ME397 Homework set #3

Due: 2023-04-17 at **5:00pm**

READ TASK 2 BEFORE WORKING ON TASK 1.

Instructions: You will turn in one (1) python/pyomo script and invite me to your GitHub repository from Task 2. For example, if I were to be turning in this homework, I would turn in files with the following names:

RHODES_HWK_3_OPT.py

And invite the teacher to be a collaborator on:

https://github.com/joshdr83/RHODES_ME397_HWK3

You are not allowed to work in teams, but you can use the entire internet or any other non-person resource to figure it out. You should first create a virtual environment that has pyomo installed to work in before you begin.

1. **(150 points)** In class on 3/29/2023 we went over optimization in pyomo, including a pyomo script that optimized how much solar and energy storage you would need to put out a constant demand. For your homework, you will edit that script to estimate the lowest cost mix of how much wind, solar, and energy storage would be required to run the entirety of ERCOT in 2022.

   ERCOT demand is generally measured in GW, which is 1,000,000 times larger than the kW used in the example problem, so you should update your assumptions like the below (generally just multiplied by 1,000,000). Note that we are also adding wind and assuming that it cost about $1.2B/GW to build it.

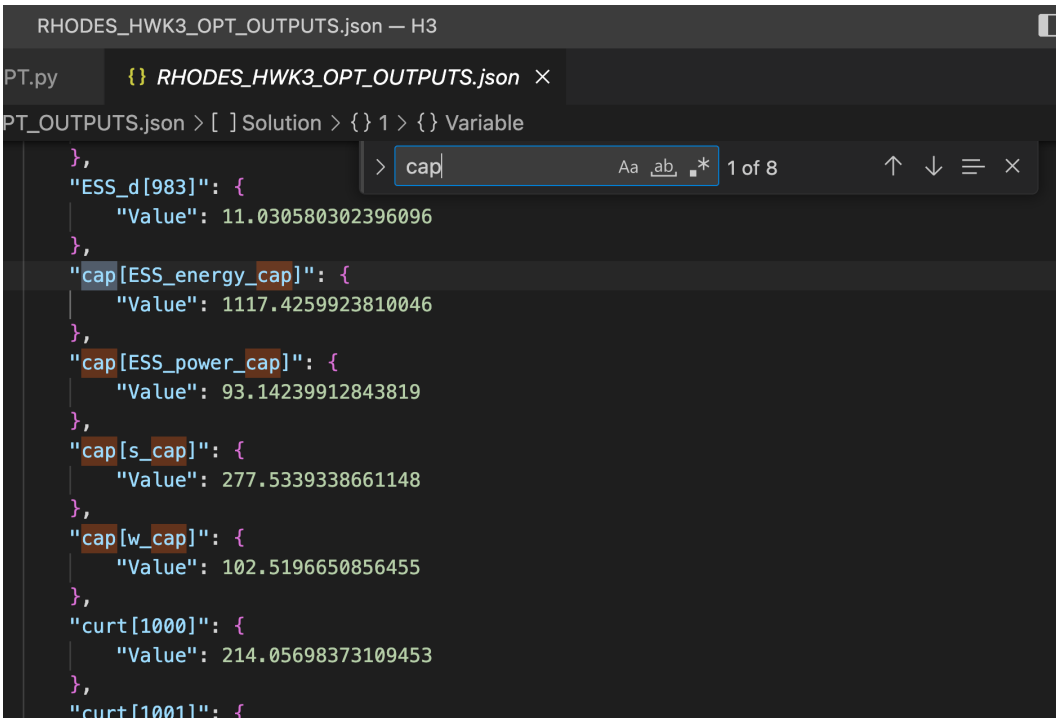
   Also, instead of assuming that demand is a constant like in the example, the included data file also has a column ERCOT's 2022 demand that you will need to use.

```
## constants and assumptions
# capital costs for solar, and energy storage systems
solar_cap_cost          = 800000000       # $/GW
wind_cap_cost           = 1200000000      # $/GW
ESS_p_cap_cost          = 200000000       # $/GW
ESS_e_cap_cost          = 150000000       # $/GWh

# energy storage operational assumptions
ESS_min_level           = 0.20      # %, minimum level of discharge of the battery
ESS_eta_c               = 0.95      # ESS charging efficiency, looses 5% when charging
ESS_eta_d               = 0.9       # ESS discharging efficiency, looses 10% when discharging
ESS_p_var_cost          = 5000     # ESS discharge cost $/GWh

curtailment_cost        = 1000     # curtailment penalty $/GWh
```

