6*/
    std::cout << (float) 34 / 5; /*prints 6.8*/

• What is wrong with these?

    std::cout << (int) 34 / 5.0; /*prints 6.8*/
    std::cout << (float) (34/5); /*prints 6.0*/
Precedence

• What is precedence?
  – Binding power of operator
  – (*, /, %) vs. (+, -)

• How do we override precedence?
  – Parenthesis!

• Examples:
  12 * 4 + 6 * 10 vs. ((12 * 4) + 6) * 10
BMI Calculator

```cpp
int main() {
    //declare variables
    double height;
    double weight;
    double bmi;

    //compute BMI
    height = 70.0;
    weight = 195.0;
    bmi = weight / (height*height) * 703;

    //print results
    std::cout << “Current BMI: ” << bmi << std::endl;

    return 0;
}
```
How do we read into a variable in C++?

• Declare a variable
• Read value from user and store at variable location
• How do we do this?

```cpp
#include <iostream>
int main() {
    int x;
    std::cin >> x;
    std::cout << x;
    return 0;
}
```
Programming Demo
New Operators for Expressions

• What if you have the statement \texttt{var = var + 1;}
  \texttt{var += 1; /*Add operand on right to var*/}
  \texttt{var++; /*Increment var by one*/}

• What if you have the statement \texttt{var = var - 5;}
  \texttt{OR var = var + var;}
  \texttt{var -= 5;}
  \texttt{var += var;}

• Pre vs. Post increment: \texttt{++var vs. var++}
Decisions in Life

• What is a decision?
• When do we make decisions?
• How do we make decisions?
  If it is sunny today
    then I’ll go to the beach and fly a kite
  Else if it is raining today
    then I’ll stay inside and read a book
  Else if it is snowing
    then I’ll go to the mountains to ski
Decisions within Decisions

• What happens if there is no wind at the beach?
• How does this change our decisions?
  
  If it is sunny today
  then I’ll go to the beach
  if it is windy at the beach
  then I’ll fly a kite
  if it is not windy at the beach
  then I’ll walk on the shore
Flow chart for decisions

Is it sunny? Yes → Go to beach

Is it windy? Yes → Fly kite

Is it raining? Yes → Read book

No → Go outside

Walk on beach
Decisions in our programs

• Use an if/else

  if (<expression>) {
    <statement>;
    ...
    <statement>;
  }
  else {
    <statement>;
    ...
  }
What is the <expression>?

Could be a relational expression:

<expression> <relational op> <expression>

• Relational Ops
  
  == - equal to
  
  != - not equal to
  
  < - less than
  
  > - greater than
  
  <= - less than or equal to
  
  >= - greater than or equal to
Examples

• if(2 + 1)
• if(2 − 4)
• if(2 − 2)
• if(4 == 4)
• if((2+1) == 4)
• if(4.1 != 4)
• if(3 <= 4)
• if(4 >= 4)
• if(3.5 > 4)
• if(4 < 4)
• if(3+2*2 > 9)
• if((3+2)*2 > 9)
Reading/Assignments

• Read Chap. 2.1 – 2.2