Introduction to Creating a Vision Solution in the Cloud

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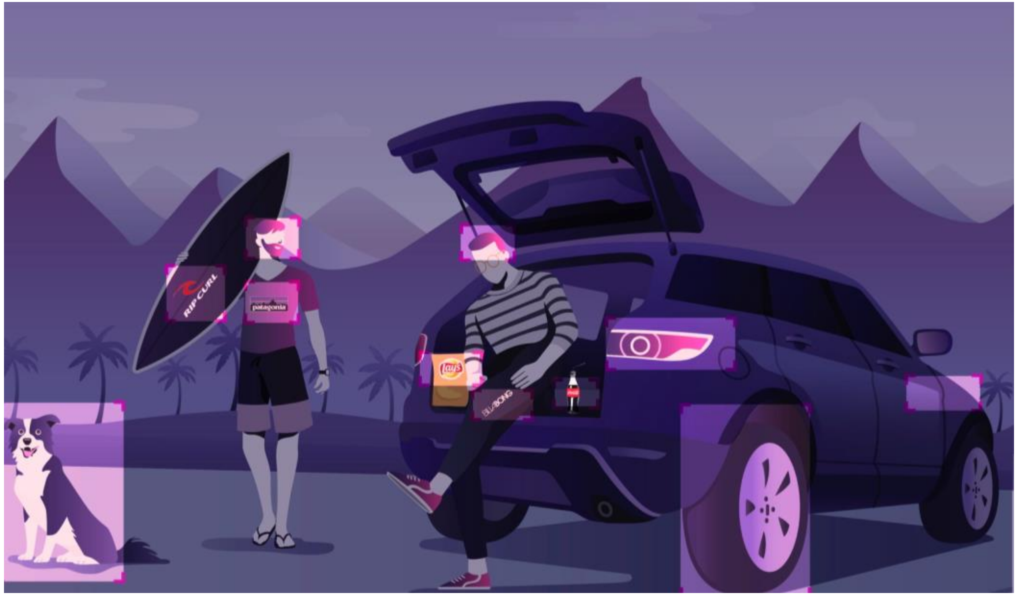
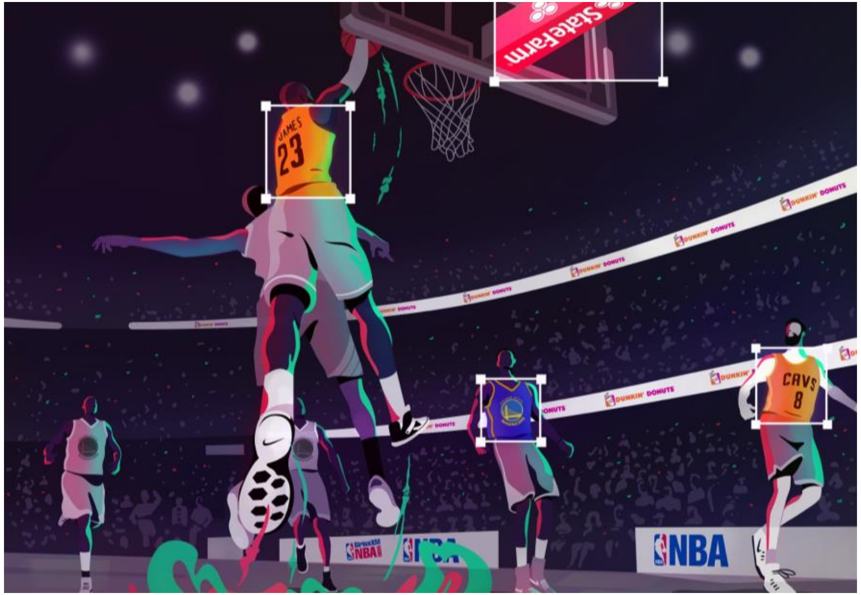
May 2018

GumGum Overview

GumGum is an artificial intelligence company with a particular focus in computer vision





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Agenda

1. Why Computer Vision in the Cloud?
2. Performance Metrics
3. Computer Vision System Design
   - Computer Vision Modules, Features and API
   - Efficiency Studies (CPU vs GPU)

