Group project: House price prediction

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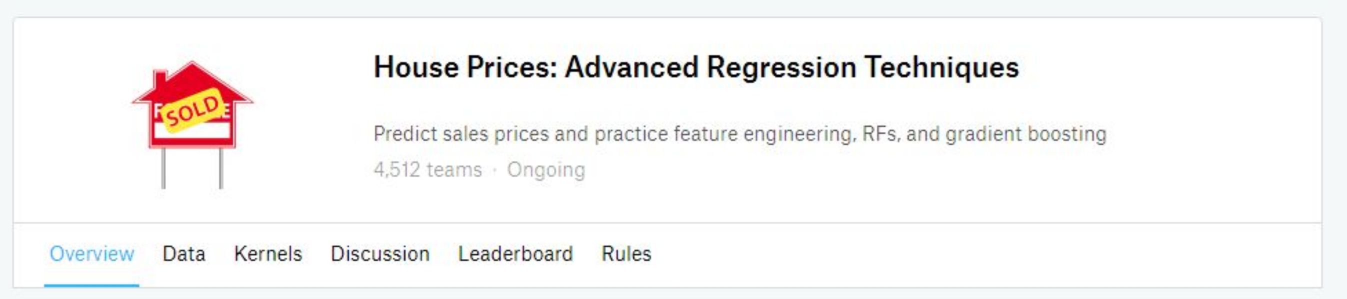
SCS_3253_009 Machine Learning

Data source: ongoing Kaggle competition



House Prices: Advanced Regression Techniques

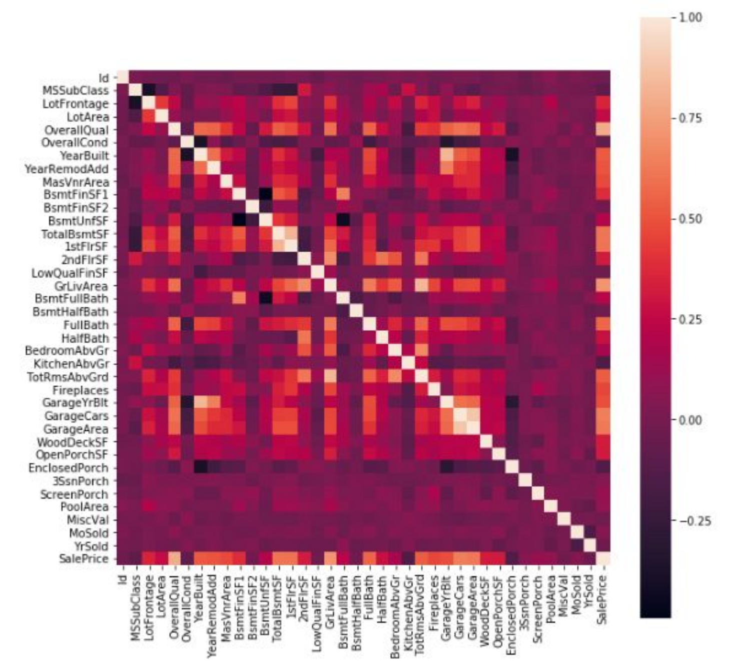
Predict sales prices and practice feature engineering, RFs, and gradient boosting

4,512 teams · Ongoing

There are 79 explanatory variables, 1460 rows in train dataset and 1459 rows in test dataset

