Probabilistic Forecasting with DeepAR and AWS SageMaker

DeepAR – Yet Another Forecasting Algorithm?

Advantages of DeepAR

+ Probabilistic Forecasts

Like…

- ARIMA
- Regression Models

But not…

- Plain LSTMs (Neural Network)

Advantages of DeepAR

+ Automatic Feature Engineering

Like…

- Plain LSTMs

But not…

- ARIMA
- Regression Models
- Etc.

Advantages of DeepAR

+ One algorithm for multiple timeseries

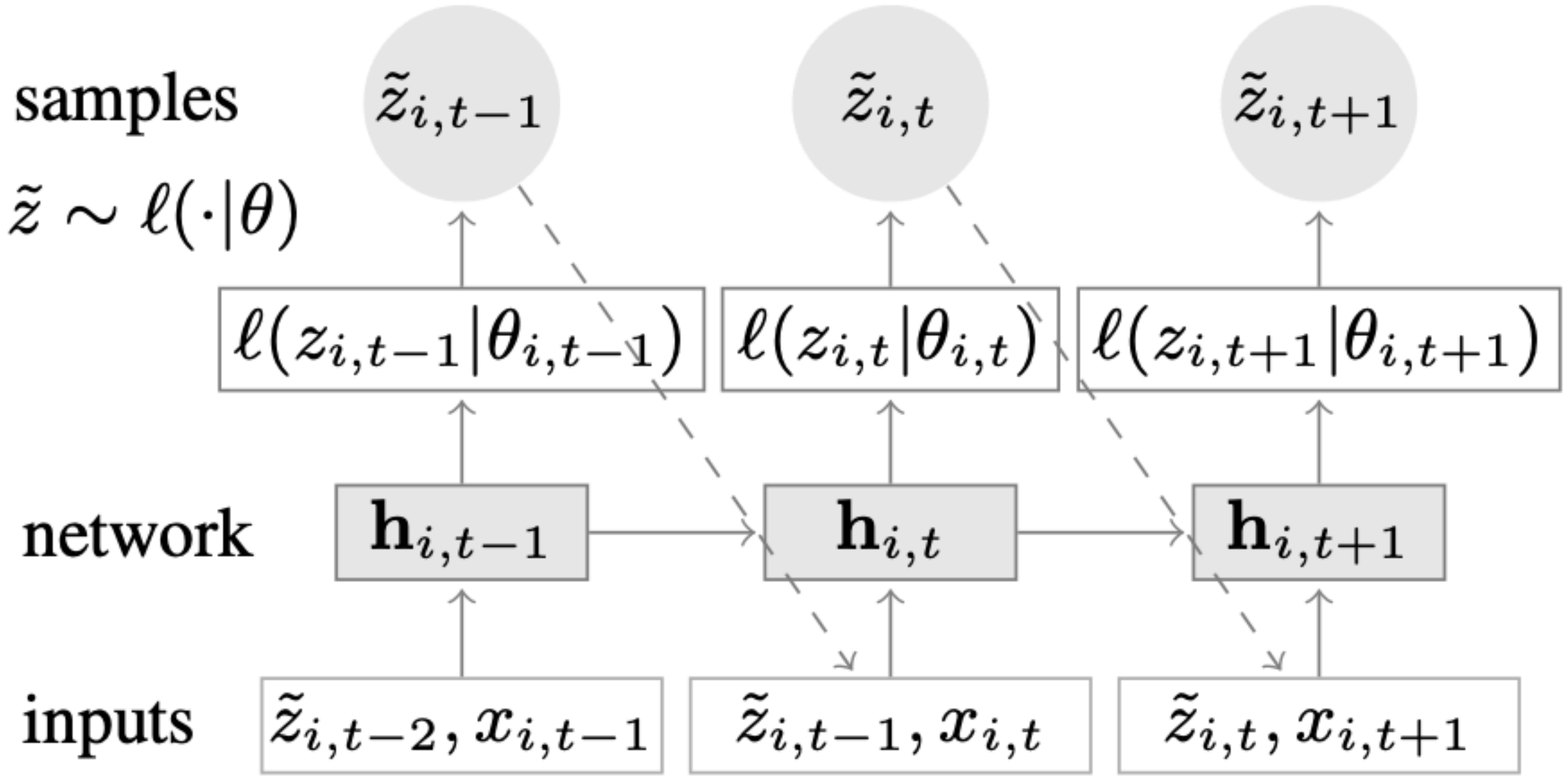
Like…

- Meta Learning?
- Transfer Learning?

