Continuous Weather Forecasting Using Autonomous Deep Learning

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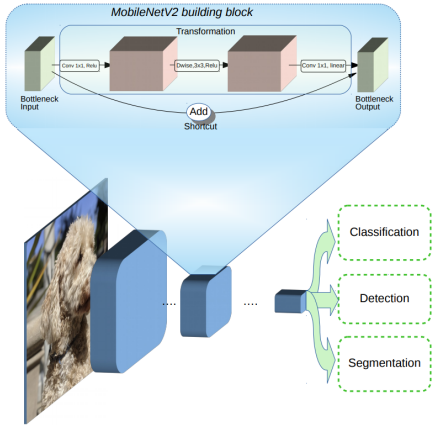
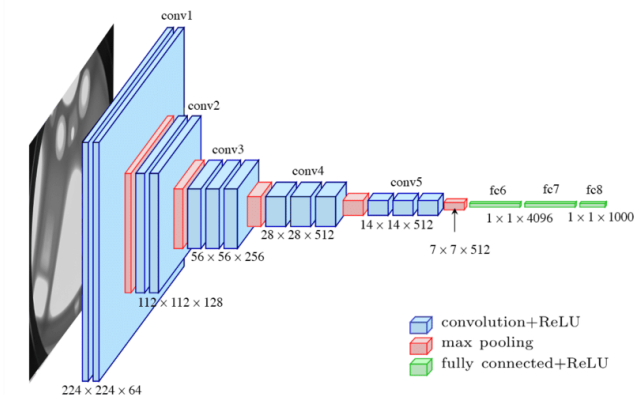
Pratama, Mahardhika, et al. "Autonomous deep learning: Incremental learning of denoising autoencoder for evolving data streams." *arXiv preprint arXiv:1809.09081*(2018).

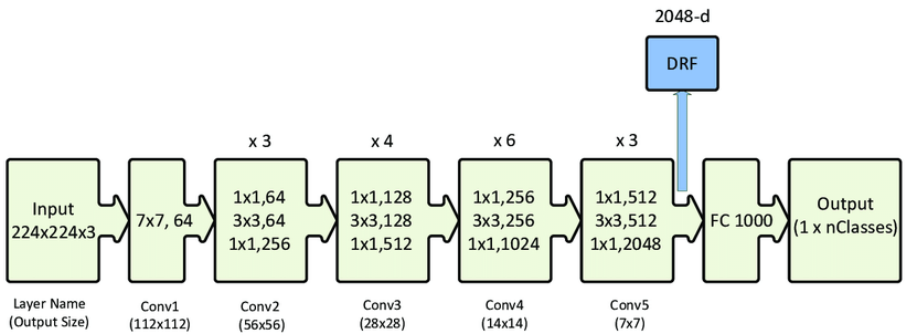
What network to choose?



