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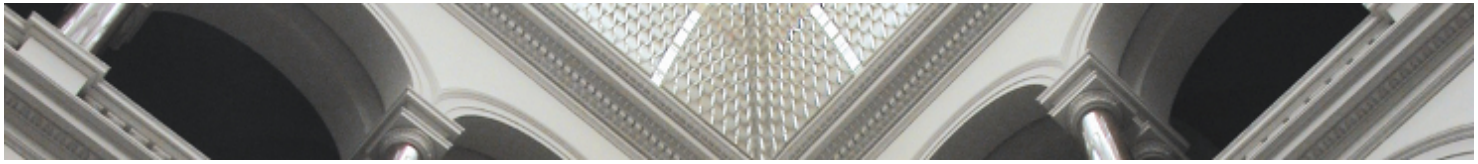
Designing Recurrent Neural Networks for Explainability

Pattarawat Chormai | Technische Universität Berlin | 06/11/2018



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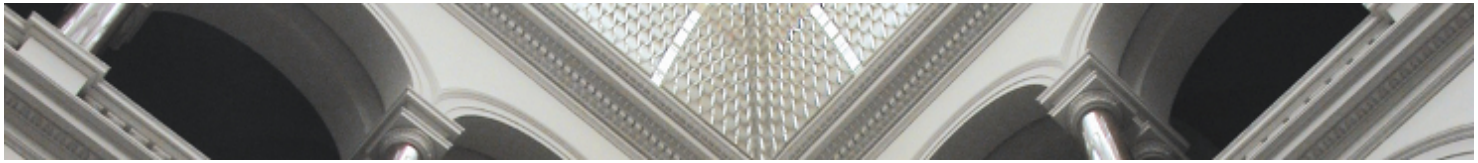
Outline

Why should we care about explainability?

Explanation Methods

Conclusion



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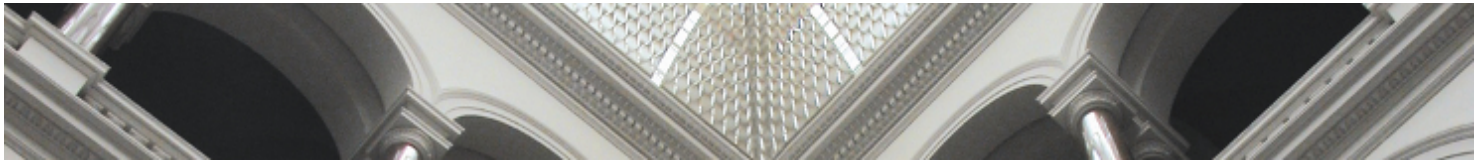
Why should we care about explainability?

Machine Learning will soon involve in more critical applications, such as in heathcare. Thus, we need to make it accountable by being to investigate and explore how it works internally.t



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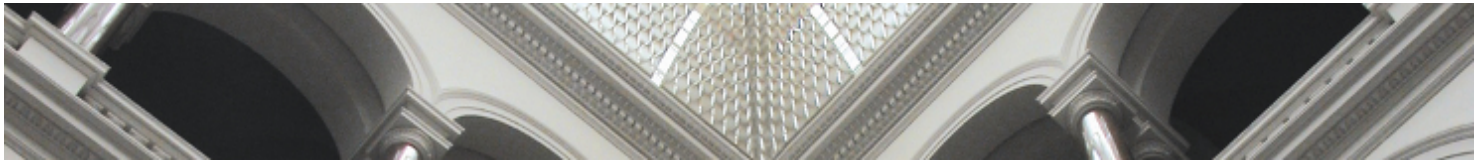
Explanation Methods

1. Sensitivity Analysis [SVZ13]



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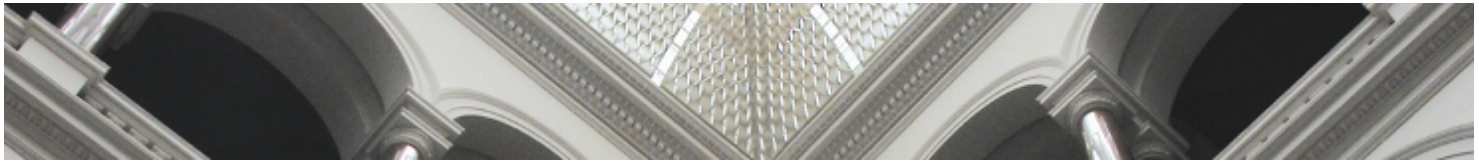
Explanation Methods

