QUEST FOR THE BEST CAT PHOTO

FINAL PRESENTATION

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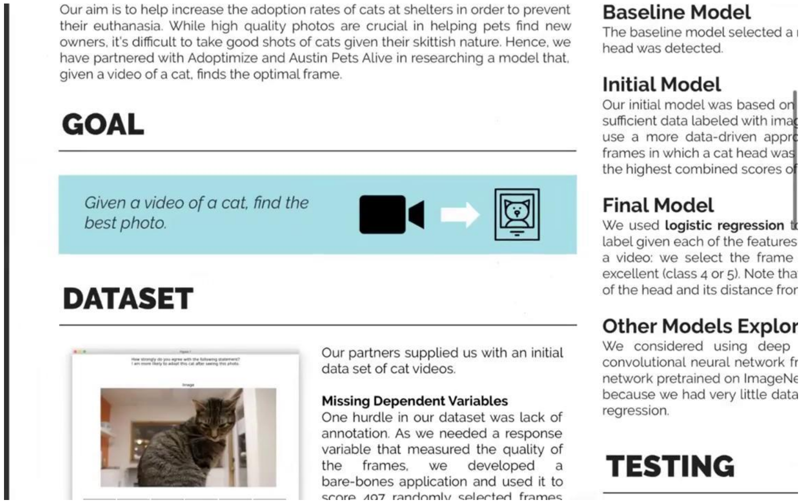
ADDITIONAL INFORMATION

To see a quick summary of this presentation, see the video below or [this poster].



PROBLEM

- About 6.5M dogs and cats each year enter animal shelters, according to the ASPCA
- But approximately 1.5M of these are put down

That's 1 in 4 pets.

THE QUALITY OF THE PHOTO OF A PET IS CORRELATED TO ITS LIKELIHOOD OF BEING ADOPTED

GOALS

increase adoption rates

decrease euthanasia for shelter cats

SPONSOR: AUSTIN PETS ALIVE!

- Animal shelter based in Texas
- No-kill shelter
- Saved over **70,000 animal lives** since 2008

Austin Pets Alive! is not your average animal shelter. We pioneer innovative lifesaving programs designed to save the animals most at risk of euthanasia.

Adopt

Looking for a furry friend to add to the family? We have thousands of animals that would love to be part of your home.

Foster

Open your heart and home to a pet in need, and be the bridge to a dog or cat's forever home.

Volunteer

Our volunteers make lifesaving possible – become a volunteer today!

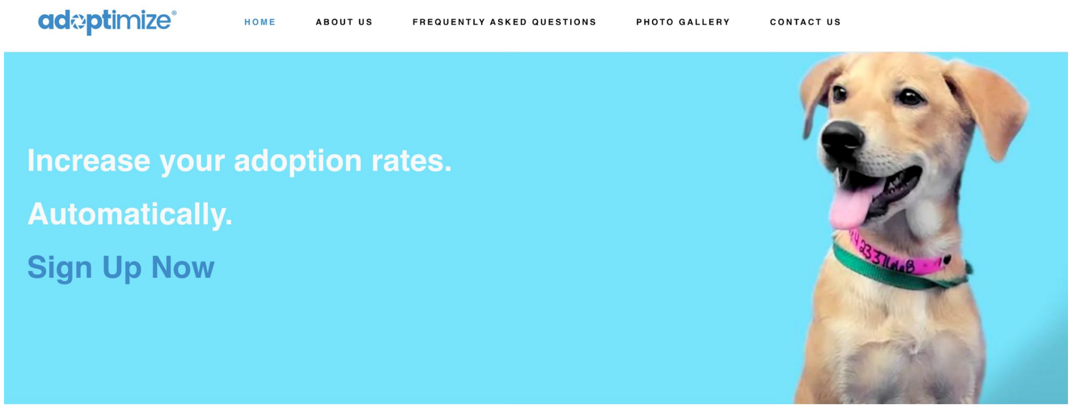
SPONSOR: ADOPTIMIZE

- Software company
- Primary goals
  - Increase adoption
  - Decrease euthanasia
  - Increase shelter engagement
- Algorithm that optimizes image taking
  - For the best chance of adoption

SPONSOR: ADOPTIMIZE

Dog model process

- Takes in **video** of animal
- Selects **optimal shot**
- Automatically **edits** image
- Outputs **enhanced optimal** image



IMPACT

124% increase in adoption
41% reduction in euthanasia

27% increase in adoption
56% reduction in euthanasia

SCOPE OF WORK

In scope

- Model taking cat videos and outputting best frame
    - Length: <60s
    - Unobstructed view of a single cat
- Functional web app for mobile devices

Out of scope

- Stylized front-end
- Measuring adoption rates

CHALLENGES

Behavior	Video Quality
○ Fur covering face ○ Not facing camera	○ Unstable camera ○ Camera quality (phone vs. laptop)
Dataset	**Limitations**
○ Small number of cat videos ○ No labeled data	○ Environment ○ Equipment

