**CS 4500, Spring 2018**

*HW3: Extend HW #2 by exploring a 5 X 5 redistricting scheme with respect to geography*

HW3 is an *individual* assignment. You are NOT to get help from classmates, roommates, or paid programmers. If you turn in something you didn’t program yourself and I find that out, you will flunk this assignment with no opportunity for makeup. If you are a discovered plagiarist twice in this class, you flunk the class. It is, after all, partly a class about ethical professionalism.

If you have questions about HW3, ask the instructor. You may look for general programming advice from websites, BUT YOU MUST LIST ALL THE URLs THAT YOU VISIT FOR THAT ADVICE. Being a quality professional includes always giving credit where credit is due.

The program you are will submit will be run using the Python 3.6.4 interpreter. You can download Python, and get much information about it, at <https://www.python.org/>. They have loads of documentation and aids at <https://www.python.org/doc/> .

If you use any of the code from any of these sources, or from any OTHER source, you MUST include a citation to the URL in your opening comments of your program, and you must indicate in an internal comment where you used the code. This may be unusual for you, but it is required in CS 4500, for reasons that should become clearer later in the semester. For now, just do it.

The structure of all software you write for this course should follow the following “recipe.”

1. Opening comment: This should contain your name, the date, the title of our course, version of your software, description of the purpose of the software, any external files involved with the software, and information about any sources you used while writing the software. (The sources could include websites, as described above, people who helped you, or documents important to the development.)
2. Internal comments: include paragraphing comments for major chunks of your code. Include extra comments for anything a reader might find to be “tricky” or non-intuitive. For any functions, describe any global variables (including files) used in the function. Describe in comments what the function is supposed to do, what any parameters are for, and what is returned (including nothing if that’s appropriate).
3. Use good habits for writing easy-to-read Python code. Be careful with variable names, white space, and indentation. (Indentation is especially important in Python.) Using functions to decompose your problem solving.

A, B, and C will be graded for all of your assignments. You are likely to be annoyed when you lose points for this. Please remember, I warned you. You may be surprised how much I value good documentation and structure. Let me explain.

Most programmers who do this work for a living eventually get things to run; that’s not really separates good software professionals from mediocre software professionals. The best software professionals are efficient problem solvers, good technical writers, good teammates, and decent people with integrity. Good documentation is, in my humble opinion, the mark of a quality software professional. I will insist on good documentation for everything you submit for CS 4500. Although my opinion may be humble, it will be part (though not all) of the grading process in this course.

**Grading Rubric:**

This assignment is worth 50 points. Here are the questions I will ask while assigning you a grade:

1. Was your program turned in before the deadline?
2. Did your program follow the specification EXACTLY?
3. Does your program work as specified on the tests to which I subject it?
4. Did you include sufficient and high quality documentation in your source code?
5. Are all sources used in developing the code explicitly cited in the program?

For HW #3, extend your work on HW #2 with redistricting schemes and the following set of 25 voters:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| P | G | G | G | G |
| G | P | P | P | G |
| G | P | G | G | G |
| G | G | G | P | P |
| P | G | P | G | P |

There are 15 green voters, and 10 purple voters, a 60-40 split. We assume that in each election, there is one green candidate and one purple candidate in each district, and that green voters always vote for the green candidate, and purple voters always vote for the purple candidate. The 25 voters are to be split into 5 districts with 5 voters in each district.

When you break a set (in our case, 25 voters) into subsets (in our case, 5 districts) such that each item in the original set appears once and only once in one of the districts, it is called a “partition” of the original set. We will restrict our attention to districts that have an equal number of voters in each (in our case, 5 voters in each district). Even with these restrictions, there are 623360743125120 such partitions. I will call each possible partition of these voters into 5 districts a “redistricting scheme.”

It can make a dramatic difference in the outcome of an election how the districts are formed. I showed you in class three different schemes; in one, green won 3; in another, green won 5; in the third scheme, green won 2. (When green wins g districts, purple wins (5-g) districts.)

Your program should use this information to randomly generate 1 million redistricting schemes, and keep track of any information you think the ethicist might find interesting. Unlike HW #2, in HW #3 we care about the contiguity of each redistricting scheme. For each random redistricting scheme, check whether it is contiguous. If it is contiguous, then capture statistics an ethicist may find interesting. Some ideas for statistics are:

* How often are all 5 districts contiguous?
* How many total contiguous redistricting schemes were generated?
* What are the results of each contiguous redistricting? (These statistics will be similar to those on HW #2)

Keep in mind, you may have to generate on the order of 10 million random redistricting schemes to see a statistically significant number of contiguous redistricting schemes. 100 contiguous schemes is ideal, and under 10 is not enough. Use your best judgment on a number in between.

The information you generate for the ethicist should be displayed on the screen when you program is run, and that same information should also be written to a text file. The text file should reside in the same directory as the program file that is running. The name of that textfile should be the last thing your program writes to the screen just before finishing.

**Bonus:** Explore equivalence preserving transformations of contiguous district schemes. In other words, is there some transformation you can apply to the contiguous district scheme that preserves it’s contiguity?