



# 模式识别

邢向磊, 哈尔滨工程大学 ([xingxl@hrbeu.edu.cn](mailto:xingxl@hrbeu.edu.cn))

<http://homepage.hrbeu.edu.cn/web/xingxianglei>

# 什么是模式识别？(通向人工智能的重要途径)



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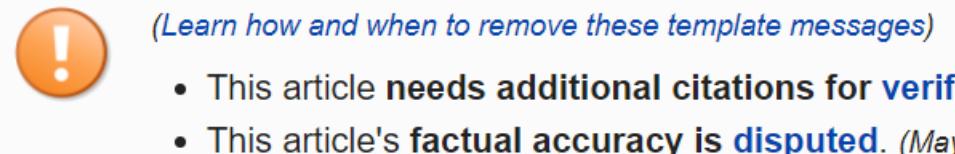
## Pattern recognition

From Wikipedia, the free encyclopedia

*This article is about pattern recognition as a branch of engineering. For the cognitive process, see [Pattern recognition \(disambiguation\)](#).*

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- This article **needs additional citations for verification.** ([May 2019](#))
- This article's **factual accuracy is disputed.** ([May 2019](#))

**Pattern recognition** is the automated recognition of patterns and regularities in [data](#). Pattern recognition is closely related to [artificial intelligence](#) and [machine learning](#),<sup>[1]</sup> together with applications such as [data mining](#) and [knowledge discovery in databases](#) (KDD), and is often used interchangeably with these terms. However, these are distinguished: [machine learning](#) is one approach to pattern recognition, while other approaches include hand-crafted (not learned) rules or heuristics; and pattern recognition is one approach to artificial intelligence, while other approaches include [symbolic artificial intelligence](#).<sup>[2]</sup> A modern definition of pattern recognition is:

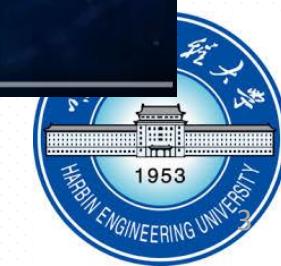
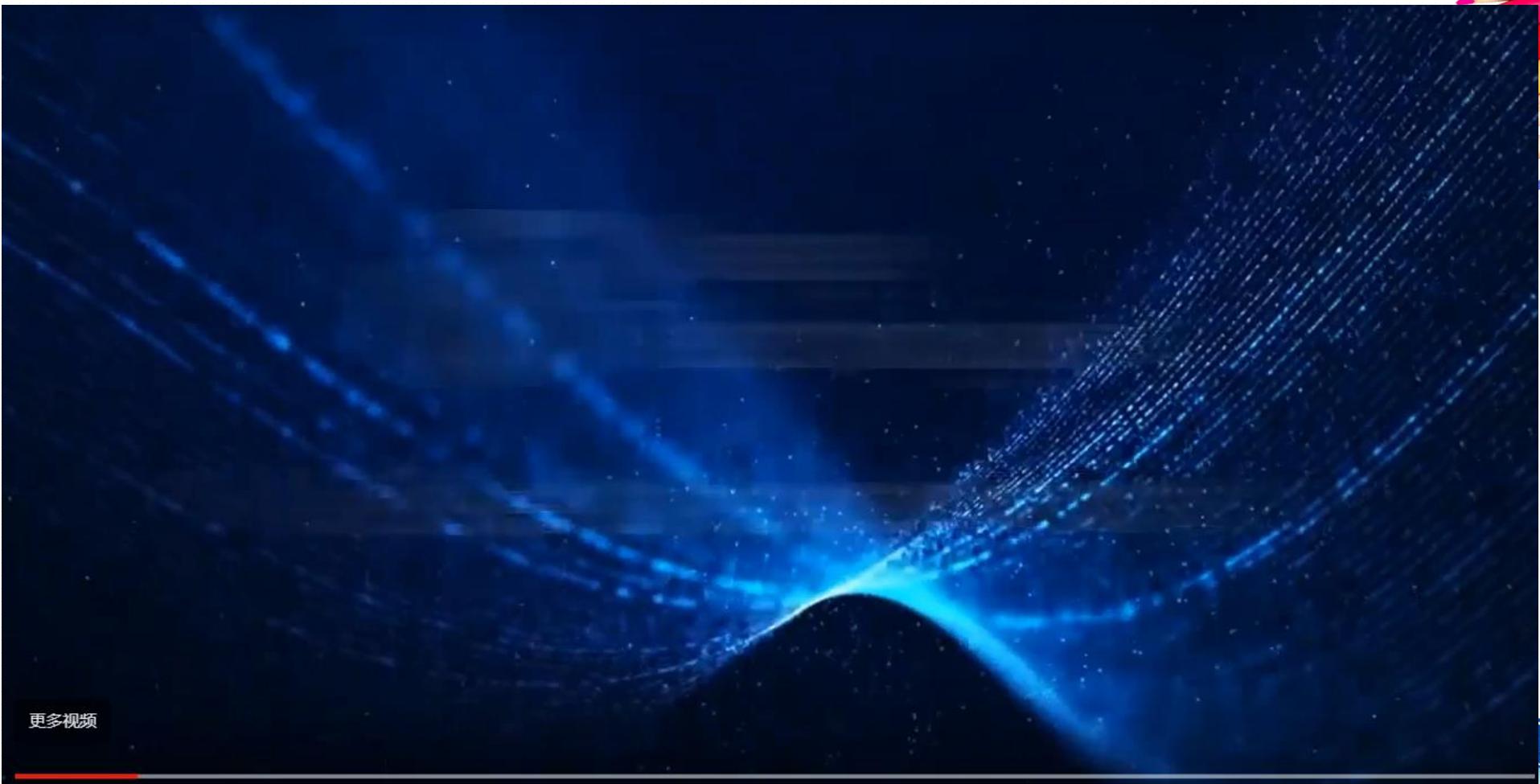
The field of pattern recognition is concerned with the automatic discovery of regularities in [data](#) through the use of computer algorithms and with the use of these regularities to take actions such as classifying the data into different categories.<sup>[3]</sup>



# 模式识别实际应用：人脸识别

## 人脸识别

- 身份认证
- 打卡签到
- 手机解锁
- 安检...

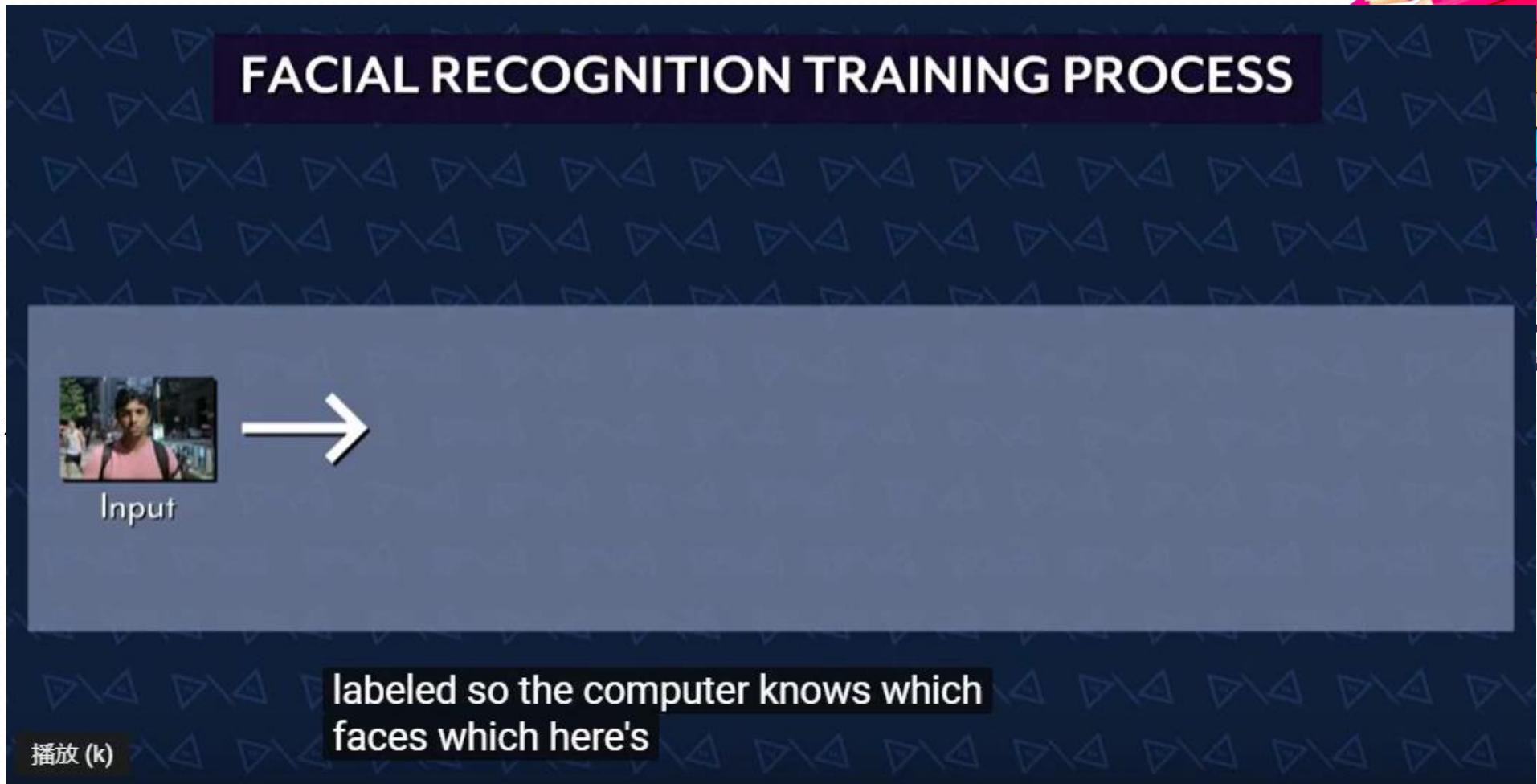
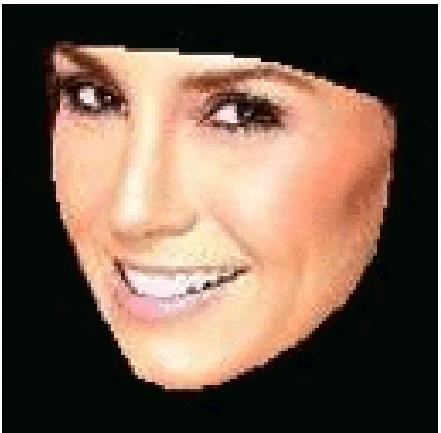


