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Milestone 2

Repository

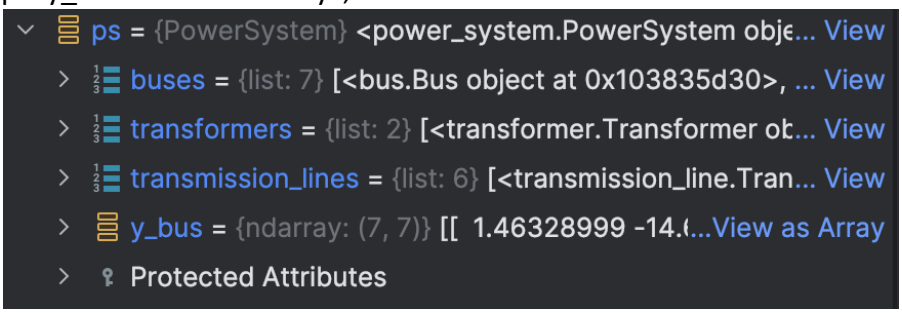
Link: https://github.com/griffincj/Power-System-Analysis

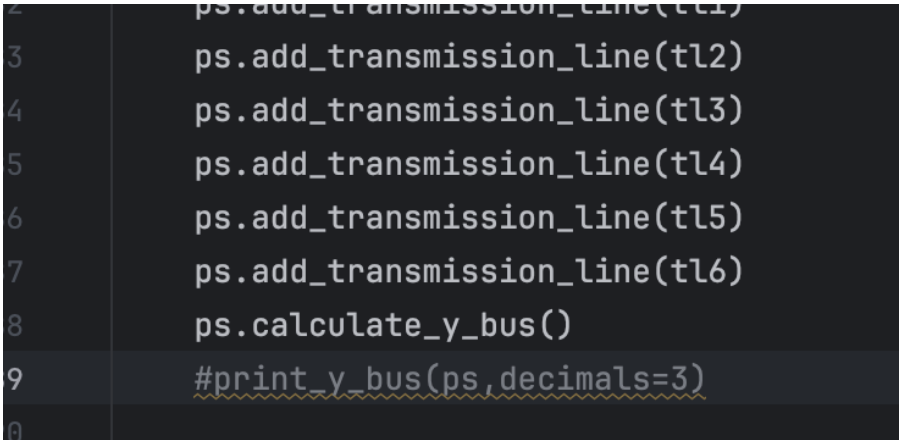
Main Module

For this milestone, the main.py module now includes the instantiation of the power system class, called which is called `PowerSystem`, and is included in the `power_system.py` module. After initializing all transmission lines, transformers, and buses from the previous milestone, the power system's calculate_y_bus() method is called to calculate the Y-Bus Matrix.

The homework example was also moved to a separate method in the main module, to clean up the main method.

To view the y-bus, either use the scientific tools provided by PyCharm and navigate to ps>y_bus>"View as Array", or uncomment the last line of the main method:





For convenience, results are also included in the final section.

PowerSystem

The power system class represents a collection of circuit elements and the methods needed to calculate power flow.

Attributes

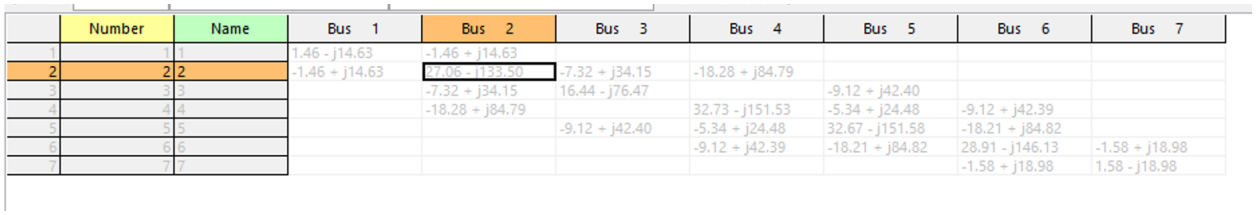
- Transformers:
  - List
  - Initial value: []
  - Represents collection of transformers belonging to power system
- transmission_lines:
  - List
  - Initial value: []
  - Represents collection of transmission lines belonging to power system
- buses:
  - List
  - Initial value: []
  - Represents collection of buses belonging to power system
- Y_bus:
  - np.zeros((1, 1))
  - Initial value: np.zeros((1, 1))
  - Represents the y_bus. Initialized as a 1x1 matrix, but will be set to # buses x # buses by the calculate_y_bus() method

