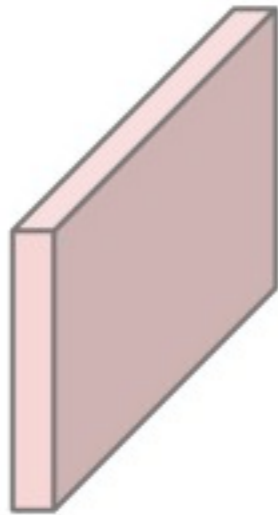


# Convolutional Neural Networks for Computational Biology

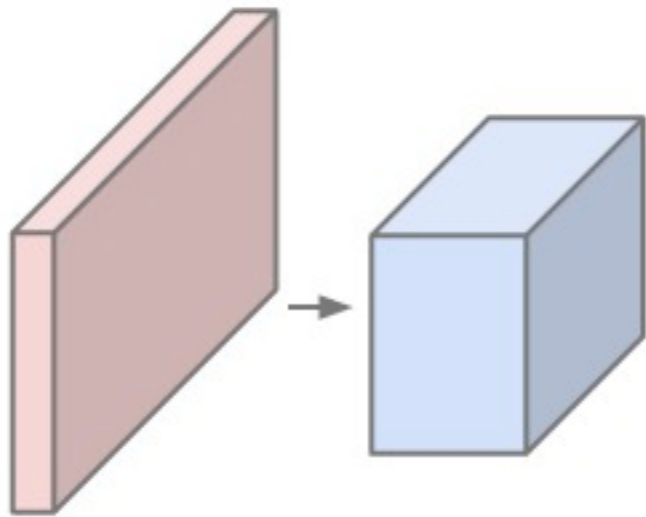
Matteo Manica  
[tte@zurich.ibm.com](mailto:tte@zurich.ibm.com)

SIB Autumn School 2017

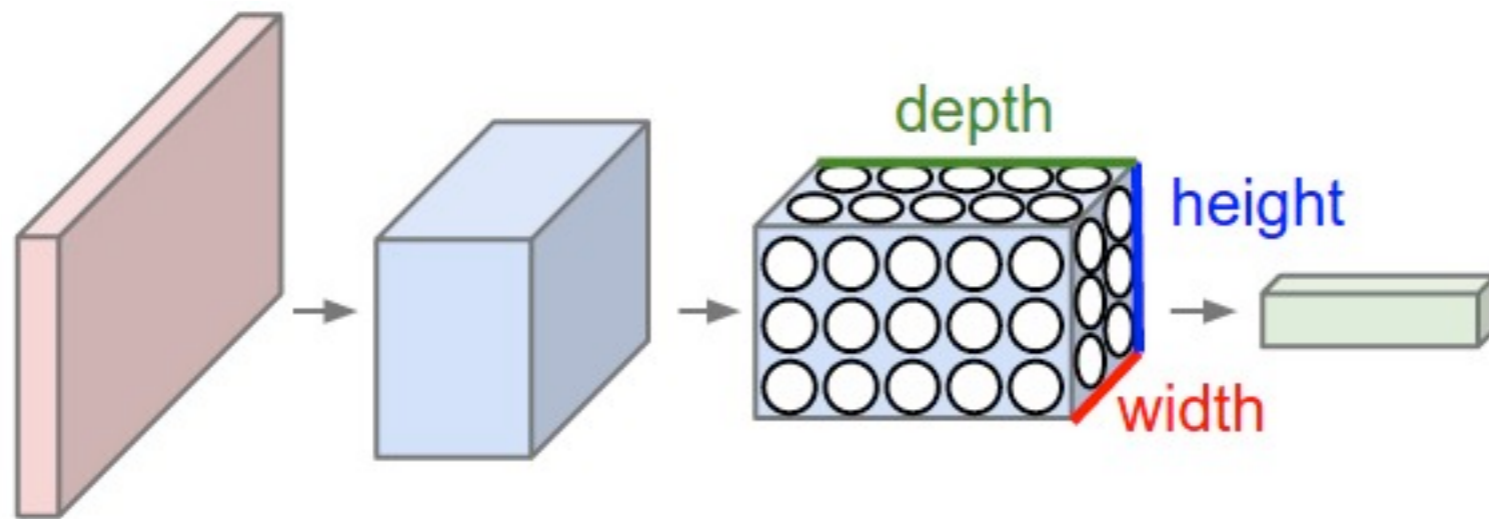
# What's a CNN?