1. Sensitivity Analysis [SVZ13]
2. Guided Backprop [SDBR15]



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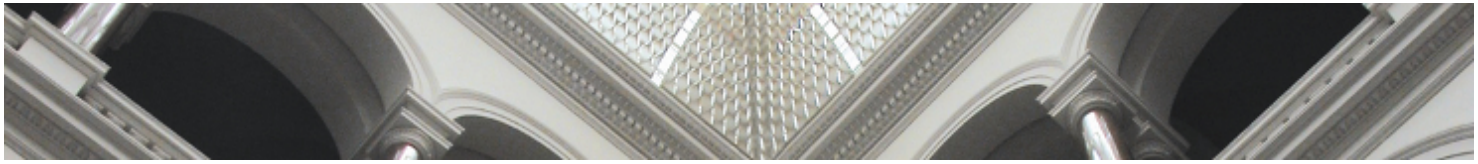
Explanation Methods

1. Sensitivity Analysis [SVZ13]
2. Guided Backprop [SDBR15]
3. LRP [BML$^+$16] and DeepTaylor Decomposition [MLB$^+$17]



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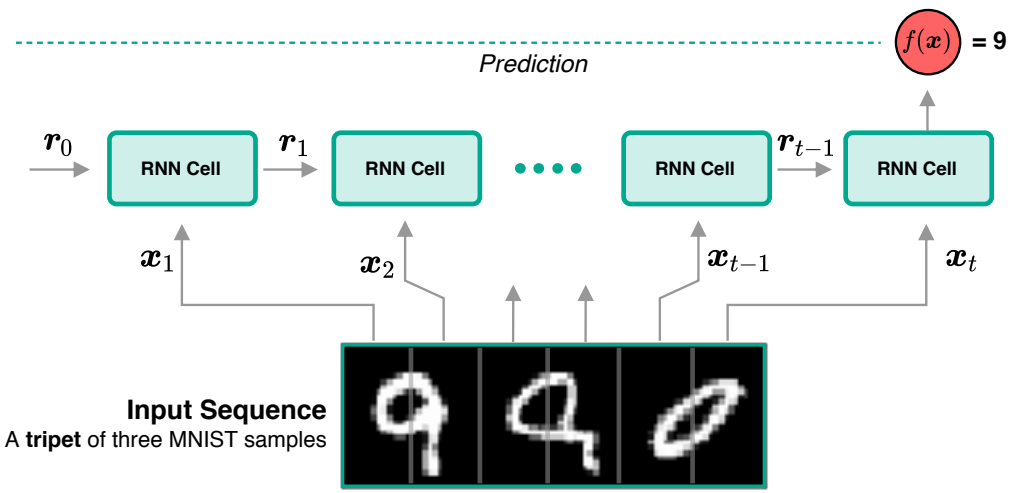
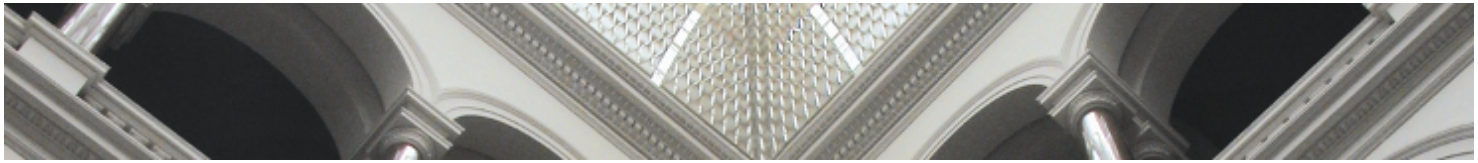
Experimental Setup

– **Problem:** Majority-Sample Sequence Classification

We use Adam, Seq-length 12, archieve accuracy 98% for MNIST, 89% for FashionMNIST





