Generative Adversarial Networks (GANs), Nnet Visualization

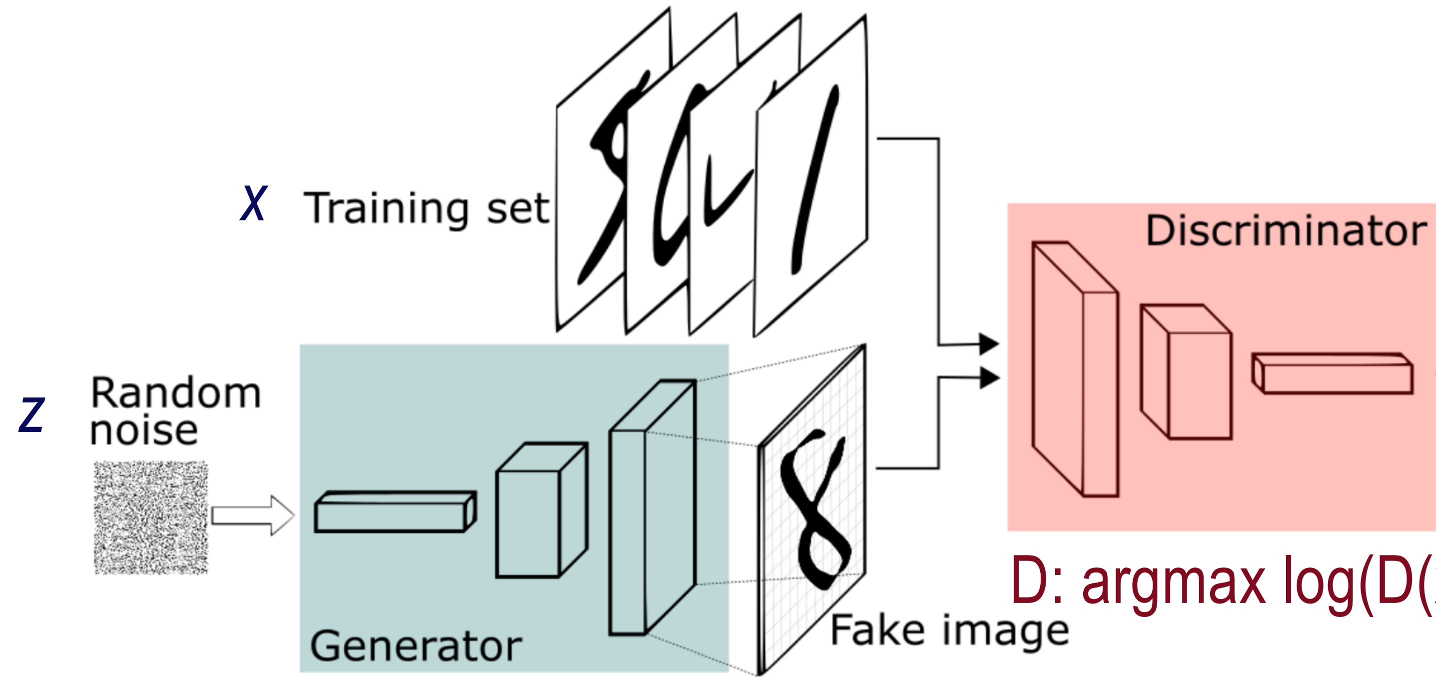
Lyle Ungar

GANS
Conditional GANS
Visualization for NNets

These are …

https://sites.google.com/view/cvpr2018tutorialongans/

Generative Adversarial Networks: GANs



D: argmax log(D(x))+ log(1 − D(G(z)))

G: argmin log(1 − D(G(z)))

https://medium.freecodecamp.org/
an-intuitive-introduction-to-

$$\min_G \max_D V(D,G) = \mathbb{E}_{\boldsymbol{x}\sim p_{\text{data}}(\boldsymbol{x})}[\log D(\boldsymbol{x})] + \mathbb{E}_{\boldsymbol{z}\sim p_{\boldsymbol{z}}(\boldsymbol{z})}[\log(1 - D(G(\boldsymbol{z})))]$$

