Project 3 Predictive Modeling

Image Super-Resolution

Group 4

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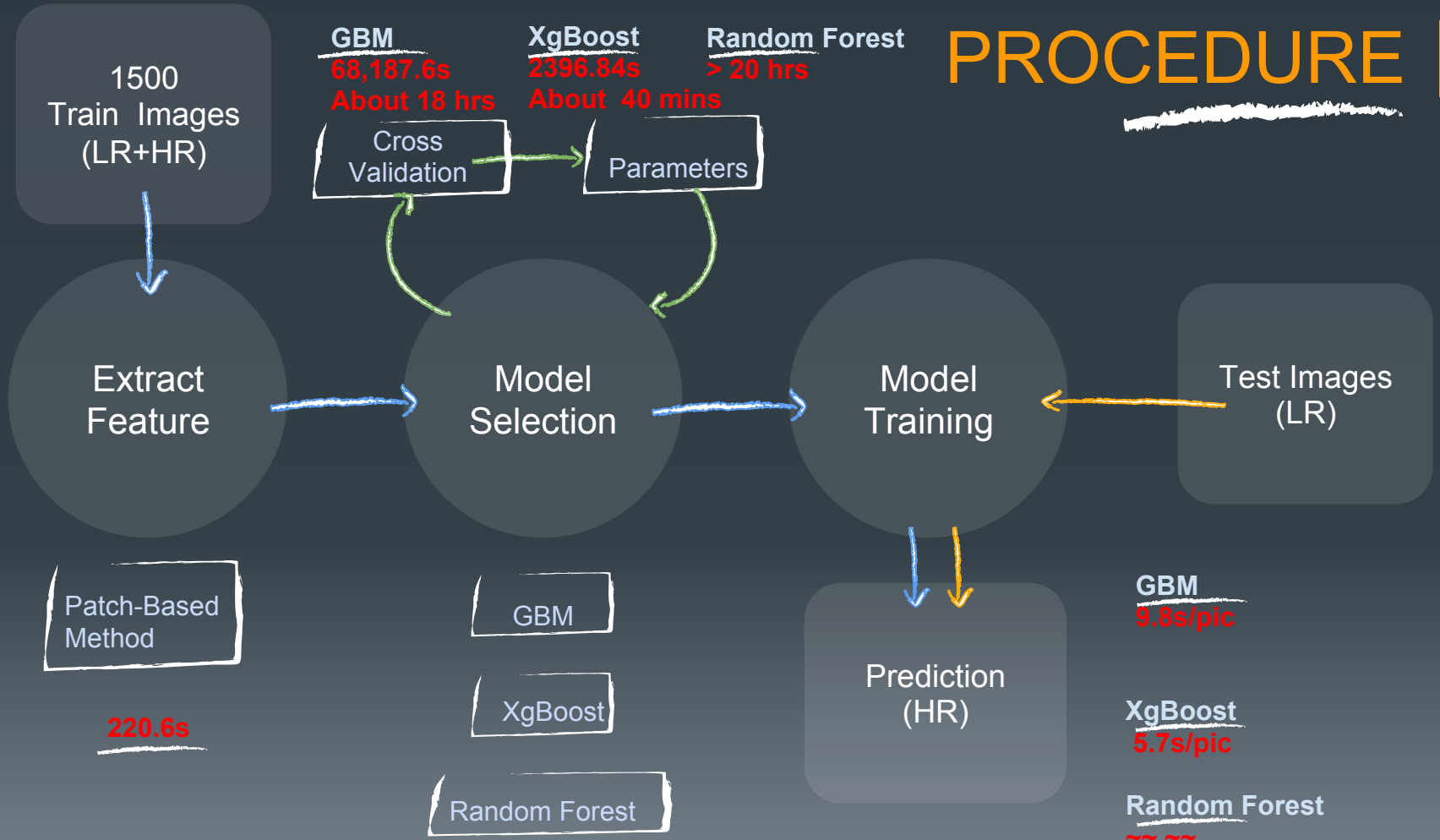
PROJECT GOAL

Produce a predicted high resolution image as output based on the blurry and low-resolution input.