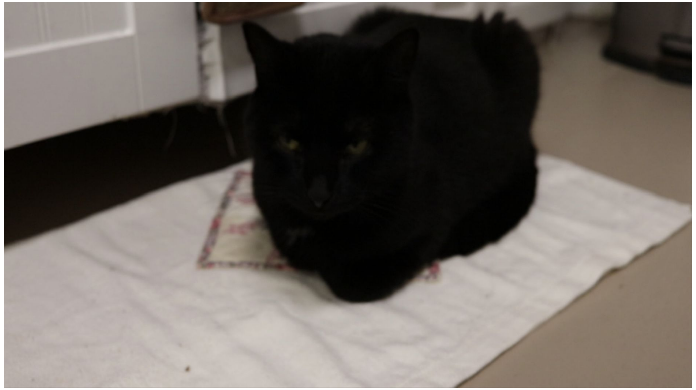
The data poses some **challenges...**

THE DATA

The Good

- Full body visible
- Looking directly at camera
- Clear, high quality image
- Good lighting

The Bad



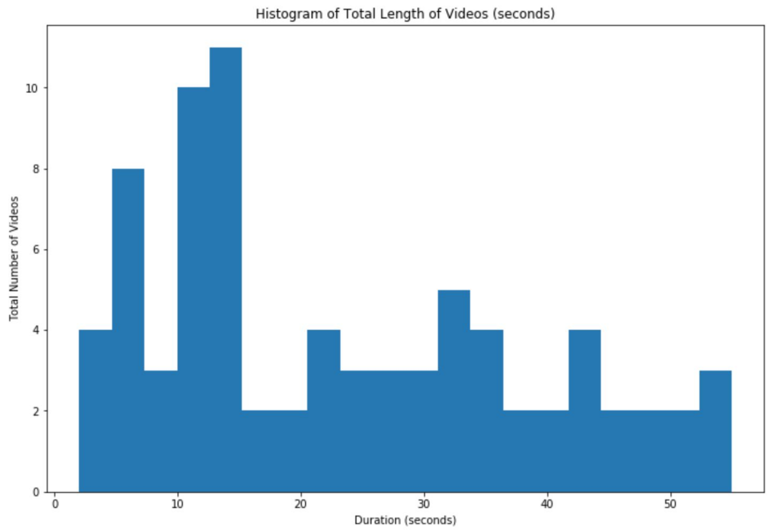
- Full body not visible
- Can’t distinguish facial features
- Looking away from camera
- Blurry image
- Darker area

HEURISTICS

- Detection of Cat Features
- Image Sharpness
- Relative Size of Cat Features

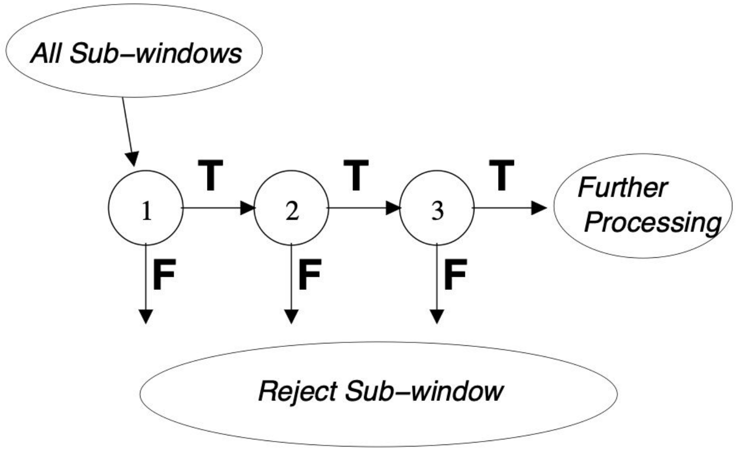
EDA: GENERAL DATA SENSE

- Initial data cleaning yielded 79 videos
- Duration: Avg: 23 seconds. Min 2 seconds. Max 55 seconds



LITERATURE REVIEW: VIOLA-JONES

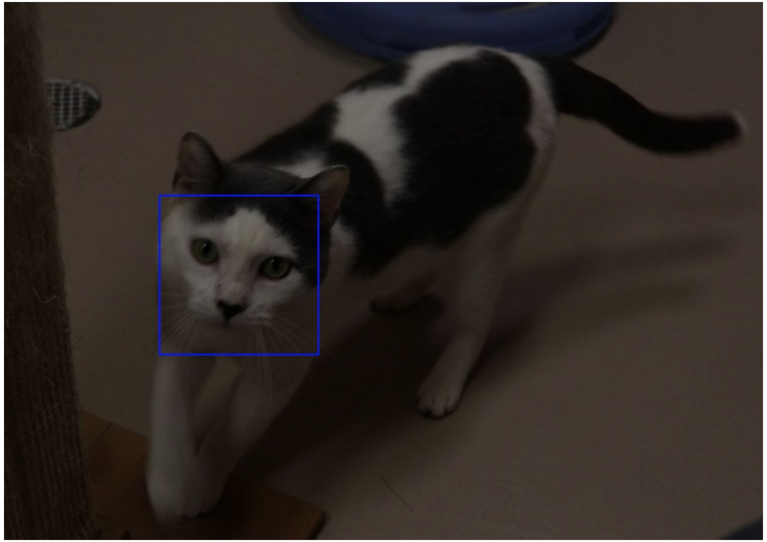
- *Rapid Object Detection using a Boosted Cascade of Simple Features*
- Haar-like Features
    - Pre-Compute Integral Image
- AdaBoost on Decision Stumps
- Cascade
- Sliding Windows

