Fifth Update – Connectome Informed Attention

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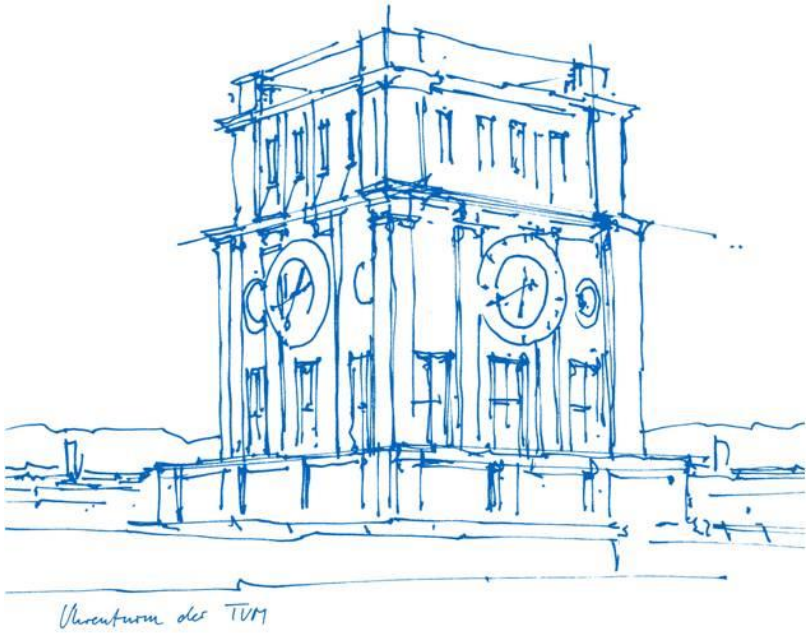
Munich, November 2022



