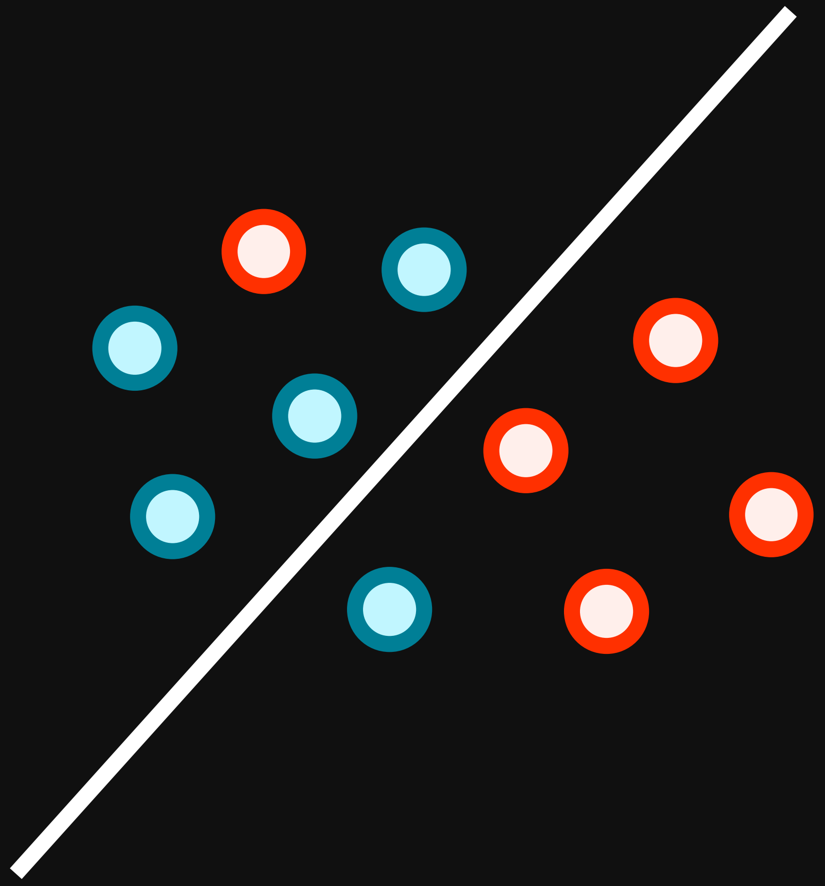
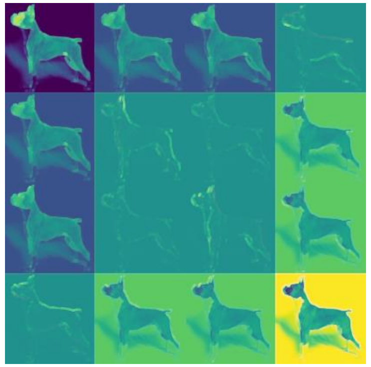
Basics of Machine Learning

Dmitry Ryabokon, github.com/dryabokon



Lesson 17
Intro to Deep Learning



Intro to Deep Learning

Summary

- CNNs out of box
- Some datasets available for research
- Basic Operations

CNNs out of box

The popular networks

Classification

- LeNet Model
- AlexNet Model
- VGG Model
- ResNet Paper
- YOLO9000 Paper
- DenseNet Paper

Segmentation

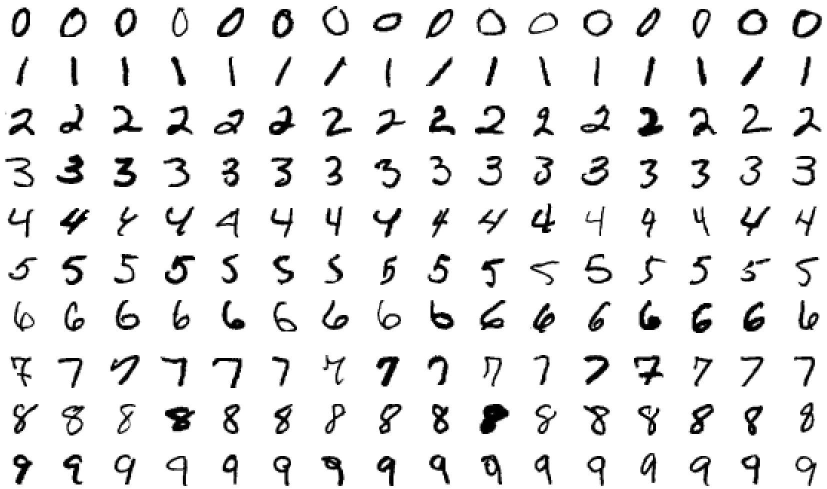
- FCN8 Paper
- SegNet Paper
- U-Net Paper
- E-Net Paper
- ResNetFCN Paper
- PSPNet Paper
- Mask RCNN Paper

Detection

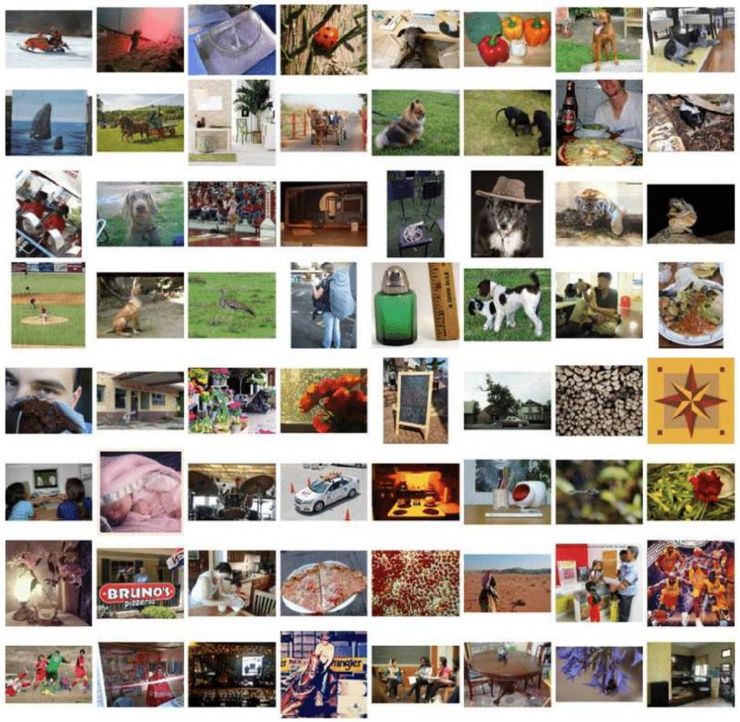
- Faster RCNN Paper
- SSD Paper
- YOLOv2 Paper
- R-FCN Paper