MobileNetV2



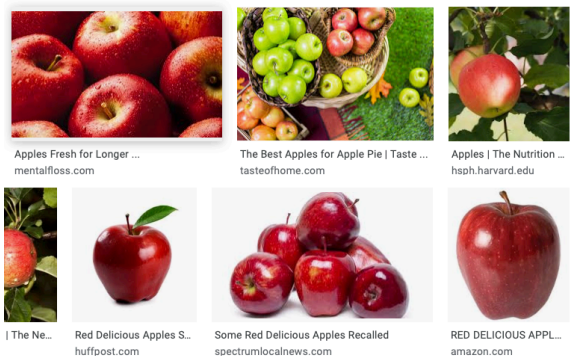
VGG16

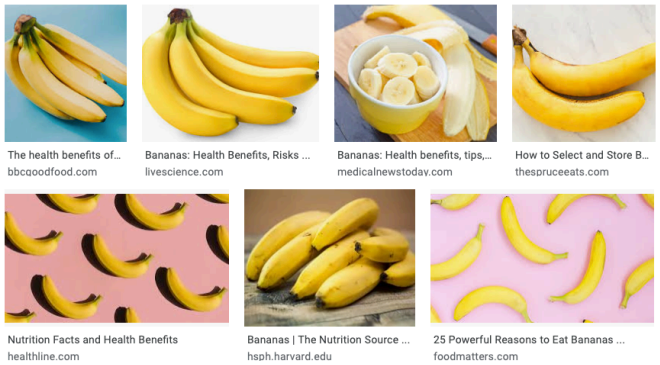


ResNet50

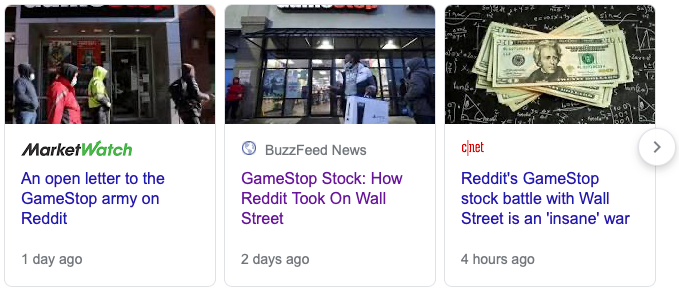
Complexity varies

- Case 1:
  - Distinguish apples from bananas

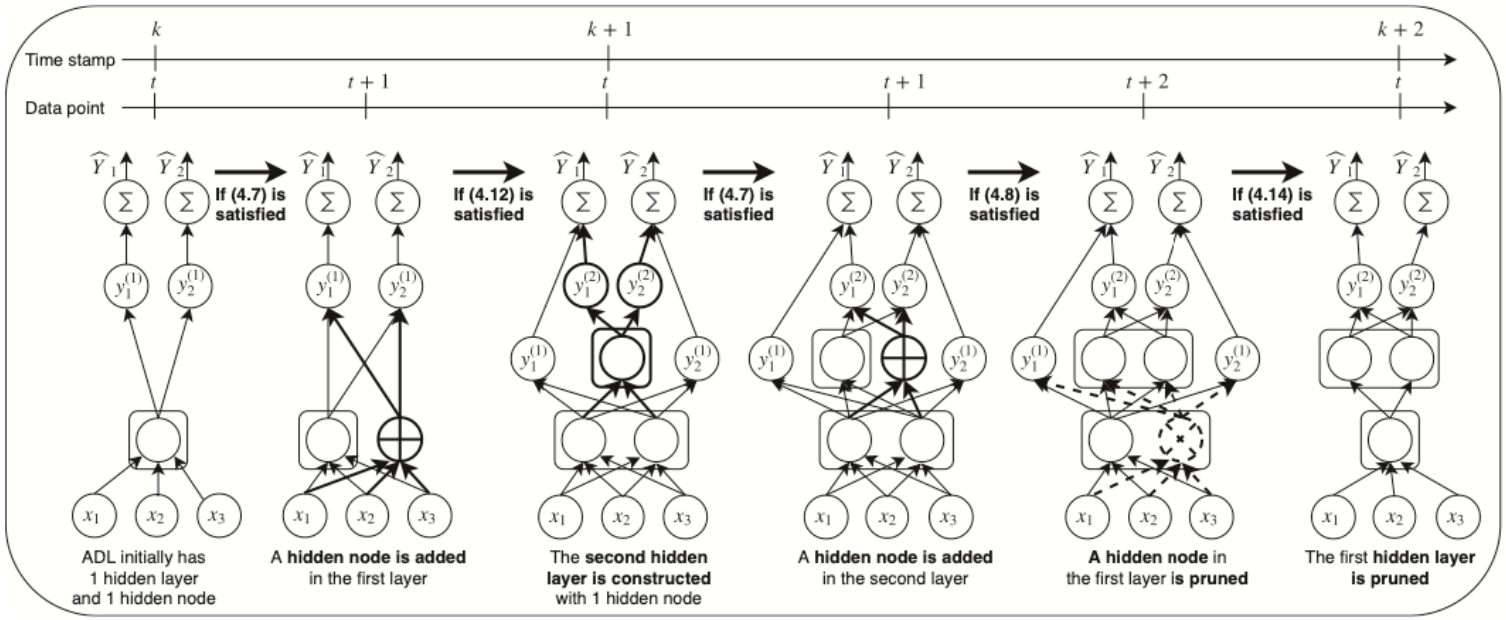




- Case 2:
  - Predict stock prices from news data



Autonomous DNN: adaptive network size



Example of an automated DNN construction

Ashfahani, Andri, and Mahardhika Pratama. "Autonomous deep learning: Continual learning approach for dynamic environments." *Proceedings of the 2019 SIAM International Conference on Data Mining*. Society for Industrial and Applied Mathematics, 2019.

