Skolkovo Institute of Science and Technology
Center for Energy Science and Technology

Course: Fundamentals of Power Systems
Term 2: 2021
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Homework 4: Optimal Power Flow, Security-Constrained Optimal Power Flow

General Instructions: *The report should contain answers to the questions in the task and short description of every step in your code – in comments or Jupyter markdowns. The Jupyter notebook should be uploaded to canvas. If you have any supplementary materials: functions in a separate file, data, please, submit a compressed folder which includes them as well as the notebook. The logic of the solution to the problem and all notations should be clear. The notebook must work correctly if one restarts and runs all cells. The report (.ipynb file) should be submitted by* ***November 30***

Concepts Covered: *OPF, SC-OPF, Data processing, MATPOWER grid cases*

Name: _____

You are given several files that contain data of a power grid. Namely, *BaseMVA.txt, branch.csv, bus.csv, gen.csv, gencost.csv*. The data organization in them is similar to MATPOWER (see the documentation here). In this homework, you are expected to familiarize yourself with standard power grid case description using provided data and documentation. Next, implement OPF and SCOPF for the case provided. The graph of this power grid is represented in Figure 1

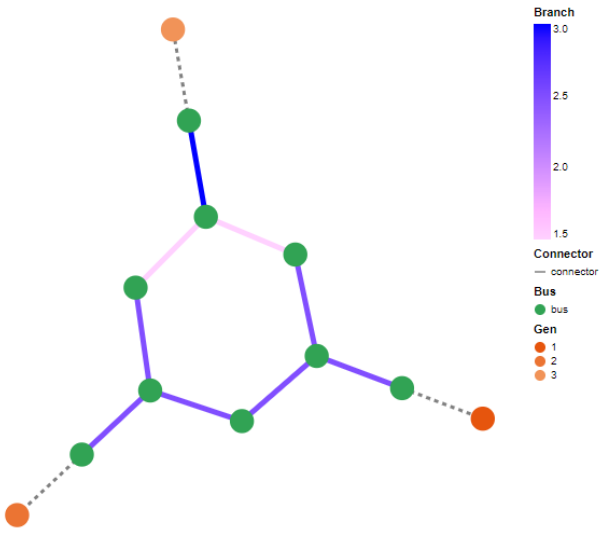

Figure 1: Graph of a power system. Color of a branch depicts a value of branch flow limit (the more wan its color is the less its limit is)

Problem 1 (Data) [40 points]

(a) (**20 pt**) Read the data, construct the admittance matrix Y.

(b) (**20 pt**) Determine inequality constraints given in the case. Assume long term rating for lines. Which bus is the reference one?

Problem 2 (AC) [60 points]

(a) (**20 pt**) Run AC-OPF for given network and print the results as: 1) Objective function value (in currency per MW) 2) DataFrames in the following form (you can choose your own naming for columns):

- ◇ **BranchData:** *columns:* from bus, to bus, reactive power to, reactive power from, active power to, active power from; *rows:* individual branches.
- ◇ **BusData:** *columns:* voltage magnitude, voltage angle; *rows:* individual buses.
- ◇ **GenData:** *columns:* active power, reactive power; *rows:* individual generators.

(b) (**10 pt**) Run **preventive** SC-AC-OPF, print the results in the same way as in (a). Each contingency is a drop of a single line.

(c) (**30 pt**) Run **corrective** SC-AC-OPF, print the results in the same way as in (a). Each contingency is a drop of a single line or a single generator (except the reference one). Compare the results (objective and control variables for 0-contingency) for preventive, corrective and non security constrained OPFs if any exists. Make a conclusion.