CNNs out of box

Some datasets available for research



MNIST: 10 classes, ~7000 ex. per class

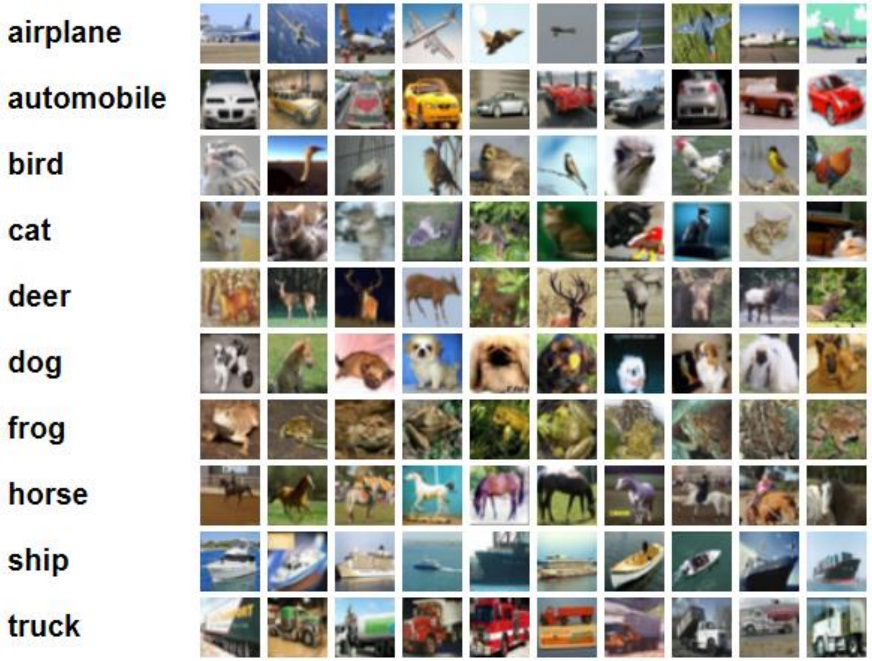


ImageNet: 1000 classes, ~100 ex per class

CNNs out of box

Some datasets available for research

The Street View House Numbers
10 classes, ~2000 ex. per class

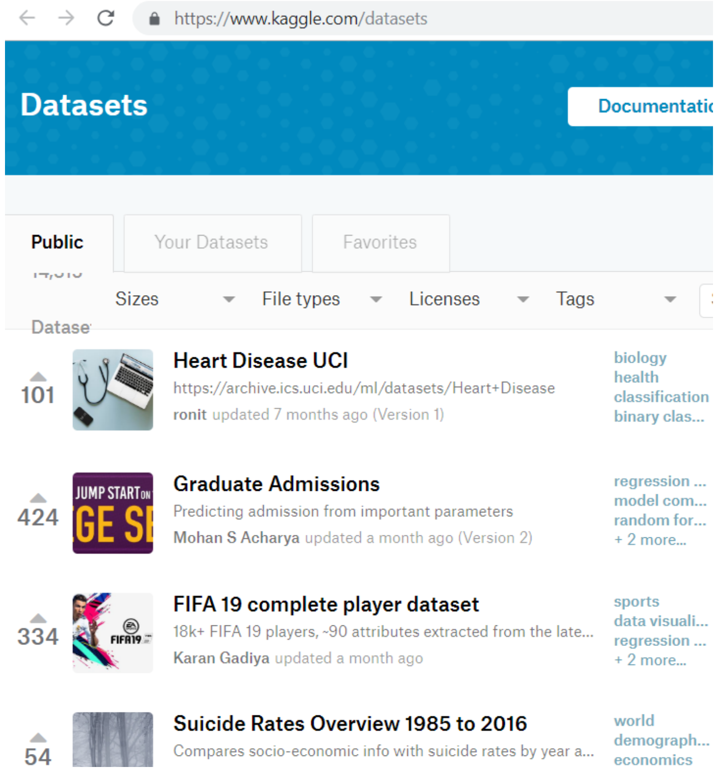


CIFAR: 10 classes, 6000 ex. per class
100 classes, 600 ex per class

CNNs out of box

Some datasets available for research

Olivetti database: 40 classes



101 **Heart Disease UCI**
https://archive.ics.uci.edu/ml/datasets/Heart+Disease
ronit updated 7 months ago (Version 1)
biology
health
classification
binary clas...

424 **Graduate Admissions**
Predicting admission from important parameters
Mohan S Acharya updated a month ago (Version 2)
regression ...
model com...
random for...
+ 2 more...

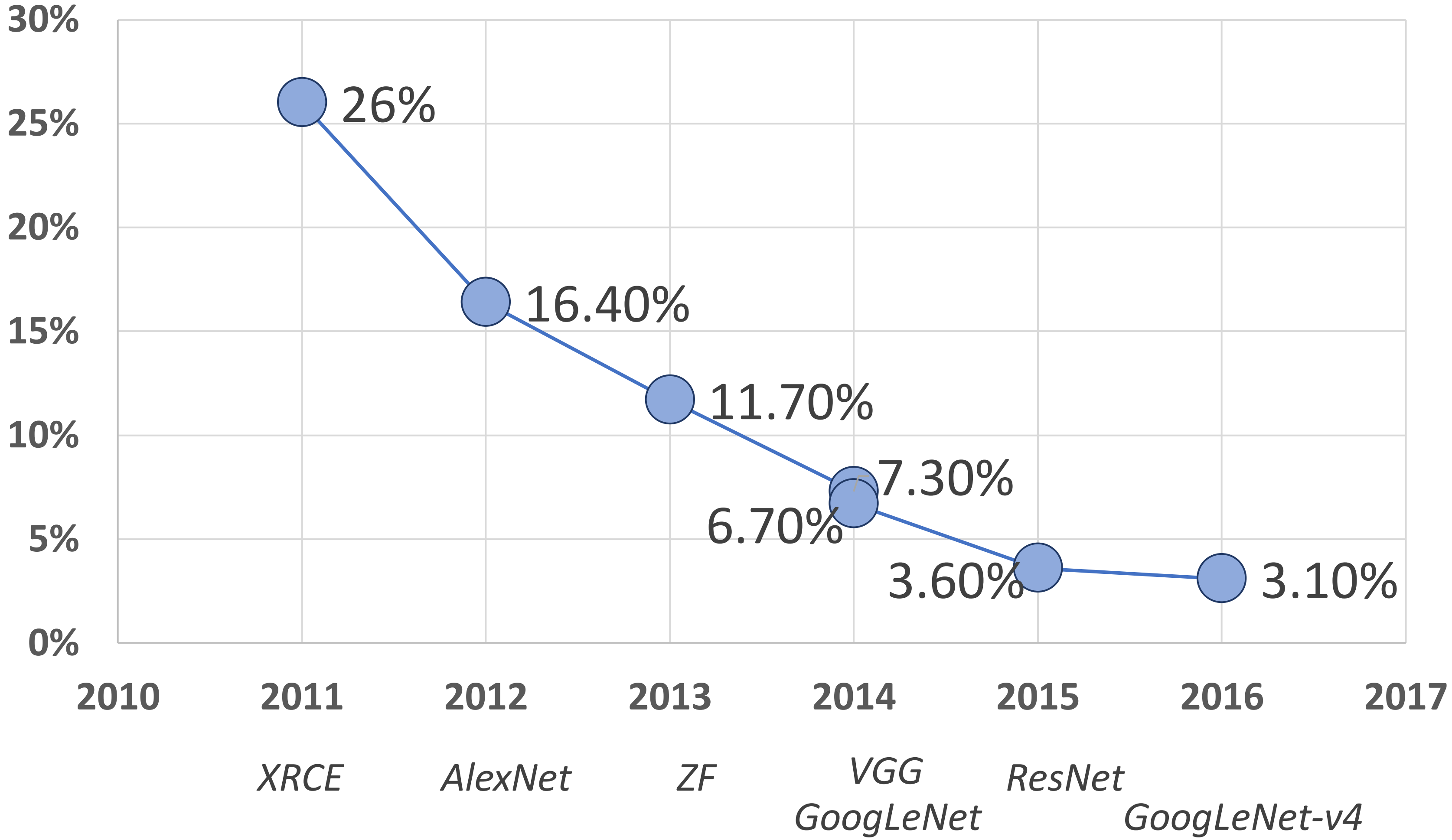
334 **FIFA 19 complete player dataset**
18k+ FIFA 19 players, ~90 attributes extracted from the late...
Karan Gadiya updated a month ago
sports
data visuali...
regression ...
+ 2 more...

