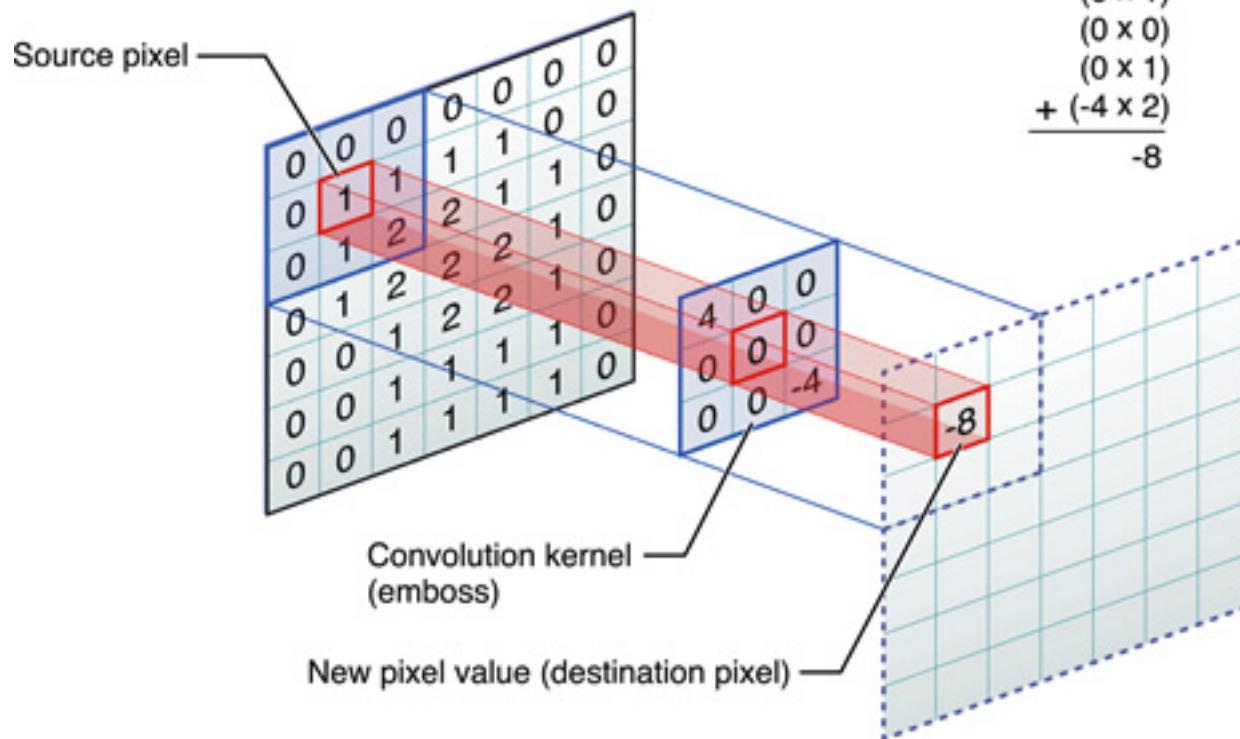
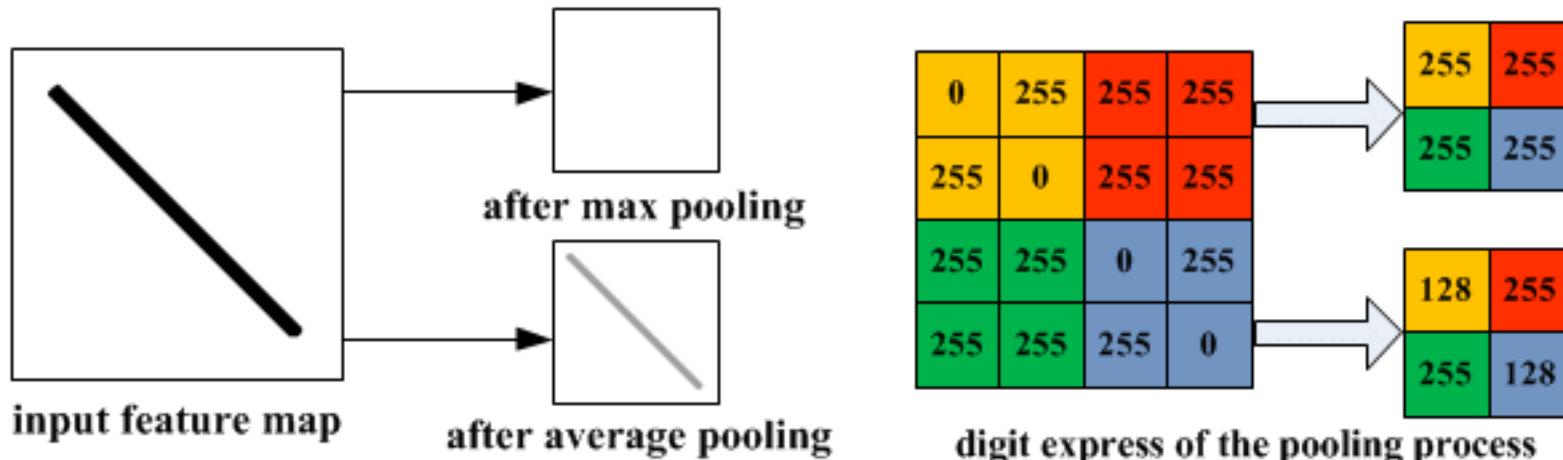


DMIA trends

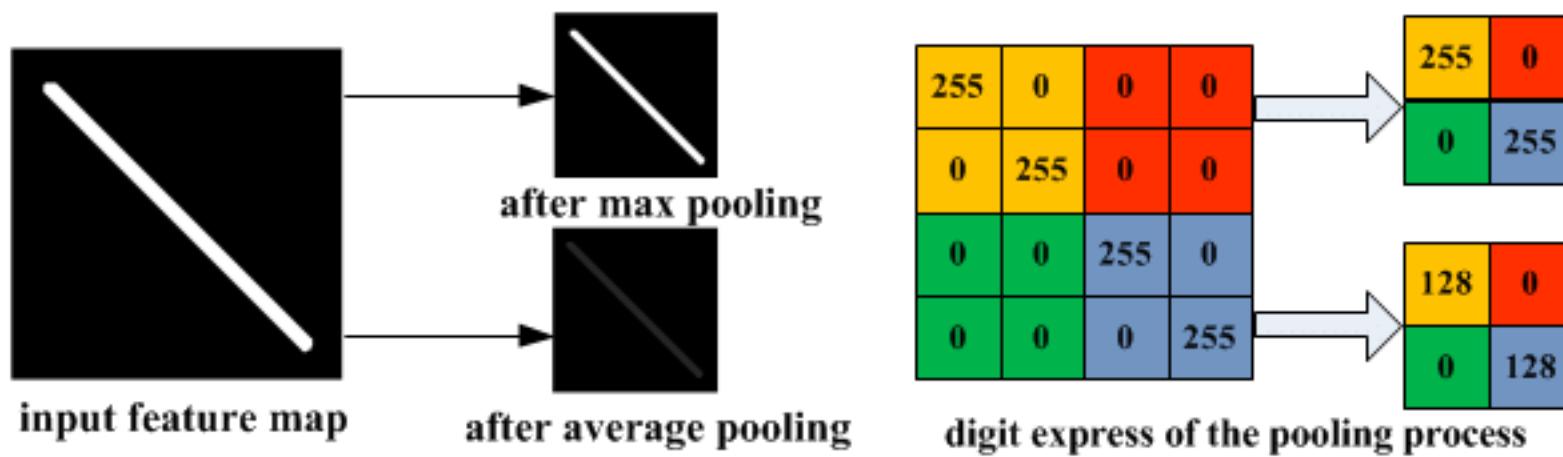
Convolution neural networks

Center element of the kernel is placed over the source pixel. The source pixel is then replaced with a weighted sum of itself and nearby pixels.

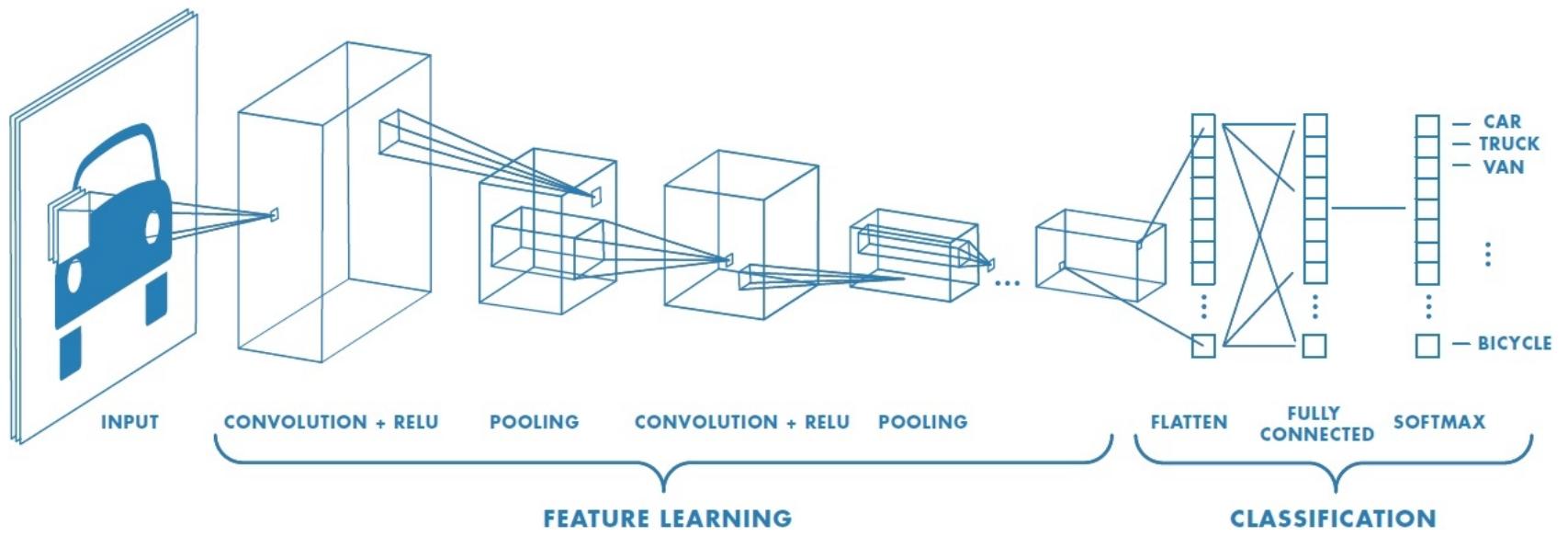




(a) Illustration of max pooling drawback



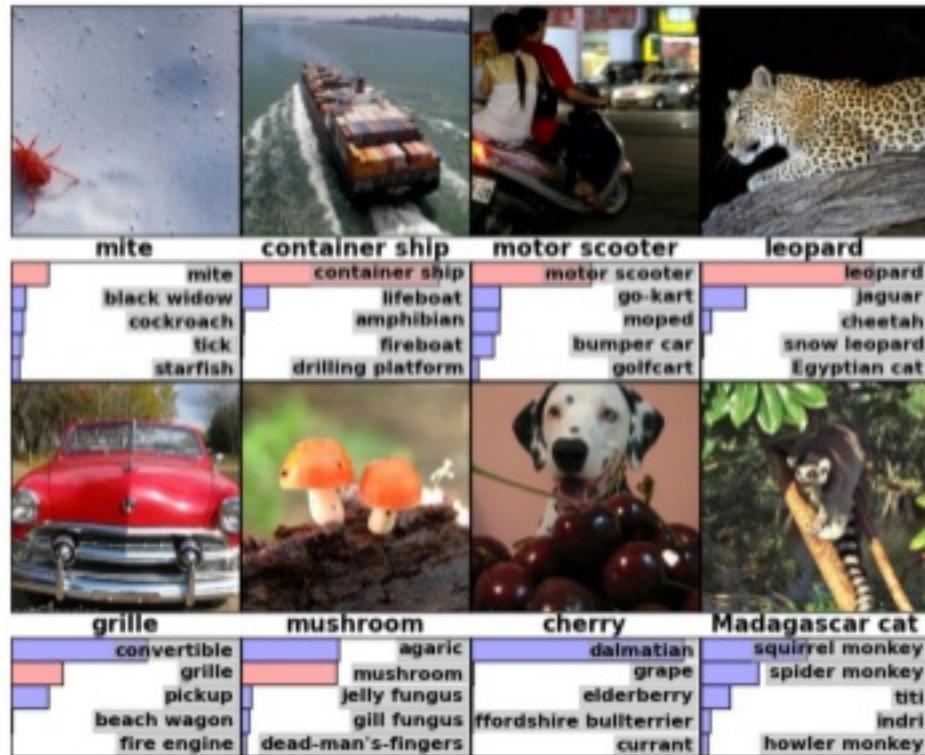
(b) Illustration of average pooling drawback



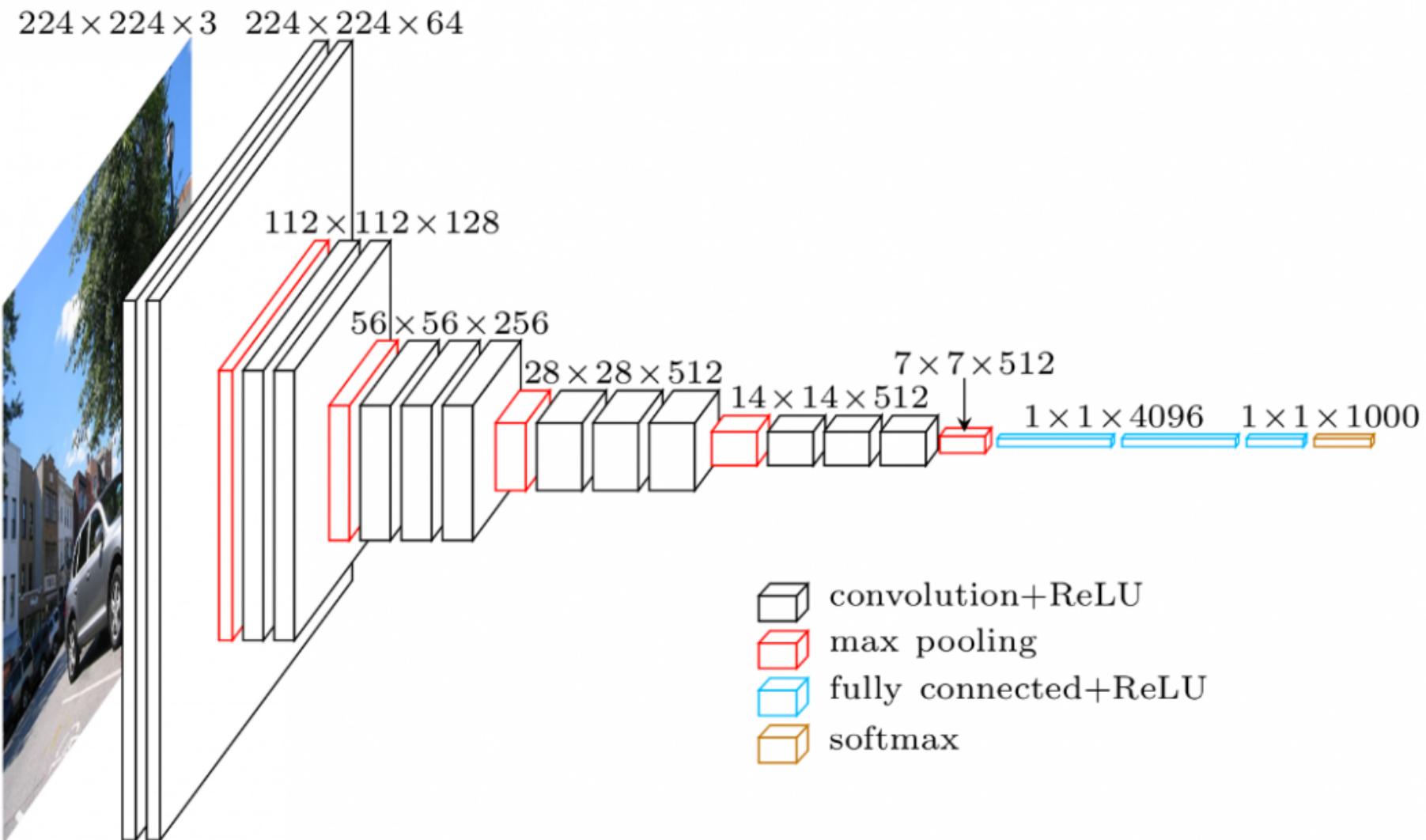
ImageNet Challenge

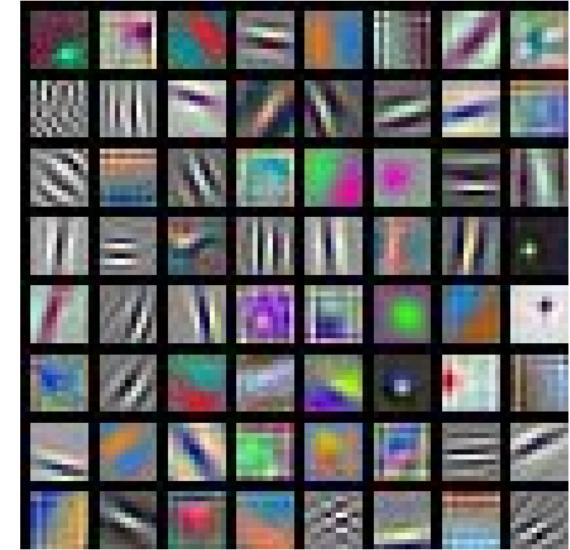
IMAGENET

- 1,000 object classes (categories).
- Images:
 - 1.2 M train
 - 100k test.

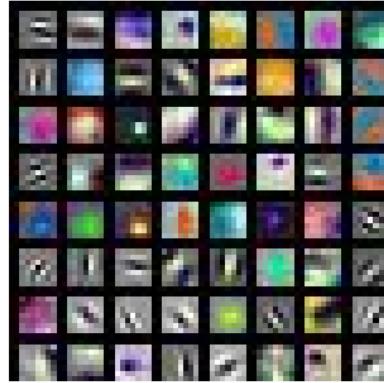


VGG16





AlexNet:
 $64 \times 3 \times 11 \times 11$



ResNet-18:
 $64 \times 3 \times 7 \times 7$

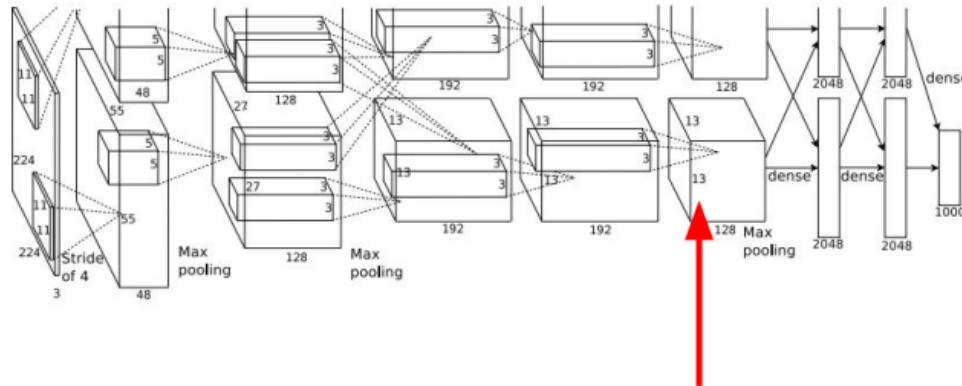


ResNet-101:
 $64 \times 3 \times 7 \times 7$



DenseNet-121:
 $64 \times 3 \times 7 \times 7$

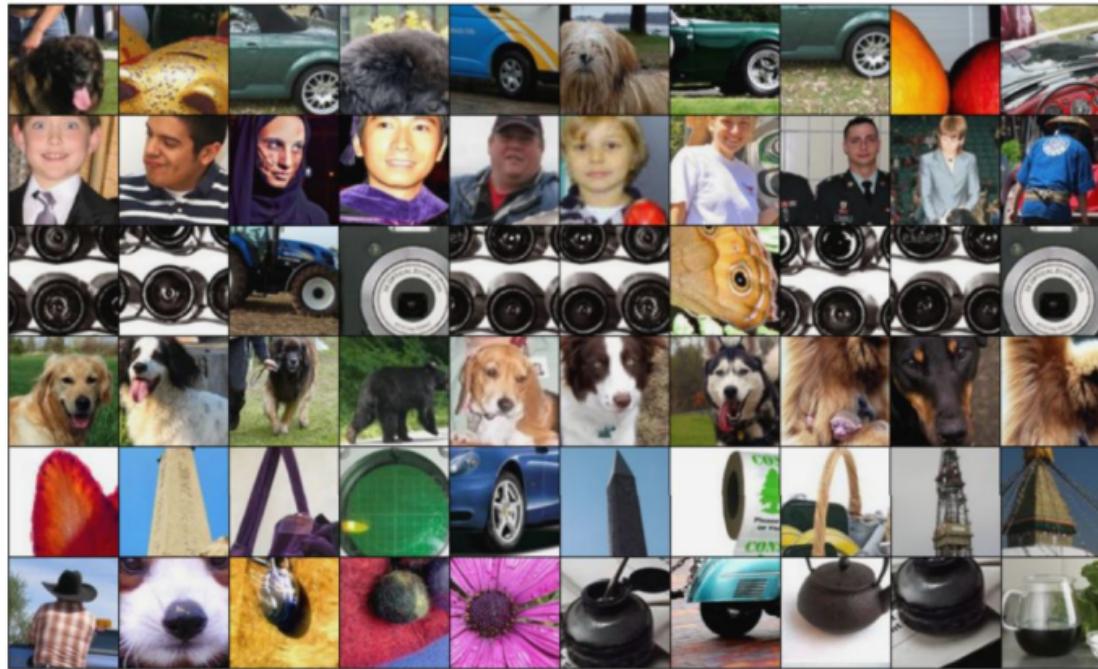
Maximally Activating Patches



Pick a layer and a channel; e.g. conv5 is $128 \times 13 \times 13$, pick channel 17/128

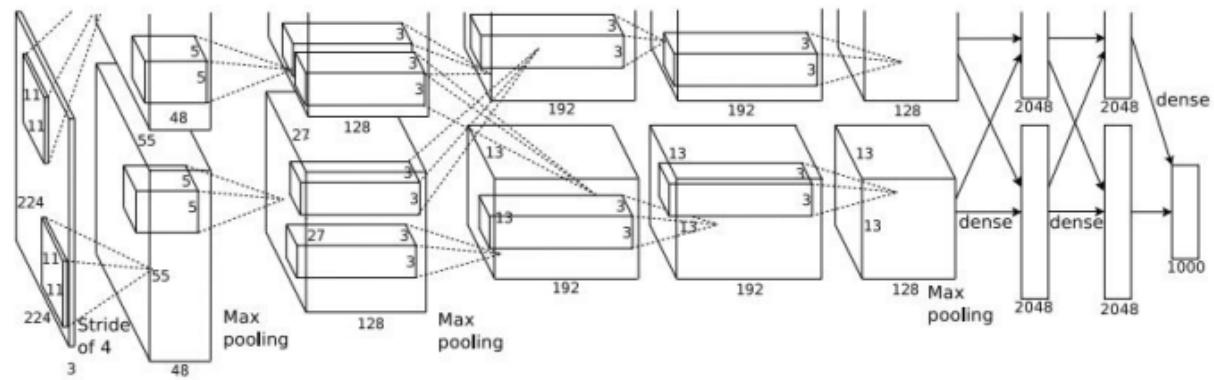
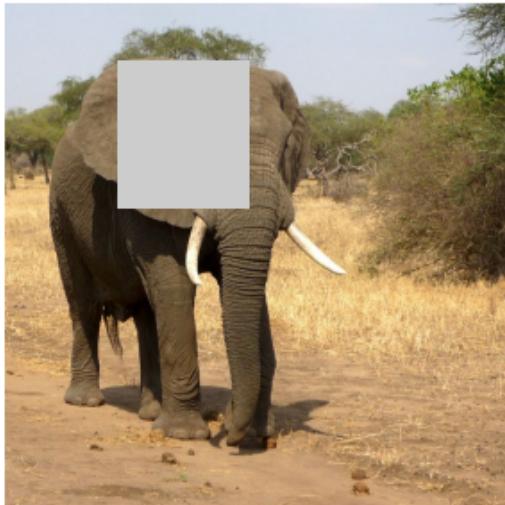
Run many images through the network,
record values of chosen channel

Visualize image patches that correspond
to maximal activations

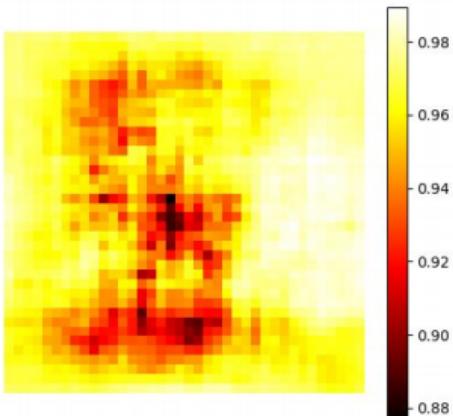


Occlusion Experiments

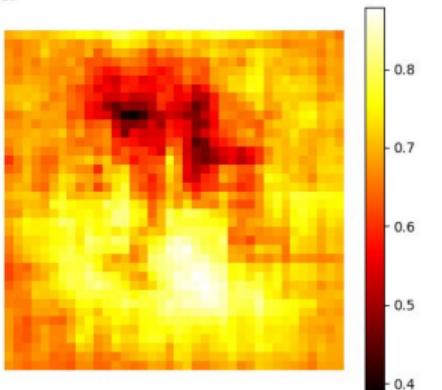
Mask part of the image before feeding to CNN, draw heatmap of probability at each mask location



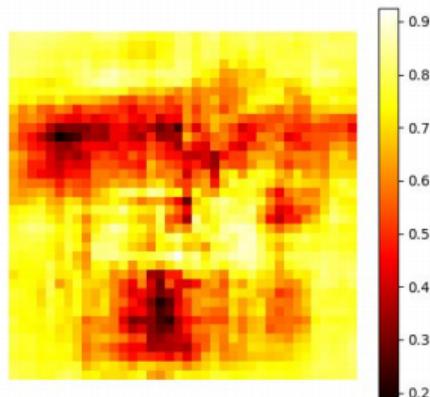
schooner



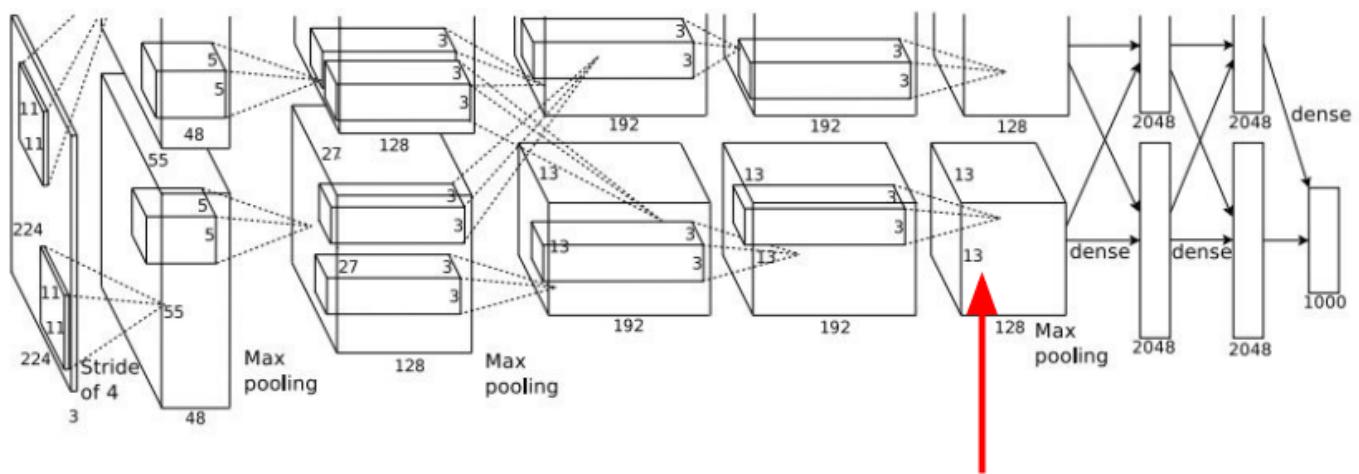
African elephant, *Loxodonta africana*



go-kart

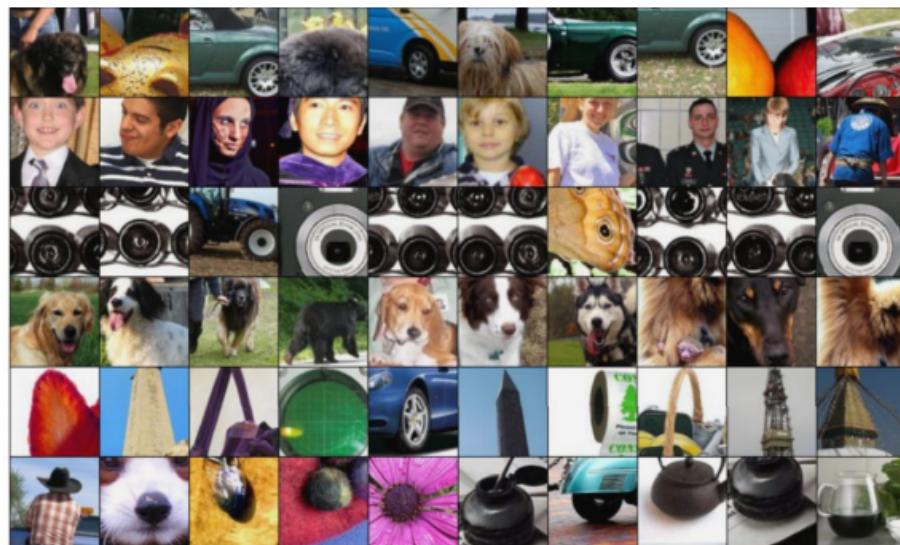
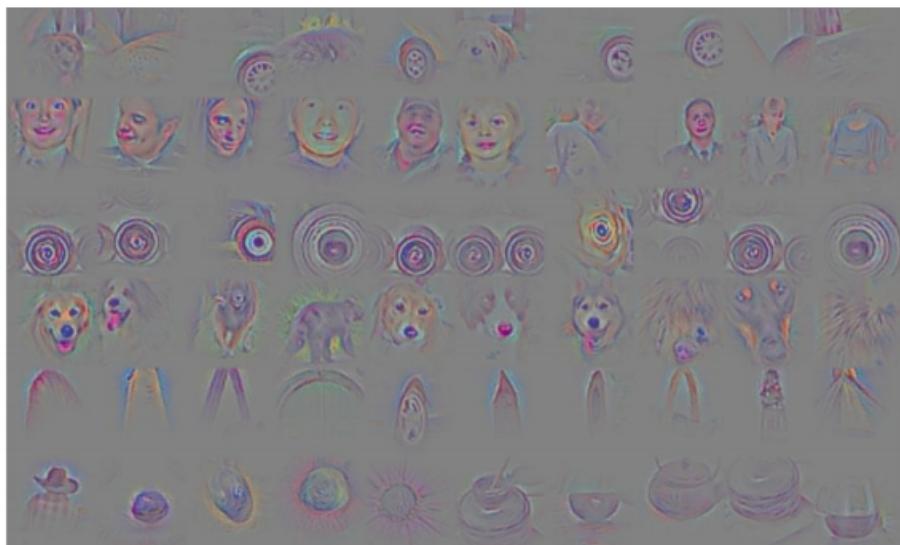


Intermediate Features via (guided) backprop



Pick a single intermediate neuron, e.g. one value in $128 \times 13 \times 13$ conv5 feature map

Compute gradient of neuron value with respect to image pixels



(Guided) backprop:

Find the part of an image that a neuron responds to

Gradient ascent:

Generate a synthetic image that maximally activates a neuron

$$I^* = \arg \max_I f(I) + R(I)$$

Neuron value

Natural image regularizer



$$\arg \max_I S_c(I) - \boxed{\lambda \|I\|_2^2}$$

Simple regularizer: Penalize L2
norm of generated image



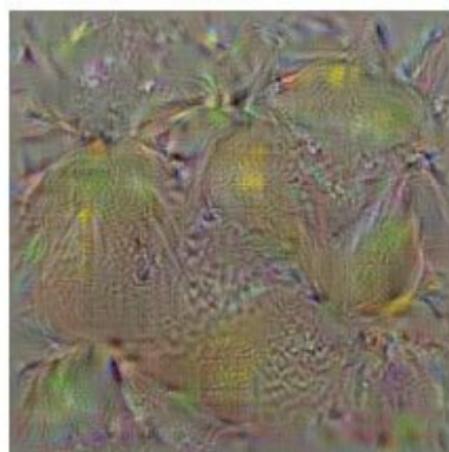
dumbbell



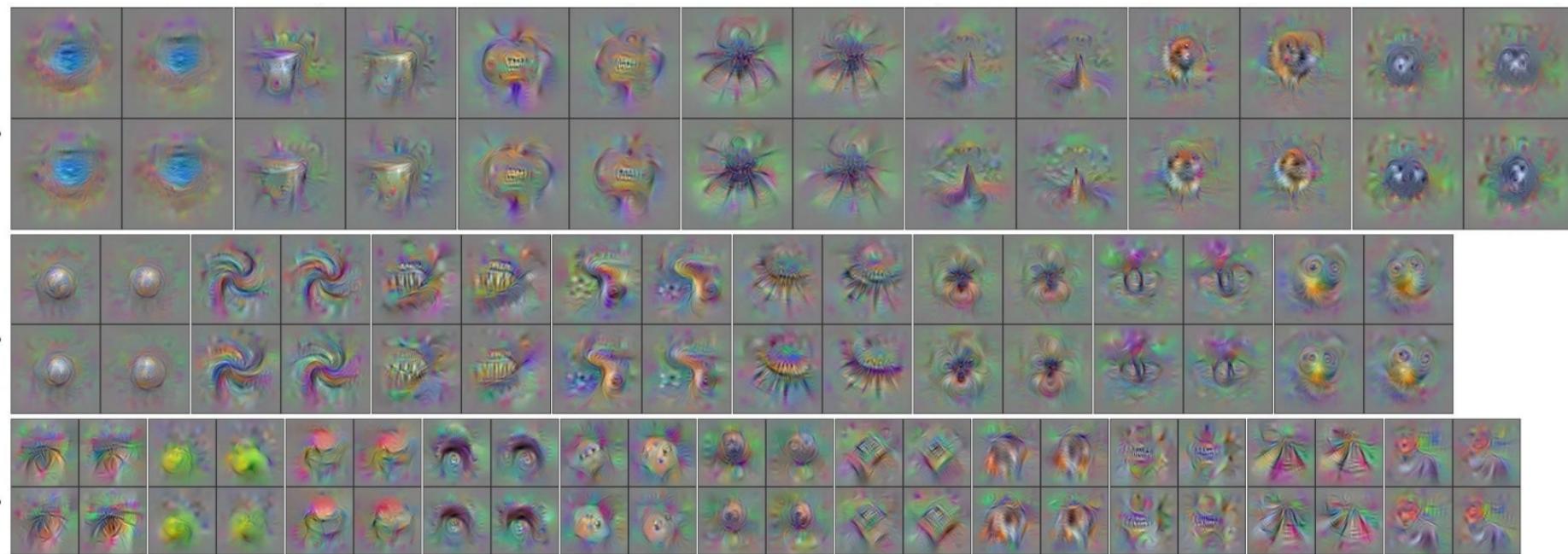
cup



bell pepper



lemon





bell pepper



cardoon



strawberry



orange



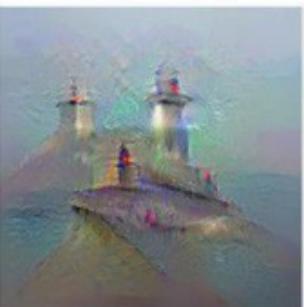
pineapple



beer bottle



birdhouse



breakwater



breastplate



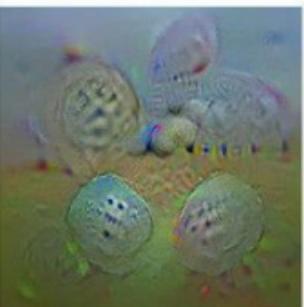
broom



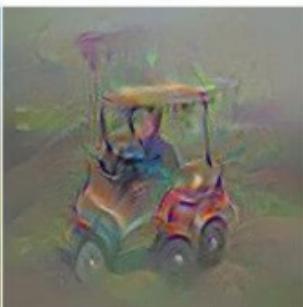
entertainment



gasmask



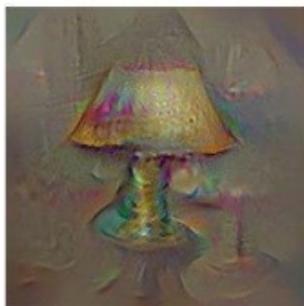
golf ball



golfcart



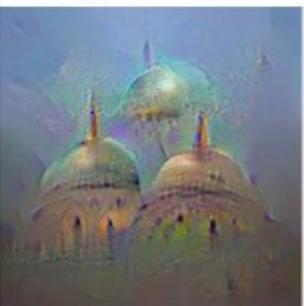
gown



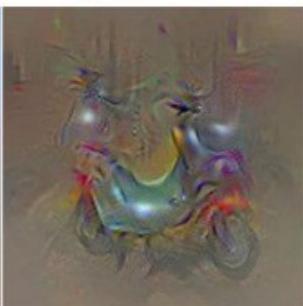
lampshade



monitor



mosque



motor scooter



pirate