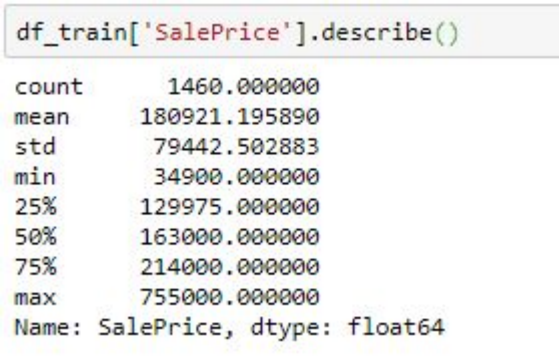
Data descriptive analysis

Numeric columns correlation



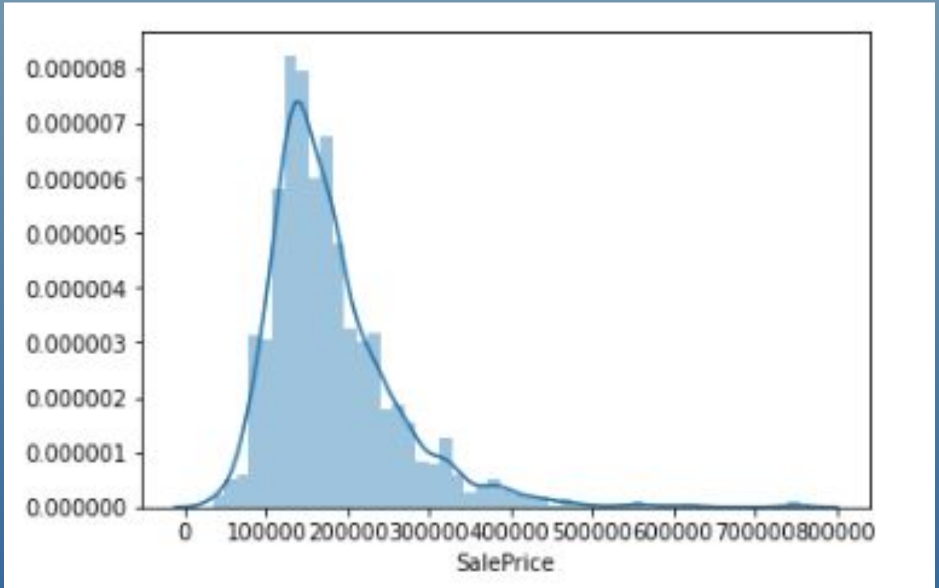
Data descriptive analysis (cont.)

Sales price distribution



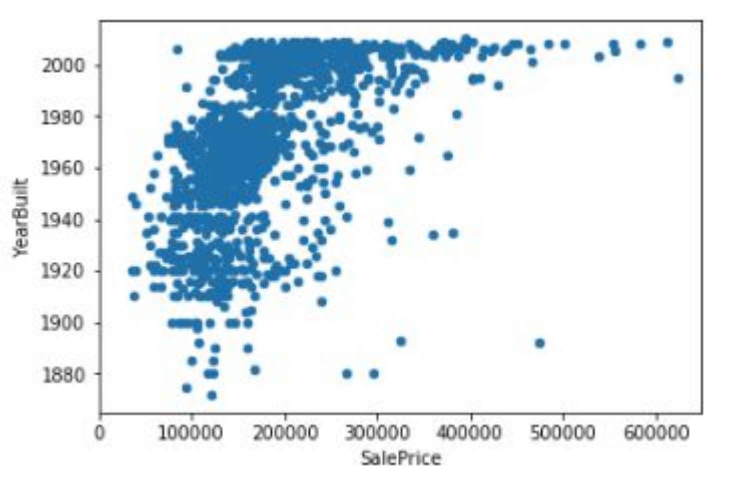
```
df_train['SalePrice'].describe()
```

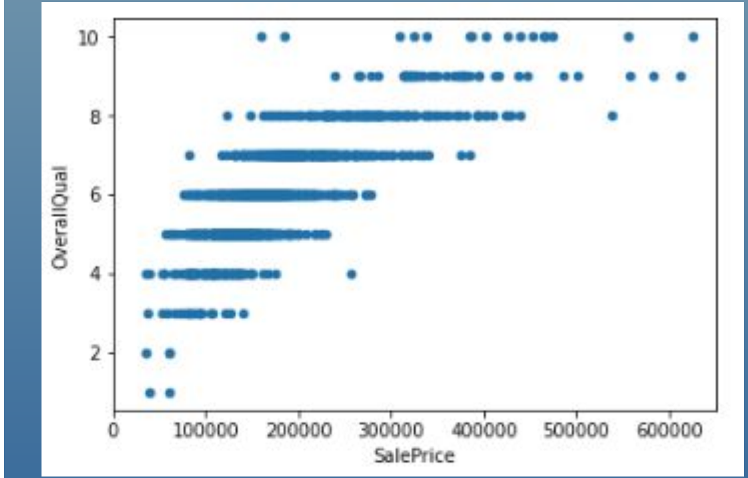
```
count      1460.000000
mean     180921.195890
std       79442.502883
min       34900.000000
25%      129975.000000
50%      163000.000000
75%      214000.000000
max      755000.000000
Name: SalePrice, dtype: float64
```



Data descriptive analysis (cont.)

