House Price Prediction in Iowa State

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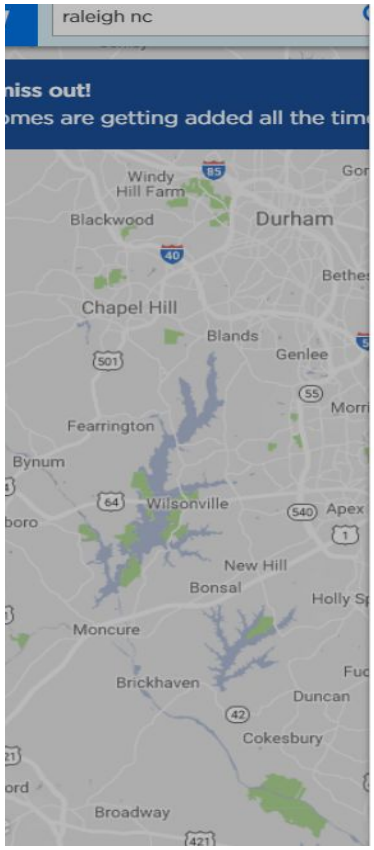


INTERIOR FEATURES

Bedrooms
Beds: 7

Bathrooms
Baths: 8 full, 4 half

Flooring
Floor size: 18,398 sqft
Flooring: Carpet, Hardwood, Tile

Other Interior Features
Fireplace
View Virtual Tour

SPACES AND AMENITIES

Spaces
Wet Bar
Pool
Fitness Center
Tennis Court

Amenities
Elevator
Security System

CONSTRUCTION

Type and Style
Single Family

Dates
Built in 1999

Materials
Exterior material: Stone

EXTERIOR FEATURES

Patio
Porch

Lot
Lot: 15.27 acres

Given Features of a House.

Predict it's Price?

Introduction and Motivation

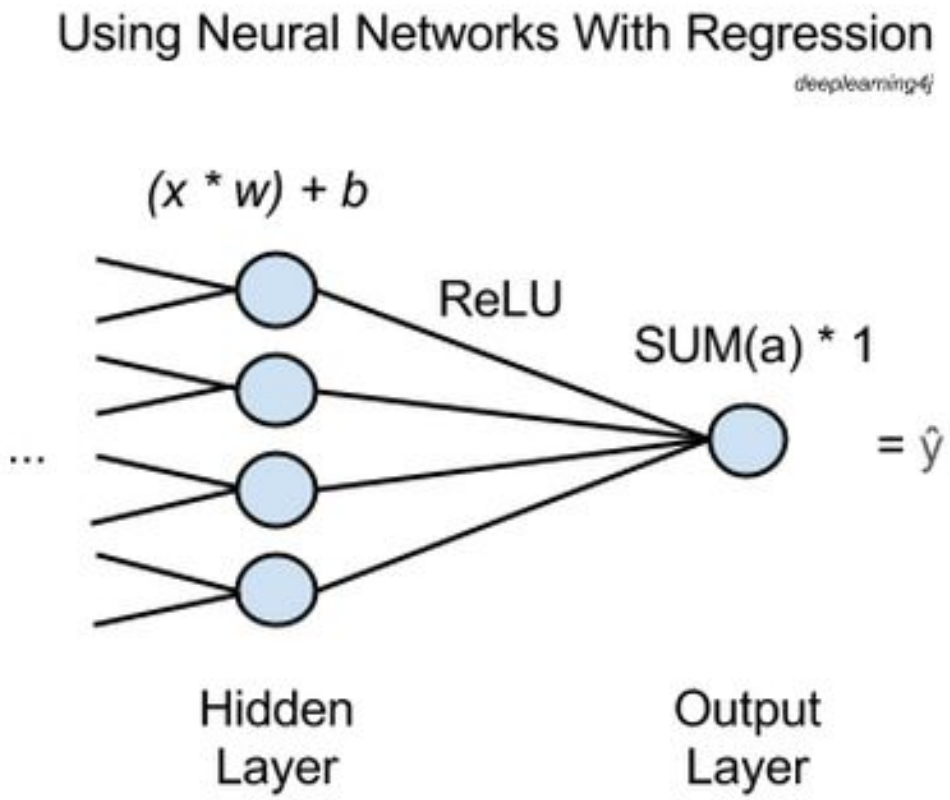
Business Point of View

INVEST

How does he predict which house is the best?

