# Control Statements and Functions

EECS 230

Winter 2018

# 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

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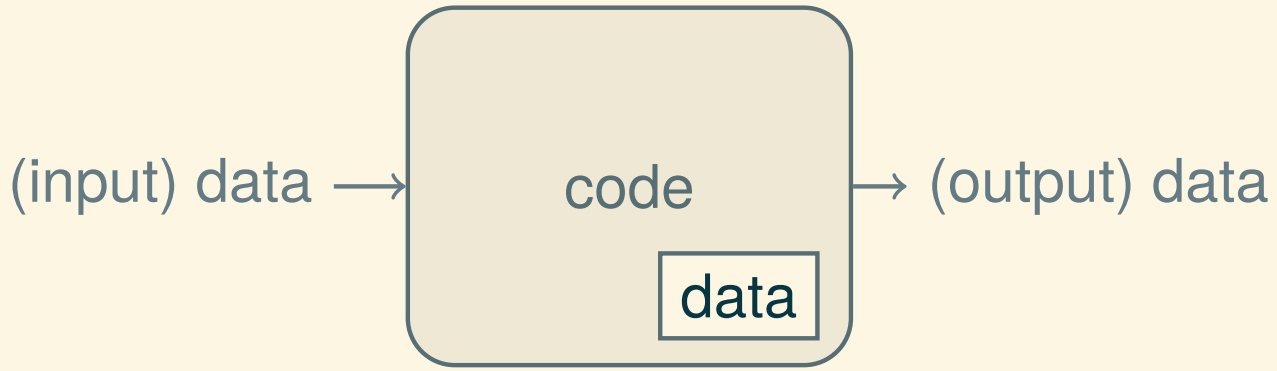
So what I'll be showing you is mainly syntax for things you already know.

# 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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  - Communication protocols
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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 $+=$ c | means | a $=$ a $+$ c |
| a $*=$ scale | means | a $=$ a $*$ scale |
| $++$a | means | a $+=$ 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);`
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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:

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

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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while (condition) statement
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# 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:

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for (int i = 0; i < 100; ++i)
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for loops are the idiomatic way to count in C++

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*init-expr*;

while (*cond-expr*) {
    *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;
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int main () {
        cout << sqrt(square(3) + square(4)) << '\n';
}
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```
double sqrt(double);
```

# 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;
}
```