Cat or Dog: Predictive Modeling

STAT GU4243 - Applied Data Science

Group 6

Columbia University

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Group members

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Why do this?—Motivation

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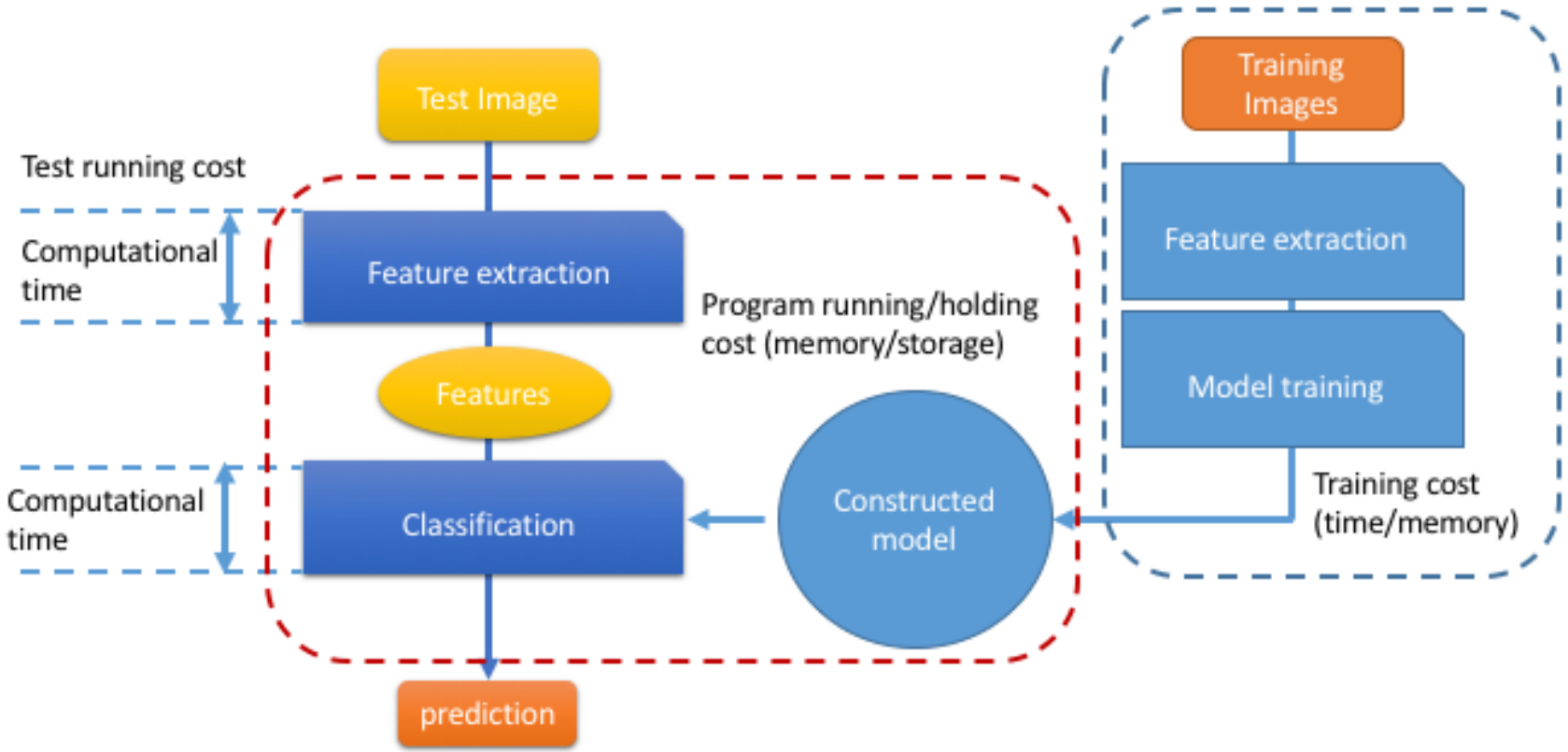
Spec & Scope

[C]*arry out model evaluation and selection for predictive analytics on image data* ... [using] *a set of 4387 labeled images of cats and dogs* ... *creat*[e] *a mobile AI program that accurately distinguishes between* [them] ... *balance between the complexity of variables/features/models used and the predictive performance.*

Spec & Scope


Test Image
Test running cost
Computational time
Feature extraction
Features
Computational time
Classification
prediction
Program running/holding cost (memory/storage)
Constructed model
Training Images
Feature extraction
Model training
Training cost (time/memory)

Exploratory Analysis

What makes one animal different from another? [Intuition]
What approaches did previous semesters' groups employ? [Research]

Feature Extraction

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5. RGB = red, green, blue.

