Declarations

A declaration introduces a *name* into a *scope* (region of code):

- gives a type for the named object
- sometimes includes an initializer
- must come before use

Examples:

- `int a = 7;
- int b;
- vector<string> c;
- double my_sqrt(double);`
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Declarations are frequently introduced through *headers*:

```cpp
int main()
{
    std::cout << "Hello, world!\n";
}
```

Error: unknown identifier `std::cout`
Headers

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```cpp
#include <iostream>

int main()
{
    std::cout << "Hello, world!\n";
}
```
Definitions

A declaration that (also) fully specifies the declarandum is a \textit{definition}.

Examples:

\begin{verbatim}
int a = 5;
int b;
\end{verbatim}

\begin{verbatim}
vector<double> v;
double square(double x) {
  return x * x;
}
\end{verbatim}

\begin{verbatim}
struct Point {
  int x, y;
}
\end{verbatim}

Examples of non-definition declarations:

\begin{verbatim}
extern int b;
double square(double);
struct Point;
\end{verbatim}
Definitions

A declaration that (also) fully specifies the declarandum is a *definition*.

Examples:

\[ \text{int } a = 5; \]
Definitions

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```c
int a = 5;
int b;    // but why?
```
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vector<double> v;
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Examples of non-definition declarations:

```cpp
extern int b;
double square(double);
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## Declarations and definitions

<table>
<thead>
<tr>
<th></th>
<th>declarations</th>
<th>definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>may be repeated</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>must come before use</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>
Why both?

To refer to something, we need only its declaration.
We can hide its definition, or save it for later.
In large programs, declarations go in header files to ease sharing.
double my_sqrt(double x)
{
    
}

int main()
{
    
    my_sqrt(y)

}
int main()
{
    · · · my_sqrt(y) · · ·    // unknown identifier
}

double my_sqrt(double x)
{
    · · ·
}
double my_sqrt(double);

int main()
{
    · · · my_sqrt(y) · · ·
}

double my_sqrt(double x)
{
    · · ·
}
Library declaration example

In `my_math.h`:

```c
double my_sqrt(double);
```

In `my_math.cpp`:

```c
#include "my_math.h"

double my_sqrt(double x)
{
    · · ·
}
```

In some other (`client`) .cpp source file:

```c
#include "my_math.h"

int f() {
    · · · my_sqrt(c) · · ·
}
```
Testing

One client of our library code is our test suite, in `my_math_test.cpp`:

```cpp
#include "my_math.h"
#include <UnitTest++/UnitTest++.h>

TEST(My_sqrt_9_is_correct)
{
    CHECK_EQUAL(3, my_sqrt(9));
}
```
More testing

```cpp
#include "my_math.h"
#include <UnitTest++/UnitTest++.h>

TEST(My_sqrt_2_is_close) {
  CHECK_CLOSE(1.414, my_sqrt(2), 0.001);
}

TEST(My_sqrt_throws_on_negative) {
  CHECK_THROW(my_sqrt(-9), std::runtime_error);
}
```
Building

CMakeLists.txt needs to specify which files should be compiled together to make which programs:

cmake_minimum_required(VERSION 3.3)
project(my_sqrt CXX)
include(.eecs211/CMakeLists.txt)

add_program(sqrt_client
    sqrt_client.cpp
    my_sqrt.cpp)

add_test_program(my_sqrt_test
    my_sqrt_test.cpp
    my_sqrt.cpp)
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