

CSCI 1108



Object Recognition



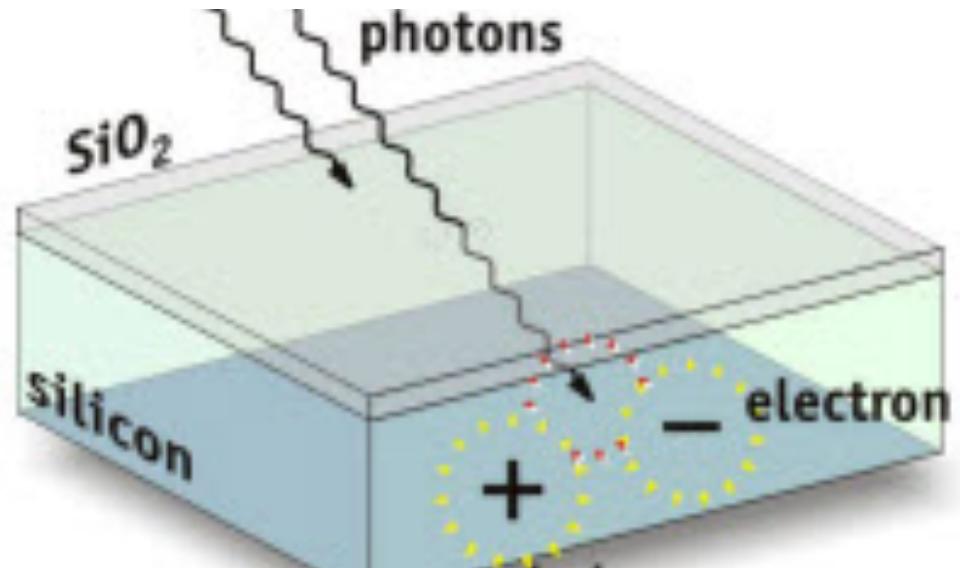
What is this

- Interpreting the sensed environment is another crucial part in robotics
- The general idea is to match sensor patterns with expected patterns for specific objects

Photoelectric effect

Photons cause a small discharge, which is then amplified

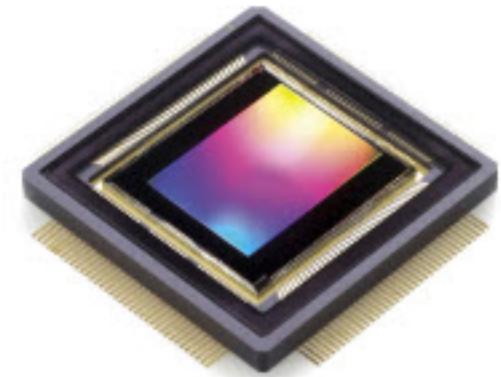
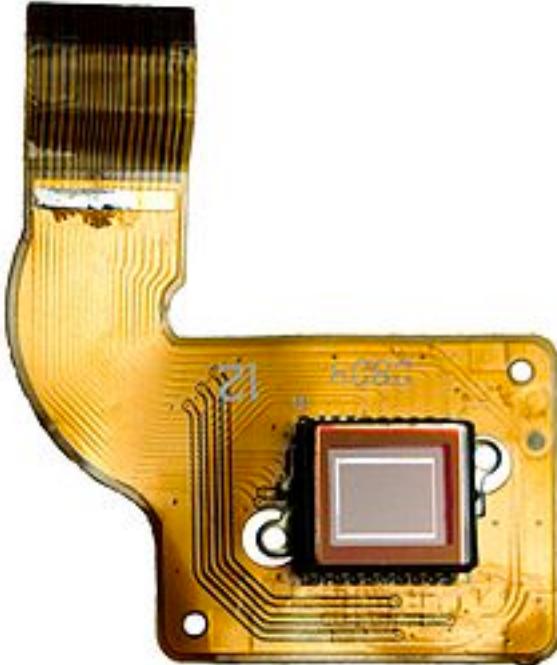
PIXEL



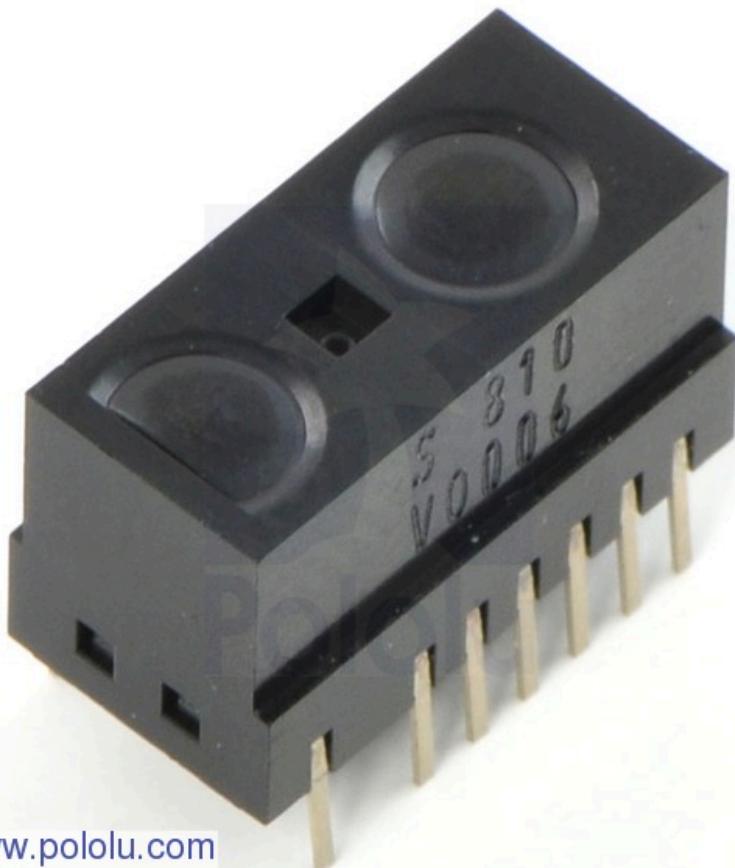
Imaging chips

CCD
(charge-coupled
device)

