Introduction to Computer Vision

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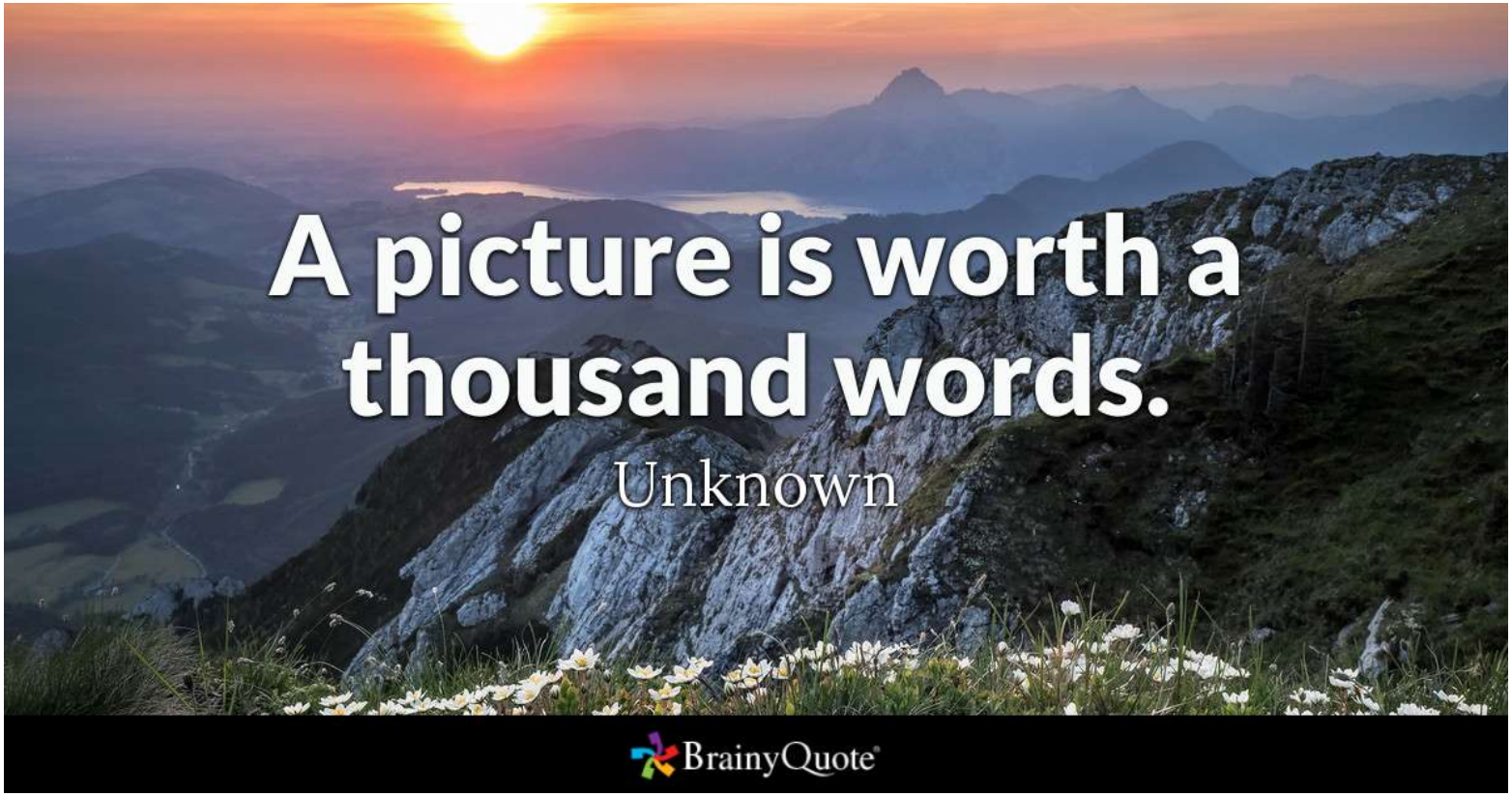
Ngày 24 tháng 2 năm 2022

Today:

- What is computer vision?
- Course overview
- Evaluations

What is Computer Vision?



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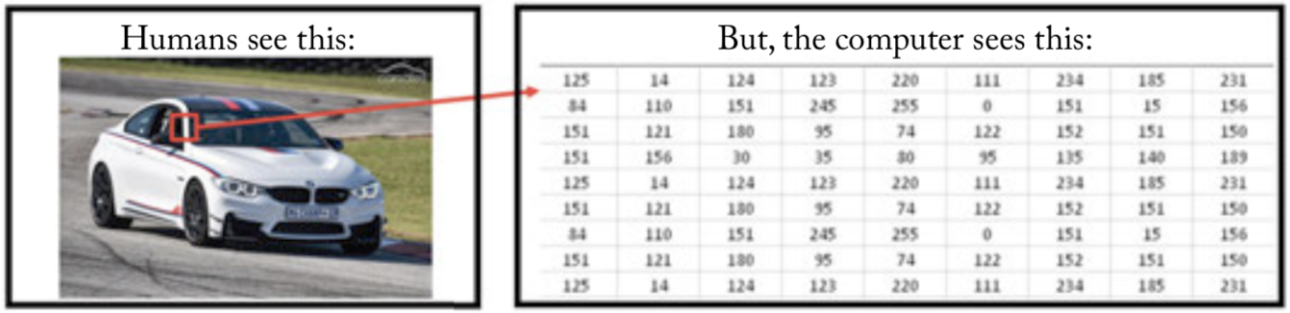