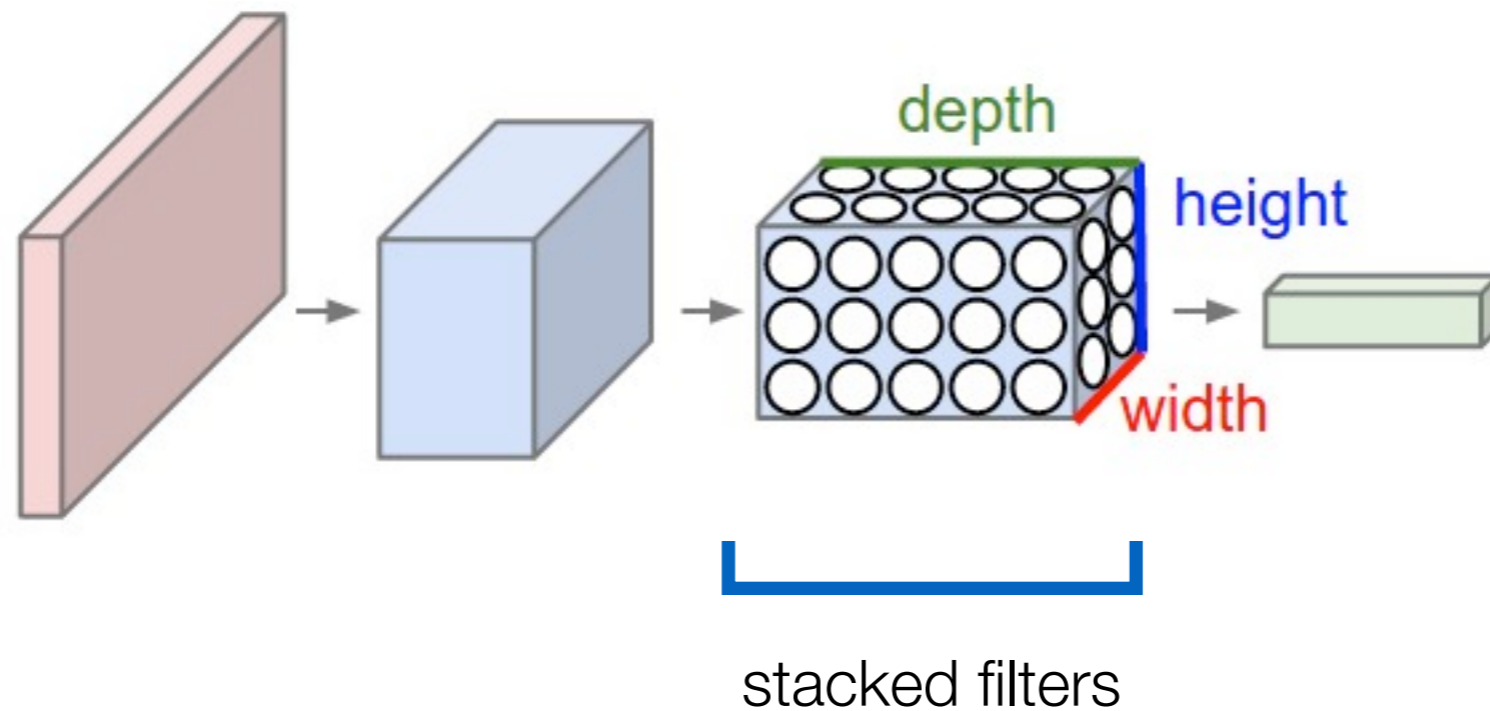
# What's a CNN?



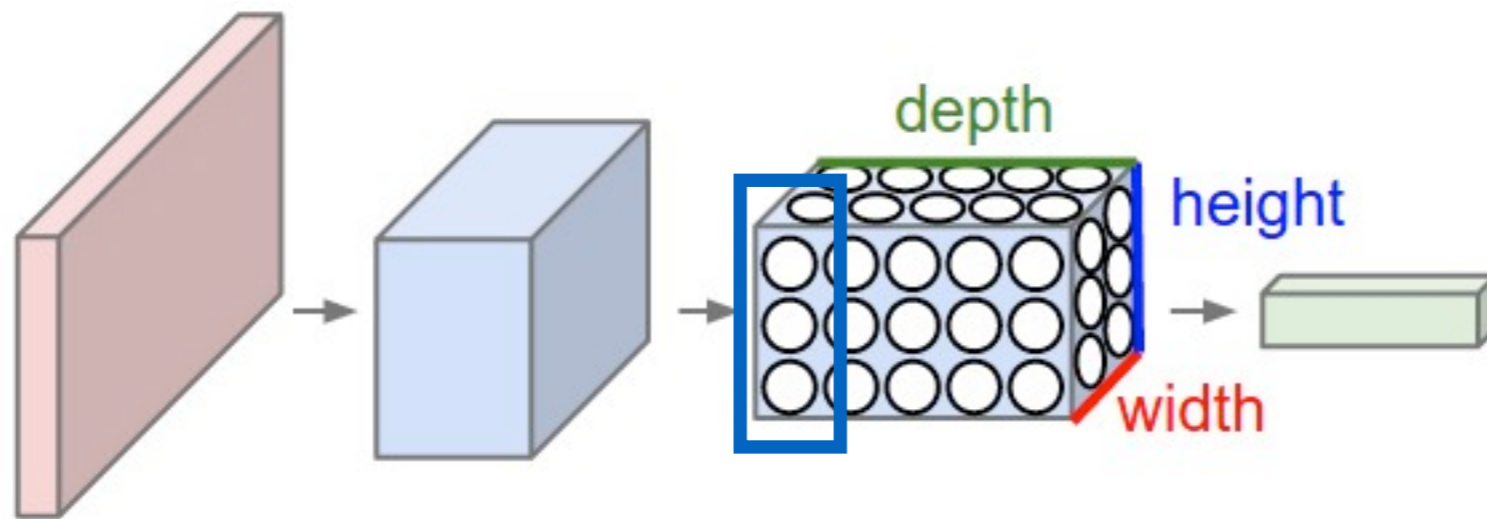
# What's a CNN?



