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# Temporal Graph Neural Networks with GraphNeuralNetworks.jl



Google Summer of Code

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## GraphNeuralNetworks.jl

A graph neural network Julia package based on the Flux.jl.

Among its features:

- Standard graph convolutions
- Batched graph support
- Custom layer creation
- GPU computing via CUDA.jl
- Graphs.jl integration
- Various ML task examples
- Heterogeneous and temporal graphs

**Installation** `pkg> add GraphNeuralNetworks`

## Gender classification in brain networks

Gender classification is the problem of determining the category of the graph, in this case female and male.

### Temporal Brain Networks Dataset

The networks are obtained from resting-state fMRI data.

**Nodes:** 102 brain regions

**Edge weights:** region activity correlations

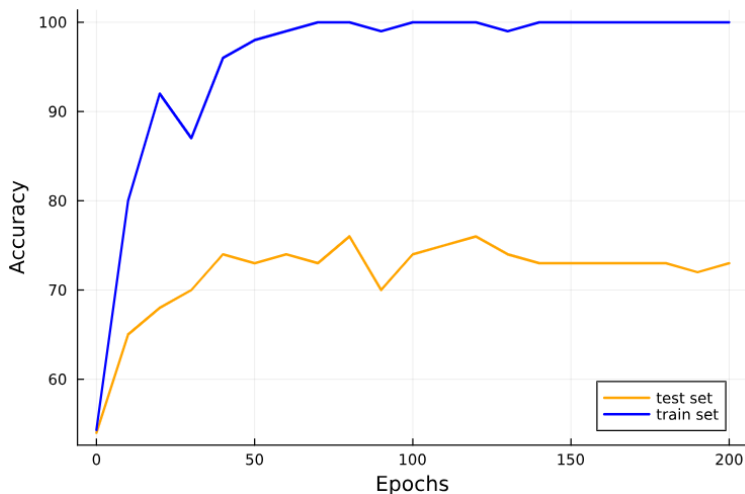
**Node features:** concatenation of one-hot encoding and mean activation of a node

**Graph features:** one-hot encoding of the gender

### Model

- Graph Isomorphism Network for every snapshot  $X' = f_{\theta}([(1 + \epsilon)I_N + A]X)$  where  $f_{\theta}$  is a Multi Layer Perceptron
- Global pooling (mean) on node dimension
- Global pooling (mean) on time dimension
- A fully connected layer

### Results



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## Temporal graphs

Real-world dynamic networks (social, transportation, brain) are modeled as sequences of static graphs.

## Traffic prediction example

Traffic forecasting is the problem of predicting future **traffic trends** on a road network given historical traffic data.

### METR-LA Dataset

It contains traffic data from 207 sensors in highways of Los Angeles County.

**Nodes:** sensors

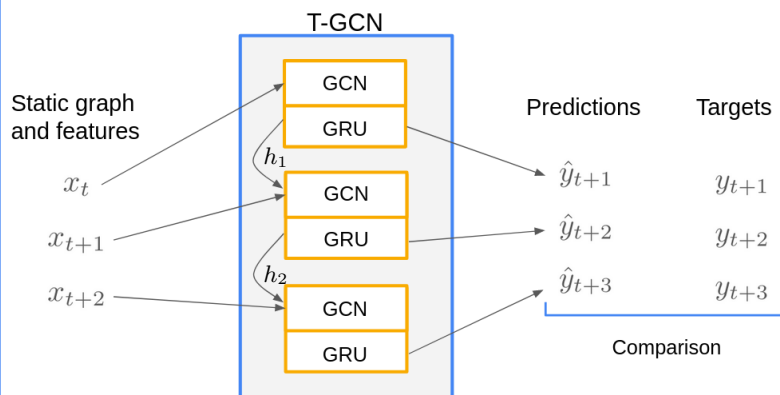
**Edge weights:** distances between the sensors

**Node features:** traffic speed and time of the day

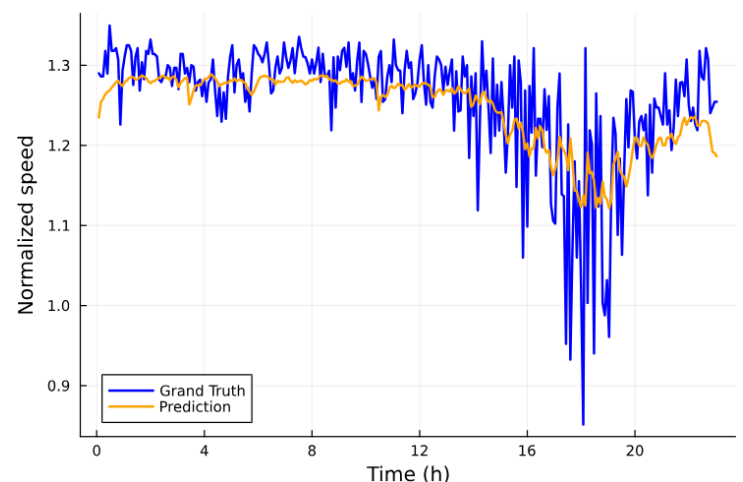
### T-GCN Model

It is a recurrent model and a cell is composed of:

- Graph Convolutional Network to model spatial dependence
- Gated Recurrent Unit to model temporal dependence



### Results



### References

"T-GCN: A Temporal Graph Convolutional Network for Traffic Prediction" Zhao et al.

"Diffusion Convolutional Recurrent Neural Network: Data-driven Traffic Forecasting" Li et al.

"How Powerful are Graph Neural Networks?", Xu et al.

<https://summerofcode.withgoogle.com/archive/2023/projects/vbQaqNYW>

<https://github.com/CarloLucibello/GraphNeuralNetworks.jl>