Fifth Update – Connectome Informed Attention

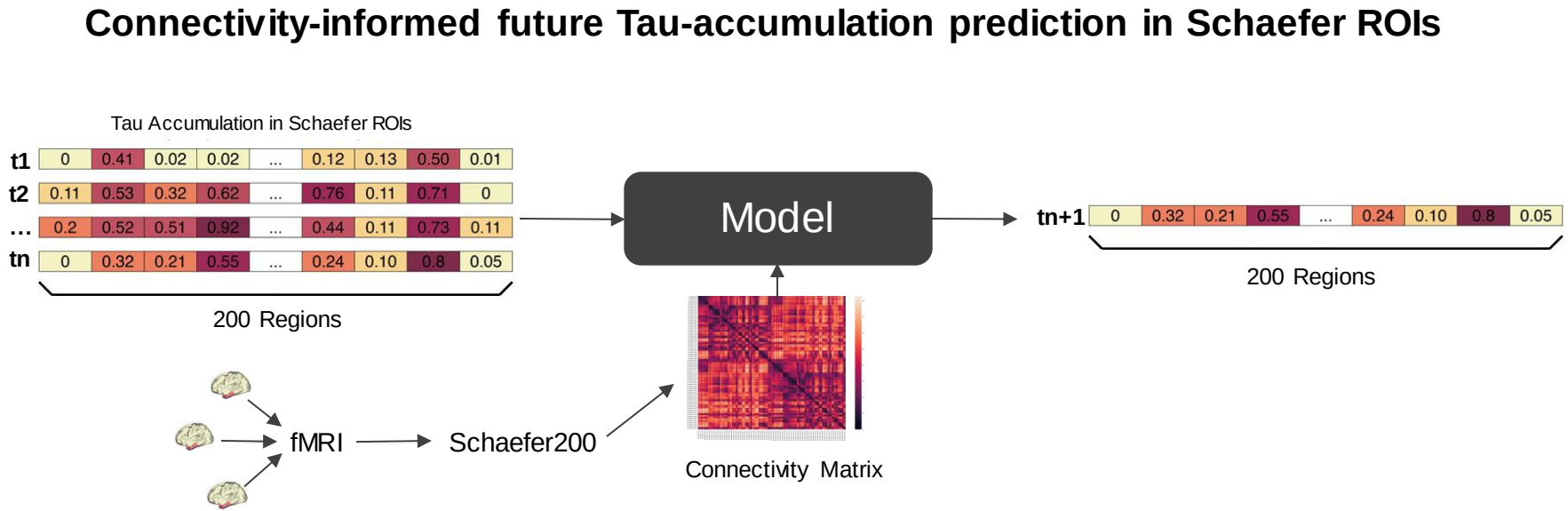
Overview

1. Introduction
   - Goal
   - Current Status
2. Progress & Findings
   - Connectivity-informed Dual-Encoder Transformer
   - Triformer
   - Connectome-head
   - Long Range Spatiotemporal Transformer
3. Evaluation and Discussion
   - Result Analysis
   - Open Questions
   - Next Steps

1. Introduction

- **Goal**
- Current Status

Goal

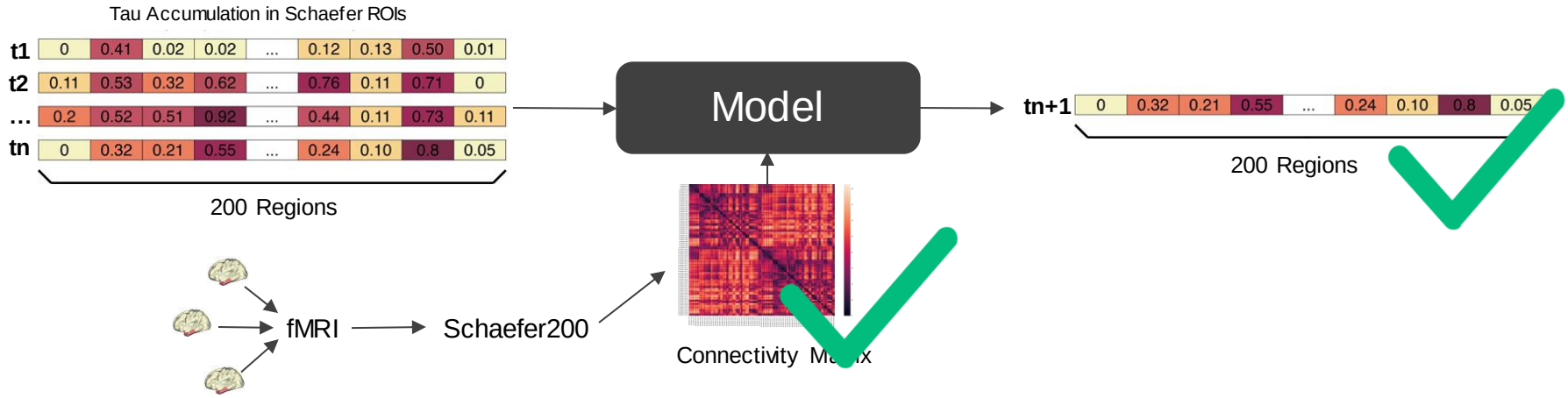

Connectivity-informed future Tau-accumulation prediction in Schaefer ROIs
Tau Accumulation in Schaefer ROIs
t1 0 0.41 0.02 0.02 ... 0.12 0.13 0.50 0.01
t2 0.11 0.53 0.32 0.62 ... 0.76 0.11 0.71 0
... 0.2 0.52 0.51 0.92 ... 0.44 0.11 0.73 0.11
tn 0 0.32 0.21 0.55 ... 0.24 0.10 0.8 0.05
200 Regions
Model
tn+1 0 0.32 0.21 0.55 ... 0.24 0.10 0.8 0.05
200 Regions
fMRI
Schaefer200
Connectivity Matrix

Current Status

	Test Loss	Test Accuracy
MLP	0.036	0.898
LSTM	**0.0297**	0.939
Transformer	0.03215	0.9482
Early Fusion	0.0307	**0.9536**
Late Fusion	0.0441	0.9120
Initialized Attention	0.0306	0.9445

Current Status

Connectivity-informed future Tau-accumulation prediction in Schaefer ROIs



Current Status

How can we optimize our results with the connectivity information ?

