

# Content-Based Image Retrieval

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# Outline

- 1 Content-Based Image Retrieval
  - Definition
  - High level Pipeline
  - Research question
- 2 Research Trends
  - Convolutional Neural Network
  - Global Design
  - Image Classification
  - Image Similarity
- 3 My Work
  - Objective
  - Roadmap
  - Implementation
  - Evaluation

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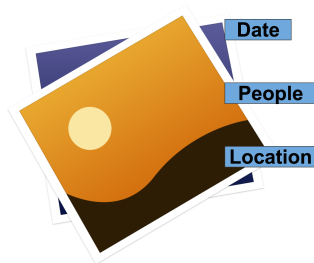
- Evaluation

# Definition

Yes







No



# Real World Applications

## Google Query By Image

Google  car-04.jpg x ferrari car   

Web **Images** News Shopping Maps More ▾ Search tools

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About 3,840 results (0.84 seconds)




Image size:  
1920 × 1200

Find other sizes of this image:  
[All sizes](#) - [Medium](#) - [Large](#)

Best guess for this image: **ferrari car**

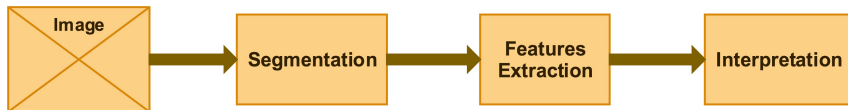
# Real World Applications

## CamFind

- Entity Recognition
- Visual search engine



# Pipeline



Problems :

- A lot of different Features Detectors
  - Low level Features
  - Semantic Gap

# Research question

## The Semantic Gap

How deep learning methods can help to bridge the semantic gap in Content-Based Image Retrieval ?



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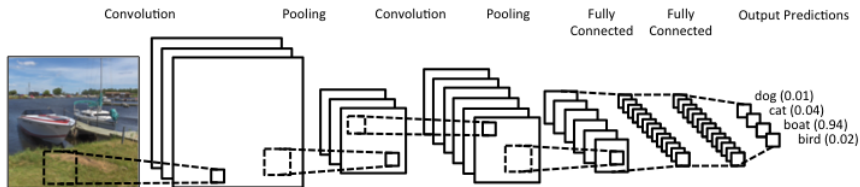
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# Convolutional Neural Network

- Deep Learning method
- Learn Features from all kind of Signals
- Learn Higher Level Features
- Invariance to Several Transformations

# High Level Design

## Design



# LeNet-5 Breakthrough

## Handwritten Digit Recognition

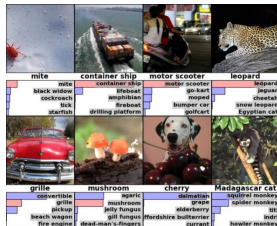


Best Performance by LeNet 5  
designed by Yann LeCun

- Two Convolutional Layers
- One Fully Connected Layer
- One Softmax Layer

# AlexNet Breakthrough

## Image Classification

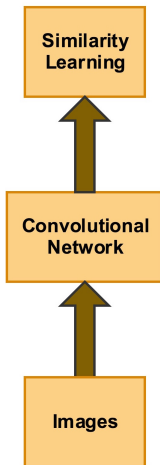


Best Performance by AlexNet  
designed by Alex Krizhevsky

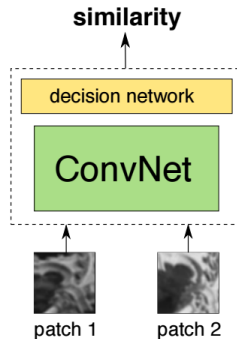
- Five Convolutional Layers
- Three Pooling Layers
- Two Fully Connected Layers
- One Softmax Layer

# Two Approaches

## Conventional



## Siamese Network



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# Objective

## Objective

Design a Convolutional Neural Network for Image Similarity Tasks.



# Roadmap

- ① Re-implement traditional Convolutional Neural Network
- ② Design a new Convolutional Neural Network
- ③ Evaluate the new net on several benchmarks

# Implementation

## Deep Learning Framework Theano

- Python library
- Implement a lot of useful functions
  - Support GPU computing

# Evaluation

## Three Benchmarks :

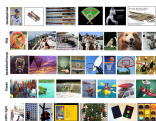


Figure: Caltech



Figure: Paris



Figure: PubFig83

# Summary

- Content-Based Image Retrieval technologies are needed
- Convolutional Neural Network has already proven to be efficient for Image Classification
- Investigate how they can be used for Image Similarity

Thank you for your attention !

Questions ?