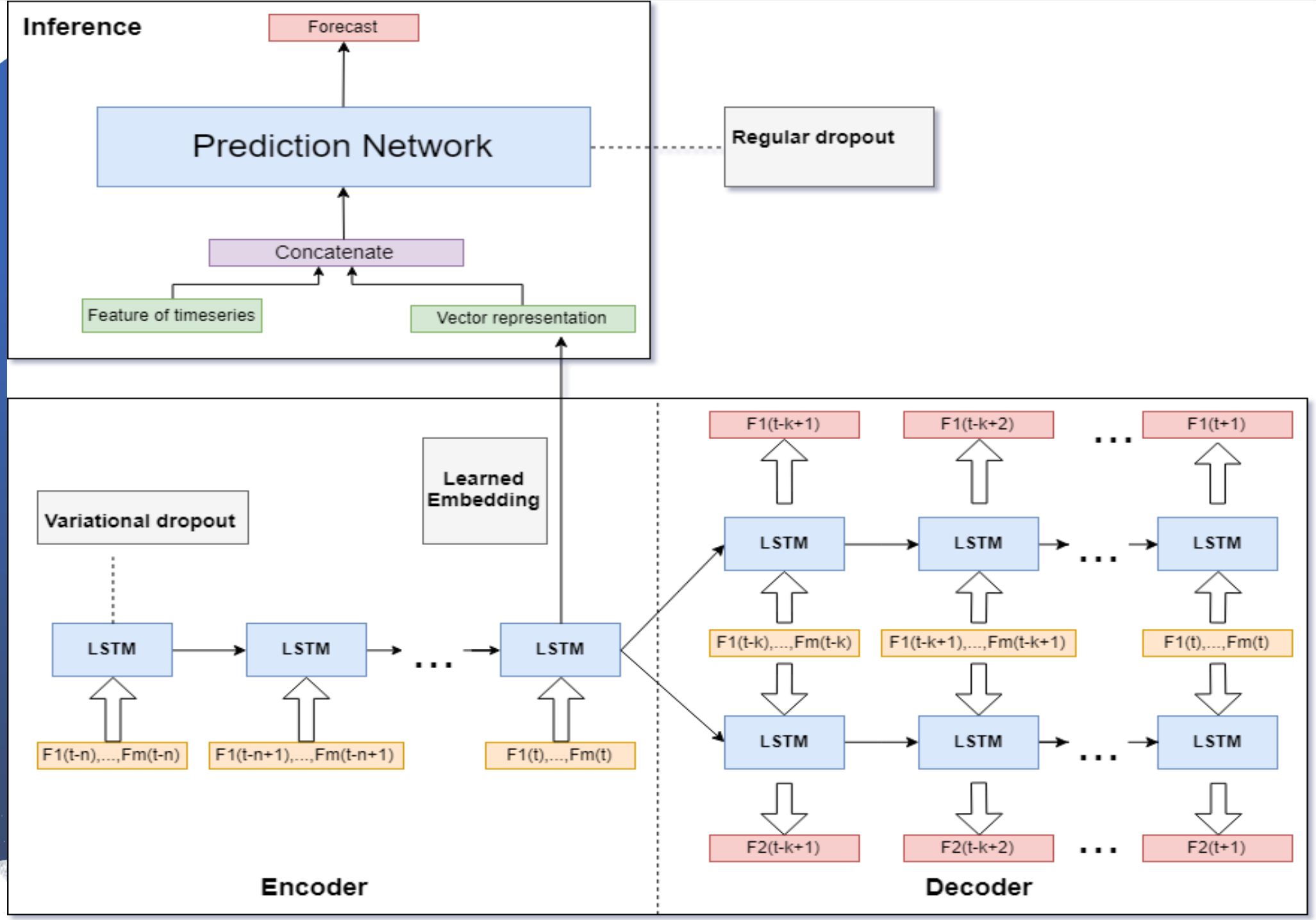
Bayesian neural network

OUTLINES

- Bayesian model
- Pediction 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

for $b = 1$ to B **do**
  $e^*_{(b)} \leftarrow \mathit{VariationalDropout}(g(x^*), p)$
  $z^*_{(b)} \leftarrow \text{Concatenate}(e^*_{(b)}, \text{extFeatures})$
  $\hat{y}^*_{(b)} \leftarrow \mathit{Dropout}\ (h(z^*_{(b)}), p)$
end for

// prediction

$\hat{y}^*_{mc} \leftarrow \frac{1}{B} \sum_{b=1}^{B} \hat{y}^*_{(b)}$

// model uncertainty and misspecification

$\eta_1^2 \leftarrow \frac{1}{B} \sum_{b=1}^{B} (\hat{y}^*_{(b)} - \hat{y}^*)^2$

return $\hat{y}^*_{mc}, \eta_1$

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

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

// Inherent noise

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

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

end for

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

// total prediction uncertainty

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

return $\hat{y}^*, \eta$

EXPERIMENTS

RESULTS