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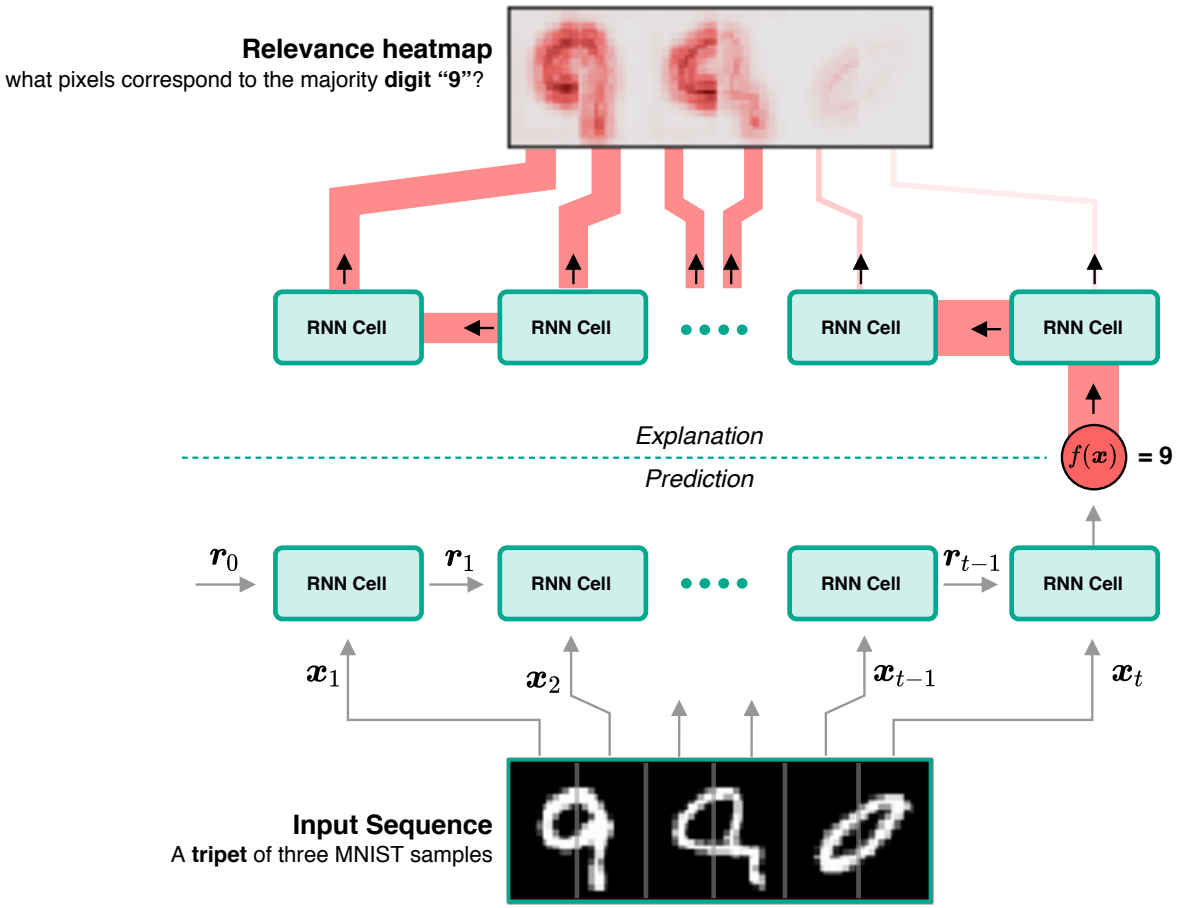

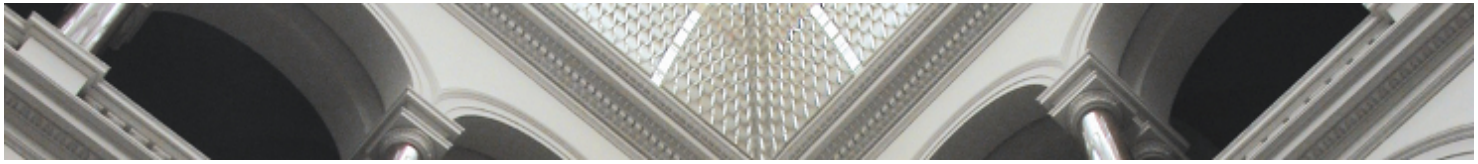

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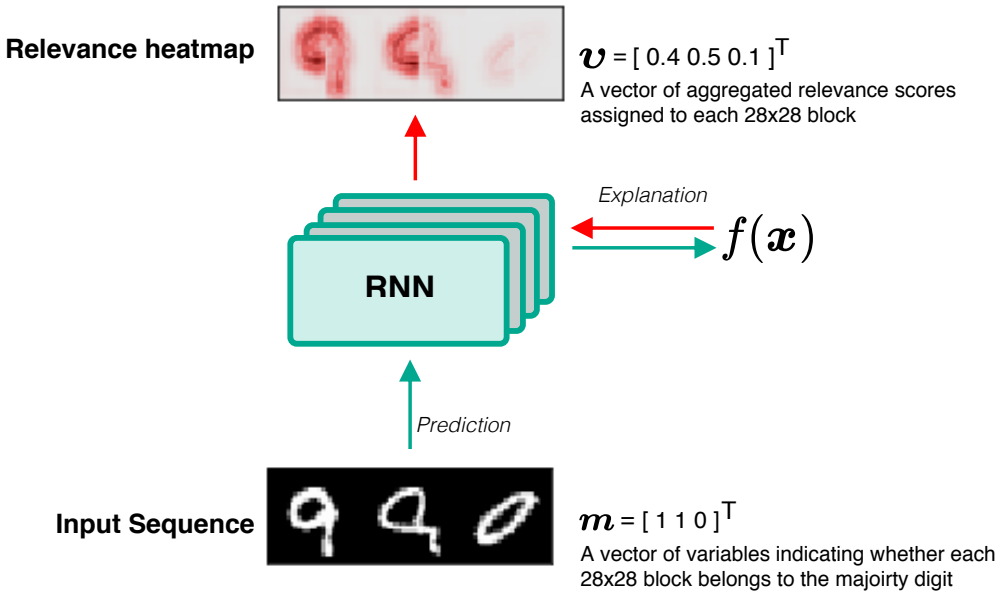
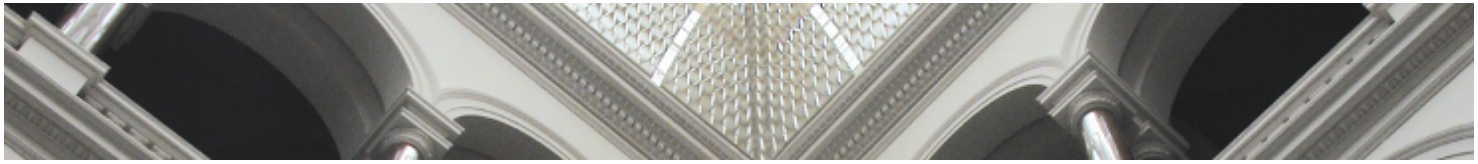
Experimental Setup

