Effect of image data on real estate price prediction

Hannah Catabia, Mona Jalal, Ramesh Pallavoor, Nithin Varma

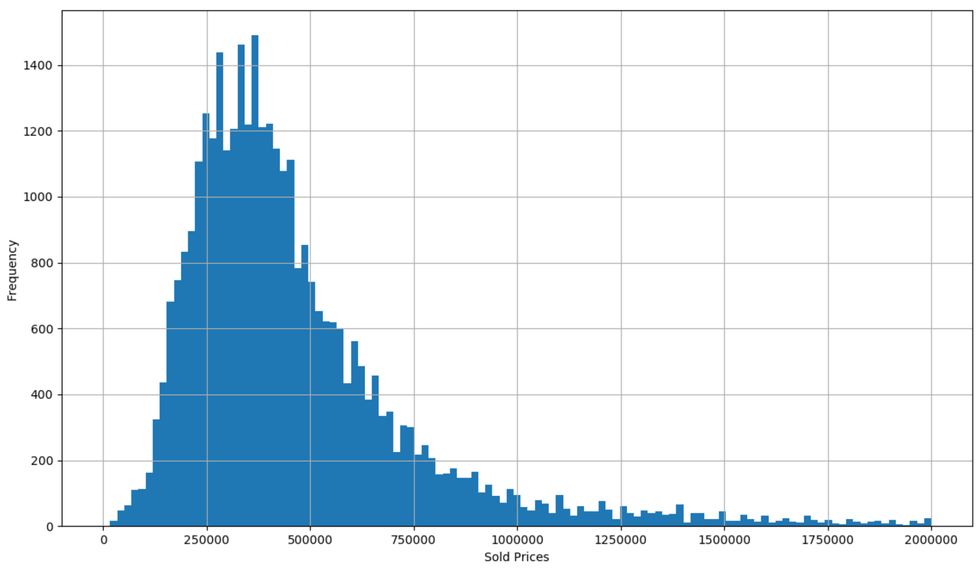
PROBLEM

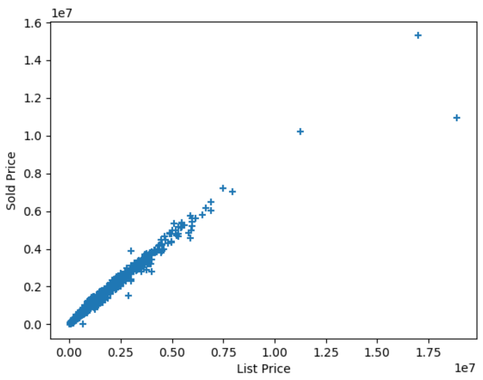
Design an algorithm to predict (selling) prices of real estate listings using both text and image data associated with them. Investigate the effect of access to image data on the error of price prediction schemes.

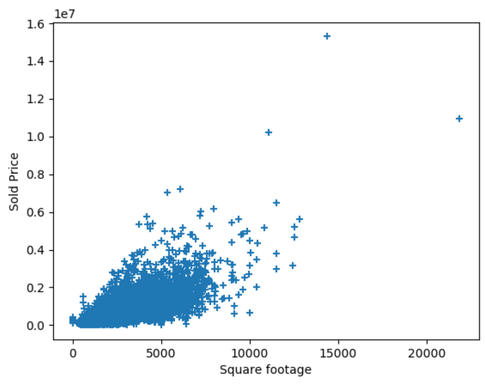
DATASETS

- Original Foxy Dataset
  - Data about 54775 listings
  - CSV files containing a total of 155 features
- Cleaned-up Dataset
  - Restricted attention to 34829 listings associated with exactly 15 images
  - Reduced the number of features to 7:
    - LIST PRICE, BEDROOM COUNT, BATHROOM COUNT, SQUARE FOOTAGE, AGE, LOT SIZE, ZIP CODE
  - Did a one-hot encoding of the 621 zip codes
  - ~500,000 images