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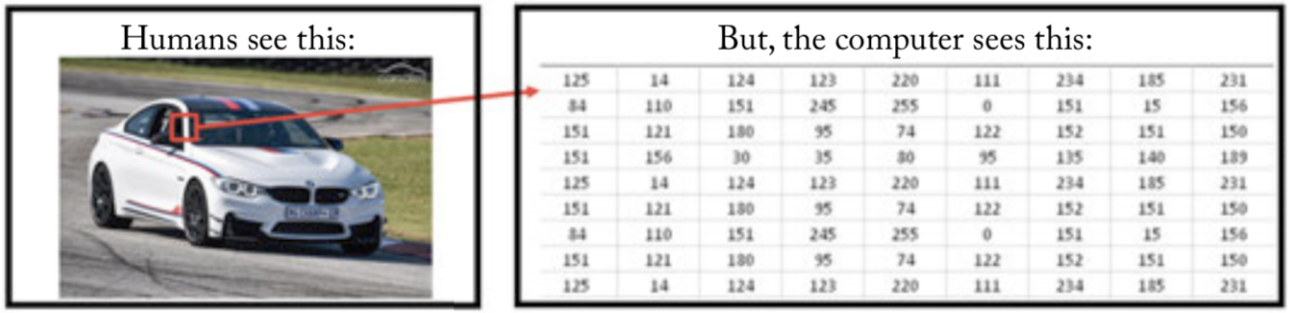
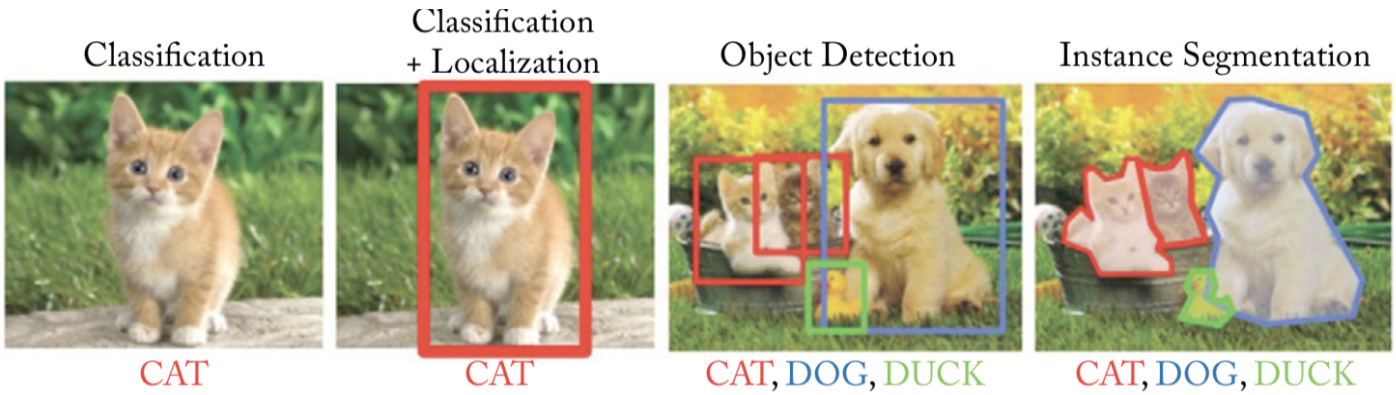
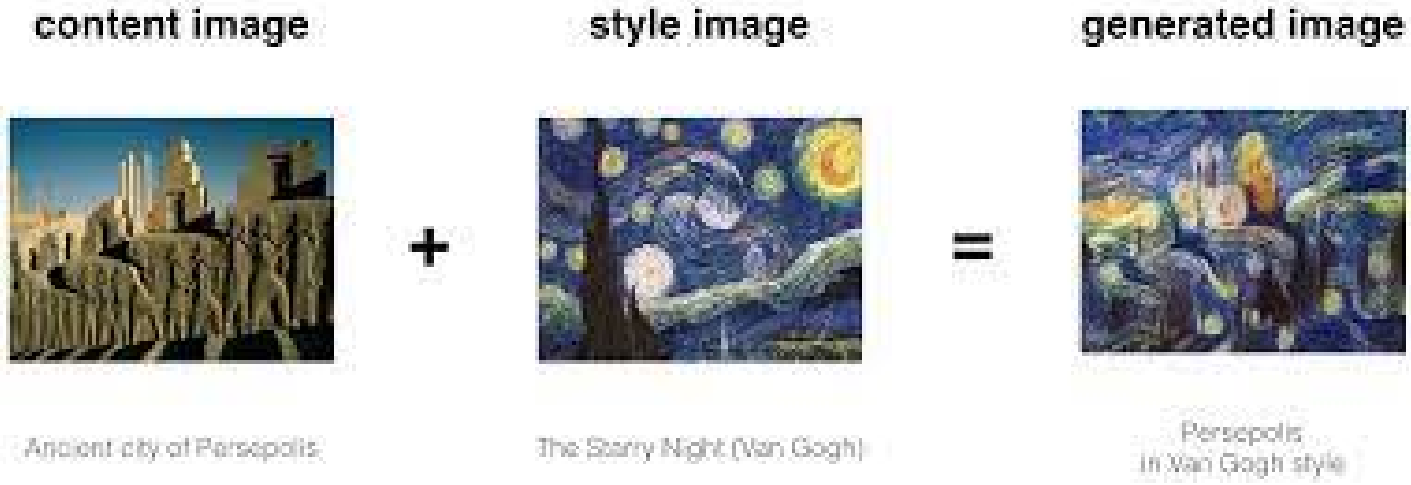


- Computer Vision = Thị giác máy tính = Làm máy tính "nhìn" và "hiểu" thông tin từ hình ảnh như chúng ta

Application of Computer Vision

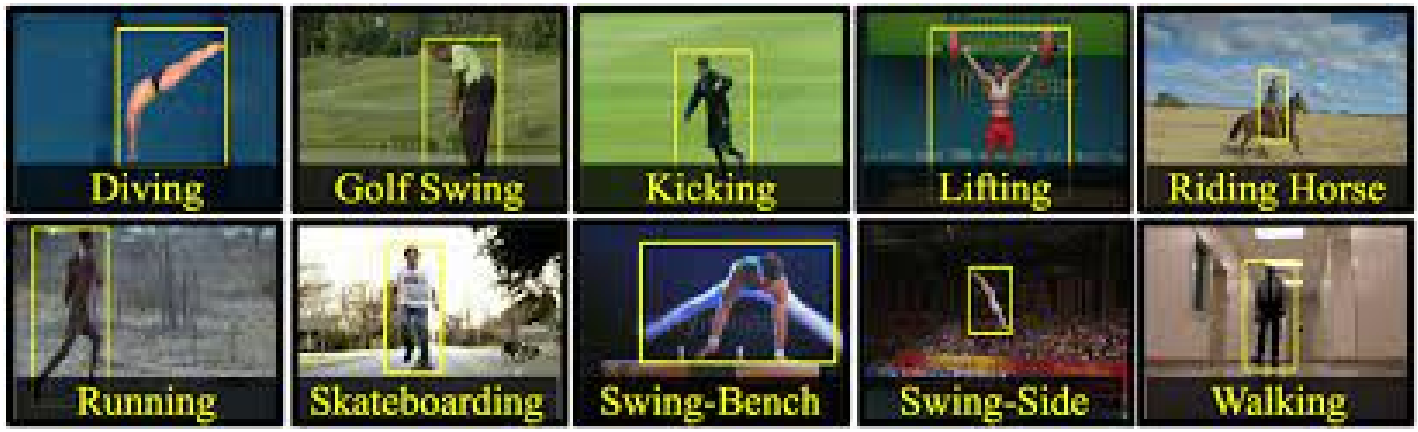
What do we want computers to do with the image data?

