



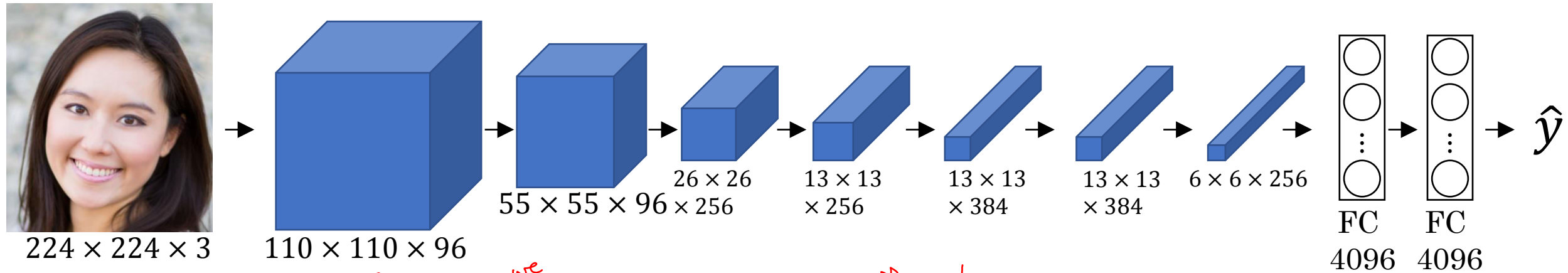
deeplearning.ai

# Neural Style Transfer

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What are deep  
ConvNets learning?

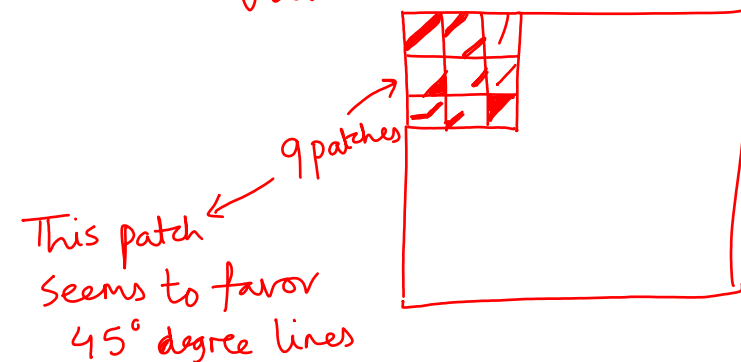
# Visualizing what a deep network is learning



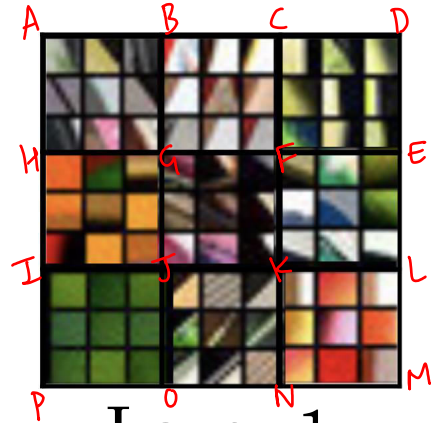
Pick a unit in layer 1. Find the nine image patches that maximize the unit's activation.

Repeat for other units.

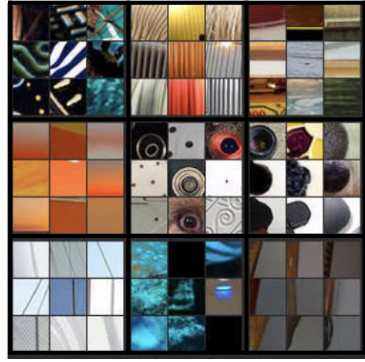
*Say we observe this hidden unit  
→ we feed it image patches as we pass through the filter w/ our strides  
→ we pick the 9 image patches that gives the highest Activation value*