# 模式识别实际应用：人脸识别



## 人脸识别步骤

- 人脸识别检测
- 关键点定位
- 人脸对齐
- ROI 内特征提取
- 识别



Yo

Your Footer Here

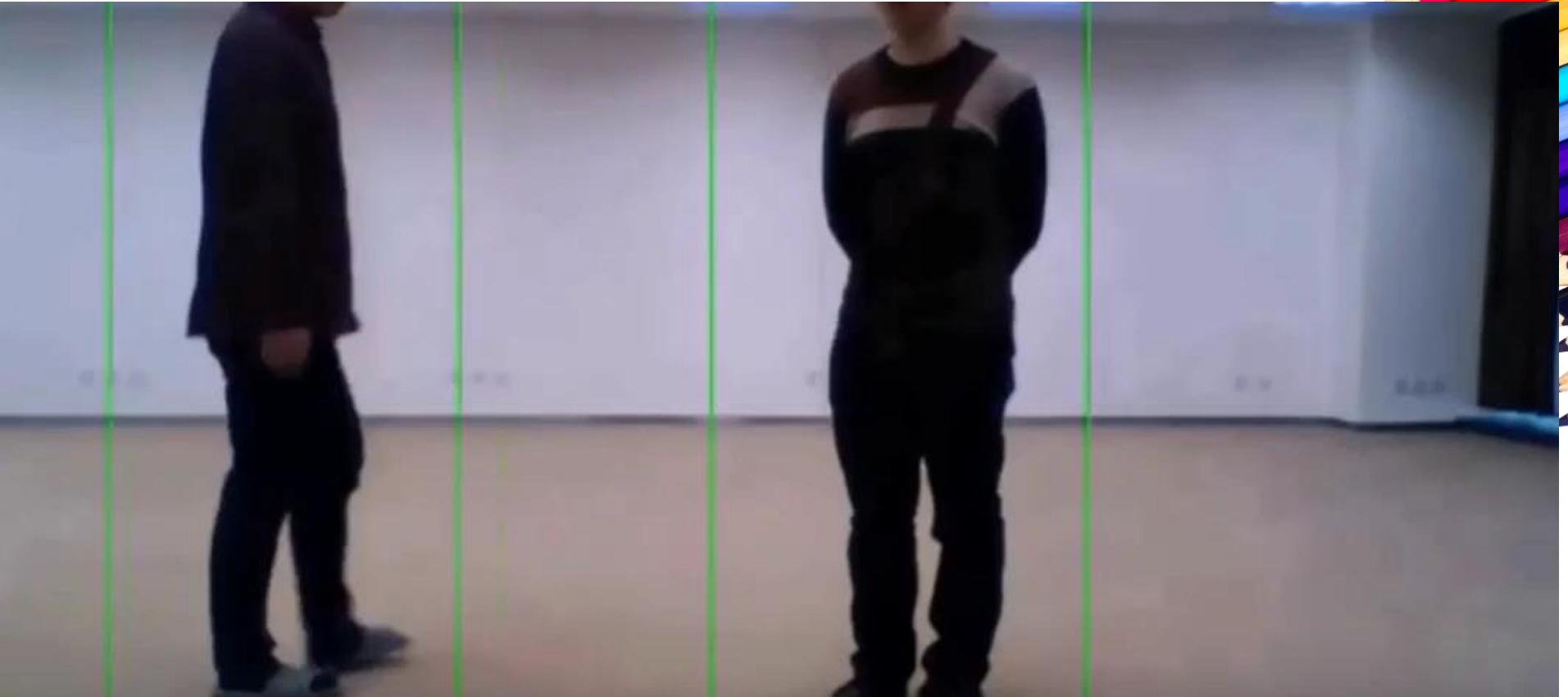


# 模式识别实际应用：步态识别

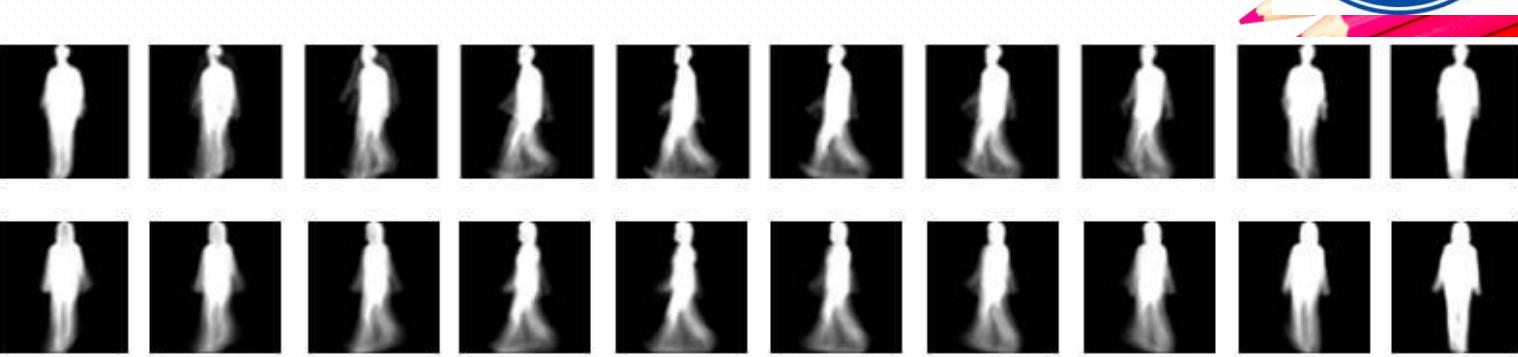
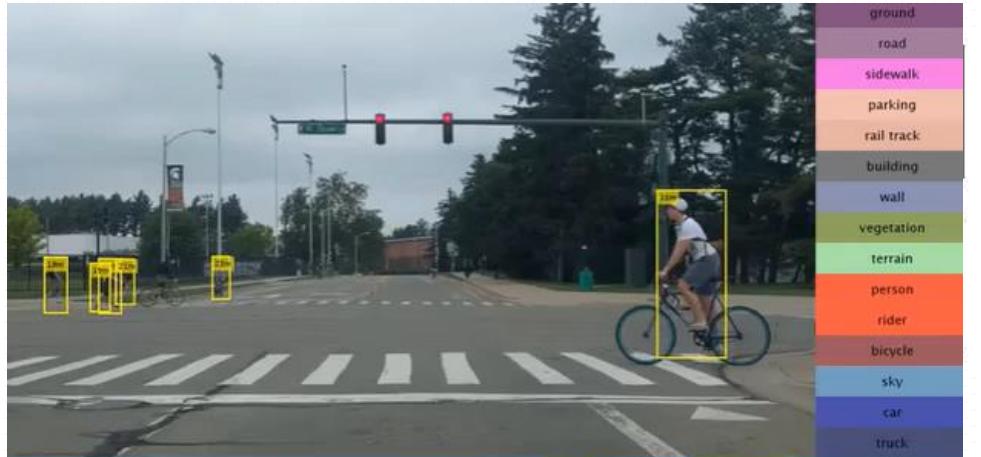


## 步态识别

- 远距离身份认证
- 非接触
- 难于伪装
  
- 涉密场所
- 刑侦
- 安防、安检...

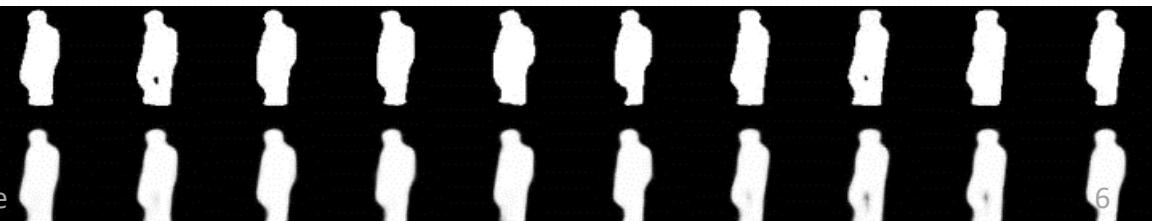
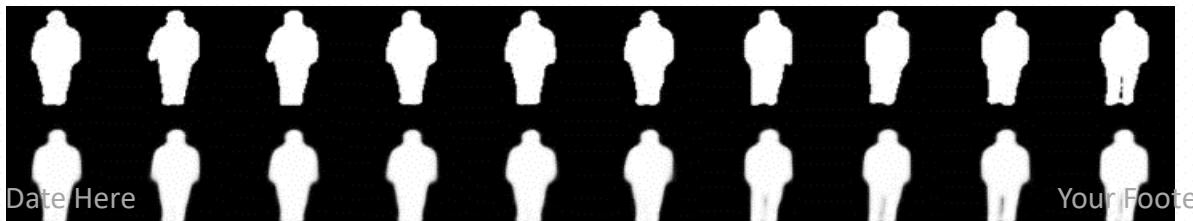
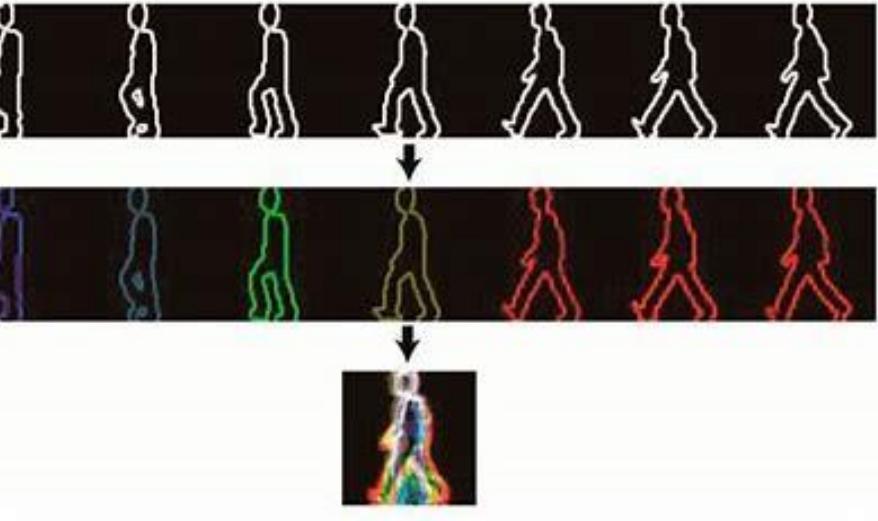


