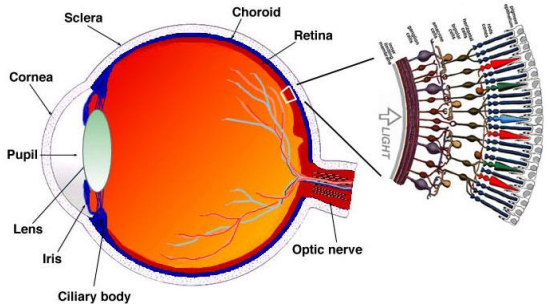
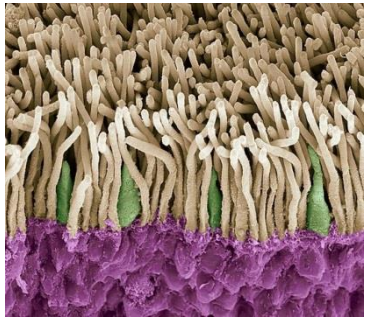
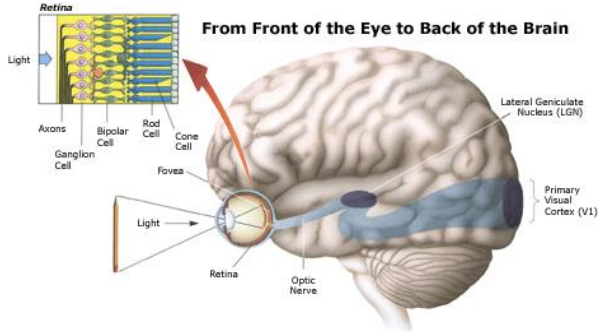
Human vision

- **Vision** is our most powerful sense in aiding our perception of the 3D world
- Retina is ~1000mm^2. Contains millions of **photoreceptors**
  (120 mil. rods and 7 mil. Cones for color sampling)
- The human eye resolution is equivalent to that of a digital camera with more than 500Megapixels!
- Provides **enormous** amount of information: data-rate of ~**3GBytes/s**
  ⇨ a large proportion of our brain power is dedicated to processing the signals from our eyes

