CMPS 2200 Recitation 01

In this recitation, we will investigate asymptotic complexity.

Some prompts will require you to edit `main.py` and others will require answers will go in `answers.md`.

Refer back to the README.md for instruction on git, how to test your code, and how to submit properly to get all the points you've earned.

Comparing search algorithms

In this lab, we'll compare the running times of `linear_search` and `binary_search` empirically.

1. In `main.py`, the implementation of `linear_search` is already complete. Your task is to implement `binary_search`. Implement a recursive solution using the helper function `_binary_search`.
2. Test that your function is correct by calling from the command-line `pytest main.py::test_binary_search`
3. Write at least two additional test cases in `test_binary_search` and confirm they pass.
4. Describe the worst case input value of `key` for `linear_search`? for `binary_search`?

   Enter your answer in answers.md
5. Describe the best case input value of `key` for `linear_search`? for `binary_search`?

   Enter your answer in answers.md
6. Complete the `time_search` function to compute the running time of a search function. Note that this is an example of a "higher order" function, since one of its parameters is another function.
7. Complete the `compare_search` function to compare the running times of linear search and binary search. Confirm the implementation by running `pytest main.py::test_compare_search`, which contains some simple checks.
8. Call `print_results(compare_search())` and paste the results here:

   Enter your answer in answers.md
9. The theoretical worst-case running time of linear search is $O(n)$ and binary search is $O(log_2(n))$. Do these theoretical running times match your empirical results? Why or why not?

   Enter your answer in answers.md
10. Binary search assumes the input list is already sorted. Assume it takes $\Theta(n^2)$ time to sort a list of length n. Suppose you know ahead of time that you will search the same list k times.

- What is worst-case complexity of searching a list of n elements k times using linear search?

  Enter your answer in answers.md
- For binary search?

  Enter your answer in answers.md
- For what values of k is it more efficient to first sort and then use binary search versus just using linear search without sorting?

  Enter your answer in answers.md