

Lab 5

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This should be a group project. Each group should contain one or two “experts,” a beginner, and as many intermediates as appropriate.

Project 1

For Beginners

You are the “faculty member” for this project. Meet with “intermediate” and “advanced” programmers to discuss your requirements. Be clear about what you want in the testing program. (Different tests for each student? Or for just a class? How to grade?)

While your “consultants” work, go back to earlier exercises and work on improving programs you have already written. Be available to answer their questions. When they are ready, work with them to test their code and be sure it meets your needs.

For Intermediates

You will be the “programming staff” who will work to implement the requirements. Consult with the “client” and the “senior programmer” to work out the data structures.

For Experts

You are the senior programmer on this project. You are in charge of the overall architecture and data structures. Communicate to your “team” the outline the program and work with them to implement it.

A faculty member in the astronomy department has asked you to write a program for him to generate final exams for his introductory class. He provides you with the file testbank.txt which you can find in Resources/Data.

You are to write a program to randomly draw 25 questions from the test bank, then to scramble the multiple-choice answers. The answer choices will be written in the usual format of A, B, C, D, E. The program should also be able to grade the resulting exams.

Develop a document describing the functional requirements of the program.

Describe the design of your program. This should specify the data structures you have chosen to manipulate the data. Also describe any modules or classes you will write.

Describe the outputs and how they will be used when the program is in use.

Design a set of unit tests for the program. Note: you will need to “take” some of the generated tests in order to test the grading capabilities. You do not need to know anything about astronomy since the first answer (numbered 0) in the master file is always correct. Explain how your testing procedure will work.

Write and test the program.

Check your program into SourceTree when you first start and be sure to commit all changes as you go.

Project 2

Exchange your test-generating program with another “team member”. Conduct a code review of each other’s code.

Project 3

Please read all instructions before beginning.

Standard chemical formulas order the elements in increasing electronegativity, e.g. HCl, CaCO₃. Another method called the Hill system: carbon first, followed by hydrogen if present, followed by the other elements in alphabetical order. If the molecule has no carbon then all the elements, including H, are listed in alphabetical order. The Hill system is widely used for chemical databases.

Design and implement a program to convert a formula in one system into the other.

You will need at least three classes and possibly more (depending on your language and design). Create a class `Element` that contains the attributes `Name`, `Symbol`, and `Atomic Number`. The `Element` class should have a method `print_element` to print the chemical symbol given the atomic number. (Python: you may call this `__str__` if you wish)

From the `Element` class derive a class `Atom` that extends `Element` with atomic mass and the value of the Pauling electronegativity. This class should overload addition (+) such that the “sum” of two atoms is the sum of their atomic masses. (Ignore any issues of mass deficit.)

Design a class `Molecule` that will use the `Atom` class. Suggestion: `Molecule` can be an array or list of `Atoms`. `Molecule` will contain the methods to convert standard (electronegativity) ordering to Hill ordering and vice versa. It will also have methods to compute and to print the weight of the molecule in Daltons.

We will not try to deal with subscripts so the digit indicating repeats will follow the elemental symbol. Your program does not have to handle formulas with parentheses. Feel free to try to permit them. If you do not allow parentheses be sure to reject the formula with an appropriate message.

The data required are in the file `PeriodicTable.csv` file in `Resources/Data`. Chemists will note that the atomic mass is only for the most abundant isotope. This is adequate for our purposes.

Test your code. Use at least

NaCl
CaCO3
NH4MnO4
C12H22O11