GANs

- **Make generative model, *G*, close to data PDF**

$$\boldsymbol{\theta}^* = \arg\min_{\boldsymbol{\theta}} D_{\mathrm{KL}}\left(p_{\mathrm{data}}(\boldsymbol{x}) \| p_{\mathrm{model}}(\boldsymbol{x};\boldsymbol{\theta})\right) \quad = \quad E(\Sigma\ p_{data} \log(p_{model}/p_{data})$$

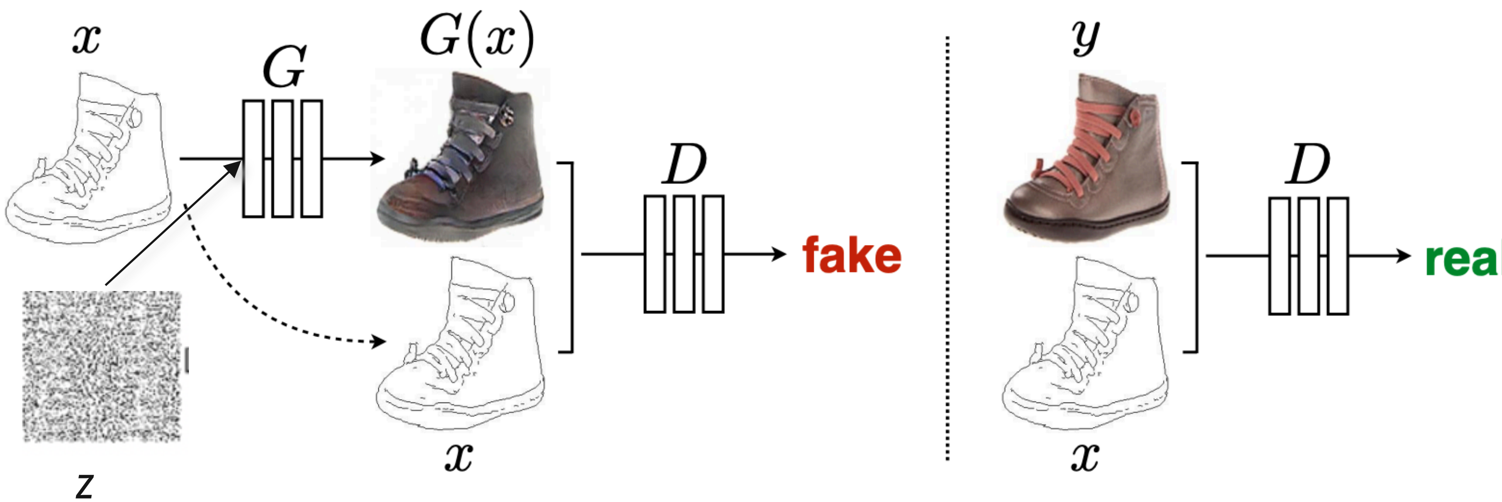
- **For actual data this is the MLE:**

$$\begin{aligned}
\boldsymbol{\theta}^* &= \arg\max_{\boldsymbol{\theta}} \prod_{i=1}^{m} p_{\mathrm{model}}\left(\boldsymbol{x}^{(i)};\boldsymbol{\theta}\right) \\
&= \arg\max_{\boldsymbol{\theta}} \log \prod_{i=1}^{m} p_{\mathrm{model}}\left(\boldsymbol{x}^{(i)};\boldsymbol{\theta}\right) \\
&= \arg\max_{\boldsymbol{\theta}} \sum_{i=1}^{m} \log p_{\mathrm{model}}\left(\boldsymbol{x}^{(i)};\boldsymbol{\theta}\right) \qquad E(\Sigma\ p_{data} \log(p_{model}/p_{data})
\end{aligned}$$

GANs Training

- **Training can be slow and unstable**
  - Better convergence if you alternately train discriminator and generator