2. Progress & Findings

- **Improved Early Fusion**
- Connectivity-informed Dual-Encoder Transformer
- TriFormer
- Connectome-head Transformer
- Results
- Long-Range Spatiotemporal Transformer

Current Status

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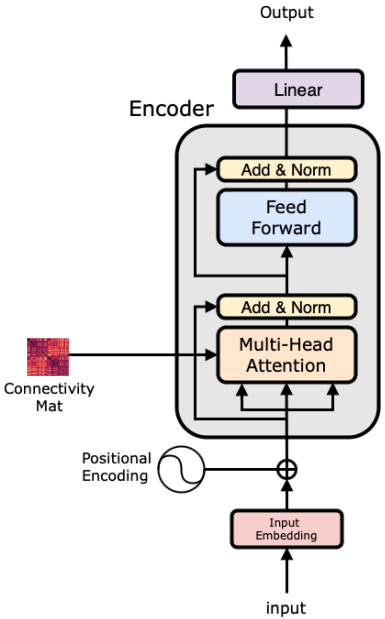
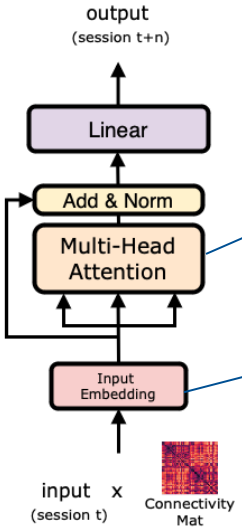
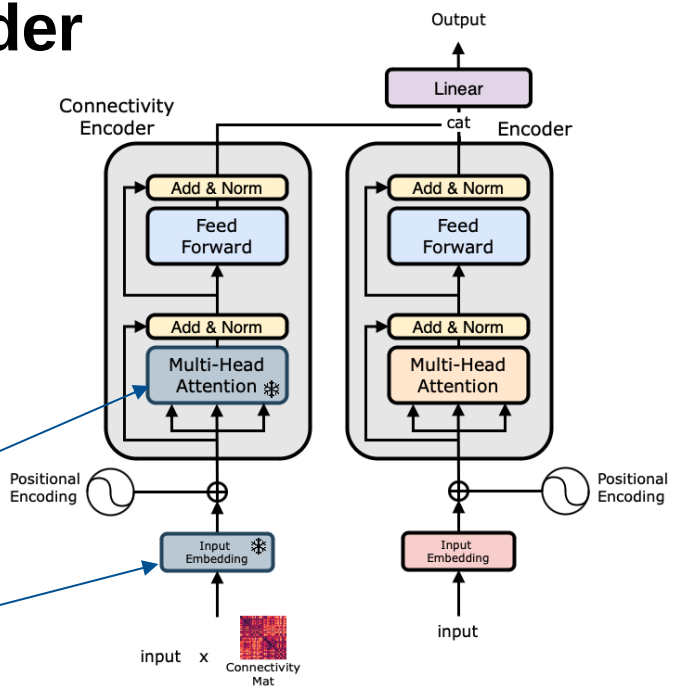
Connectivty-informed Dual-Encoder Transformer