- **Problem:** Majority-Sample Sequence Classification
- **Evaluation:** Cosine Similarity

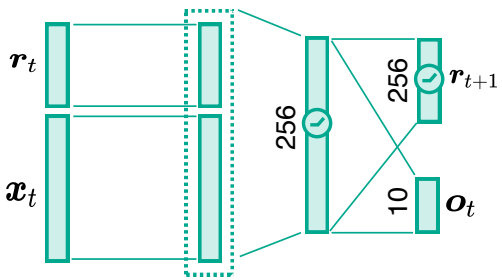


Heatmap Quality

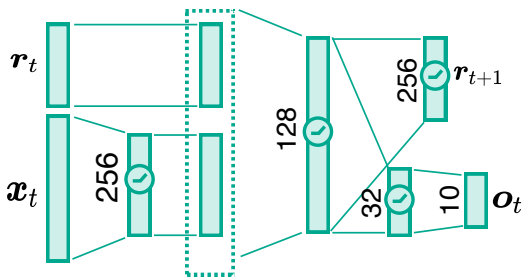
$$\cos(\boldsymbol{m}, \boldsymbol{v}) = \frac{\boldsymbol{m}^T \boldsymbol{v}}{\|\boldsymbol{m}\| \|\boldsymbol{v}\|}$$



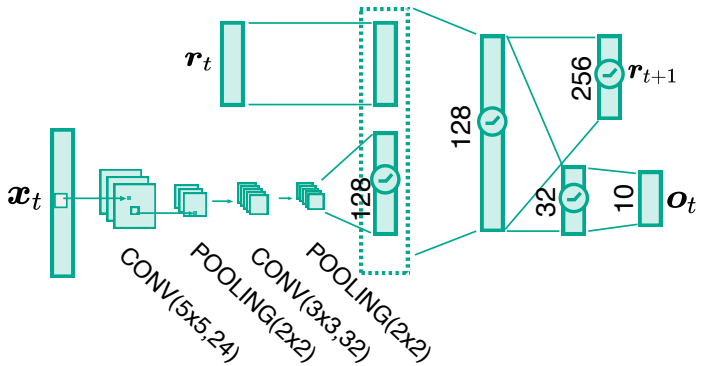
Experiment 1: Standard RNN Architectures