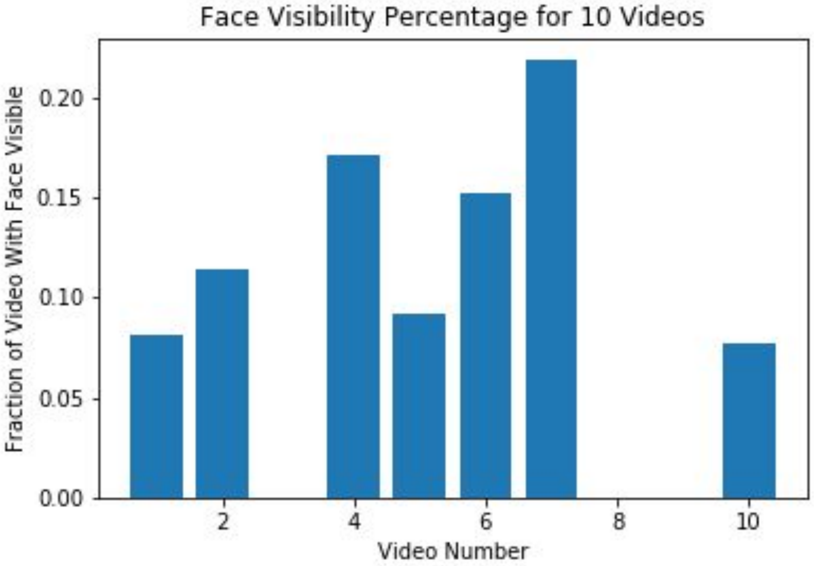


High-level view of cascade approach

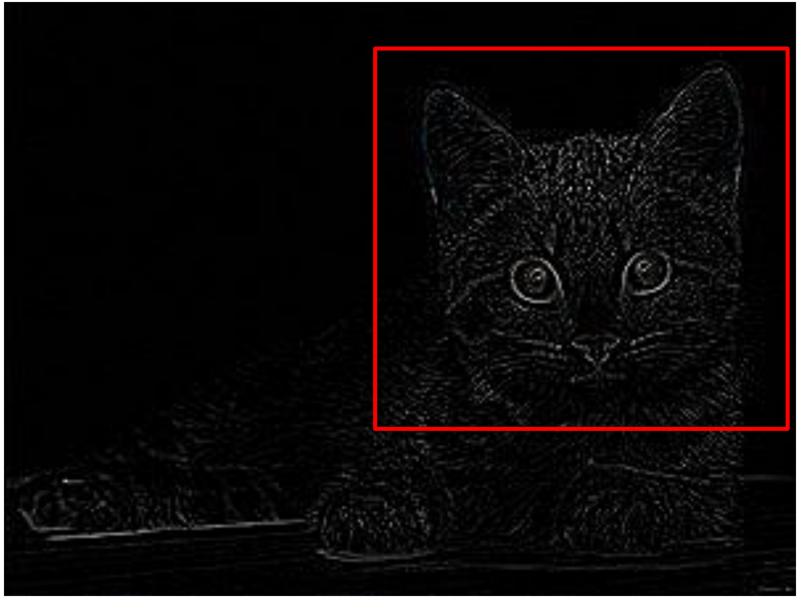
EDA: CAT FACE DETECTION

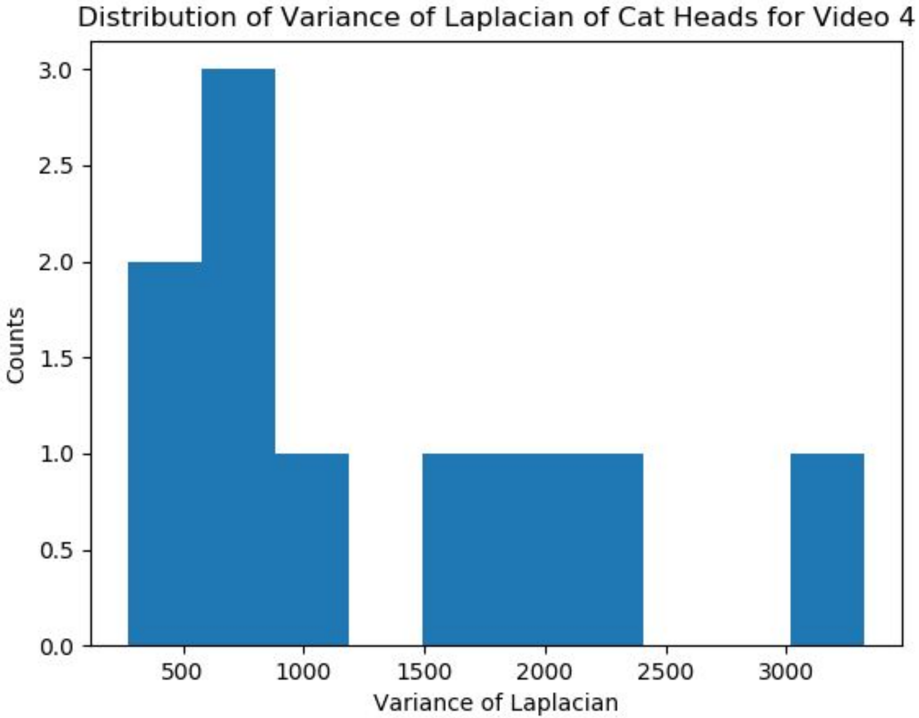
- Ran cat face detection using Haar Cascade
  - Low Recall Rate
- Subsample of 10 videos
- Every 10th frame per video



