

Spatio Temporal - ODS C east

- Technical challenges \Rightarrow Pies ①
- Non Euclidean geometry ②
- Traffic forecasting ③
- Spatial Dependence
- Graph Convolution

Image \Rightarrow Graph nodes

(EigenValues) Expensive

so
 \downarrow

- Diffusion Convolution
- RNN {temporal part}
- Diffusion Convolution GRU

W

• Long term forecasting

Scheduled Supply - Model learn
from its mistakes.

Diffusion Convolution GRU

LA \rightarrow Spider \rightarrow Graph
SF \rightarrow IOI \rightarrow Easy

————— X ————— X

Missing value imputation

Technical Challenges



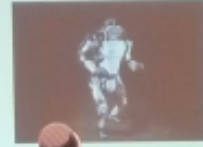
irregular grid

- sensors deployed on an irregular grid
- hard to represent



missing values

- sensors failure, transmission problem
- dirty data



high-order correlations

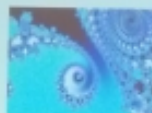
- variables space/time are correlated
- hard to learn

Technical Challenges



error cascading

- predictions are sequential
- error propagate



multi-resolution

- space and time at different scales
- complex hierarchy



prior knowledge

- understanding governing equations
- physical constraints

Graph Convolution



graph Laplacian $L = D - A$
 eigenvectors $L = U\Lambda U^T$
 $\mathcal{F}(x) = U^T x$ $\mathcal{F}^{-1}(y) = Uy$

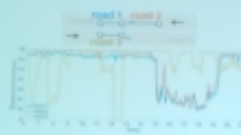
$$x \star g = \mathcal{F}^{-1}(\mathcal{F}(x) \odot \mathcal{F}(g)) = U(U^T x \odot U^T g)$$

graph convolution $g_0 \circ x = U_{g_0}(U^T x)$

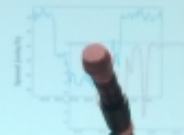
Battaglia, et al. "Spatiotemporal Traffic Forecasting with Graph Convolutional Recurrent Neural Networks" (2018)

Traffic Forecasting

- Spatiotemporal forecasting problem requires modeling complex spatial and temporal dynamics