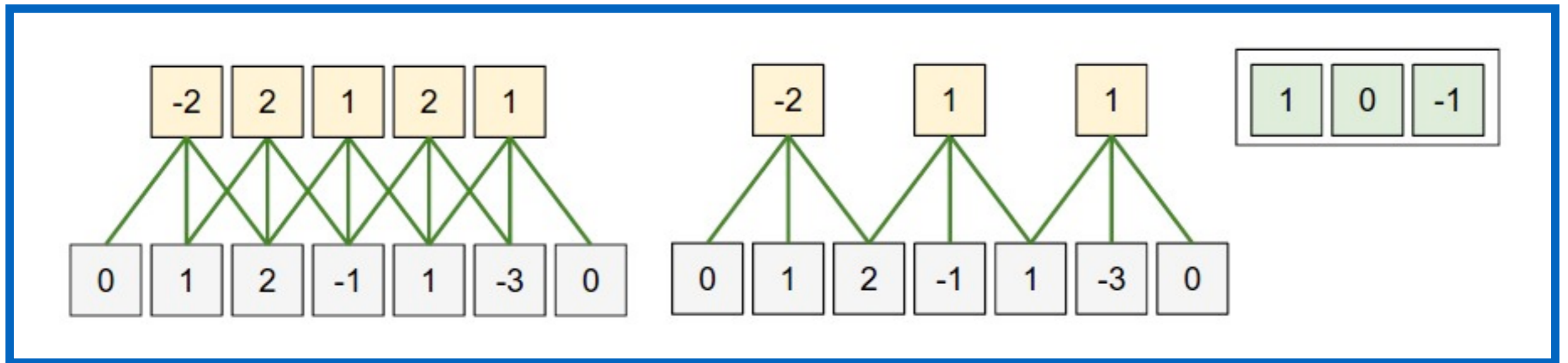
# What's a convolutional layer?



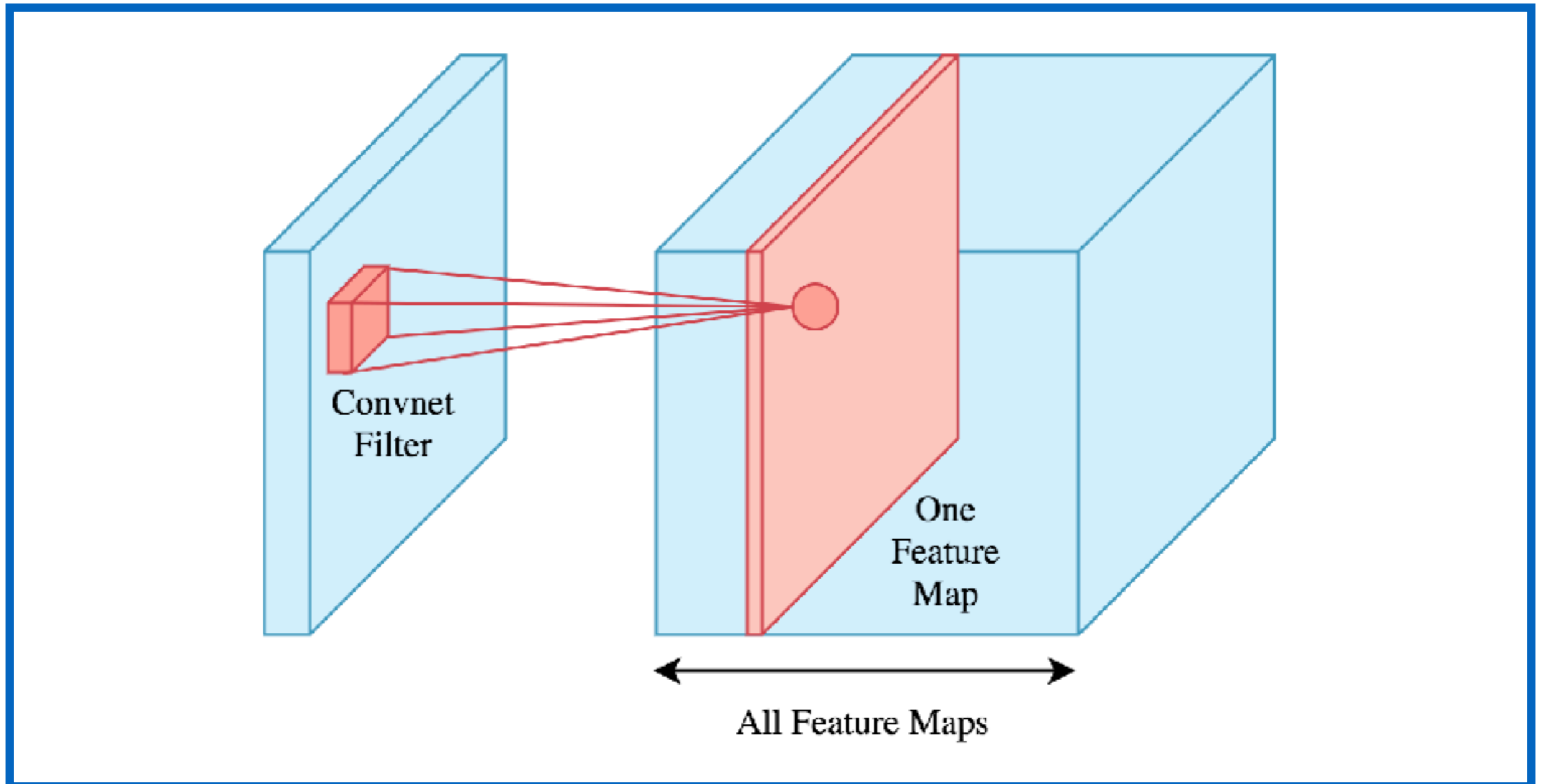
# What's a filter?



# What's a filter?

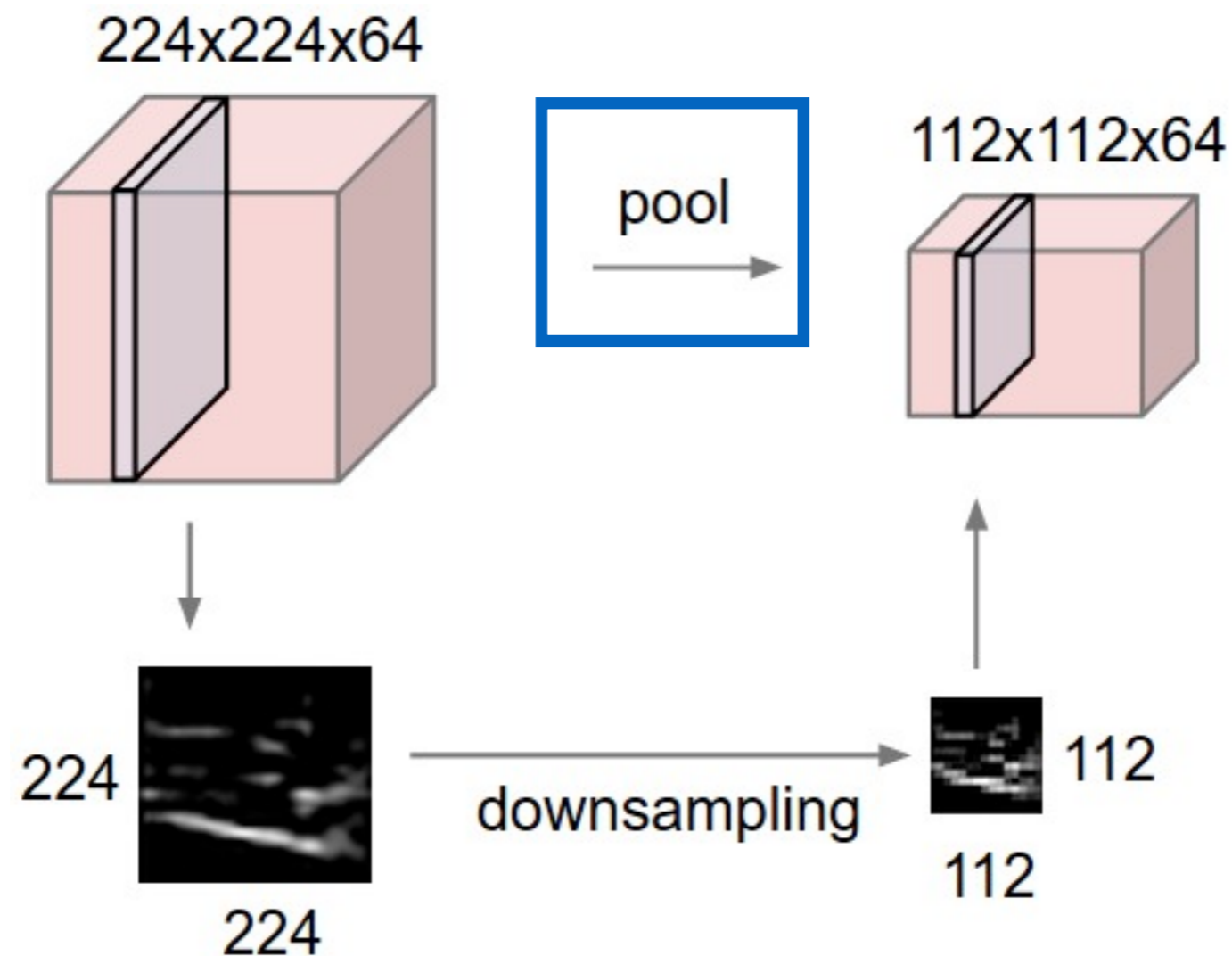


# What's a filter?

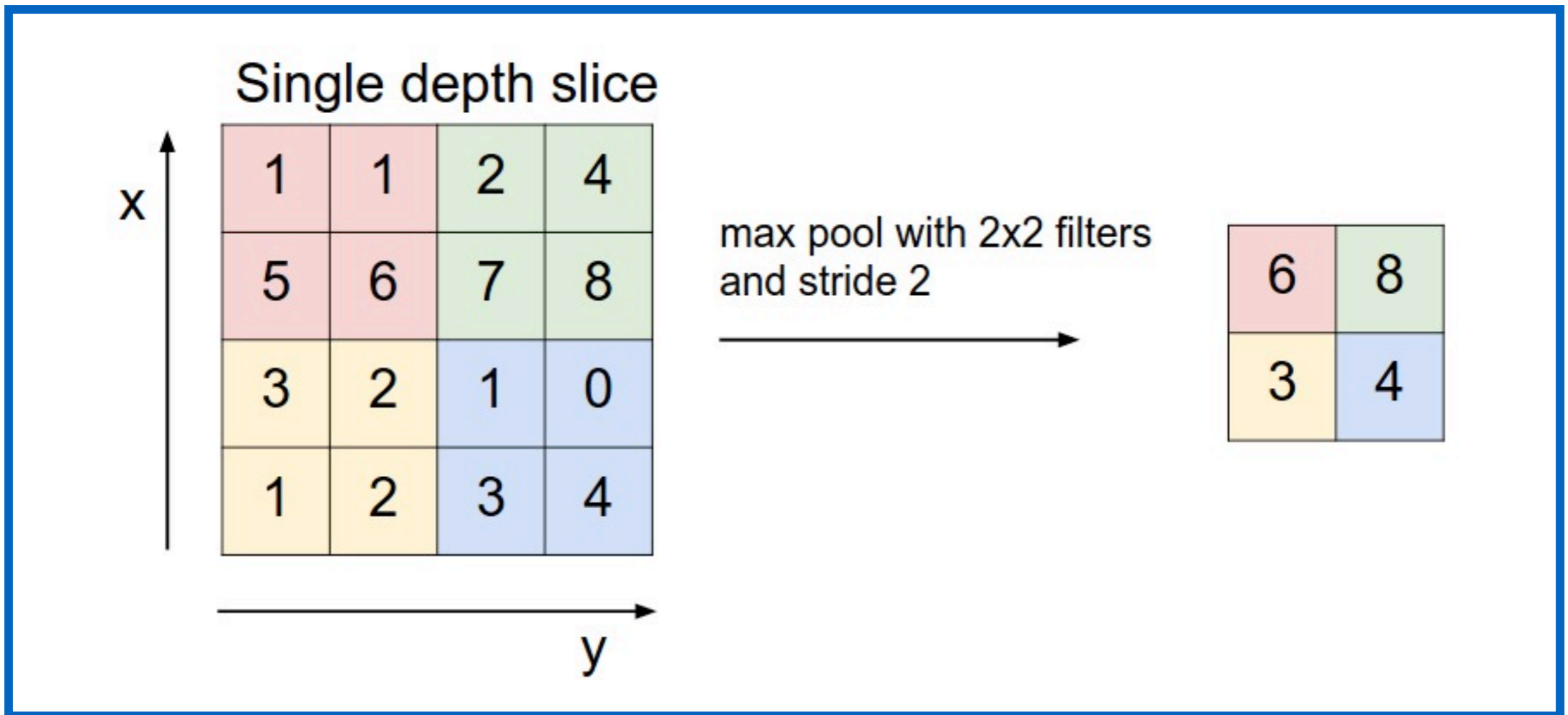