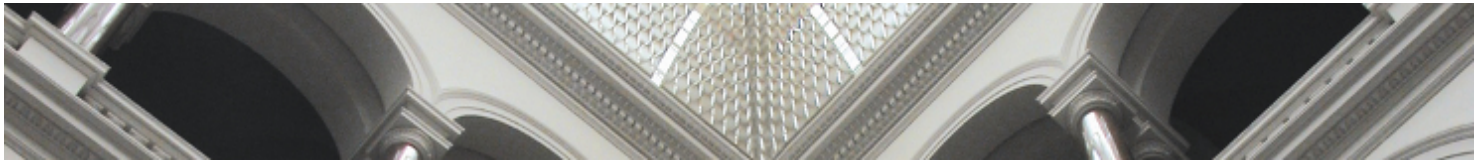
Shallow



Deep

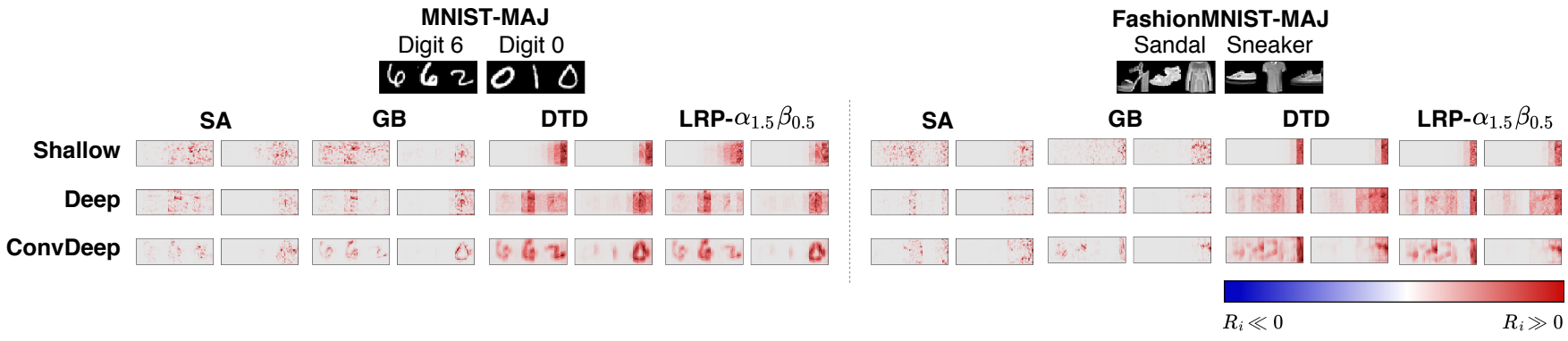


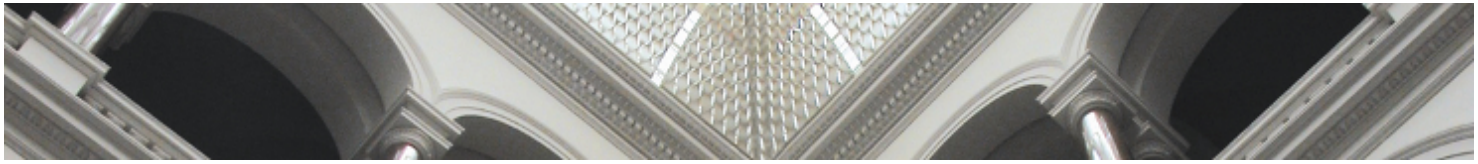
ConvDeep



Experiment 1: Standard RNN Architectures

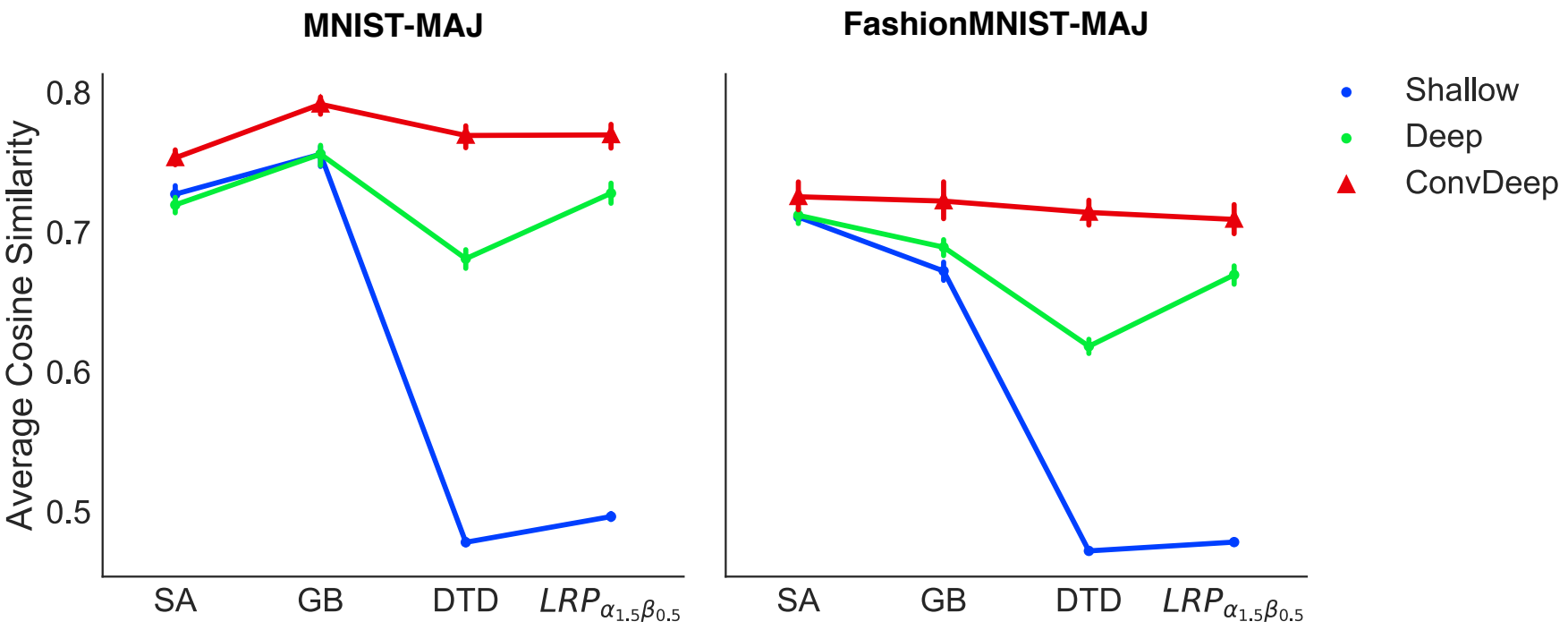
Sample Relevance Heatmaps

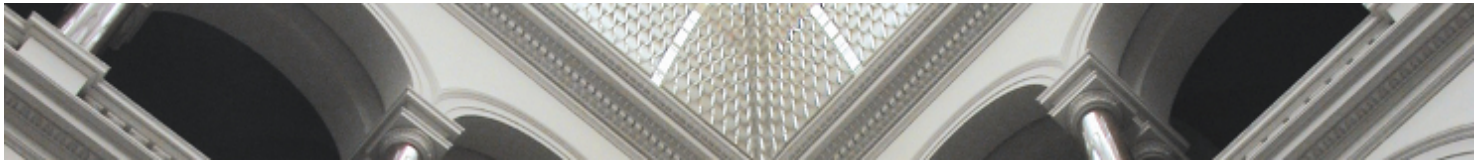




Experiment 1: Standard RNN Architectures

Cosine Similarity Evaluation





