



CSCI 1108



Object Recognition

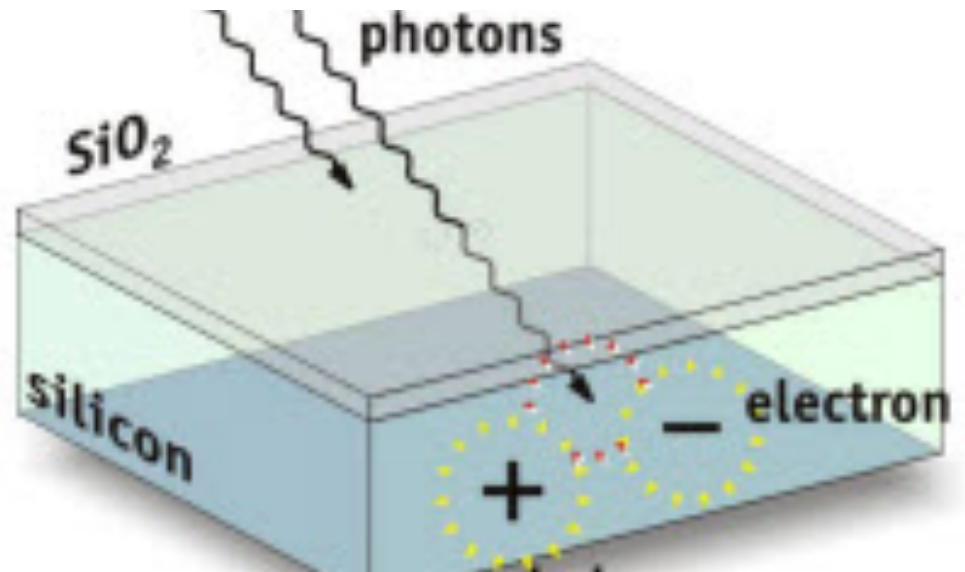


What is this

- 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



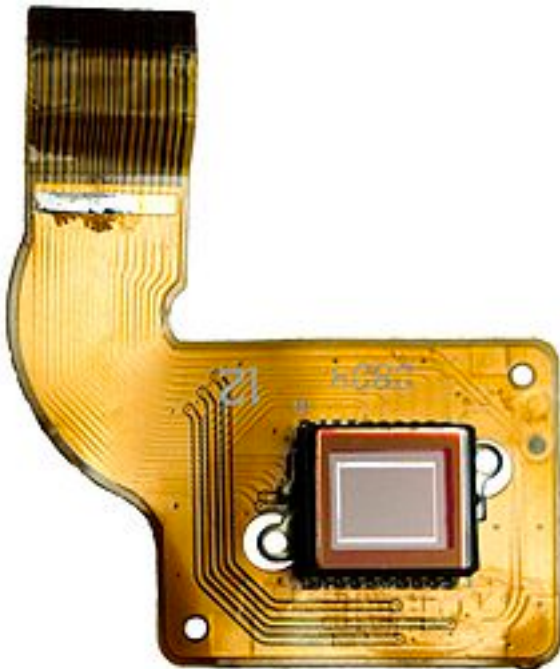
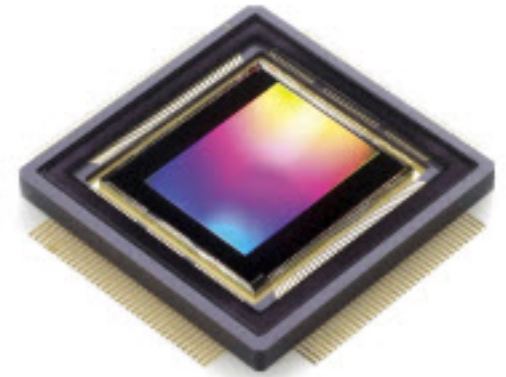
PIXEL