Conditional GANS for Image Translation (outline to photo)



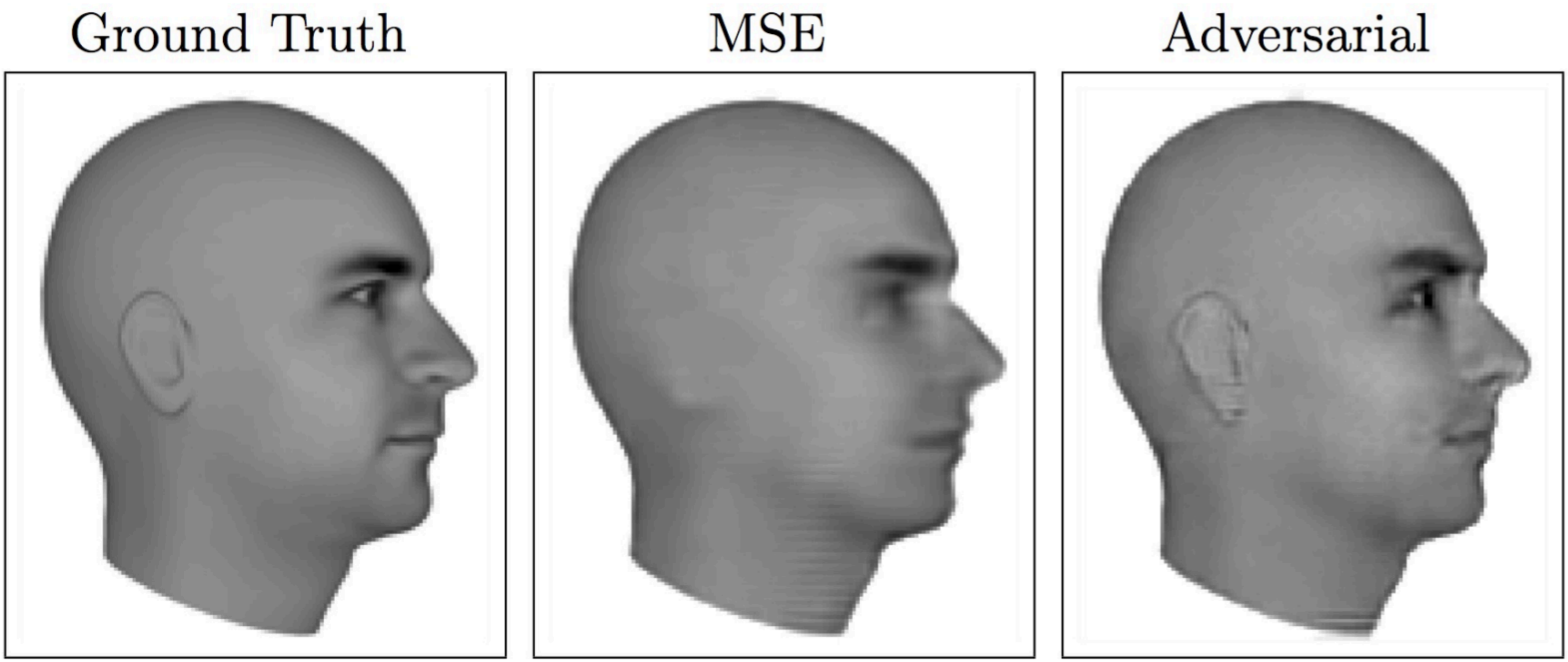
$$\min_G \max_D V(D,G) = \mathbb{E}_{x,y}[\log D(x,y)] + \mathbb{E}_{x,z}[\log(1 - D(x, G(x,z)))]$$

https://arxiv.org/pdf/1611.07004.pdf

GANs: Image translation

https://arxiv.org/pdf/1701.00160.pdf
Isola et al. (2016)