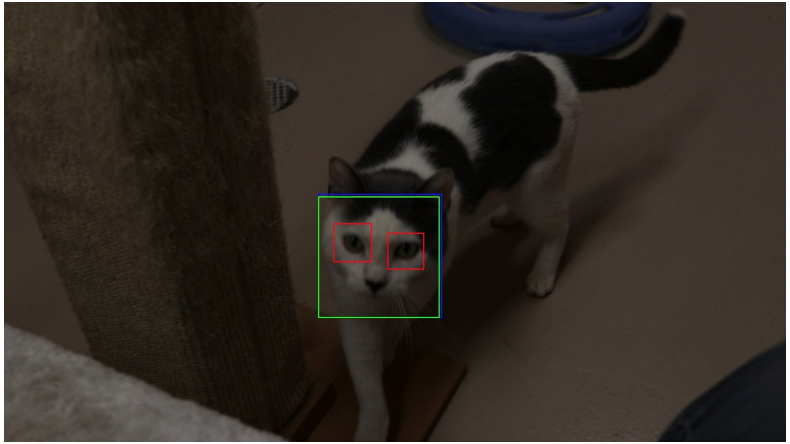


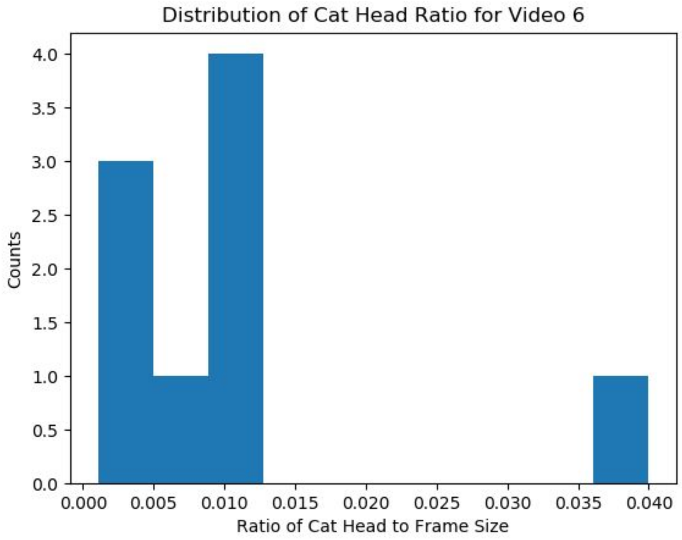
EDA: MEASURES OF SHARPNESS





EDA: HEAD SIZE RATIOS





BASELINE VS. INITIAL MODEL

baseline	initial
random image selected from set of frames with cat head detected	image selected from set of frames with cat head detected, with highest combined scores of sharpness and best cat head size