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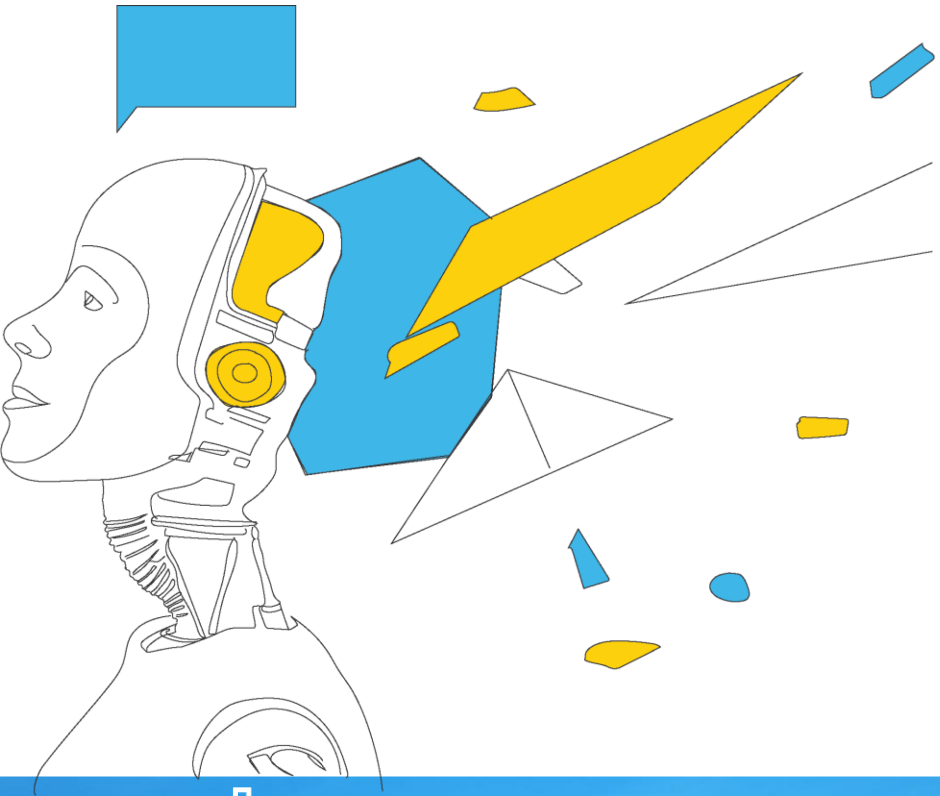
Why Computer Vision in the Cloud?



It depends!

- Reliability
- Latency
- Hardware and Software Resources
- Power, Size and Cost Constraints
- Volume of Data/Throughput

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Computer Vision System Design

Key Performance Indicators

Precision	Recall	F1 Score	CPM	Throughput	Class Support
$(\frac{TP}{TP+FP})$	$(\frac{TP}{TP+FN})$	$2 * (\frac{Precision*Recall}{Precision+Recall})$	$(\frac{\$}{1000 frames})$	$(\frac{frames}{sec})$	$labels = [l_1, l_2, \ldots l_N]$

- **TP** – True Positive
- **FP** - False Positive
- **FN** - False Negative

***CPM** – Cost Per Mille

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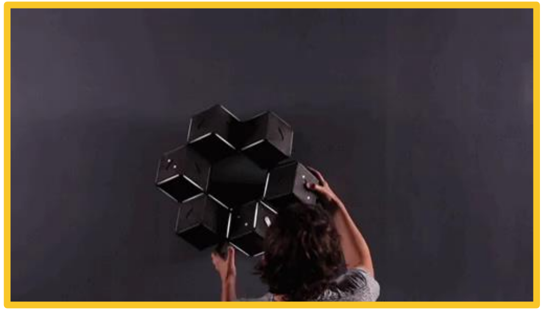
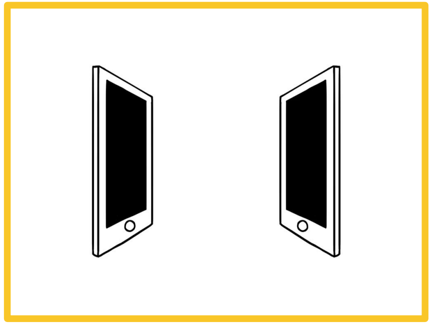
Design Principles