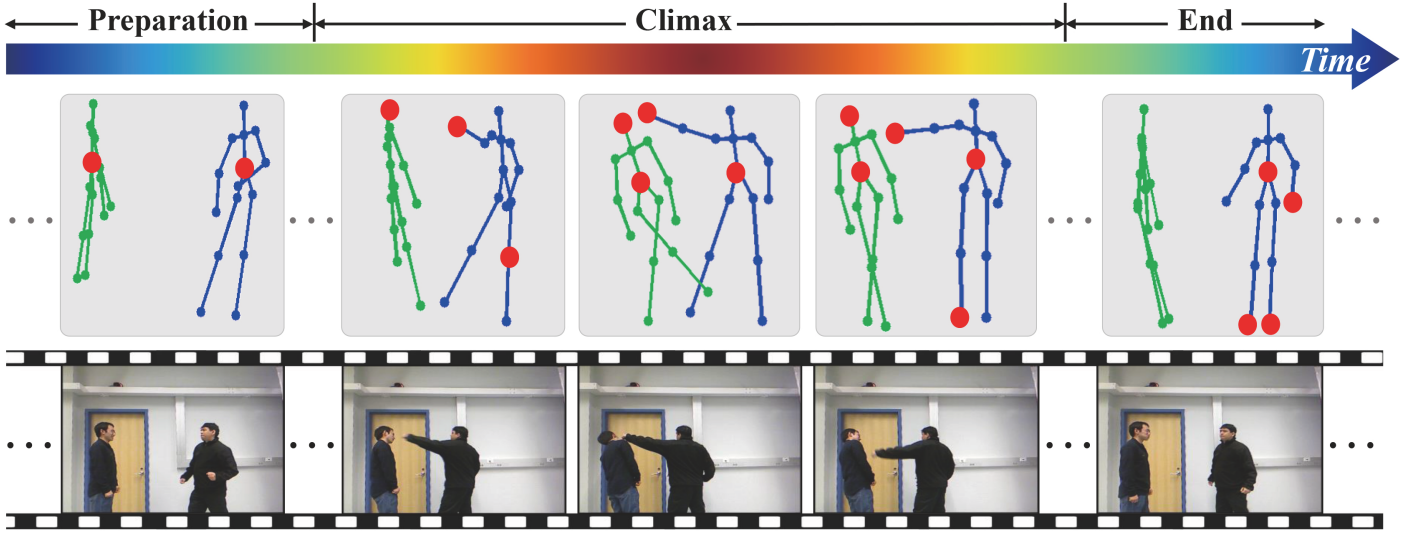




Application of Computer Vision

CV with video:





Application of Computer Vision

From 2D to 3D

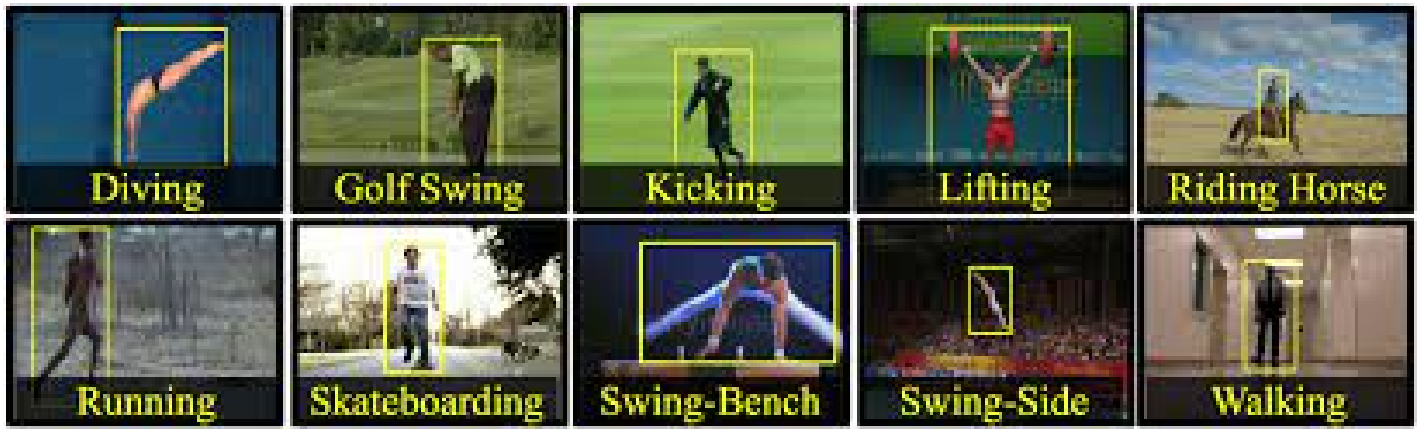


Image processing vs Computer Vision

- Giống nhau: Input đều là ảnh/video
- Khác nhau:
  1. Mục đích
     - Image processing: Cải thiện chất lượng ảnh (denoise, deblur, constrast, super resolution...)
     - Computer vision: Tìm hiểu nội dung ảnh (image content), như ảnh chụp cái gì, đối tượng trong ảnh là gì/làm gì/ở đâu hoặc đưa ra được các kết luận/quyết định.

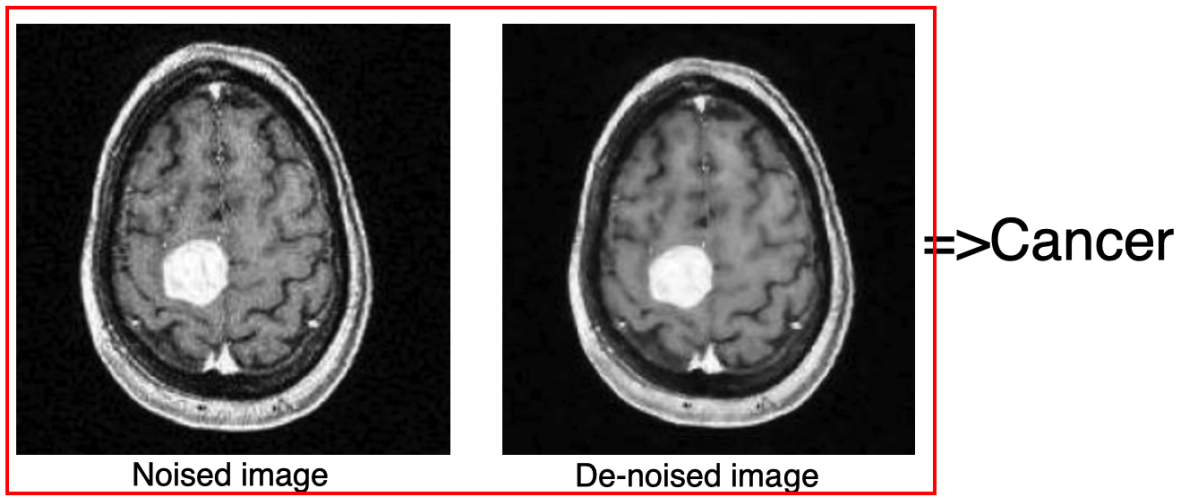
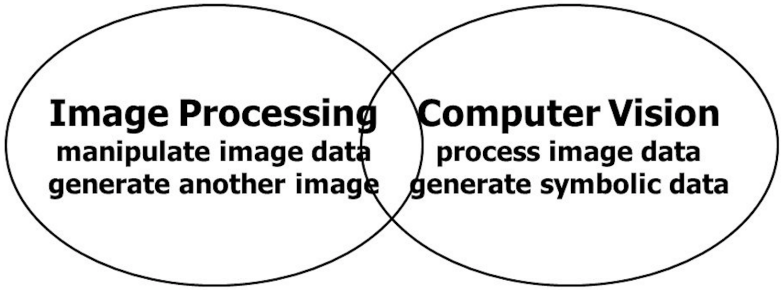
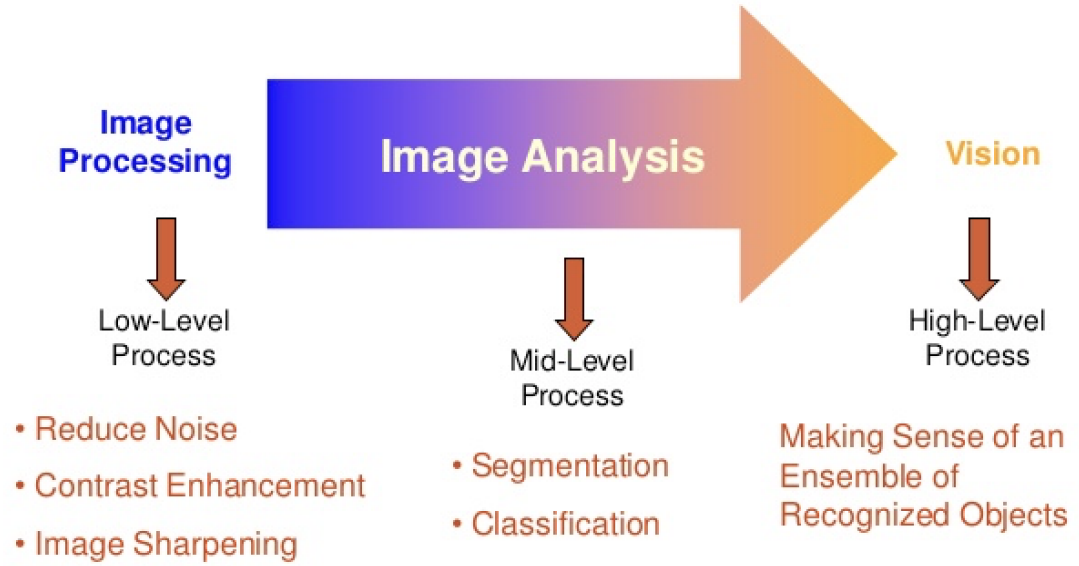