TESTING THE MODELS

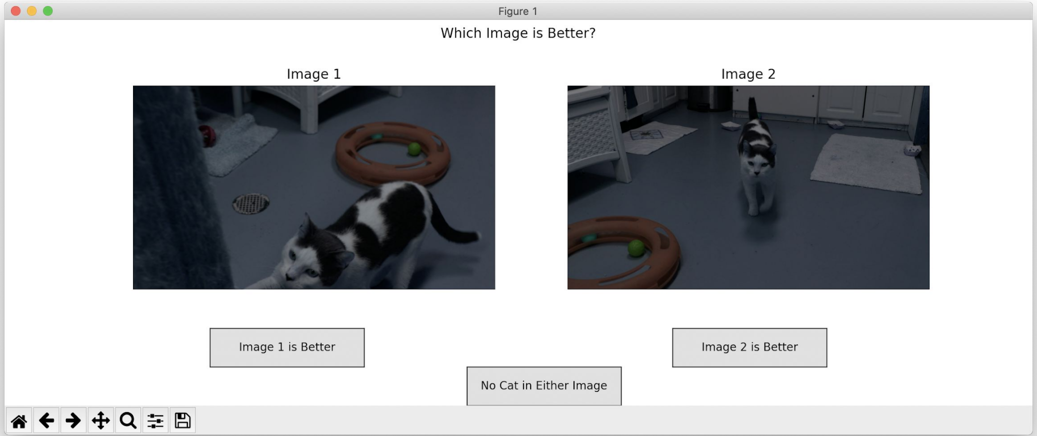
Implementation

Blind A/B testing: baseline vs. developed output

Results

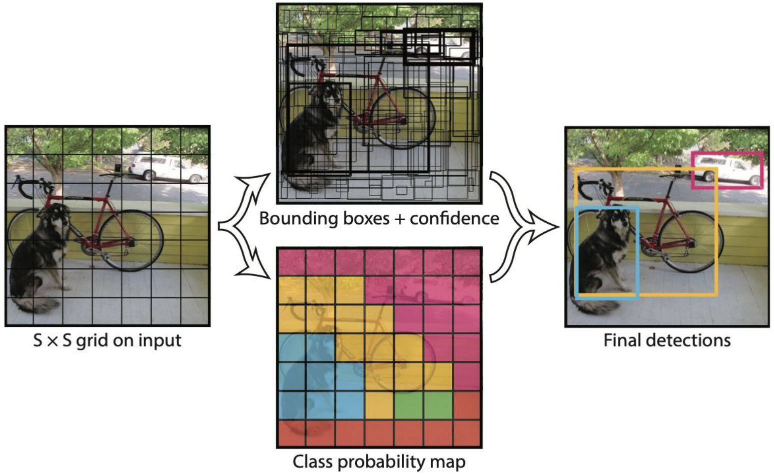
64% of the time developed model produced “better” image

Testing interface



LITERATURE REVIEW: YOLO

- *You Only Look Once: Unified, Real-Time Object Detection*
- Simultaneous Box and Class Proposal
- Simplicity: CNN
- Optimized for Speed



Each grid cell is responsible for producing exactly *B=2* bounding boxes representing existence of any object with center in the cell

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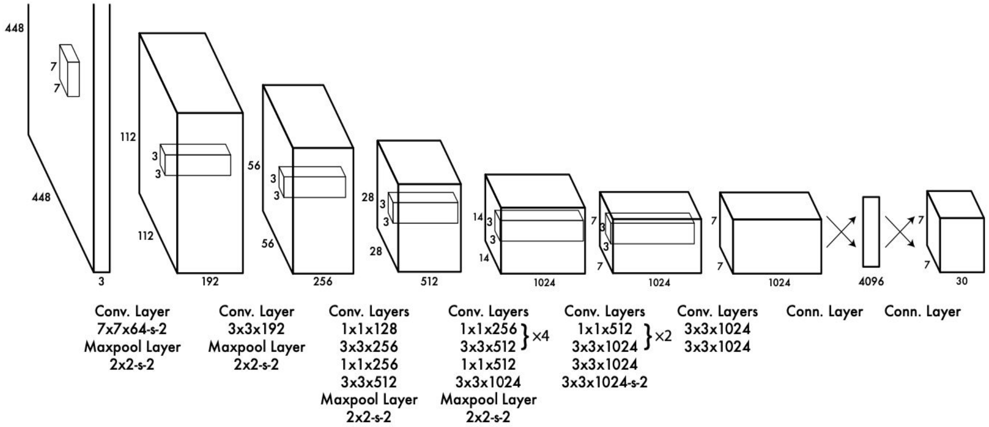
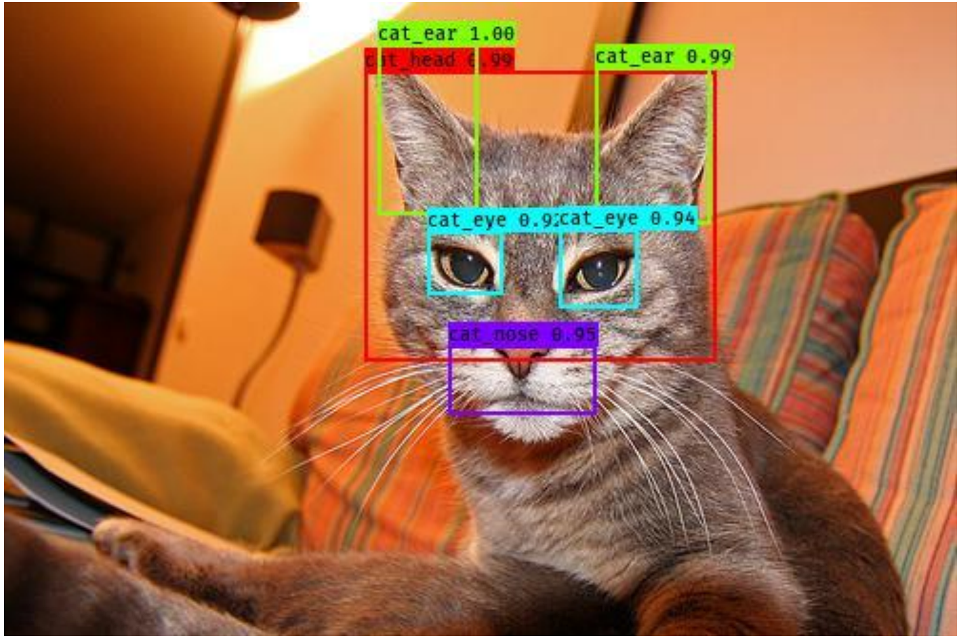