54 **Suicide Rates Overview 1985 to 2016**
Compares socio-economic info with suicide rates by year a...
world
demograph...
economics

.. and much more @ kaggle

CNNs out of box

ImageNet Classification error



CNNs out of box

Usage of the neural networks

identify the name of a street (in France) from an image

compressing and decompressing images

semantic image segmentation

real-world image text extraction.

image classification

image-to-text

unsupervised learning

3D object reconstruction

image matching and retrieval

automatic speech recognition

localizing and identifying multiple objects in a single image

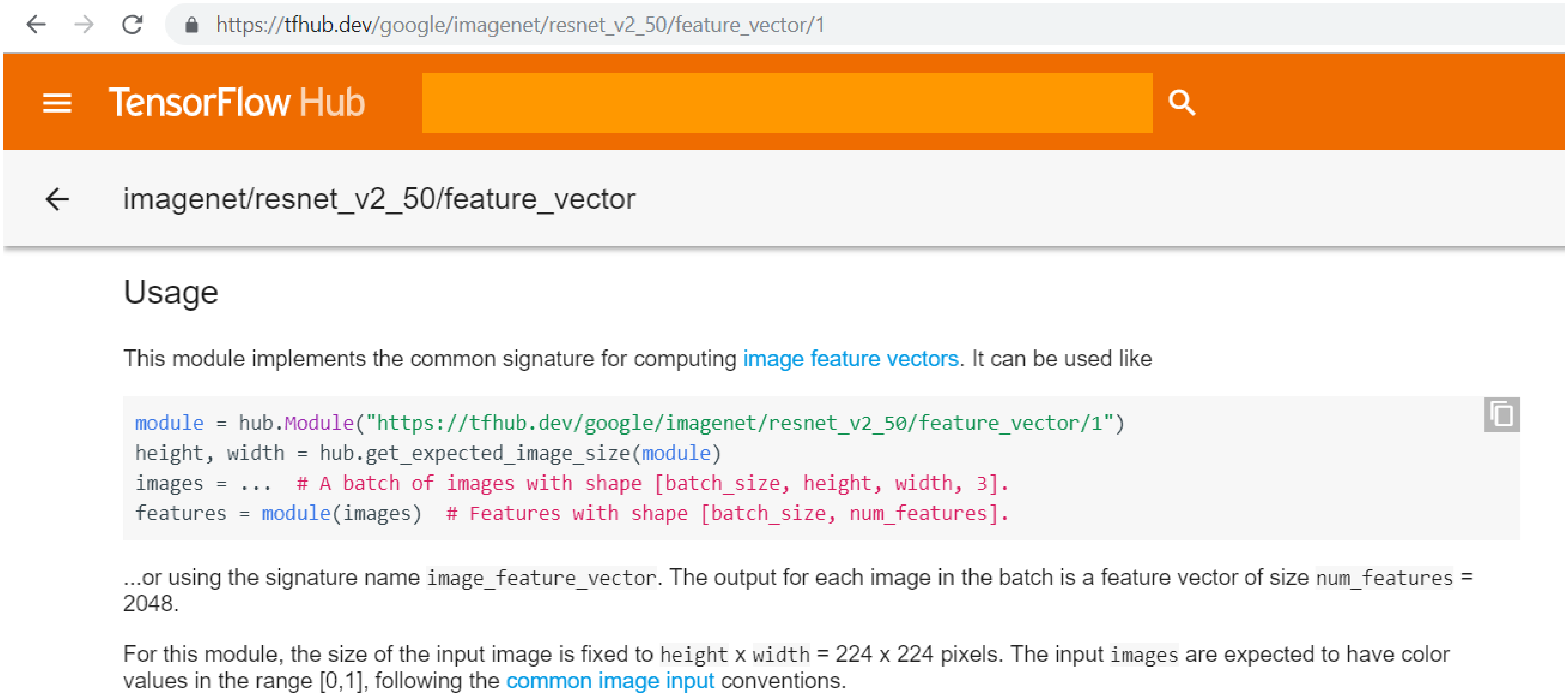
computer vision

discovery of latent 3D keypoints

predicting future video frames

https://github.com/keras-team/keras/tree/master/examples
https://github.com/tensorflow/models/tree/master/research