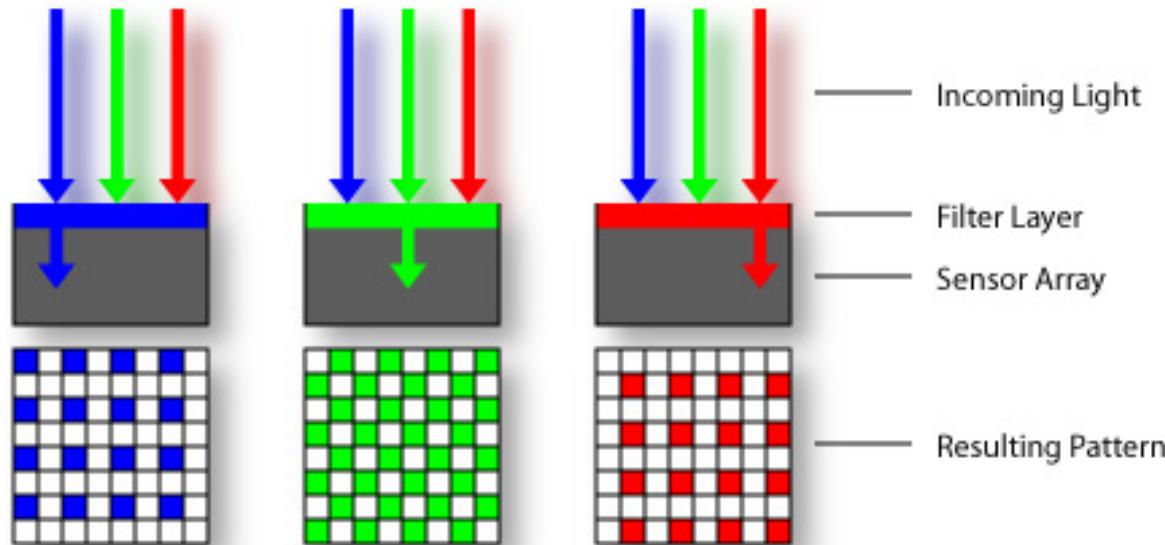
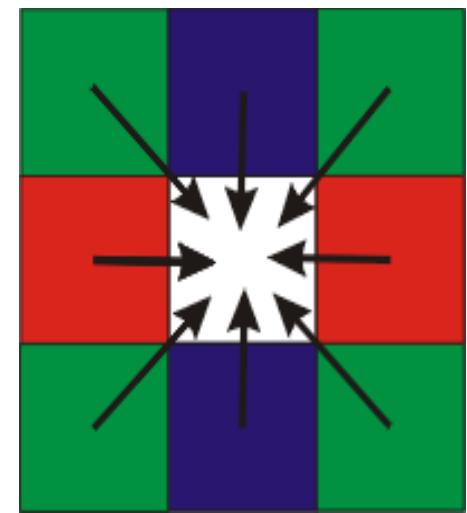
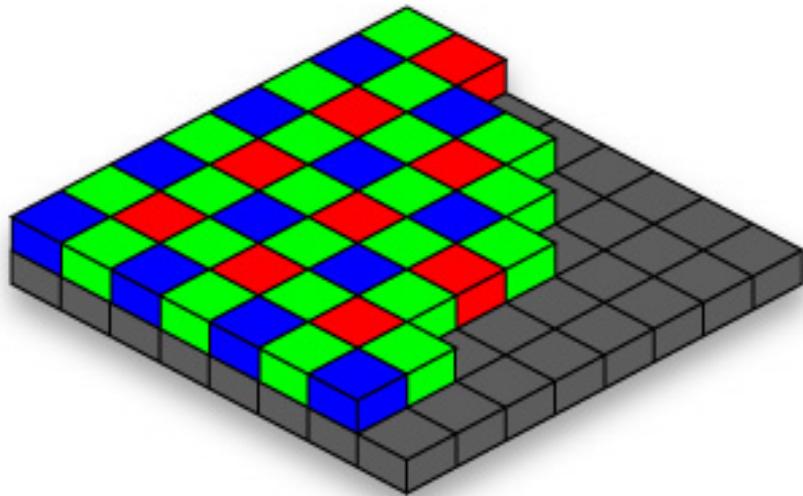
and
CMOS
(complementary
metal-oxide
semiconductor)



