Transmission Line Event Detection and Identification

ECE 6160
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Background

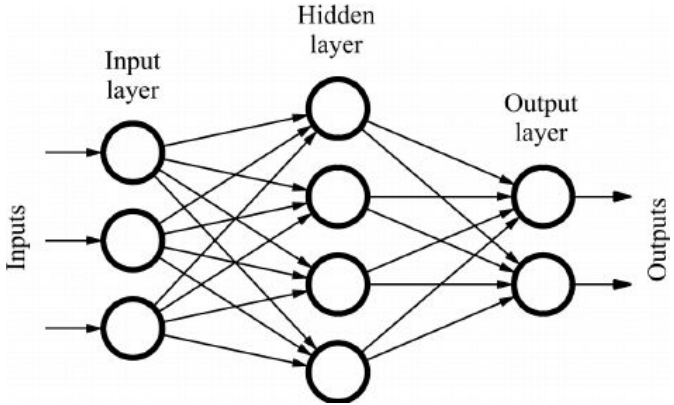
- A major theme for this class is: “How exactly will integrating smart grid and new technologies improve monitoring and control of the grid?
- Through Synchronized Measurement Technology like PMUs, time-synchronized system-wide data can be collected in real time.
- For this project, we used a feedforward artificial neural network to examine an immense amount of data trained by the Levenberg-Marquardt algorithm.

Impacts and Innovations

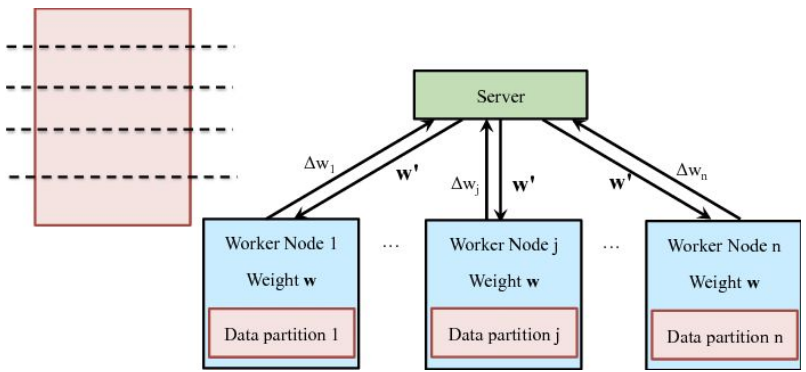
- Due to the complexity of the power system, it is necessary to continuously monitor the transmission of power to avoid major contingencies.
- Through the use of distributed architecture of ANNs data can be evaluated quickly and accurately.
- Analytics paired with visualization should help operators have a much easier time monitoring the status of the grid which bolsters the robustness of the power system.

Code Architecture

1) The PMU data is loaded in.
2) The data is truncated so that only the current magnitude values remain.
3) 19 neural networks are then created and trained with the input and output data of each of their respective TL branches.
4) Once the NNs are trained, simulation data can be evaluated in real time when connected to servers.
5) When the output from the trained NN is received, it is estimated to be 1 or 0 which is on and off respectively.



Feedforward Neural Network



Distributed Architecture Neural Network

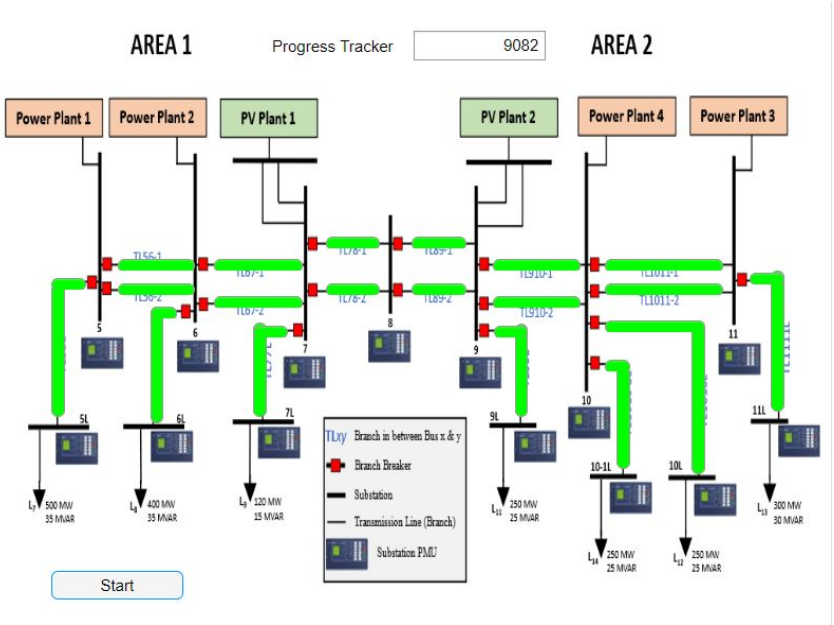
Results

- First progress report used single Levenberg-Marquardt neural network
- Created 19 separate Distributed Architecture Neural Networks to increase accuracy