CNNs out of box



https://tfhub.dev/google/imagenet/resnet_v2_50/feature_vector/1
TensorFlow Hub

imagenet/resnet_v2_50/feature_vector

Usage

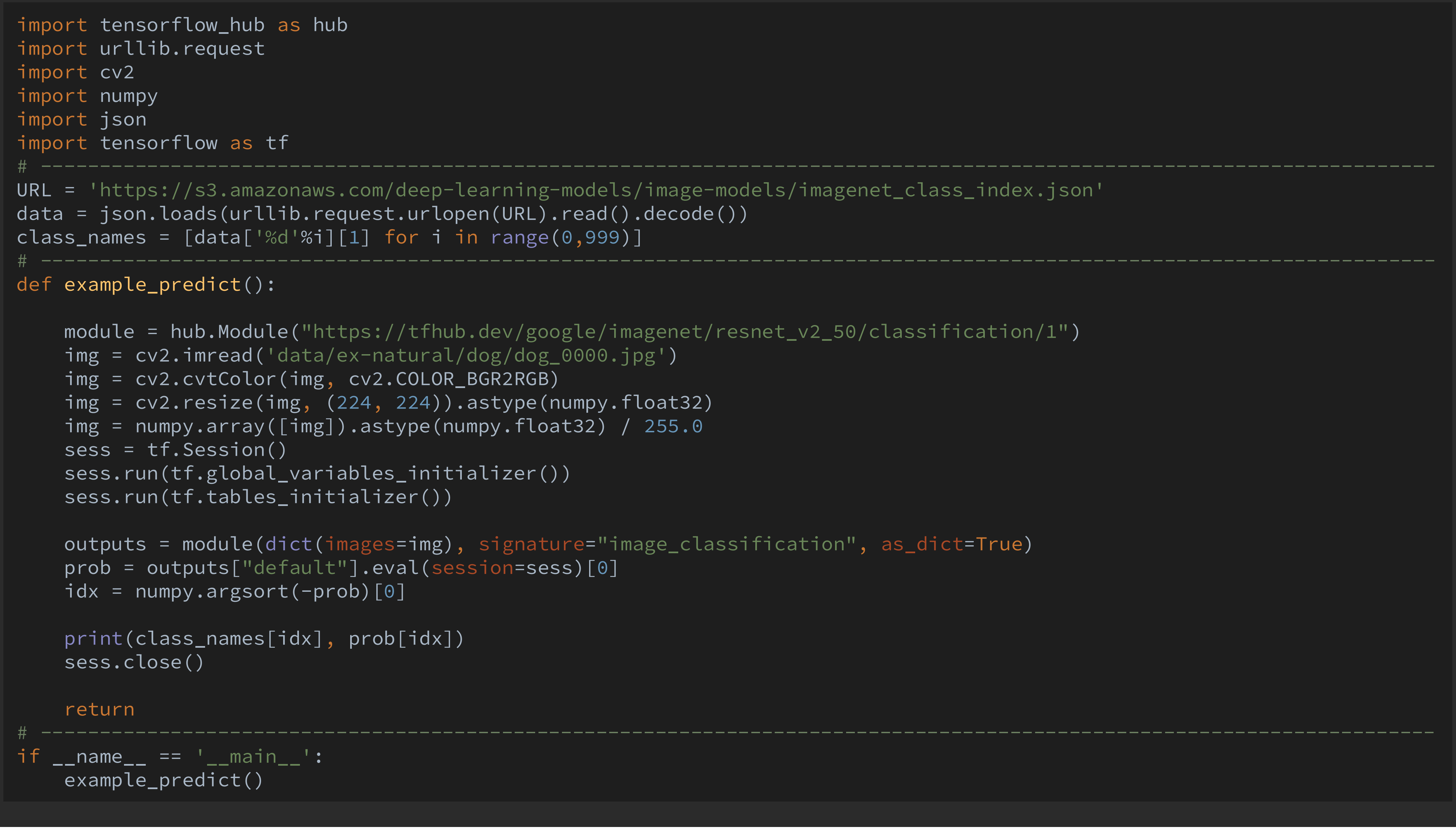
This module implements the common signature for computing image feature vectors. It can be used like

```
module = hub.Module("https://tfhub.dev/google/imagenet/resnet_v2_50/feature_vector/1")
height, width = hub.get_expected_image_size(module)
images = ...  # A batch of images with shape [batch_size, height, width, 3].
features = module(images)  # Features with shape [batch_size, num_features].
```

...or using the signature name `image_feature_vector`. The output for each image in the batch is a feature vector of size `num_features` = 2048.

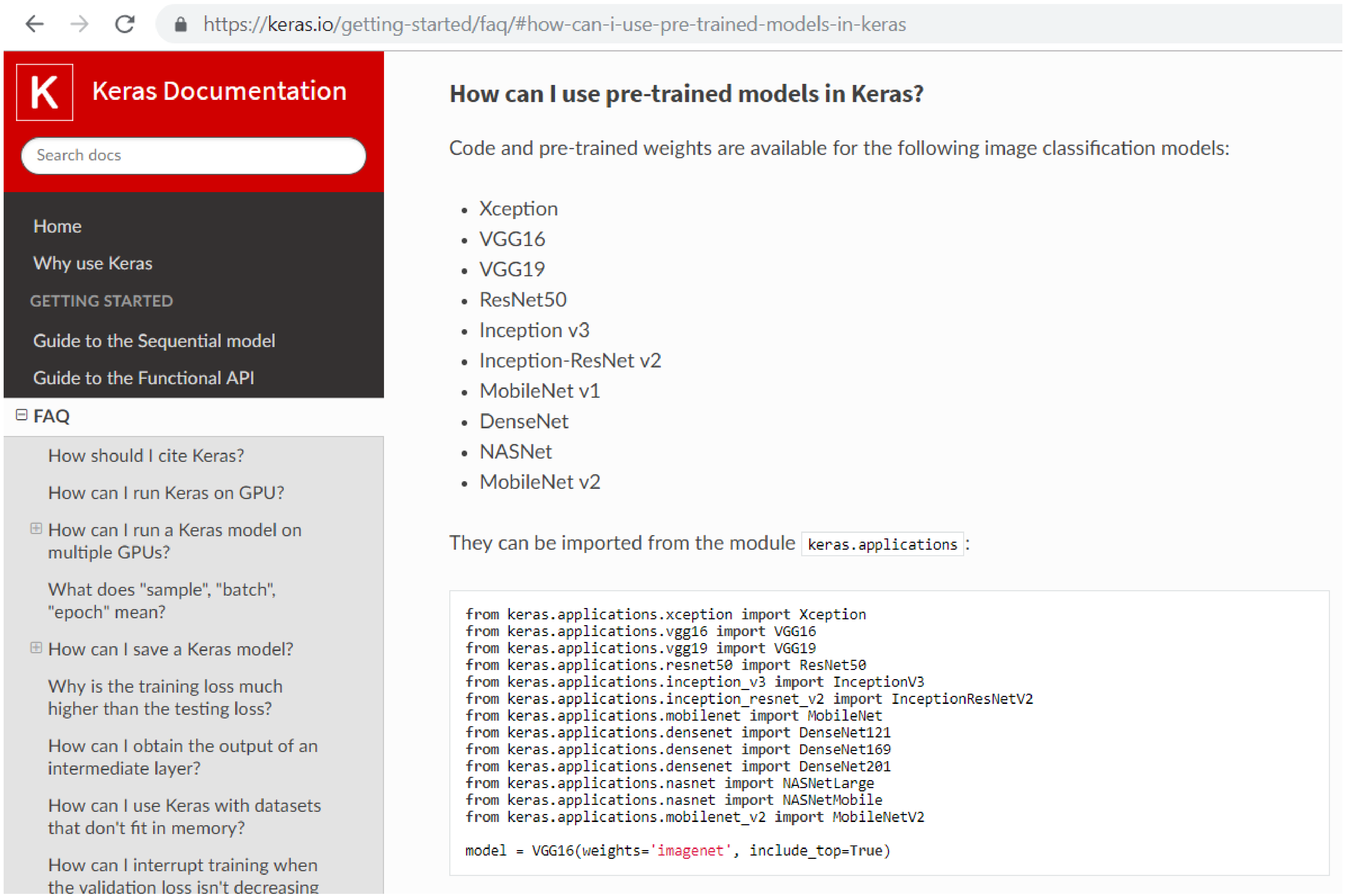
For this module, the size of the input image is fixed to `height` x `width` = 224 x 224 pixels. The input `images` are expected to have color values in the range [0,1], following the common image input conventions.