GANs: Predict next video frame

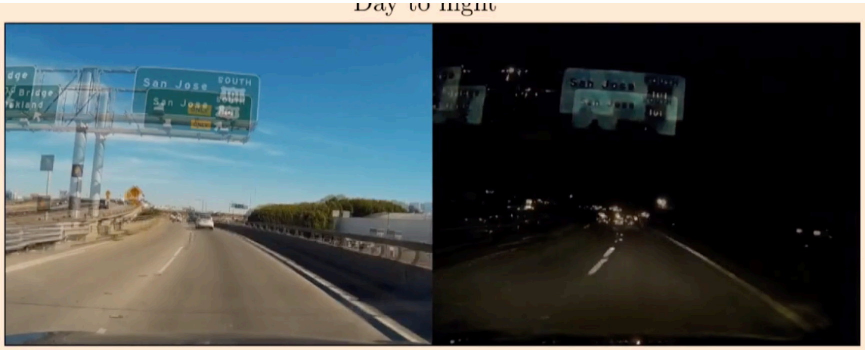


https://arxiv.org/pdf/1701.00160.pdf
Lotter et al. 2015

GANs: Image translation

- Summer to winter
- Sketch to photo
- Low resolution to high resolution photo
- Young to old
- Photo to impressionist painting

Day to night



(Liu et al., 2017)

https://www.youtube.com/watch?time_continue=3704&v=AJJRWFVfNPg

Questions?

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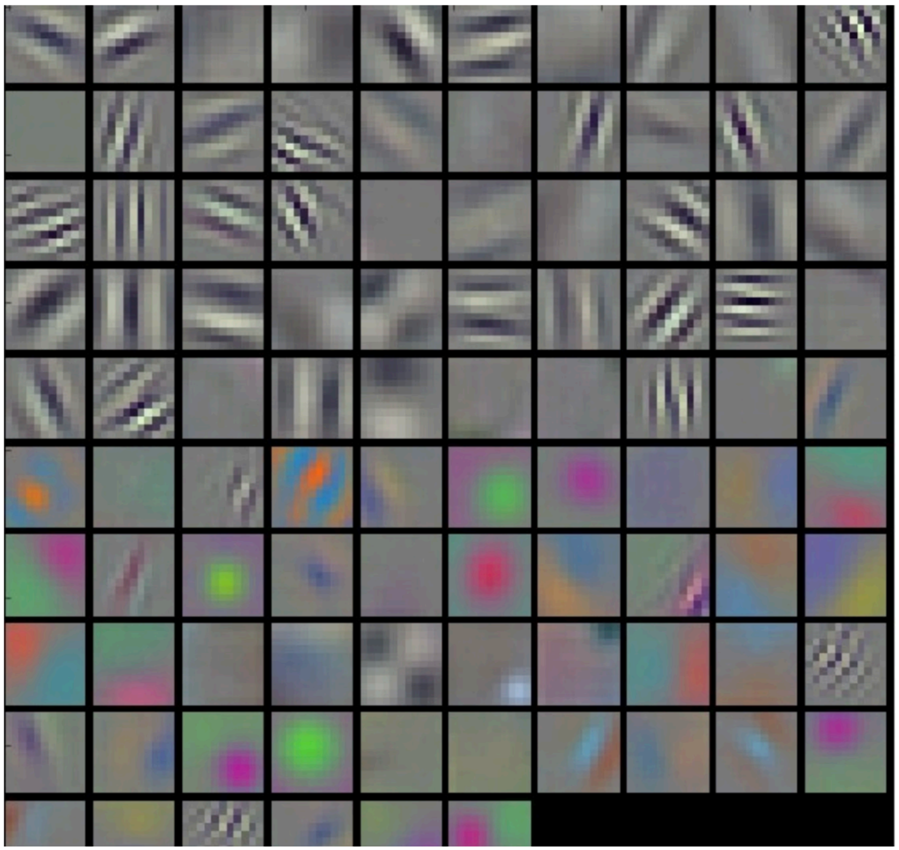
Visualizing networks