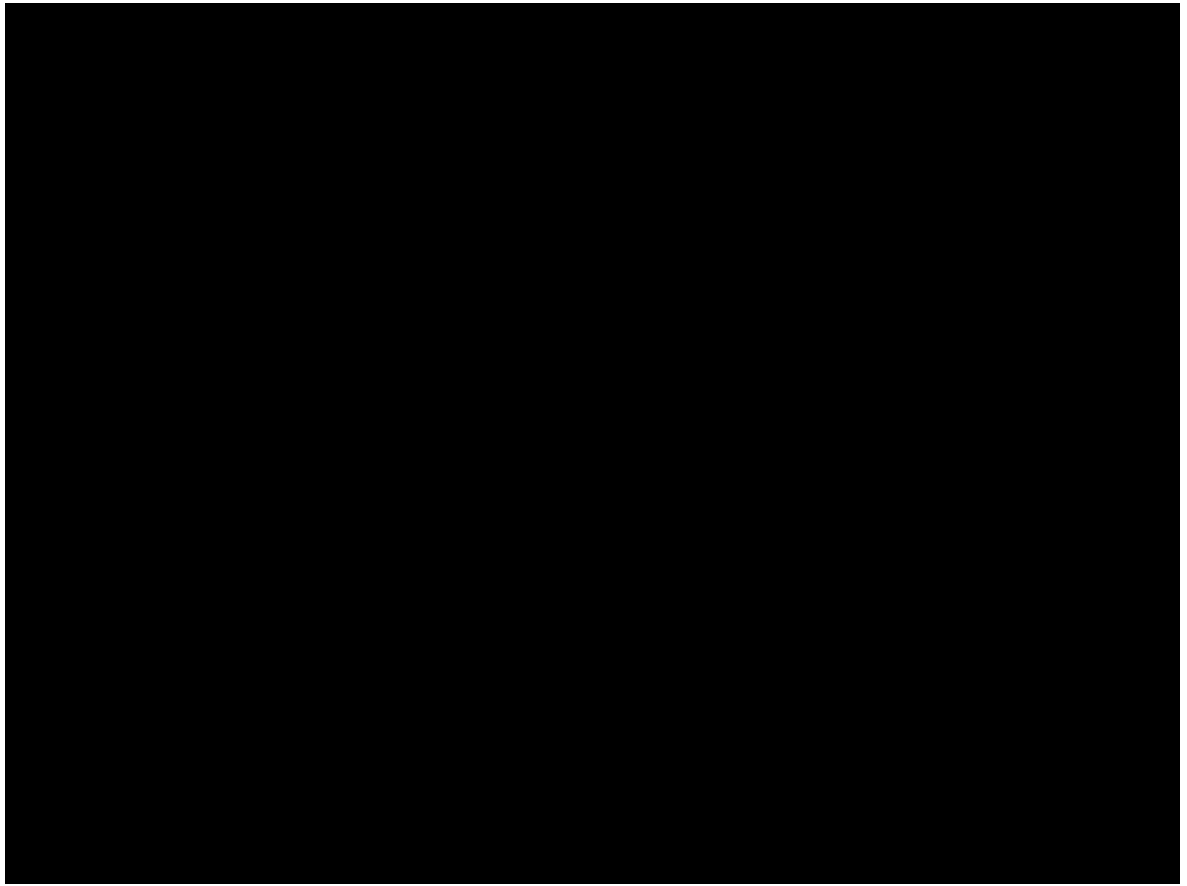
Training Method	% Accuracy	Training Time
Levenberg-Marquardt	98%	1:16
Gradient Descent	91.40%	0:08
One Step Secant	97.50%	0:11
Scaled Conjugate Gradient	97.00%	0:03
Fletcher-Powell Conjugate Gradient	97.10%	0:05
Bayesian Regularization	98.30%	10:00
Quasi-Newton	96.90%	0:53
Resilient Backpropagation	97.50%	2:04
19 Levenberg-Marquardt Distributed Neural Networks	99.8%	0:30

Graphical User Interface

- Used MATLAB AppDesigner to create graphical user interface tool.
- Green lines to indicate expected results, red lines to indicate event on grid
- Start button in bottom corner



Video Demo



Conclusion and Future Directions

- Tools like our visualization will help operators maintain situational awareness of the grid. To make the grid more safe and efficient data from synchronized measurement technology must be utilized effectively.
- For future direction, testing all of the available training algorithms with the distributed architecture can maybe help increase accuracy closer to 100%.
- Adding voltage magnitude may also help increase the accuracy.