Image processing vs Computer Vision

2. Đầu ra (Output):



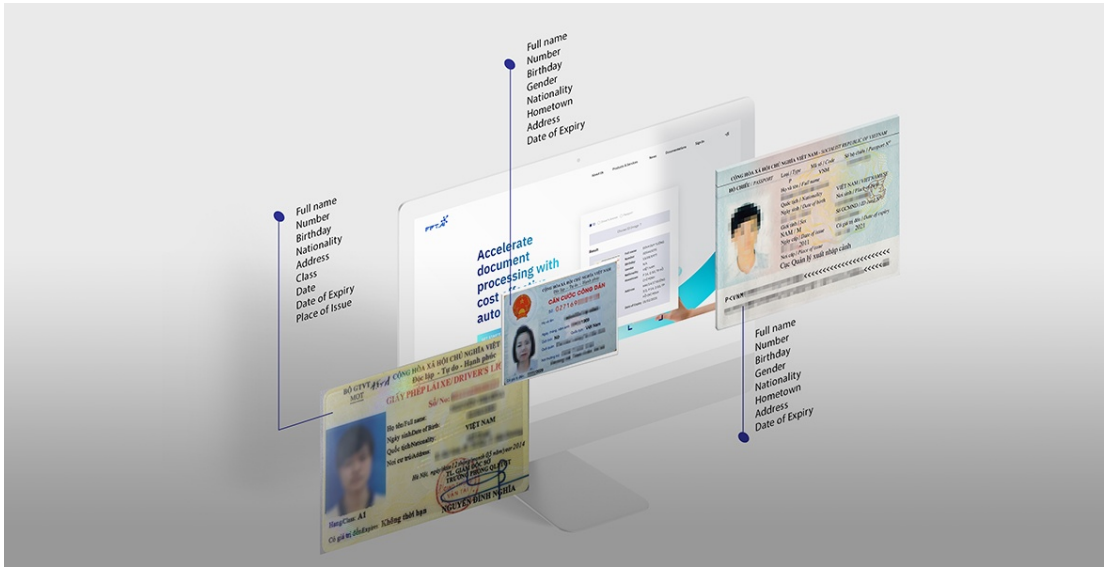
3. Mức độ xử lý:



Why USE computer vision?

- Slower => Faster,
- Expensive =>Cheaper
- Manual => Automated
- Difficult=> Easy
- Inconvenient =>Convenient,
- Unscalable => Scalable.

Why USE computer vision?



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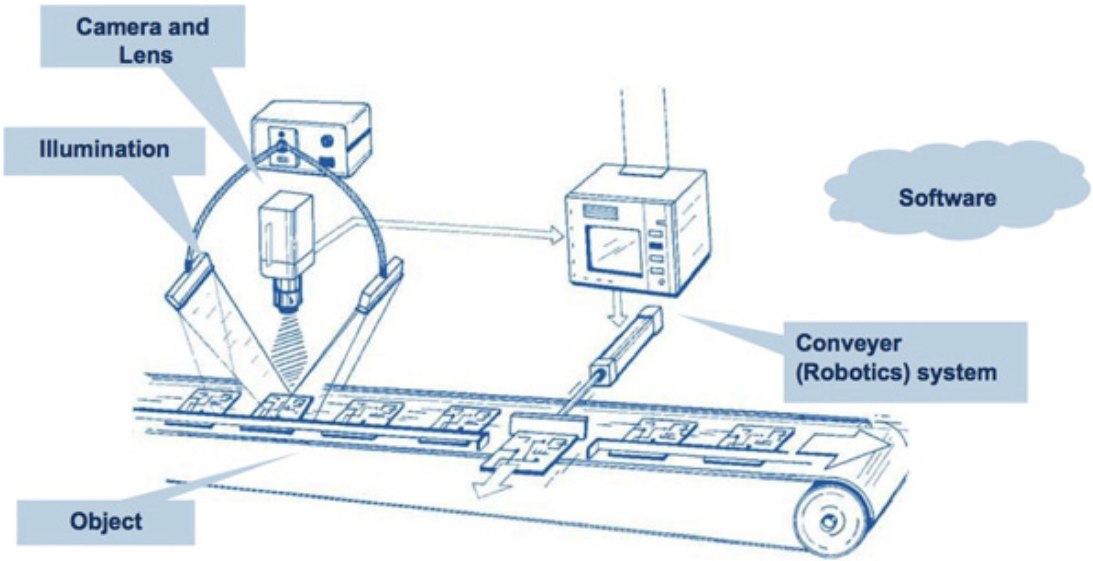