# 模式识别实际应用：步态识别



## 步态识别步骤

- 行人检测
- 步态特征提取
  - 轮廓特征图
  - 轮廓序列
- 多视角识别



# 基于共享表示的多视图生成模型 (ICPR18)



- 多视图数据识别的难点，类内差异远大于类间差异
- 传统方法的主要解决方案，投影到公共子空间,如[Xing, PR16]

## Cross-view Gait Recognition

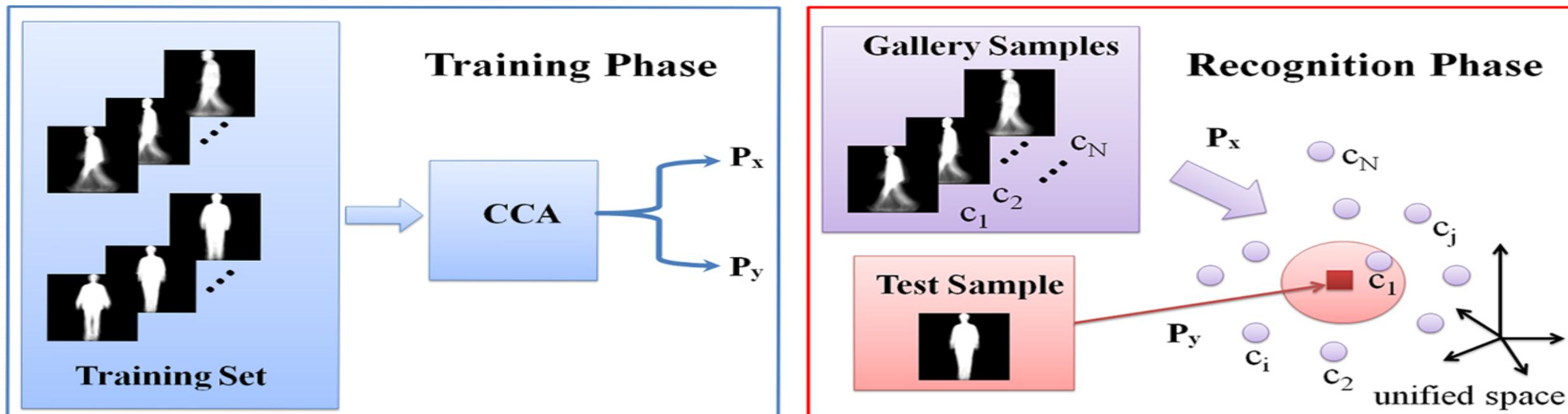
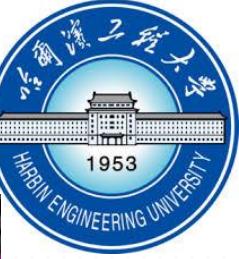
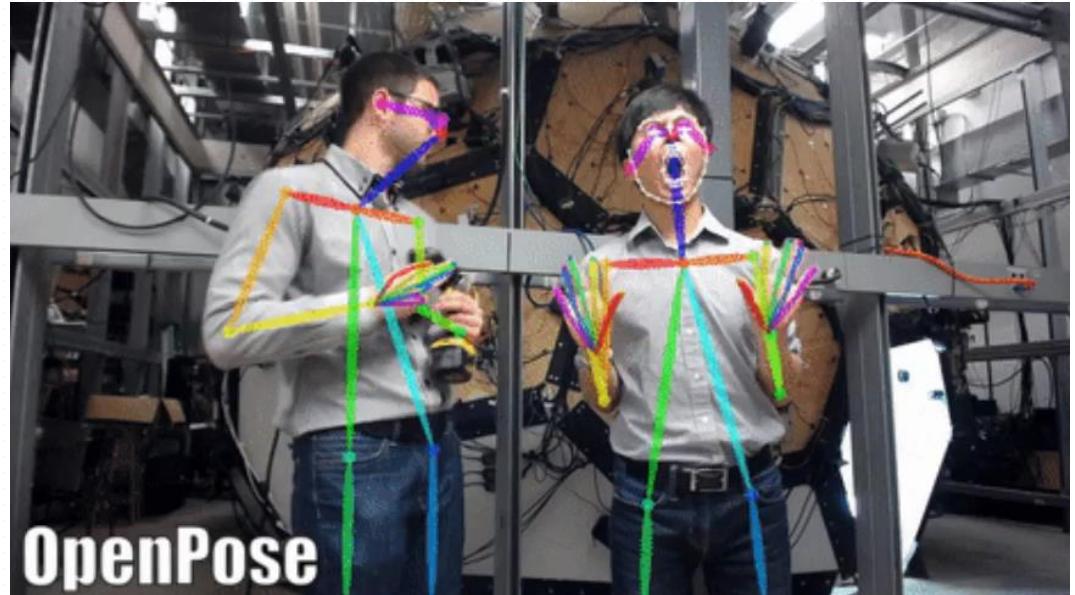


Figure. Overview of the C3A via optimally correlated projections

Xianglei Xing, Kejun Wang, Tao Yan, Zhuowen Lv,  
Complete canonical correlation analysis with application to multi-view gait  
recognition, *Pattern Recognition*, Volume 50, 2016, Pages 107-117



# 模式识别实际应用：步态识别



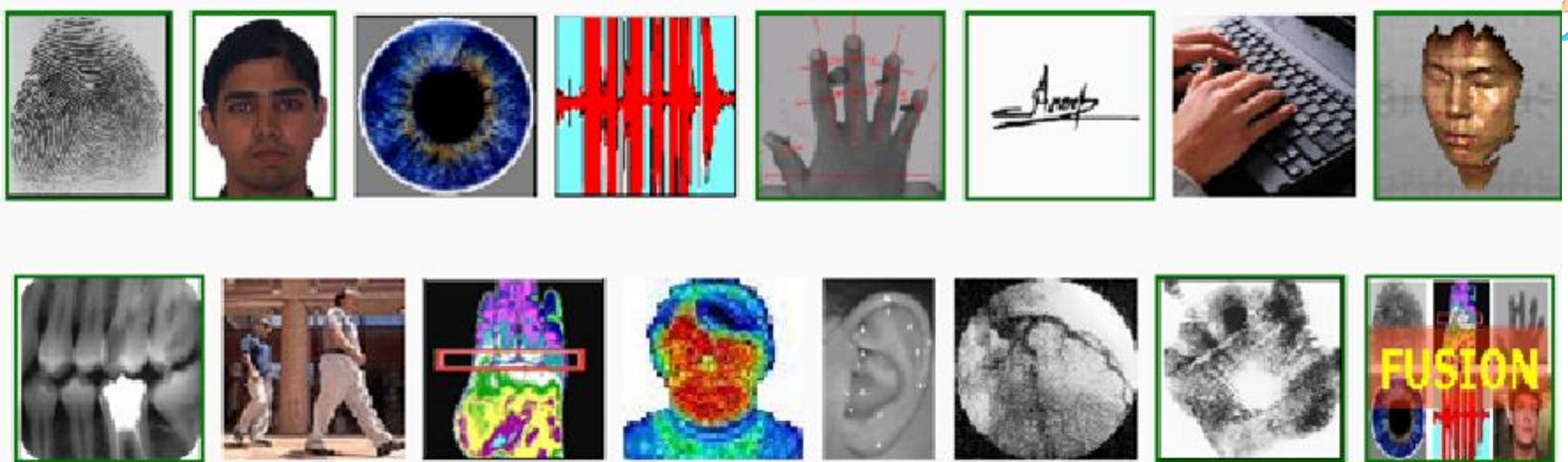
## 步态识别

- 轮廓信息+动态几何模型
- 特定条件下，融合表现信息
  - (短时间隔)
  - (如行人重识别任务)

