Term Project

Exercise 1 - Data Import
Load the provided .csv file from the data folder which contains a number of time series. The file has two timestamps in the first columns (utc and cet format). You can use the base library from Julia "Dates"[1]. Hint: the CSV.read function accepts the keyword argument "dateformat". This will auto convert the corresponding timestamp in the a column of type "DateTime".
Filter the dataset for the year 2018. Create a column "hour" based on the timestamp which holds the hour of the year as an Int (first hour = 1, last hour = 8760). Select the columns which are specified in the "Data" section of Exercise 2 below. Since the data is given as 15 min time series you have to use the average to get an hourly value. Hint: you can use the groupby and combine functions from the DataFrames package. The 'mean' function can be imported from the Base library "Statistics".

Exercise 2 - Linear Programming
Write a julia script which solves the following linear program. For the definition of the parameters, please use the values you imported in the previous task.

Definitions:

$technology\ (t):$	Generation Technologies
$hours\ (h):$	Hours of the year
$demand_h:$	Demand in hour h
$production_{t,h}:$	Maximum Production by technology t in hour h
$cost_t:$	Costs of production of technology t
$x_{t,h}:$	Actual Production by technology t in hour h
$curtailment_h:$	Curtailment in hour h

Model:

$$
\begin{aligned}
\min \quad & \textstyle\sum_{t,h} cost_{t,h} \cdot x_{t,h} & & \\
s.t. \quad & \textstyle\sum_t x_{t,h} - curtailment_h & = demand_h & \forall h \in hours \\
& x_{\text{"}solar\text{"},h} & = production_{\text{"}solar\text{"},h} & \forall h \in hours \\
& x_{\text{"}wind\_onshore\text{"},h} & = production_{\text{"}wind\_onshore\text{"},h} & \forall h \in hours \\
& x_{t,h} & \leq production_{t,h} & \forall h \in hours \\
& x_{t,h} & \geq 0 & \\
& curtailment_h & \geq 0 &
\end{aligned}
$$

Data:

- Technologies: solar, wind_onshore, nuclear, coal
- Hours: 1-8760

[1] Docs available at: https://docs.julialang.org/en/v1/stdlib/Dates/#Dates

- Cost:
  - Solar: 0
  - Wind_Onshore: 0
  - Nuclear: 3
  - Coal: 8
- Demand: Data from .csv file. Column: DE_load_actual_entsoe_transparency
- Production:
  - Solar: Data from .csv file. Column: DE_solar_generation_actual
  - Wind_Onshore: Data from .csv file. Column: DE_wind_onshore_generation_actual
  - Nuclear: 8000 for every hour
  - Coal: 100000 for every hour

Exercise 3 - Plots
In this task, you are asked to plot the results of your optimization model.
For the first graph, create a stacked area plot of generation profiles. You are asked to depict the following results: onshore wind, solar, nuclear, coal and curtailment. Your plot should depict the first 100 hours. You are free to choose your own colors, scalings etc., but everything must be clearly visible. Provide valid axis labels, a meaningful title and a legend. For the second graph, you are supposed to create a barplot, depicting the aggregated renewable and conventional as well as total generation. Once again, you are free to choose colors etc., but valid axis labels and a meaningful title must be provided. Further, it must be made clear which bar is related to which result.

General Remarks
You need to upload working julia code, make sure your code actually works as intended by restarting the session and running the code again. Scripts producing errors will automatically fail. Make sure to only upload the commented script code (no data etc.).