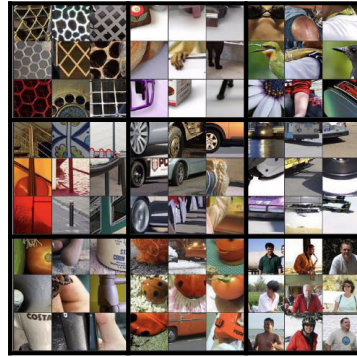
# Visualizing deep layers



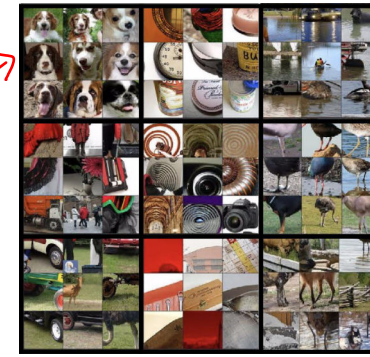
Layer 1



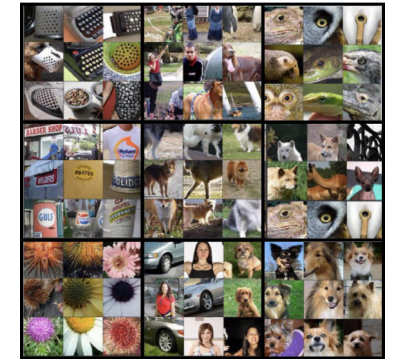
Layer 2



Layer 3



Layer 4



Layer 5

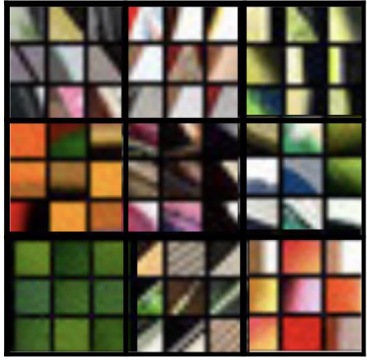
- ↓  
9 3x3 patches
- patch IJOP favors green color
  - patch GHIT favors orange color
  - patch CDEF favors vertical lines w/ some green coloring
  - patch ABGH favors 135° lines

Deeper layers see a larger patch of the image

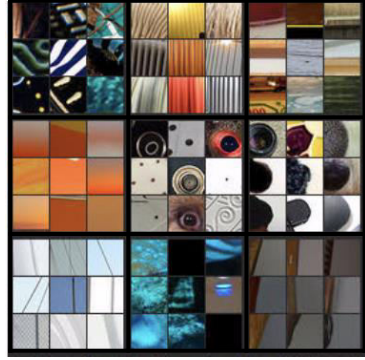
- like a face
- bird's lower body

★ Shows 9 hidden units in layer 2, each hidden unit has 9 image patches that the corresponding hidden unit saw that resulted in max activation

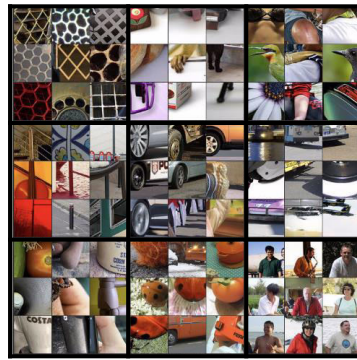
# Visualizing deep layers: Layer 1



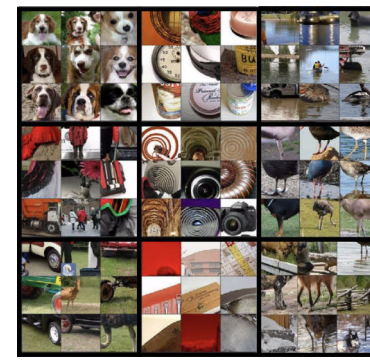
Layer 1



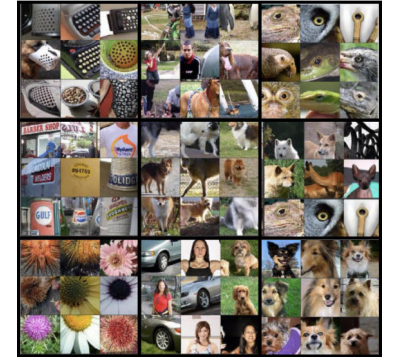
Layer 2



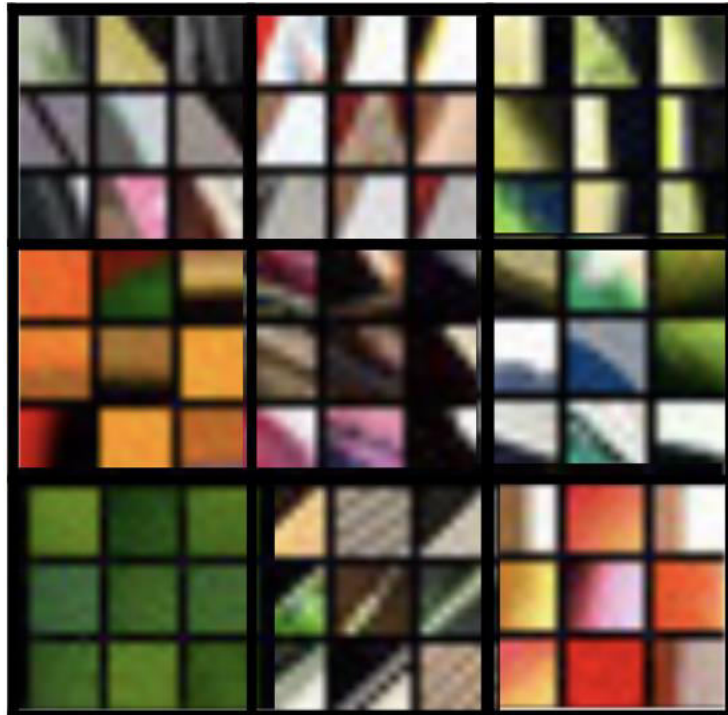
Layer 3



Layer 4

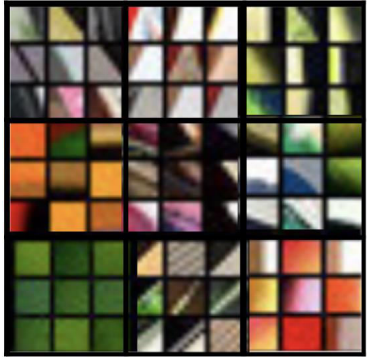


Layer 5

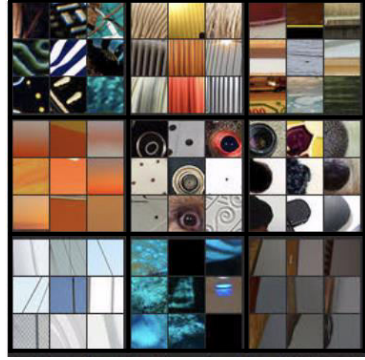




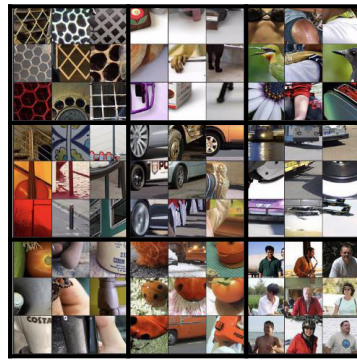
# Visualizing deep layers: Layer 2



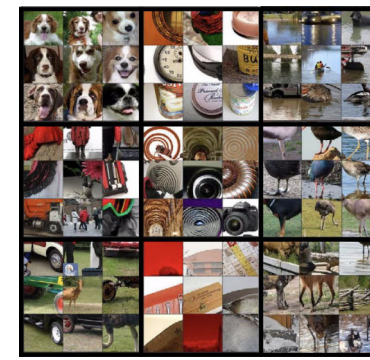
Layer 1



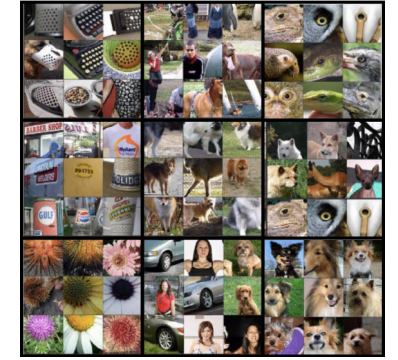
Layer 2



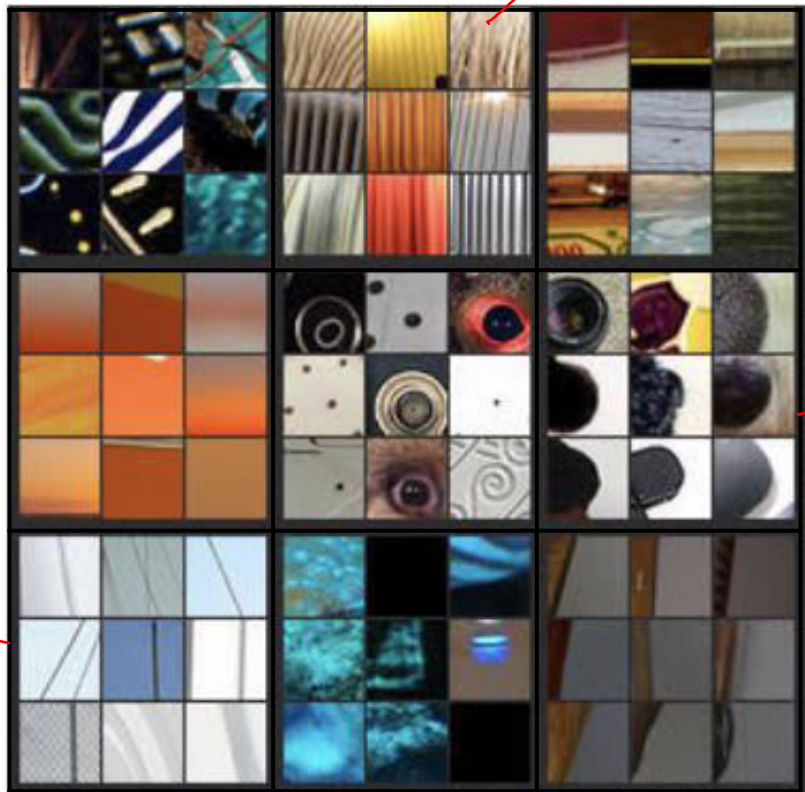
Layer 3



Layer 4



Layer 5

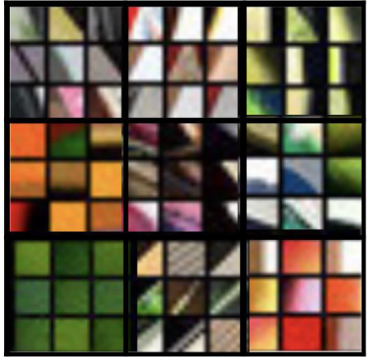


Looks for  
thin vertical  
lines

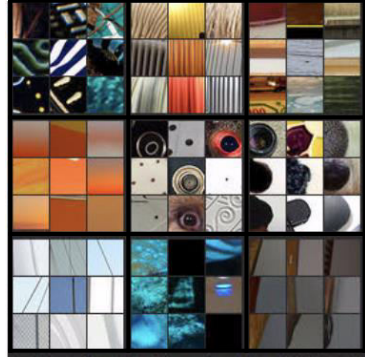
Looking for  
vertical lines

Looking for Rounded  
Images to the left

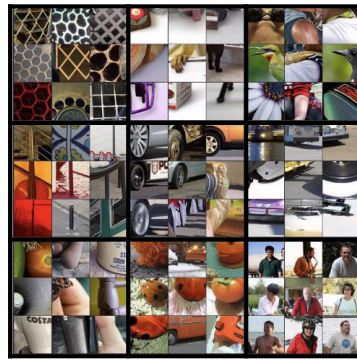
# Visualizing deep layers: Layer 3



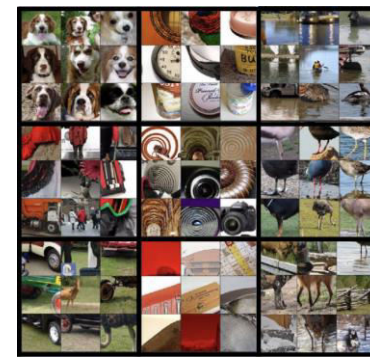
Layer 1



Layer 2



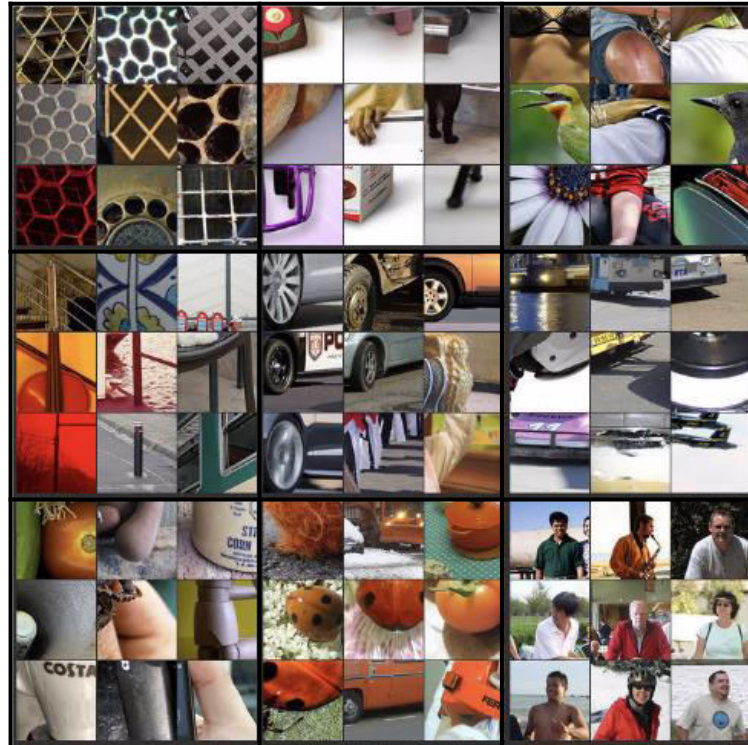
Layer 3



Layer 4



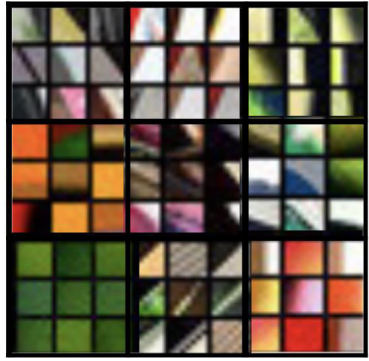
Layer 5





# Visualizing deep layers: Layer 3

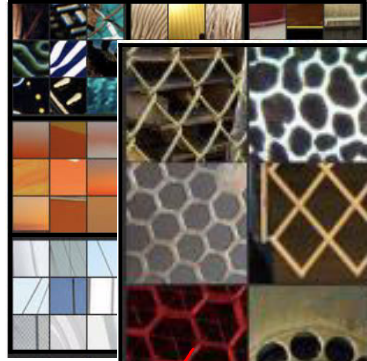
→ Looks for more complicated features w/rt. layer 1



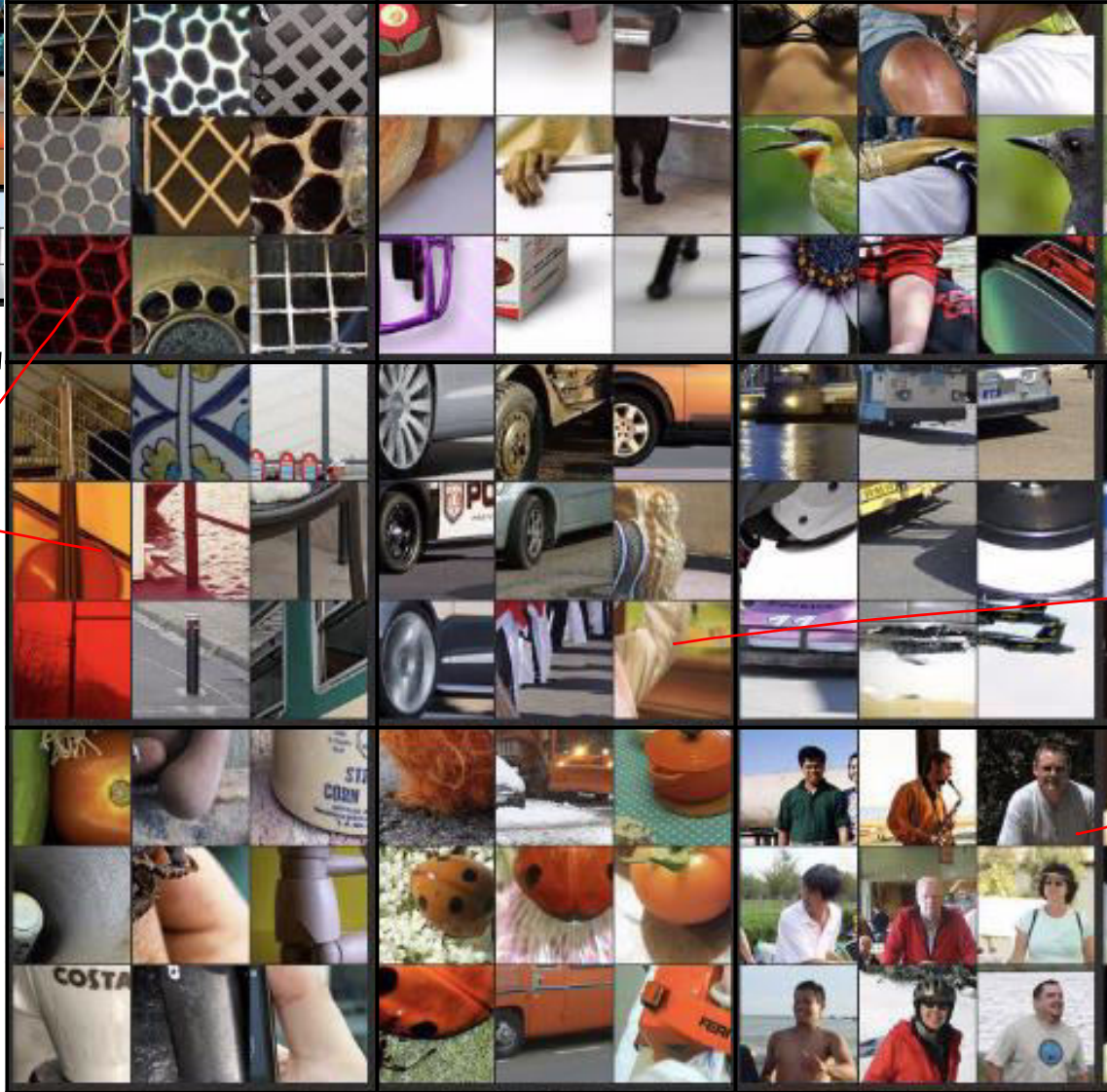
Layer 1

Looking for vertical line in the mid of the image

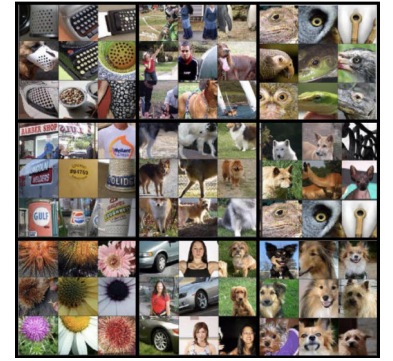
Looking for honey comb patterns



Layer 2



Layer 4



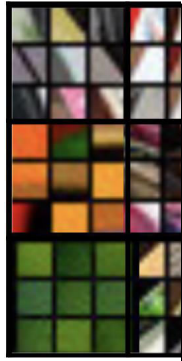
Layer 5

Looking for striped circles (wheels)

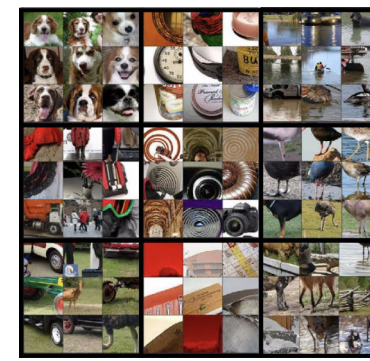
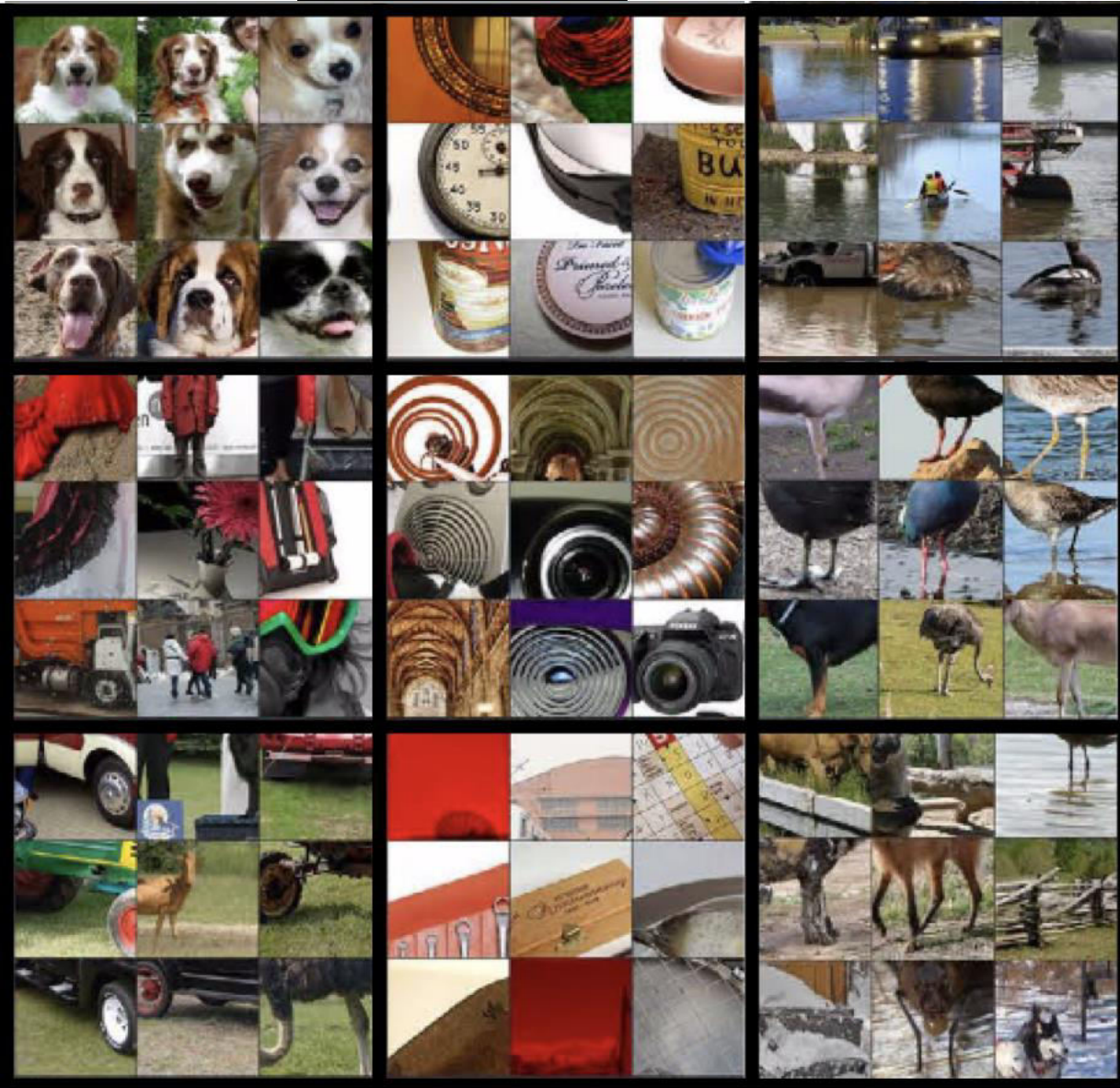
Looking for people's images



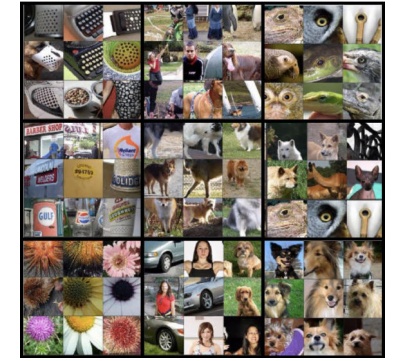
# Visualizing deep layers: Layer 4



Layer 4



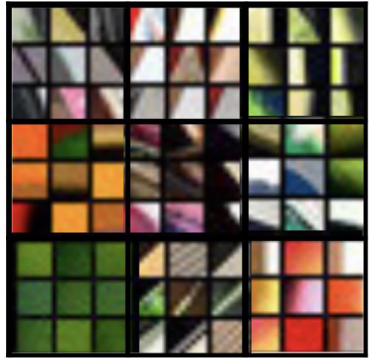
Layer 4



Layer 5



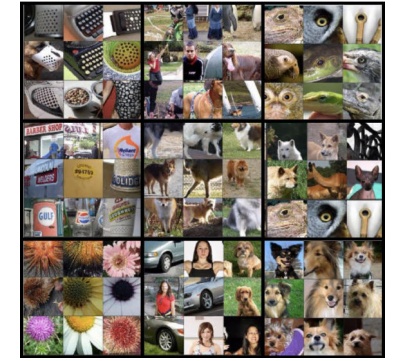
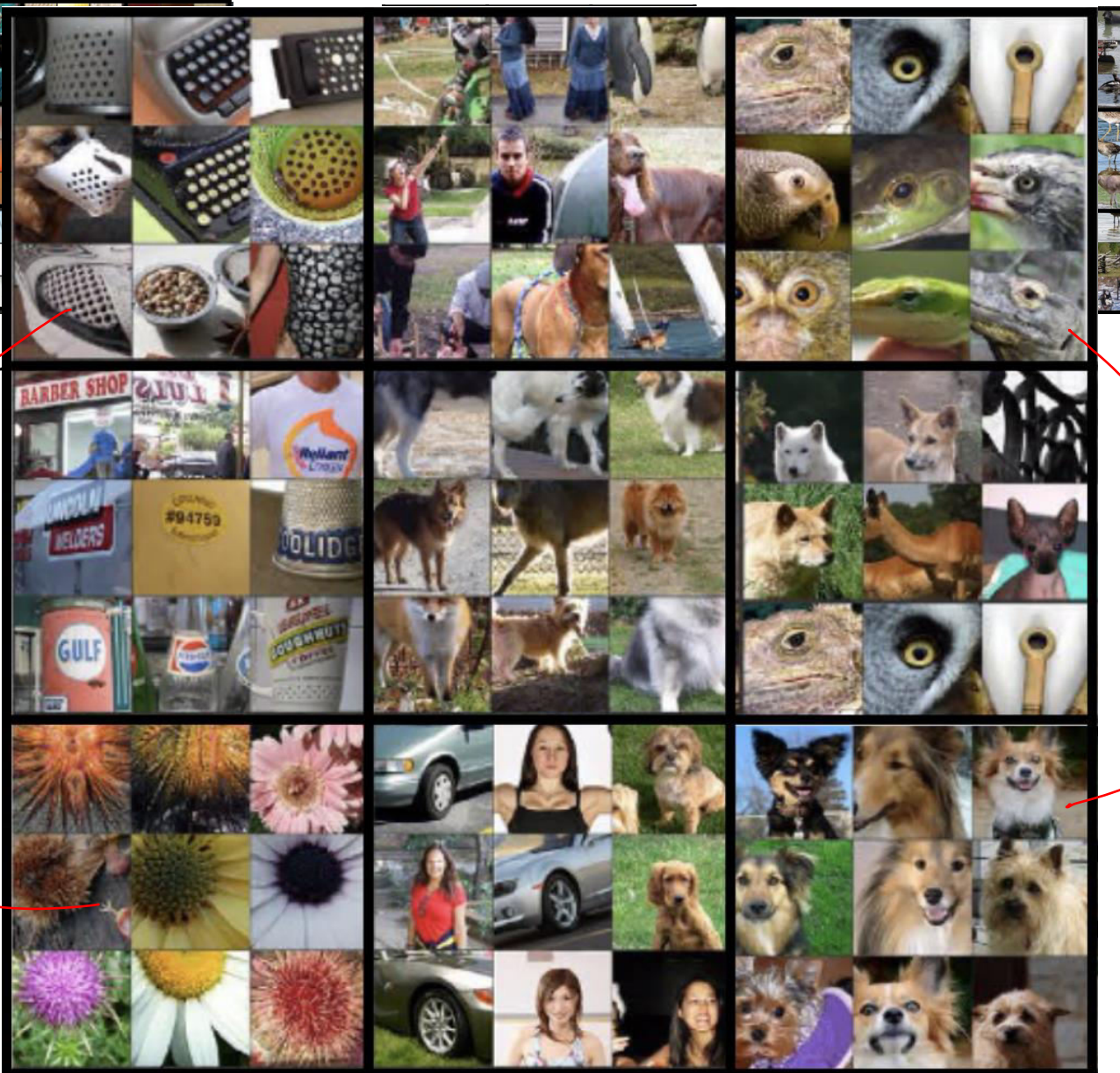
# Visualizing deep layers: Layer 5



Layer 1



Layer 1



Layer 5

Detects Images  
w/ Lots of "Dots"

Detects  
flowers

Detects eyes

Dog face