DATA VISUALIZATION







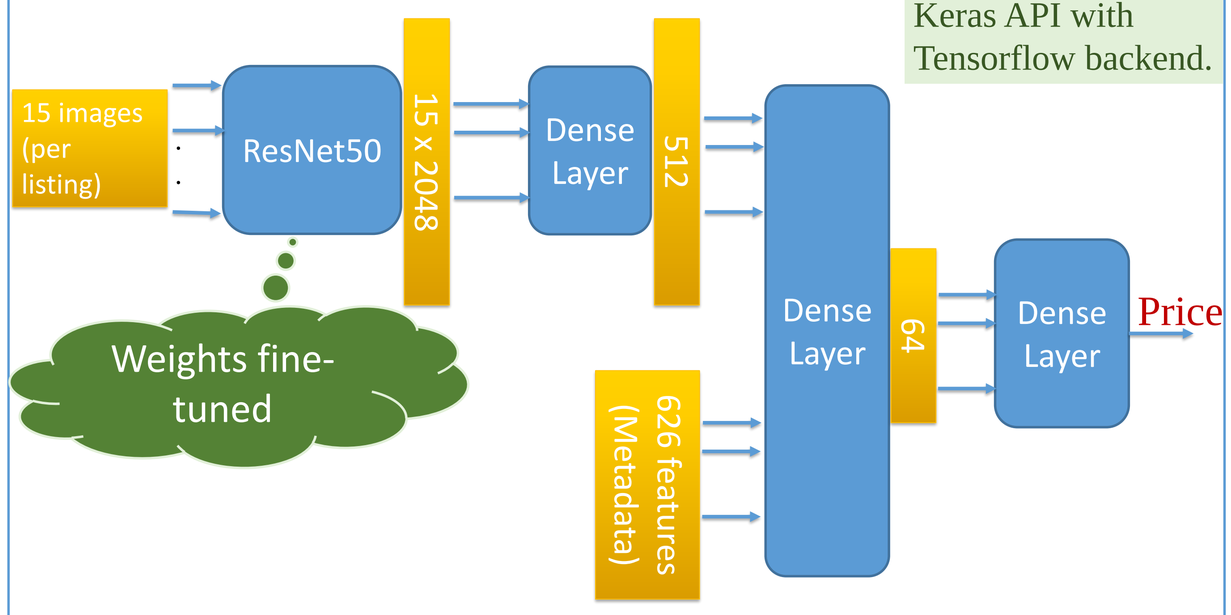
- Histogram of SOLD PRICES, the quantity to be predicted and plots of the most important features in metadata against SOLD PRICE.

REMOVING LIST PRICE

- Removed LIST PRICE from the set of features in the non-image data.
- LIST PRICE alone predicts the SOLD PRICE with a MAPE (Mean Absolute Percentage Error) of ~6 % .
- Learning task becomes trivial if we assume the knowledge of LIST PRICE.

BEST-PERFORMING MODEL

Implemented using Keras API with Tensorflow backend.



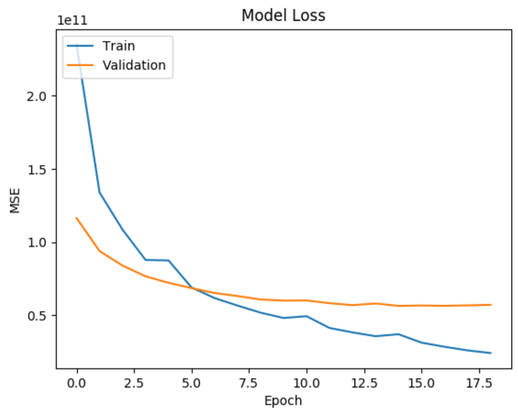
Training and Testing

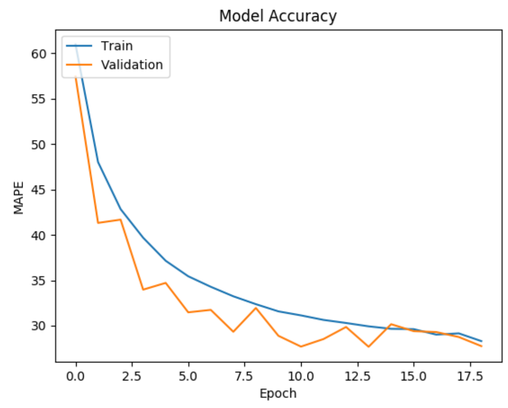
- Data split: 80% for training, 10% for validation, 10% for testing.
- Loss function being optimized: Mean Squared Error (MSE)
- Other metrics being measured: Mean Absolute Percentage Error (MAPE) and Mean Absolute Error (MAE).
- Early stopping condition: If the best validation MAPE has not changed over the past 5 epochs, we stop training.
- Batch size: 32, Max. number of epochs: 100 (typically stops after 25 epochs), Optimizer: RMSProp

Results (performance of the model on the test set)

MAE ~ $125,000 MAPE ~ 28%

Absolute percentage error	Fraction of data
≤ 5%	13%
≤10%	26%
≤ 15%	39%
≤ 20%	50%
≤ 25%	61%
≤ 30%	70%





FINETUNING WEIGHTS OF RESNET50

- Finetuned ResNet50 with Room categorization dataset from Poursaeed et al. (2017).
- Base Model: ResNet50 pretrained with ImageNet
- Froze the first 11 conv. layers and replaced final layer with a fully connected layer that predicted 7 categories (using softmax activation).
- Loss : Categorical cross entropy, Optimizer: SGD
- Number of epochs: 25 , Batch size : 75
- Test Loss ~ 0.3, Test accuracy ~ 0.9

REFERENCES

- **Vision-based real estate price estimation**. *Omid Poursaeed, Tomas Matera, Serge J. Belongie.* arXiv preprint 2017.
- **Keras**. *Francois Chollet et al.*, GitHub 2015, https://github.com/fchollet/keras