Infrared Proximity Sensor



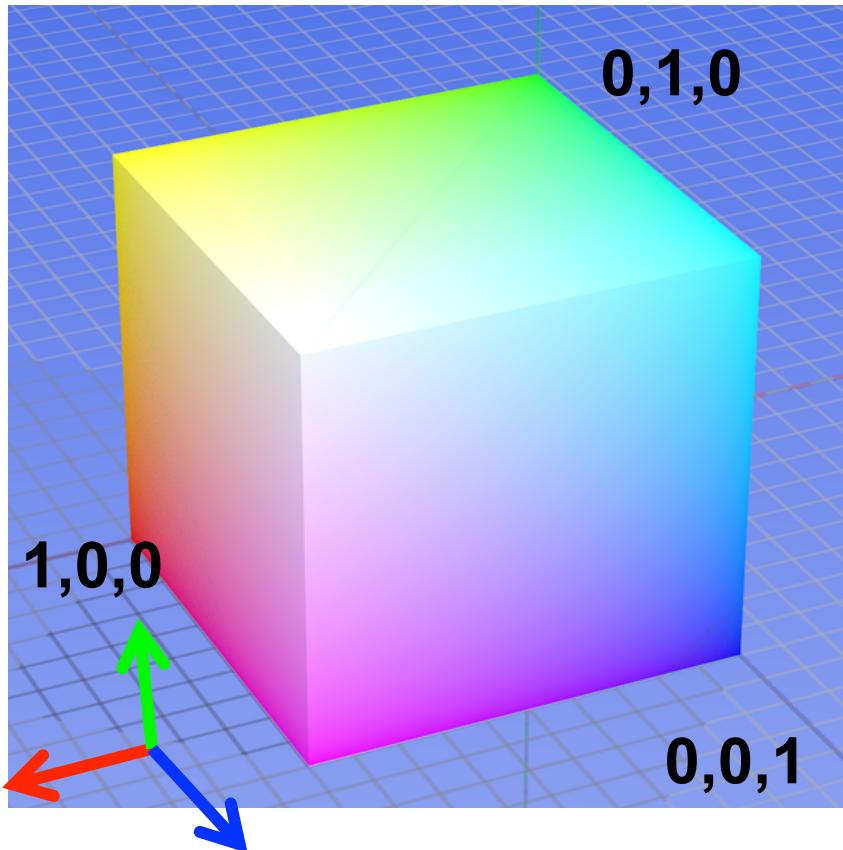
Practical Color Sensing: Bayer Grid



- Estimate RGB at ‘G’ cells from neighboring values

Color spaces: RGB

Default color space



R
(G=0,B=0)



G
(R=0,B=0)



B
(R=0,G=0)

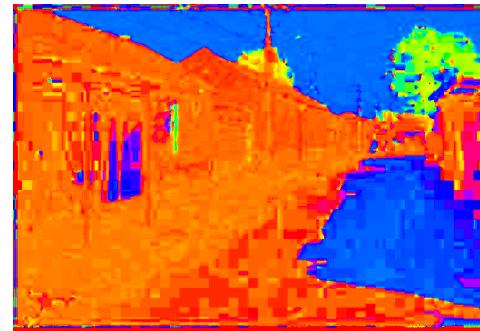
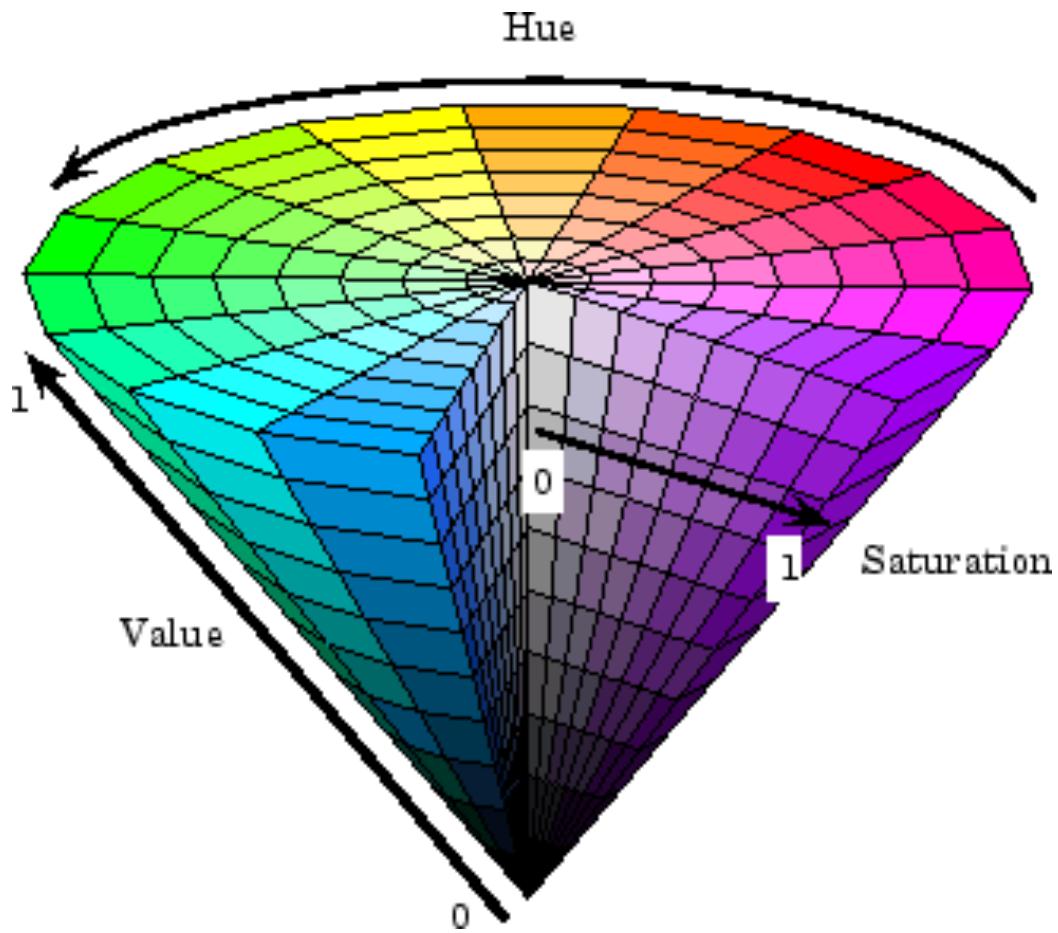
Some drawbacks

