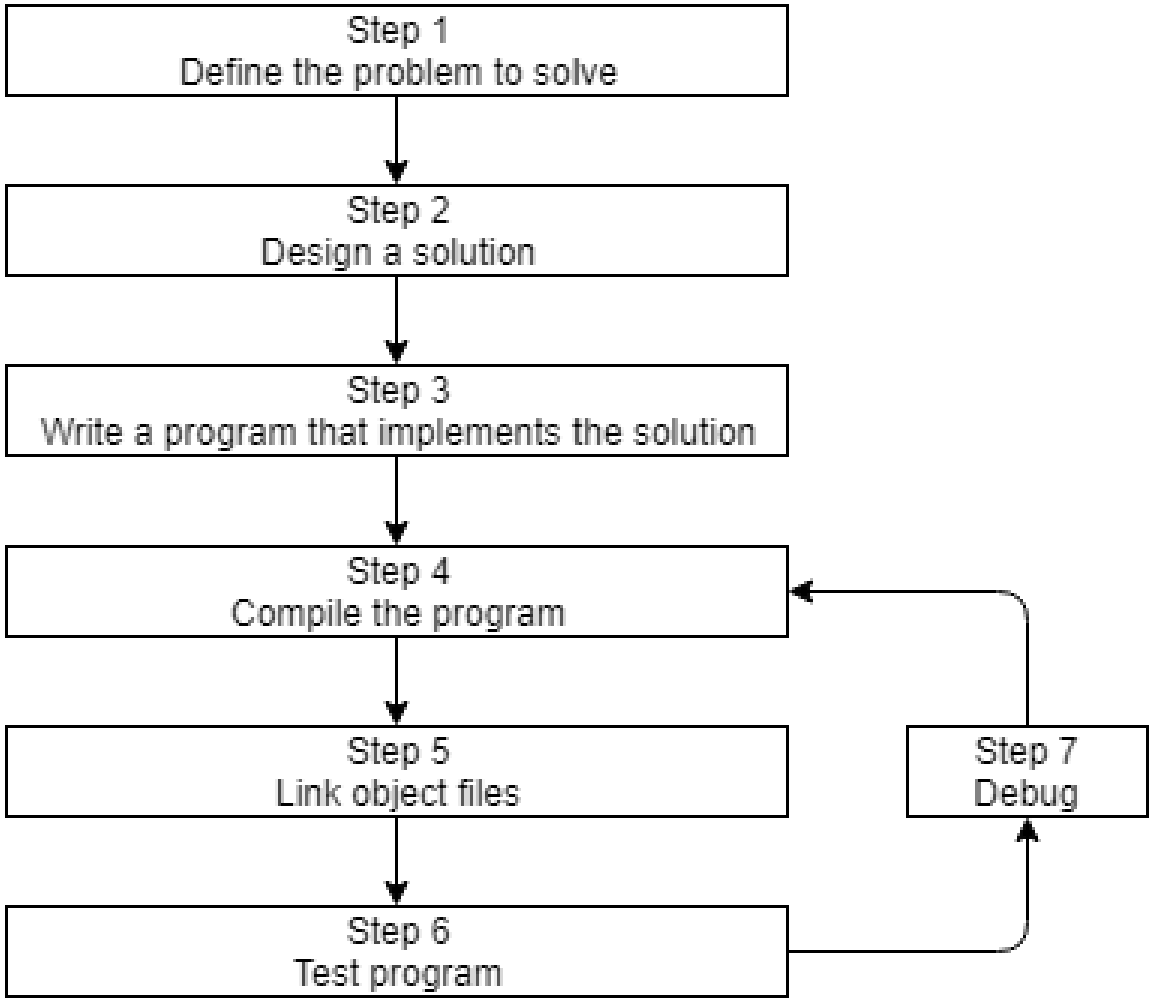
Programming Languages and Tools: Programming with C++ CS:3210:0003

Lecture/Lab #14

Developing C++ Programs



Compile and Link

- Compilation:
  1. Check syntax
  2. Convert C++ code -> machine language instructions
     .cpp File -> .o Object File
- Linking:
  1. Resolve dependencies between files
  2. Resolve library (packaged precompiled) files
     - C++ standard libraries (iostream, etc.)
     - Other libraries
- Building: source code -> executable (binary)

Compile and Link

- `g++ file.cpp -o file.bin`
  - compiles `file.cpp`,
  - links included libraries,
  - creates binary `file.bin`
- `g++ -c file.cpp`
  - compiles `file.cpp` to object code file `file.o`
- `g++ -o file.bin file.o`
  - links included libraries to binary `file.bin`

Separate Compilation

- To compile multiple files, use g++ with multiple arguments:
  `g++ file1.cpp … filen.cpp –o binname.bin`
- Compiler doesn't remember definitions from `filei.cpp` while compiling `filej.cpp`
- Forward declarations work across files compiled together

Activity

- Create a folder `workspace/calc`
- Copy `prob8.cpp` from `class/homeworks/hw1/solutions/` to `workspace/calc/`
- Separate `prob8.cpp` into 3 files and compile to `calc.bin`:
  1. `menu.cpp` will contain the `Menu` function
  2. `choice.cpp` will contain the `Choice` function
  3. `main.cpp` will contain `main()`

Activity

- Create a folder `workspace/bin`
- Copy `prob3.cpp` from `class/homeworks/hw2/solutions/` to `workspace/bin/`
- Separate `prob3.cpp` into 3 files and compile to bin`.bin`:
  1. `binio.cpp` will contain the `inputint()` and `printBin()` and any helper functions
  2. `conv.cpp` will contain the `dec2Bin()` and `bin2Dec()` and any helper functions
  3. `menu.cpp` will contain `menu()` and the functions to perform the menu ops
  4. `main.cpp` will contain `main()`

Header Files

- Store and propagate declarations to code in `.cpp` files.
  - Ex: `iostream` stores declaration of `std::cout`
- Extension: `.h`
- Header files:
  1. Header guard
  2. Declarations
- To access header files (don't compile them):

  `#include "headerName.h"`
- Definitions go in corresponding `.cpp` file

Header Files

- Include header files in corresponding implementation files
  - Because compilers can usually check whether the types match
- Preprocessor replaces `#include<header>` by contents of header
- Don’t define functions inside header files
  - If you do, linker will have to deal with multiple definitions

- Tell the preprocessor where to look
  1. `#include <headerName>` looks in `include directories`
  2. `#include “headerName”` looks locally first, then in `include directories`

The One Definition Rule (ODR)

- Within the same scope, an entity (function/variable/type) can have only one definition
- This applies across multiple files if they are compiled together

- If violated, compiler error
- Harder to fix with included files
- Don’t `#include .cpp` files
  - Instead compile them

Activity

- Create a folder `workspace/bin2` (by copying `workspace/bin`)
- Move all declarations to header files, `#include` the right header files in each file, and compile to bin `.bin`:
  1. `binio.cpp` will contain definitions of `inputint()` and `printBin()` and any helper functions, and `binio.h` the declarations
  2. `conv.cpp` will contain definitions of `dec2Bin()` and `bin2Dec()` and any helper functions and `conv.h` the declarations
  3. `menu.cpp` will contain `menu()` and functions to perform the menu ops and `menu.h` the declarations
  4. `main.cpp` will contain `main()`