01 Scalability



02 Modularity/ Flexibility



03 (A)Synchronicity

04 Efficiency

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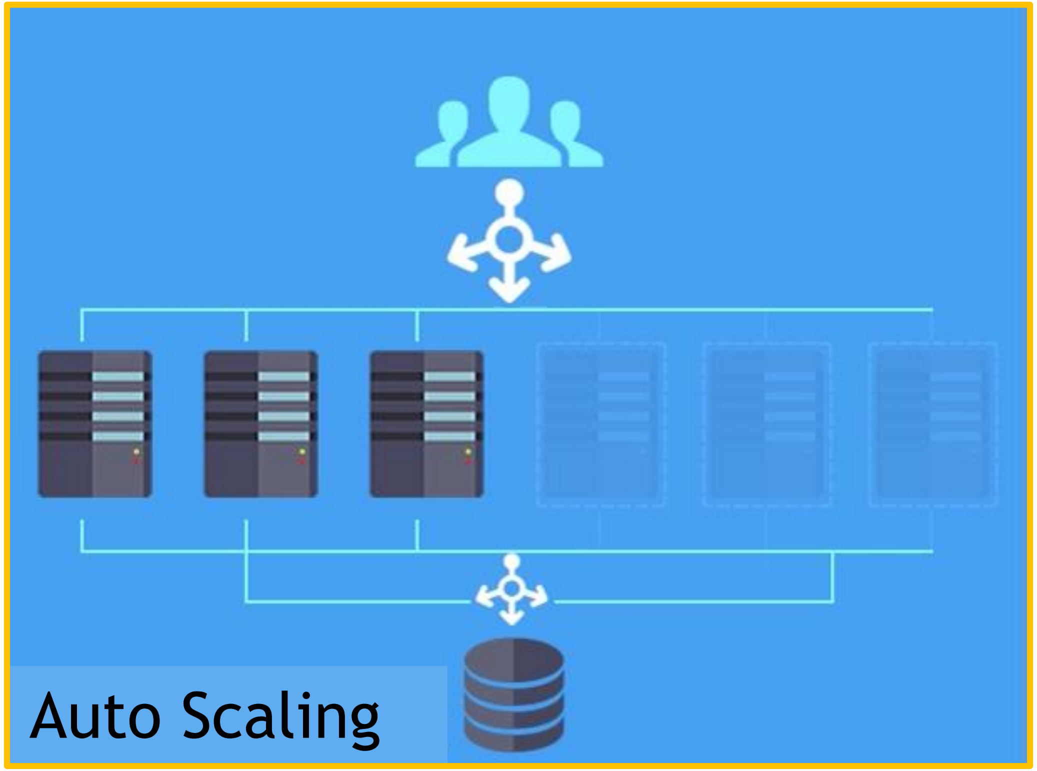
Design Principles - 01 Scalability

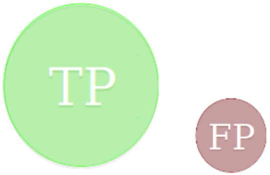
Design Principles - 01 Scalability: How



Design Principles - 01 Scalability: Effect on metrics

Example: Logo Detection Engine

Estimate Acc.

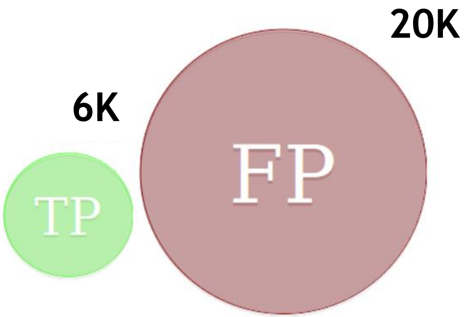


Recall = 60%
FPR = 2%

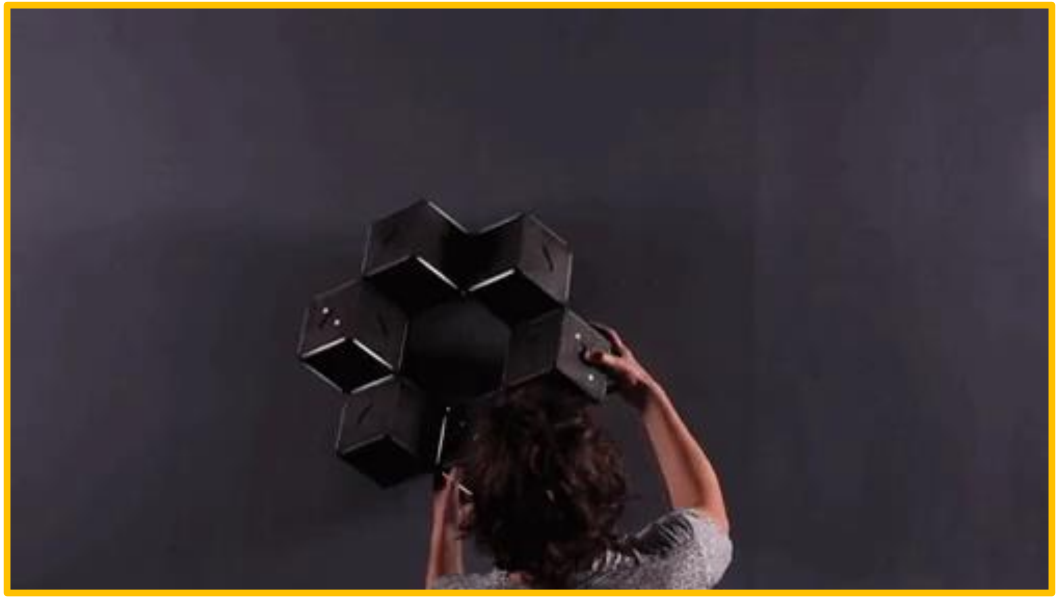
Production

Throughput = 1M images/day
Estimated presence of logos = 1% = 10K images
Expected Recall = 0.6*10K = 6K
Expected FPs = 0.02*(1M-10K)
~ 20K