Published Results

Table 1: Numerical results of benchmarked algorithm

Data sets	Performance	DEVDAN	pEnsemble	pEnsemble+	AE	DAE
SUSY	CR	**77.53 ± 3.22**	74.44 ± 2.4	76.99 ± 4.6	76.37 ± 3.91	76.24 ± 4
	ET	4K	13K	35K	1K	1
	HN	20.6 ± 2.8	2.09 ± 0.99	8.94 ± 2.91	10	10
	NoP	435.5 ± 58.9	36.43 ± 21.21	230 ± 80	212	212
HEPMASS 19%	CR	**83.91 ± 2.45**	82.6 ± 1.9	82.3 ± 2.2	79.92 ± 2.73	79.8 ± 2.69
	ET	1.2K	12K	7.6K	464.45	519
	HN	19.99 ± 0.4	2.01 ± 0.69	2.01 ± 0.69	10	10
	NoP	622.5 ± 15	24.14 ± 8.23	24.14 ± 8.23	312	312
RLCPS	CR	**99.99 ± 0.03**	99.7 ± 0.3	99.8 ± 0.3	99.99 ± 0.03	99.99 ± 0.04
	ET	7K	60K	12.6K	1K	1K
	HN	60.23 ± 1.82	49.7 ± 15.14	6.96 ± 1.06	10	10
	NoP	724.68 ± 26.82	24	83.52 ± 12.72	122	122
RFID localization	CR	98.9 ± 3.33	60.4 ± 6.7	60.9 ± 7.6	99.02 ± 3.34	**99.19 ± 2.03**
	ET	176.58	499	700	49.94	60.81
	HN	51.74 ± 9.47	1.57 ± 0.65	1.31 ± 0.46	10	10
	NoP	417.54 ± 76.94	42.7 ± 22.48	43.73 ± 13.52	84	84
Electricity pricing	CR	69.4 ± 8.74	**72.6 ± 11.4**	72.6 ± 12.1	67.72 ± 10.48	68.61 ± 8.55
	ET	17.32	71.2	78.2	8.18	9.67
	HN	10.58 ± 1.26	1	1.01 ± 0.12	10	10
	NoP	117.74 ± 17.7	12	12	112	112
Weather	CR	74.04 ± 5.68	78.4 ± 4.3	**78.8 ± 4**	73.76 ± 5.76	71.18 ± 7.06
	ET	6.93	33.49	29.42	3.2	3.7
	HN	14 ± 0.57	1	1	10	10
	NoP	153.54 ± 24.56	24	24.33 ± 2	112	112
KDDCup 10%	CR	**99.84 ± 0.21**	99.3 ± 0.4	96.7 ± 6	99.83 ± 0.21	99.81 ± 0.21
	ET	338.6	5362.9	860	116.69	133.37
	HN	36.01 ± 6.09	1	1	10	10
	NoP	1587 ± 270.72	12	12	442	442
SEA	CR	**92.29 ± 6.48**	92 ± 5.7	92 ± 6	91.74 ± 6.61	92.12 ± 6.34
	ET	38.88	178.2	200	18.59	21.4
	HN	18.4 ± 10.4	2.51 ± 0.81	2.51 ± 0.81	10	10
	NoP	112.35 ± 62.87	60.3 ± 19.43	60.3 ± 19.43	62	62
Hyperplane	CR	**92.12 ± 3.47**	91.8 ± 1.9	87.6 ± 6.2	90.92 ± 3.18	91.43 ± 3.29
	ET	38.34	68.2	150	149.8	21.36
	HN	4.21 ± 0.95	2.66 ± 1.79	2.76 ± 0.47	10	10
	NoP	31.4 ± 6.77	52.75 ± 44.98	54.68 ± 10.92	72	72