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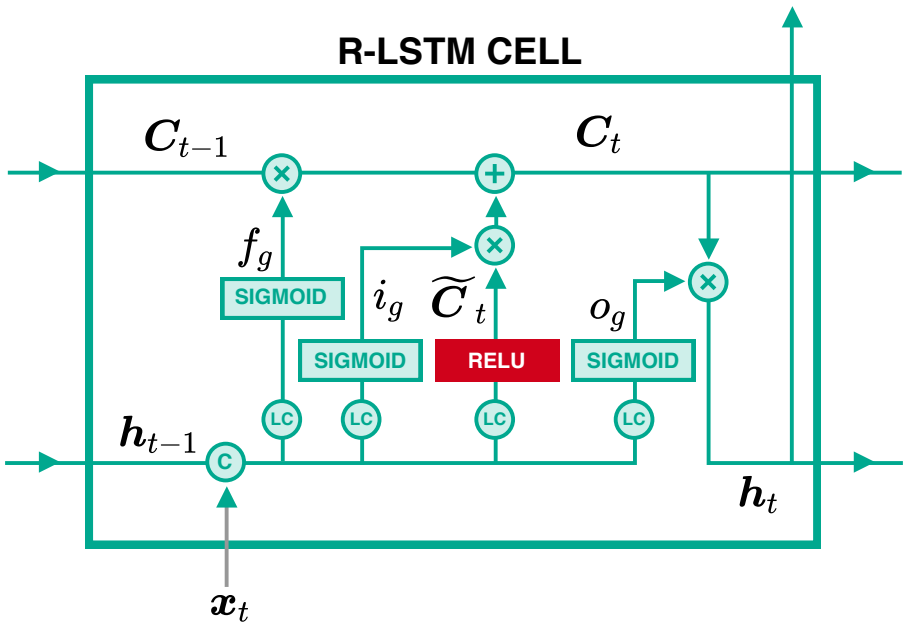
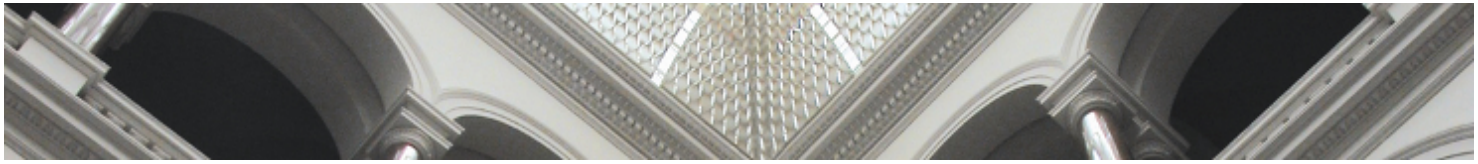
Experiment 2: More Explainable Models

1. LSTM [HS97] with tanh is replaced by ReLU (R-LSTM)
   — Gating units are ignored during explaining [AMMS17].



C Vector concatenation LC Linear combination ⊗ Element-wise multiplication ⊕ Element-wise addition