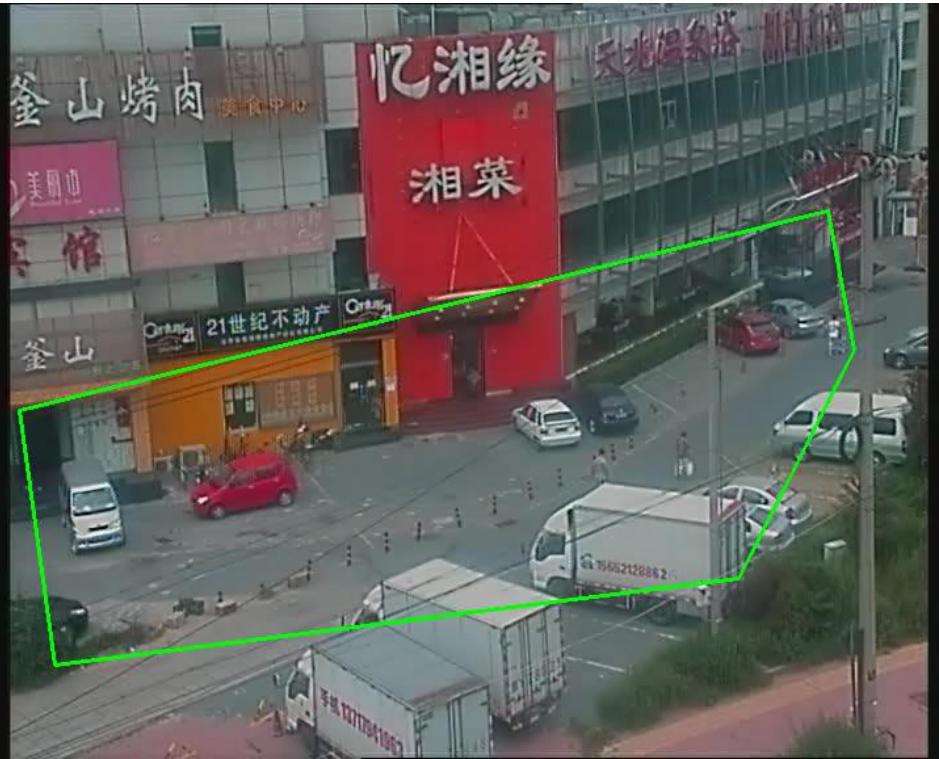
Your Date Here

Your Foo

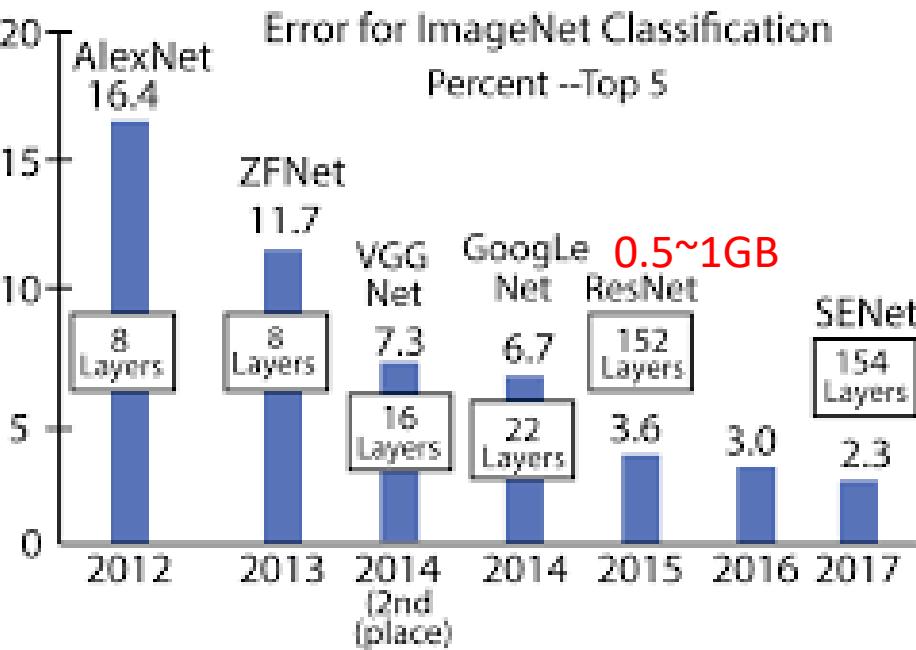
# 模式识别实际应用：生物特征识别



# 模式识别实际应用：车牌识别

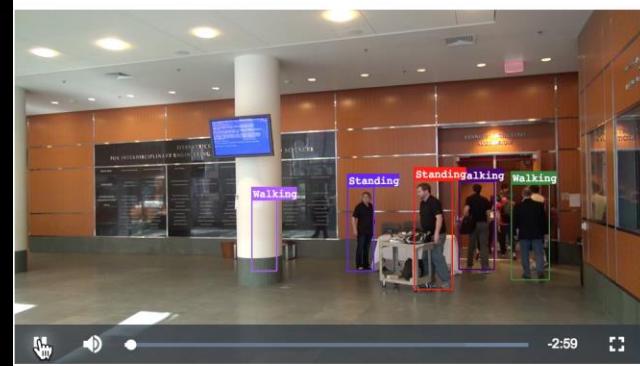
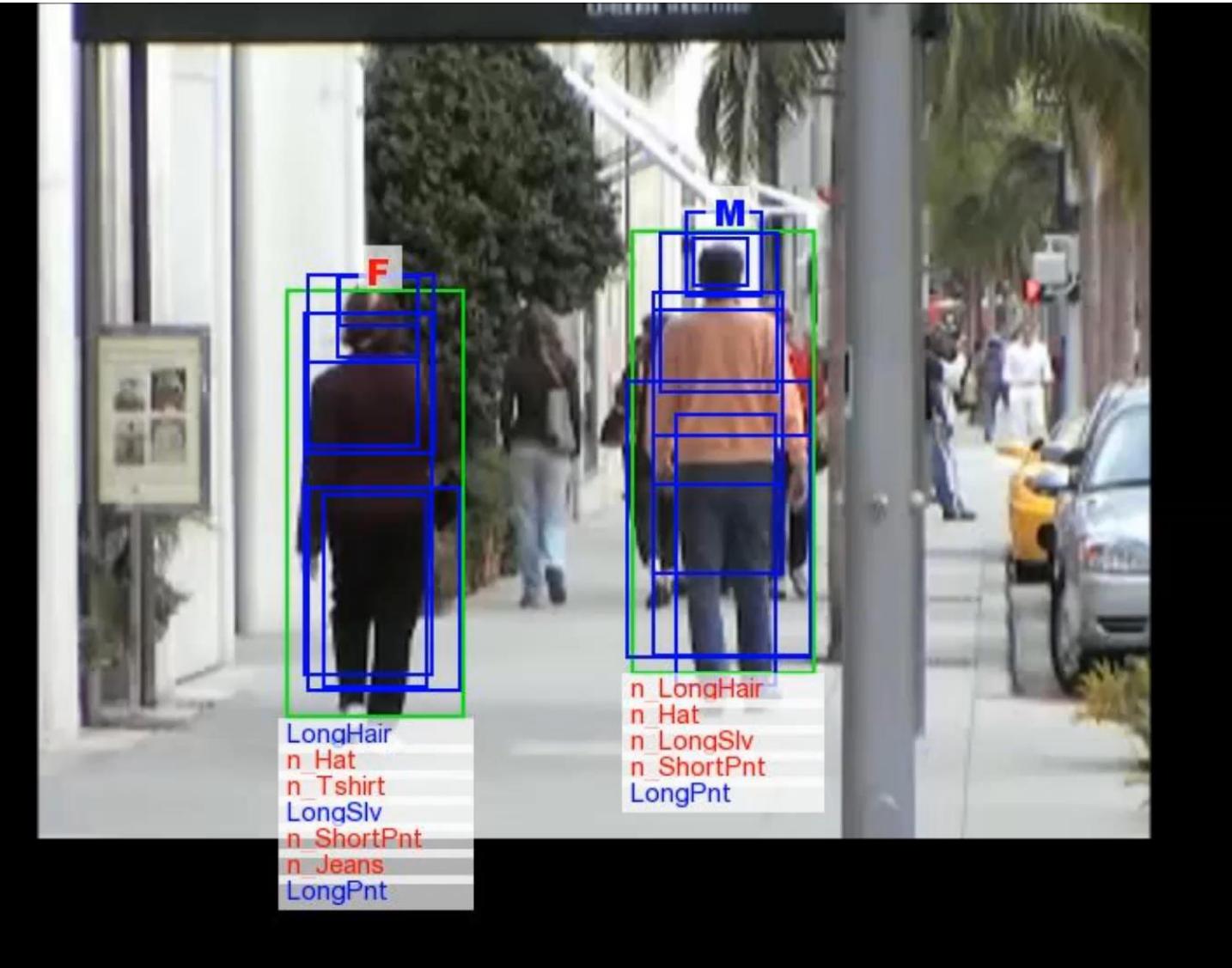


# 模式识别实际应用：大规模视觉识别



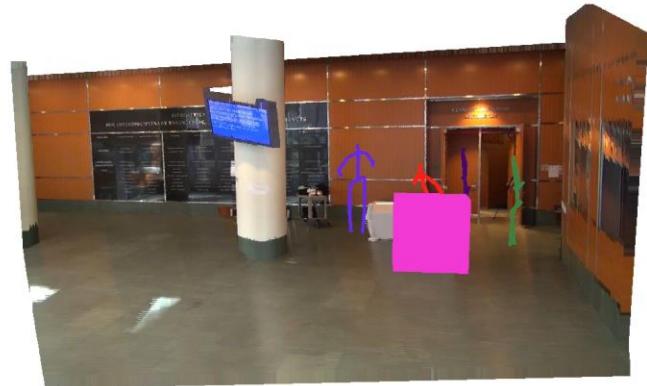
- *ImageNet*是一个超过15 million的图像数据集，大约有22,000类
- ILSVRC全称*ImageNet Large-Scale Visual Recognition Challenge*,  
从2010开始~2017最后一届，使用*ImageNet*数据集的一个子集，总共有1000类  
每类大约有1000张图像，有大约1.2 million的训练集，5万验证集，15万测试集