YOLO architecture; note only convolutional and fully connected layers

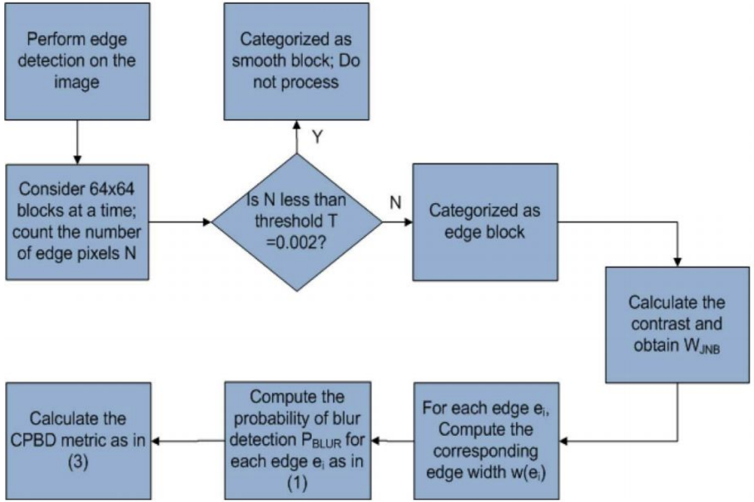
TRAINING YOLO

- YOLO vs Haar Cascade
- 4 Features
  - Eyes, Nose, Ears, Head
- 100 Training Examples
- AWS EC2 g3s.xlarge
  - NVIDIA Tesla M60 GPU



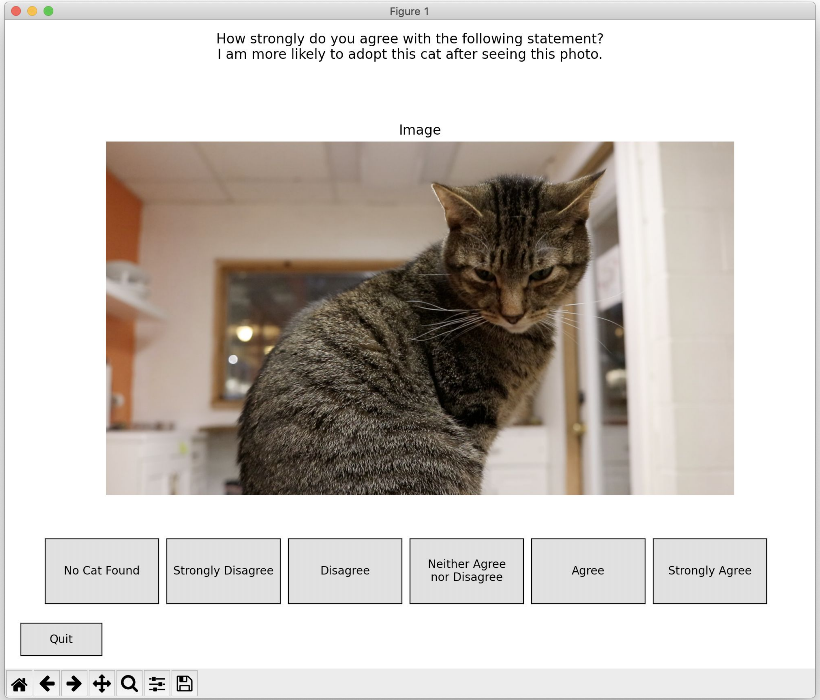
LITERATURE REVIEW: CPBD

- *A No-Reference Image Blur Metric Based on the Cumulative Probability of Blur Detection (CPBD)*
- Probabilistic model for sharpness
- Percentage of detected edges where blur is not detected
- 0 <= cpbd <= 1