Non-Euclidean Spatial Dependency



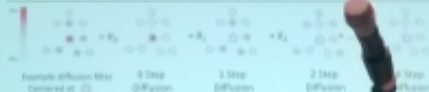
Non-stationary Temporal Dynamics

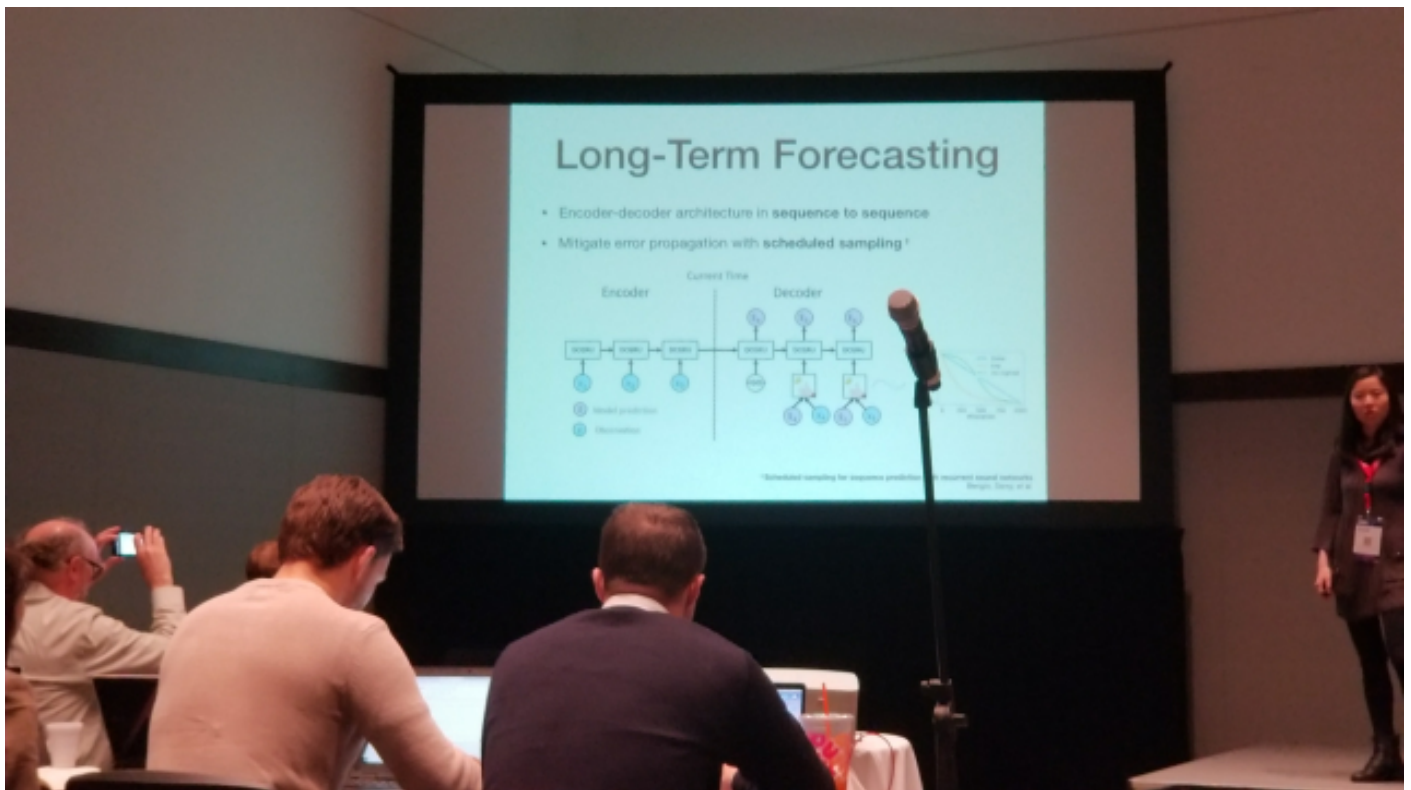
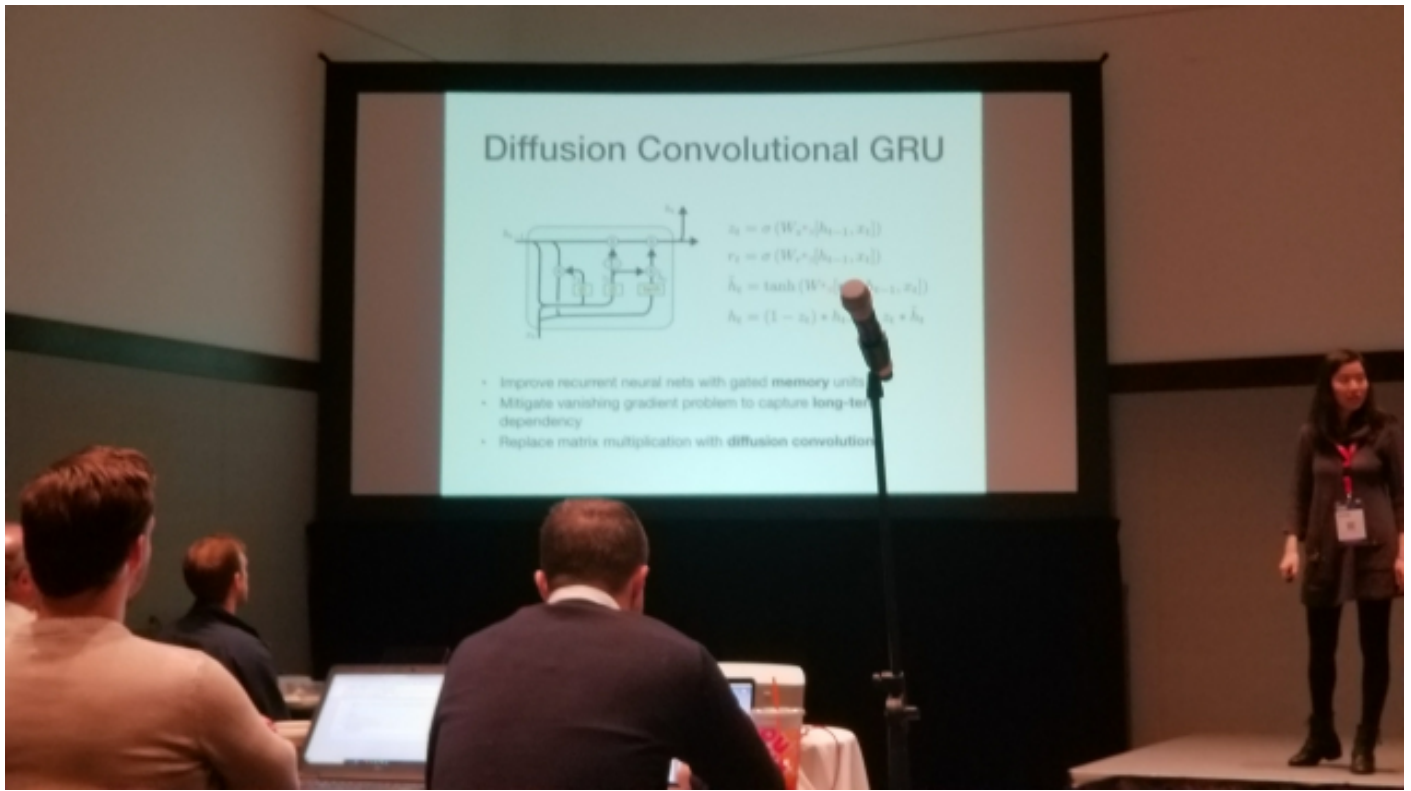
Diffusion Convolution

- Adjacency matrix $A_{ij} = \exp\left(-\frac{d(v_i, v_j)^2}{2\sigma^2}\right)$
- In/Out degree matrix $D_{ii} = \sum_j A_{ij}$ $D_{jj} = \sum_i A_{ij}$
- Random walk matrix $D_i^{-1} A^T$ $D_o^{-1} A$

Diffusion Convolution

$$\mathcal{P} = \sum_{k=0}^{\infty} \alpha(1-\alpha)^k (\mathbf{D}_O^{-1}W)^k$$







Last modified: 11:45 AM