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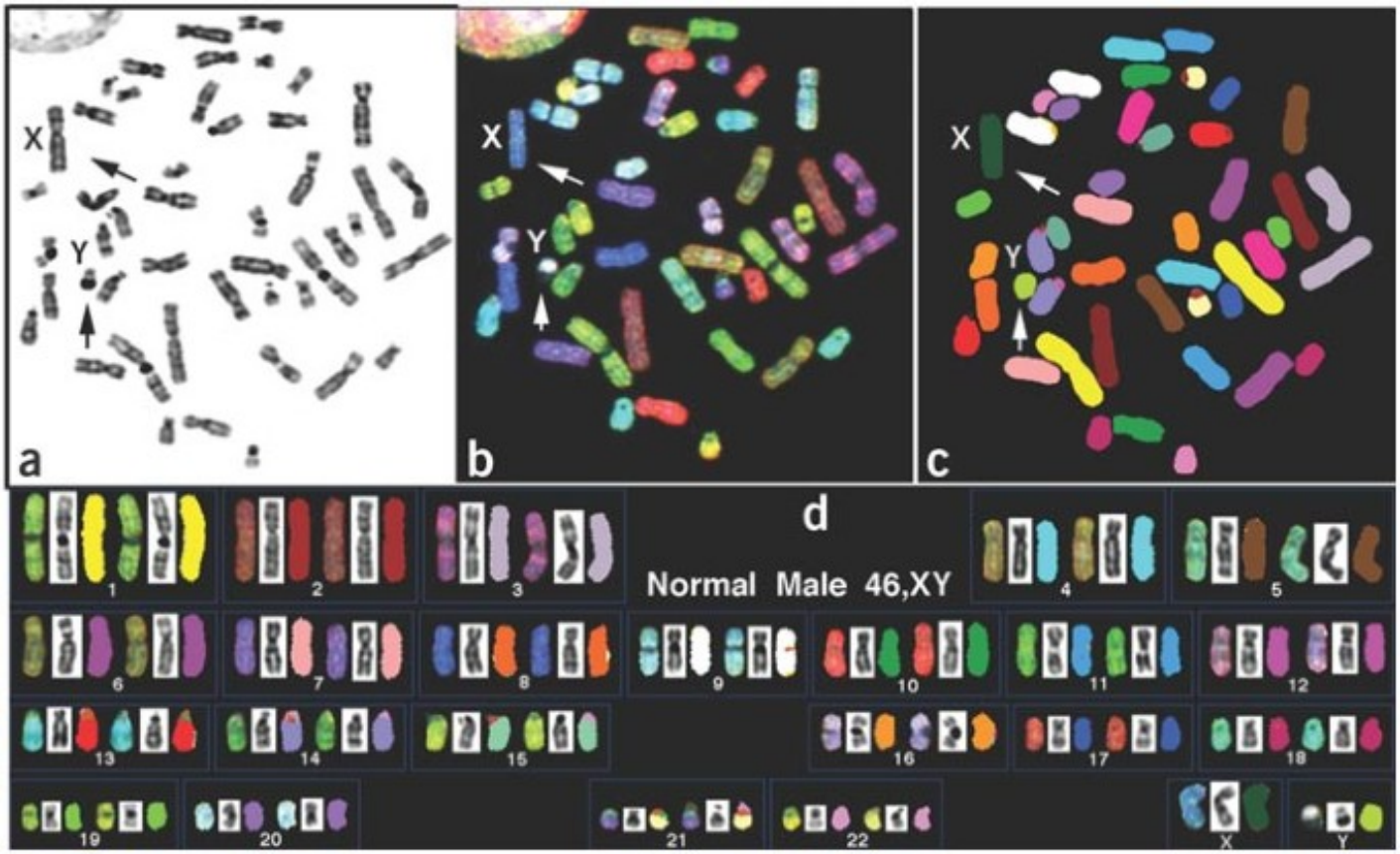
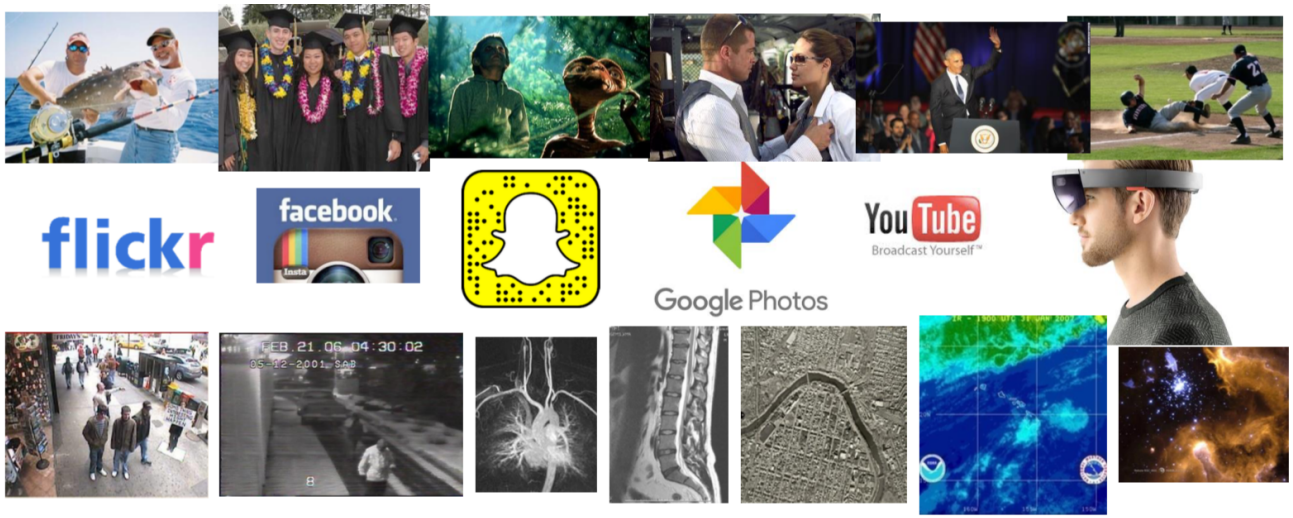


Why study computer vision?

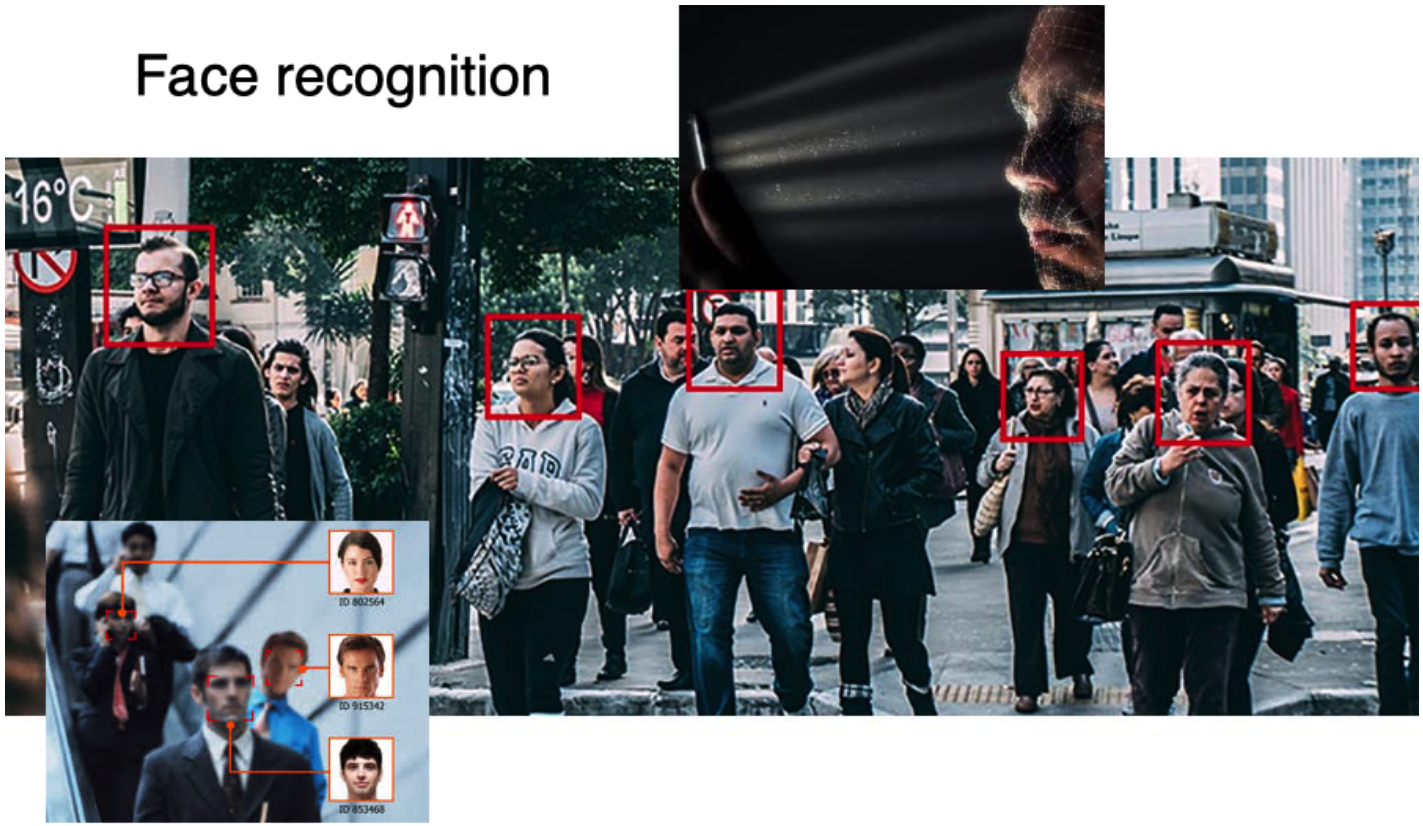
- Billions of images/videos captured/uploaded/shared per day



- Core of multiple AI systems

Why study computer vision?

