

# HeTVAE: Heteroscedastic Temporal VAE

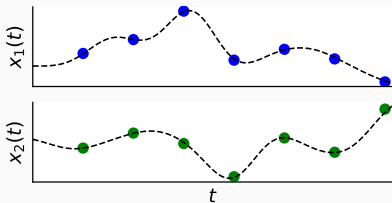
For Irregular Time Series

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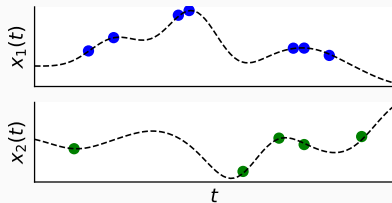
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# Irregularly Sampled Time Series



Multivariate regularly sampled



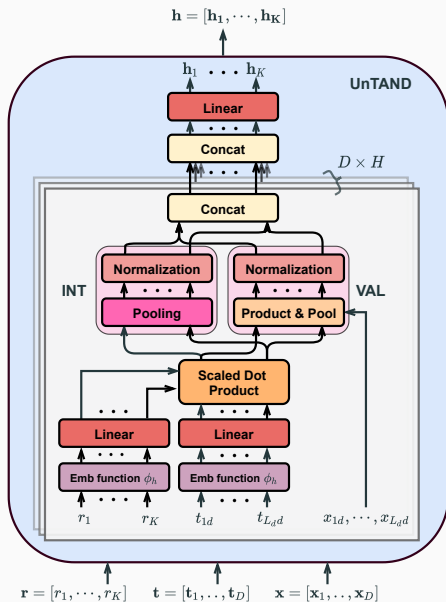
Multivariate **irregularly** sampled

- Uncertainty-Aware Multi-Time Attention Network layer to encode information about input uncertainty due to variable sparsity.

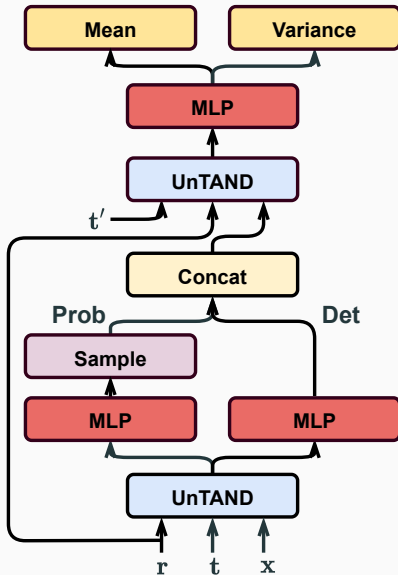
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- Augmented learning objective for training the HeTVAE.
- Improves uncertainty quantification in the output interpolations compared to several baselines and state-of-the-art methods.

# UnTAN: Uncertainty Aware Multi-Time Attention Networks



# HeTVAE Architecture



## Augmented Learning Objective

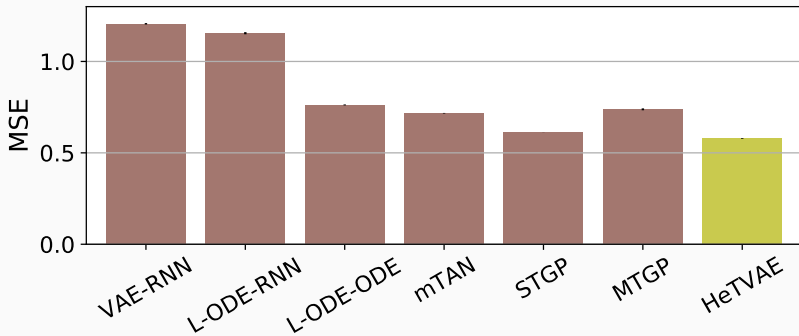
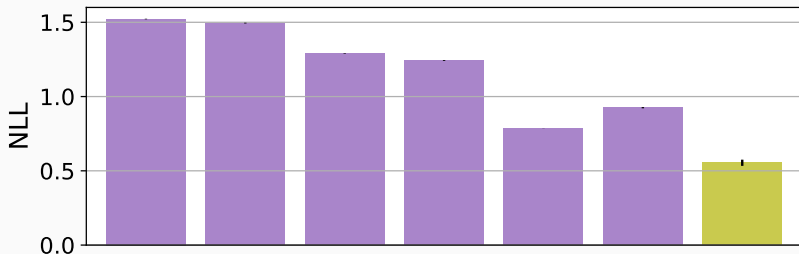
$$\mathcal{L}_{\text{NVAE}}(\theta, \gamma) = \sum_{n=1}^N \frac{1}{\sum_d L_{dn}} \left( \mathbb{E}_{q_\gamma(\mathbf{z}|\mathbf{r}, \mathbf{s}_n)} [\log p_\theta^{\text{het}}(\mathbf{x}_n | \mathbf{z}_n^{\text{cat}}, \mathbf{t}_n)] \right. \\ \left. - D_{\text{KL}}(q_\gamma(\mathbf{z}|\mathbf{r}, \mathbf{s}_n) \| p(\mathbf{z})) - \lambda \mathbb{E}_{q_\gamma(\mathbf{z}|\mathbf{r}, \mathbf{s}_n)} \|\mathbf{x}_n - \boldsymbol{\mu}_n\|_2^2 \right)$$



## Augmented Learning Objective

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# Probabilistic Interpolation: PhysioNet



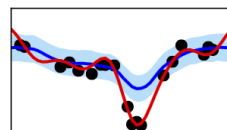
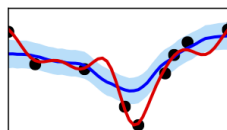
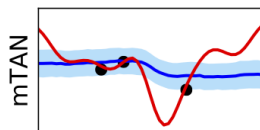
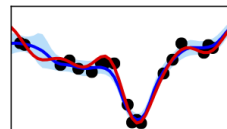
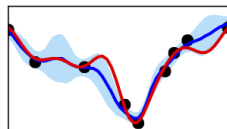
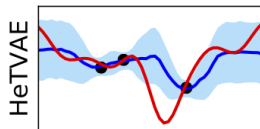
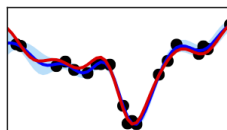
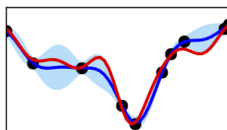
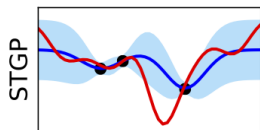
# Qualitative Evaluation

• Observed data    — Ground truth    — Reconstructions

$n = 3$

$n = 10$

$n = 20$



## Thank You.

- Code: <https://github.com/reml-lab/hetvae>
- Paper: <https://arxiv.org/pdf/2107.11350.pdf>
- Contact: [snshukla@cs.umass.edu](mailto:snshukla@cs.umass.edu)