Solution : Use this model

Class Point of View

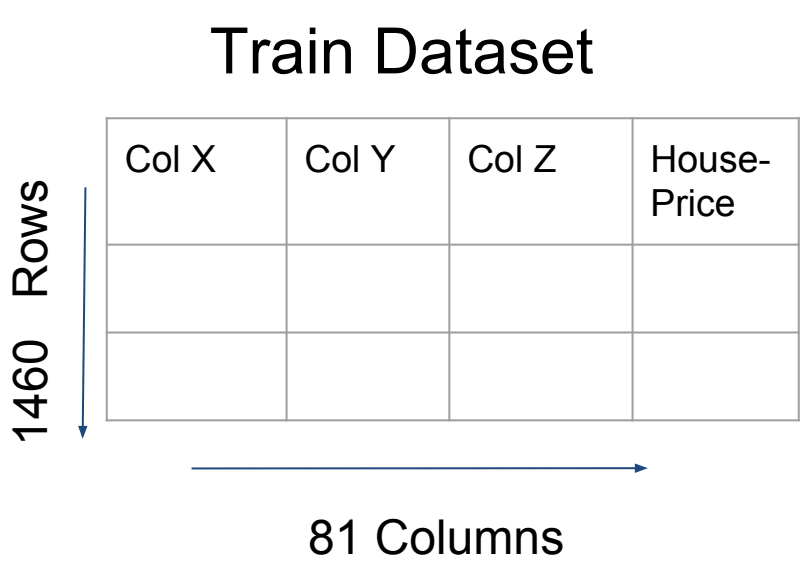


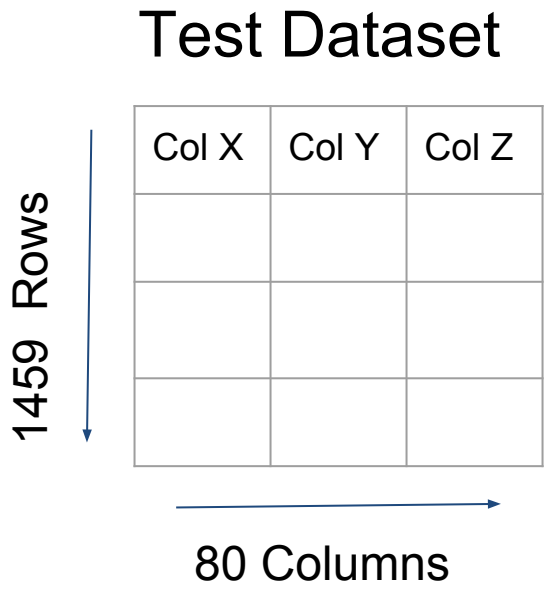
Advanced Neural Nets

Dataset

- Target attribute :
  Sale Price of the house
  Ex : $39050

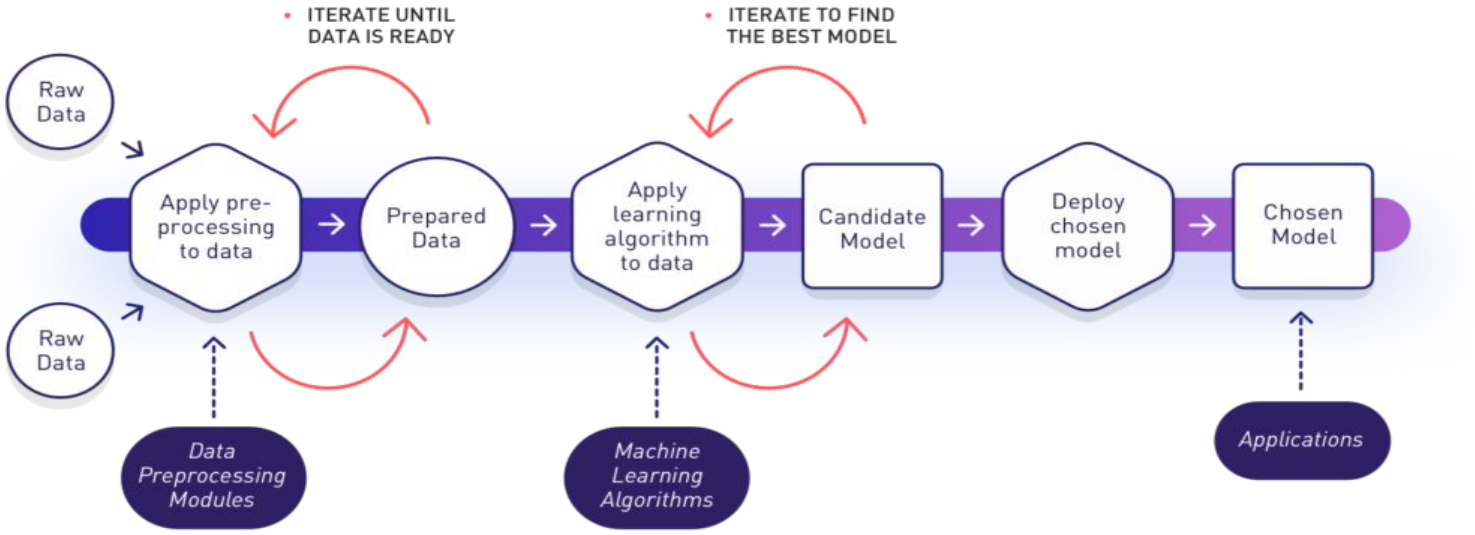
- Dataset contains 80 attributes
  EX : Basement Quality : good