Imaging chips

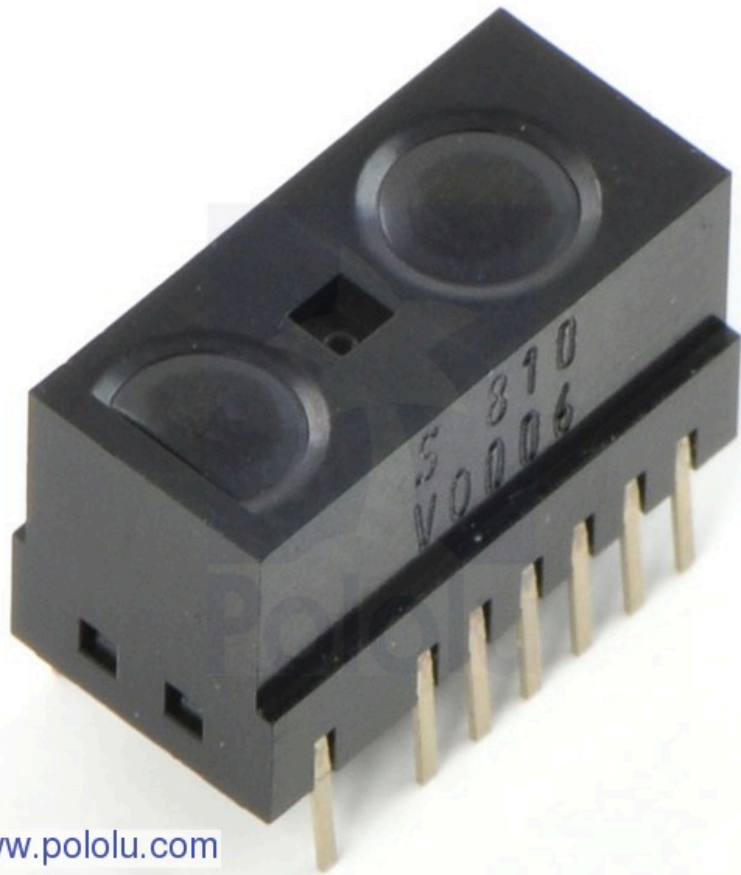
CCD
(charge-coupled
device)

and

CMOS
(complementary
metal-oxide
semiconductor)



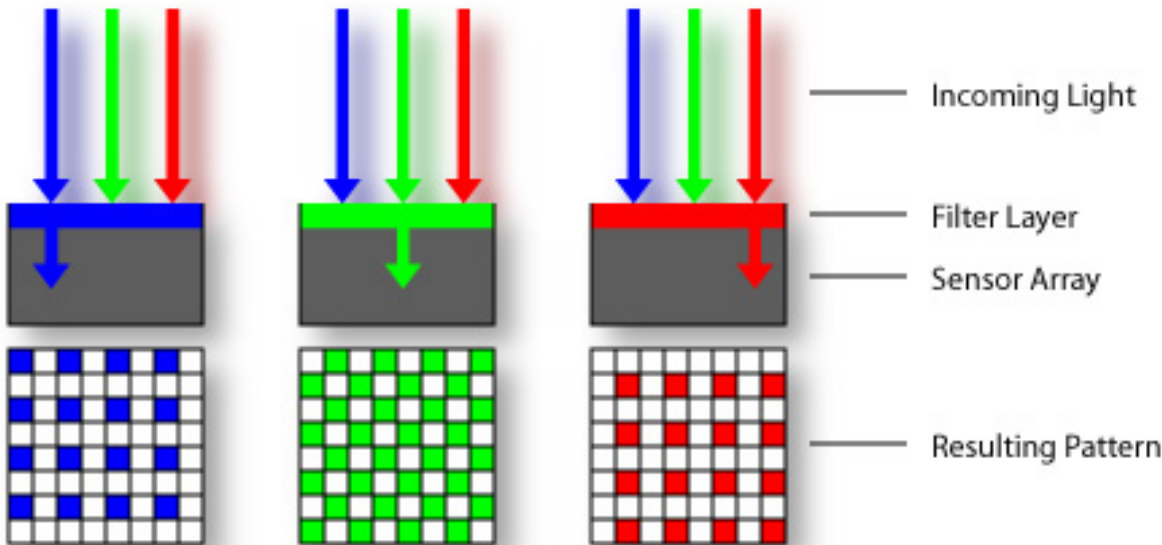
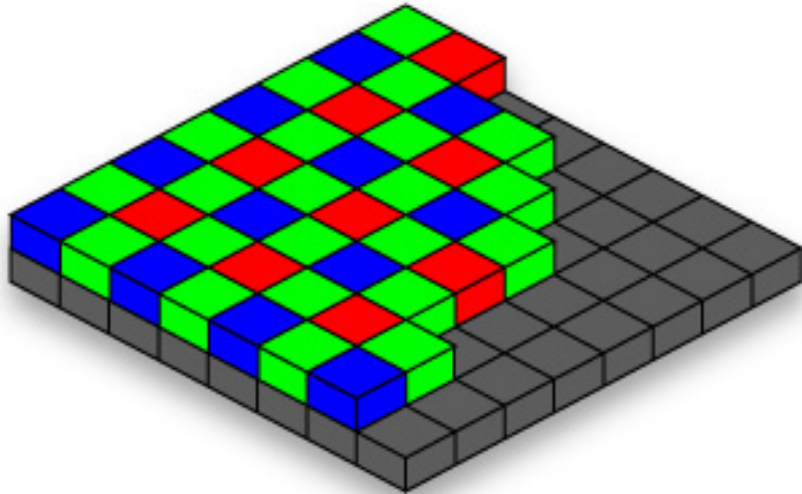
Infrared Proximity Sensor