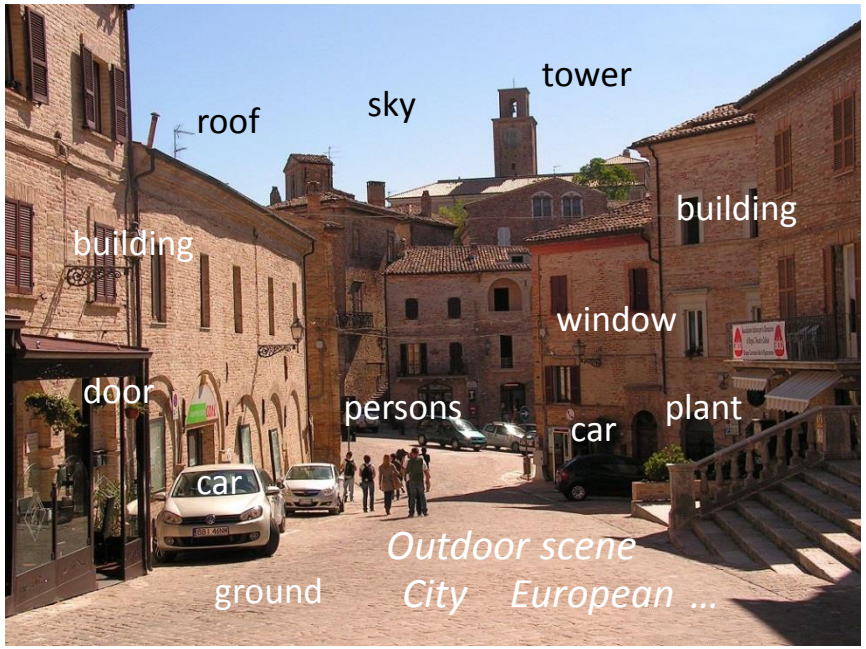




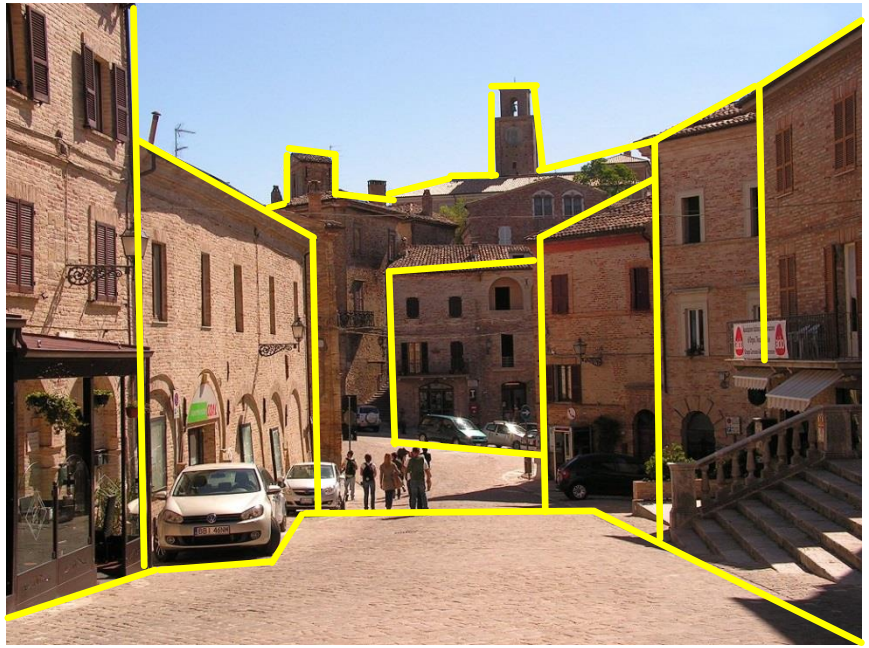


Computer vision | definition

- Automatic extraction of “meaningful” information from images and videos



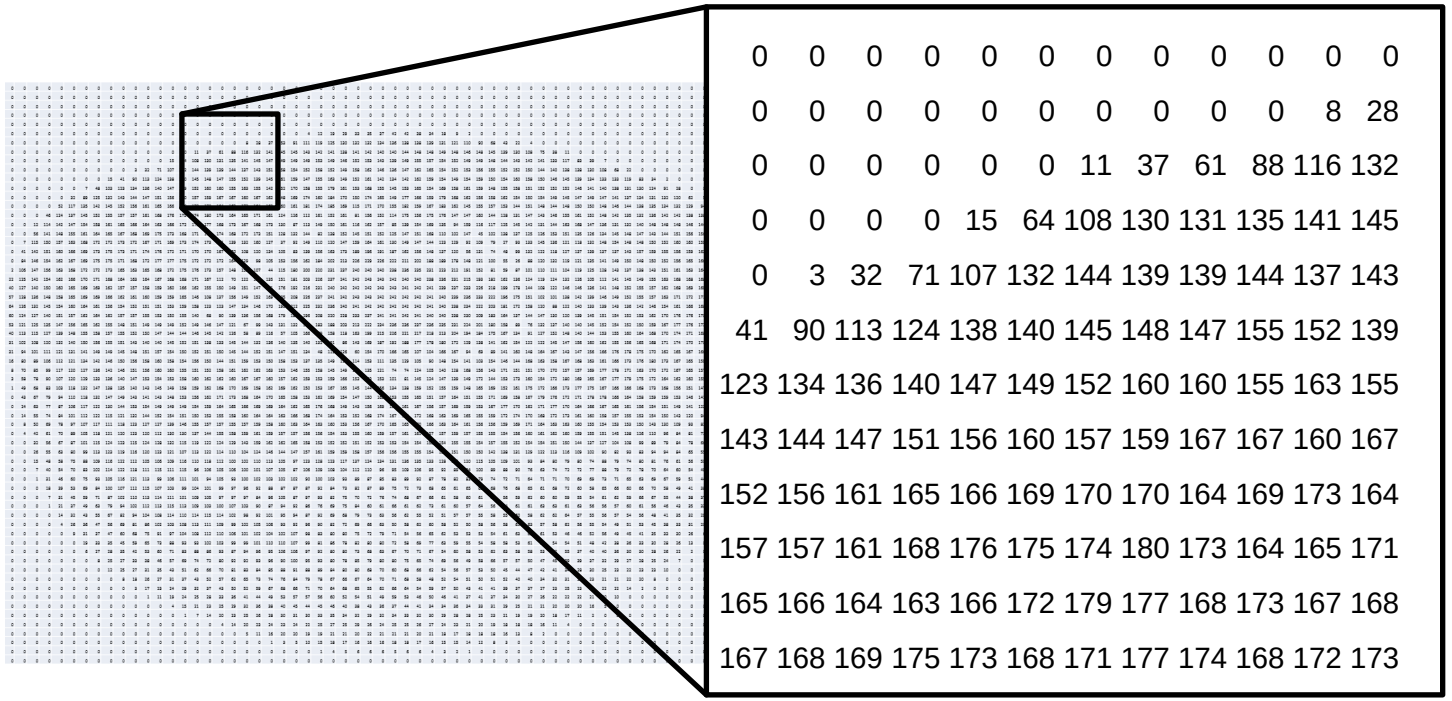
Semantic information



Geometric information

Computer vision | why is it hard?

- Half of primate cerebral cortex is devoted to visual processing
- Achieving human-level visual perception is probably “AI-complete”



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0	0	0	0	15	64	108	130	131	135	141	145
0	3	32	71	107	132	144	139	139	144	137	143
41	90	113	124	138	140	145	148	147	155	152	139
123	134	136	140	147	149	152	160	160	155	163	155
143	144	147	151	156	160	157	159	167	167	160	167
152	156	161	165	166	169	170	170	164	169	173	164
157	157	161	168	176	175	174	180	173	164	165	171
