



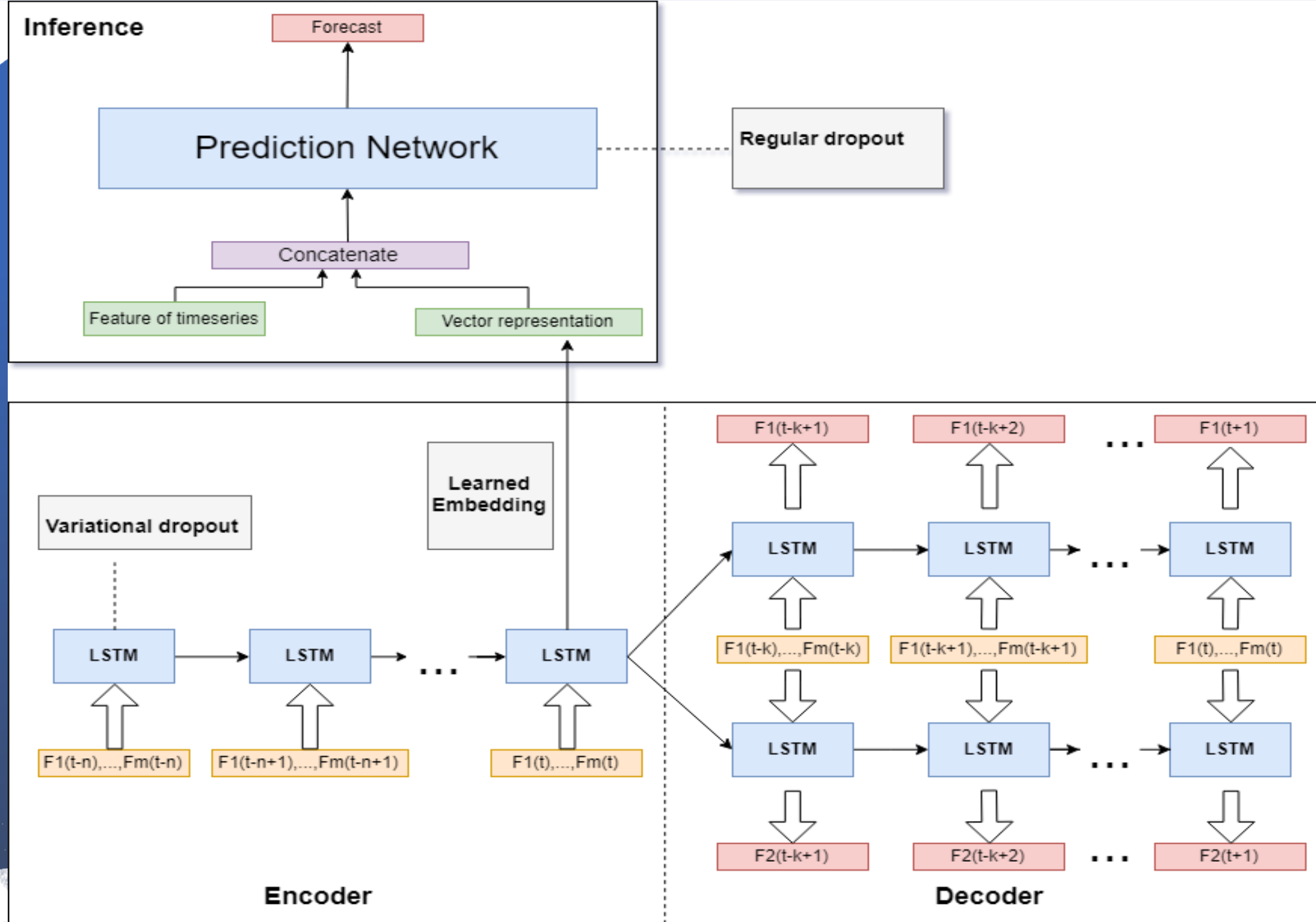
Bayesian neural network



OUTLINES

- Bayesian model
- Prediction uncertainty
- Experiments
- Results

BAYESIAN MODEL





PREDICTION UNCERTAINTY

- Model uncertainty
- Model misspecification
- Inherent noise

MODEL UNCERTAINTY & MODEL MISSPECIFICATION

Algorithm 1: MCdropout

Input: data x^* , encoder $g(\cdot)$, prediction network $h(\cdot)$, dropout probability p , number of iterations B

Output: prediction \hat{y}_{mc}^* , uncertainty η_1

- 1: **for** $b = 1$ to B **do**
- 2: $e_{(b)}^* \leftarrow \text{VariationalDropout}(g(x^*), p)$
- 3: $z_{(b)}^* \leftarrow \text{Concatenate}(e_{(b)}^*, \text{extFeatures})$
- 4: $\hat{y}_{(b)}^* \leftarrow \text{Dropout}(h(z_{(b)}^*), p)$
- 5: **end for**
- // prediction*
- 6: $\hat{y}_{mc}^* \leftarrow \frac{1}{B} \sum_{b=1}^B \hat{y}_{(b)}^*$
- // model uncertainty and misspecification*
- 7: $\eta_1^2 \leftarrow \frac{1}{B} \sum_{b=1}^B (\hat{y}_{(b)}^* - \hat{y}^*)^2$
- 8: **return** \hat{y}_{mc}^*, η_1

INHERENT NOISE

Algorithm 2: Inference

Input: data x^* , encoder $g(\cdot)$, prediction network $h(\cdot)$, dropout probability p , number of iterations B

Output: prediction \hat{y}^* , predictive uncertainty η

// prediction, model uncertainty and misspecification

1: $\hat{y}^*, \eta_1 \leftarrow \text{MCdropout}(x^*, g, h, p, B)$

// Inherent noise

2: **for** x'_v **in** validation set $\{x'_1, \dots, x'_V\}$ **do**

3: $\hat{y}'_v \leftarrow h(g(x'_v))$

4: **end for**

5: $\eta_2^2 \leftarrow \frac{1}{V} \sum_{v=1}^V \left(\hat{y}'_v - y'_v \right)^2$

// total prediction uncertainty

6: $\eta \leftarrow \sqrt{\eta_1^2 + \eta_2^2}$

7: **return** \hat{y}^*, η

The background features a large, dark blue, irregular shape on the left side, resembling a splash or a cloud. To its right is a lighter blue area with a fine, grainy texture. Scattered throughout these areas are numerous small, dark blue dots and specks, giving the impression of a starry field or a microscopic view.

EXPERIMENTS



RESULTS