Statistical Machine Learning Models

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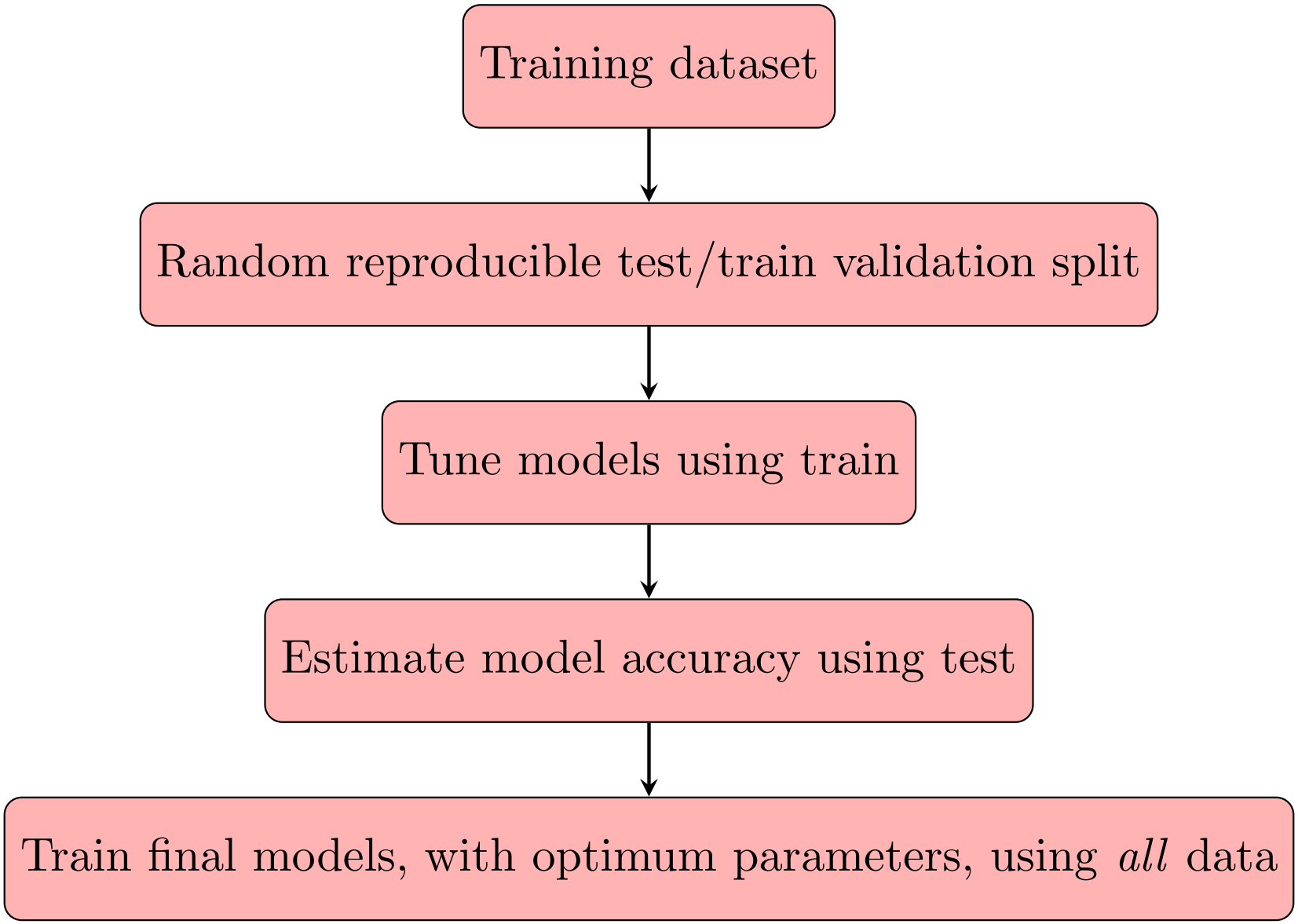
6. Extreme gradient boosting ("XGBoost").

