Application example: Photo OCR

Problem description and pipeline

Machine Learning

The Photo OCR problem

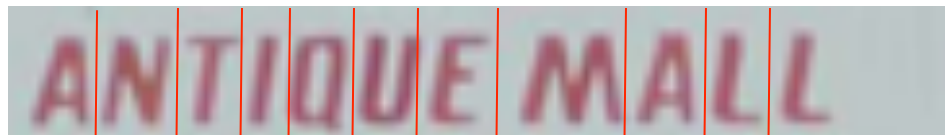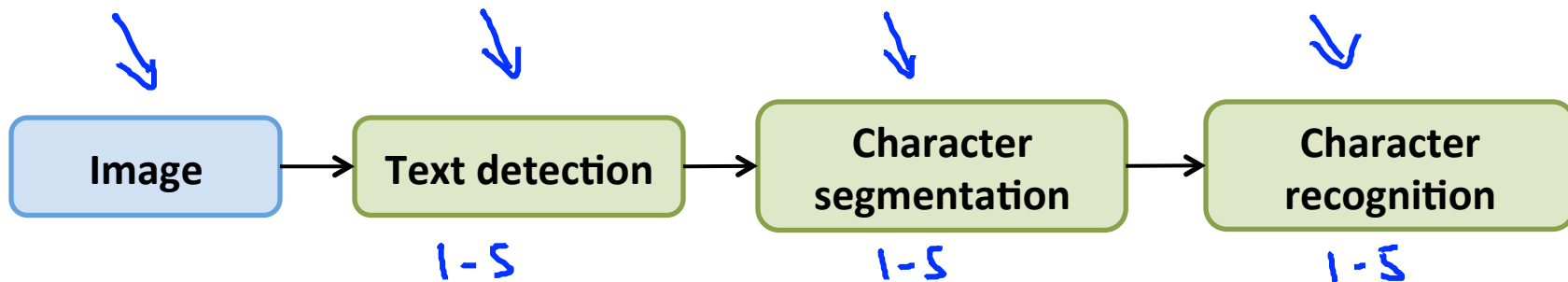# Photo OCR pipeline