# 模式识别实际应用：行人属性分析



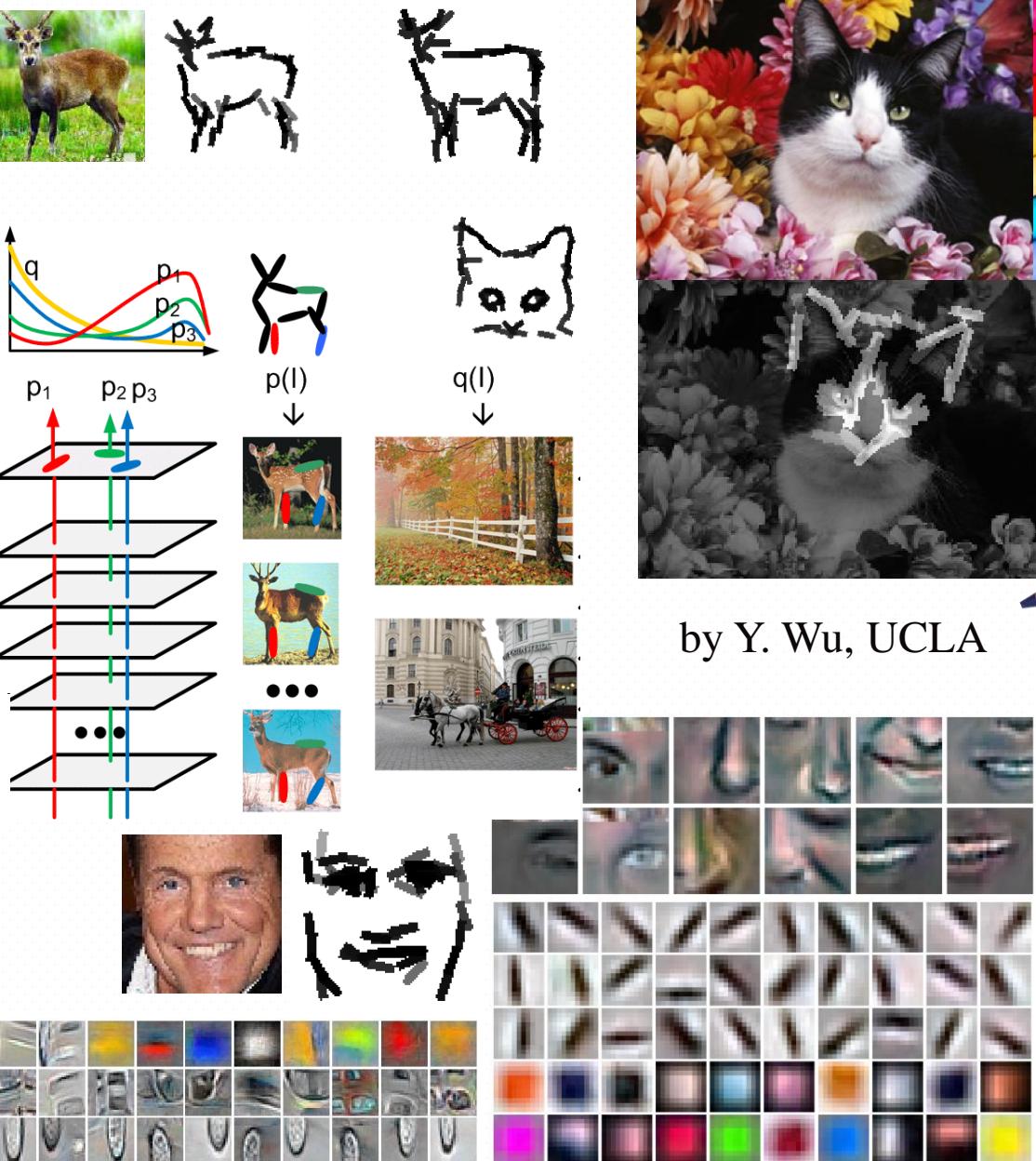
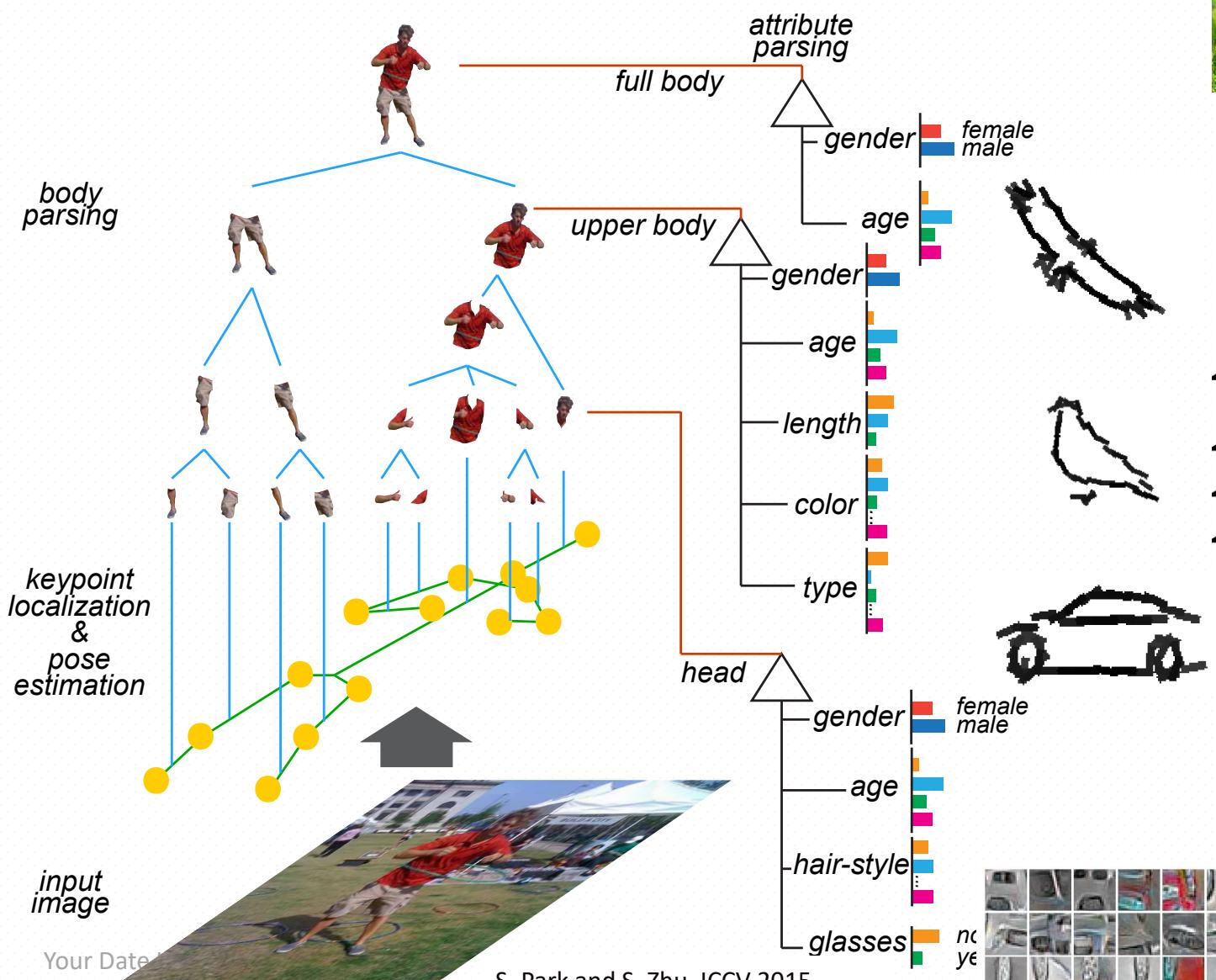
#FRAME: 90, TIME: 0:03

By VCLA@UCLA



- Female ShortHair Sleeves Pants
- Male ShortHair Sleeves Jeans
- Male ShortHair Tshirt Pants
- Male ShortHair Tshirt Jeans
- Female ShortHair Glasses Tshirt Jeans

# 模式识别实际应用：结构分析/描述



# 模式识别实际应用：行人结构分析



frame 74



By VCLA@UCLA

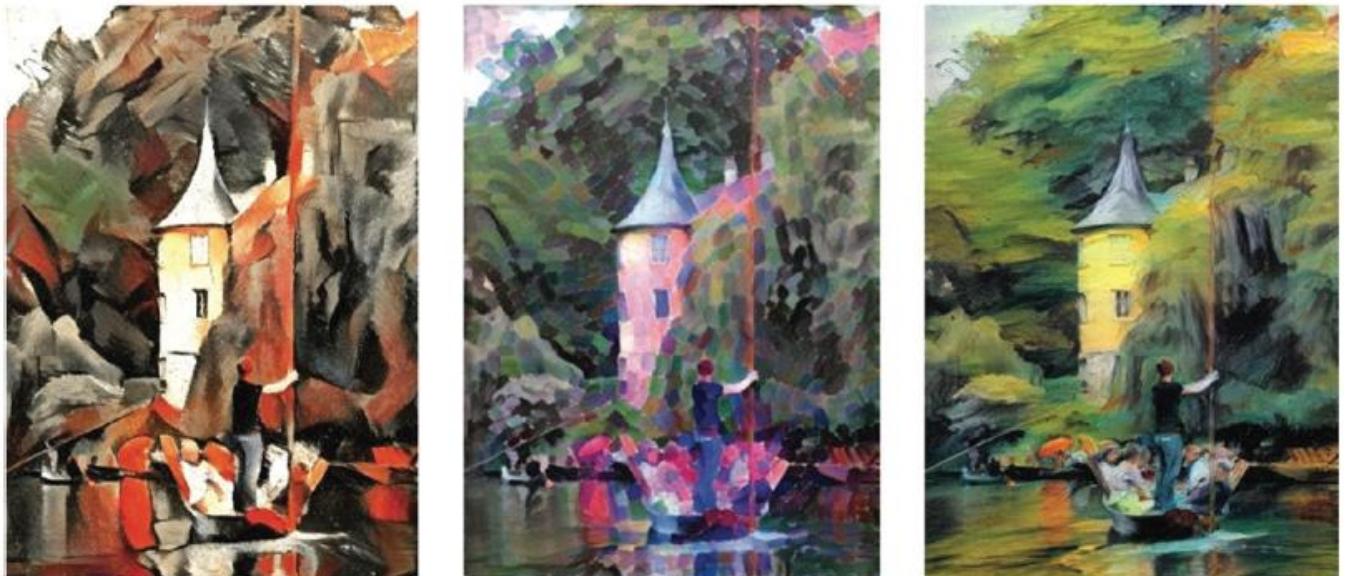
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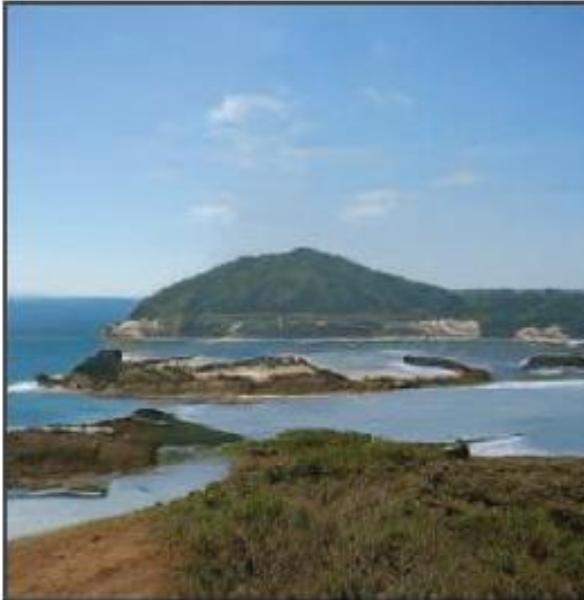




