COMPUTER SCIENCE

LESSON 22+24, TUESDAY NOV 28ST + THURSDAY NOV 30TH

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THIS WEEK IN CS AND STEM

- A computerized clinician? The Chinese AI Xiaoyi passes the nation's medical licensing exam with 96 points over the required score
  - https://futurism.com/first-time-robot-passed-medical-licensing-exam/
- This is where we start screaming. Maybe genetic mods aren't that far off afterall, but perhaps 3rd eyes should remain spiritual.
  - https://futurism.com/genetically-modified-beetles-grew-fully-functional-third-eye/

ASSIGNMENT 7 SOLUTION

RECURSIVE FUNCTIONS

- What is a recursive function?
  - A function that depends on previous calls of itself, or rather a result from a prior iteration.
  - Take the factorial function for example. You can either make it ITERATIVE or RECURSIVE
- How do recursive functions run? What does the implementation look like?
- When would you use a recursive function as opposed to an iterative one?

RECURSIVE FUNCTIONS

- What could be some pitfalls in recursive functions?
  - If the base case is missing (ie. the recursive function just keeps going forever in an infinite loop)
  - When the recursion step doesn't reduce to a smaller subproblem (ie. the program does not converge)
  - It takes too long, ie. much longer than the iterative function

WRITING RECURSIVE FUNCTIONS

- Let's try a few more examples for recursive functions:
  - Greatest common divisor (gcd)
  - The sum of the first n natural numbers
  - Towers of Hanoi (a mind-game. It goes something like this: "There are three pegs which can hold stacks of disks of different diameters. A larger disk may never be stacked on top of a smaller. Starting with *n* disks on one peg, they must be moved to another peg one at a time. What is the smallest number of steps to move the stack?"
    - Hanoi(n) = 1 if n=1, 2*Hanoi(n-1)+1 if n>1

HOW COULD WE MAKE RECURSIVE FUNCTIONS MORE EFFICIENT?

- The main problem with recursive functions is that they tend to overcalculate - or rather they calculate the same thing multiple times (think of the Fibonacci function!)
- What if we could hold the values and prevent the function from overcalculating? Can you think of a way to do that with the tools we already have?

DICTIONARIES

- This is a whole new kind of data structure called a set. It looks like a list, but there are some major differences.
- Dictionaries can be indexed by ANYTHING – not just integers. These variables are called *keys*. It is also defined using curly braces, not brackets or parentheses.
  - Try it out in the jupyter notebook “Lecture22_23_Sets_Dictionaries.ipynb”

IMPROVING YOUR RECURSIVE FUNCTIONS

- Now let's return to the functions you've made and include an updating dictionary to prevent over-calculating. What would this look like?

- Can you do the same thing with another data type? Do you notice a difference in computation time between them? Which is more efficient?

ASSIGNMENT #8

- Not an actual assignment. I've posted a review list for the mid-year exam on Dec 21 – what I suggest you do this week is go over it and collect/organize your materials. Compose a list of ideas or concepts that you don't understand well or need to work harder on so you can start on those early.
- Remember you can discuss any difficulties in the course with me and with your fellow students!
- The week of Dec 12 + 14 will be our review week, you should have a list of items to discuss prepared by Dec 3rd and submitted to me by 11:59pm that same day. It can be a short or long list, bullet points or descriptions, but it should have at least 1 entry of what you would like to see during the review week.

REFERENCES

- http://web.mit.edu/6.005/www/fa15/classes/10-recursion/
- https://www.python-course.eu/recursive_functions.php
- https://docs.python.org/3/tutorial/datastructures.html

UPCOMING LECTURES

- ROM Speaks Dec 4th, 5th : Canada's Oceans, Towards 2020
  - https://www.rom.on.ca/en/whats-on/canadas-oceans-towards-2020?utm_medium=email&utm_source=engagingnetworks&utm_campaign=CanadaOceans&utm_content=Canada+Oceans
- AstroTours Dec 7th : Gravitational Waves, Sirens of the Universe
  - http://www.astro.utoronto.ca/astrotours/?page_id=392