→ 1. Text detection

→ 2. Character segmentation

→ 3. Character classification
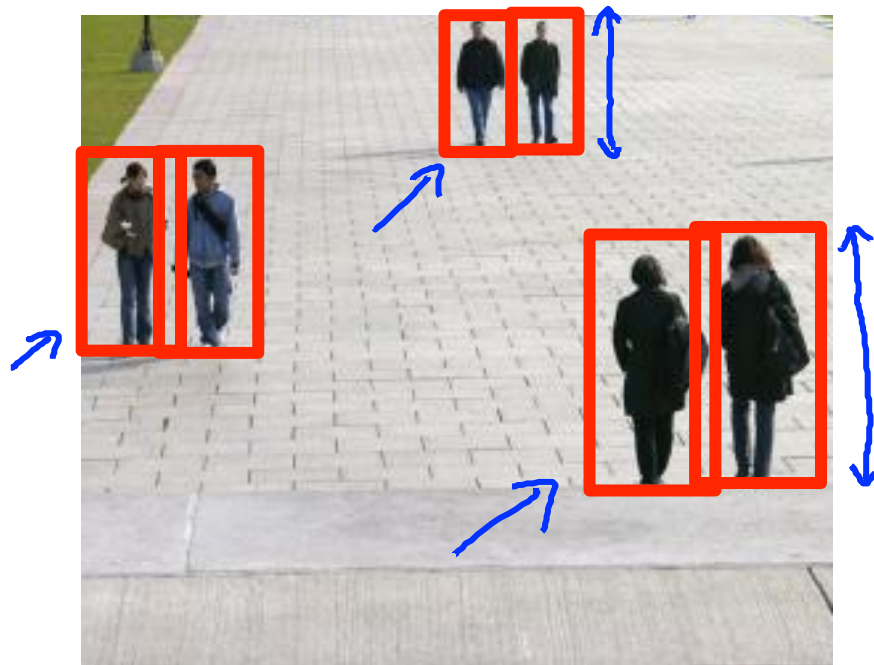

Cleaning → Cleaning

Photo OCR pipeline

Application example: Photo OCR

Sliding windows

Machine Learning

Text detection

Pedestrian detection

Supervised learning for pedestrian detection

$x =$ pixels in 82x36 image patches

Positive examples $(y = 1)$ Negative examples $(y = 0)$

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Sliding window detection

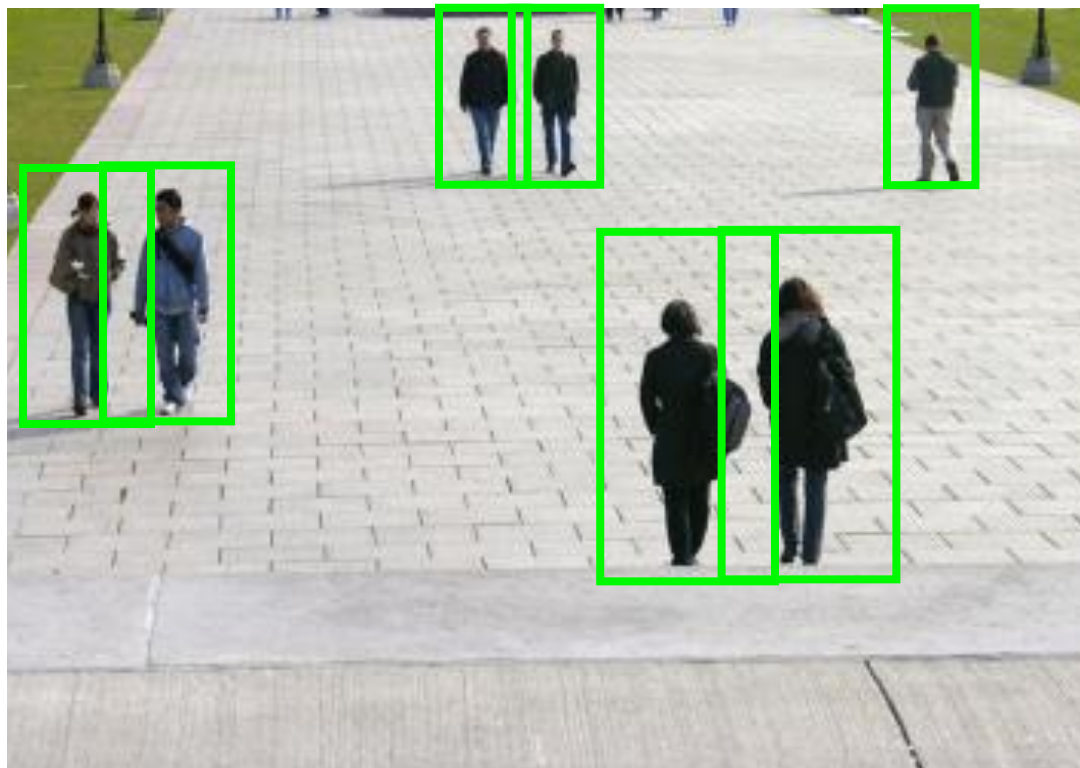step-size /stride

Sliding window detection

82×36
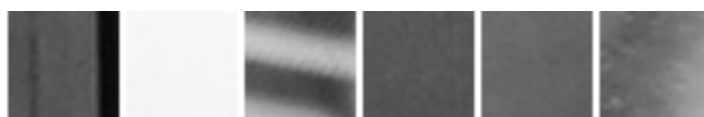
Sliding window detection

Sliding window detection
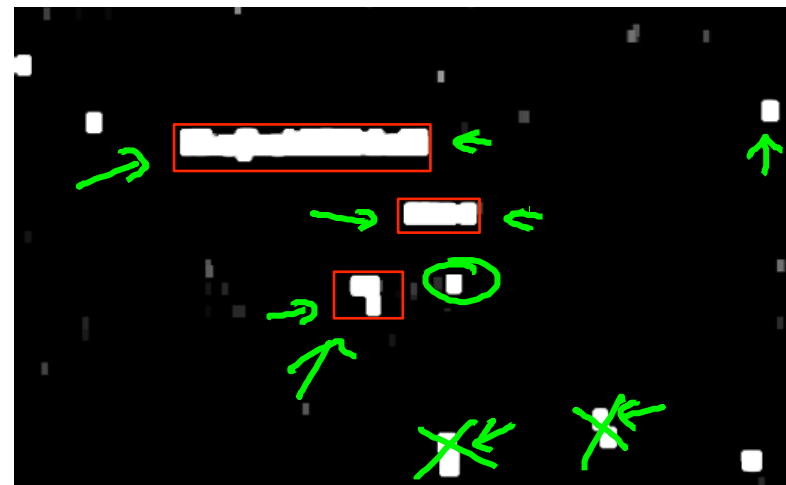
Text detection

Text detection

Positive examples $(y = 1)$

Negative examples $(y = 0)$

Text detection

"expansion"