Sales price over year built and over house quality





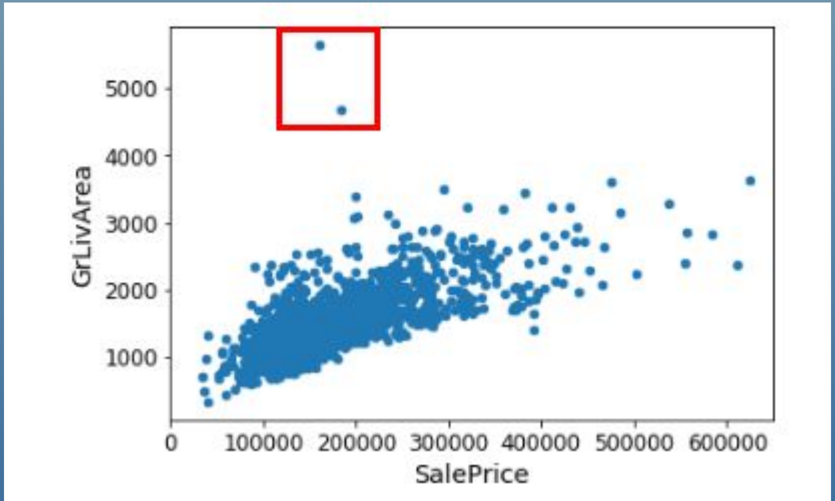
Data preparation

New features added:

- Years between renovation and sold date
- Above ground living area over Lot area
- Above ground living area over number of bedrooms
- Overall quality over Overall condition

Data preparation (cont.)

- We noticed that source data has some significant outliers and removed two data point from the training dataset to increase accuracy of prediction.



Data preparation (cont.)

- Data transformation of numerical and categorical features using:
  - ➢ Pipeline
  - ➢ SimpleImputer
  - ➢ MinMaxScaler
  - ➢ OneHotEncoder
- The feature number after transformation grew up from 79 to 291

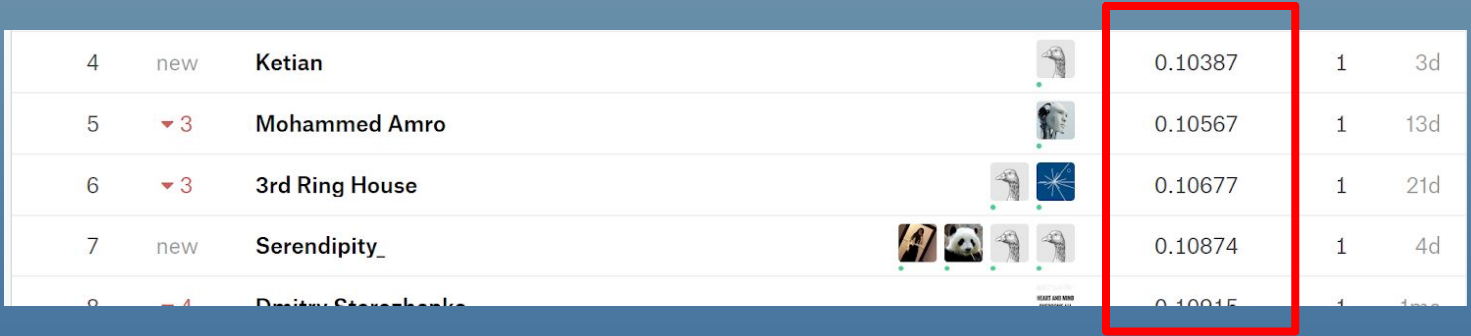
Base model selection

The following regression models have been selected for initial assessment:

- Linear Regression
- SVR
- Ridge
- Lasso
- ElasticNet
- SGDRegressor
- KNeighbors Regressor
- Decision Tree Regressor
- Random Forest Regressor