CNNs out of box



```python
import tensorflow_hub as hub
import urllib.request
import cv2
import numpy
import json
import tensorflow as tf
# ----------------------------------------------------------------------------------------------------------------------
URL = 'https://s3.amazonaws.com/deep-learning-models/image-models/imagenet_class_index.json'
data = json.loads(urllib.request.urlopen(URL).read().decode())
class_names = [data['%d'%i][1] for i in range(0,999)]
# ----------------------------------------------------------------------------------------------------------------------
def example_predict():

    module = hub.Module("https://tfhub.dev/google/imagenet/resnet_v2_50/classification/1")
    img = cv2.imread('data/ex-natural/dog/dog_0000.jpg')
    img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
    img = cv2.resize(img, (224, 224)).astype(numpy.float32)
    img = numpy.array([img]).astype(numpy.float32) / 255.0
    sess = tf.Session()
    sess.run(tf.global_variables_initializer())
    sess.run(tf.tables_initializer())

    outputs = module(dict(images=img), signature="image_classification", as_dict=True)
    prob = outputs["default"].eval(session=sess)[0]
    idx = numpy.argsort(-prob)[0]

    print(class_names[idx], prob[idx])
    sess.close()

    return
# ----------------------------------------------------------------------------------------------------------------------
if __name__ == '__main__':
    example_predict()
```

CNNs out of box


https://keras.io/getting-started/faq/#how-can-i-use-pre-trained-models-in-keras
K
Keras Documentation
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Home
Why use Keras
GETTING STARTED
Guide to the Sequential model
Guide to the Functional API
⊟ FAQ
How should I cite Keras?
How can I run Keras on GPU?
⊞ How can I run a Keras model on multiple GPUs?
What does "sample", "batch", "epoch" mean?
⊞ How can I save a Keras model?
Why is the training loss much higher than the testing loss?
How can I obtain the output of an intermediate layer?
How can I use Keras with datasets that don't fit in memory?
How can I interrupt training when the validation loss isn't decreasing

How can I use pre-trained models in Keras?

Code and pre-trained weights are available for the following image classification models:

- Xception
- VGG16
- VGG19
- ResNet50
- Inception v3
- Inception-ResNet v2
- MobileNet v1
- DenseNet
- NASNet
- MobileNet v2

They can be imported from the module `keras.applications`:

```
from keras.applications.xception import Xception
from keras.applications.vgg16 import VGG16
from keras.applications.vgg19 import VGG19
from keras.applications.resnet50 import ResNet50
from keras.applications.inception_v3 import InceptionV3
from keras.applications.inception_resnet_v2 import InceptionResNetV2
from keras.applications.mobilenet import MobileNet
from keras.applications.densenet import DenseNet121
from keras.applications.densenet import DenseNet169
from keras.applications.densenet import DenseNet201
from keras.applications.nasnet import NASNetLarge
from keras.applications.nasnet import NASNetMobile
from keras.applications.mobilenet_v2 import MobileNetV2

model = VGG16(weights='imagenet', include_top=True)
```

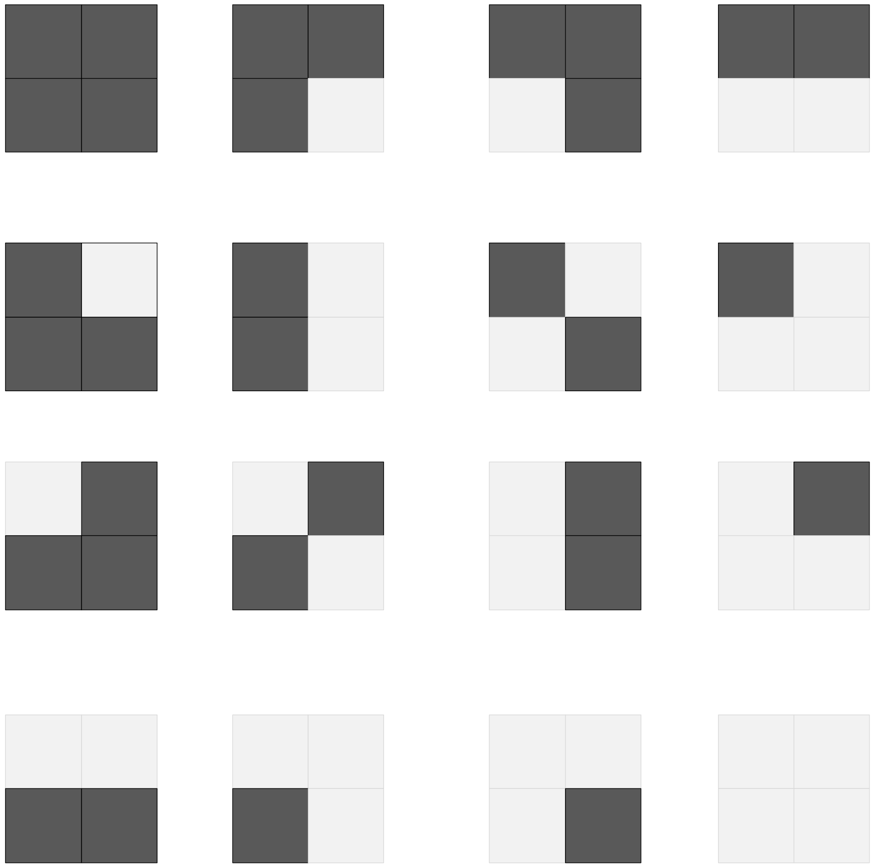
CNNs out of box

```
from keras.applications import MobileNet
from keras.applications.xception import Xception
from keras.applications.mobilenet import preprocess_input
import urllib.request
import cv2
import numpy
import json
from keras import backend as K
K.set_image_dim_ordering('tf')
# ---------------------------------------------------------------------------------------------------------------
-------
URL = 'https://s3.amazonaws.com/deep-learning-models/image-models/imagenet_class_index.json'
data = json.loads(urllib.request.urlopen(URL).read().decode())
class_names = [data['%d'%i][1] for i in range(0,999)]
# ---------------------------------------------------------------------------------------------------------------
-------
def example_predict():

    CNN = MobileNet()
    #CNN = Xception()

    img = cv2.imread('data/ex-natural/dog/dog_0000.jpg')
    img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
    img = cv2.resize(img, (224, 224)).astype(numpy.float32)

    prob = CNN.predict(preprocess_input(numpy.array([img])))
    idx = numpy.argsort(-prob[0])[0]
    print(class_names[idx], prob[0, idx])

    return
# ---------------------------------------------------------------------------------------------------------------
-------
if __name__ == '__main__':
    example_predict()
```