Connectivity-initialized Multi-Head Attention



Connectivity Pretraining



Connectivity-informed Dual-Encoder Transformer

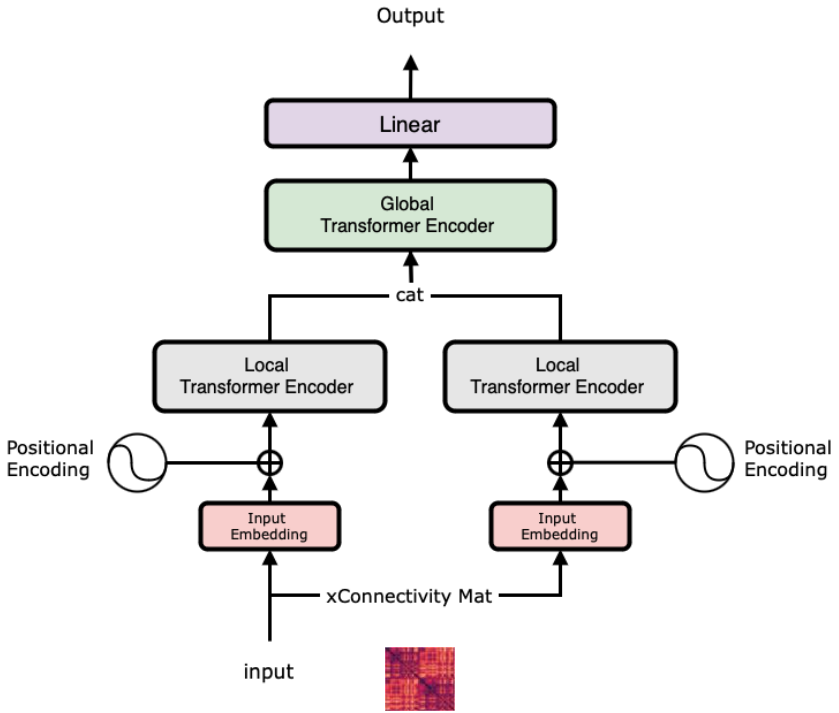
Test Loss	Test Accuracy
0.035	**0.91**

2. Progress & Findings

- Improved Early Fusion
- Connectivity-informed Dual-Encoder Transformer
- **TriFormer**
- Connectome-head Transformer
- Results
- Long-Range Spatiotemporal Transformer

TriFormer

Test Loss	Test Accuracy
0.0312	**0.9498**

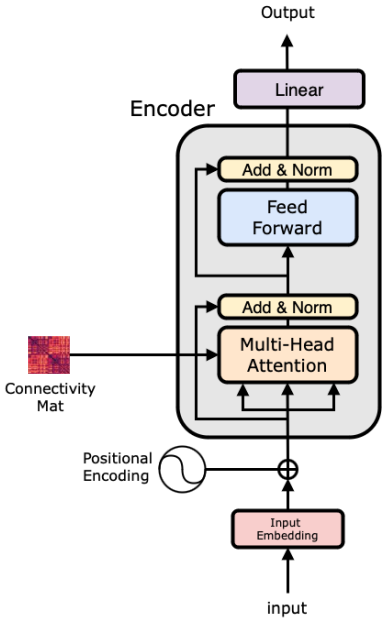


TriFormer Architecture

2. Progress & Findings

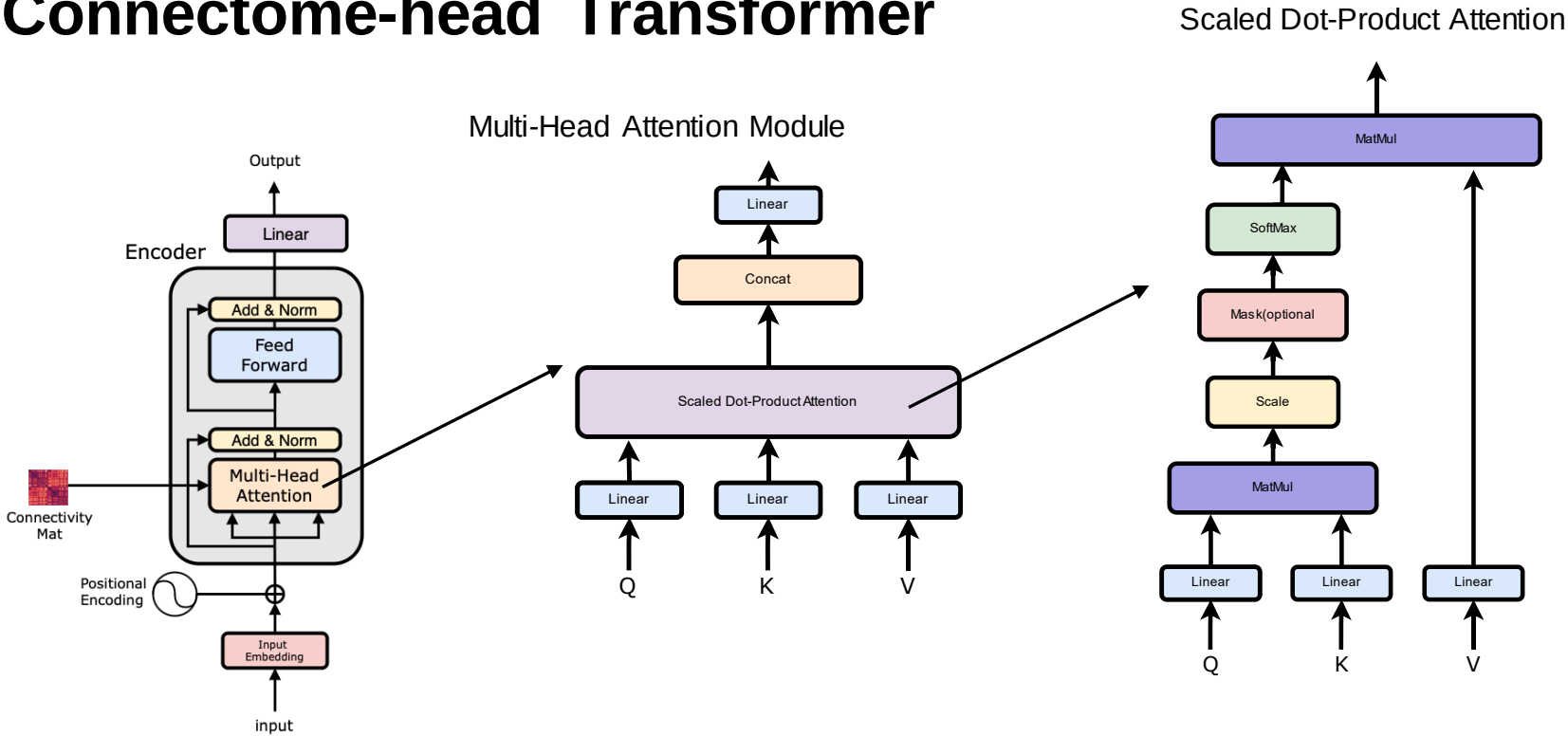
- Improved Early Fusion
- Connectivity-informed Dual-Encoder Transformer
- TriFormer
- **Connectome-head Transformer**
- Results
- Long-Range Spatiotemporal Transformer