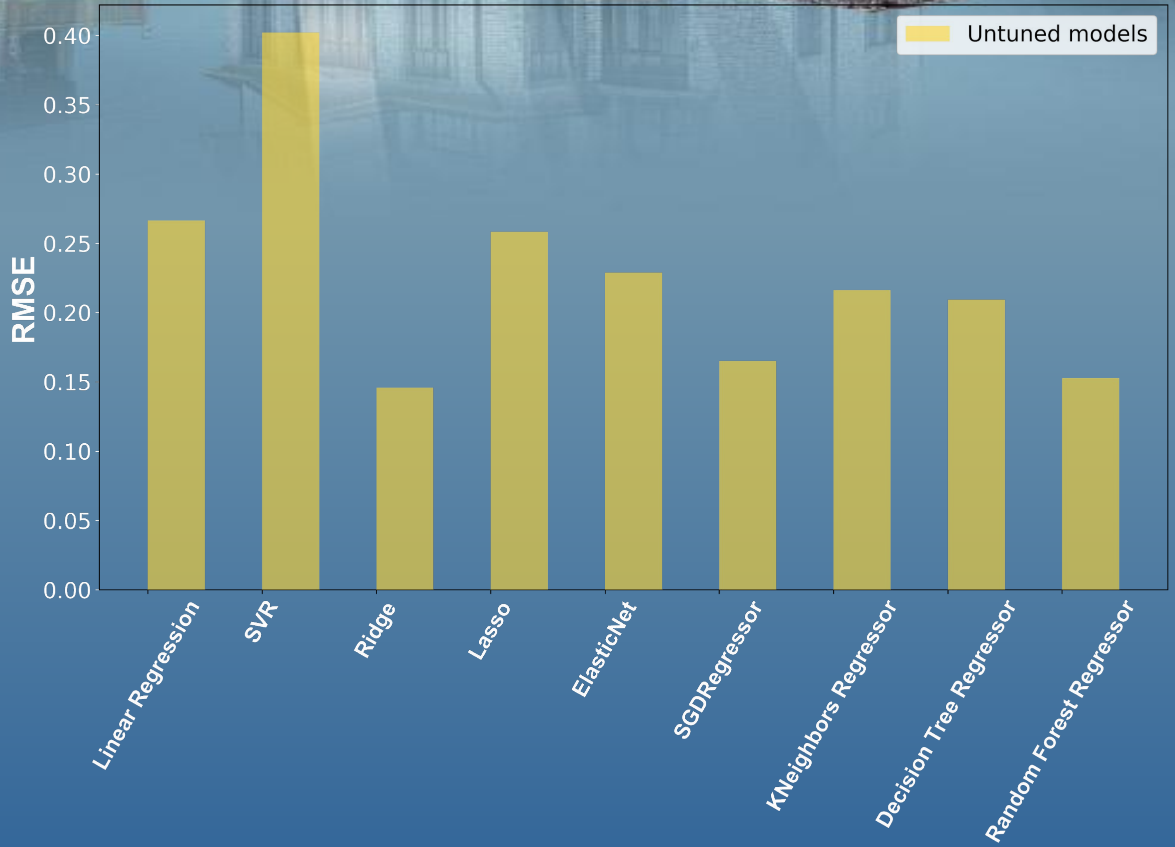
Performance Metric

RSME(log(SalePrice), log(predicted SalePrice))



4	new	Ketian	0.10387	1	3d
5	▼3	Mohammed Amro	0.10567	1	13d
6	▼3	3rd Ring House	0.10677	1	21d
7	new	Serendipity_	0.10874	1	4d
8	▼4	Dmitry Storozhenko	0.10915	1	1mo

