Control Statements and Functions

EECS 230

Spring 2016

Agenda

- Computation
  - What is computable? How best to compute it?
  - Abstractions, algorithms, heuristics, data structures
- Language constructs and ideas
  - Sequential order of execution
  - Expressions and statements
  - Selection
  - Iteration
  - Functional abstraction
  - Vectors

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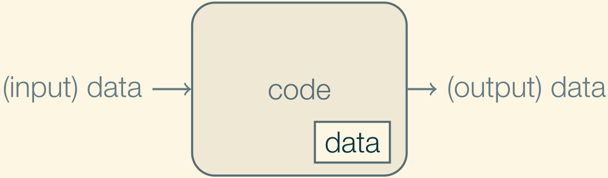
So what I'll be showing you is mainly syntax for things you already know.

Computation: the big picture



- Input: from keyboard, files, mouse, other input devices, the network, other programs
- Code: consumes the input and does something to produce the output
- Output: to the screen, files, printer, other output devices, the network, other programs

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  - Input/output formats
  - Communication protocols
  - Data structures

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Note the emphasis is on structure and organization

Programming language features

Each language feature exists to express a fundamental idea:

$+$	addition
$*$	multiplication
{ *stm stm* ... }	sequencing
if (*expr*) *stm* else *stm*	selection
while (*expr*) *stm*	iteration
f(x);	function call

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The meaning of each feature is simple, but we combine them into programs of arbitrary complexity.

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When in doubt, parenthesize (but don’t overdo it)

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Some common operators:

Operator(s)	Meaning	bool	int	double
$+, -, *, /$	arithmetic		Yes	Yes
%	remainder		Yes	
$==$	equal	Yes	Yes	Yes
$!=$	not equal	Yes	Yes	Yes
$<, <=, >, >=$	comparisons		Yes	Yes
&&, ||	and, or	Yes		

Concise operators

For many binary operators, there are (roughly) equivalent more concise versions:

$a \mathrel{+}= c$	means	$a = a + c$
$a \mathrel{*}= \text{scale}$	means	$a = a * \text{scale}$
$++a$	means	$a \mathrel{+}= 1$
	or	$a = a + 1$

Use them when they make your code clearer

Statements

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Examples:

- `a = b;`
- `double d2 = 2.5;`
- `if (x == 2) y = 4;`
- `while (cin >> number) numbers.push_back(number);`
- `int average = (length + width) / 2;`
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I don't expect you to recognize all of these…yet.

Selection

Sometimes we must choose between alternatives.

For example, suppose we want to identify the larger of two numbers. We can use an if statement:

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if (a < b)
    max = b;
else
    max = a;
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The syntax is

if (*condition*)
    statement-if-true
else
    statement-if-false

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Use a compound statement:

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} else {
    max = a;
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if (a < b) {
    max = b;
    min = a;
} else {
    max = a;
    min = b;
}
```

The syntax is

```
{
    first-statement
    second-statement
    // etc.
}
```

Iteration (while)

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int i = 0;

while (i < 100) {
	cout << i << '\t' << square(i) << '\n';
	++i;
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The syntax is

while (*condition*) *statement*

Iteration (for)

```
int i = 0;          // initialization
while (i < 100) {
    cout << i << '\t' << square(i) << '\n';
    ++i;            // step
}
```

This pattern—a loop with initialization and step—is so common that there's special syntax for it:

```
for (int i = 0; i < 100; ++i)
    cout << i << '\t' << square(i) << '\n';
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for loops are the idiomatic way to count in C++

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for (*init-expr*; *cond-expr*; *step-expr*)
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init-expr;
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    body-stm
    step-expr;
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- …is logically separate.
- …make the program clearer.
- …can be reused.
- …eases testing, distribution of labor, and maintenance.

A function example

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int square(int n) {
    return n * n;
}

int main {
    cout << sqrt(square(3) + square(4)) << '\n';
}
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    double c2 = a + b;
    double c  = sqrt(c2);
                                        double sqrt(double);
    cout << c << '\n';
}
```

Function definition syntax

Our function

```
int square(int x)
{
    return x * x;
}
```

is an example of

```
return-type function-name(param-type param-name,...)
{
    // code, which can use parameter(s) param-name, etc.
    return some-value;
}
```