Connectome-head Transformer



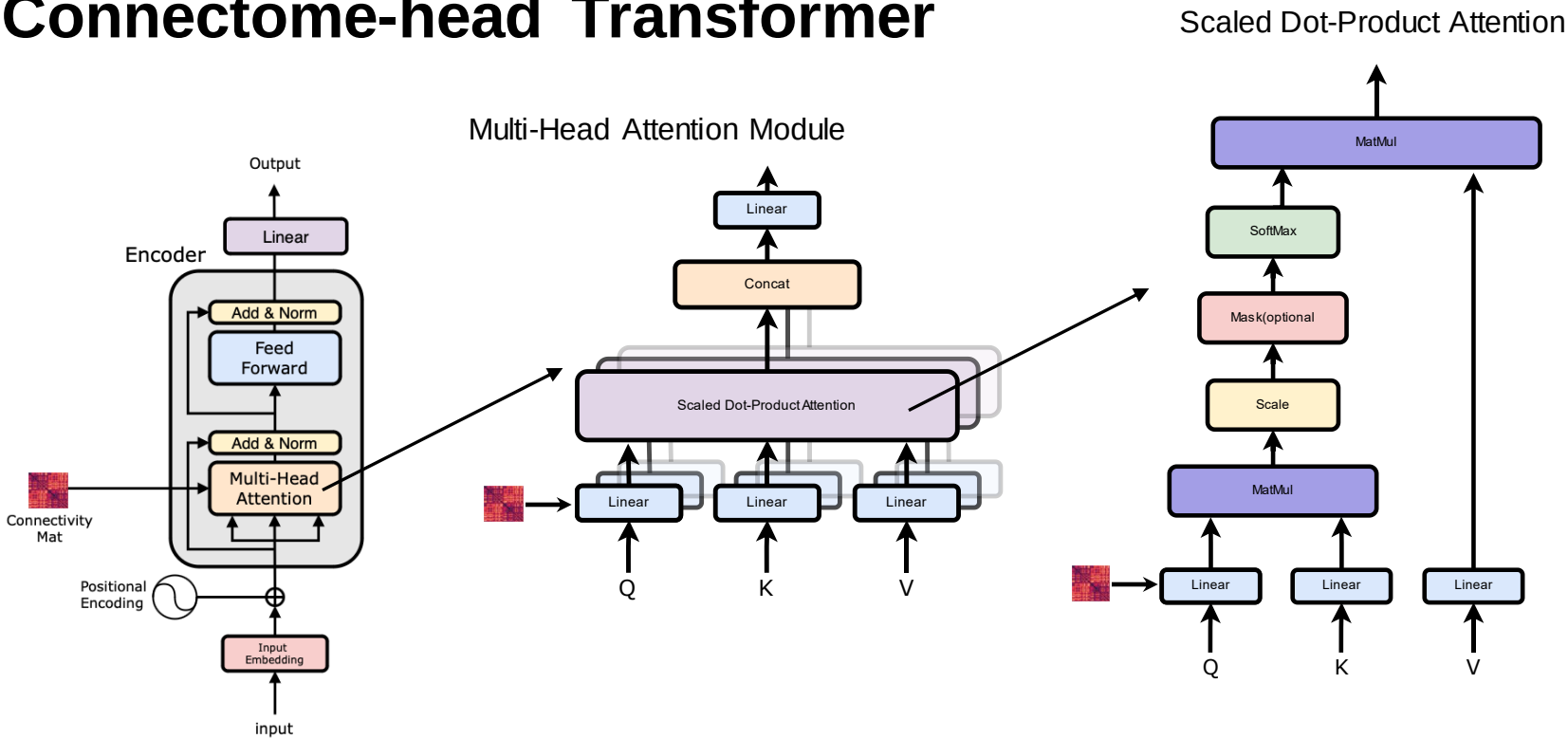
Connectivity-initialized Multi-Head Attention