Core of multiple AI systems



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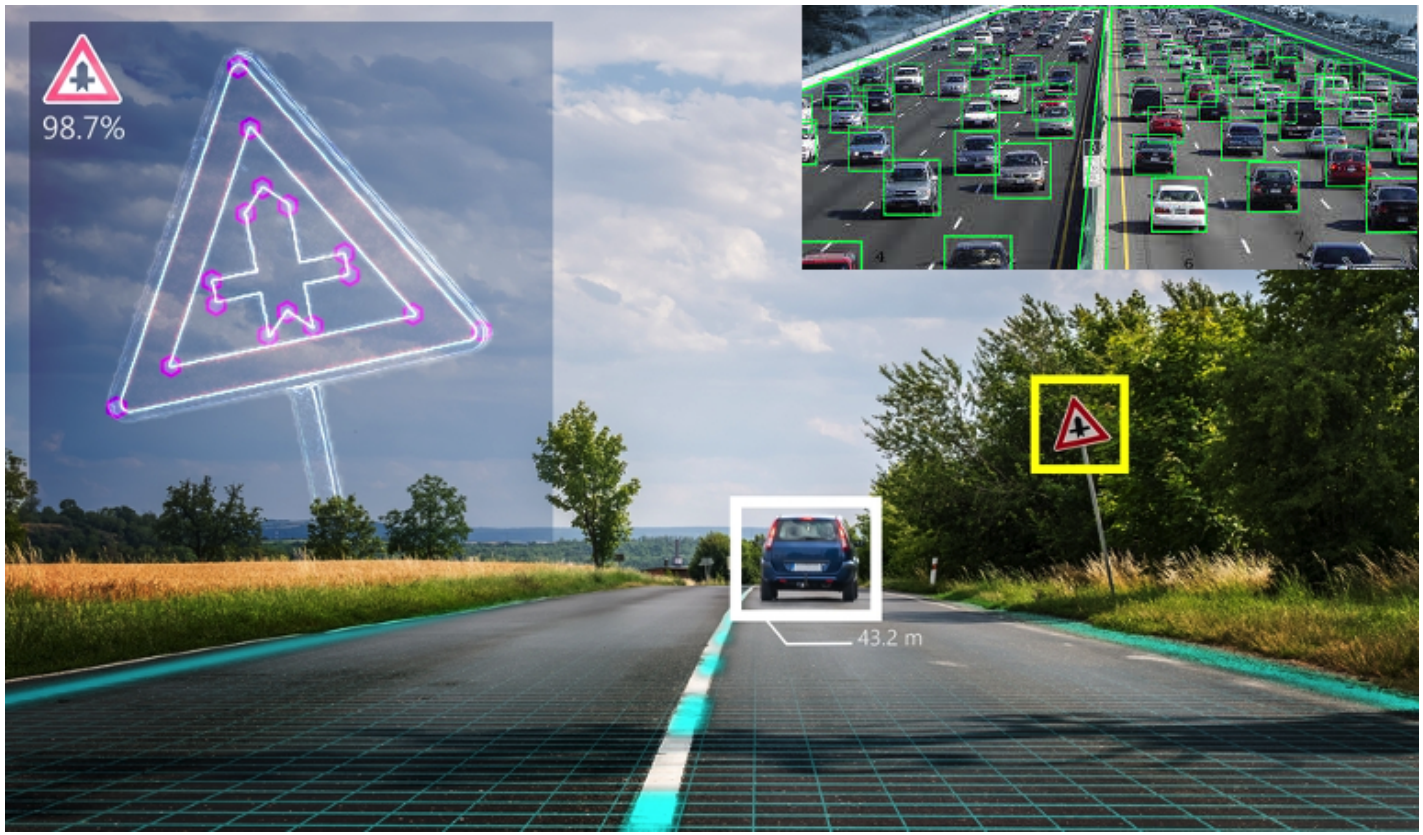
Core of multiple AI systems



Why study computer vision?

Core of multiple AI systems

Current state of machine vision

- Thousand of CV applications are proposed less than 5 years old
- Very active research area, and rapidly changing
- Deep learning powering many modern applications
- CV is still core of AI and VR system in futures

Challengle of Computer vision ?

Why is computer vision difficult?

Viewpoint variation

Illumination

Scale

Challengle of Computer vision ?

Why is computer vision difficult?

Intra-class variation

Motion (Source: S. Lazebnik)

Background clutter

Occlusion

Challengle of Computer vision ?

But there are lots of cues we can exploit...