# 模式识别实际应用：风格迁移



# 模式识别实际应用：图像生成/ART创作

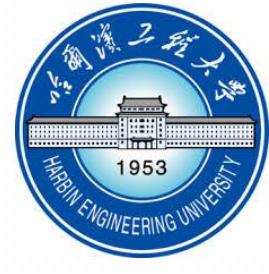


Your Date Here

BigGAN

Your Footer Here

*Portrait of Edmond Belamy,*  
sold by Christie's for \$432,500  
in October 2018.



# 模式识别实际应用：艺术品及古董鉴定

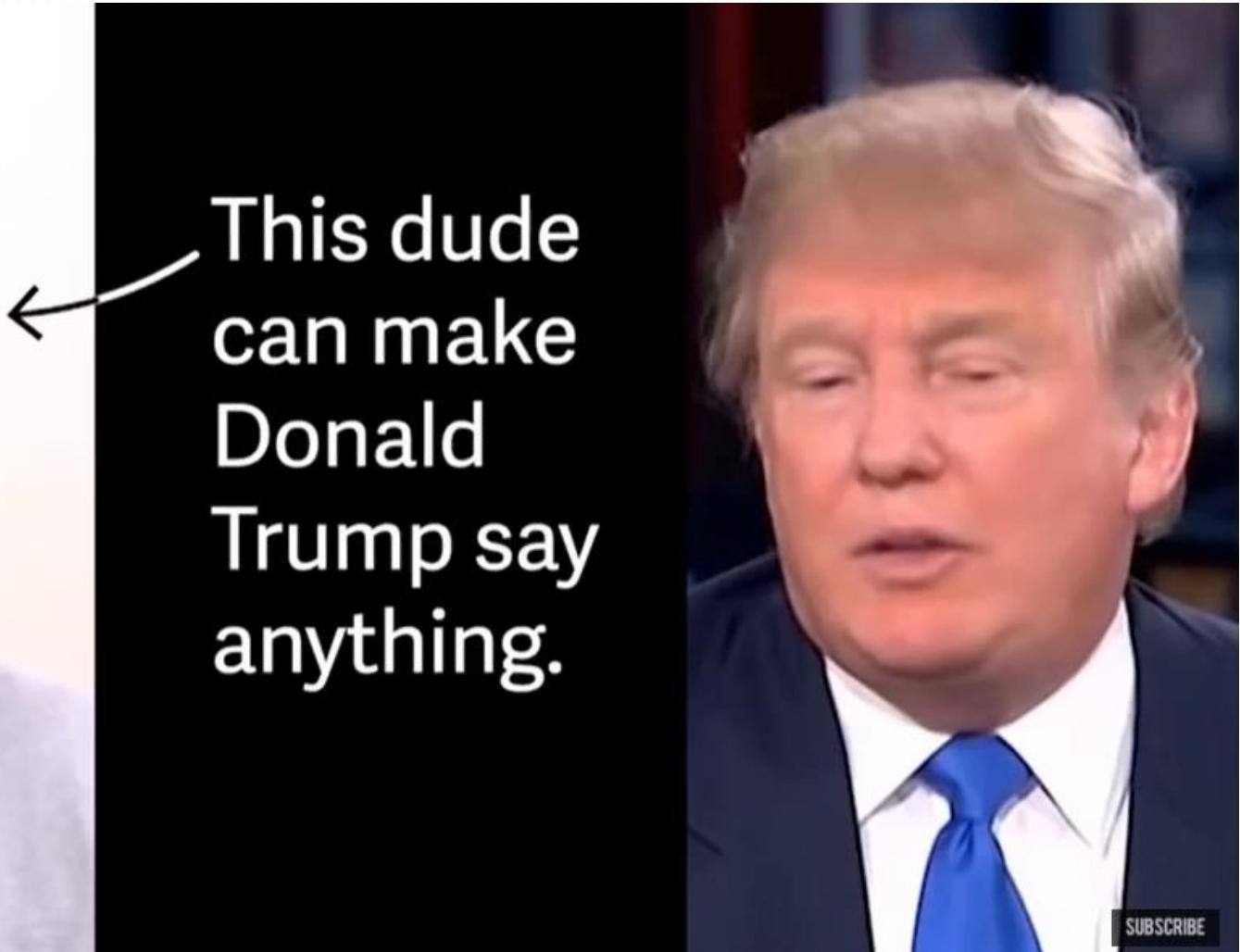


哪幅画是真迹？



难点：通常我们只有小样本

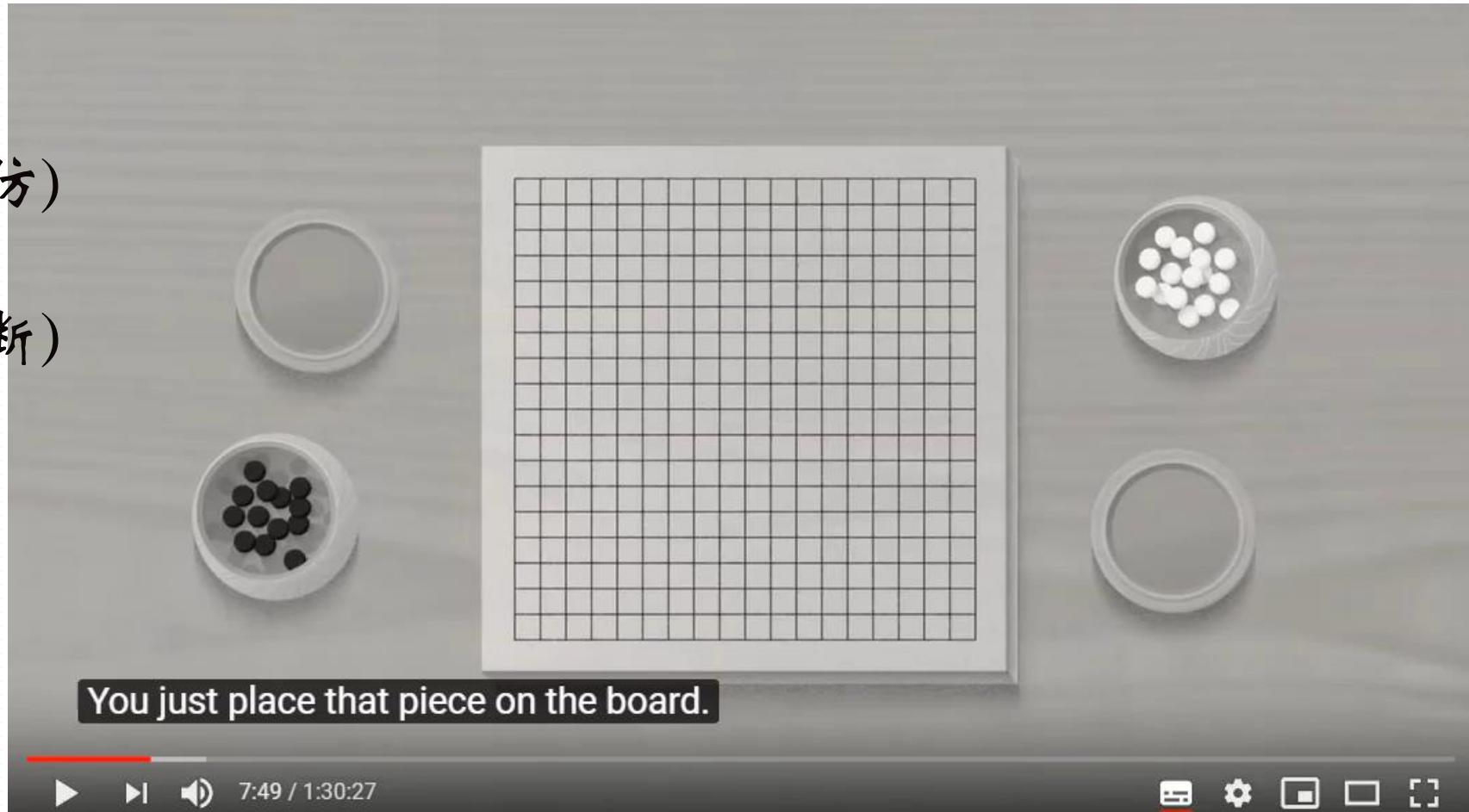
# 模式识别实际应用：视频/语音编辑合成



# 模式识别实际应用: *AlphaGo/Zero*

## *AlphaGo*

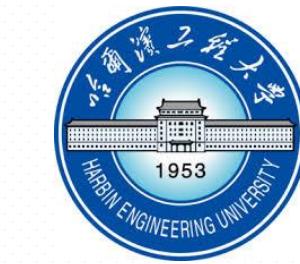
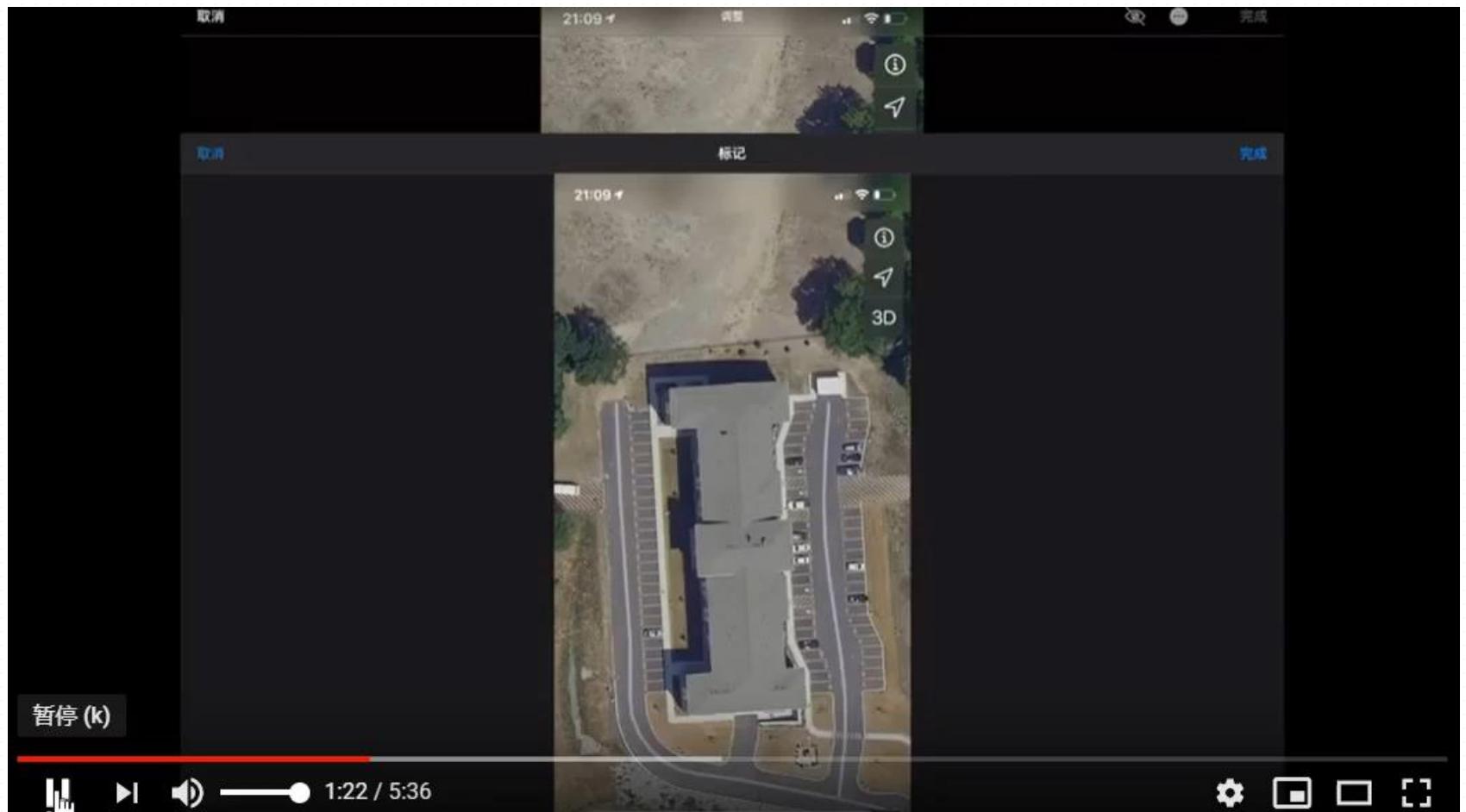
- 策略网络(监督分类/模仿)
  - 减小树搜索宽度
- 价值网络(回归/全局判断)
  - 减小树搜索深度
- 蒙特卡洛搜索树
  - 规划/模拟未来