www.pololu.com



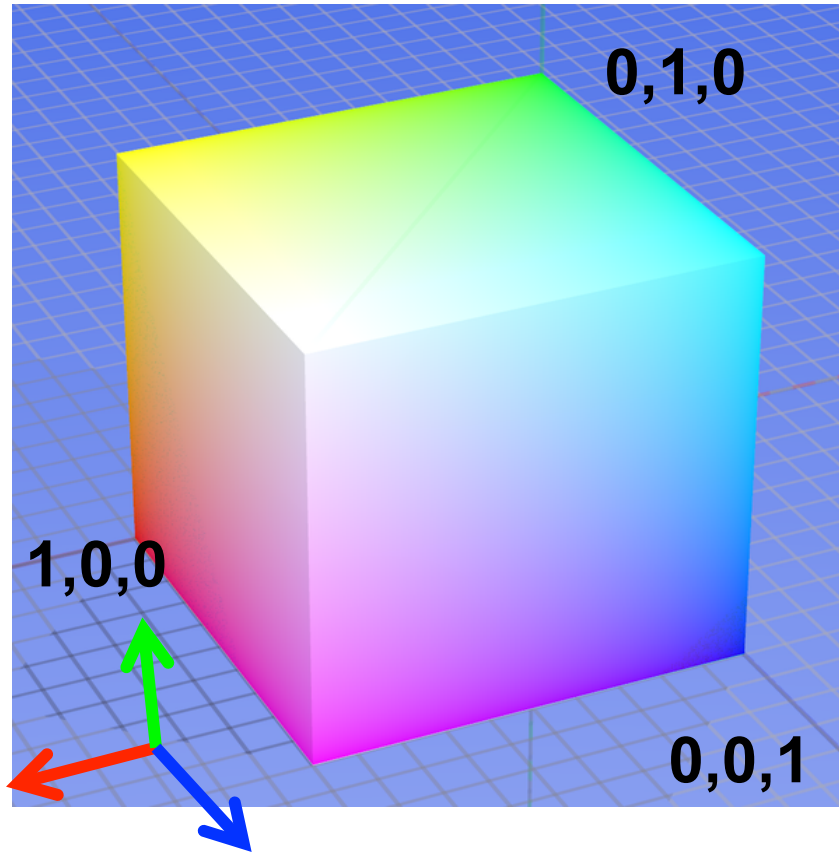
Practical Color Sensing: Bayer Grid



- Estimate RGB at 'G' cells from neighboring values

Color spaces: RGB

Default color space



R
(G=0,B=0)



G
(R=0,B=0)