- BIGDATA
- Hardware computation tool
- Fund

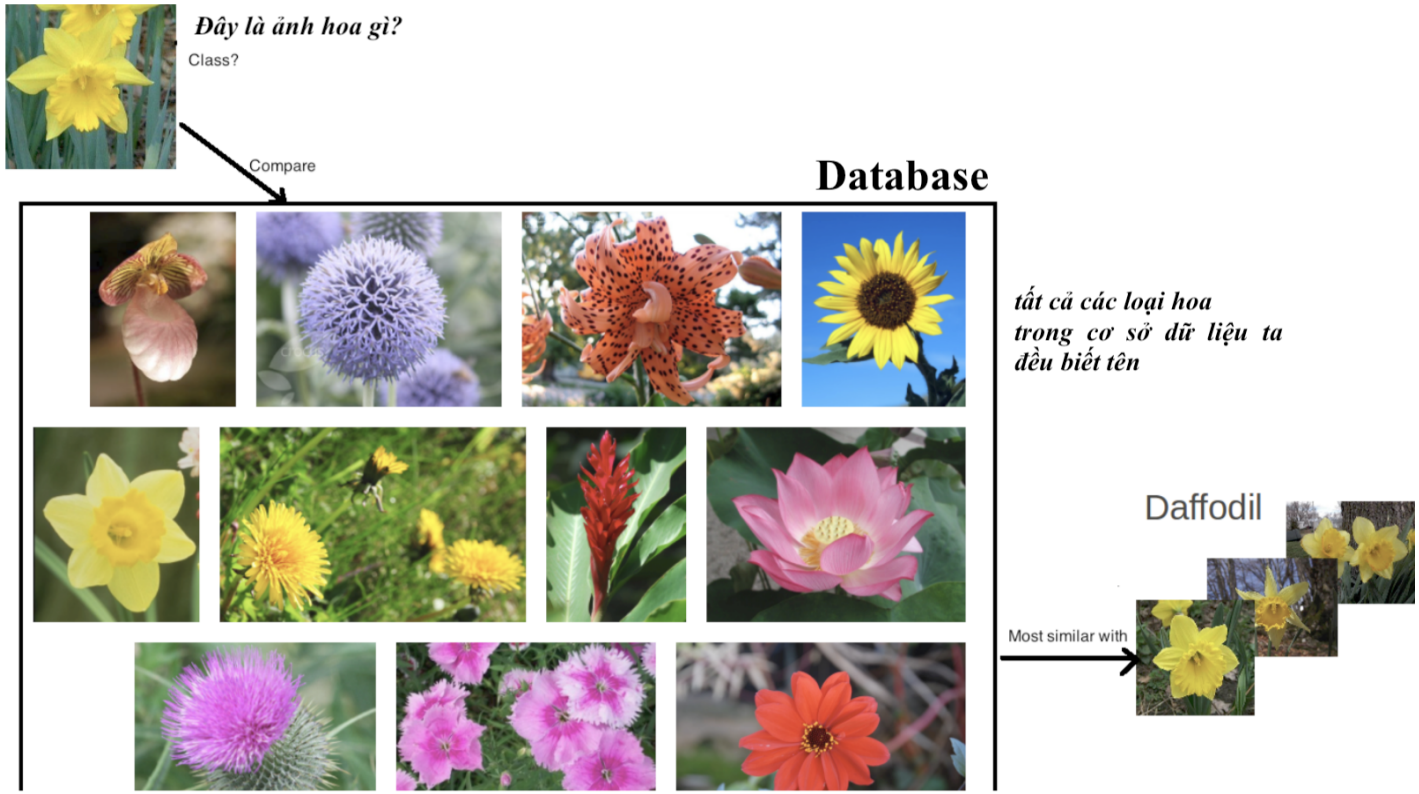
How the Computer Vision systems work?

- Teaching => Learning => Learning from "known"
- Dạy máy tính phân biệt đúng/sai (có/không) từ cái đã biết
- So sánh ảnh đầu vào với các bức ảnh máy đã biết (ảnh đó chụp cái gì/ đối tượng trong ảnh đang ở đâu, làm gì...)
- Ảnh đầu vào sẽ có thông tin giống với ảnh nó tương tự nhất

Examples

Examples

Learning = Comparing !!!



Comparing 2 images: challenging problems?

- Different size/resolution
- Different viewpoint/pose
- Different light condition
- Occlusion (Che khuất)
- Intra class variation
- Inter class variation

Challenge

Examples from VERI-Wild dataset

Challenge

(a). The horse are captures at different scales and poses.

(b). Light conditions change.

(c). Deformation

(d). Occlusion

(e). Background cluster

Examples of horse images (animal classification dataset)

Challenge

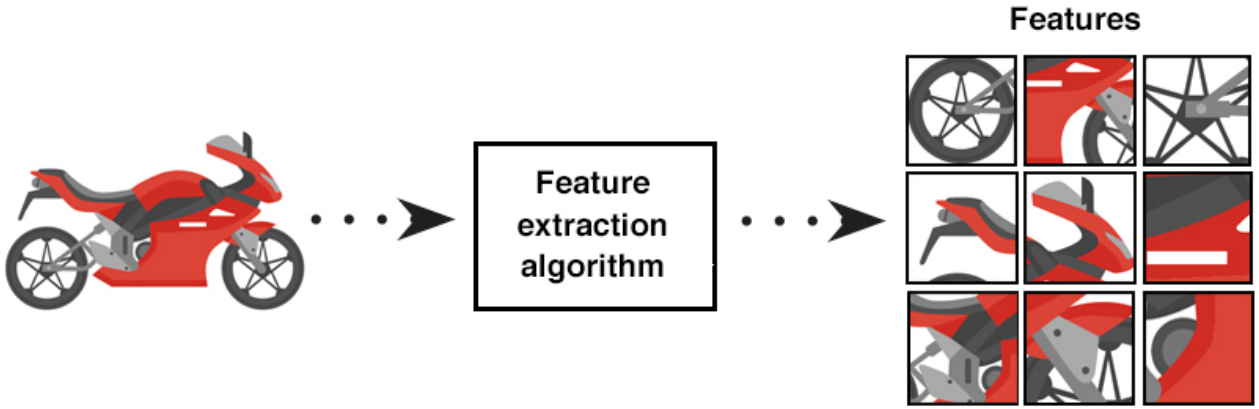
Intra-class variation (ảnh thuộc cùng 1 class nhưng khác nhau) + **Inter-class variation** (ảnh thuộc các class khác nhau nhưng trông lại giống nhau)

Comparing 2 images: challenging problems?

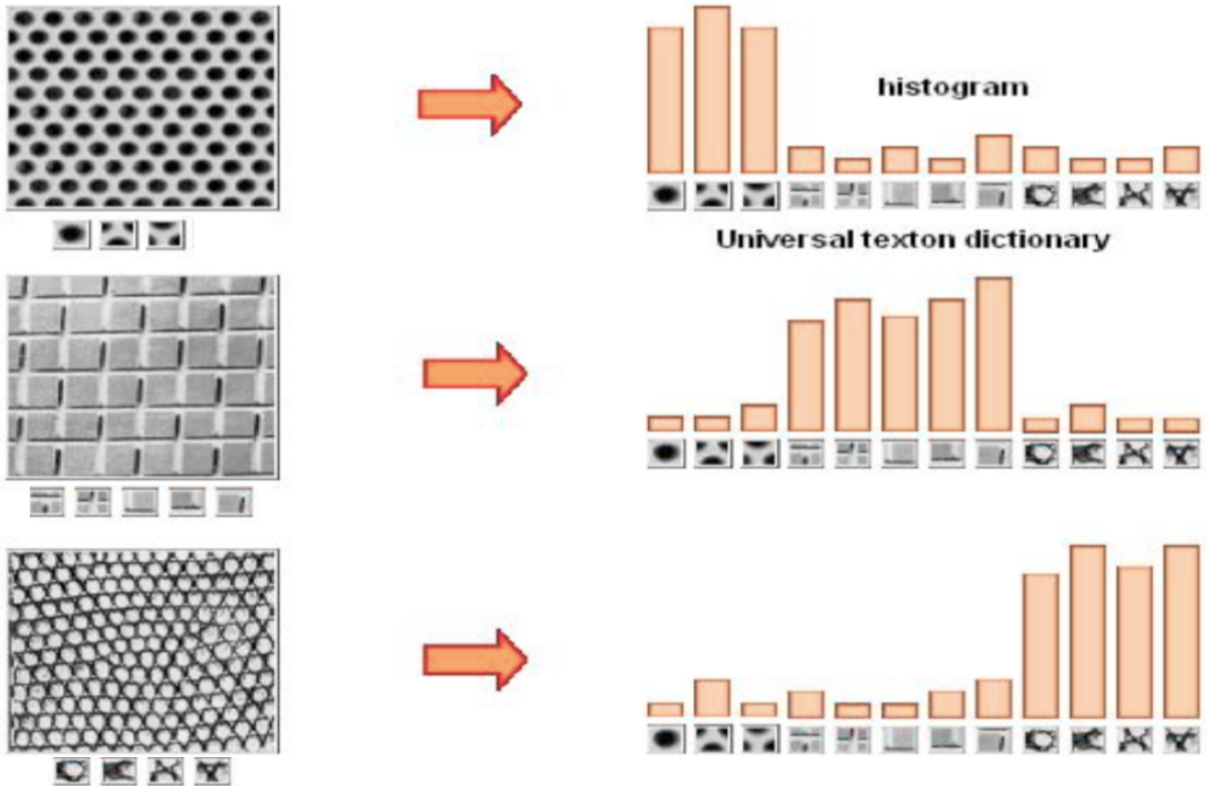
- Different size/resolution
- Different viewpoint/pose
- Different light condition
- Occlusion (Che khuất)
- Intra class variation
- Inter class variation