Literature Survey

- Advanced Machine learning
  - Data Cleaning
  - Data Preprocessing
  - Supervised Learning (Neural Network)
  - Regression

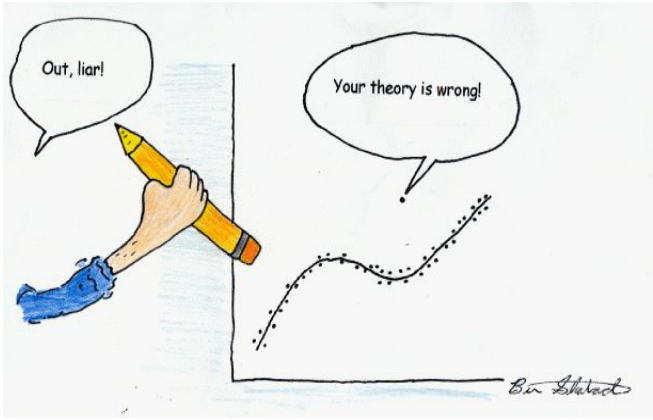


Data Cleaning and Preprocessing

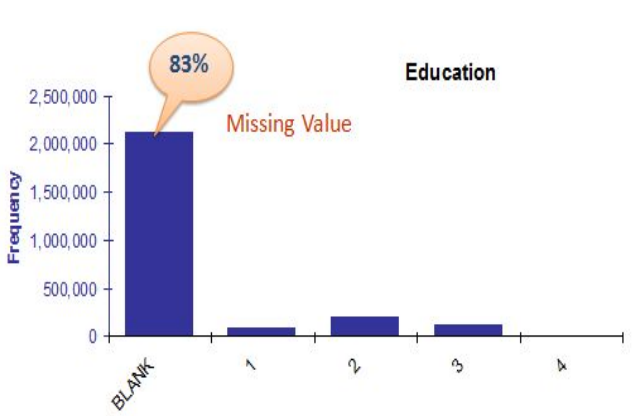
The below steps were applied on both train and test data :