Realized Precision



Design Principles - 02 Modularity/Flexibility



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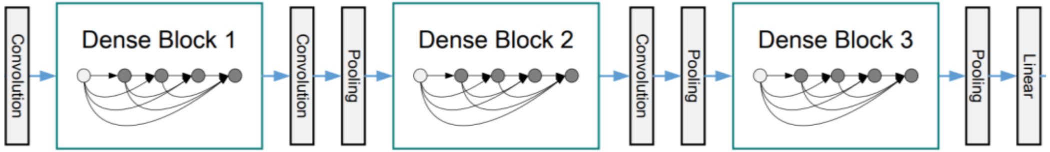
Design Principles - 02 Modularity/Flexibility

Red Ford Mustang

Red-Ford-Mustang

Not-Red-Ford-Mustang



DenseNet

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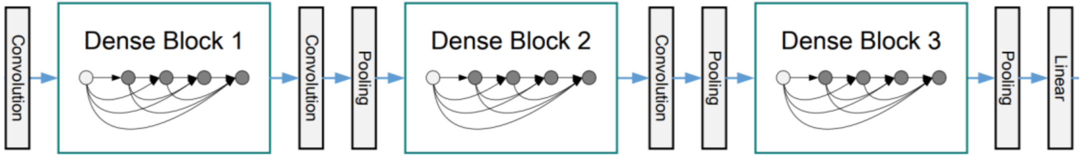
Design Principles - 02 Modularity/Flexibility

Blue BMW Z4

Blue-BMW-Z4

Not-Blue-BMW-Z4



DenseNet

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Design Principles - 02 Modularity/Flexibility