- Strongly correlated channels
- Non-perceptual

Color spaces: HSV



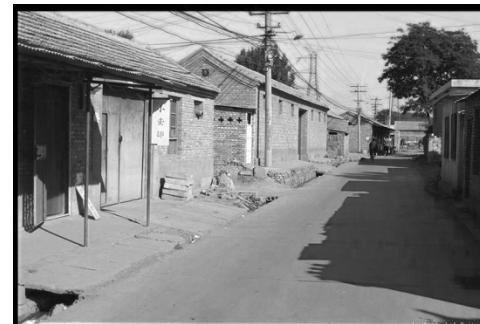
Intuitive color space



H
($S=1, V=1$)



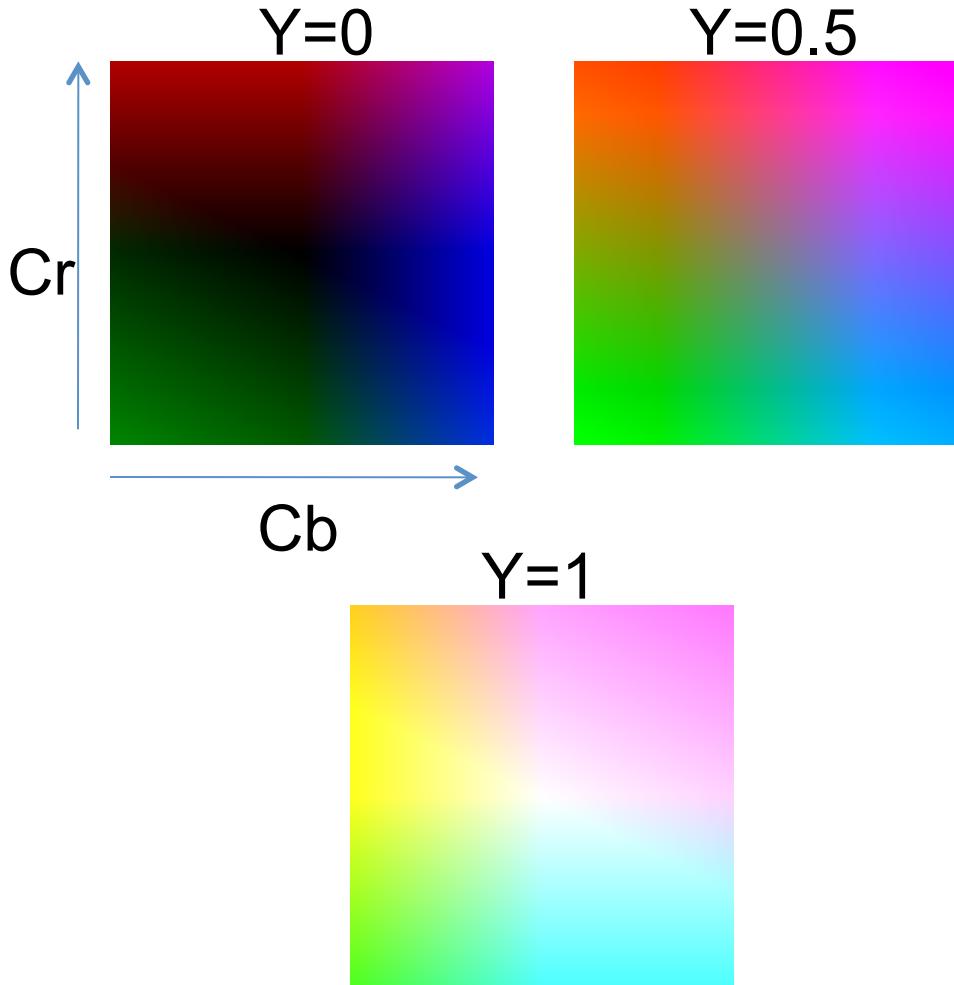
S
($H=1, V=1$)



V
($H=1, S=0$)

Color spaces: YCbCr

Fast to compute, good for compression, used by TV



Y
(Cb=0.5,Cr=0.5)