Connectome-head Transformer



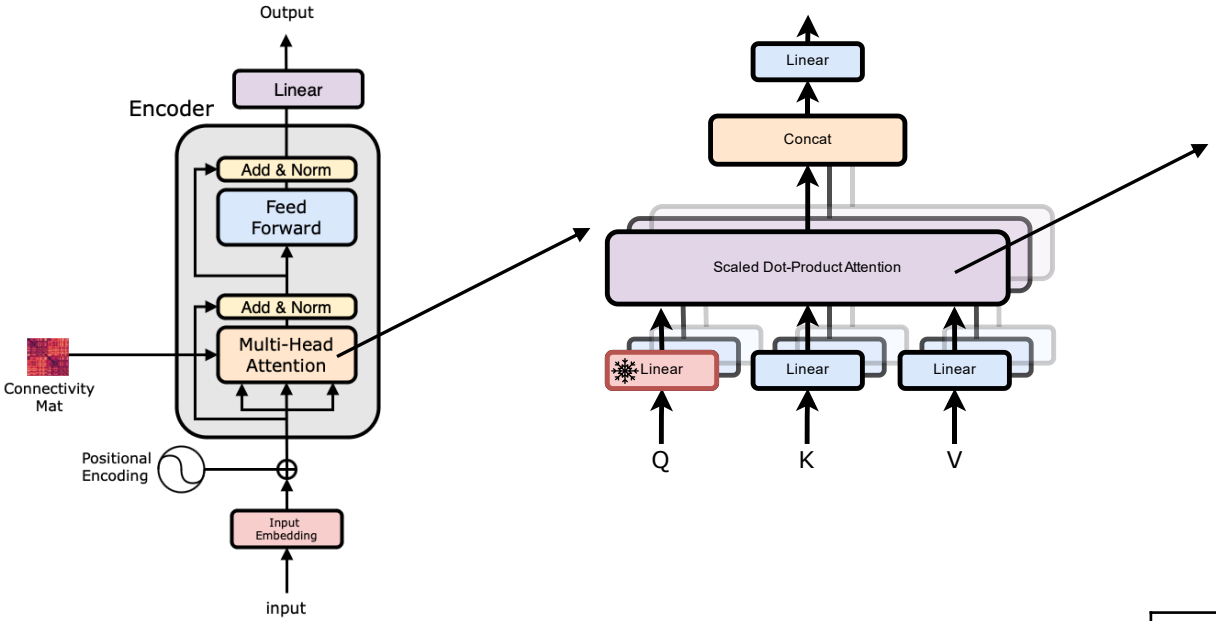
Connectivity-initialized Multi-Head Attention