# 模式识别实际应用：辅助驾驶



# 模式识别实际应用：辅助驾驶(智能召唤)

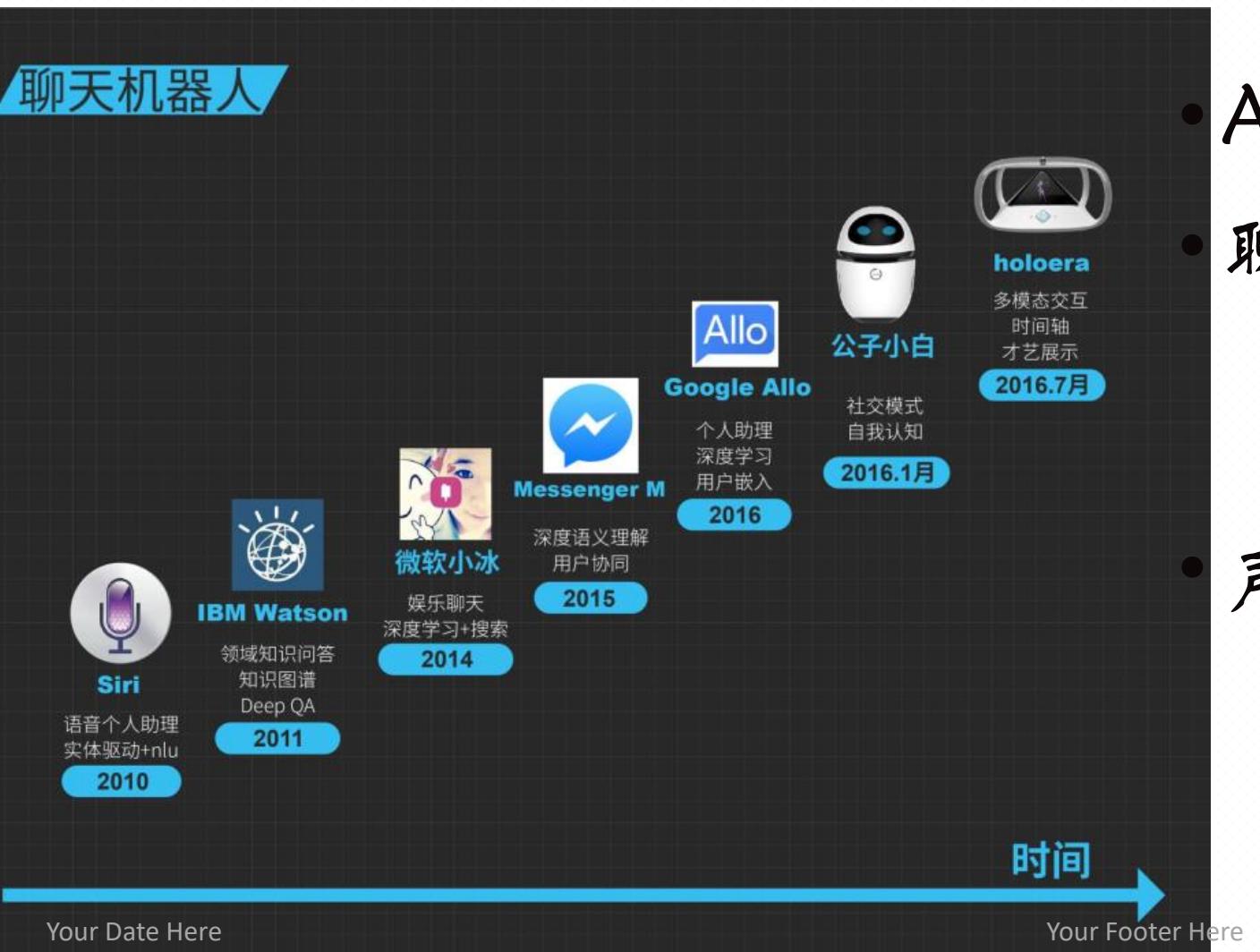


# 模式识别实际应用：辅助驾驶





# 模式识别实际应用：语音识别/自然语言处理 /文本分类.....



- AI 同声传译

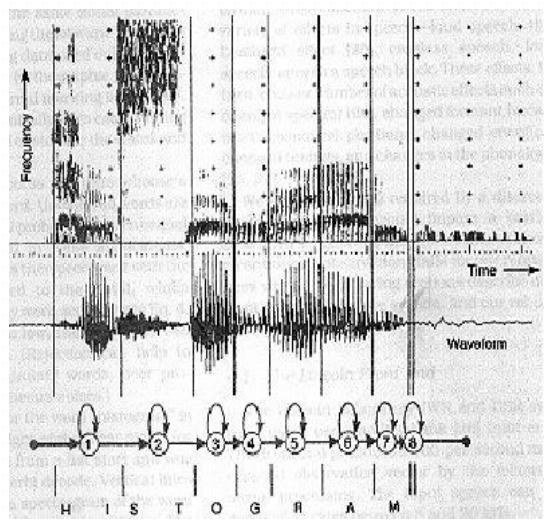
- 聊天机器人

- *Siri*、*IBM Watson*、*微软小冰*、*Messenger M*、*Google Allo*

- 声纹识别

- 语音识别/认证

- 水下声纹识别

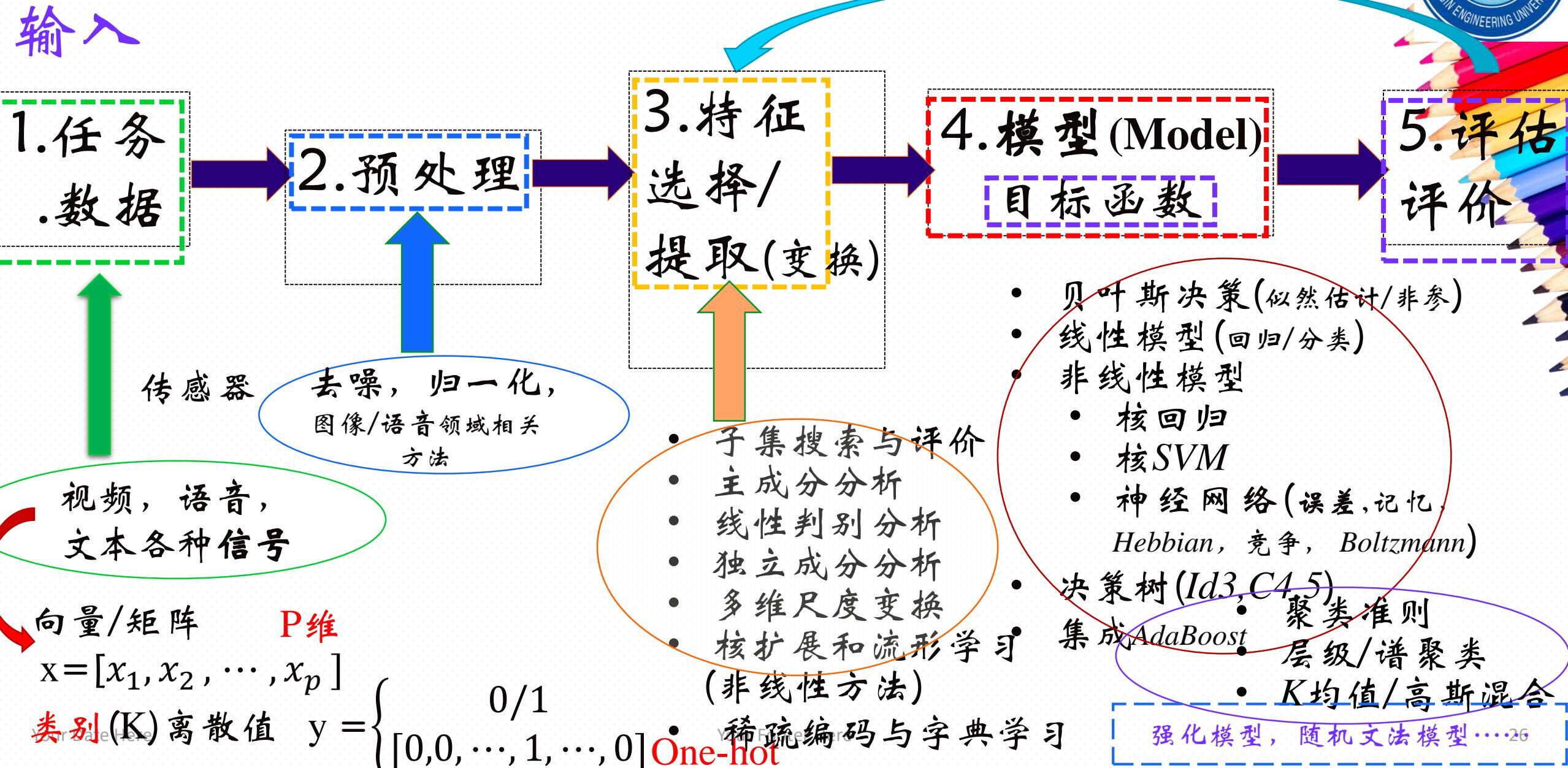
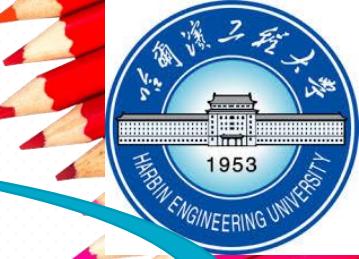


# COFFEE Break

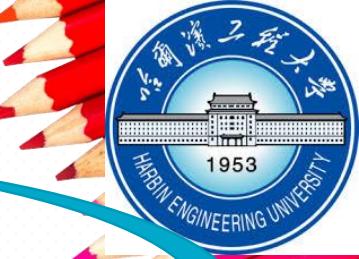
We will start again in 5'



# 模式识别系统构成



# 模式识别系统构成



输入

1. 任务  
· 数据

2. 预处理

3. 特征  
选择/  
提取(变换)

4. 模型 (Model)

目标函数

5. 评估  
评价

传感器

去噪, 归一化,  
图像/语音领域相关  
方法

视频, 语音,  
文本各种信号

向量/矩阵

P维

$$x = [x_1, x_2, \dots, x_p]$$

类别 (K) 离散值

$$y = \begin{cases} 0/1 \\ [0, 0, \dots, 1, \dots, 0] \end{cases}$$

One-hot  
稀疏编码与字典学习

- 判别式
- 生成式
- 描述式

- 子集搜索与评价
- 主成分分析
- 线性判别分析
- 独立成分分析
- 多维尺度变换
- 核扩展和流形学习  
(非线性方法)

- 贝叶斯决策 (似然估计/非参)
- 线性模型 (回归/分类)
- 非线性模型
  - 核回归
  - 核SVM
  - 神经网络 (误差, 记忆, Hebbian, 竞争, Boltzmann)
