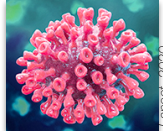


# A GNN+mRNN based metamodel for Pandemic Transmission Dynamics

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## Motivation

Capture a detailed description of a pandemic spread using real spatiotemporal data for evaluating and testing different policy scenarios.



## Prior work

### Classical Models for Infectious Disease Transmission

$f(x)$  Stochastic models Computationally expensive Hand-crafted parameters

USA Influenza spread simulation:

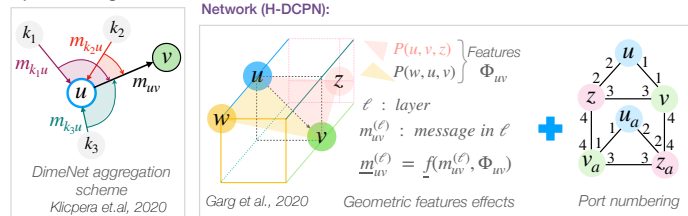


## Our approach

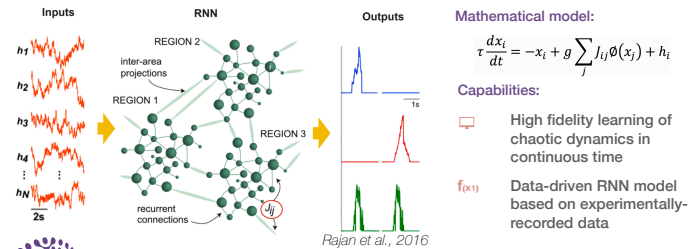
### Graph Neural Networks (GNNs)

**Expressivity** **Generalisation** **Invariance**  $f(x)$  Powerful representation learning of complex structured data

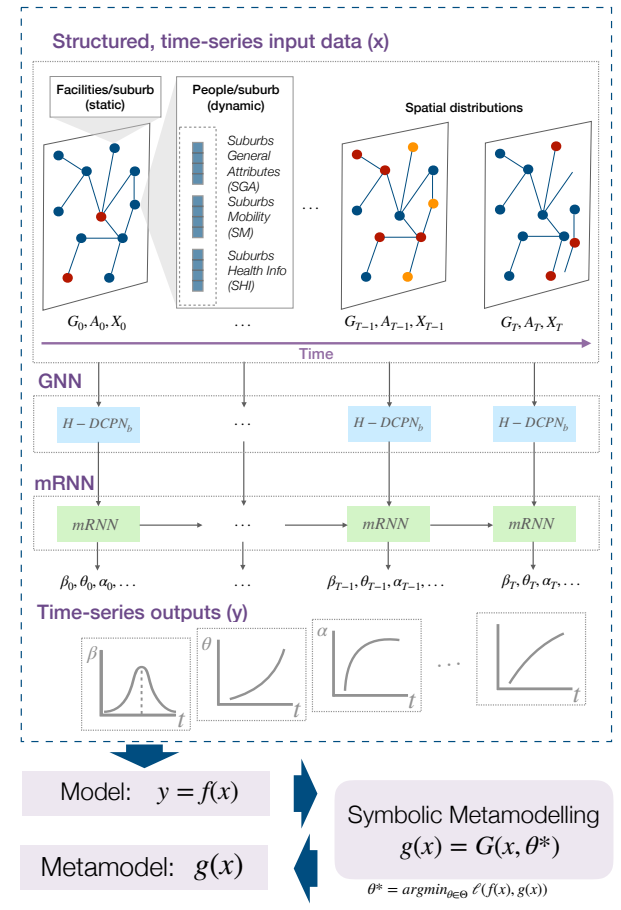
Spatial learning in GNNs:



### Multi-region Recurrent Neural Networks (mRNNs)



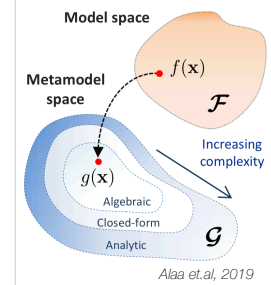
## Proposed GNN+mRNN framework



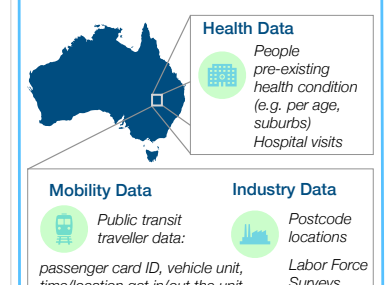
## Our main contributions

- ✓ A bipartite based GNN model (H-DCPNb) that captures the transmission spread dynamics across (i) individuals and (ii) facilities with granularity descriptors (e.g. health condition, age, mobility).
- ✓ A sequence modelling that temporally integrates the GNN learnt representations using multi-region recurrent neural network (mRNN).
- ✓ A metamodel equation of the proposed GNN+mRNN model that integrates multiple, time-series spreading rate results (e.g. per age, health condition, mobility) which is capable of explaining the transmission dependency between descriptors.

### The metamodeling problem



### Input data



### Census Data Distribution



### References

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