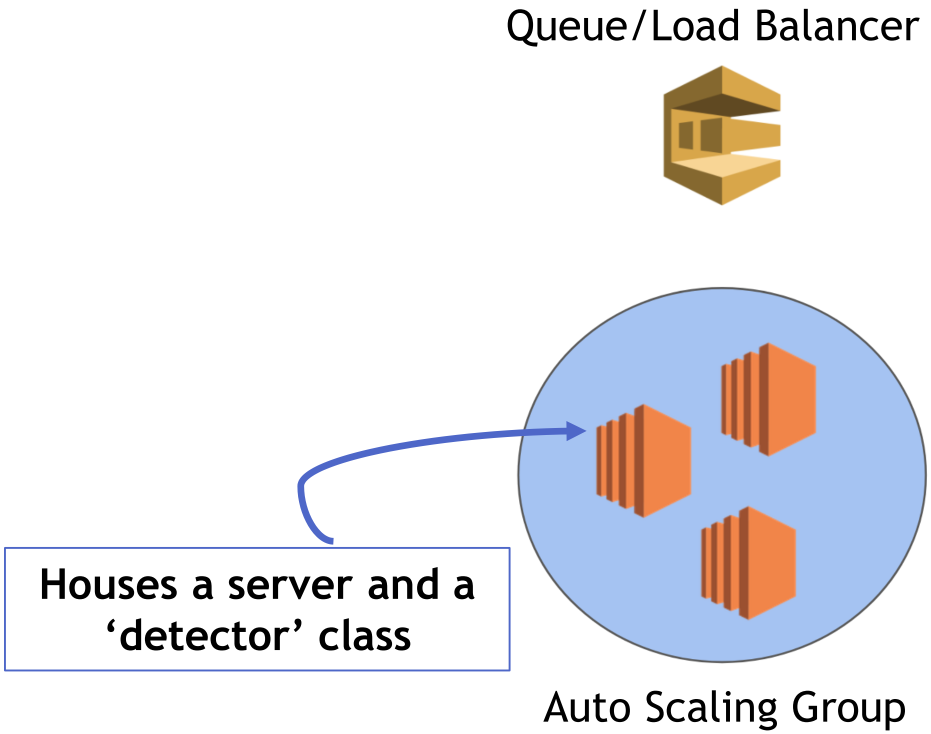
Computer Vision Modules

ML-based: CNNs, LSTMs, SVMs

Traditional: Feature Matching

Hybrid: Feature Matching + SVM

Heuristic: Design Logic



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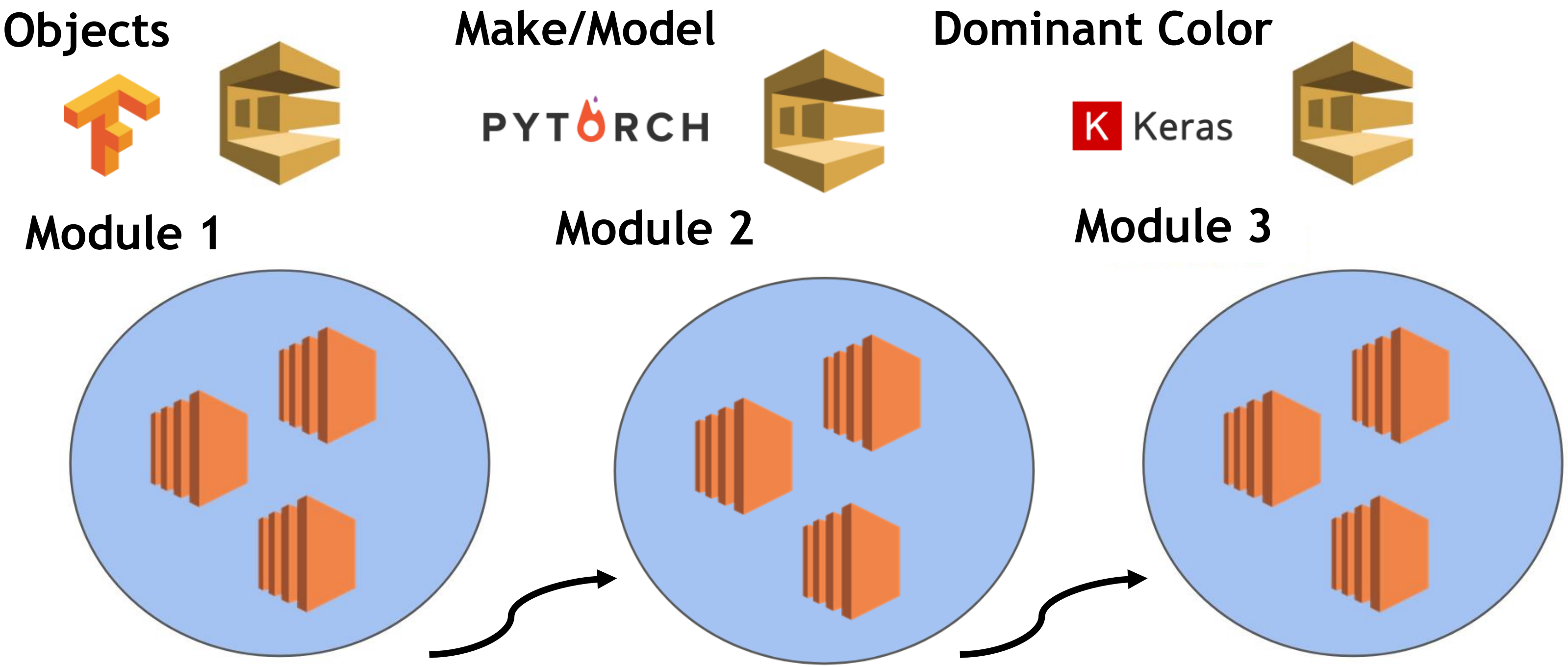
Design Principles - 02 Modularity/Flexibility

Computer Vision Features



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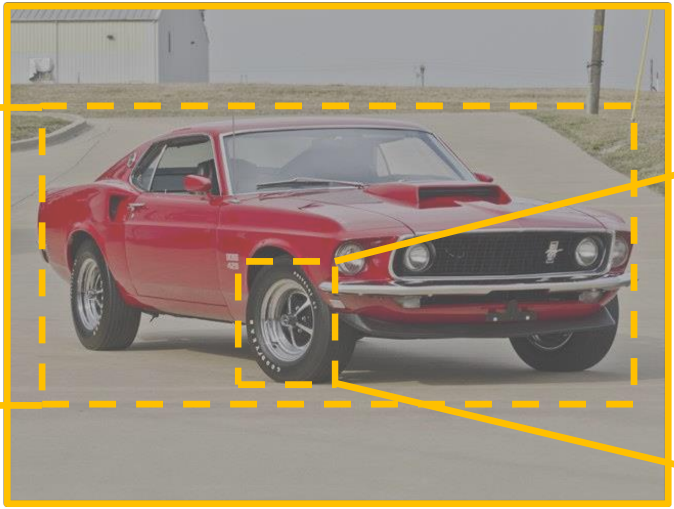
JSON for Inter-Process Communication