Disadvantages

- Time- and resource intensive to train
- Difficult to set hyperparameters and to tune

DeepAR – How does it work?



SALINAS, David, et al. DeepAR: Probabilistic forecasting with autoregressive recurrent networks. *International Journal of Forecasting*, 2019.

Example Datasets for DeepAR

- Sales at Amazon
- Sales in Stores
- Forecast Load of Servers in Datacenter
- Car traffic
- Energy Consumption in Households

AWS Sagemaker

Label	Build	Train & Tune	Deploy & Manage
Amazon SageMaker Ground Truth Build and manage training data sets	**Amazon SageMaker Studio** Integrated development environment (IDE) for machine learning		
	Amazon SageMaker Autopilot Automatically build and train models		**Amazon SageMaker Model Monitor** Automatically detect concept drift
	Amazon SageMaker Notebooks One-click notebooks with elastic compute	**Amazon SageMaker Experiments** Capture, organize, and search every step	**Amazon SageMaker Neo** Train once, deploy anywhere
	AWS Marketplace Pre-built algorithms and models	**Amazon SageMaker Debugger** Debug and profile training runs	**Amazon Augmented AI** Add human review of model predictions
		Automatic Model Tuning One-click hyperparameter optimization	

https://aws.amazon.com/sagemaker/?nc1=h_ls

Let´s code - Imports

```
import boto3
import s3fs
import sagemaker
from sagemaker import get_execution_role
from sagemaker.amazon.amazon_estimator import get_image_uri
```

Data preparation


```
{"start": "2009-11-01 00:00:00", "target": [4.3, "NaN", 5.1,
...], "cat": [0, 1], "dynamic_feat": [[1.1, 1.2, 0.5, ...]]}

{"start": "2012-01-30 00:00:00", "target": [1.0, -5.0, ...],
"cat": [2, 3], "dynamic_feat": [[1.1, 2.05, ...]]}

{"start": "1999-01-30 00:00:00", "target": [2.0, 1.0], "cat":
[1, 4], "dynamic_feat": [[1.3, 0.4]]}
```

Hyperparameter

```
hyperparameters = {
      "time_freq": "H",
      "context_length": "72",
      "prediction_length": "24",
      "num_cells": "50",
      "num_layers": "3",
      "likelihood": "gaussian",
      "epochs": "25",
      "mini_batch_size": "64",
      "learning_rate": "0.001",
      "dropout_rate": "0.05",
      "early_stopping_patience": "30" }
```

Train Model - I

```
sagemaker_session = sagemaker.Session()

role = sagemaker.get_execution_role()

image_name = sagemaker.amazon. \
             amazon_estimator.get_image_uri(region,
                                             "forecasting-deepar",
                                             "latest")
```

Train Model - II

```
estimator = sagemaker.estimator.Estimator(
      sagemaker_session=sagemaker_session,
      image_name=image_name,
      role=role,
      train_instance_count=1,
      train_instance_type="ml.c4.xlarge",
      base_job_name="electricity-deepar",
      output_path="s3://" + s3_output_path)

estimator.set_hyperparameters(**hyperparameters)
```

Fit Model

```
data_channels = {
      "train": f"s3://{s3_data_path}/train/",
      "test": f"s3://{s3_data_path}/test/"
}

estimator.fit(inputs=data_channels)
```

Deployment

```
job_name = estimator.latest_training_job.name

endpoint_name = sagemaker_session.endpoint_from_job(
                          job_name=job_name,
                          initial_instance_count=1,
                          instance_type="ml.m4.xlarge",
                          deployment_image=image_name,
                          role=role )
```

Questions?

Feel free to contact me!

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