Không thể so sánh trực tiếp 2 ảnh $\Rightarrow$ So sánh dựa trên đặc điểm /đặc trưng trong ảnh

Đặc trưng ảnh

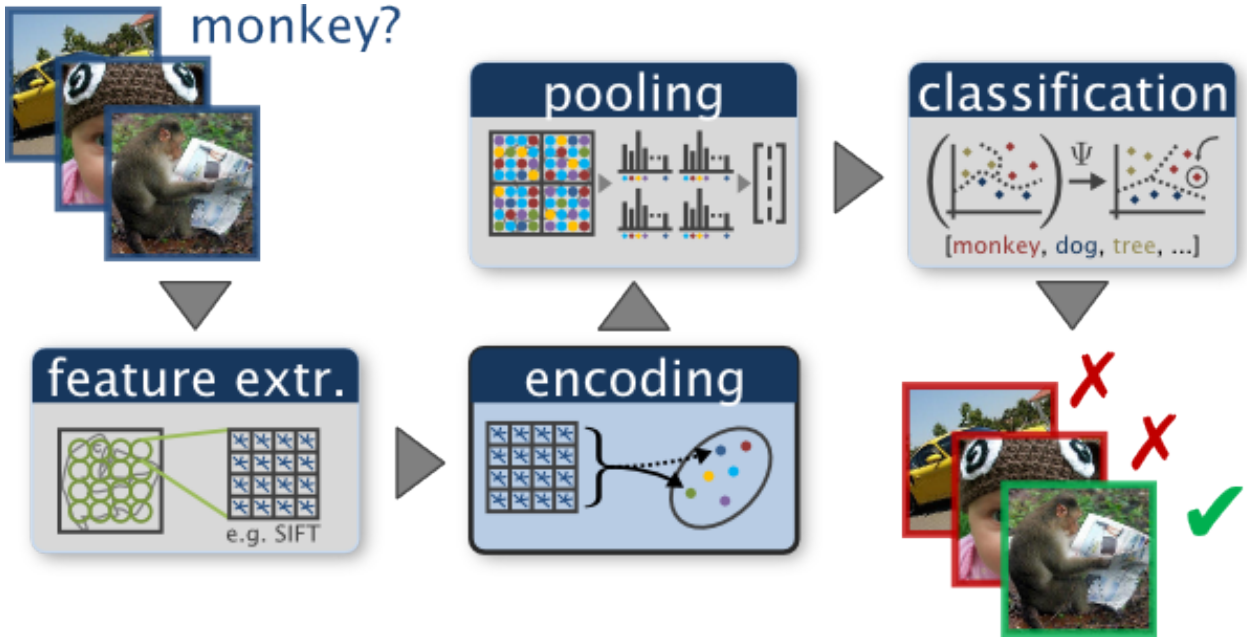


Minh hoạ đặc trưng ảnh



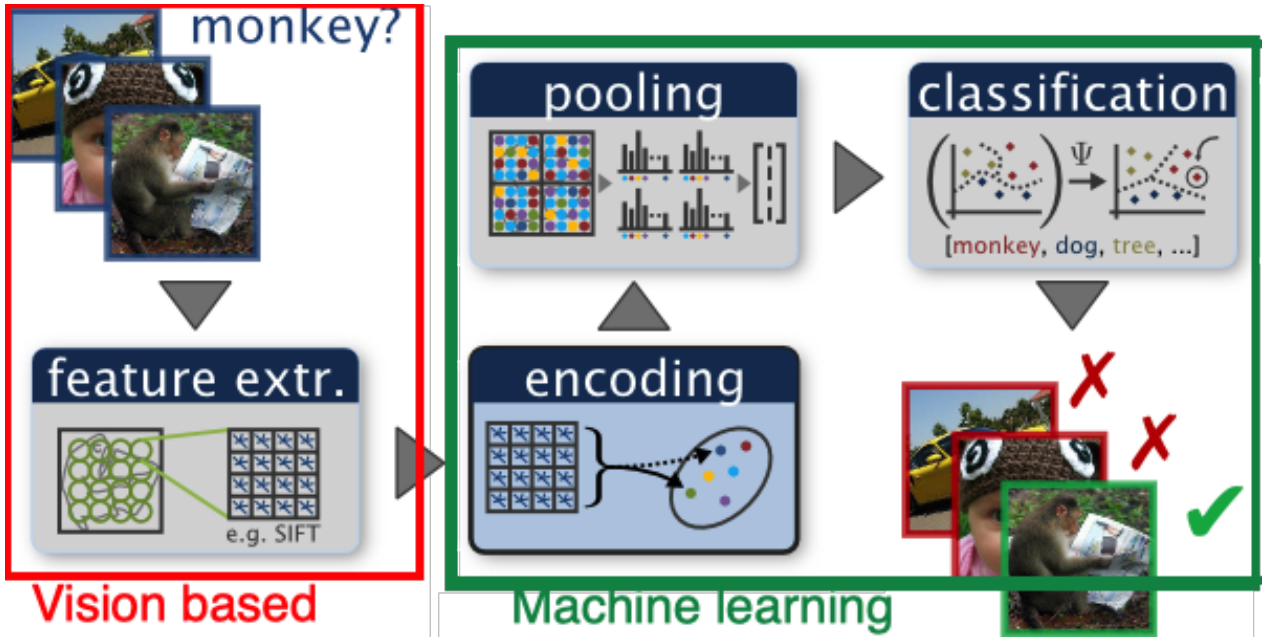
So sánh sự tương tự giữa các ảnh bằng cách so sánh các đặc trưng (features) của chúng!

CV pipeline



Mô phỏng ý tưởng của bài toán phân loại ảnh trong thị giác máy

Course overview



Objective of course

What you will learn:

- Understand main ideal of computer vision problem
- Know how to solve basic CV problem
- Run a basic CV algorithms (recognition, tracking, segmentation)
- Custom your own computer vision application

What you will NOT learning:

- How computer vision works
- How neural networks or deep-learning work and design.

Contents of course

Contents of course

1. Làm quen với Python, Google Colab
2. Làm quen với ảnh và một số thư viện xử lý ảnh (python)
3. Lab1: Image features
4. Lab2: Image classification using basic machine learning algorithms
5. Lab3: Deep-learning
6. Lab4: Using pre-trained model
7. Lab5: Customize one application step by step

Evaluations

1. Giữa kỳ: Làm bài tập thực hành (=> viết báo cáo kết quả)
2. Cuối kỳ: Làm project cuối khoá (mỗi nhóm tối đa 3 bạn, tìm hiểu về chủ đề tự chọn): hoàn thiện 1 ứng dụng CV