CISC 1600/1610 Computer Science I

Functions/modularity

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JMH 328A

Blocks of statements

Statements in a program are grouped:

- with curly braces { } for `if`, `switch`, and loops
- conceptually (with blank lines, indentations, and comments)

Good ----, world!

```
> ./timeGreetings
What is your name? Joe
What time is it? 0900
Good morning, Joe.
> ./timeGreetings
What is your name? Laura
What time is it? 1400
Good afternoon, Laura.
>
```


Code for timeGreetings.cpp

Get name and time

Output time-based greeting

- Outputs sub-divided into time-based blocks

Write once, use repeatedly

```
cout << count << " mississippi\n";
```

Can print:

```
1 mississippi
```

Can print:

```
1 mississippi
2 mississippi
3 mississippi
```

Define equation once, use repeatedly

Factorial: n! = n x (n-1) x … x 2 x 1

```
int product=1;
for ( int i=1; i<=5; i++)
{
   product = product*i;
}
```

Functions

1. Identify a set of statements with a single keyword
2. Use single keyword to run the larger set of statements anywhere in your code

```
int a=factorial(5);
```

Defining a function

Similar to variable

- function declaration
  - must be declared before it is used
  - declaration provides overview of function behavior
- function definition
  - provides the statements performed by the function

Functions in your C++ file

```
#include<iostream>
using namespace std;

int factorial(int number);  // declaration

int main () {
   . . .
   int a=factorial(4);      // usage
   . . .
}

int factorial(int number) {  // definition
   int product=1;
   for ( int i=1; i<=5; i++)
   {
      product = product*i;
   }
   return product;
}
```

Function declaration

Establish:

- function name
- output type
- input types and names

```
return_type fcn_name(input_list);

int sum_range(int min, int max);
// sum numbers from min to max
```

Function definition

Provides the statements performed when function is used

```
return_type fcn_name(input_list){
   statement1;
   . . .
   statementN;
}

int sum_range(int min, int max){
   int sum=0;
   for (int i=min; i<=max; i++)
      sum+=i;
   return sum;
}
```

Function use – "function call"

- Names function to use
- Provides input **arguments** for the function
- (If appropriate) can assign output

```
int a = factorial(6);
```

- Call types must be consistent with declaration and definition

The return statement

- When function is "called", information may be expected back

```
int a = factorial(3);
```

- `return` specifies what value to give the caller

Alternate function declaration

```
return_type  fcn_name(input_list);
```

```
int sum_range(int, int);
```

Only argument types **required** in declaration
But argument names **highly** recommended

Call-declaration consistency

- Compiler forces match between call and declaration

```
float final_price(int numItems, float single_cost);
x = final_price(3.43,10);
```

Will force type-conversion: 3.43->3, 10->10.000

- Does not check logical ordering of arguments

```
int sum_range(int min, int max);
a = sum_range(10,3);
```

Will not re-order input: min=10, max=3

Implicit type conversions

- Optimally, variable types should be consistent in computations and value assignments:

```
int a=2, b=3, c, d;
c=a+b;
```

- When variables are inconsistent, **type-casting** is often performed automatically (in some systems, an error may occur)

```
d=c-1.3;  // result becomes int
```

Explicit type conversions

When variables are inconsistent, can explicitly type-cast with `static_cast<type>(..)`

```
int a=2, b=3, c, d;
c=a+b;
d=c-static_cast<int>(1.3);
```

Pre-defined functions

```
float y = sqrt(9);
```

Import functions with `#include<cmath>`

- `sqrt(x)` is a function that returns $\sqrt{x}$
- `abs(x)` is a function that returns $|x|$
- `ceil(x)` is a function that returns $\lceil x \rceil$
- `floor(x)` is a function that returns $\lfloor x \rfloor$
- `pow(x,y)` is a function that returns x^y

More pre-defined functions: Random numbers

`rand()` function returns a "random" number between `0` and `RAND_MAX-1` (`RAND_MAX==2,147,483,647` on storm)

Import functions with `#include<cstdlib>`

Pseudo-random based on number-of-calls, e.g.:

```
return 2042    for call 1
return 43      for call 2
return 3205394 for call 3
```

Time-based "random" numbers

At start of program, call

```
srand(time(0));
```

To set the random-number "seed" to the number of seconds elapsed since 1/1/1970

Smaller random numbers

- Use % and + to scale to desired number range
- Simulate rolling of die:

  int roll = (rand() % 6) + 1;

- Simulate picking 1 of 26 students in our class:

  int studentNum = ???

Review/clarification of `int` division

If `a` and `b` are `int`s

- `a/b` computes the integer number of times `b` goes into `a`
- `a%b` computes the remainder after dividing `a` by `b`

```
6/4 == 1
6%4 == 2
```