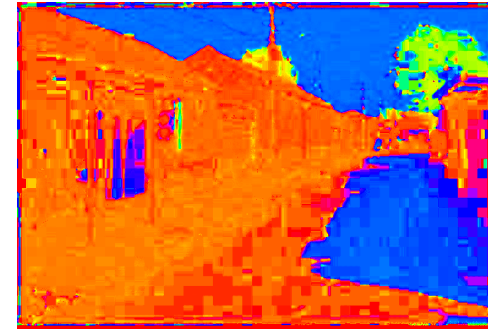
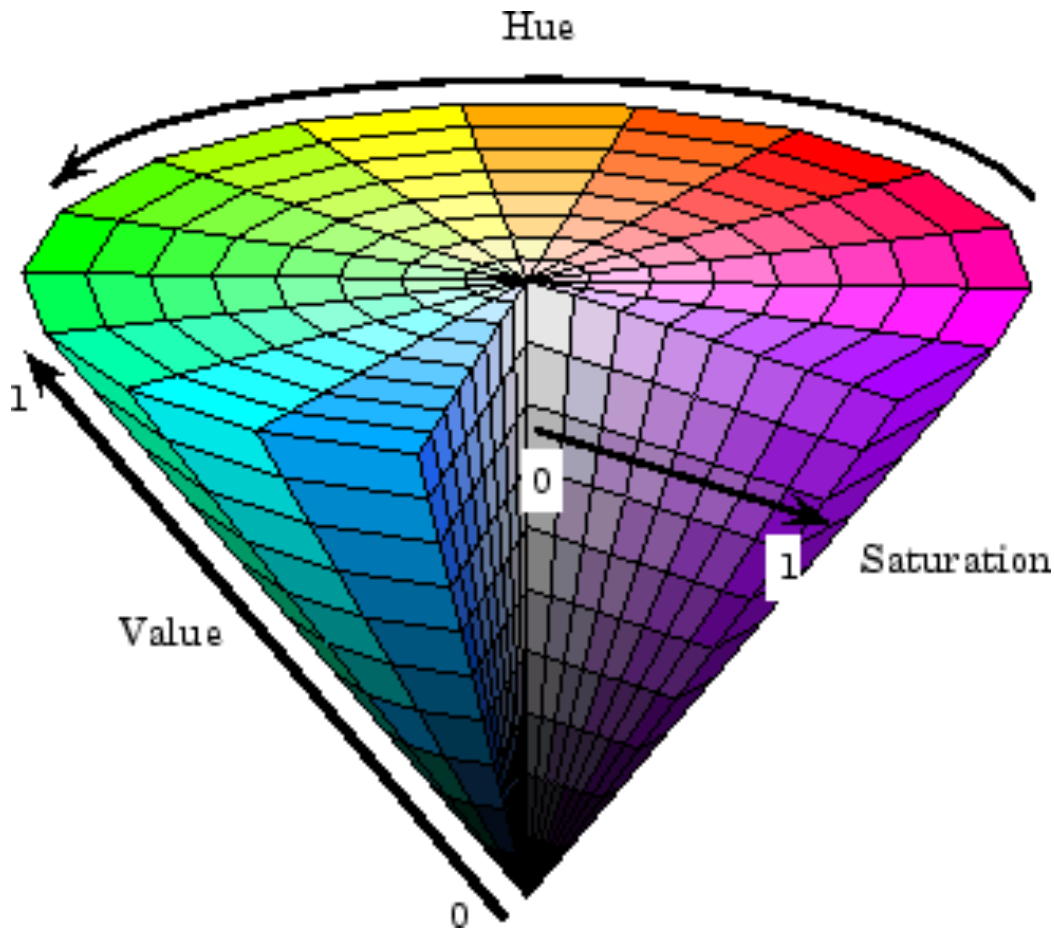
B
(R=0,G=0)

Some drawbacks

- Strongly correlated channels
- Non-perceptual

Color spaces: HSV

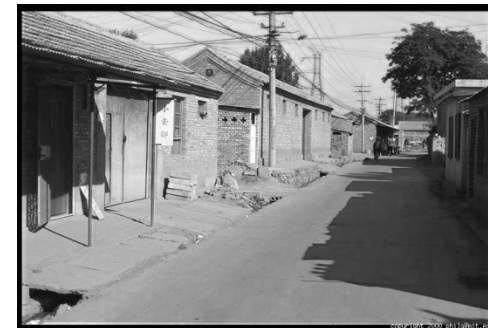
Intuitive color space



H
(S=1,V=1)