# How do we reduce dimensionality?

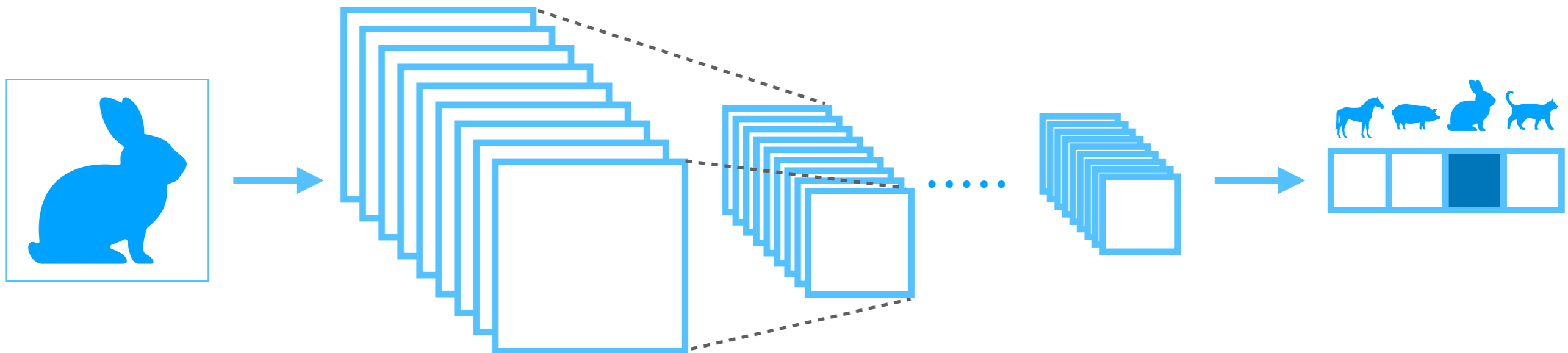


# Pooling Layers

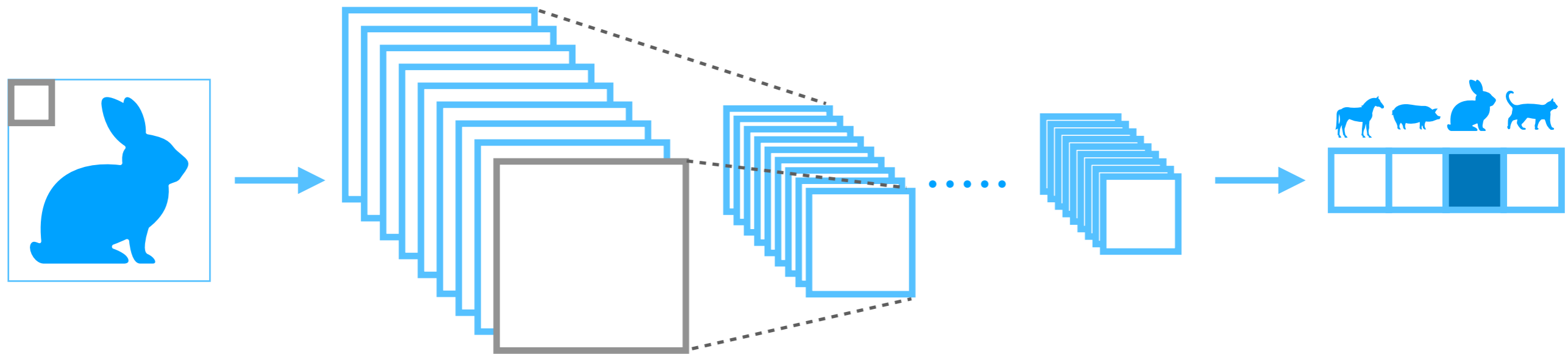


Are CNNs useful?

# Are CNNs useful?



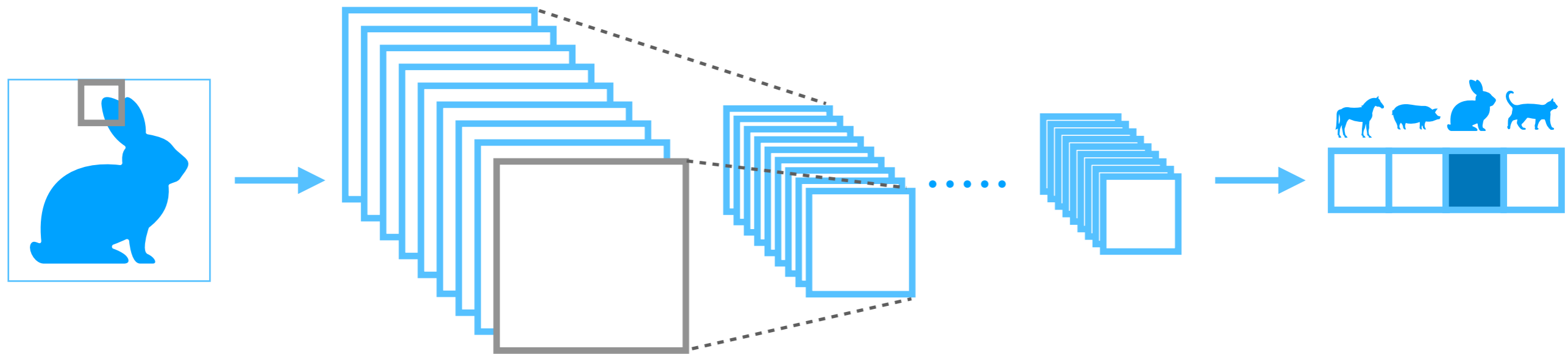
# Are CNNs useful?



increasing **complexity** of the features

increasing **compression** of the image

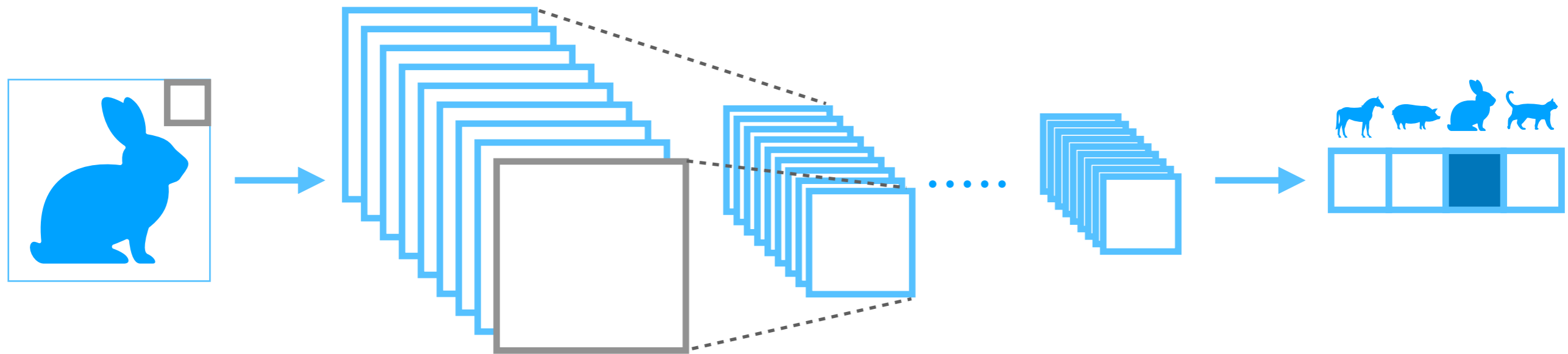
# Are CNNs useful?



increasing **complexity** of the features

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# Are CNNs useful?



increasing **complexity** of the features

increasing **compression** of the image

Are CNNs useful for  
Computational Biology?



# Are CNNs useful for Computational Biology?

DNA motif analysis

Proteins sequence analysis

Histopathology imaging



# Are CNNs useful for Computational Biology?

DNA motif analysis

Proteins sequence analysis

Histopathology imaging

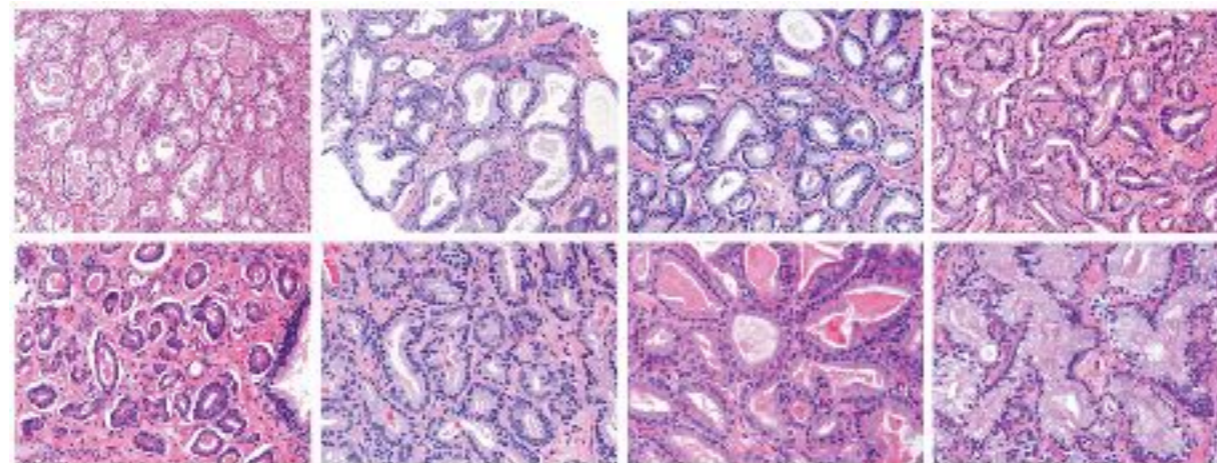
```
      10      20      30      40      50      60
MANLGCWMLV LQVATWSDLG LCKRRPKPGG WNTGGSRYPG QGSPGGNRYP PGGGGWGQP
      70      80      90     100     110     120
HGGGWGQPHG GGWQPHGGG WGQPHGGGWG QGGGTHSQWN KPSKPKTNMK HMAGAAAAGA
     130     140     150     160     170     180
VVGGLGGYML GSAMSRPIIH FGS DYEDRYR RENMHRYPNQ VYRPMDEYS NQNNFVHDCV
     190     200     210     220     230     240
NITIKQHTVT TTKGENFTE TDVKMMERVV EQMCITQYER ESQAYYQ RGS SMVLFSSPPV
     250
ILLISFLIFL IVG
```

# Are CNNs useful for Computational Biology?

DNA motif analysis

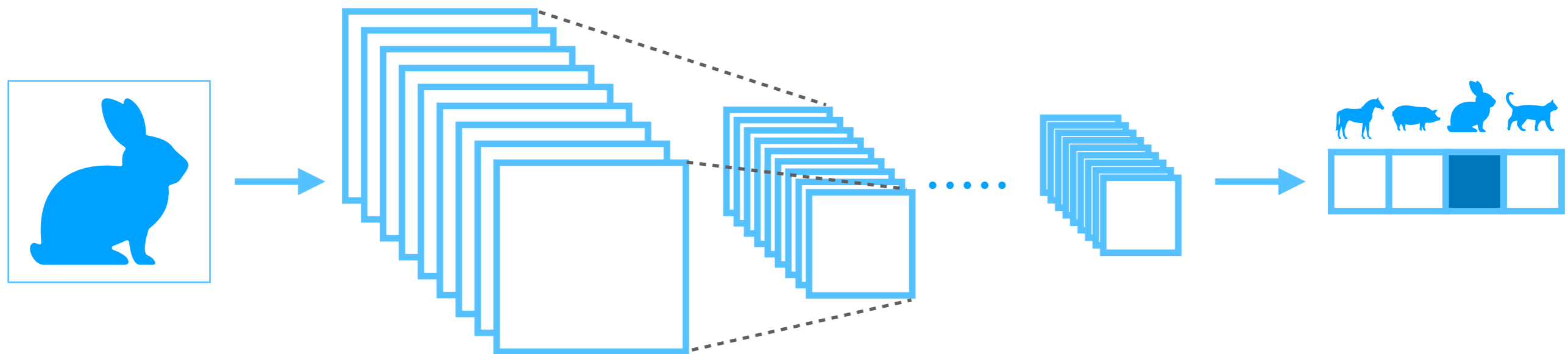
Proteins sequence analysis

Histopathology imaging



DeepSWATH

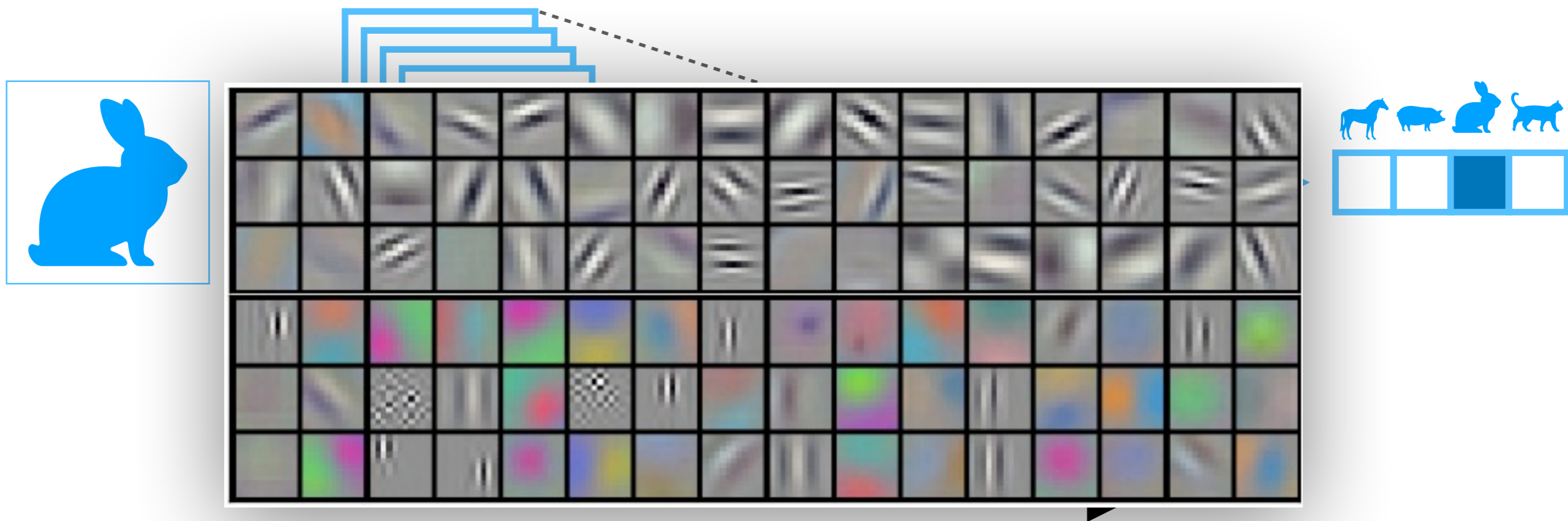
# DeepSWATH



increasing **complexity** of the features

increasing **compression** of the image

# DeepSWATH



increasing **complexity** of the features

increasing **compression** of the image

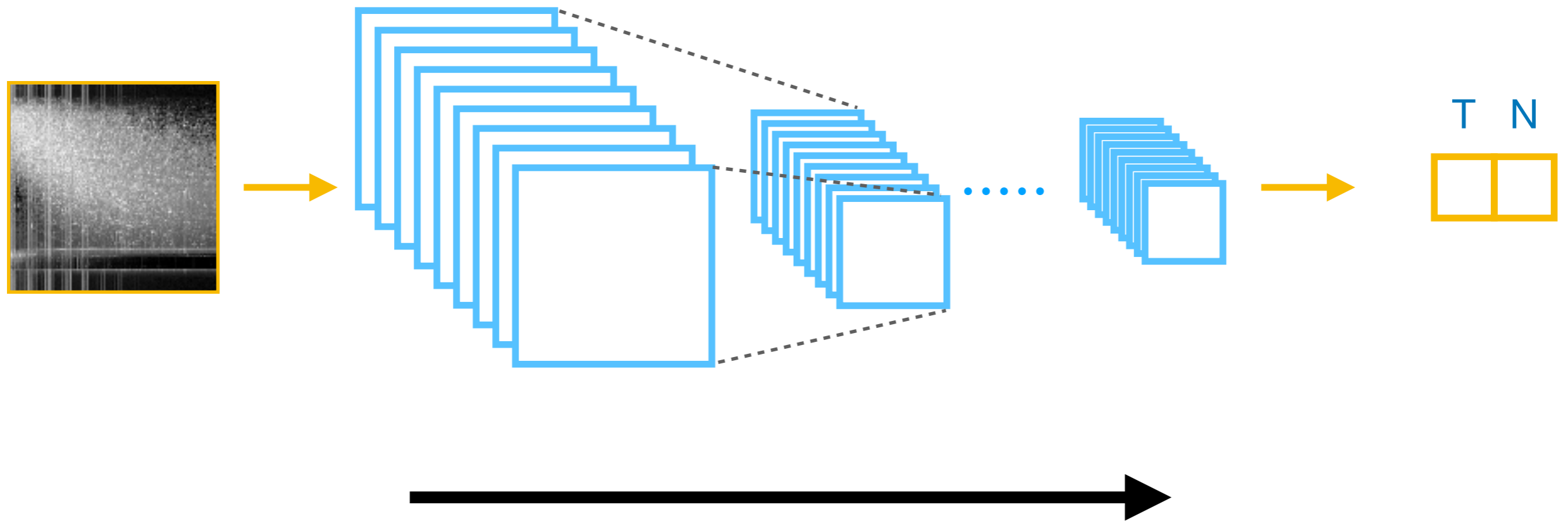
