Forward Propagation

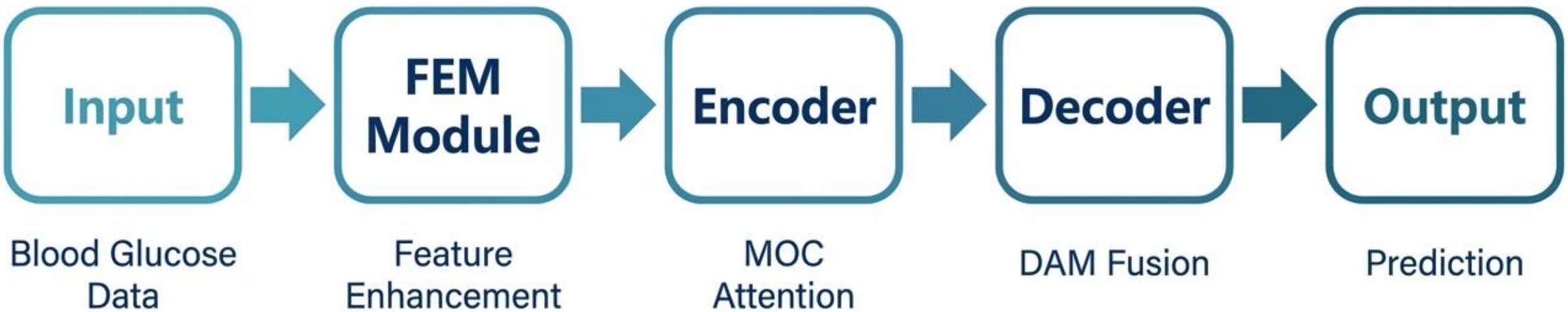
BGformer Blood Glucose Prediction Model - Mathematical Expression

BS6220: Spatial and Multi-omics Data Analytics

Problem Context: Blood Glucose Prediction

- Input: Continuous glucose monitoring data (5-min intervals)
- Challenge: Predict glucose 60-90 minutes ahead
- Application: Early warning for diabetes management
- Solution: BGformer transformer-based model

Forward Propagation Pipeline



FEM Module: Periodic Features (Eq. 5-7)

Formula Definitions:

$$hour\_of\_day(x) = \frac{hour(x)}{23} - 0.5$$

$$minute\_of\_hour(x) = \frac{minute(x)}{59} - 0.5$$

Range: $[-0.5, +0.5]$

Numeric Example:

Timestamp	hour_of_day	minute_of_hour
08:15:30	-0.152	-0.246
08:20:30	-0.152	-0.161

FEM Module: Trend Features (Eq. 11)

$$trend(i) = (1-alpha) * \text{SUM}(alpha^t * x_{i-t})$$

Numeric Example:

Parameters: alpha = 0.3

Input (x): [120, 125, 130] mg/dL (x_{i-2}, x_{i-1}, x_i)

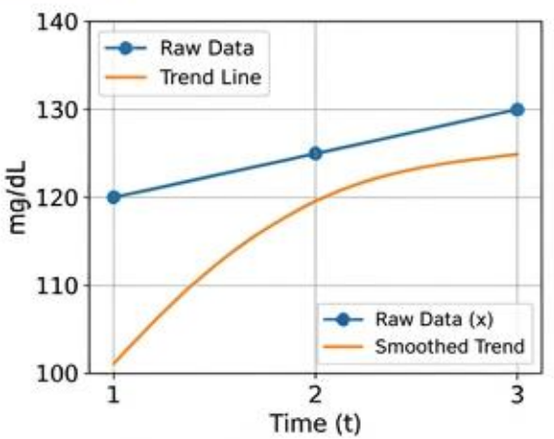
Weights ($alpha^t$): [0.3^0, 0.3^1, 0.3^2] = [1, 0.3, 0.09]

Calculation ($\text{SUM}(alpha^t * x_{i-t})$): (1 * 130) + (0.3 * 125) + (0.09 * 120)

= 130 + 37.5 + 10.8

= **178.3**

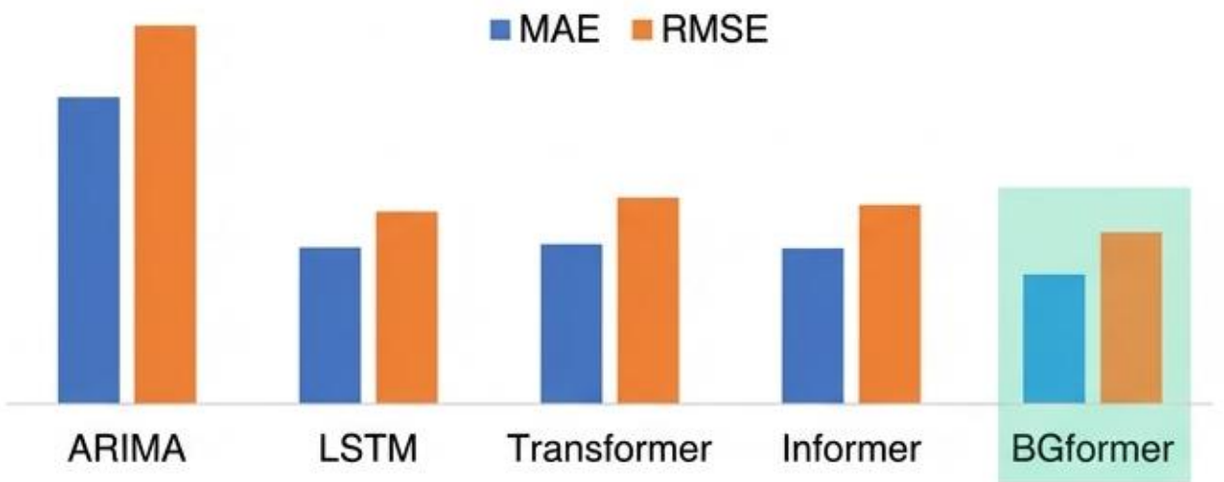
Result: $\text{trend}(i) = (1 - 0.3) * 178.3 = 0.7 * 178.3 =$ **124.81** mg/dL



Experimental Results (60-min Prediction)

- Dataset info:
  - DirecNet
  - 16 diabetic patients
  - 5-min intervals

Model	MAE	RMSE
ARIMA	56.03	69.88
LSTM	28.44	35.70
Transformer	29.33	38.15
Informer	28.47	37.06
BGformer	**23.46**	**31.35**



Key Result:

BGformer **achieves 14% improvement over** Informer

Team Contribution

- Class Presentation: [Name 1, Name 2]
- Recorded Presentation: [Name 3]
- Research & Slides: [Name 4, Name 5]
- Numeric Example: [Name 6]
- Coordination: [Name 7]

AI Tools Used: Claude AI for content generation, Google Gemini for slide images

[1] Xue et al. (2024). BGformer: An improved Informer model. Journal of Biomedical Informatics.