Basic operations

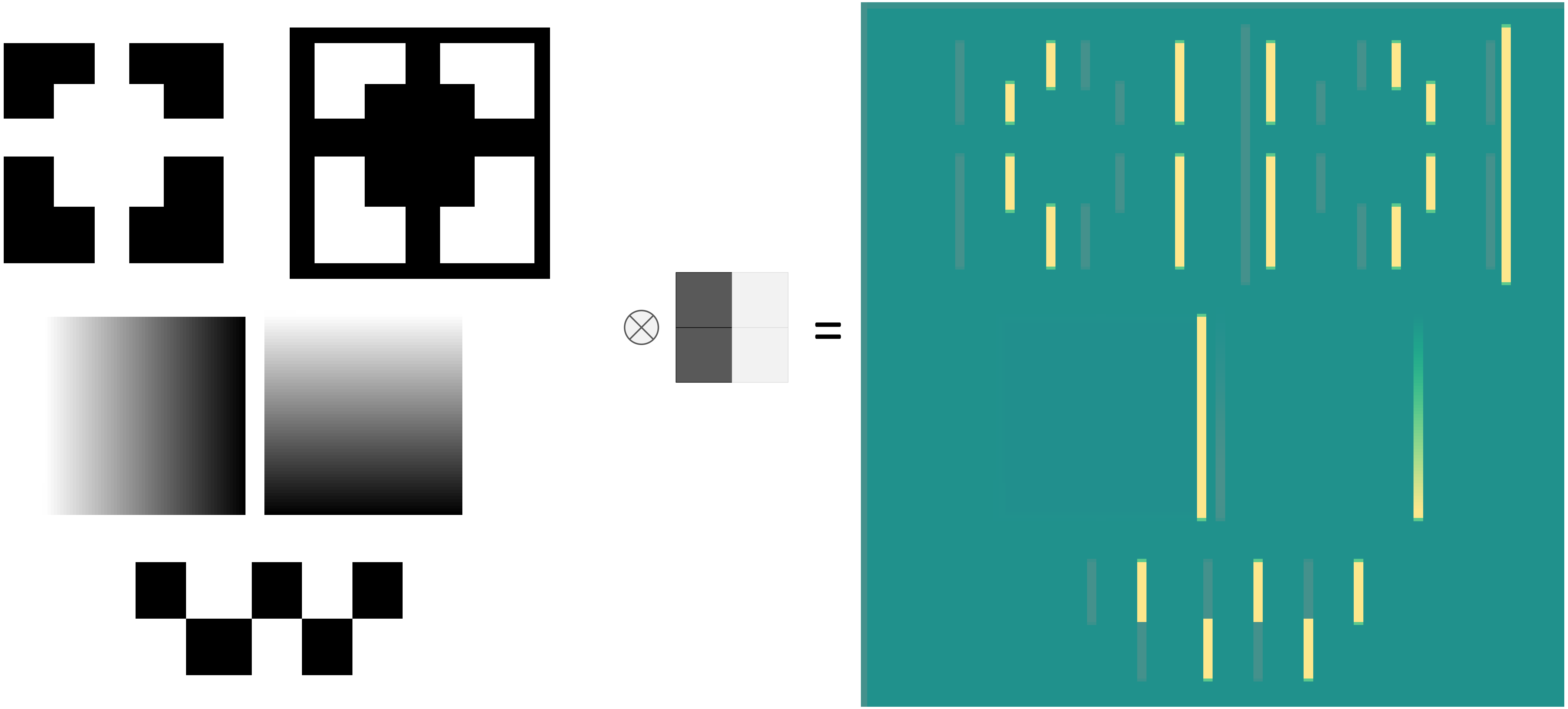
Basic operations

Convolution



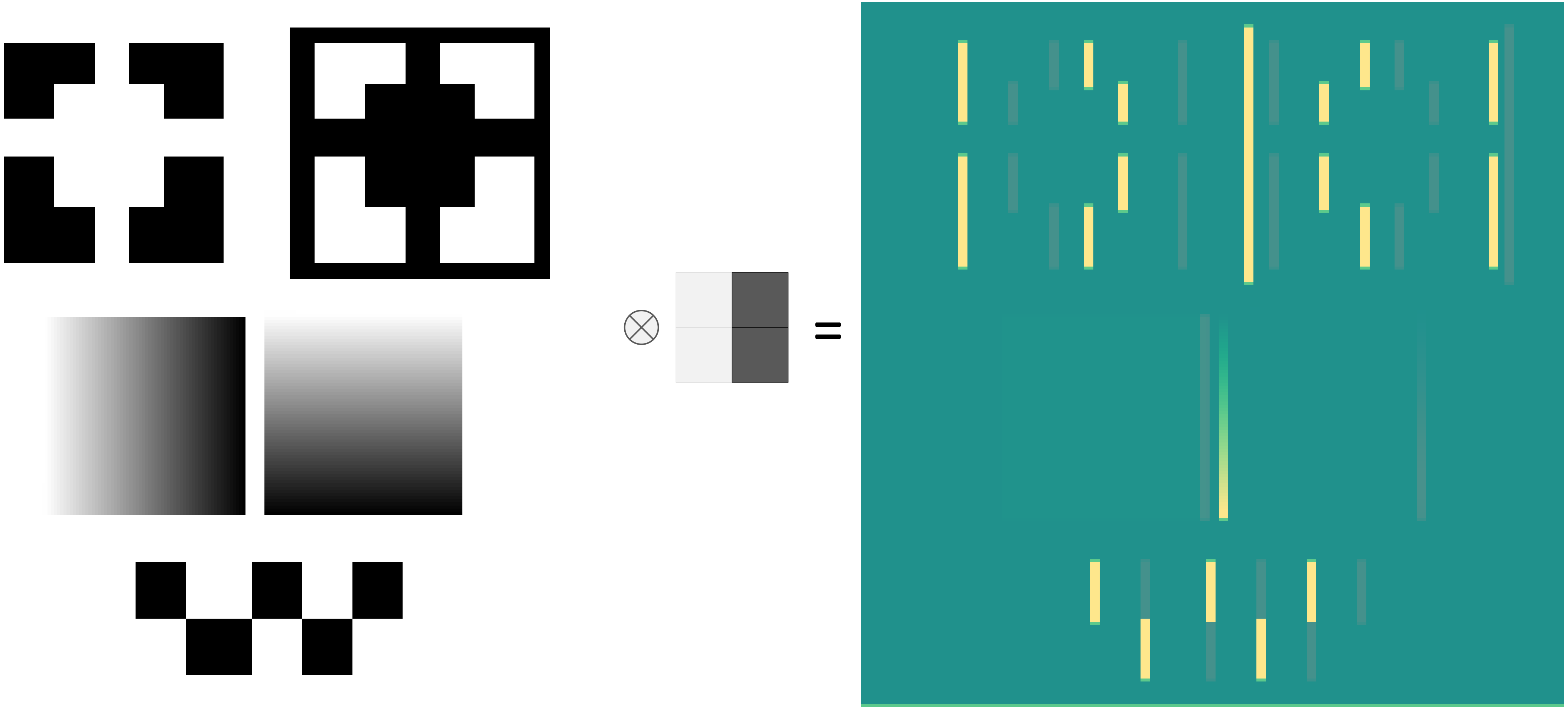
Basic operations

Convolution



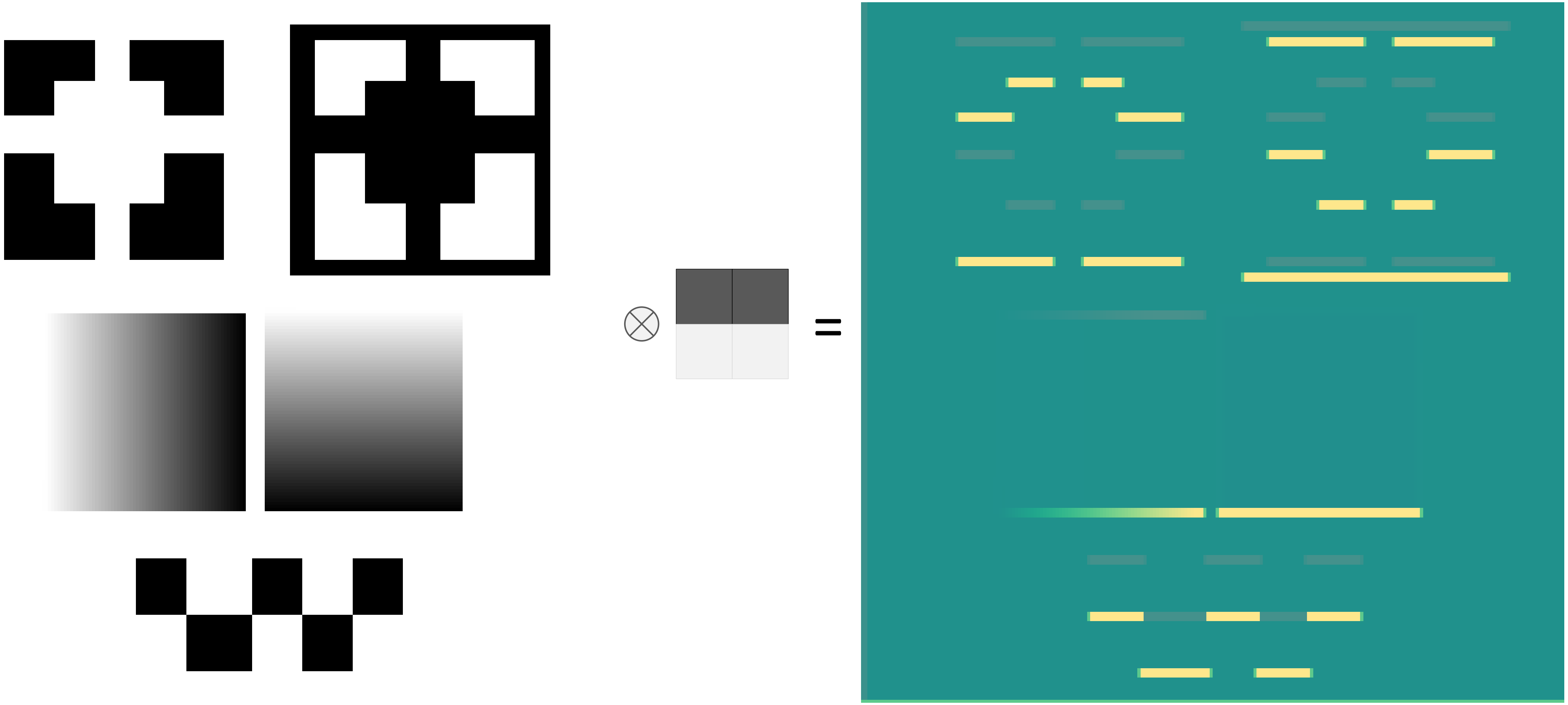