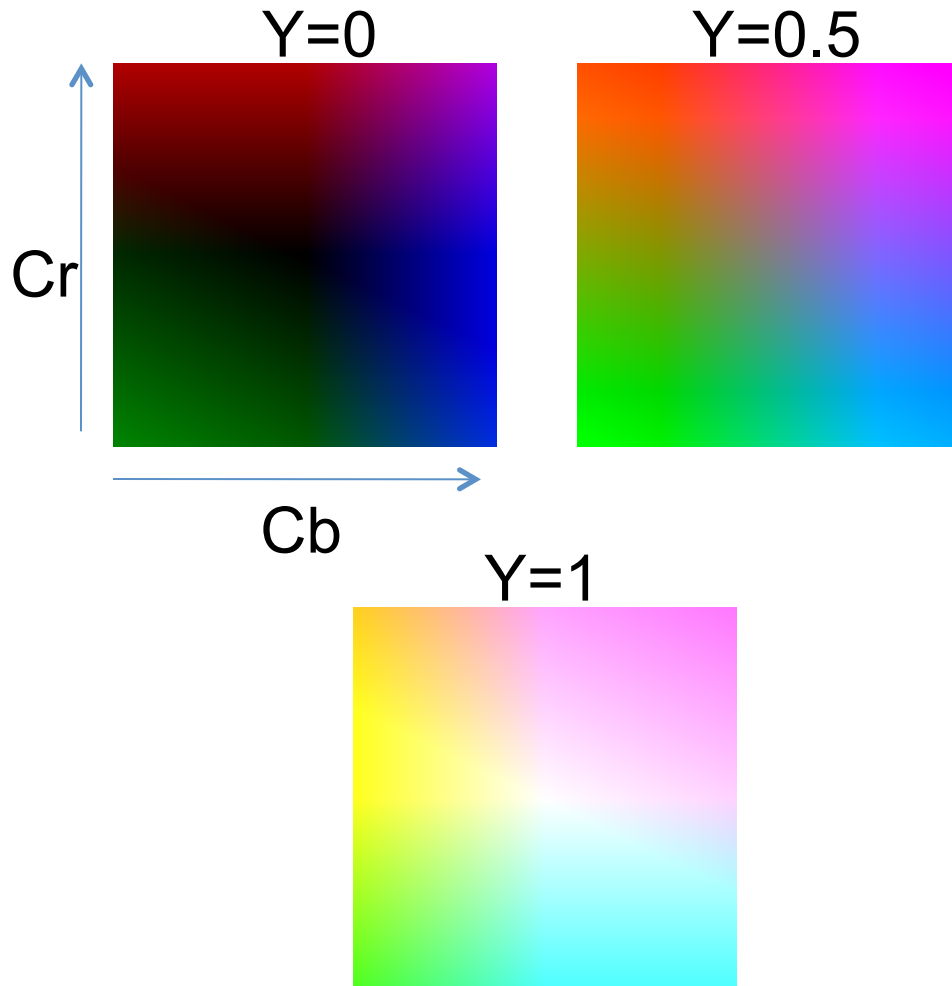
S
(H=1,V=1)



V
(H=1,S=0)

Color spaces: YCbCr

Fast to compute, good for compression, used by TV



Y
(Cb=0.5,Cr=0.5)



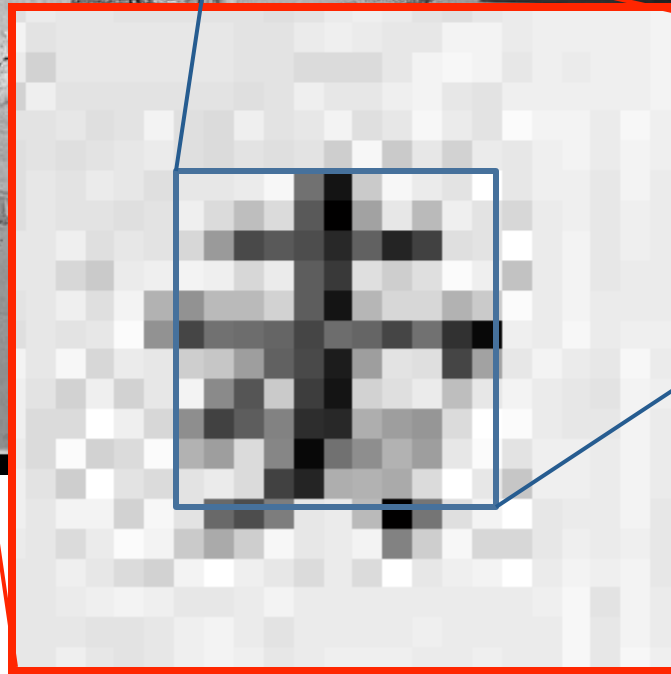
Cb
(Y=0.5,Cr=0.5)



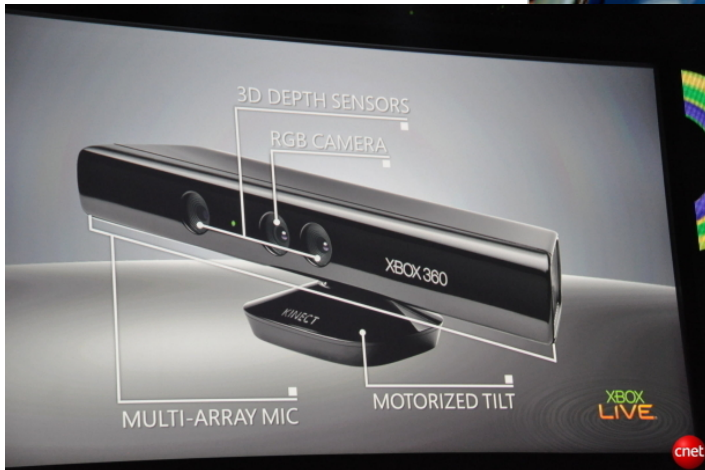
Cr
(Y=0.5,Cb=0.5)



0.92	0.93	0.94	0.97	0.62	0.37	0.85	0.97	0.93	0.92	0.99
0.95	0.89	0.82	0.89	0.56	0.31	0.75	0.92	0.81	0.95	0.91
0.89	0.72	0.51	0.55	0.51	0.42	0.57	0.41	0.49	0.91	0.92
0.96	0.95	0.88	0.94	0.56	0.46	0.91	0.87	0.90	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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▶▶ manufacturer products

consumer products ◀◀

Our Vision. Your Safety.

rear
looking
camera



forward
looking
camera

side looking camera

EyeQ Vision on a Chip



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Vision Applications

Road, Vehicle,
Pedestrian Protection
and more



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AWS Advance Warning System



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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](#)

> [read more](#)

Point & Find

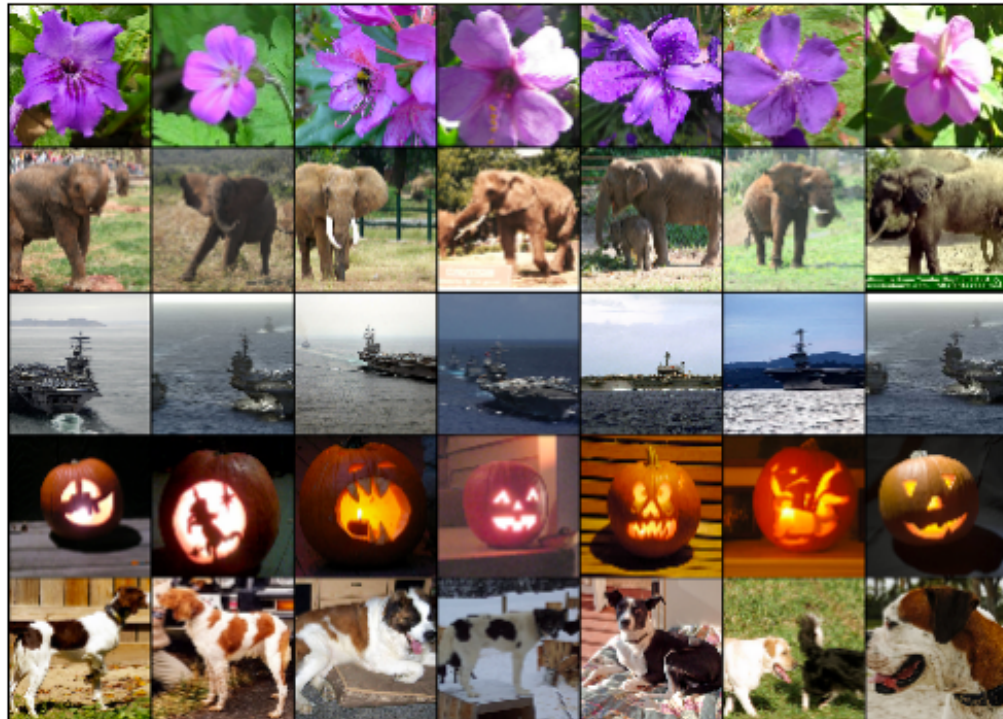


German Traffic Sign Competition



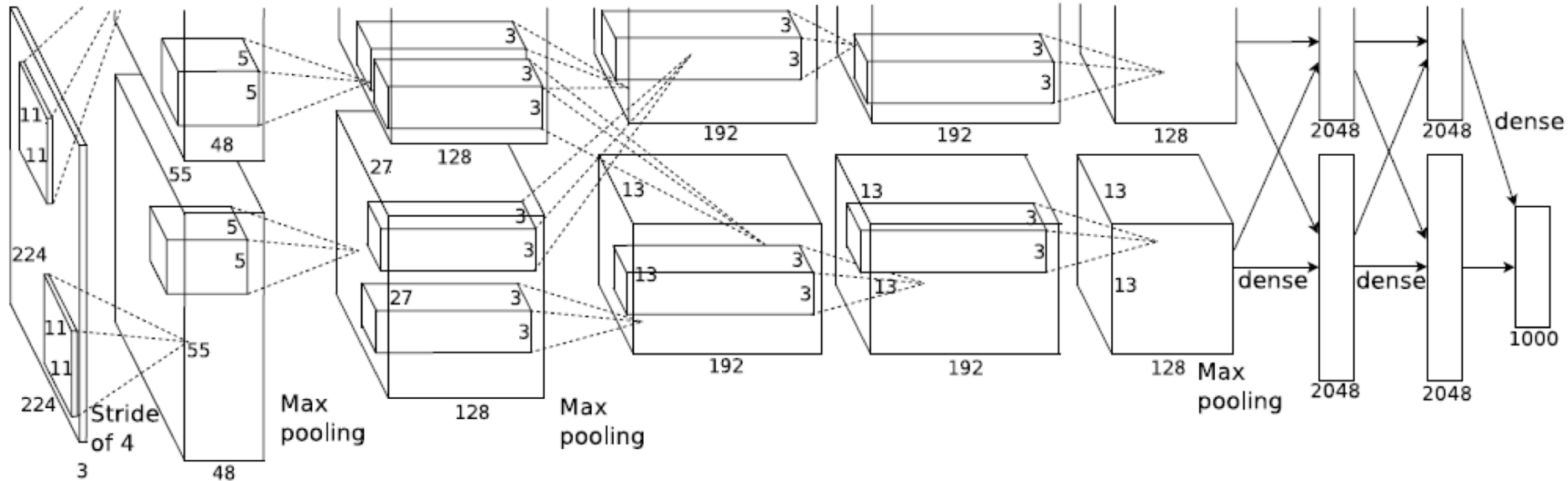
ImageNet Competition

			
mite	container ship	motor scooter	leopard