CR: classification rate, ET: execution time, HN: hidden nodes, NoP: number of parameters

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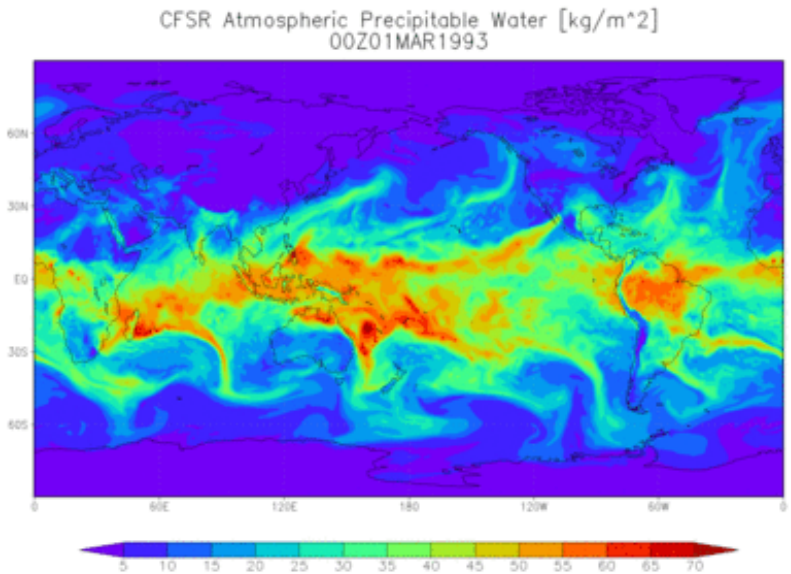
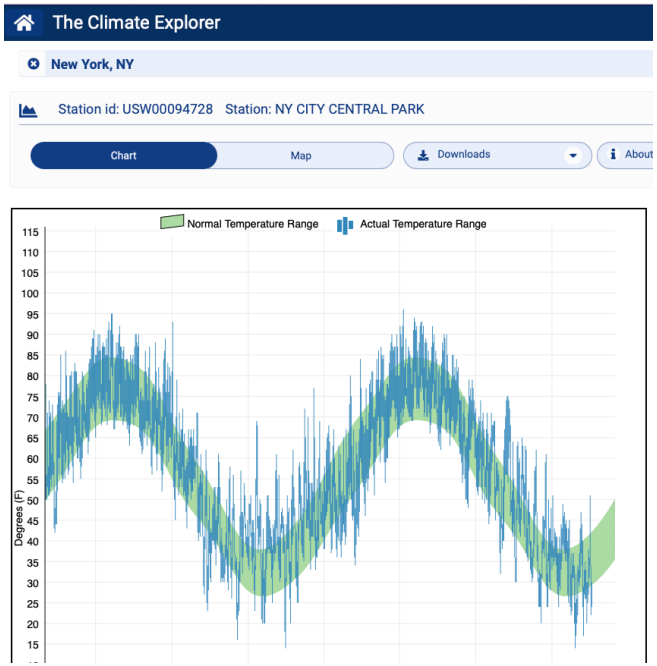
Dataset

- Several categories of model data are available through NOAA's National Operational Model Archive and Distribution System (NOMADS). These broad categories of data are Reanalysis, Numerical Weather Prediction, Climate Prediction, and Derived/Other Model Data.
- However these data are formatted in different types – needs decoding and reformatting