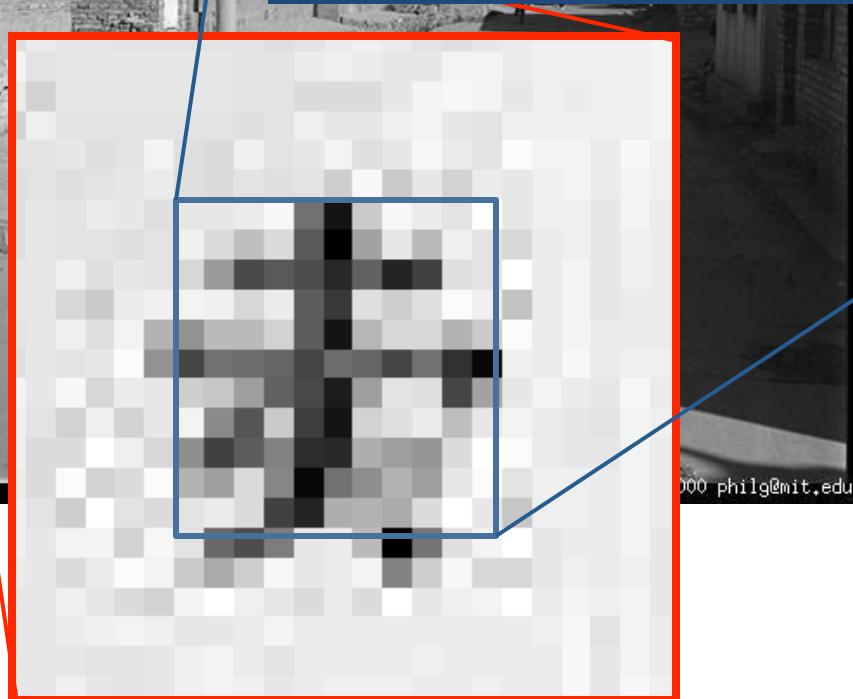
Cb
(Y=0.5,Cr=0.5)



Cr
(Y=0.5,Cb=0.5)

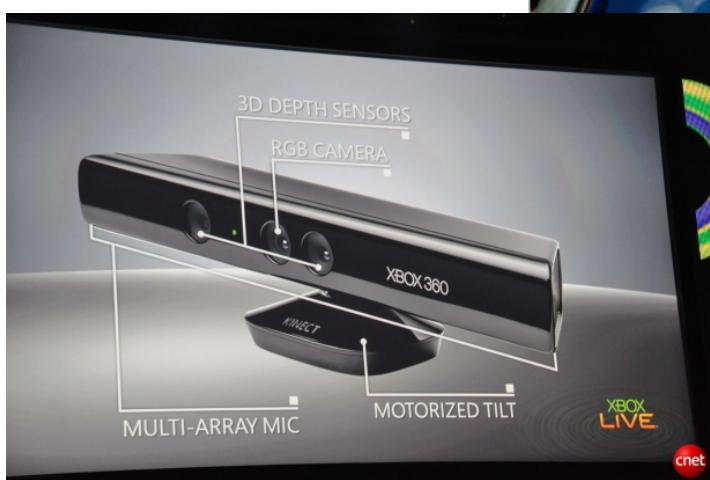


0.92	0.93	0.94	0.97	0.62	0.37	0.85	0.97	0.93	0.92	0.92	0.99
0.95	0.89	0.82	0.89	0.56	0.31	0.75	0.92	0.81	0.95	0.95	0.91
0.89	0.72	0.51	0.55	0.51	0.42	0.57	0.41	0.49	0.91	0.91	0.92
0.96	0.95	0.88	0.94	0.56	0.46	0.91	0.87	0.90	0.97	0.97	0.95
0.71	0.81	0.81	0.87	0.57	0.37	0.80	0.88	0.89	0.79	0.85	
0.49	0.62	0.60	0.58	0.50	0.60	0.58	0.50	0.61	0.45	0.33	
0.86	0.84	0.74	0.58	0.51	0.39	0.73	0.92	0.91	0.49	0.74	
0.96	0.67	0.54	0.85	0.48	0.37	0.88	0.90	0.94	0.82	0.93	
0.69	0.49	0.56	0.66	0.43	0.42	0.77	0.73	0.71	0.90	0.99	
0.79	0.73	0.90	0.67	0.33	0.61	0.69	0.79	0.73	0.93	0.97	
0.91	0.94	0.89	0.49	0.41	0.78	0.78	0.77	0.89	0.99	0.93	



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James Hays, Brown U



►► manufacturer products

consumer products ◀◀

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rear
looking
camera



forward
looking
camera

side looking camera

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Pedestrian Protection
and more

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News

› Mobileye Advanced Technologies Power Volvo Cars World First Collision Warning With Auto Brake System