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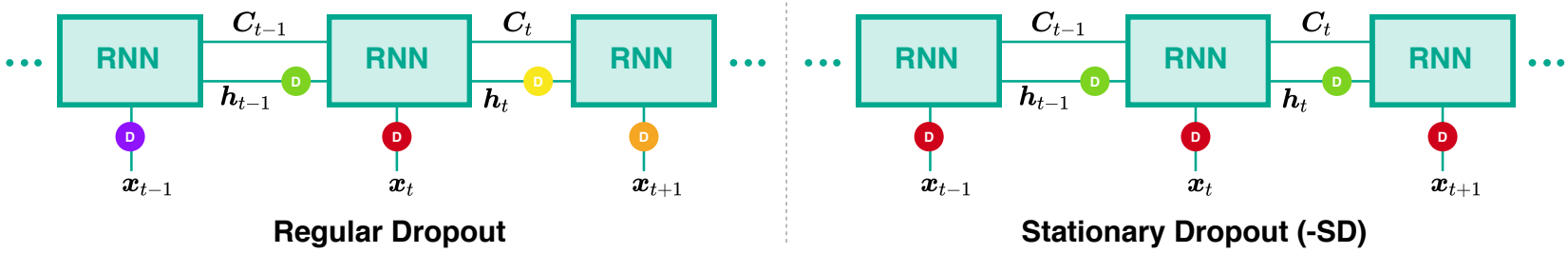
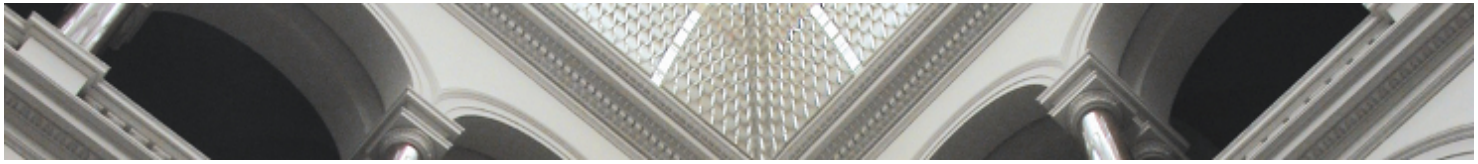
Experiment 2: More Explainable Models

2. Stationary Dropout [GG16]





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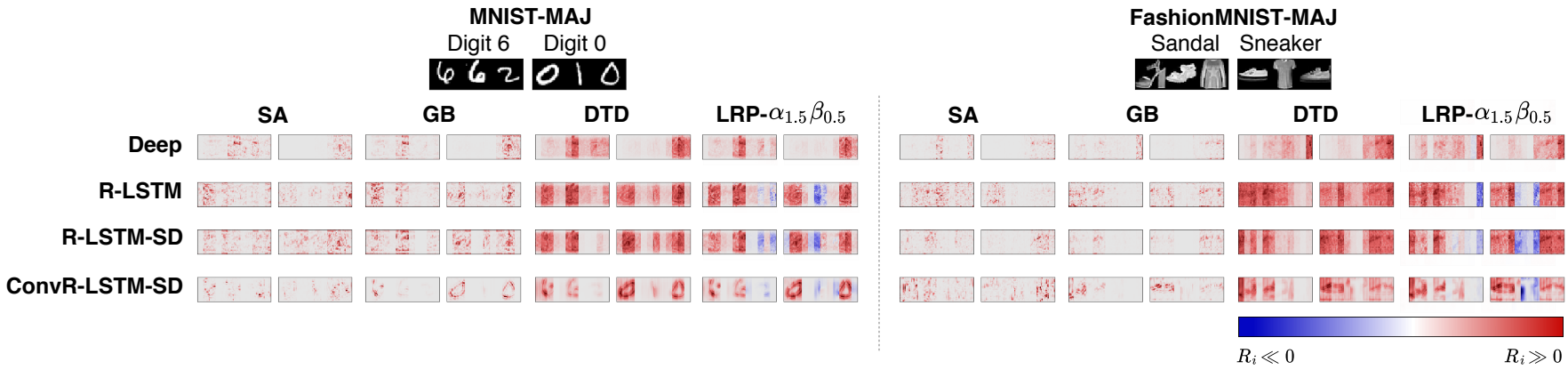