Dataset

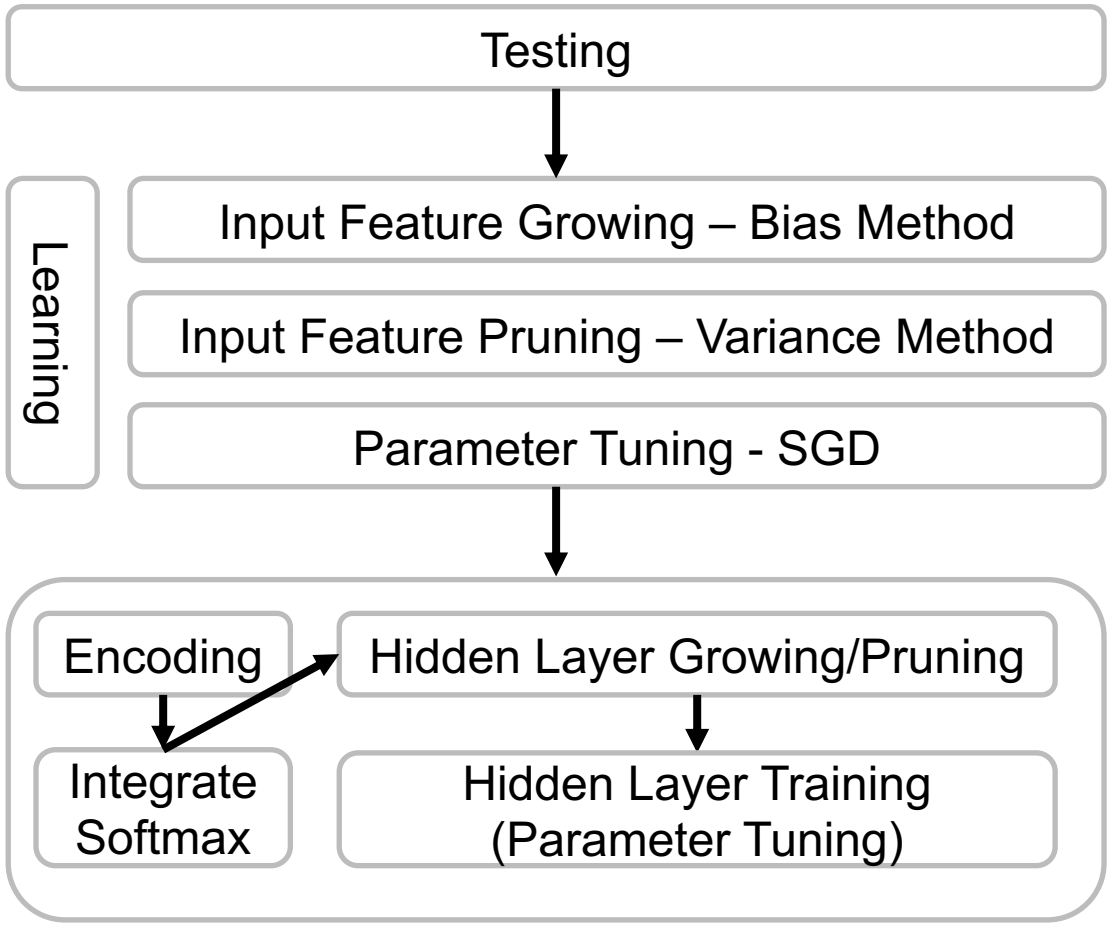
- https://crt-climate-explorer.nemac.org/historical-weather-data/?county=New%20York%20County&city=New%20York%2C%20NY&fips=36061&lat=40.71&lon=-74.01&nav=historical-weather-data&station=USW00094728&station-name=NY%20CITY%20CENTRAL%20PARK&mode=daily_vs_climate&zoom=9



USW00094728-temperature-degreeF

date	min	max	normal_min	normal_max
18690101	29.0	19.0	38.9	27.9
18690102	27.0	21.0	38.8	27.7
18690103	35.0	27.0	38.7	27.6
18690104	37.0	34.0	38.5	27.4
18690105	43.0	37.0	38.4	27.3
18690106	38.0	34.0	38.3	27.2
18690107	48.0	35.0	38.2	27.1
18690108	54.0	40.0	38.2	27.0
18690109	48.0	38.0	38.1	26.9
18690110	44.0	33.0	38.0	26.8
18690111	33.0	30.0	38.0	26.8
18690112	37.0	29.0	38.0	26.7
18690113	38.0	28.0	37.9	26.7
18690114	42.0	32.0	37.9	26.6
18690115	42.0	39.0	37.9	26.6
18690116	38.0	32.0	37.9	26.6
18690117	35.0	29.0	37.9	26.6
18690118	29.0	26.0	38.0	26.5
18690119	34.0	27.0	38.0	26.6
18690120	37.0	30.0	38.0	26.6
18690121	42.0	29.0	38.1	26.6
18690122	29.0	17.0	38.2	26.6
18690123	39.0	20.0	38.2	26.6
18690124	48.0	35.0	38.3	26.7
18690125	38.0	22.0	38.4	26.7
18690126	31.0	18.0	38.5	26.8