› Volvo: New Collision Warning with Auto Brake Helps Prevent Rear-end

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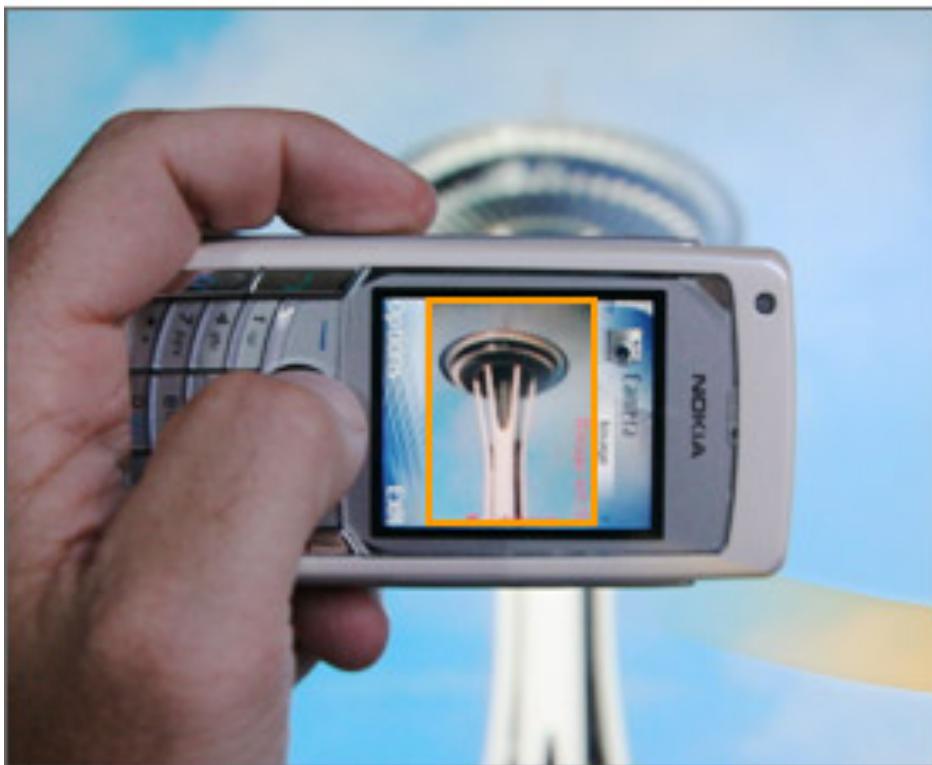
Events

› [Mobileye at Equip Auto, Paris, France](#)

› [Mobileye at SEMA, Las Vegas, NV](#)

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Point & Find



Space Needle - Wikipedia, the free encyclopedia - Windows Internet Explorer

http://en.wikipedia.org/wik/Space_Needle

Space Needle - Wikipedia, the free encyclopedia

Sign in / Create account

Space Needle

From Wikipedia, the free encyclopedia

The Space Needle is the Pacific Northwest's most recognizable landmark and is the symbol of the U.S. city of Seattle, Washington. Located on the grounds of Seattle Center, it was built for the 1962 World's Fair, during which time nearly 20,000 people a day used the elevators — 2.3 million visitors in all for the World Fair. It is now privately owned. The Space Needle is a tower 184 m (605 feet) high and 42 m (138 feet) wide at its widest point and weighs 9,500 tons. It is built to withstand winds of up to 200 km/h (200 mph) and earthquakes up to 9.1 magnitude and has 25 lightning rods on the roof to withstand lightning strikes.

The Space Needle features an observation deck at 159 m (520 feet), the SkyCity restaurant, and a gift shop. From the top of the needle you can see not only the downtown Seattle skyline, but also the Cascade Mountains, Mount Rainier, Elliott Bay and surrounding islands. Photographs of the Seattle skyline often show the Space Needle in the foreground.

Space Needle from DOWNTOWN Seattle

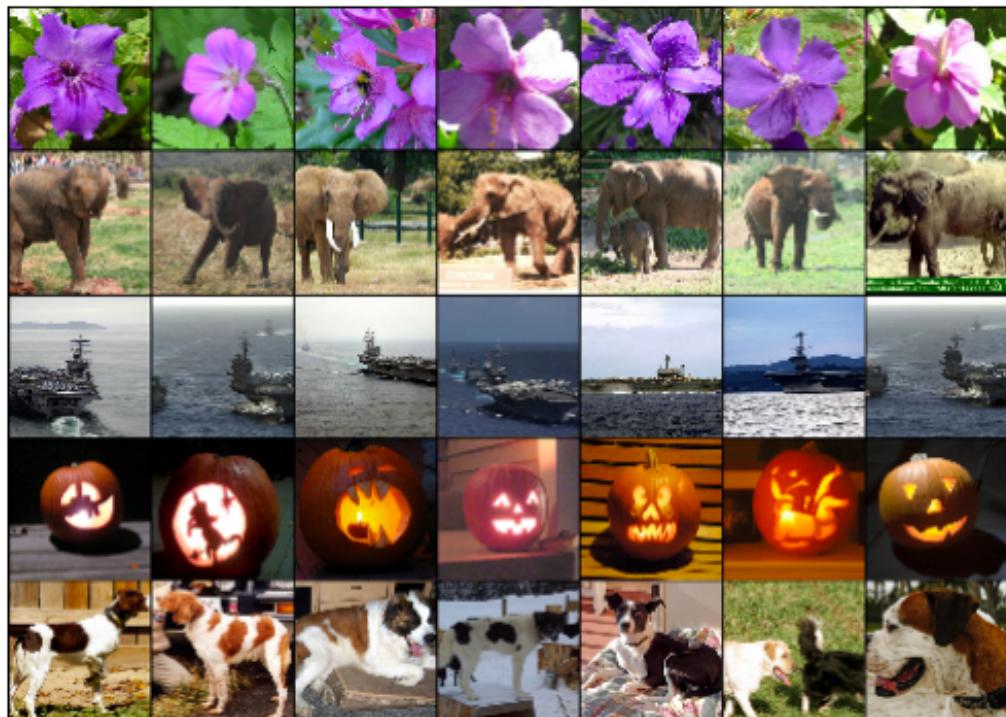
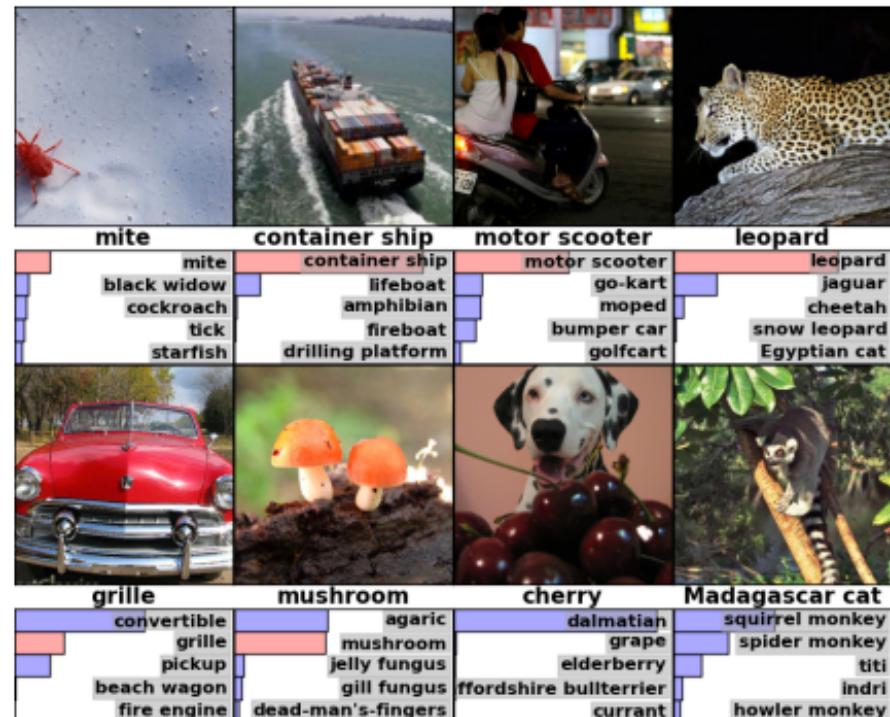
Internet 100%