- **Display pattern of hidden unit activations**
  - Just shows they are sparse
- **Show input that maximizes a node's output**
  - Over all inputs in the training set
  - Over the entire range of possible inputs
  - Early layers do feature detection
  - Later layers do object detection
- **Show how occluding parts of an image affect classification accuracy**

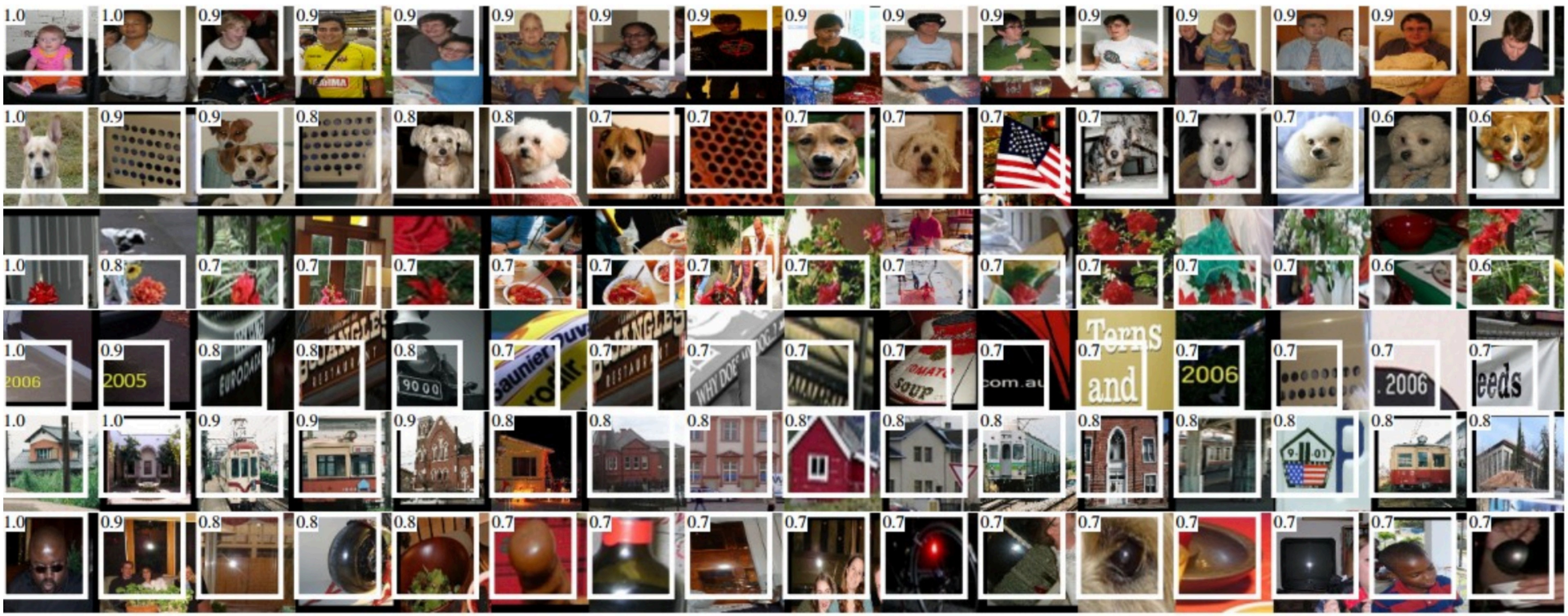
http://cs231n.github.io/understanding-cnn/

