

Lab 16: Recursion

Part 0: Clone the Repo

Again, since the numbering is a bit weird, you'll find the repo at

```
git clone https://github.com/physics91si/username-recursion.git recursion
```

Part 1: Fibonacci with cache

Remember the Fibonacci sequence from Lab 2? Of course you do: $\text{fib}(n) = \text{fib}(n-1) + \text{fib}(n-2)$, and $\text{fib}(0) = 0$ and $\text{fib}(1) = 1$. Now we'll implement it more efficiently, using a cache.

To compare, you can write out our old-fashioned fibonacci function real fast. You'll see that a number as low as, say, $\text{fib}(40)$ will make your computer have to think quite a bit. But since we know most of the "thinking" is just recalculating the same results over and over again, we can speed it up dramatically if we store intermediate results in a cache. **Your task is to write an efficient fibonacci function with a cache.** You can implement the cache as a global dictionary.

If you play around with this function, you'll note that it works quite fast, until your inputs give you

```
RuntimeError: maximum recursion depth exceeded in comparison
```

Python actually lets you change the maximum recursion depth. For example,

```
import sys
sys.setrecursionlimit(5000000)
```

But you should be careful, because for every level of recursive call, it takes up a little more space in memory.

Once you get deep enough, you'll start getting segfaults, and in this context, it usually means that the program should be rewritten with a while-loop.

Part 2: Levenshtein Distance

The Levenshtein distance is a metric for determining how different two words are, in terms of the minimum number of changes we need to take one word from the other, where a change is defined as a single character insertion, deletion, or substitution. For example,

- $\text{lev}(\text{"armchair"}, \text{"armhair"}) == 1$ because we make one change: delete **c**.
- $\text{lev}(\text{"physics"}, \text{"psychics"}) == 3$ because we make three changes: substitute **h**->**s**, substitute **s**->**c**, then insert **h**.

Your task is to write the recursive function $\text{lev}()$.

Hint: You can express the Levenshtein distance between two strings in terms of the Levenshtein distance between the strings with the last letter chopped off of one or both of them.