Basic operations

Convolution



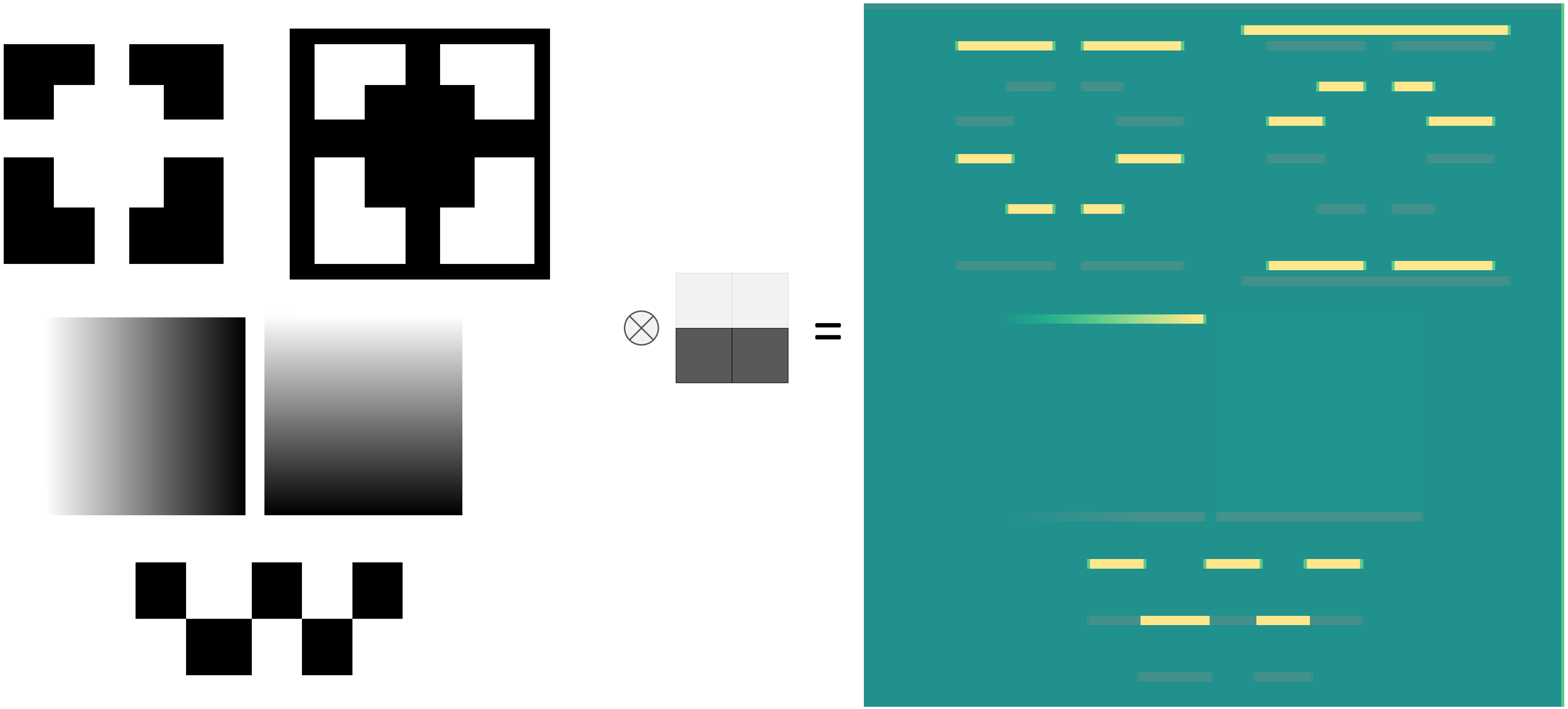
Basic operations

Convolution



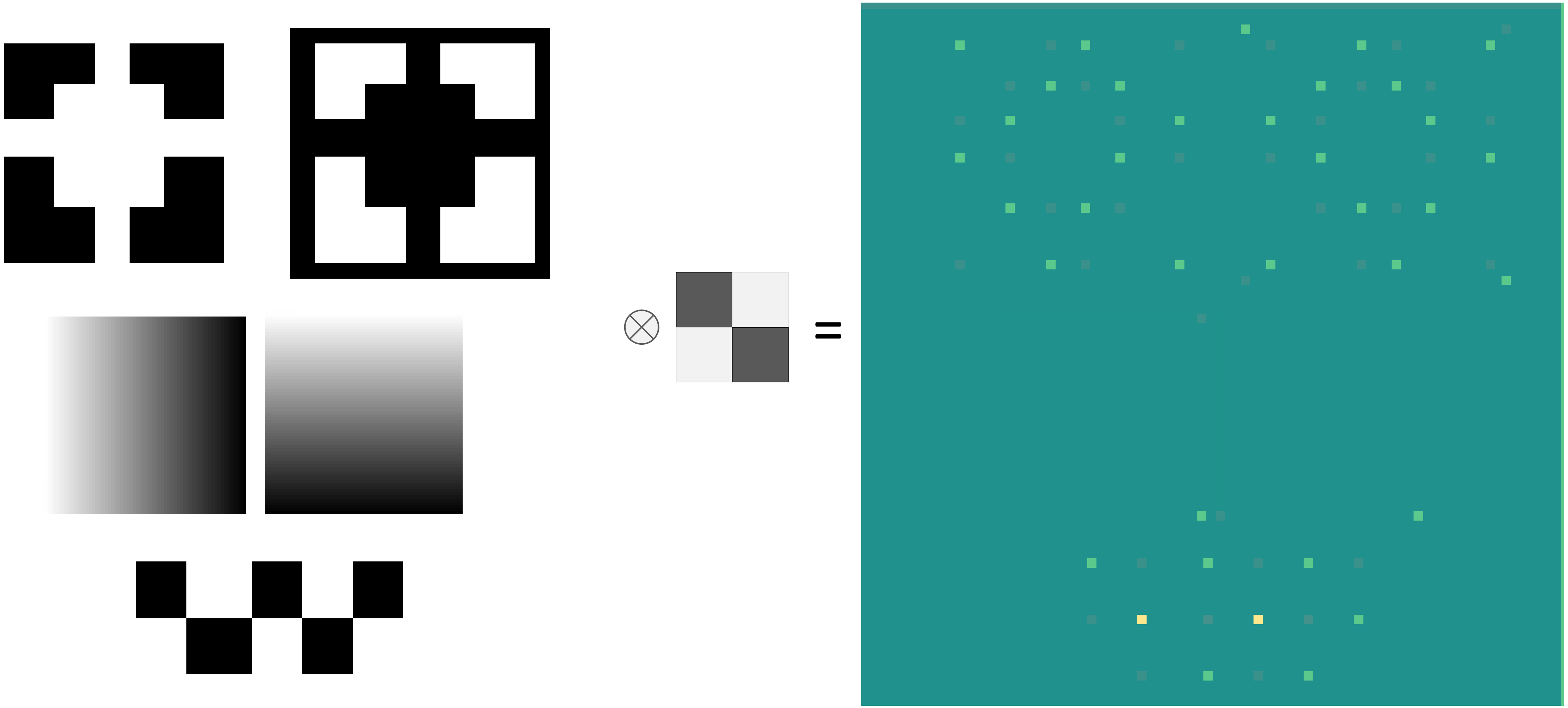
Basic operations