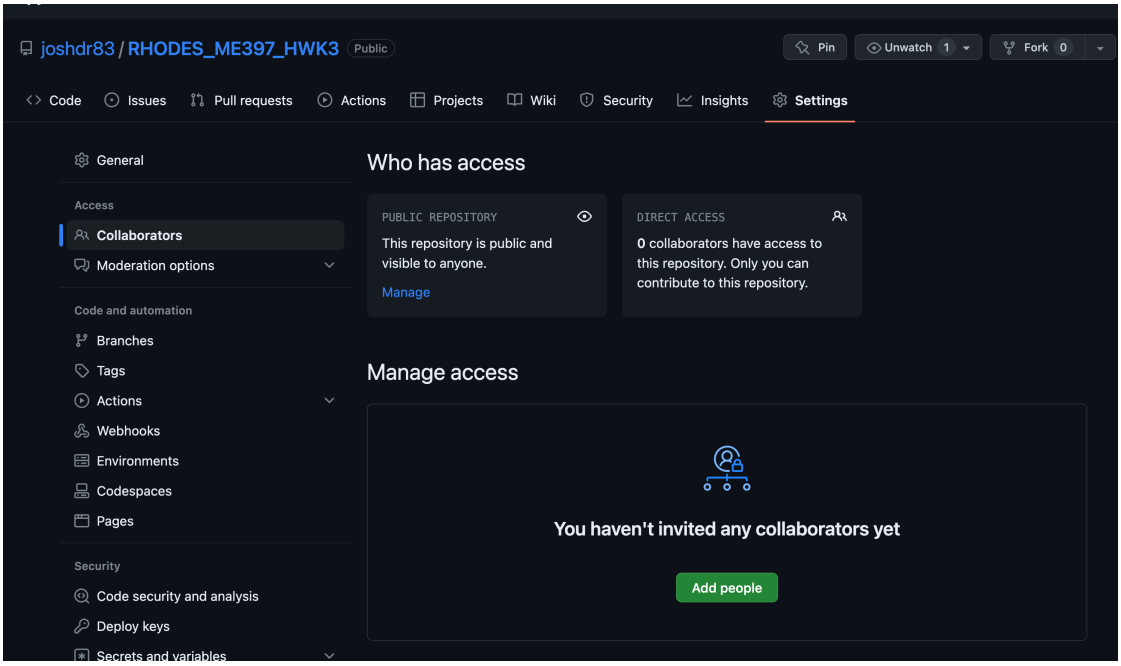
Your input data will be in a file called “2022_ERCOT_data.csv” in a folder called “opt_model_data” that will be in the same directory as your pyomo script. It will be similar to the setup for the example problem from the lecture.

```
data = DataPortal()
data.load(filename = 'opt_model_data/2022_ERCOT_data.csv', se
```

When I run the script that looks to find the least-cost mix of wind, solar, and energy storage to meet all of ERCOT’s 2022 demand my solution comes out to 102 GW of wind, 277 GW of solar, 93 GW of energy storage power capacity, and 1,117 GWh of energy storage energy capacity, see screenshot below for my outputs file showing the optimal capacities.



2. **(150 points)** I would like you to create and use a **public** GitHub repository to keep track of the changes you make to Task 1. All you need to do is push at least three changes (more is fine) to your GitHub repository as you work on Task 1. You will just invite me to collaborate on your repository **when you are finished**.



For example, my history for the Task 1 looks like: