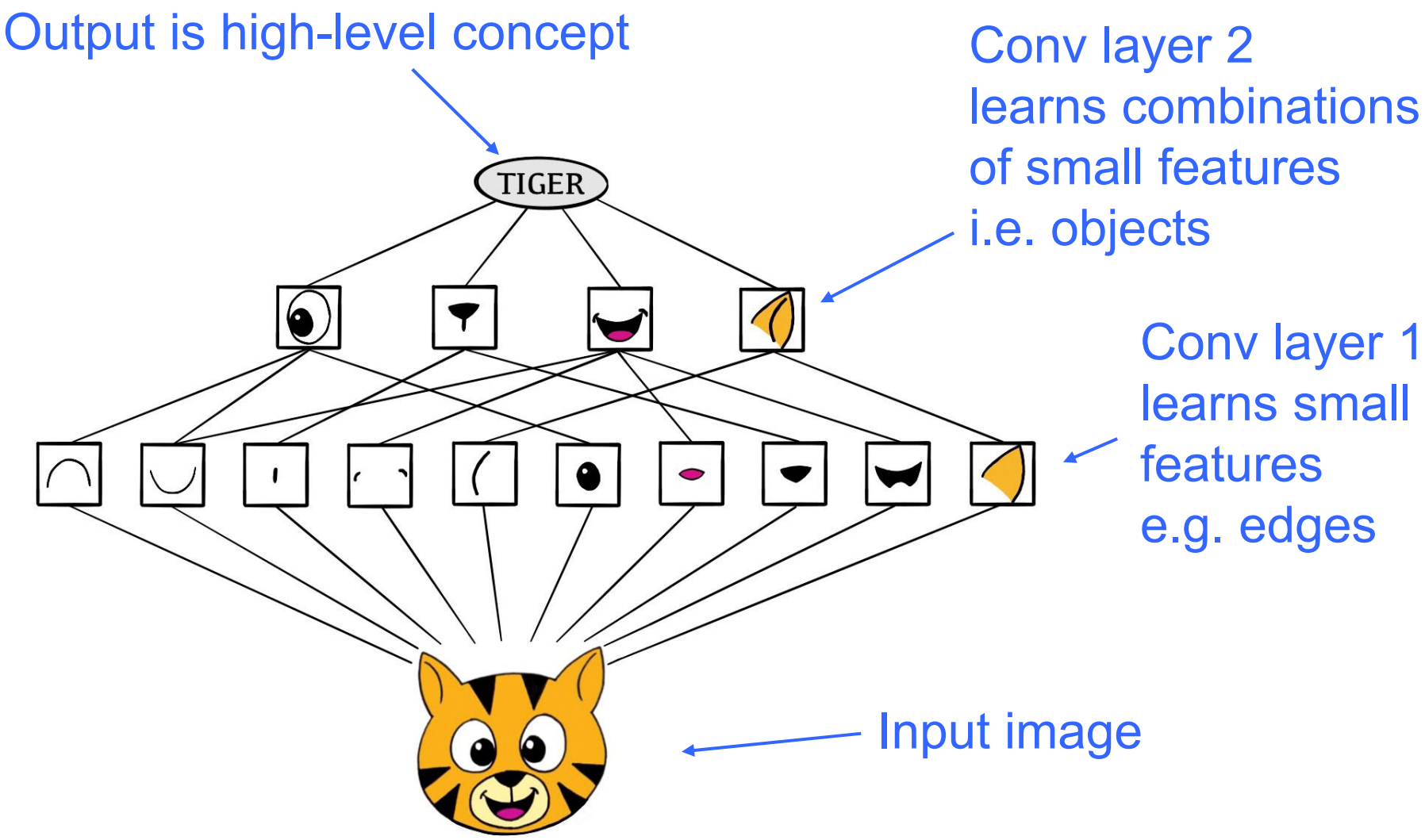
Today

- Neural networks and deep learning
  - Single layer neural networks
    - using keras package
    - architectures for different questions
      - regression, classification, multifunction
  - Multi-layer neural networks
  - Convolutional neural networks
  - Recurrent neural networks
    - self study

deep

Convolutional NNs



Convolutional NNs

- Example: CIFAR100
  - standard benchmark dataset: 100 categories
  - ecology subset: 61 categories
- 08_3_convolutional_nnet.R

Convolution layer

Input image matrix $\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \\ j & k & l \end{bmatrix}$

Convolution filter $\begin{bmatrix} \alpha & \beta \\ \gamma & \delta \end{bmatrix}$

convolve

Output matrix $\begin{bmatrix} a\alpha + b\beta + d\gamma + e\delta & b\alpha + c\beta + e\gamma + f\delta \\ d\alpha + e\beta + g\gamma + h\delta & e\alpha + f\beta + h\gamma + i\delta \\ g\alpha + h\beta + j\gamma + k\delta & h\alpha + i\beta + k\gamma + l\delta \end{bmatrix}$

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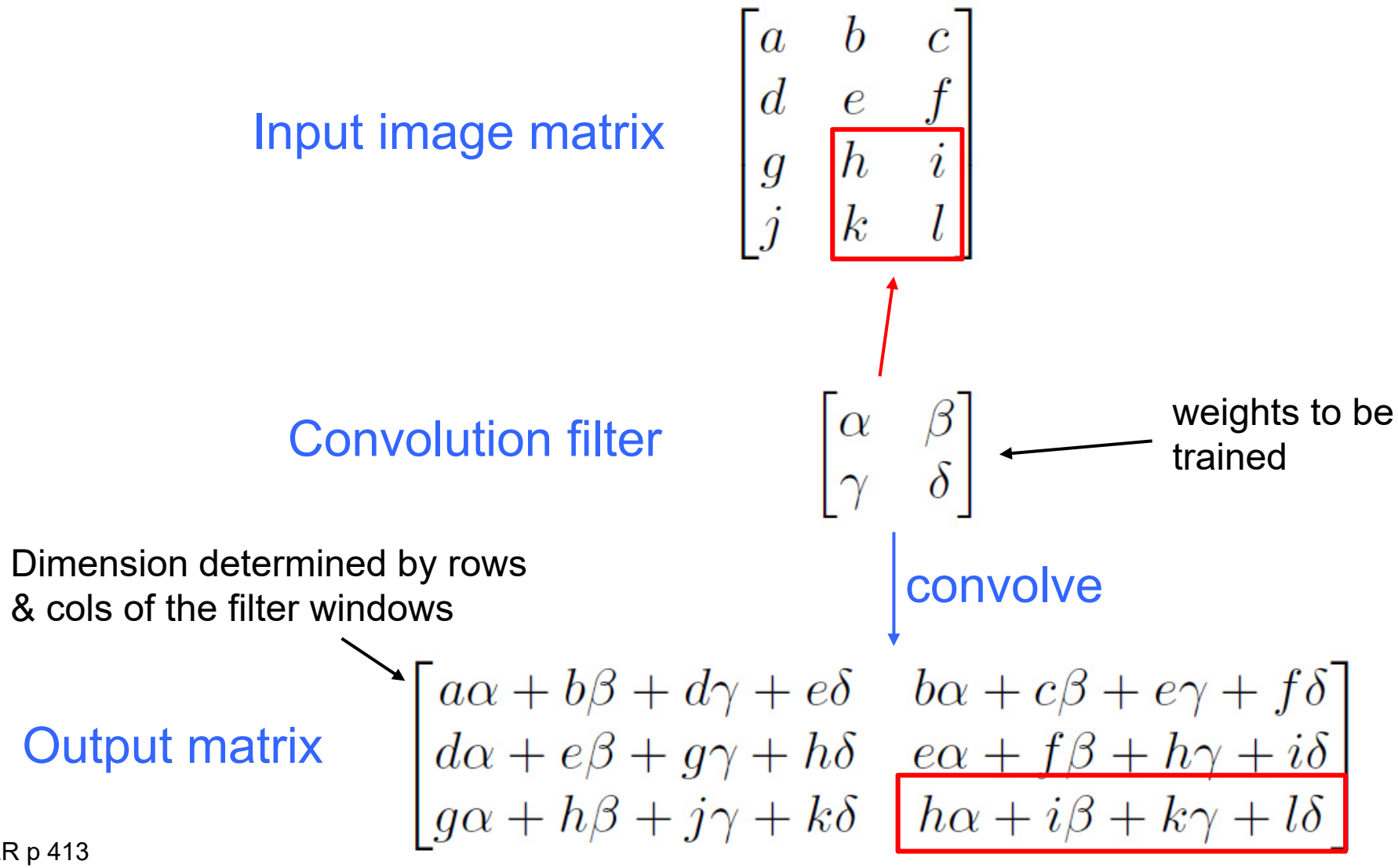
Convolution layer



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Convolution layer

input image filter convolved image

vertical features

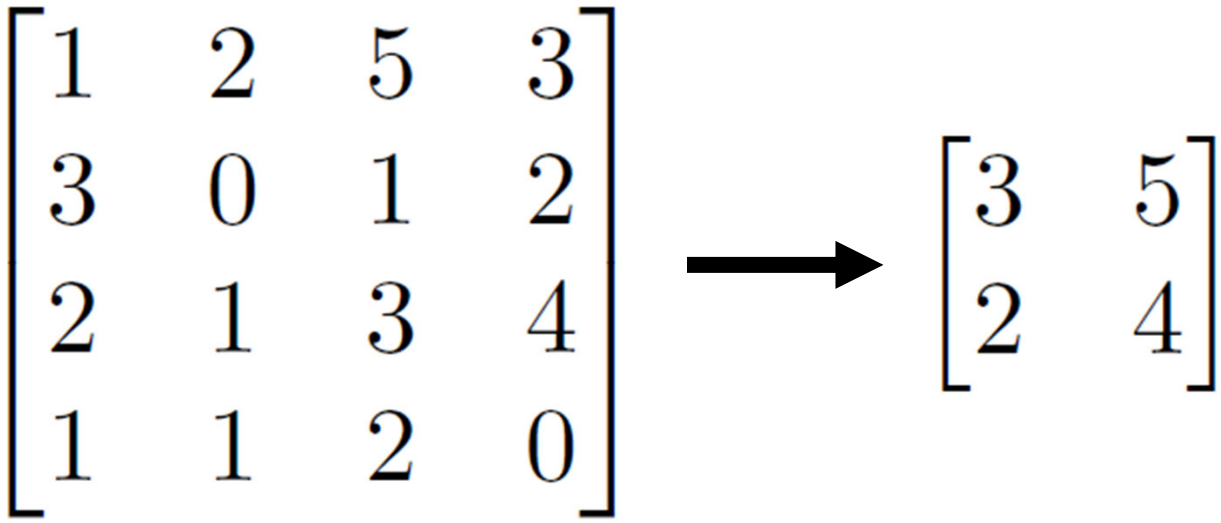
horizontal features

filters highlight local features

Pooling layer

Condenses information

e.g. “Max pooling”



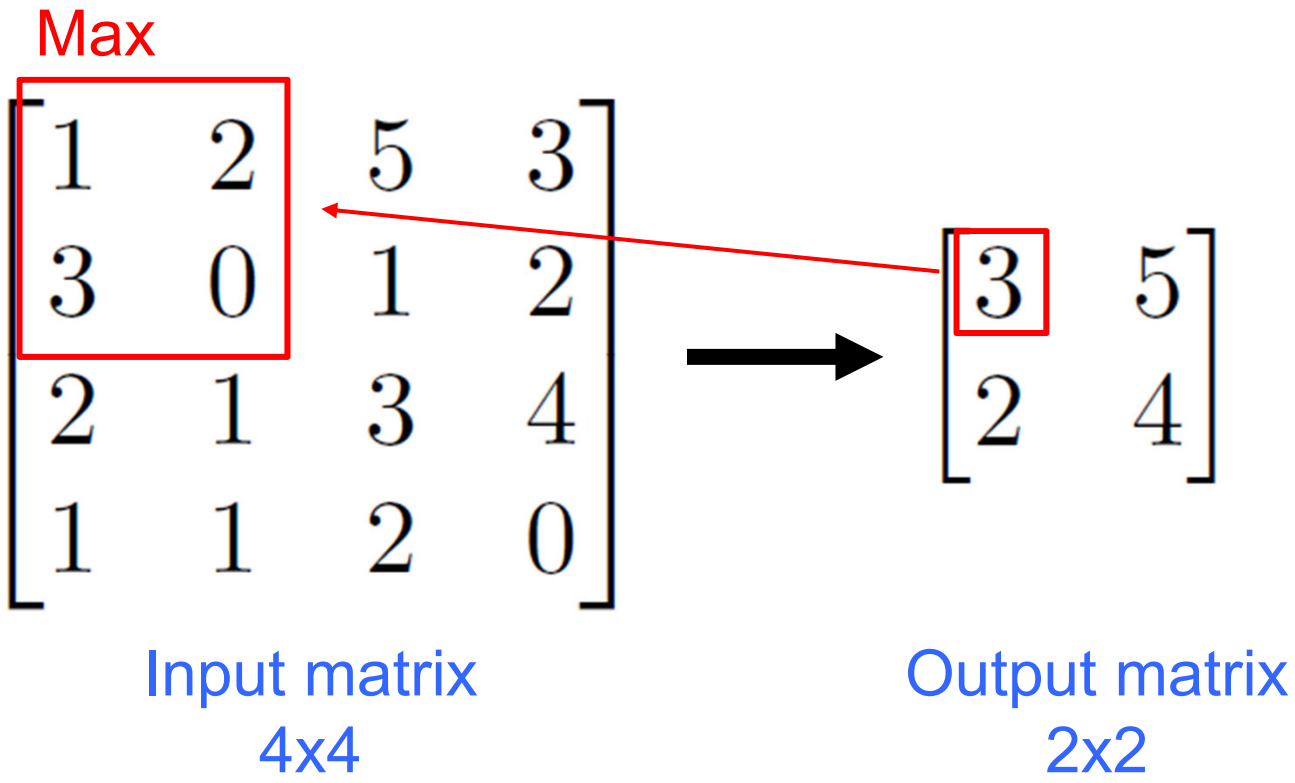
Input matrix
4x4

Output matrix
2x2

Pooling layer

Condenses information

e.g. “Max pooling”



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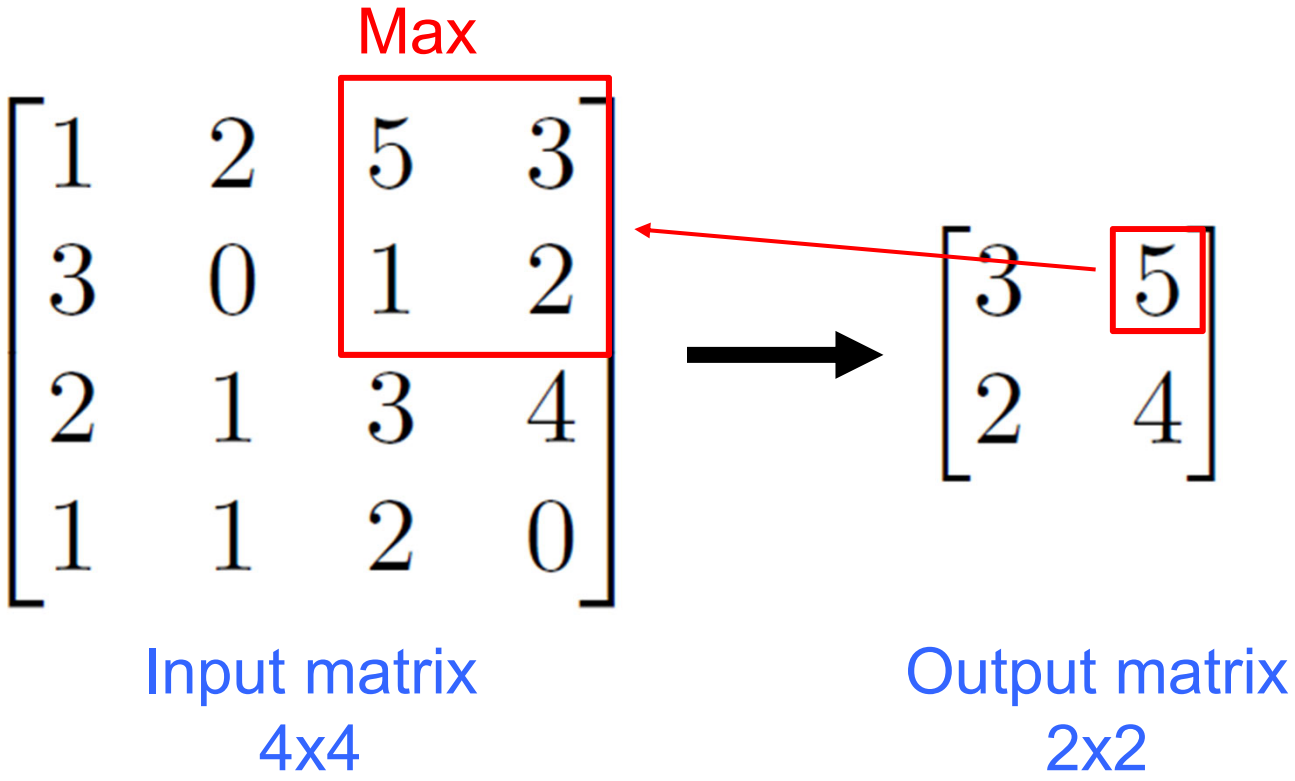

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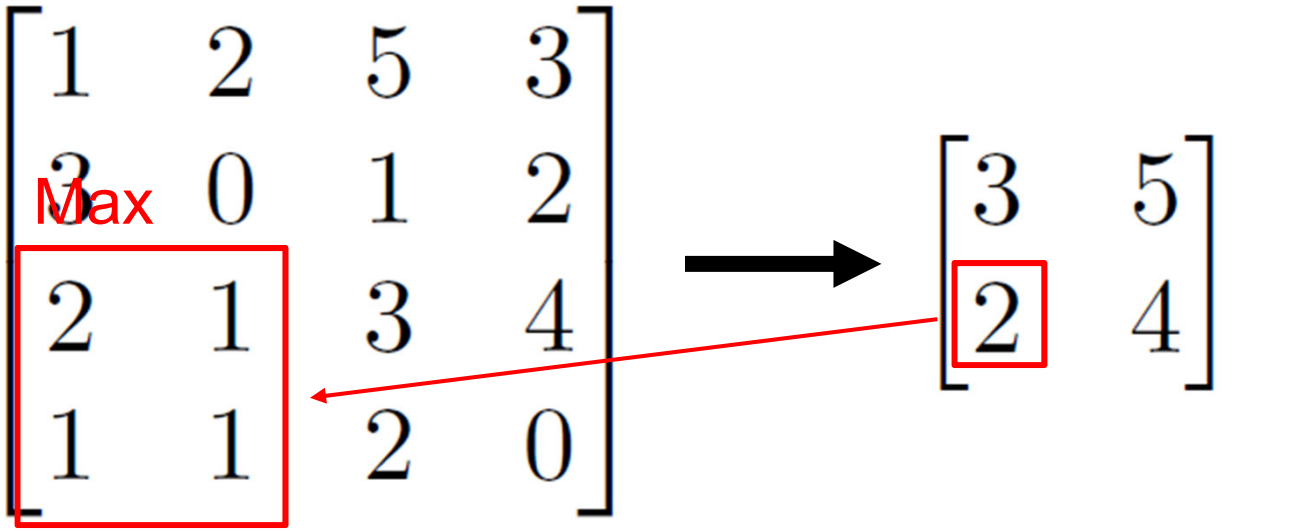

Pooling layer

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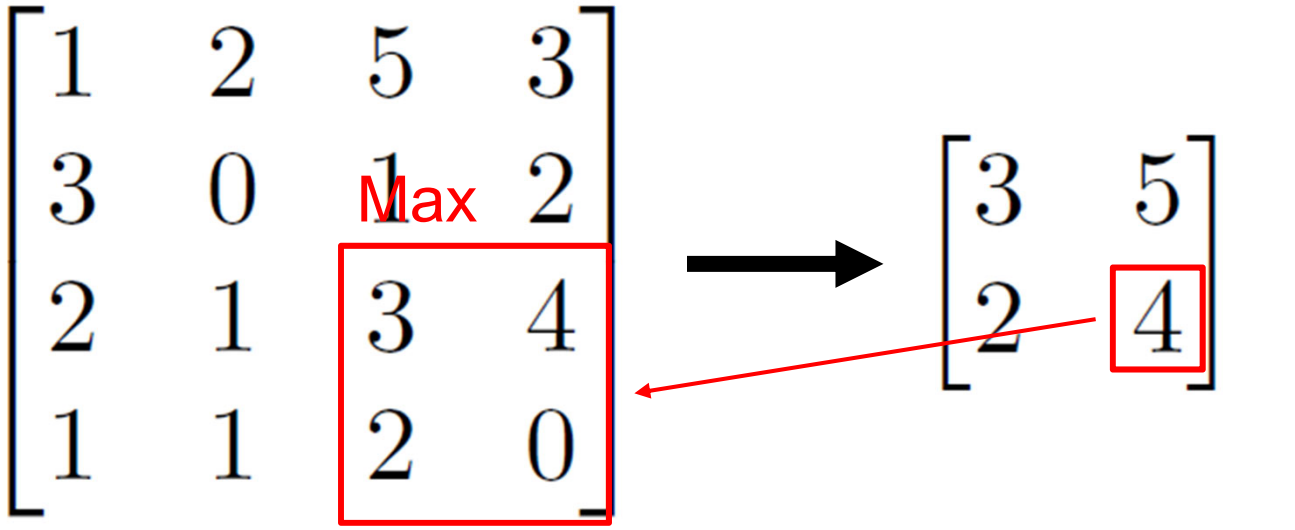
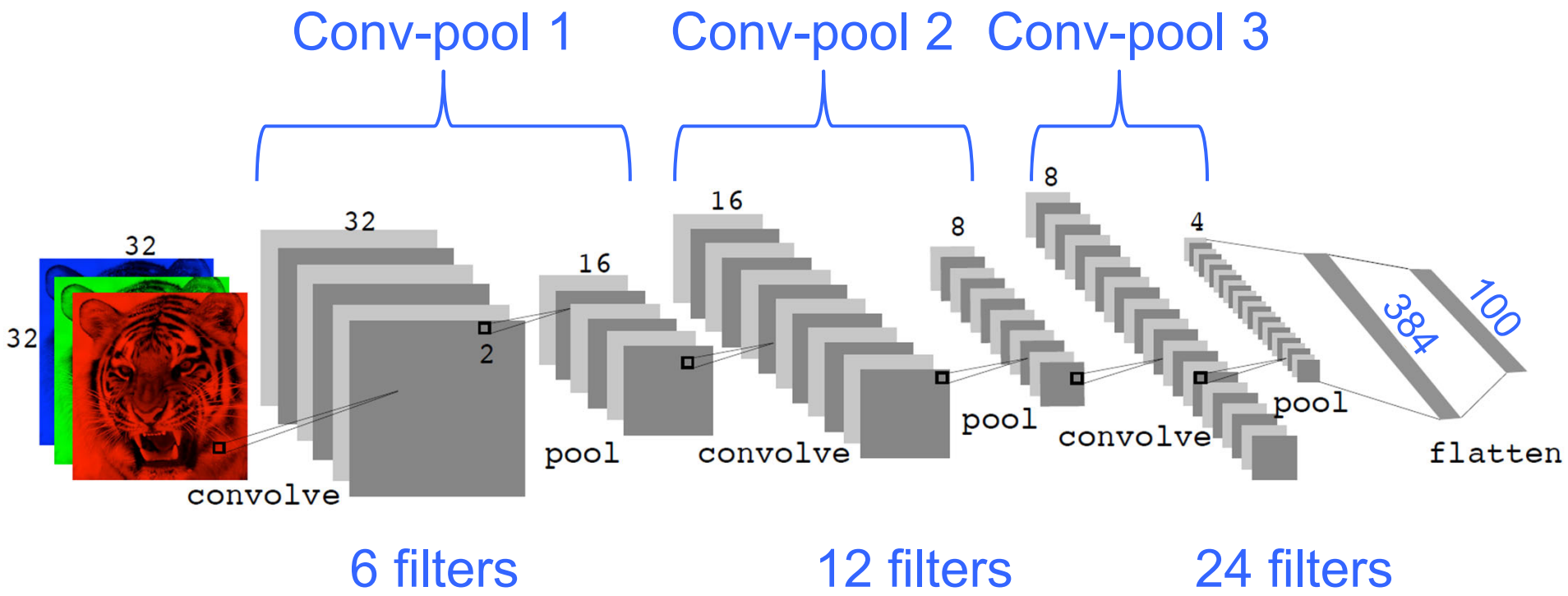
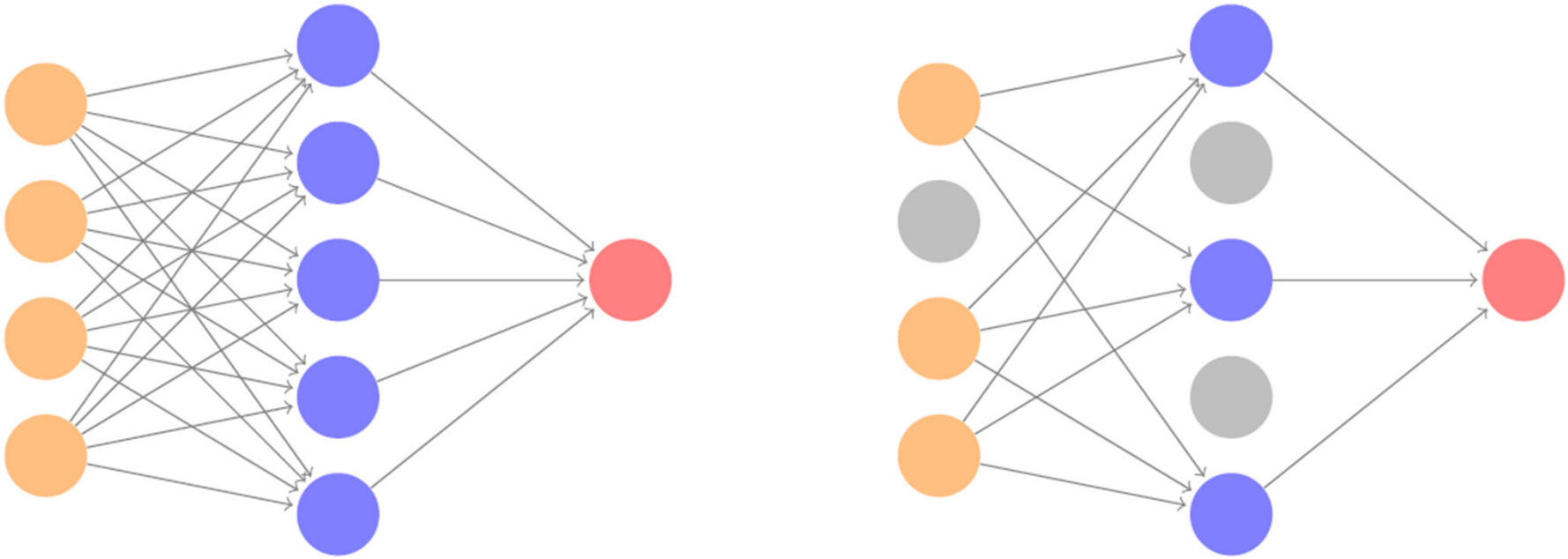


Architecture

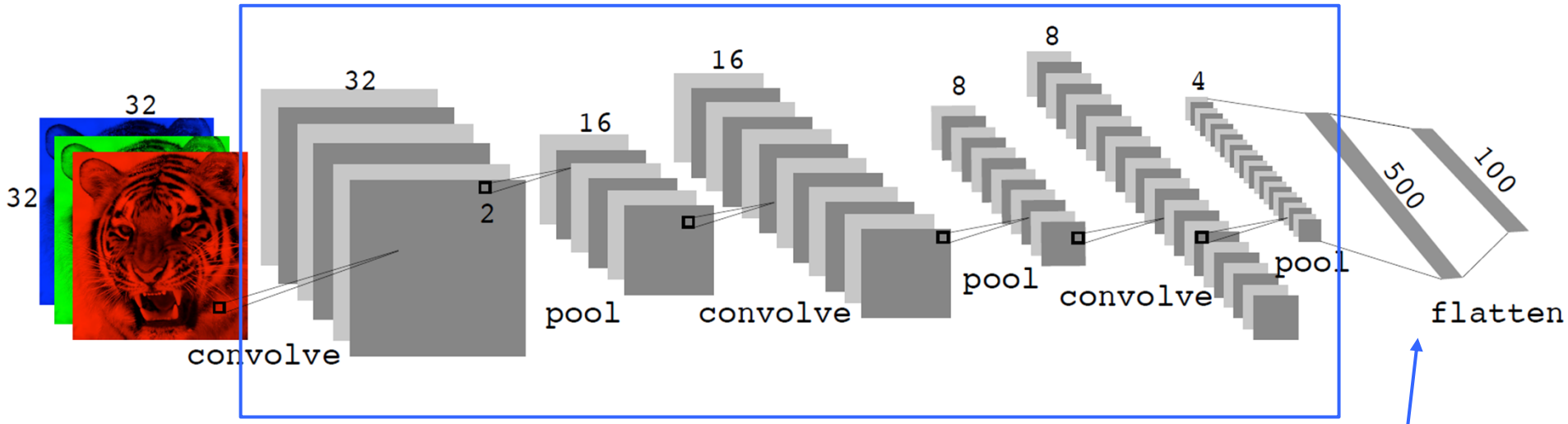


Training algorithm: dropout



Pretrained models

Transfer learning



Freeze convolve-pool layers (architecture, weights etc)

Reconfigure and/or retrain dense layers