

# Pattern Recognition Problems

$X$  – observations

$K$  – object states, hidden/latent variables

$D$  – decisions

$p(x,k)$  – model

**Decision making problem:**

*Given  $x$  from  $X$  make a decision  $d$  from  $D$ .*

Often  $D=K$  and **inference problem** looks like:

*Given  $x$  from  $X$  infer  $k$  from  $K$ .*

# Optical Character Recognition

that hung about his very existence, seemed like some sinister enchanter, capable by the mere power of his voice of wrecking the structure of civilization.

It was even possible, at moments, to switch one's hatred this way or that by a voluntary act. Suddenly, by the sort of violent effort with which one wrenches one's head away from the pillow in a nightmare, Winston succeeded in transferring his hatred from the face on the screen to the dark-haired girl behind him. Vivid, beautiful hallucinations flashed through his mind. He would flog her to death with a rubber truncheon. He would tie her naked to a stake and shoot her full of arrows like Saint Sebastian. He would ravish her and cut her throat at the moment of climax. Better than before, moreover, he realized *why* it was that he hated her. He hated her because she was young and pretty and sexless, because he wanted to go to bed with her and would never do so, because round her sweet supple waist, which seemed to ask you to encircle it with your arm, there was only the odious scarlet sash, aggressive symbol of chastity.

The Hate rose to its climax. The voice of Goldstein had become an actual sheep's bleat, and for an instant the face changed into that of a sheep. Then the sheep-face melted into the figure of a Eurasian soldier who seemed to be advancing, huge and terrible, his sub-machine gun roaring, and seeming to spring out of the surface of the screen, so that some of the people in the front row actually flinched backwards in their seats. But in the same moment, drawing a deep sigh of relief from everybody, the hostile figure melted into the face of Big Brother, black-haired, black-moustachio'd, full of power and mysterious calm, and so vast that it almost filled up the screen. Nobody heard what Big Brother was saying. It was merely a few words of encouragement, the sort of words that are uttered in the din of battle, not distinguishable individually but restoring confidence by the fact of being spoken. Then the face of Big Brother faded away again, and instead the three slogans of the Party stood out in bold capitals:

But the face of Big Brother seemed to persist for several seconds on the screen, as though the impact that it had made on

that hung about his very existence, seemed like some sinister enchanter, capable by the mere power of his voice of wrecking the structure of civilization.

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with which one wrenches one's head away from the pillow in a nightmare, Winston succeeded in transferring his hatred from the face on the screen to the dark-haired girl behind him. Vivid, beautiful hallucinations flashed through his mind. He would flog her to death with a rubber truncheon. He would tie her naked to a stake and shoot her full of arrows like Saint Sebastian. He would ravish her and cut her throat at the moment of climax. Better than before, moreover, he realized *why* it was that he hated her. He hated her because she was young and pretty and sexless, because he wanted to go to bed with her and would never do so, because round her sweet supple waist, which seemed to ask you to encircle it with your arm, there was only the odious scarlet sash, aggressive symbol of chastity.

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# Music Scores Recognition

Allegro

This image shows a page of a musical score for piano, marked "Allegro". The score is written in 2/4 time and consists of four systems of music. Each system has a treble and bass clef staff. The music features a rhythmic pattern of eighth and sixteenth notes in the right hand, and chords and eighth notes in the left hand. The dynamic marking is *mf*. There are several chord symbols, including B and B7, and some fingering numbers like 3, 4, and 7. The score ends with a double bar line and a repeat sign.

Allegro

This image shows the same musical score as the first image, but with blue highlights and green annotations. The highlights are on the notes and chords in both the treble and bass staves. The green annotations include a "7" above a chord in the second system, a "3 4" below a chord in the third system, and a "7" above a chord in the fourth system. There are also some green markings on the notes in the treble staff. The dynamic marking is *mf*. The score ends with a double bar line and a repeat sign.

# Face Recognition

удивленный  
**Facial expression synthesis**



**Technique outline**

**TAKE photos of facial expressions**

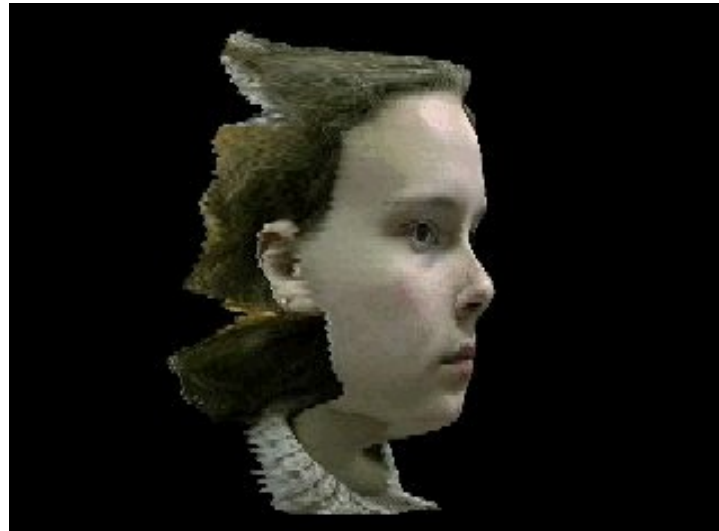


# Facial Expression Synthesis



*Pictures and movies are taken from [www.irtc.org.ua/image](http://www.irtc.org.ua/image)*