Maximally activating inputs for the first CONV layer of an AlexNet

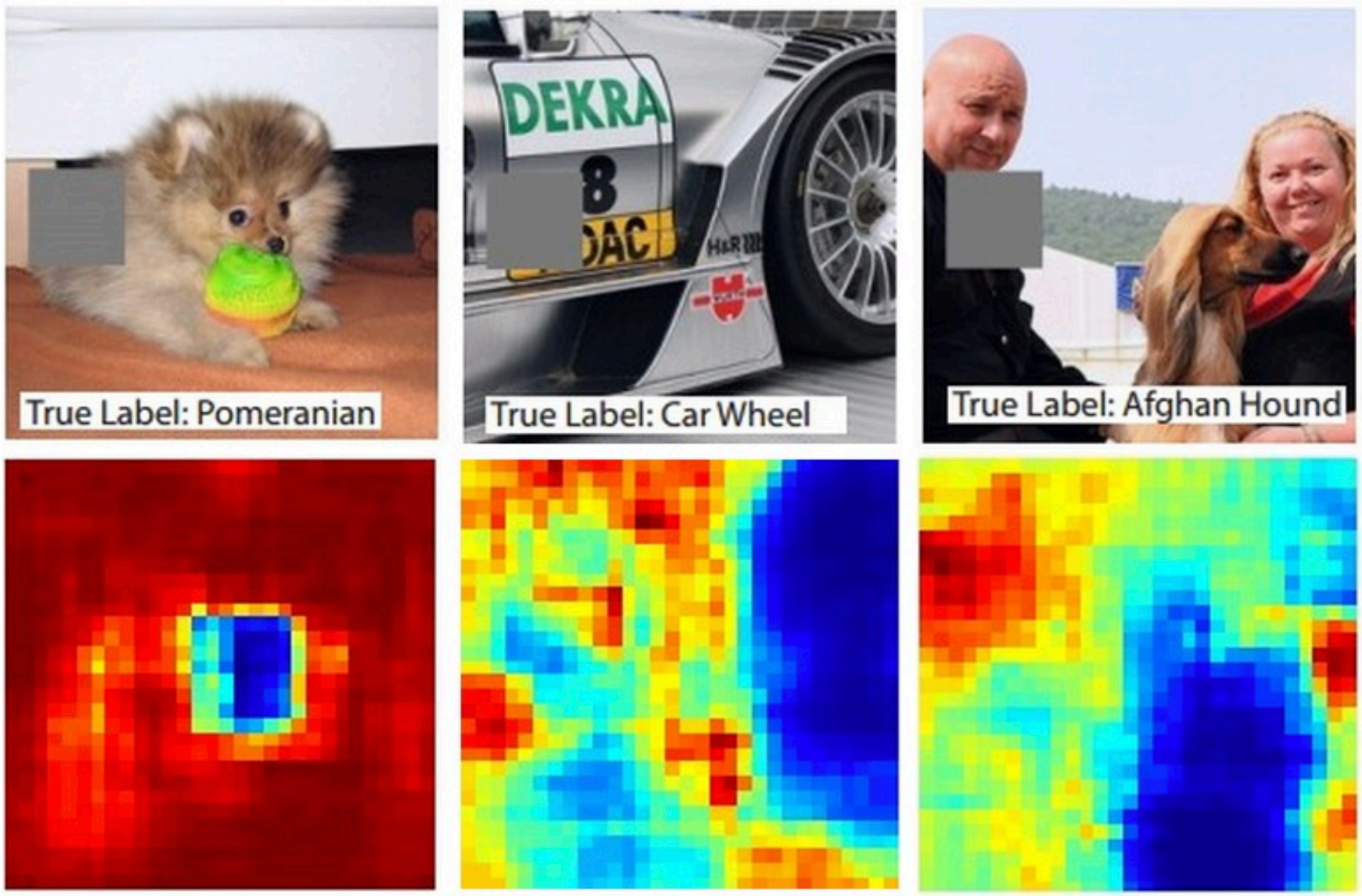


http://cs231n.github.io/understanding-cnn/

Maximally activating images for some 5th maxpool layer neurons of an AlexNet.



P(correct label) after occlusion



Matthew Zeiler's
Visualizing and Understanding Convolutional Networks:

You should know

- **GANS and conditional GANS**
  - What goes in, what comes out, loss function
  - Generative, not discriminative
- **Visualization of Nnets**
  - Which input (over real images or over all possible inputs) maximizes the output of (‘excites’) a neuron.
  - Sensitivity of prediction to occlusion

Questions?

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