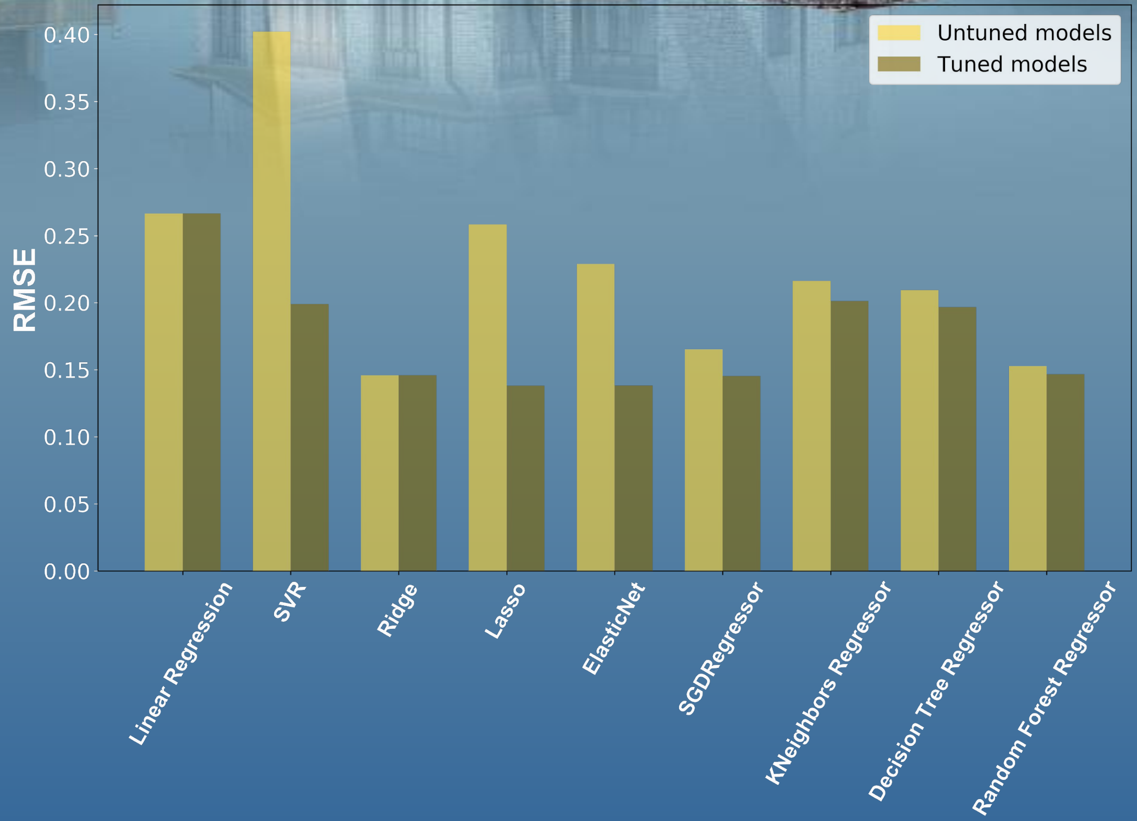
RMSE untuned models



Tuning hyperparameters

Model name (sklearn)	Tuned hyperparameters
LinearRegression	{'fit_intercept': True}
SVR	{'max_depth': 16, 'max_features': 125, 'min_samples_leaf': 2, 'min_samples_split': 2, 'n_estimators': 1000}
Ridge	{'alpha': 1.0, 'fit_intercept': True, 'solver': 'auto'}
Lasso	{'alpha': 71, 'max_iter': 100}
ElasticNet	{'alpha': 100, 'l1_ratio': 1.0}
SGDRegressor	{'eta0': 0.001, 'learning_rate': 'constant', 'loss': 'squared_epsilon_insensitive', 'max_iter': 50, 'penalty': 'none', 'power_t': 0.5}
K-Neighbours Regressor	{'algorithm': 'auto', 'n_neighbors': 7, 'p': 1, 'weights': 'distance'}
Decision Tree Regressor	{'max_depth': 9, 'max_features': 'auto', 'max_leaf_nodes': None, 'min_samples_leaf': 2, 'min_samples_split': 18}
Random Forest Regressor	{'max_depth': 16, 'max_features': 125, 'min_samples_leaf': 2, 'min_samples_split': 2, 'n_estimators': 1000}