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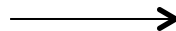
1D Sliding window for character segmentation
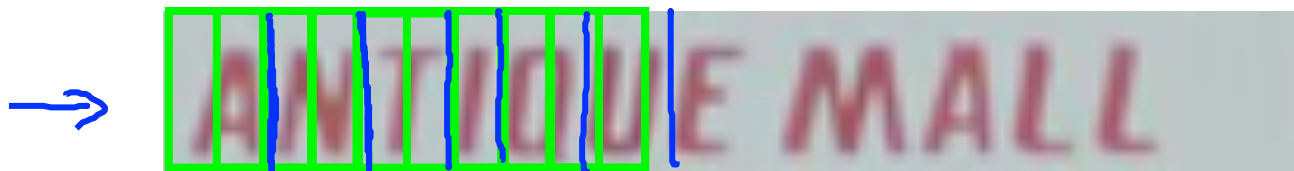
To see the split between the characters
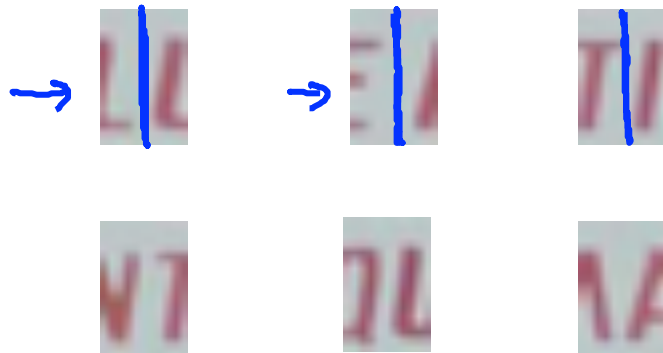
Positive examples $(y = 1)$
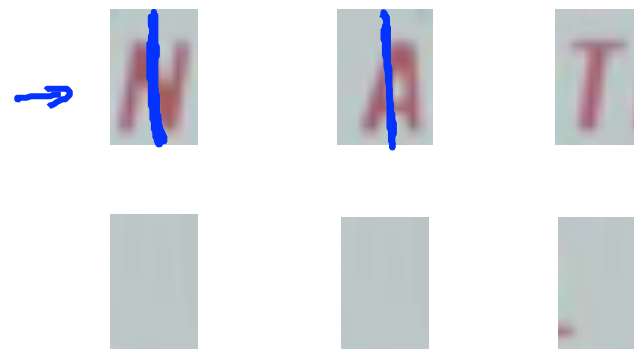
Negative examples $(y = 0)$

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Photo OCR pipeline

→ 1. Text detection

→ 2. Character segmentation

→ 3. Character classification

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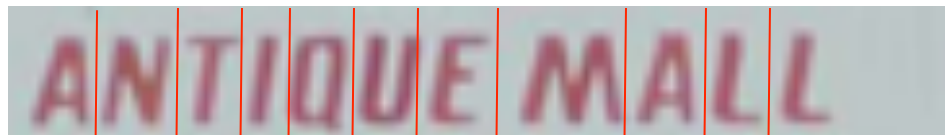
Application example: Photo OCR