A screenshot of a Microsoft Internet Explorer browser window displaying the Wikipedia page for the Space Needle. The URL in the address bar is "http://en.wikipedia.org/wik/Space_Needle". The page content describes the Space Needle as a prominent landmark in Seattle, built for the 1962 World's Fair. It is 184 meters high and weighs 9,500 tons. The page includes sections on its history, construction, and features like the observation deck, SkyCity restaurant, and gift shop. A large image of the Space Needle is shown on the right side of the page, with a yellow rectangular box highlighting the tower. Two orange arrows point from the phone's screen in the image on the left to the highlighted area on the Wikipedia page.

German Traffic Sign Competition

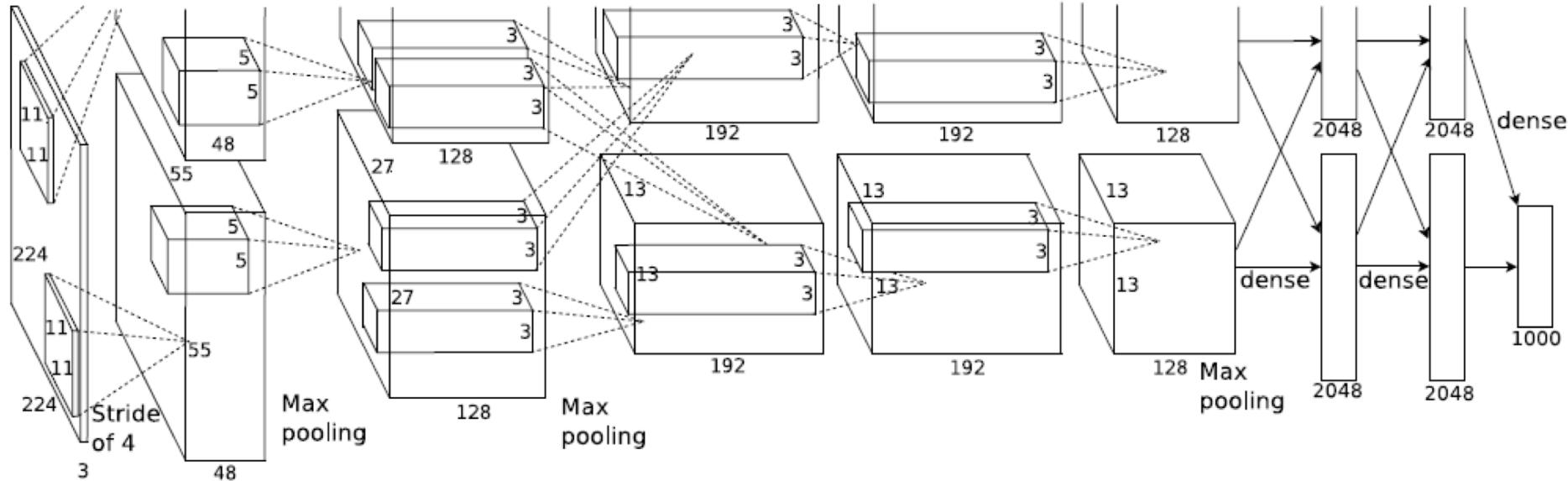


ImageNet Competition



Perceptron and deep learning

Alex Net



Frank Rosenblatt
(1928–1971)



David Rumelhart
(1942–2011)

...



LeCun



Hinton



Bengio

...