Connectome-head Transformer



Connectivity-initialized Multi-Head Attention

Connectome-head Transformer



Connectivity-initialized Multi-Head Attention

Test Loss	Test Accuracy
0.0319	**0.943**

2. Progress & Findings

- Improved Early Fusion
- Connectivity-informed Dual-Encoder Transformer
- TriFormer
- Connectome-head Transformer
- **Results**
- Long-Range Spatiotemporal Transformer

Results

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Dual-Encoder	0.035	0.91
Triformer	0.0312	0.9498
Connectome-head	0.0319	0.9438

2. Progress & Findings

- Improved Early Fusion
- Connectivity-informed Dual-Encoder Transformer
- TriFormer
- Connectome-head Transformer
- Results
- **Long-Range Spatiotemporal Transformer**

Long-Range Spatiotemporal Transformer Architecture

Long-Range Transformers for Dynamic Spatiotemporal Forecasting

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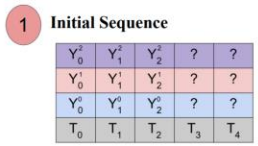

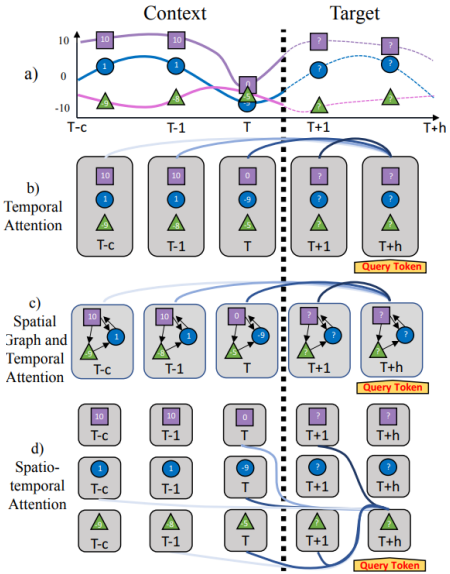

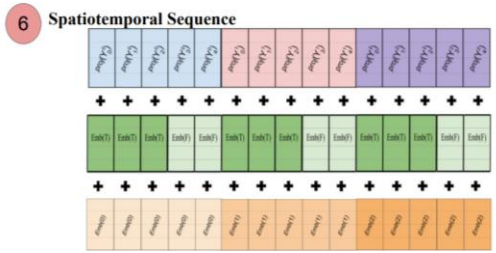

High computational resources needed

- minimum size of 41 GB in GPU

Intended use: cutting edge baseline

- Tradeoff between *effort* <-> *meaning* not valuable enough

arXiv:2109.12218v2

2. Evaluation and Discussion

- Result Analysis
- Open Questions
- Next Steps

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Evaluation and Discussion - Results

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2. Evaluation and Discussion

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New Open Questions

Is Connectivity data **significantly** improving our results ?

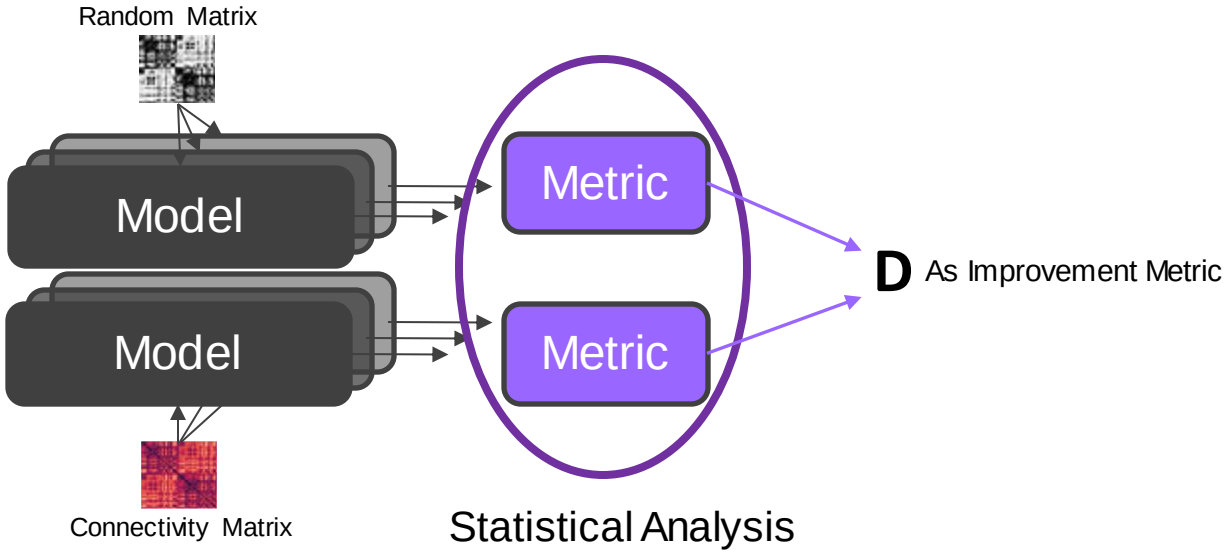
If so, which architecture profits the most from connectivity matrix?

