Assignment #2 –
Pre-HW2 (Part 1) Due Monday, April 18th 2022 at 11:59 pm
HW2 (Part 2) Due Monday, April 25th 2022 at 11:59 pm

Assignment Overview and Outcomes
The focus of this homework is on how to solve simple problems using programming language asking for user input, loading a data set, creating arrays and lists, and using loops to preform your computations on the dataset. At the end of this project, you will:

- Develop a program to read data from user input and produce data to the standard output.
- Develop a program to read in a dataset, translate a given mathematical expression to syntactically correct programming statements, and loop over the dataset to perform the mathematical operations.
- Write a program that conforms to a programming style specified by the instructor.

Be sure to properly document the program. Consult the class Programming Style Guidelines document (provided by the instructor) for style expectations. A well-written program is easier to debug, easier to maintain over time, and easier to extend as new requirements arise.

Sustainability Motivation
The United Nations (UN) has set forth 17 goals for sustainable development. Goal 7 is designed to "Ensure access to affordable, reliable, sustainable and modern energy for all". Access to energy resources is necessary for quality of life, including jobs, agriculture, and climate-related issues. Energy resources includes electricity as well as access to clean, renewable fuels and the technologies for harnessing and distributing energy. There are a number of renewable, clean energy sources available. In this project, we will consider hydro power as a renewable energy source.

Hydropower Technology Background
Hydropower, otherwise known as hydroelectric power, offers a number of advantages to the communities that they serve. Hydropower and pumped storage continue to play a crucial role in our fight against climate change by providing essential power, storage, and flexibility services. Hydropower is a renewable source of energy. The energy generated through hydropower relies on the water cycle, which is driven by the sun, making it renewable.
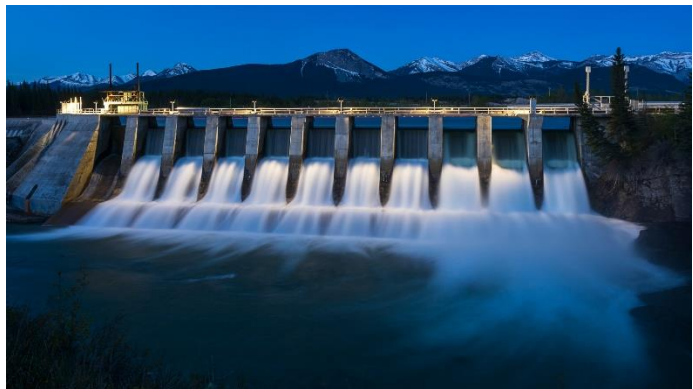
Hydropower is fueled by water, making it a clean source of energy. Hydroelectric power is a domestic source of energy, allowing each state to produce its own energy without being reliant on international fuel sources. Hydropower provides benefits beyond electricity generation by providing flood control, irrigation support, and clean drinking water. However, it is important to note that building dams has its tradeoffs – it does cut off habitat access and sediment supply through the river system which have implications of coastal erosion and consequences to fish population dynamics.
https://www.energy.gov/eere/water/benefits-hydropower

Watch this short video about hydropower showing both the benefits and the drawbacks (link).

Calculate the Energy consumed from hydroelectric power and how it has changed through time around the world:

Program to Write and Expected output:
Your program will compute:
1. the total increase in world power generation from year 2000 to year 2021.
2. the fraction of total world energy produced from hydroelectric power in 2000 and 2021, and the change between year 2000 to year 2021.
3. the fraction of total world energy produced from two other power sources of your choice (e.g. solar, wind, bio., nuclear, coal, gas) in 2000 and 2021, and the change between year 2000 to year 2021.

You will be given a dataset that has the following for the world from 2000 to 2021:

World	Year	Energy source: Clean* vs Fossil** Broken down by energy source: *Clean is composed of Bioenergy, Hydro, Nuclear, Other Renewable, Solar, Wind **Fossil is composed of Coal, Gas, Other Fossil	Generation in terawatt-hours

Instructions:
To perform your computation, you will need to think about how to break the dataset down into manageable pieces and what types of things you will need to help the computer to identify in order to perform your computation.