Scene labeling
(Farabet et al. 2013)



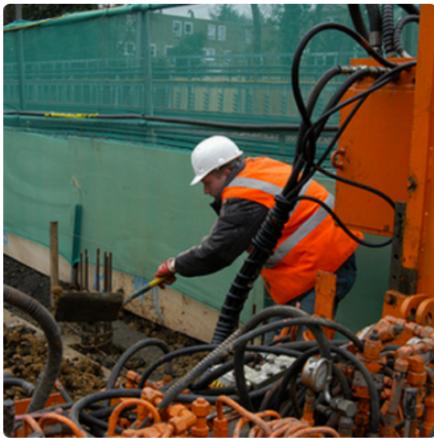
Object recognition and localization
(Sermanet et al. 2014)

Andrej Karpathy, Li Fei-Fei, CVPR 2015

Deep Visual-Semantic Alignments for Generating Image Descriptions



"man in black shirt is playing guitar."



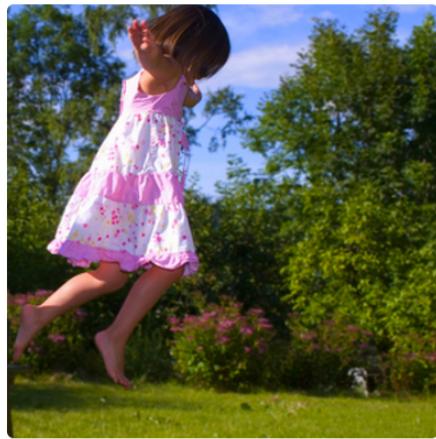
"construction worker in orange safety vest is working on road."



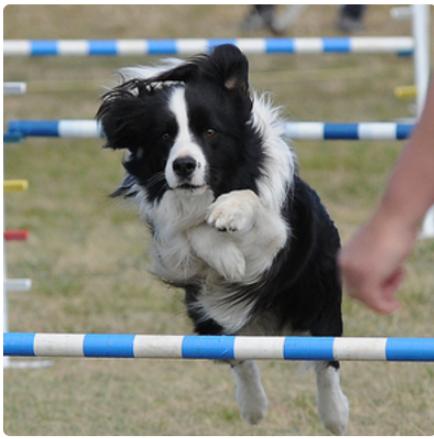
"two young girls are playing with lego toy."



"boy is doing backflip on wakeboard."



"girl in pink dress is jumping in air."



"black and white dog jumps over bar."

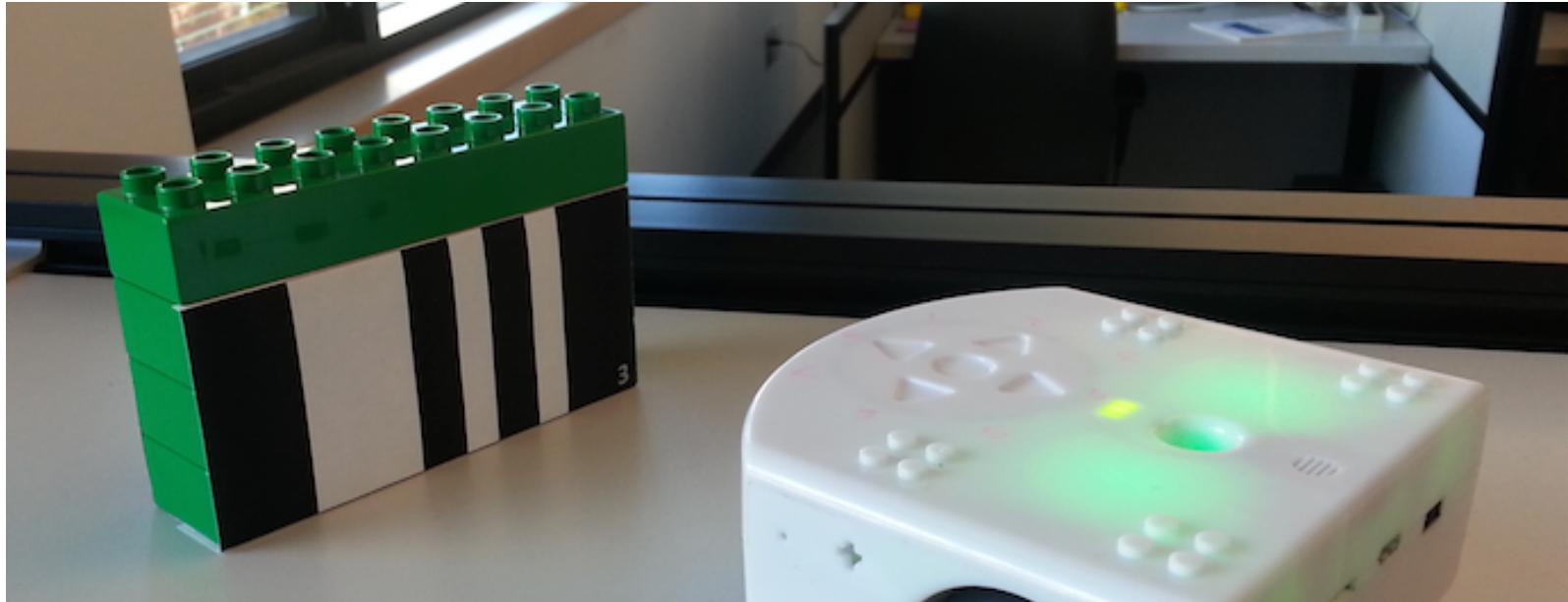


"young girl in pink shirt is swinging on swing."



"man in blue wetsuit is surfing on wave."

A simple 5 pixel infrared camera



A simple video recognition system