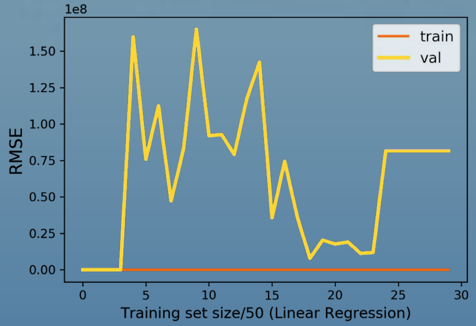
RMSE tuned models

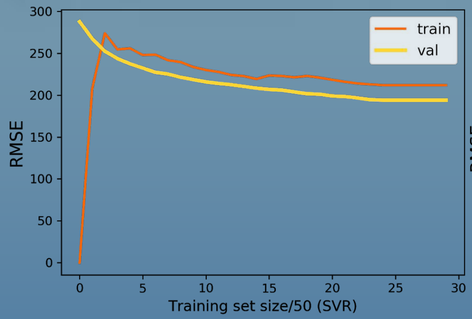


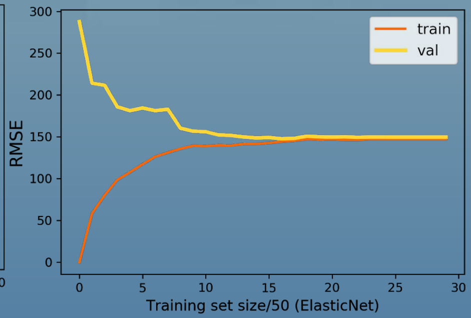
RMSE tuned models

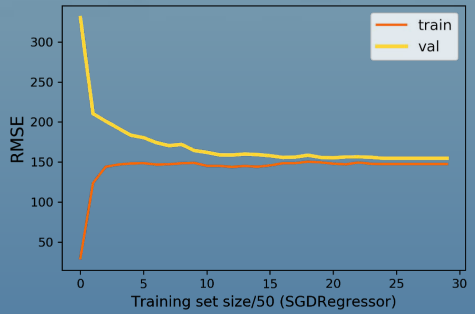
Model name (sklearn)	Untuned RMSE	Tuned RMSE	Performance Increase	Untuned r2	Tuned r2
LinearRegression	0.26636	0.26639	0.00%	0.57903	0.87793
SVR	0.40208	0.19893	⇧50.53%	0.04099	0.74334
Ridge	0.14586	0.14586	0.00%	0.87380	0.89722
Lasso	0.25845	0.13809	⇧46.57%	0.60378	0.90787
ElasticNet	0.22906	0.13824	⇧39.65%	0.68876	0.90916
SGDRegressor	0.16523	0.14529	⇧12.07%	0.83804	0.89647
K-Neighbours Regressor	0.21635	0.20128	⇧6.96%	0.72234	0.78280
Decision Tree Regressor	0.20935	0.19671	⇧6.04%	0.74002	0.76758
Random Forest Regressor	0.15267	0.14660	⇧3.98%	0.86175	0.90821