165	166	164	163	166	172	179	177	168	173	167	168
167	168	169	175	173	168	171	177	174	168	172	173

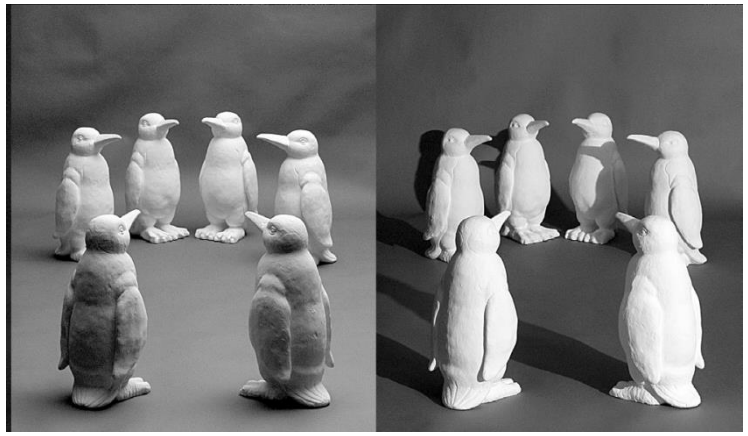
What a computer sees

What we see

Computer vision | challenges

- Viewpoint changes
- Illumination changes
- Object intra-class variations
- Inherent ambiguities:
  many different 3D scenes can give rise to a particular 2D picture

Viewpoint changes



Illumination changes

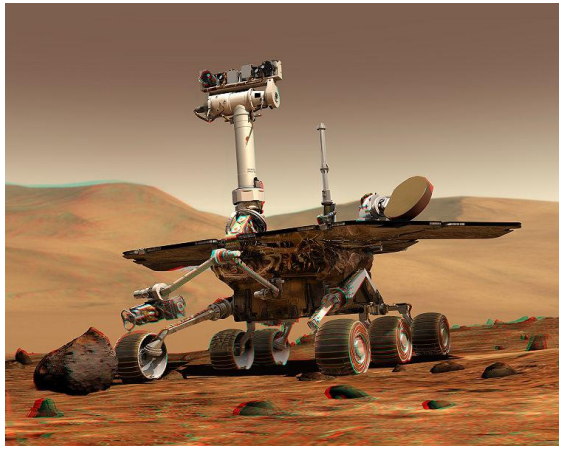
Object intra-class variations

Inherent ambiguities

Computer vision | applications

- 3D reconstruction and modeling
- Recognition
- Motion capture
- Augmented reality:
- Video games and tele-operation
- Robot navigation and automotive
- Medical imaging

Google Earth, Microsoft's Bing Maps



Mars rover Spirit used cameras for visual odometry