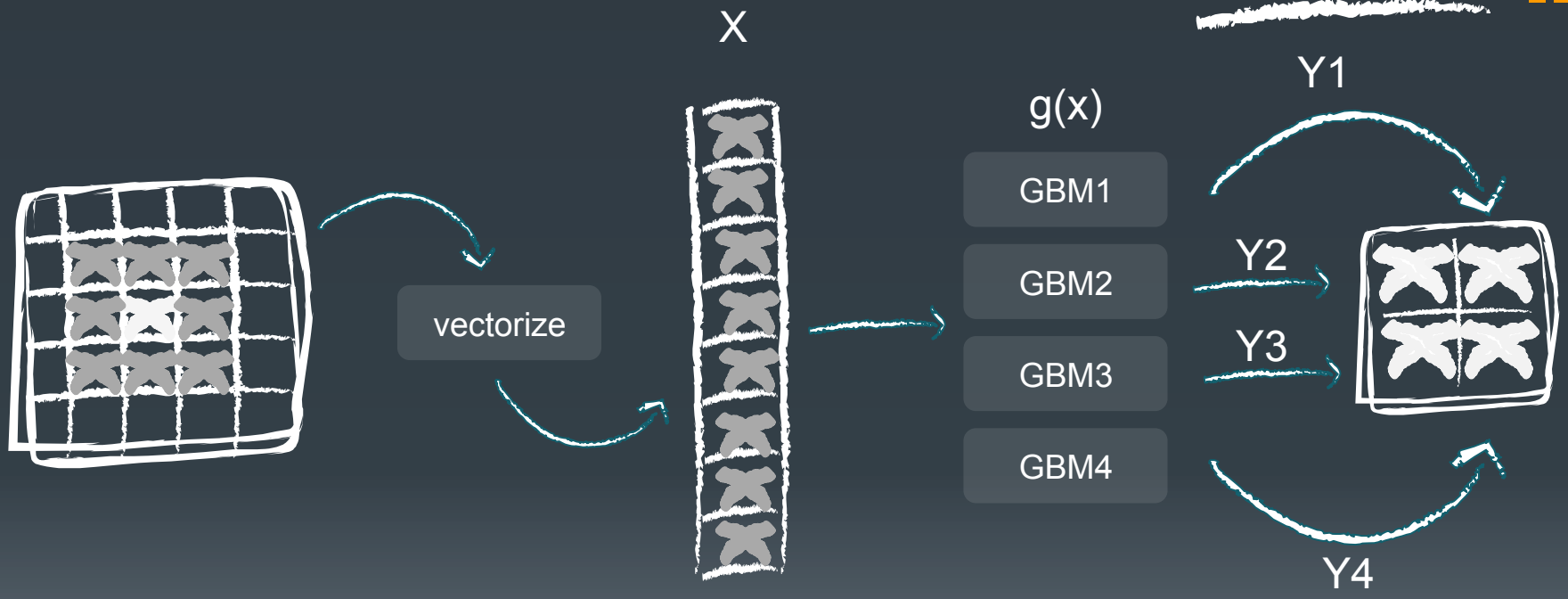
Evaluation on

1. Computational Efficiency - Running time on feature extraction and model training
2. Computational Efficiency - Running time on test data
3. Predictive Power - Error rate (MSE, PSNR)

PROCEDURE


1500
Train Images
(LR+HR)
GBM
68,187.6s
About 18 hrs
XgBoost
2396.84s
About 40 mins
Random Forest
> 20 hrs
Cross Validation
Parameters
Extract Feature
Model Selection
Model Training
Test Images
(LR)
Patch-Based Method
220.6s
GBM
XgBoost
Random Forest
Prediction
(HR)
GBM
9.8s/pic
XgBoost
5.7s/pic
Random Forest
~~ ~~

FEATURE



Baseline (GBM)