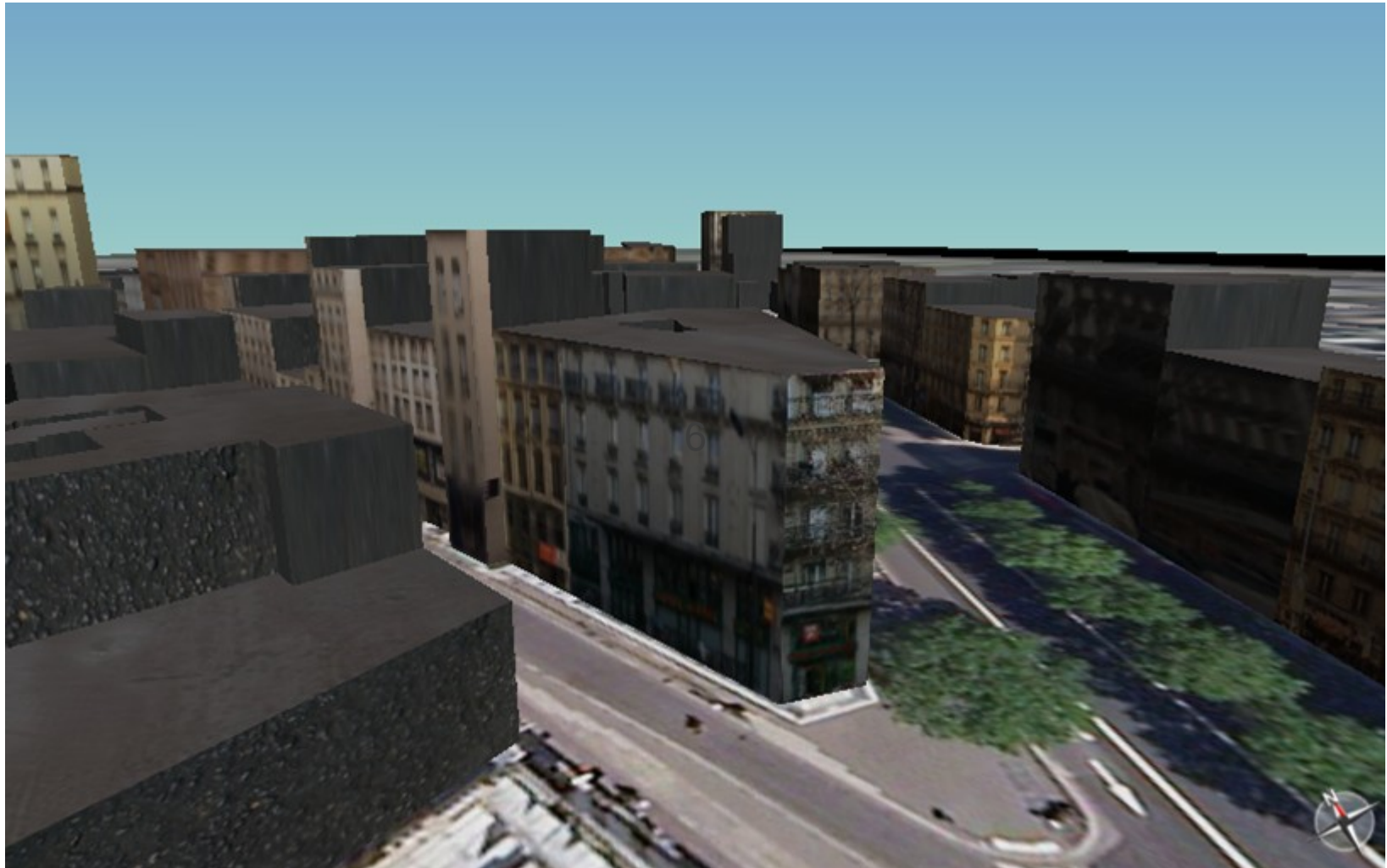
# 3D Reconstruction: Stereo



# 3D Reconstruction: Human Faces



# 3D Reconstruction: City 3D



*Pictures and movies are taken from [www.irtc.org.ua/image](http://www.irtc.org.ua/image)*



# City 3D



# Course Overview

1. Overview. Bayesian decision making problems formulation
2. Bayesian decision making problems.
3. Two statistical models. MLE learning and Linear discriminative analysis.
4. Linear discriminative analysis. Perceptron, SVM, Kernels.
5. Unsupervised learning. EM.
6. Hidden Markov Models (acyclic). MAP inference
7. HMM(a). Marginals.  $\oplus$  semiring. Special cases
8. Stochastic Context-Free Grammars. Inference.
9. Learning HMM(a). Generative.
10. Learning HMM(b). Discriminative.
11. MRF as Entropy Minimization. Inference problems.
12. LP relaxation and Dual Decomposition.
13. Conclusions, overview.

# Hyper-Links to Video

- Face expression synthesis  
[http://www.irtc.org.ua/image/pages/research/Facial\\_expression\\_synthesis](http://www.irtc.org.ua/image/pages/research/Facial_expression_synthesis)
- 3D facial shape recovery on a base of single image  
[http://www.irtc.org.ua/image/pages/research/Face3D\\_Demo](http://www.irtc.org.ua/image/pages/research/Face3D_Demo)
- City 3D <http://www.youtube.com/watch?v=xOikeSs0gnE>