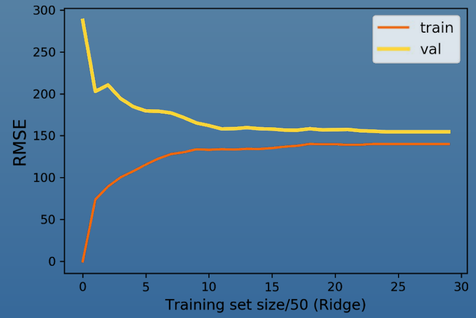
Learning curves for select tuned models

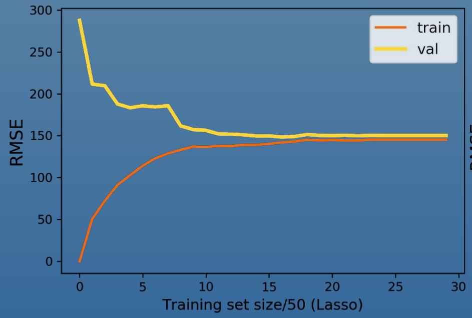


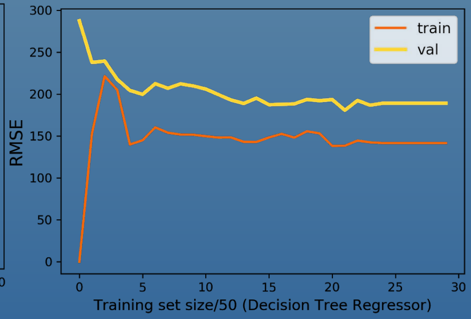


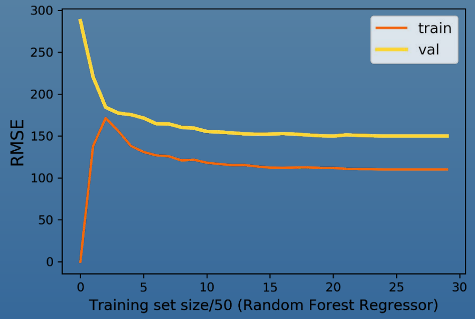






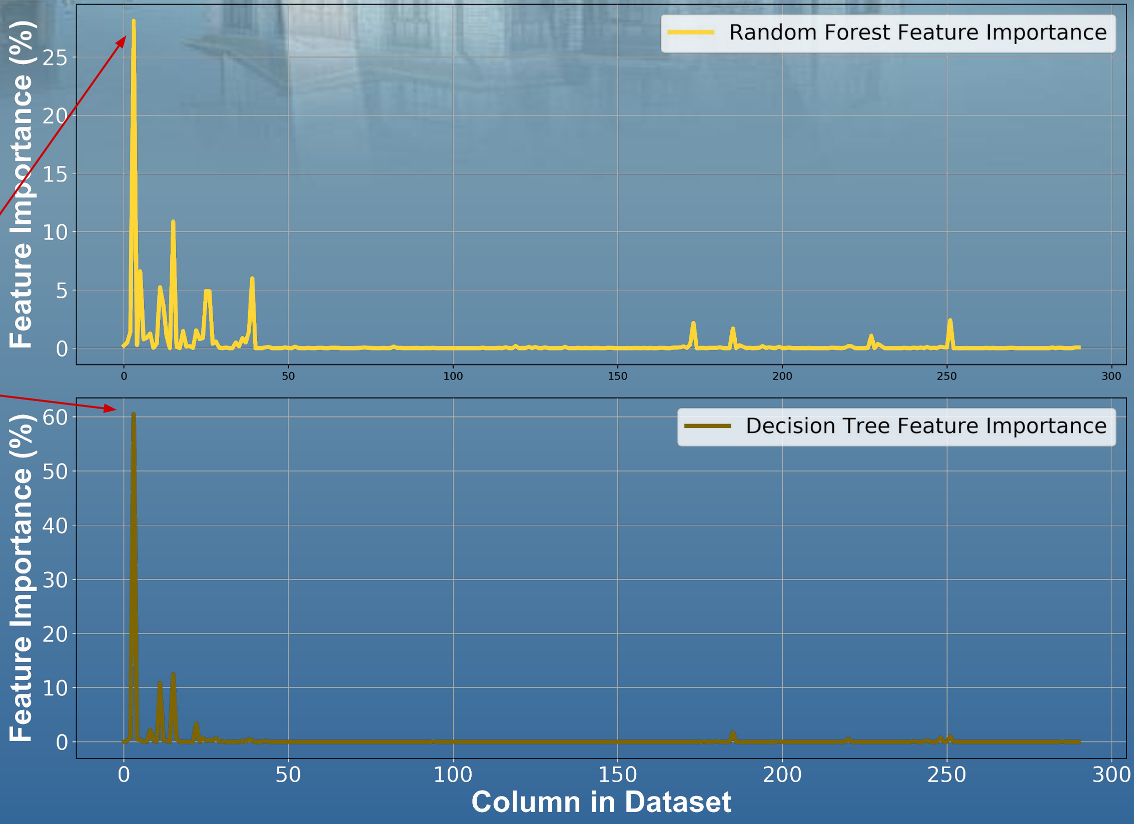






Feature importance

Most important feature: LotArea



Aggregate Learning

The following models were selected for ensemble learning:

- Bagging Regressor
- Gradient Boosting Regressor
- Stacking

Bagging Regressor

Model name (sklearn)	Tuned hyperparameters
BaggingRegressor	{'base_estimator': SVR(C=113564, cache_size=200, coef0=0.0, degree=3, epsilon=0.1, gamma=0.0007790692366582295, kernel='rbf', max_iter=-1, shrinking=True, tol=0.001, verbose=False), 'bootstrap': True, 'max_features': 1.0, ‘max_samples': 1.0, 'n_estimators': 7}