Region : List of points describing a contour

Property : Car



(Sub)Region : List of points describing a contour within another contour

Property : Tire, Black

Property : Car, Ford, Mustang, Red

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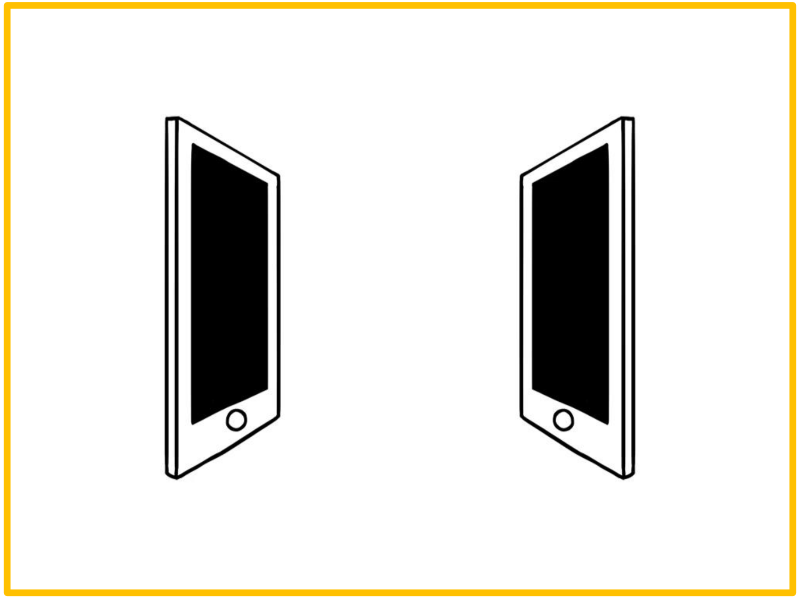
Design Principles - 03 (A)Synchronicity



Design Principles - 03 (A)Synchronicity

Incoming Requests

AWS Elastic Beanstalk

AWS ElastiCache (Redis)

The requests then go into Computer Vision Features

Design Principles - 04 Efficiency

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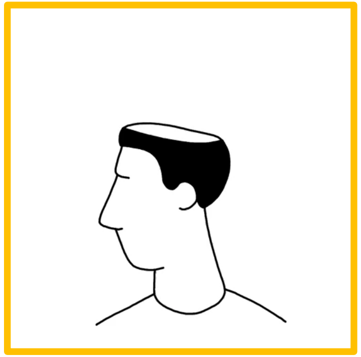
Hardware Efficiency

RAM/GPU Memory



Minimize memory footprint

Utilization

Maximize CPU/GPU utilization

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Design Principles - 04 Efficiency

	CPU	GPU
COST	Detector: $1.63 CPM Classifier: $0.124 CPM	Detector: $0.0829 CPM Classifier: $0.0338 CPM
RUNTIME	Detector: 14.59 sec/image Classifier: 1.11 sec/image	Detector: 0.4596 sec/image Classifier: 0.1873 sec/image

* CPM = Cost Per Mille

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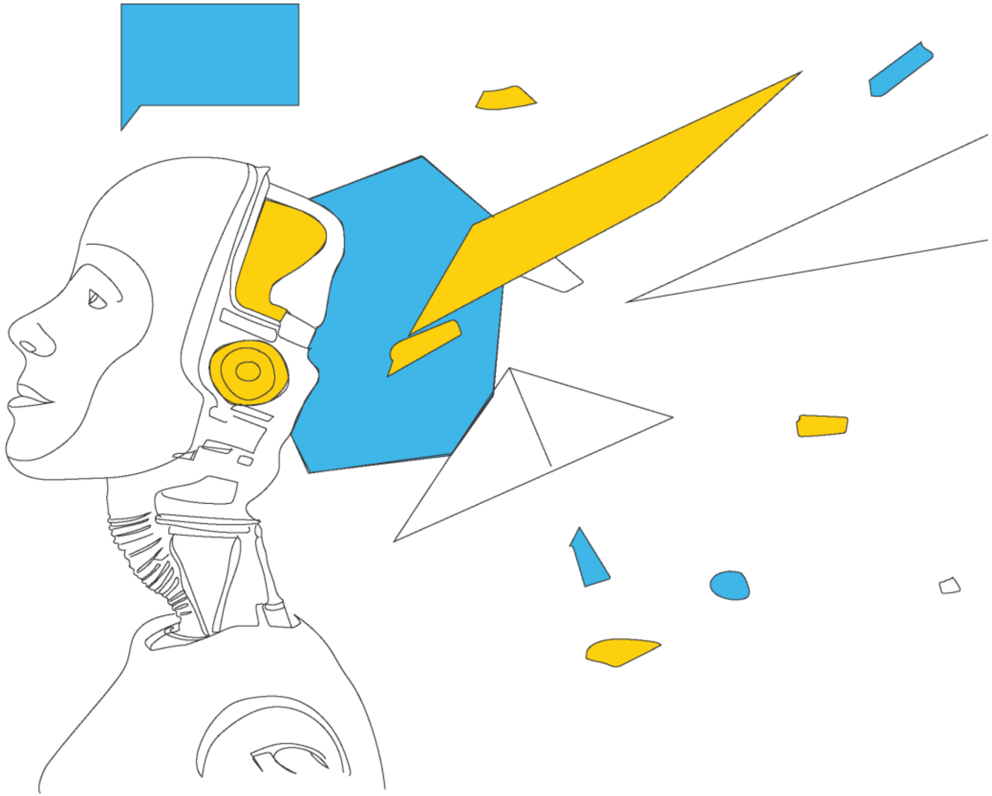
Key Takeaways