Getting lots of data: Artificial data synthesis

Machine Learning

Character recognition

Artificial data synthesis for photo OCR

Real data

Abcdefg

Abcdefg

Abcdefg

Abcdefg

Abcdefg

Artificial data synthesis for photo OCR

Real data

Synthetic data

Synthesizing data by introducing distortions

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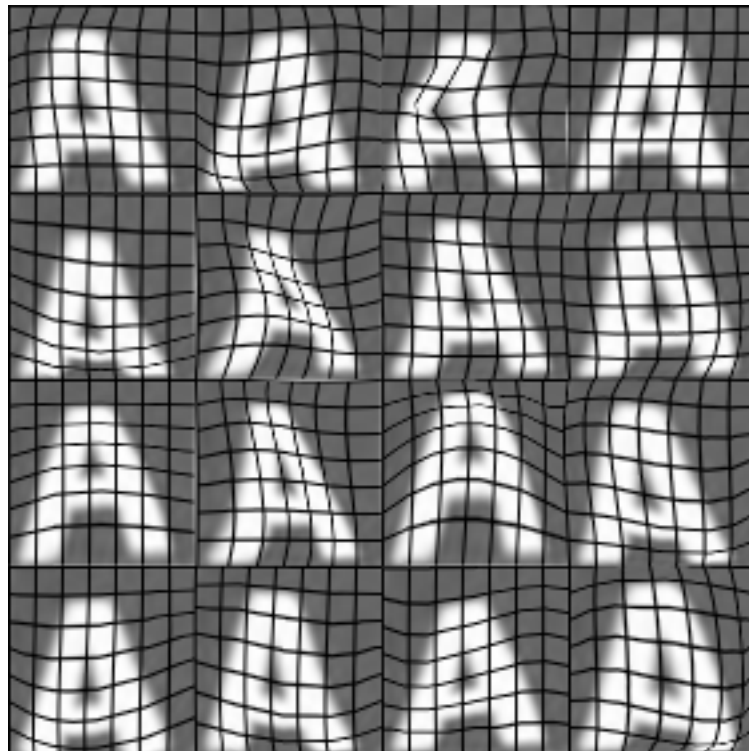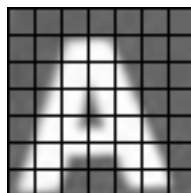
Synthesizing data by introducing distortions: Speech recognition

🔊 Original audio: ⟵

🔊 Audio on bad cellphone connection

🔊 Noisy background: Crowd

🔊 Noisy background: Machinery

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Synthesizing data by introducing distortions

→ Distortion introduced should be representation of the type of noise/distortions in the test set.
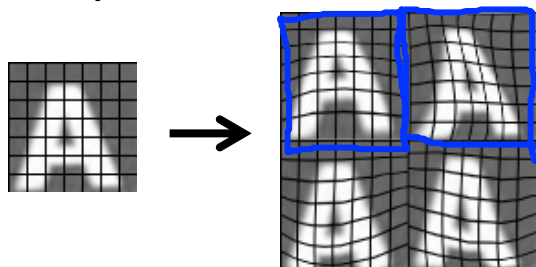
→ Audio:
Background noise,
bad cellphone connection

→ Usually does not help to add purely random/meaningless noise to your data.
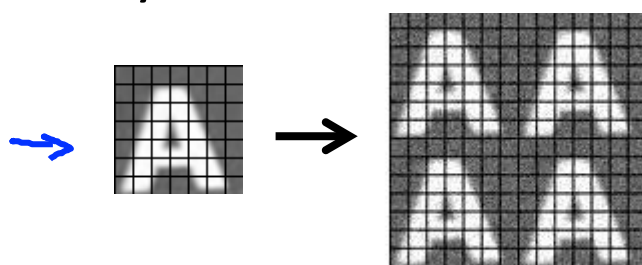
→ $x_i =$ intensity (brightness) of pixel i

→ $x_i \leftarrow x_i +$ random noise

[Adam Coates and Tao Wang]

Discussion on getting more data

1. Make sure you have a low bias classifier before expending the effort. (Plot learning curves). E.g. keep increasing the number of features/number of hidden units in neural network until you have a low bias classifier.
2. "How much work would it be to get 10x as much data as we currently have?"
    -   Artificial data synthesis
    -   Collect/label it yourself
    -   "Crowd source" (E.g. Amazon Mechanical Turk)

$\rightarrow$ #hours?

$m = 1,000$

$\rightarrow$ 10 secs / example

$m = 10,000$

Discussion on getting more data

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Machine Learning

Application example: Photo OCR

Ceiling analysis: What part of the pipeline to work on next

Estimating the errors due to each component (ceiling analysis)
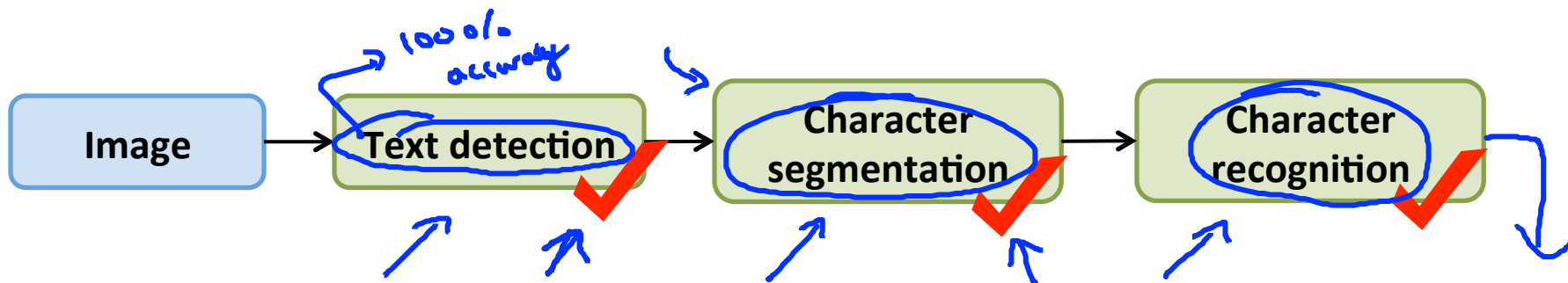
What part of the pipeline should you spend the most time trying to improve?