Model name (sklearn)	Tuned RMSE	Tuned r2
BaggingRegressor	0.19855	0.74745

⇩43.8%

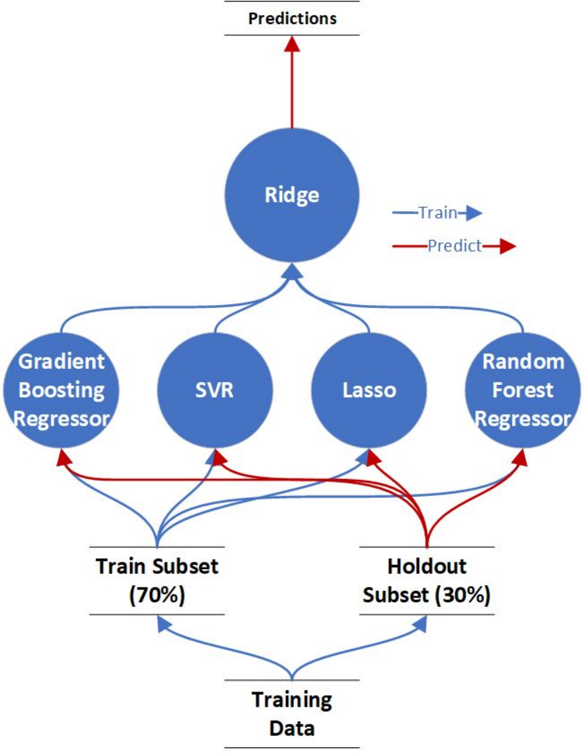
Gradient Boosting Regressor

Model name (sklearn)	Tuned hyperparameters
GradientBoostingRegressor	{'learning_rate': 0.1, 'max_depth': 6, 'max_features': 'auto', 'max_leaf_nodes': 10, 'min_samples_leaf': 2, 'min_samples_split': 50, 'n_estimators': 300, 'subsample': 0.9, 'warm_start': True}

Model name (sklearn)	Tuned RMSE	Tuned r2
GradientBoostingRegressor	0.11468	0.91971

⇧17.0%

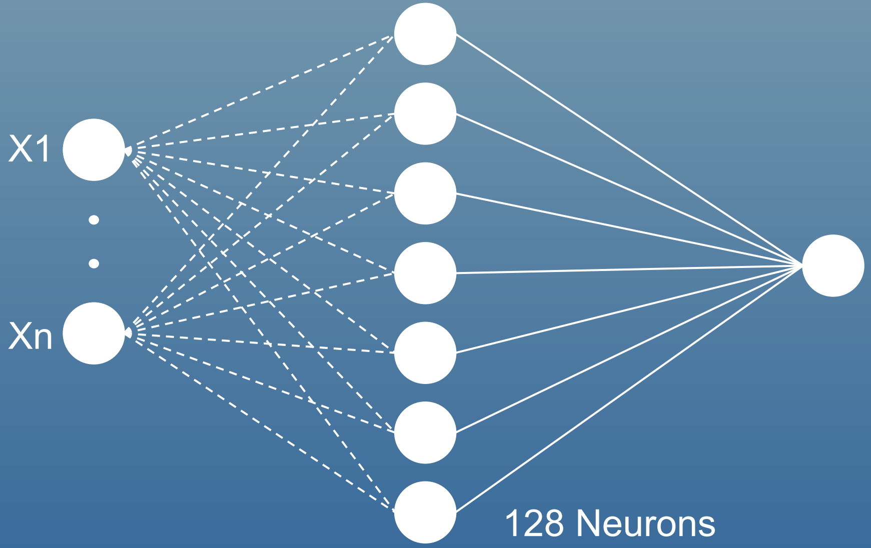
Stacking Regressor



Model name (sklearn)	Tuned RMSE	Tuned r2
GradientBoostingRegressor	0.11468	0.91971

⇧17.1%

Neural Network

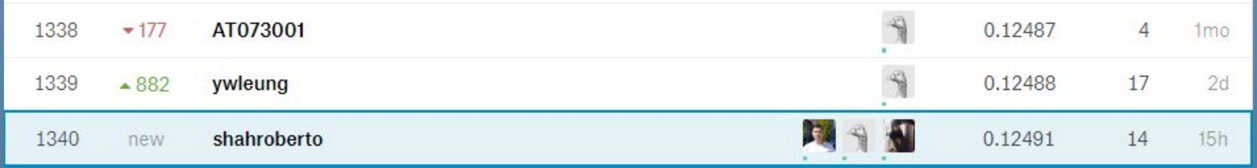


- 2 Dense Layers
  - 1 Layer - 128 Neurons
  - 2 Layer - 1 Neuron
- Activation function - RELU

Competition Public Leaderboard

The Neural network was used for final prediction using test dataset and the result was submitted to Kaggle public leaderboard.

The submission rank was 1340 out of 4,632, top 28.9%. Not bad!



1338	▾177	AT073001	0.12487	4	1mo
1339	▴882	ywleung	0.12488	17	2d
1340	new	shahroberto	0.12491	14	15h

The top 10 score was about 0.11

Questions?