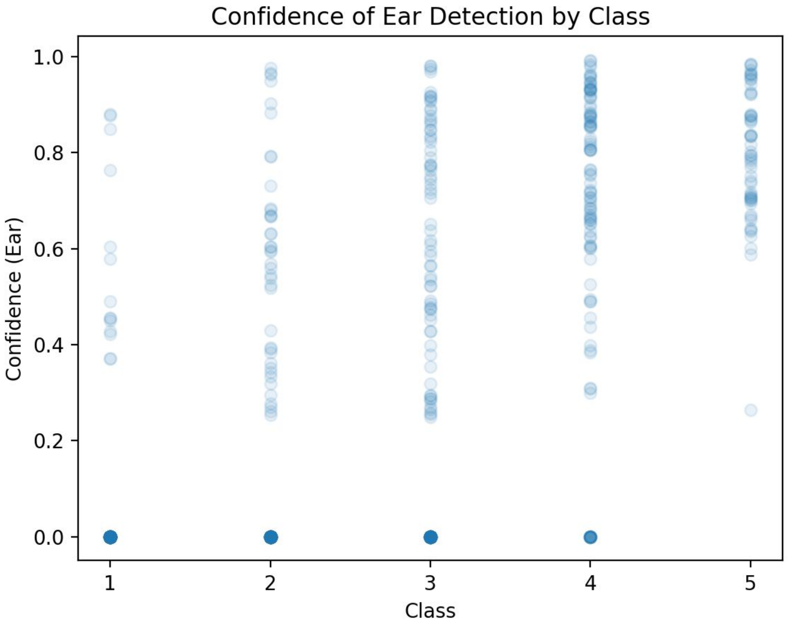


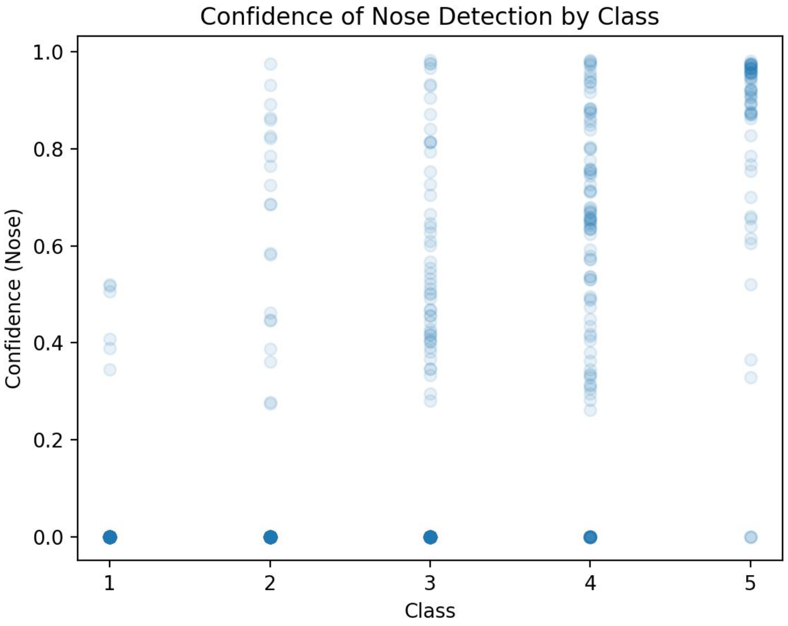
REGRESSION: LABELING

- Data-driven approach to weighting features
- Likert scale
  - 5 classes



REGRESSION: EDA ON PREDICTORS





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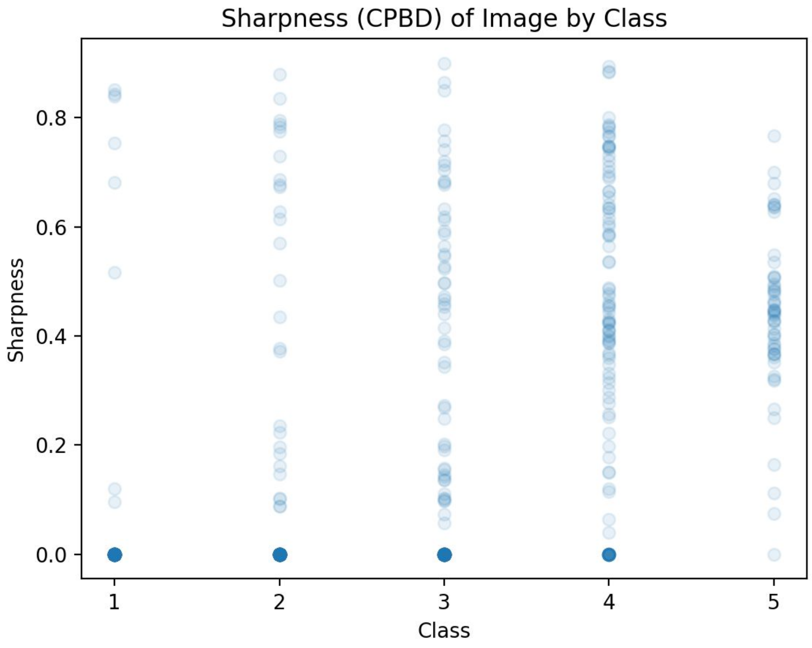
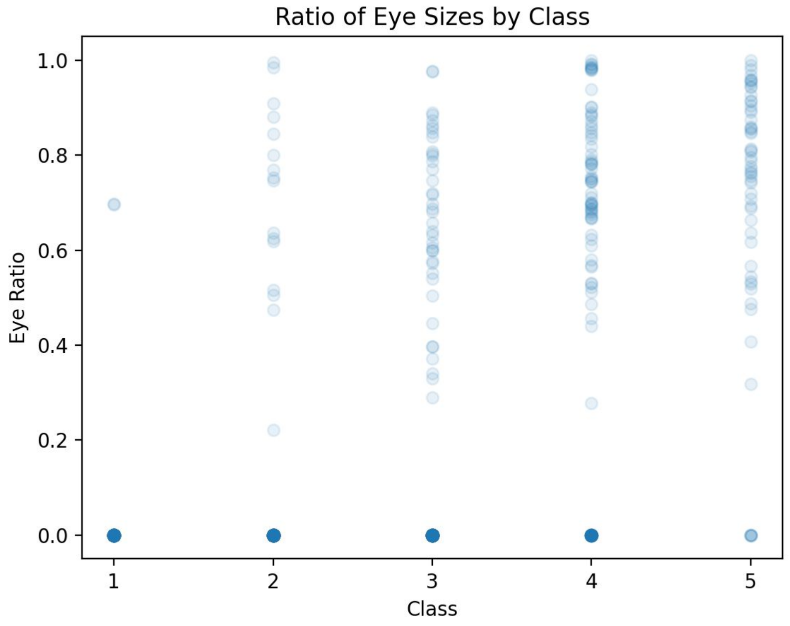