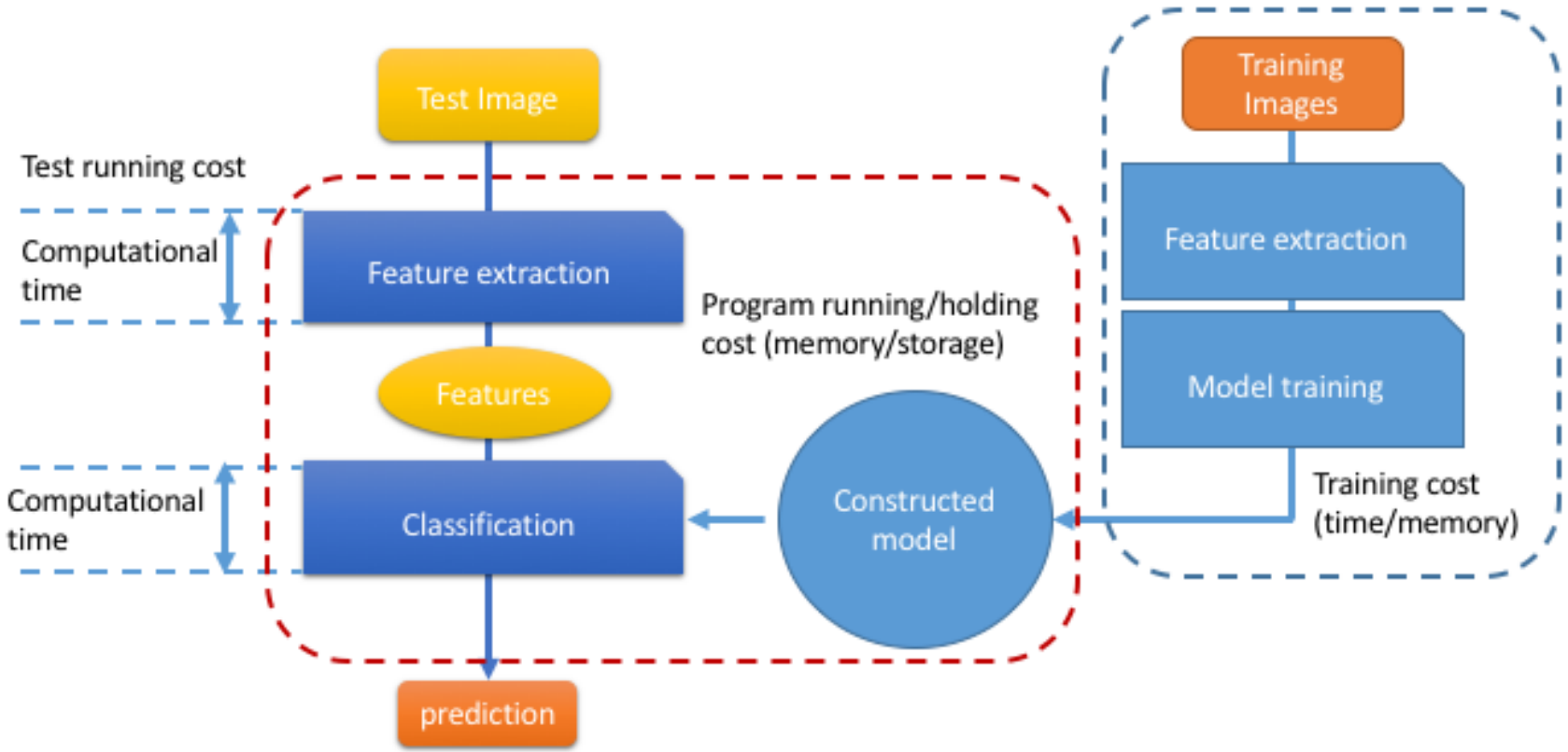
Tuning and Training

Simplifying heuristic: use *all* features, rather than subsets.
Preference for built-in package functions, rather than a generalized syntax.

How we finalized models—Flowchart



Results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Feature Extraction Time

Feature type	Color	HOG	LBP
Time (m)	7	5	20

Table: Image processing time by feature, in minutes

Training Times—Computational Cost

Model	SIFT	Color	HOG	LBP
GBM	13.452	89.036	116.964	2.74
RF	174.1	905.883	1999.23	24.842
NN	31	65.81	61.58	28.12
SVM	3.484		33.099	0.805
XGBoost	3.829	16.851	27.005	1.67
AdaBoost	16.34	103.61	142.45	3.25

Table: Training time per model, in seconds

Prediction Accuracy

Model	SIFT	Color	HOG	LBP
GBM	73.25	69.5	75.25	69.
RF	72.25	73.	74.25	69.
NN	75.75	64.5	76.75	69.
SVM	77.5		77.5	69.75
XGBoost	72	72	77.25	66.5
AdaBoost	72.75	69.5	71.75	69.75

Table: Prediction accuracy by model, in percentage

Final Result

Our final feature extraction and model choice is HOG features with XGBoost. This choice optimizes extraction time, training time, and prediction accuracy.

Confusion Matrices: Random Forest

RF Prediction	Dog	Cat
Truth		
Dog	54	19
Cat	92	35

Table: RF-SIFT Confusion Matrix

RF Prediction	Dog	Cat
Truth		
Dog	247	26
Cat	77	50

Table: RF-HOG Confusion Matrix

Confusion Matrices: Gradient Boosting Machine

GBM Prediction	Dog	Cat
Truth		
Dog	229	44
Cat	63	64

Table: GBM-SIFT Confusion Matrix

GBM Prediction	Dog	Cat
Truth		
Dog	232	41
Cat	58	69

Table: GBM-HOG Confusion Matrix

Confusion Matrices: Neural Network

NN Prediction	Dog	Cat
Truth		
Dog	233	40
Cat	55	72

Table: NN-SIFT Confusion Matrix

NN Prediction	Dog	Cat
Truth		
Dog	263	10
Cat	89	38

Table: NN-HOG Confusion Matrix

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5. ...

Thank you!