Data Cleaning steps :

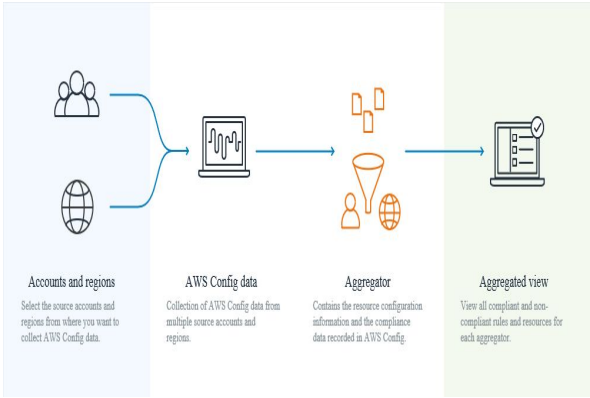
1.Removing Outliers



2. Handle Missing Values



3.Aggregations

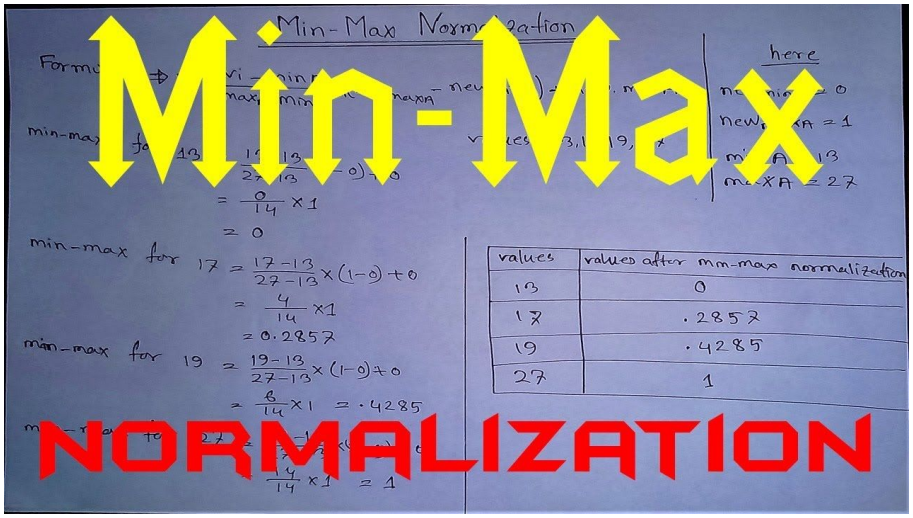


Newly Processes Data:
Train-set : 1417 rows, 67 columns
Test set : 1459 rows, 66 columns

Data Preprocessing

Data Preprocessing steps : Normalization (Min Max Scaler)

- Used only continuous features
- Used continuous and categorical features



train-numerical.csv
train-categorical.csv
train-all.csv

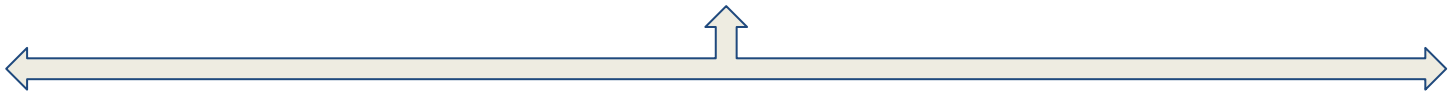
test-numeric.csv
test-categorical.csv
test-all.csv

Method: Linear Regression

$$Y = b_0 + b_1x_1 + b_2x_2 + ... + b_nx_n$$

Independent Variables (Features)