- Client Requirements
- Performance Metrics
- Scalability
- Modularity
- Synchronicity
- Efficiency

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Thank You

Resources

- Computer Vision: At the Edge or In the Cloud? It Depends.
- Keras Wiki, Keras Documentation, Github – Keras
- MXNet
- PyTorch
- Open Neural Network Exchange
- Caffe2
- TensorFlow
- Swapper - API Development Tool
- Amazon ElasticSearch
- Amazon ElasticBeanstalk
- Spring Framework for Java Platform
- Densly Connected Convolutional Networks
- Three reasons why apache avro data serialization is a good choice
- Apache Avro Schema 1.8.1

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240+
Gumgummers

70%
Of Fortune 100 Companies

16
Offices On 16 Continents

99.4%
CAGR Since 2012

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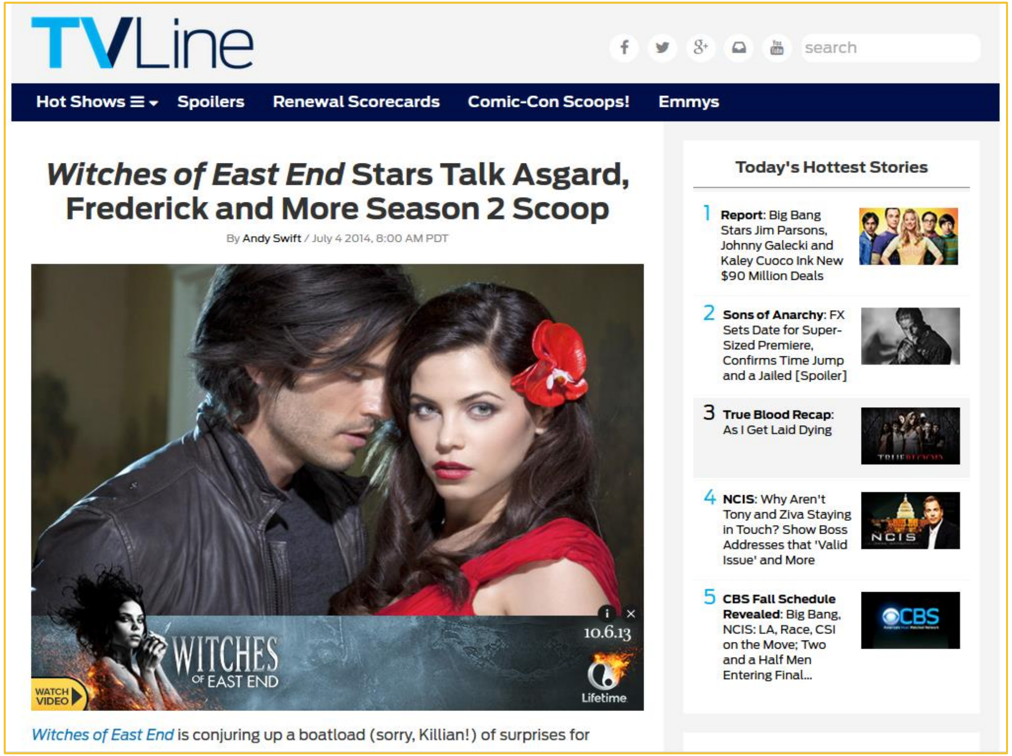
Computer Vision Applications