# DeepSWATH



learned **filters encode** information about **shapes** and image **gradients**  
nothing specific about animals!



# DeepSWATH

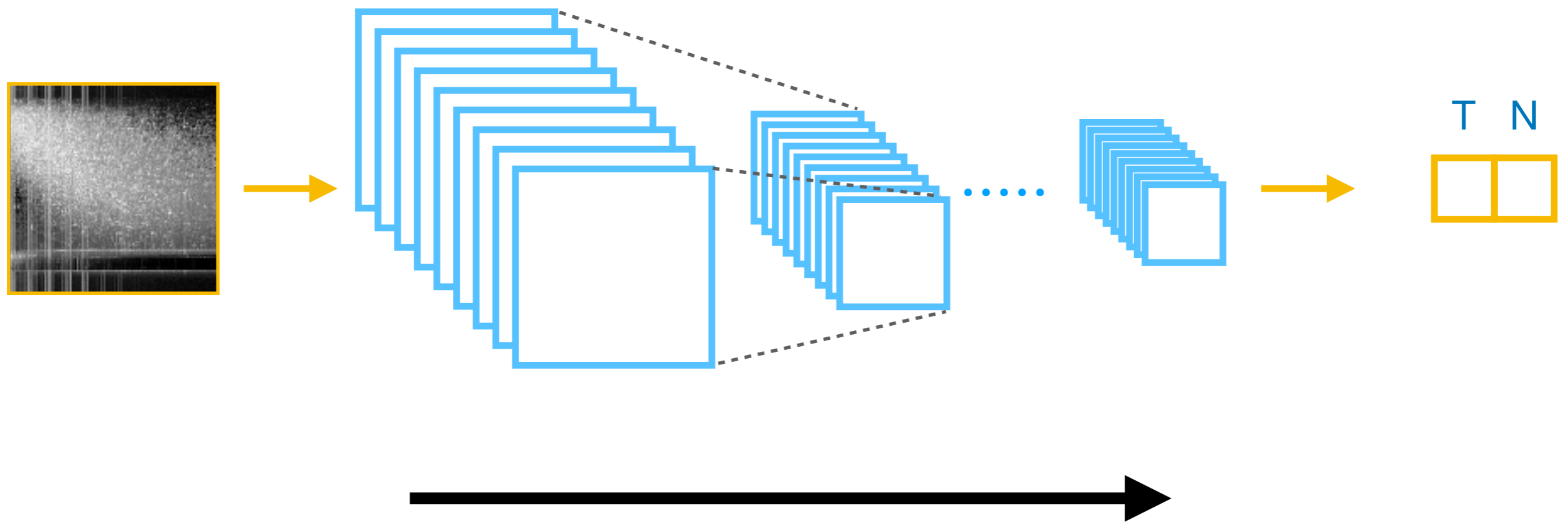


we can **use** the **learned filters** with other images

we can **apply** them **on MS1** data by treating the **raw data as images**



# DeepSWATH



with **filters learned on animals images** we reached **~70% of accuracy!**

# Let's use a CNN to detect a known DNA motif

open the jupyter notebook cnn.ipynb in your docker image