How meaningful are our Predictions ?

2. Evaluation and Discussion

- Result Analysis
- Open Questions
- **Next Steps**
  - **Statistical Analysis**
  - Experiment with more Options

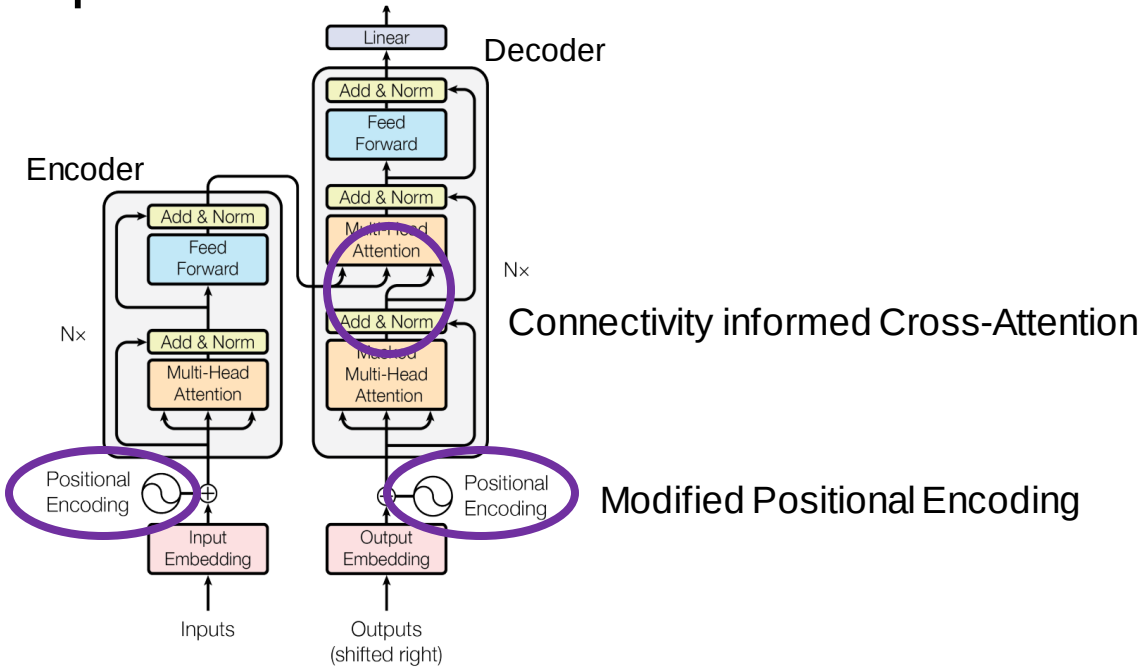
Evaluation and Discussion - Results



2. Evaluation and Discussion

- Result Analysis
- Open Questions
- **Next Steps**
  - Statistical Analysis
  - **Experiment with more Options**

Connectivity Data Incorporation



Vaswani, Ashish, et al. "Attention is all you need." *Advances in neural information processing systems* 30 (2017).

Thank you for your attention!