…in Augmented Advertising



CONTENT ENHANCES AD

Ad creative built to incorporate image content

Localized detection of objects, people, or body parts using Computer Vision

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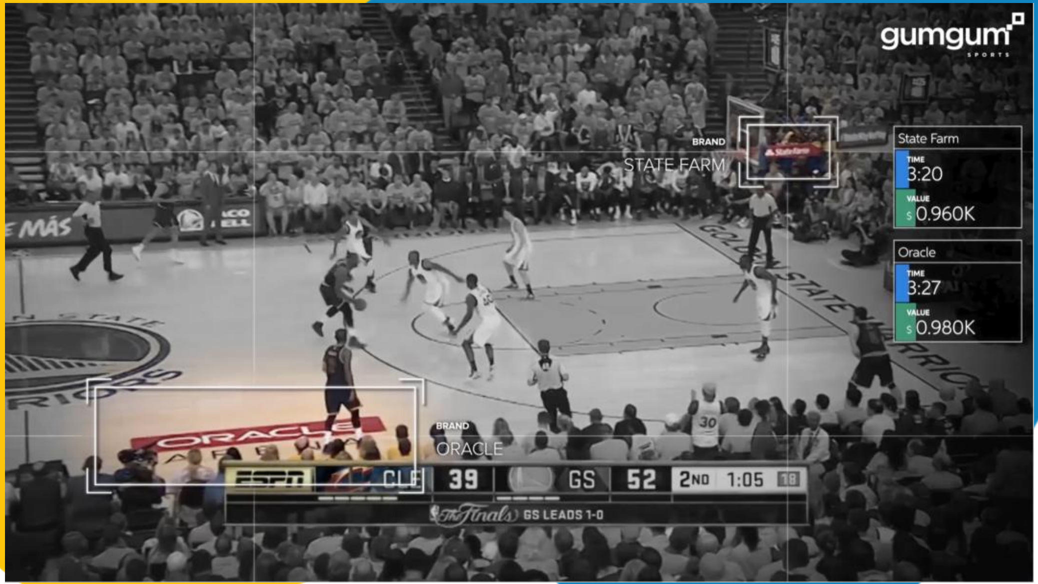
Sports Sponsorship Measurement



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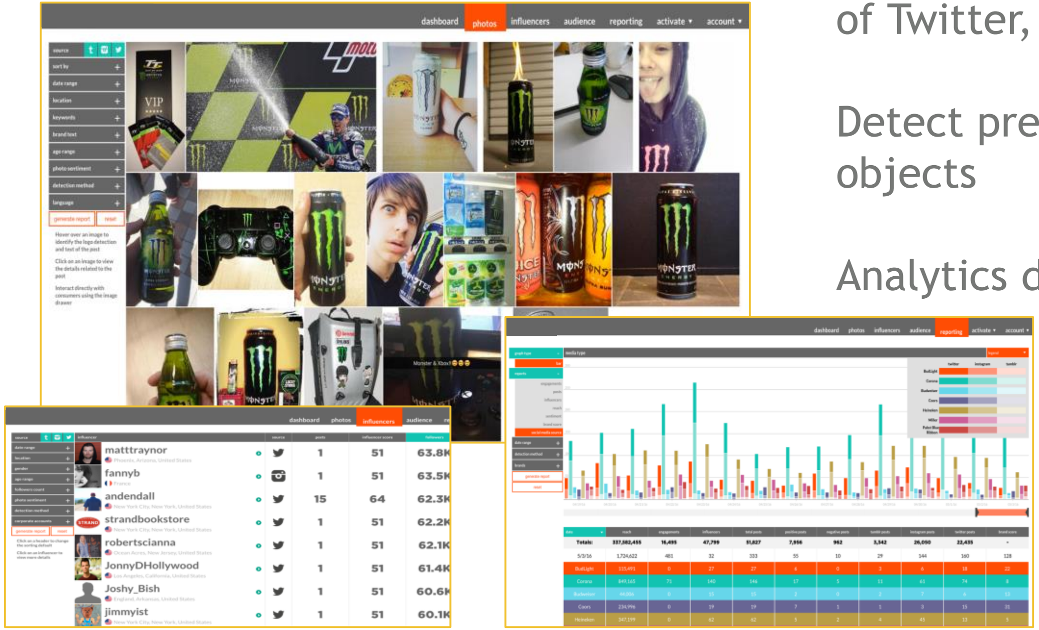
Social Listening



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Ingest social posts with visual content from firehose of Twitter, Instagram, etc.

Detect presence and location of brand logos or other objects

Analytics dashboard, interact with influencers

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Design Principles

ACCURACY SPECS CAN BE CASE SPECIFIC

Example: Brand Safety in Digital Advertising

ADVERTISER NETWORK ⟷ **AdServer** ⟷ **PUBLISHER NETWORK**

High Recall/Low Precision = Risks Minimized

High Recall/Low Precision = Inventory Reduced

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Design Principles : Modularity/Flexibility


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Inter-Process Communication


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Design Principles: Modularity/Flexibility

Inter-Process Communication

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