<ul style="list-style-type: none"> mite black widow cockroach tick starfish 	<ul style="list-style-type: none"> container ship lifeboat amphibian fireboat drilling platform 	<ul style="list-style-type: none"> motor scooter go-kart moped bumper car golfcart 	<ul style="list-style-type: none"> leopard jaguar cheetah snow leopard Egyptian cat
			
grille	mushroom	cherry	Madagascar cat
<ul style="list-style-type: none"> convertible grille pickup beach wagon fire engine 	<ul style="list-style-type: none"> agaric mushroom jelly fungus gill fungus dead-man's-fingers 	<ul style="list-style-type: none"> dalmatian grape elderberry ffordshire bullterrier currant 	<ul style="list-style-type: none"> squirrel monkey spider monkey titi indri howler monkey



Perceptron and deep learning

Alex Net



Frank Rosenblatt
(1928–1971)



David Rumelhart
(1942-2011)

...



LeCun



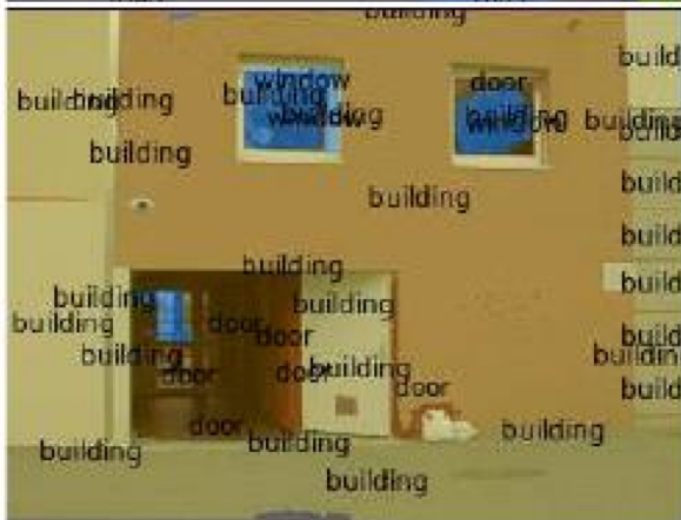
Hinton



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."



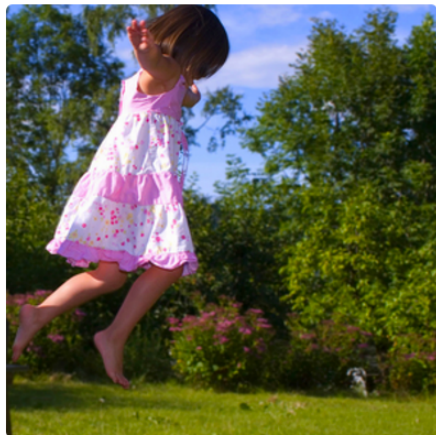
"construction worker in orange safety vest is working on road."



"two young girls are playing with lego toy."



"boy is doing backflip on wakeboard."