Methods

- add_transmission_line(self, line: TransmissionLine)
  - line: TransmissionLine object to be added
- add_transformer(self, transforner: Transformer)
  - transformer: Transformer object to be added
- add_bus(self, bus: Bus)
  - bus: Bus object to be added
- calculate_y_bus(self)
  - First, y_bus is reshaped to be of size # buses x # buses. The datatype is set to **np.complex**.
  - An “elements” list is created that combines both the list of transformers and transmission lines. This is the iterable the method uses to fill the y-bus matrix
  - A loop iterates over each element in elements.
    - For a given element, the A and B bus of the element are retrieved
    - Each bus’s ID is used as the index in the system’s y-bus matrix
    - The value of [a.id, a.id], [a.id, b.id], [b.id, a.id], and [b.id, b.id] in the y-bus matrix are set to the value of the element’s submatrix at [0,0], [0,1], [1,0], and [1,1] respectively.
  - Finally, the y-bus is returned.

Comparison to PowerWorld Results

PowerWorld:



	Number	Name	Bus 1	Bus 2	Bus 3	Bus 4	Bus 5	Bus 6	Bus 7
1	1	1	1.46 - j14.63	-1.46 + j14.63					
2	2	2	-1.46 + j14.63	27.06 - j133.50	-7.32 + j34.15	-18.28 + j84.79			
3	3	3		-7.32 + j34.15	16.44 - j76.47		-9.12 + j42.40		
4	4	4		-18.28 + j84.79		32.73 - j151.53	-5.34 + j24.48	-9.12 + j42.39	
5	5	5			-9.12 + j42.40	-5.34 + j24.48	32.67 - j151.58	-18.21 + j84.82	
6	6	6				-9.12 + j42.39	-18.21 + j84.82	28.91 - j146.13	-1.58 + j18.98
7	7	7						-1.58 + j18.98	1.58 - j18.98

Python Simulation:

(1.4632899856029267-14.632899856029025j)	(-1.4632899856029267+14.6328998 5602925j)	0j	0j	0j	0j	0j
(-1.4632899856029267+14.6328998 5602925j)	(27.00083674410 5854-133.24953291158 843j)	(-7.2964419310008 36+33.90902568 4729116j)	(-18.241104827502 09+84.77256421 182278j)	0j	0j	0j
0j	(-7.2964419310008 36+33.90902568 4729116j)	(16.41699434475 188-76.211791852221 3j)	0j	(-9.1205524137510 46+42.38628210 591139j)	0j	0j
0j	(-18.241104827502 09+84.77256421 182278j)	0j	(32.57340147768 231-151.25894481641 137j)	(-5.2117442364291 69+24.22073263 1949367j)	(-9.1205524137510 46+42.38628210 591139j)	0j
0j	0j	(-9.1205524137510 46+42.38628210 591139j)	(-5.2117442364291 69+24.22073263 1949367j)	(32.57340147768 231-151.25894481641 137j)	(-18.241104827502 09+84.77256421 182278j)	0j
0j	0j	0j	(-9.1205524137510 46+42.38628210 591139j)	(-18.241104827502 09+84.77256421 182278j)	(28.94347590513 39-146.08499299202 384j)	(-1.5818186638807 63+18.98182396 6569138j)
0j	0j	0j	0j	0j	(-1.5818186638807 63+18.98182396 6569138j)	(1.581818663880 763-18.981823966569 138j)