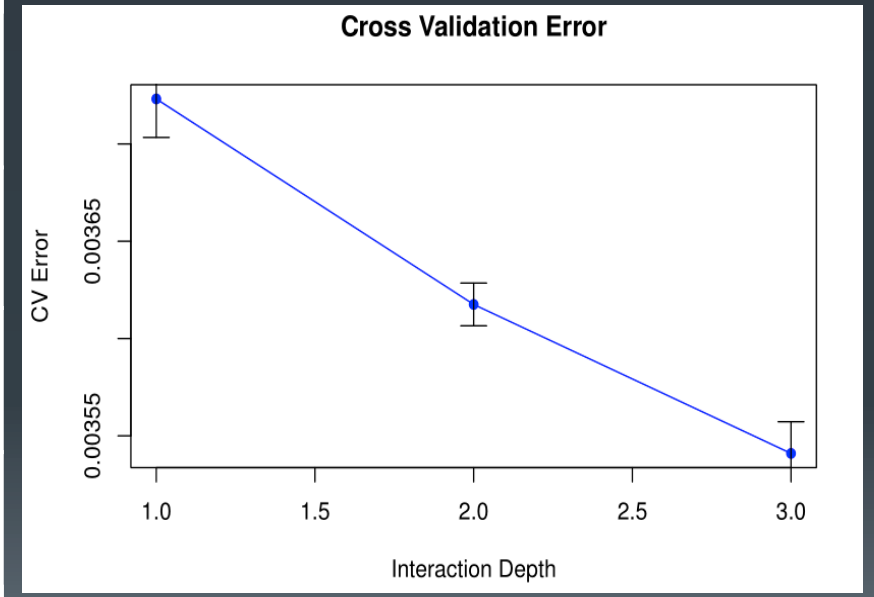
MODEL SELECTION

Gradient Boosting Machine (GBM)

- A great application of GBM is anomaly detection in supervised learning settings where data is often highly unbalanced
- GBM build trees one at a time, where each new tree helps to correct errors made by previously trained tree.

Baseline (GBM)

	Ntrees = 200		
Depth	1	2	3
MSE	0.003755	0.003572	0.003464
PSNR	24.191	24.214	24.405



Note: “Depth = 3” already take us more than 10 hours to run

Advanced Model (Random Forest)

Random Forest

- Train each tree independently, using a random sample of the data.
- This randomness helps to make the model more robust than a single decision tree, and less likely to overfit on the training data
- The main **limitation** of the Random Forests algorithm is that a large number of trees may make the algorithm **slow** for real-time prediction.

Advanced Model (XgBoost)

XgBoost

- Use of sparse matrices with sparsity aware algorithms
- Improved data structures for better processor cache utilization which makes it faster.
- Better support for multicore processing which reduces overall training time

Advanced Model (XgBoost)

	Nrounds = 100, Nthread = 2, eta = 0.5, silent=1		
Depth	2	3	4
MSE	0.002633592	0.002603574	0.002600096
PSNR	24.25706	24.31245	24.40873

Note: 1. Nrounds too large will need long time to run and result is still not good.
2. Max.depth too large will result overfit

EVALUATION

	GBM	XgBoost
Parameters	Depth=3	Depth=4
Running Time	9.8s/pic	5.7s/pic
MSE	0.003464	0.002600096
PSNR	24.405	24.40873
Training time	About 18 hours	About 40 minutes

XgBoost (test picture)

Low Resolution

Predicted Picture

High Resolution

If we have more time …

Convolutional Neural Network (CNN)

- CNNs use relatively little pre-processing compared to other image classification algorithms
- It uses GPU in our Laptop.

REPRODUCED PERFORMANCE IN CLASS

	XgBoost
Parameters	Depth=4
Running Time	Around __ mins

Thanks!

Refence

1. Han, Liu, et al. Project: Can you unscramble a blurry image? 2018, Columbia University, New York. github.com/TZstatsADS/Fall2018-Proj3-Sec1-grp1.

2. Ravanshad, Abolfazl. "Gradient Boosting vs Random Forest." medium.com, 27 Apr. 2018, medium.com/@aravanshad/gradient-boosting-versus-random-forest-cfa3fa8f0d80.

3. Rashmi, K. V., & Gilad-Bachrach, R. (2015). Dart: Dropouts meet multiple additive regression trees. arXiv preprint arXiv:1505.01866.