Component which is trained   Accuracy improvement of overall system

Component	Accuracy
Overall system	72%
Text detection	89%
Character segmentation	90%
Character recognition	100%

Another ceiling analysis example
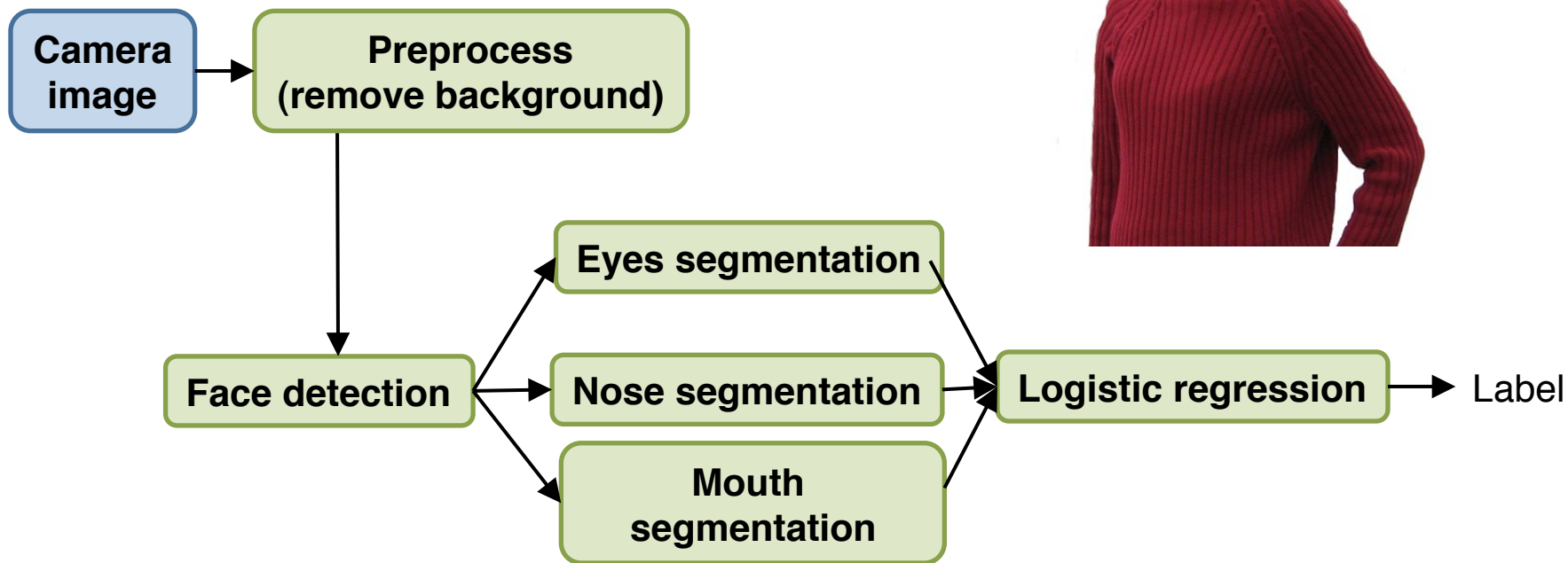
Face recognition from images
(Artificial example)

Camera image → Preprocess (remove background)

Preprocess (remove background) → Face detection

Face detection → Eyes segmentation
Face detection → Nose segmentation
Face detection → Mouth segmentation

Eyes segmentation → Logistic regression
Nose segmentation → Logistic regression
Mouth segmentation → Logistic regression

Logistic regression → Label

Another ceiling analysis example

Component	Accuracy
Overall system	85%
Preprocess (remove background)	85.1%
Face detection	91%
Eyes segmentation	95%
Nose segmentation	96%
Mouth segmentation	97%
Logistic regression	100%

Handwritten annotations: 0.1%, 5.9%, 4%, 1%, 1%, 3%

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