- 决策树 (Id3, C4.5)
- 集成 AdaBoost

- 聚类准则
- 层级/谱聚类
- K 均值/高斯混合

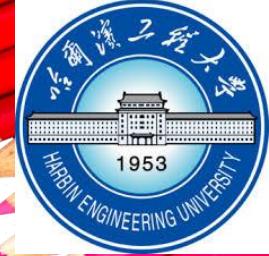
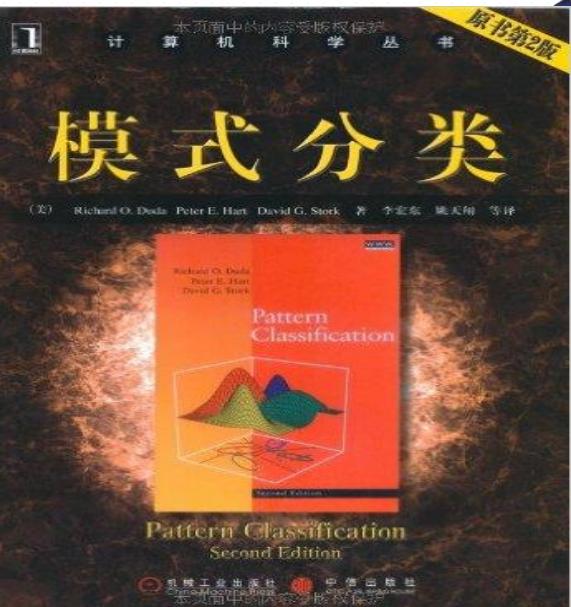
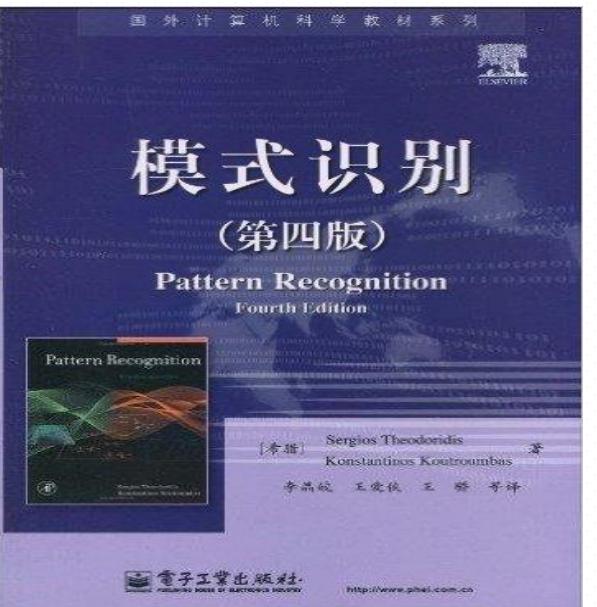
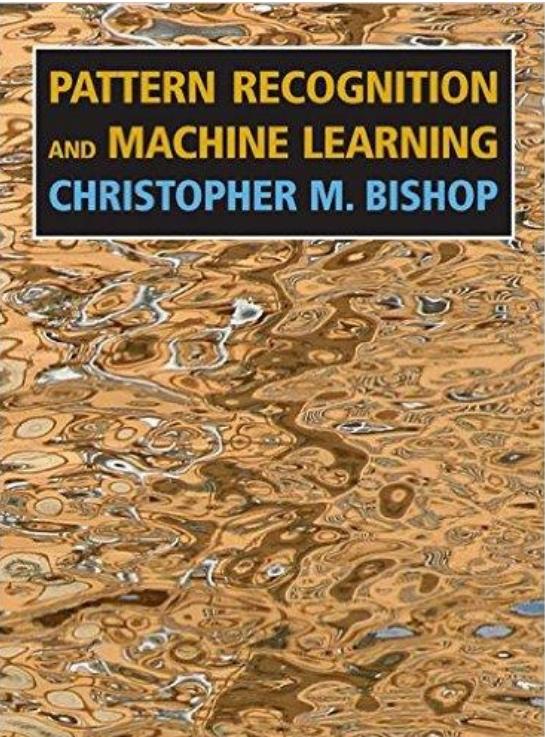
强化模型, 随机文法模型 ... 27

# 参考书

- 1. 模式识别（第四版）*Sergios Theodoridis*  
北京：电子工业出版社，2016.
  - （英文版：*Sergios Theodoridis and K. Koutroumbas, "Pattern Recognition, 4nd edition"*）
- 2. “**Pattern recognition and machine learning**”, Christopher M. Bishop,  
**Springer, 2011**
- 3. 模式分类（第二版）Richard O. Duda  
机械工业出版社，2003.
  - （英文版：*Richard O. Duda, "Pattern Classification (2<sup>nd</sup> edition)"*）
- 4. 现代模式识别. 孙即祥. 长沙：国防科  
技大学出版社，2002

入门

经典



# 考核方式

- 按照2014版大纲要求: 考试(50%)
- 平时成绩
  - 到课+课堂表现(10%)
  - 课程项目(20%)+(20%)



# BAYES DECISION THEORY

Next week

#2





Xianglei Xing

<http://homepage.hrbeu.edu.cn/web/xingxianglei>

[xingxl@hrbeu.edu.cn](mailto:xingxl@hrbeu.edu.cn)



# Thank You!

Do you have any questions?