Learning Mechanism



Implementation

- Implemented autonomous neural network w/ mnist

```
Discriminative Training: running ...
The new node no 60 is FORMED around sample 344
The new node no 61 is FORMED around sample 589
The new node no 62 is FORMED around sample 832
Discriminative Training: ... finished
=========Chunk 17 of 70=========
Discriminative Testing: running ...
Classification rate 7.474118e-01
Discriminative Testing: ... finished
DEVDAN Training: running ...
DEVDAN Training: ... finished
Discriminative Training: running ...
The new node no 63 is FORMED around sample 212
The new node no 64 is FORMED around sample 574
Discriminative Training: ... finished
=========Chunk 18 of 70=========
Discriminative Testing: running ...
Classification rate 7.526111e-01
Discriminative Testing: ... finished
DEVDAN Training: running ...
DEVDAN Training: ... finished
Discriminative Training: running ...
Discriminative Training: ... finished
=========Chunk 19 of 70=========
Discriminative Testing: running ...
Classification rate 7.585263e-01
Discriminative Testing: ... finished
DEVDAN Training: running ...
DEVDAN Training: ... finished
Discriminative Training: running ...
The new node no 65 is FORMED around sample 716
Discriminative Training: ... finished
=========Chunk 20 of 70=========
Discriminative Testing: running ...
Classification rate 7.629500e-01
Discriminative Testing: ... finished
DEVDAN Training: running ...
```

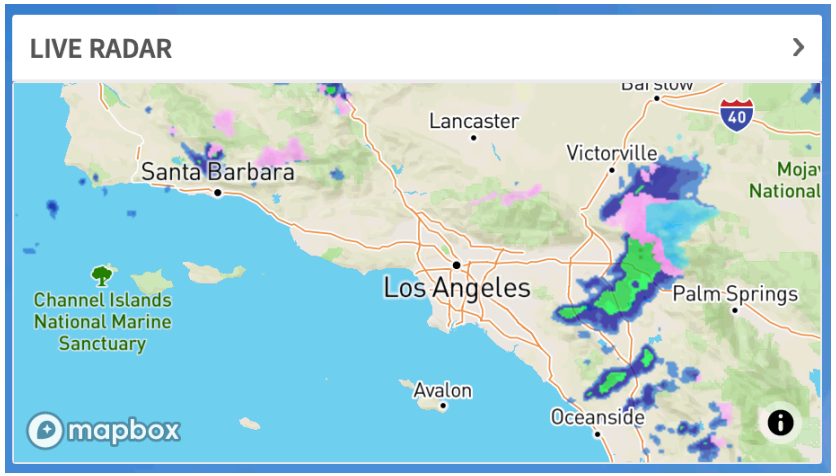
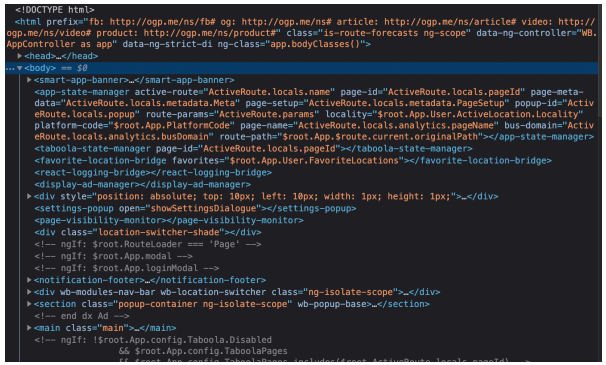
Next Steps

- Obtain more detailed weather data by using NOAA data decoder
- Or find other data sources that uses more friendly data formats
- Reformat data into usable dataset
- Training & Validating

- Weather Real-Time Forcasting Web
  - To support several different areas/cities
  - Obtain real-time weather data from other apis
  - Predict future weather with trained autonomous NN
  - Display prediction to user

Real-Time Forcasting

- Web Scraping From weatherbug.com\



- Live scraping w/ python