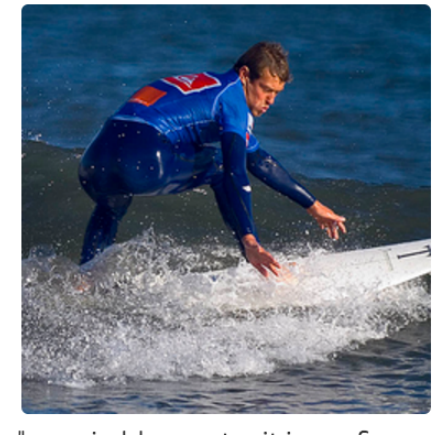
"girl in pink dress is jumping in air."



"black and white dog jumps over bar."

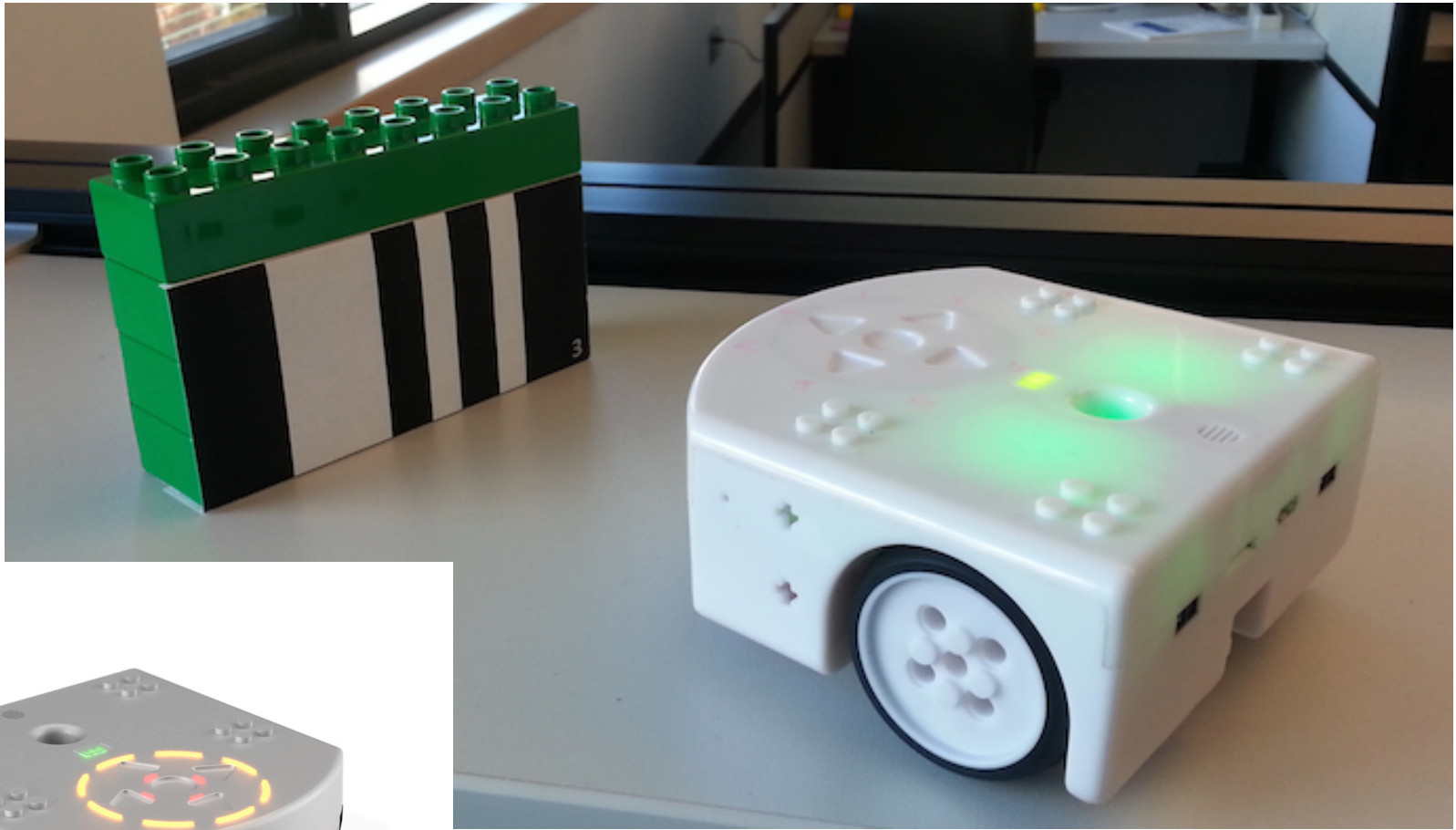


"young girl in pink shirt is swinging on swing."



"man in blue wetsuit is surfing on wave."

A simple 5 pixel infrared camera



A simple video recognition system

