Separate compilation

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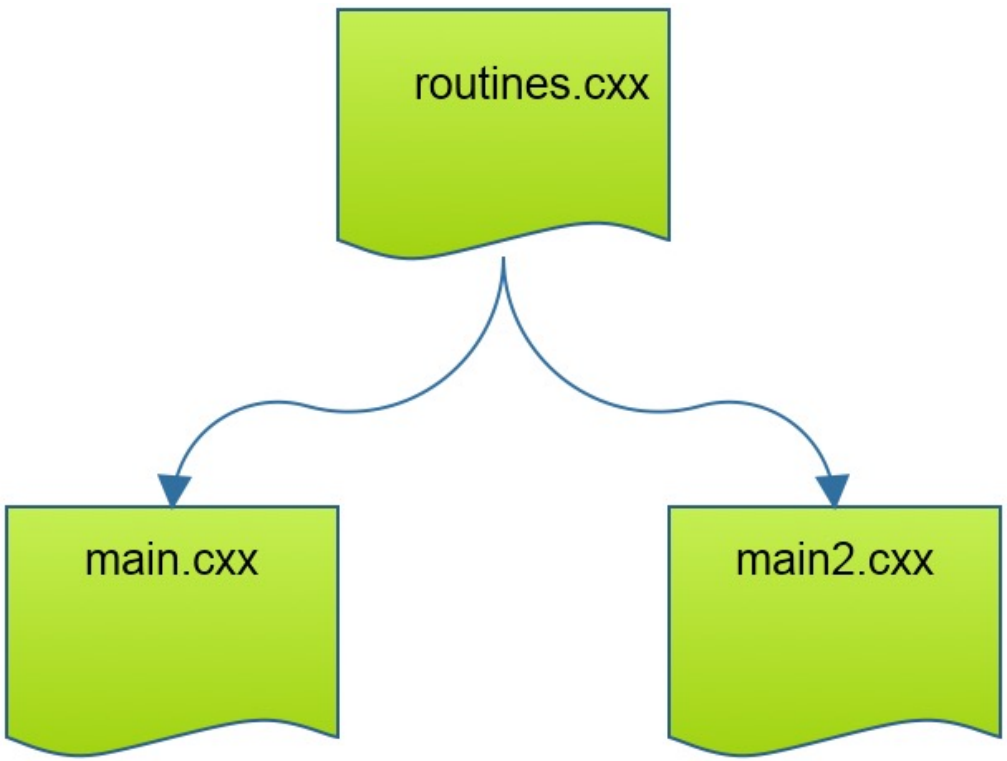
1. Include files

- Code reuse is good.
- How would you use functions/classes in more than one main?



We will discuss systematic solutions.

2. Reminder: definition vs declaration

Definition:

```
bool iseven( int n ) { return n%2==0 }
```

Declaration:

```
bool iseven( int n );
// or even:
bool iseven( int );
```

3. Declarations, case 1

Some people like defining functions after the main.
Problem: the main needs to know about them.

'forward declaration'

```
int f(int);
int main() {
  f(5);
};
int f(int i) {
  return i;
}
```

versus:

```
int f(int i) {
  return i;
}
int main() {
  f(5);
};
```

This is a stylistic choice.

4. Declarations, case 2

You also need forward declaration for mutually recursive functions:

```
int f(int);
int g(int i) { return f(i); }
int f(int i) { return g(i); }
```

5. Separate compilation

Split your program in multiple files.

- Easier to edit
- Less chance of `git` conflicts
- Only recompile the file you edit
  $\Rightarrow$ reduction of compile/build time.

6. Declarations for separate compilation

Define a function in one file;
an other file uses it, so needs the declaration:

```
// file: def.cpp
int tester(float x) {
  .....
}
```

```
// file : main.cpp
int tester(float);

int main() {
  int t = tester(...);
  return 0;
}
```

This Is Not A Good Design!

7. Declarations and header files

Using a header file with function declarations.

Header file contains only declaration:

```
// file: def.h
int tester(float);
```

The header file gets included both in the definitions file and the main program:

```
// file: def.cpp
#include "def.h"
int tester(float x) {
  .....
}
```

```
// file : main.cpp
#include "def.h"

int main() {
  int t = tester(...);
  return 0;
}
```

What happens in both cases if you leave out the `#include "def.h"`?

8. Class declarations

Header file:

```
1 // proto/classheader.hpp
2 class something {
3 private:
4   int i;
5 public:
6   double dosomething( int i, char c );
7 };
```

Implementation file:

```
1 // proto/classimpl.cpp
2 #include "classheader.hpp"
3 double something::dosomething(int i,char c) {
4   return 1.5d;
5 }
```

9. File naming convention

- Source files: `.cpp` `.cxx`
  I use `.cpp` for no real reason
- Header files: `.h` `.hpp` `.hxx`
  I use `.hpp` by analogy with `.cpp`
  `.h` reminds me too much of C.

10. Compiling and linking

Your regular compile line

```
icpc -o yourprogram yourfile.cc
```

actually does two things: compilation, and linking. You can do those separately:

1. First you compile

   ```
   icpc -c yourfile.cc
   ```

   which gives you a file `yourfile.o`, a so-called object file; and
2. Then you use the compiler as linker to give you the executable file:

   ```
   icpc -o yourprogram yourfile.o
   ```

11. Dealing with multiple files

Compile each file separately, then link:

```
icpc -c mainfile.cc
icpc -c functionfile.cc
icpc -o yourprogram mainfile.o functionfile.o
```

12. Header file with include guard

Header file tests if it has already been included:

```
// this is foo.h
#ifndef FOO_H
#define FOO_H

// the things that you want to include

#endif
```

This prevents double or recursive inclusion.

13. Make

Good idea to learn the `Make` utility for project management.

(Also `Cmake`.)

14. Skeleton example

Directory `skeletons/funct_skeleton` contains

```
funct.cpp functheader.hpp functmain.cpp
```

CMake setup:

```
add_executable(
    funct functmain.cpp funct.cpp functheader.hpp )
```

15. CMake compilation

Do `cmake` and then `make`:

```
[ 33%] Building CXX object CMakeFiles/funct.dir/functmain.cpp.o
[ 66%] Building CXX object CMakeFiles/funct.dir/funct.cpp.o
[100%] Linking CXX executable funct
[100%] Built target funct
```

16. Justification for separate compilation

- Edit only `funct.cpp`;
- Do *not* `cmake`;
- do `make`

```
( cd build && make )
Consolidate compiler generated dependencies of target funct
[ 33%] Building CXX object CMakeFiles/funct.dir/funct.cpp.o
[ 66%] Linking CXX executable funct
[100%] Built target funct
```

Only that file got recompiled.