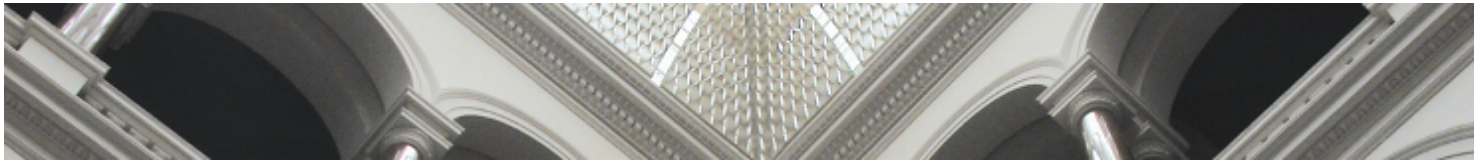

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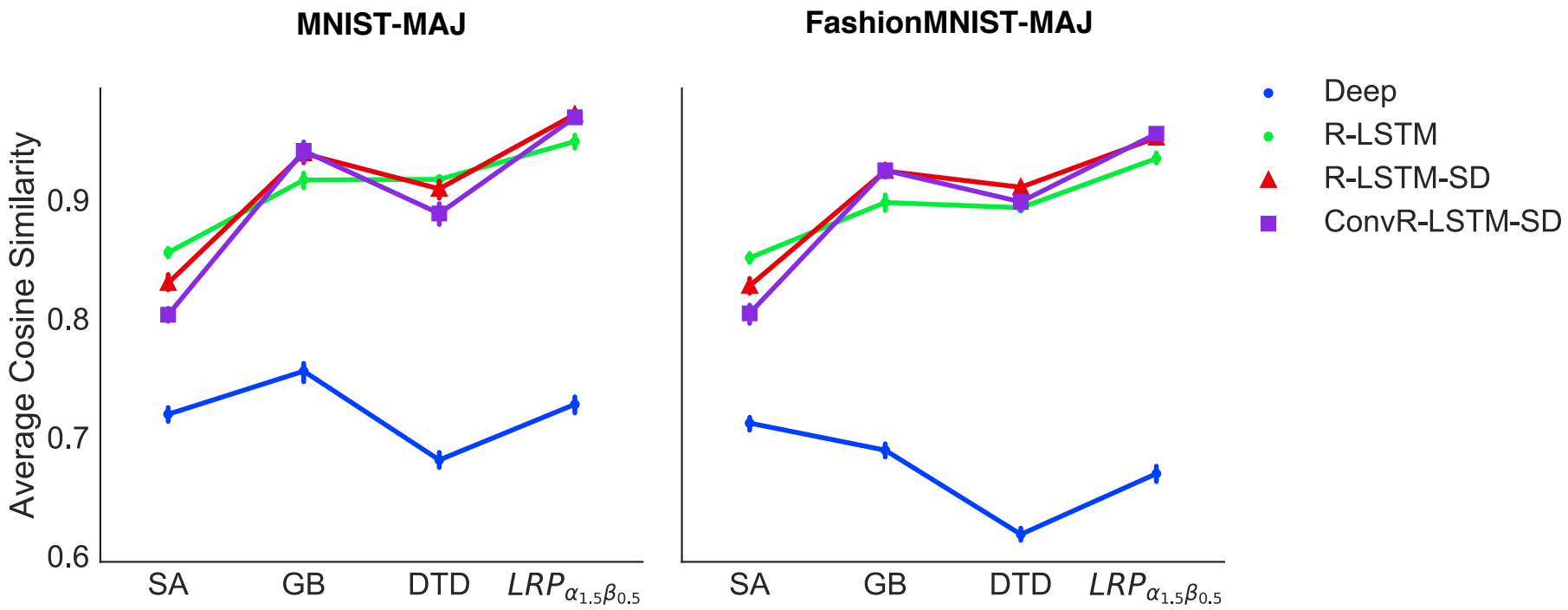
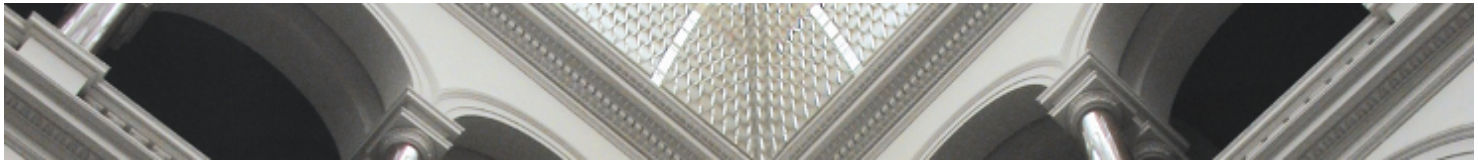
Experiment 2: More Explainable Models

Cosine Similarity Evaluation





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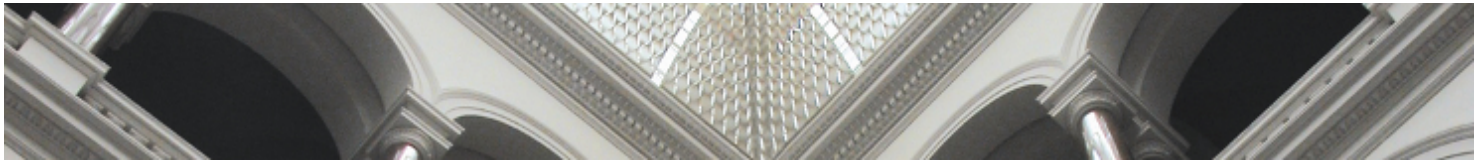
Conclusions



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References I

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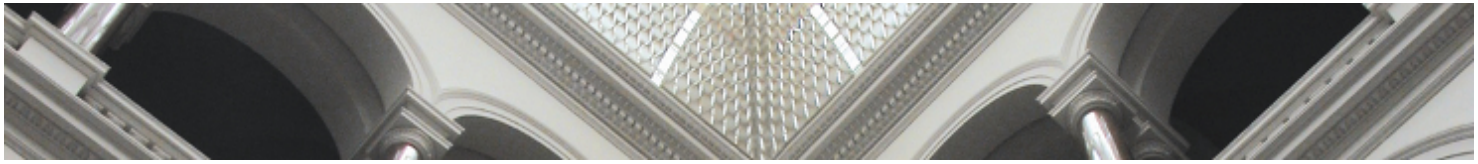

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References II

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