REGRESSION RESULTS: INITIAL

methodology

- Logistic Regression using sklearn
- L1 Regularization
- most salient features: confidence of object detection
- trained on dataset with **any** features detected
- Select for highest probability of either class 4 or 5

results

User selected	Percent of time
Frame from model	77.2%
Frame from baseline	8.9%
neither	13.9%
Selected either frame from model or neither	**91.1%**

REGRESSION RESULTS: ITERATION 2

methodology

- Only examine frames in which **all** features detected
  - Inspired by Decision Trees
- Select for highest probability of either class 4 or 5

results

User selected	Percent of time
Frame from model	74.6%
Frame from baseline	3.8%
neither	21.5%
Selected either frame from model or neither	**96.2%**

MODEL COMPARISONS

baseline	initial	final (iter #2)
random image selected from set of frames with cat head detected	image selected from set of frames with cat head detected, with highest combined scores of sharpness and best cat head ratio	maximum probability of class 4 or 5 produced from logistic regression trained on selected features

MODEL COMPARISONS

baseline	initial	final (iter #2)
random image selected from set of frames with cat head detected	image selected from set of frames with cat head detected, with highest combined scores of sharpness and best cat head ratio	maximum probability of class 4 or 5 produced from logistic regression trained on selected features
Performance against baseline:	64%	96%

OTHER MODELS EXPLORED

Linear Regression

unexplainable results; didn’t fit our data well enough

Convolutional Neural Nets

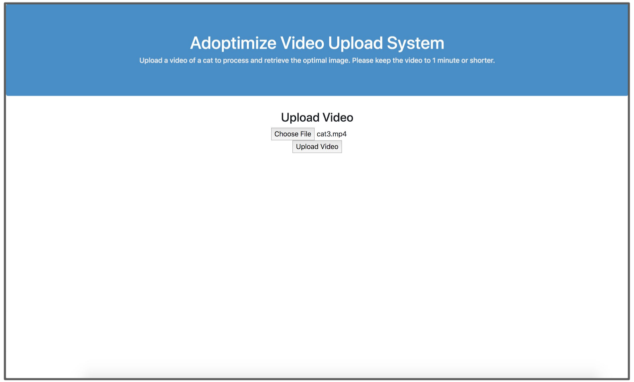
30 - 40% classification accuracy depending on parameter tuning

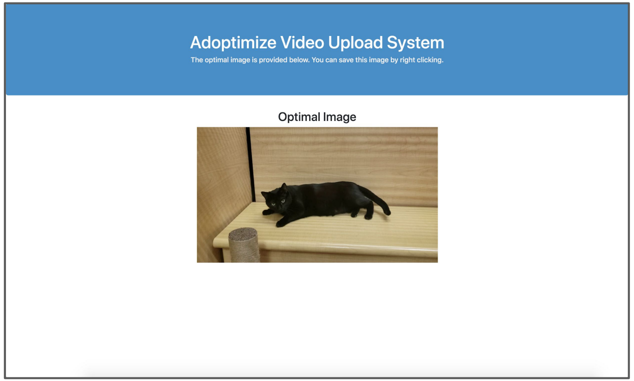
Transfer Learning

Trained on InceptionV3 Neural Network pretrained on ImageNet (60% binary accuracy, 24% 5-class accuracy)

WEB INTERFACE

- Simple web application connected to our model
  - Takes in cat video
  - Executes model
  - Returns optimal frame produced by model





WEB INTERFACE: DEMO

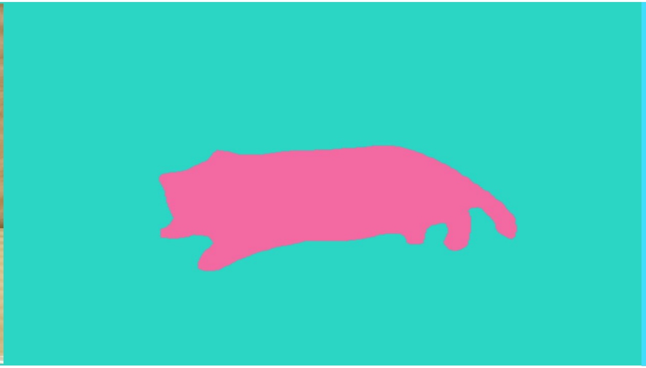
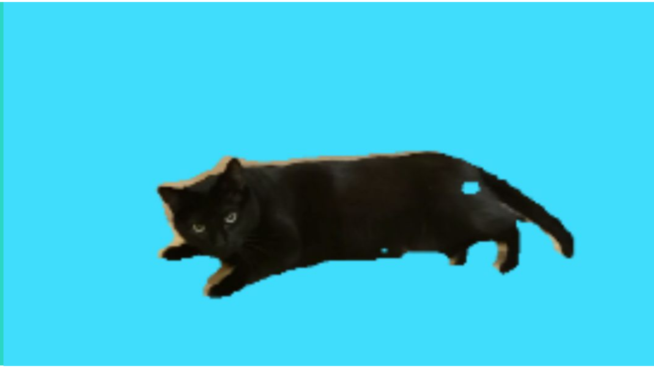
We turned this...

… into this!

EXTENSIONS: BG SUBTRACTION





EXTENSIONS

- Parallelize web app
- Make app front-end prettier
- Measure downstream impact: adoption rates
- Even more model refinements

THANK YOU

Questions?