Dependent Variable (Target)



TotalBsmtSF	LowQualFinSF	...	Fireplaces	GarageYrBlt	GarageCars	MiscVal	MoSold	YrSold	SalePrice
0.249532	0.0	...	0.000000	0.978109	0.50	0.0	0.545455	0.50	0.239442
0.224891	0.0	...	0.000000	0.970149	0.25	0.0	0.727273	0.75	0.081664
0.392389	0.0	...	0.333333	0.998507	0.75	0.0	0.454545	0.25	0.238575
0.192140	0.0	...	0.000000	0.955721	0.25	0.0	0.454545	0.00	0.093800
0.283843	0.0	...	0.333333	0.990050	0.50	0.0	0.363636	0.25	0.251406

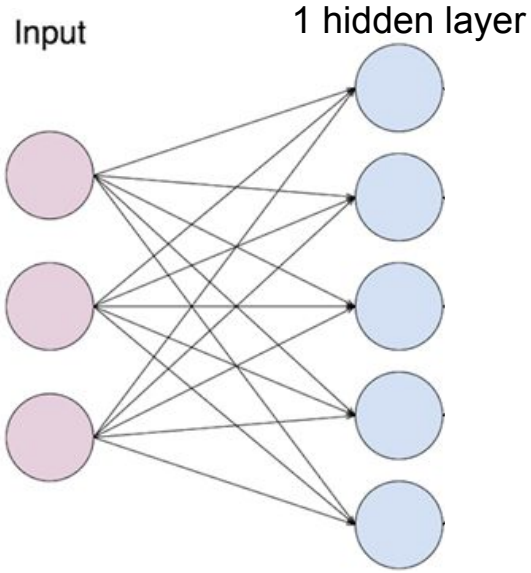
Method: Neural Net Regression

Broadly speaking we experimented with multiple ‘sizes’ of networks.

- Deep network: 100, 50, 25, 12, 6
- Medium sized network: 50, 25, 12, 6, 3
- Small sized network: 20, 10, 5

Shallow Net :
Only 1 hidden layer

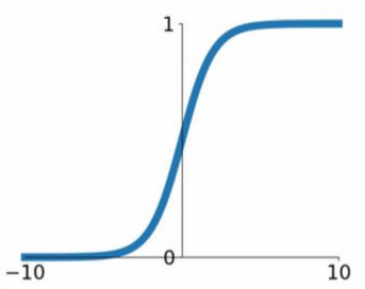
Number of neurons : 5, 12, …., 400



Activation Functions

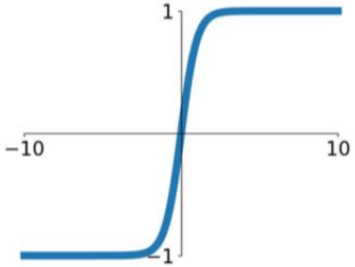
Sigmoid

$$\sigma(x) = \frac{1}{1+e^{-x}}$$



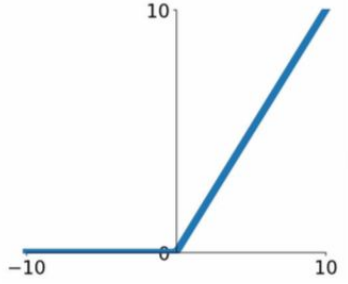
tanh

$$\tanh(x)$$



ReLU

$$\max(0, x)$$



Results (1)

Continuous Features:

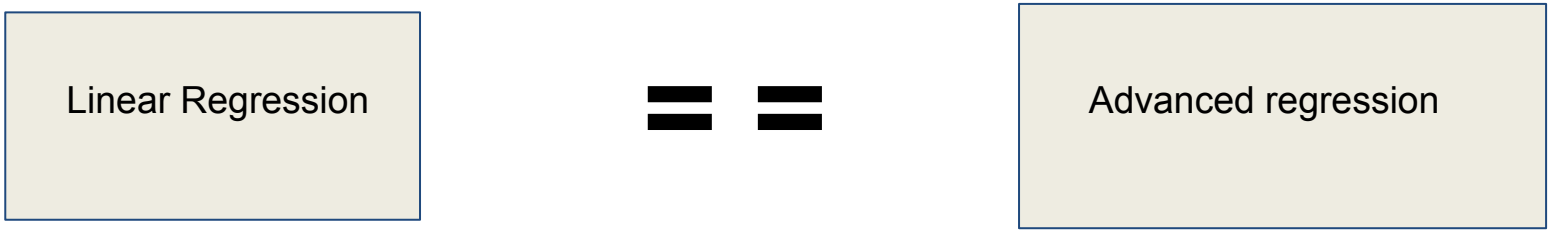
Regressor	MSE	Neural Net Layers	Number of Neurons in each layer
DNN Regression (complex)	0.0026	5	100, 50, 25, 12, 6
DNN Regression (medium)	0.0040	5	50, 25, 12, 6, 3
DNN Regression (small)	0.0038	3	20, 10, 5
Shallow Regression	0.0063	1	5
Shallow Regression	0.0035	1	12
Shallow Regression	0.0028	1	25
Shallow Regression	0.0038	1	50
Shallow Regression	0.0027	1	100
Shallow Regression	0.0026	1	200
Shallow Regression	0.0026	1	400
Linear regression	0.0028	–	–

Results (2)

Continuous and Categorical Features:

Regressor	MSE	Neural Net Layers	Number of Neurons in each layer
DNN Regression (complex)	0.0020	5	100, 50, 25, 12, 6
DNN Regression (medium)	0.0027	5	50, 25, 12, 6, 3
DNN Regression (small)	0.0016	3	20, 10, 5
Shallow Regression	0.0021	1	5
Shallow Regression	0.0018	1	12
Shallow Regression	0.0019	1	25
Shallow Regression	0.0019	1	50
Shallow Regression	0.0019	1	100
Shallow Regression	0.0019	1	200
Shallow Regression	0.0020	1	400
Linear regression	0.0024	–	–

Comparison Of Advanced Regression with Simple Linear Regression

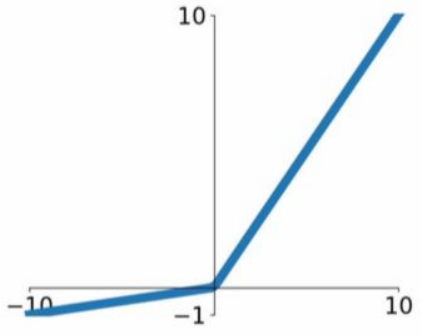


Is their performance Comparable?
Answer : YES (After using feature scaling)

Then why use Advanced techniques?

Leaky ReLU

$$\max(0.1x, x)$$

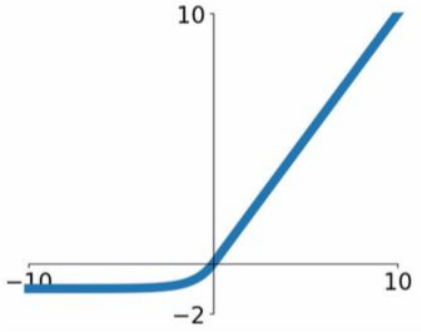


Maxout

$$\max(w_1^T x + b_1, w_2^T x + b_2)$$

ELU

$$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$$



Conclusions

- 60 % of the work was to clean and preprocess the data.
- As we make the model complicated with more number of layers and neurons, the model might be over-fitted.
- Educated guesses would be good in selecting the number of layers and number of neurons
- Linear regression might not be the best approach.
- MSE value is lower when we use all features instead of only continuous values as features.

Thank you!

ANY QUESTIONS?