Toward a Design/Programming Methodology

- Although you must write code, you shouldn't be thinking about code when you first start thinking about solving a problem
  - Analysis, Design, Implementation, but spiral through them, don’t use the “waterfall” model
- Analysis: investigation of problem, not a solution — for 108 problems there is little/no analysis, but for open-ended problems in business there are lots of people to talk to, issues to investigate
  - Deliver a set of requirements as the outcome of the analysis
- Design: Logical OO objects that help realize a solution to the problem
  - concentrate on classes and behavior, not on state
  - eventually will need to get to state, but not at first

Use Cases: From Analysis to Design

- How will someone use the program? What are typical scenarios?
  - Users have different roles, outside entities interact with the program, but also objects within the program interact with other objects
  - Give scenarios a description and provide a paragraph that describes the user/system interactions
- Use cases/scenarios can be done formally or informally, but you need to think about how the system works
  - From use case proceed to design of classes
  - Nouns are classes, verbs are methods/member functions
  - Brainstorm, throw things out, revisit analysis, get to state only at the end
Example: WOOFII in action

- How does user interact with system? Are there any issues in terms of user expectations of the system? Why?
  - Fast or small?
  - Possible additions to the system?
- Is it worth thinking about this from an OO viewpoint or is this main, two functions, and that's it
  - Suppose you have a class `WordsInaFile`, can this be used if specs change to do words in all files in a directory?
    - `WordCollection` vs. `WordsInaFile`
    - Operations on `WordCollection` objects?
- Should the `readFile` method sort objects? Why?
- Alternatives?

WOOFII classes (and maybe KWIC classes)

- Similarities/Differences
  - Is a word a string?
  - Time vs. space
  - What about repeated words on a line in both programs

- Keep in mind
  - Open/Closed principle, extend but don’t modify
  - Coupling and Cohesion, each function/class captures one abstraction, minimal coupling between functions/classes
  - Test each class outside of the main application
  - Document design decisions as they happen rather than after the fact
C++ idioms

- Consider `Date`, `DirStream`, `DirEntry`, what happens with
  - `x = y;`
  - assignment is memberwise unless operator = overloaded
  - copy constructor used in passing parameters by value
- If you need one of: destructor, assignment operator, copy constructor, you need all of them
  - heuristic only: managing resources other than memory
  - preventing objects from being copied
  - what about non-copyable state, e.g., stream
- In assignment operator, watch for self-assignment

Assignment and C++

- Copy constructor used to construct a variable that has never before existed
  - no need to check self-assignment
  - use initializer lists
  - parameter is const-reference object, sometimes non-const needed as well
- Assignment operator gives new value to existing object
  - check for self-assignment
  - clean up old resources when allocating new ones
  - Not used in `Foo x = y;`
- Both can be disabled by making methods private
**Destructors in C++**

- Destructors clean up resources allocated by an object
  - Objects/variables on the stack are destructed automatically when they go out of scope
  - Objects allocated on the heap are destructed when the `delete` operator is called
- It’s nice not to worry about reclaiming storage, easy to get wrong
  ```cpp
delete p; //if p is NULL? Points to stack object?
```
  - Java has automatic garbage collection, your C++ programs can have this too
    - commercial/free products
    - never delete anything, don’t implement destructors
- Who is responsible for deletion?
  - Creator or benefactor? What about singleton?

**The code doesn’t run**

- Test classes in isolation, not as part of the complete program
  - each class should (ideally) have its own test suite
  - day.cpp, testday.cpp, wagreader.cpp, testwagreader.cpp,...
- Use the debugger: `gdb`, `ddd`
  - debugger is much faster than edit/compile/debug
  - important for pointers to find out where the problem is
  - run, break at, where, step (into), next (statement)
- Never define a variable, especially a pointer, without giving it a value
- Ask questions of prof, TA, UTA, each other
- Post salient parts of problem, not “my code doesn’t work”