You will need to **read** the dataset into Python.

You will need to perform your computation of hydro-power and another power type by asking for the User of your program for **input** from a **list** of power type options they can choose from.

You will be using **if** statements - if statements help you to identify one string from another.

You will be using a **for** loop - a for loop will help you to move through the dataset line-by-line and allocate the data into an **array**.

You will **print** out a statement to the user telling them that total world power consumption in 2000 was ___ terawatt-hours and in 2021 the consumption has increased to ___ terawatt-hours. That means world power generation has increased by ___% over the past 20 years.

You will **print** a statement out to the user telling them that in year 2000 ___% of world energy came from hydropower (or other depending on user input) and in 2021 ___% of world energy came from hydropower (or other depending on user input).

Even though your output will be for computations between the year 2000 and 2021, your program should be designed to handle computations for any combination of years. This means that you should not write any of the numbers directly into your print statements (i.e., do not hardcode any numbers in your program output), instead print out the variable where the number is stored.

Pre-HW, Part 1 (30 pts): First, you will begin by going through Polya's problem-solving steps. Use the Polya template provided to assist with this step.

Turn the Pre-HW Part 1 into Canvas with the following questions answered.

Understanding the Problem. (10 pts)
- Do you understand everything in the problem? List anything you do not fully understand.
- What are the functional requirements of the program, i.e. what does it need to do?
- What assumptions are you making?
- What are the inputs, outputs, etc.?

Devise a Plan. (20 pts)
- What are the decisions that need to be made in this program?
- What are the sequence of steps you need to complete? Expand the list provided above as much as possible.
- How are you going to calculate the power use due % and the total power used by the world?
- What happens if the user gives you a statement that is not in your list? How are you going to handle bad input?
- Based on your answers, provide an algorithm as pseudocode or provide a flowchart of the specific steps that are needed to create this program, including error checking. Be very explicit!
- Label your algorithm or flowchart with relevant terms from the ENGR103_Concept_Definitions document on canvas.
- What do you expect from your results?
- What other errors do you anticipate?

HW Part 2 (70 pts): Clone the GitHub assignment, write your program, and push back to GitHub
Write a program to obtain user input and perform the computations using the ALL of the bolded commands in the description above. Then provide a brief perspective about how world power generation has changed over the past 20 years from your perspective. What source of power are we now using more of? What source are we now using less of? Is this sustainable?

Example case to test your program:

Test case	Program Output
Hydroelectric power change between 2020 and 2021	The total world power consumption in 2000 was 14978 terawatt-hours and in 2021 the consumption has increased to 27549 terawatt-hours. That means world power generation has increased by 84% over the past 20 years. In year 2000 17.5% of world energy came from hydropower, and in 2021 15.2% of world energy came from hydropower.

Remember: You only need to perform your computations between years 2000 and 2021. You do not need to do a computation for each year in the dataset (you can if you want to, but it is not required!)

Turn the HW Part 2 into GitHub with the following:
Upload to GitHub your .py file and a .pdf of your output from your program for the hydroelectric test case and the two other cases you try as well as your perspective about world power generation change over the past 20 years. Follow the format of the example output from the "Example case to test your program" section for each power source that you try.

Your .py file should have proper headings/formatting and commenting!
In your .pdf you should have a table that looks like this:

Case	Program Output
Hydroelectric power change between 2020 and 2021	The total world power consumption in 2000 was 14978 terawatt-hours and in 2021 the consumption has increased to 27549 terawatt-hours. That means world power generation has increased by 84% over the past 20 years. In year 2000 17.5% of world energy came from hydropower, and in 2021 15.2% of world energy came from hydropower.
Other energy source	Your output
Other energy source	Your output

Your perspective about world power generation change over the past 20 years. What source of power are we now using more of? What source are we now using less of? Is this sustainable?

Points:
Cloning from and committing/pushing to GitHub → 6 points
Commands (read, input, list, array, if, for, print) you use correctly are worth 7 points each. → 49 points
Properly using mathematical operations → 5 points
Properly commenting your code → 5 points
Your thoughtful analysis about how power generation has changed over the past 20 years → 5 points