Convolution



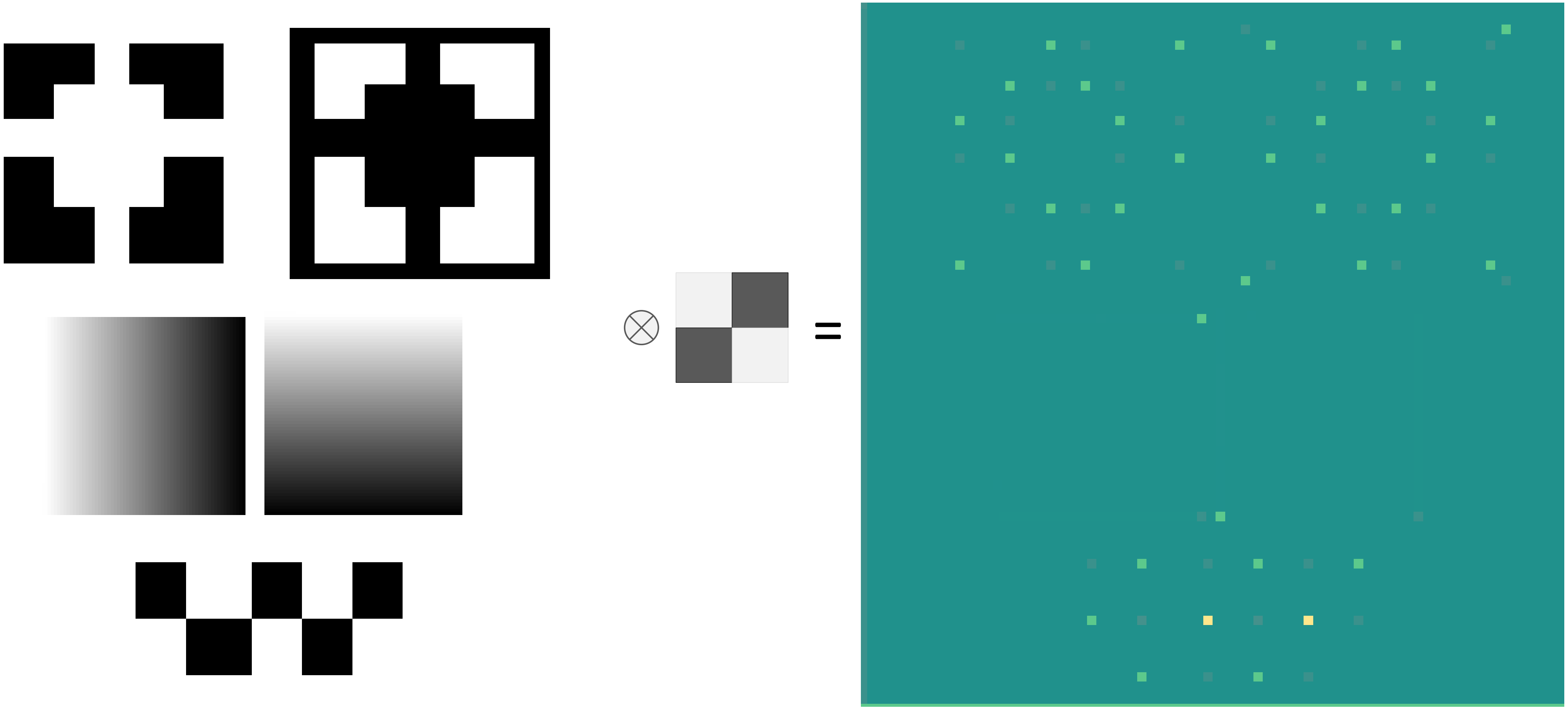
Basic operations

Convolution



Basic operations

Convolution



Basic operations

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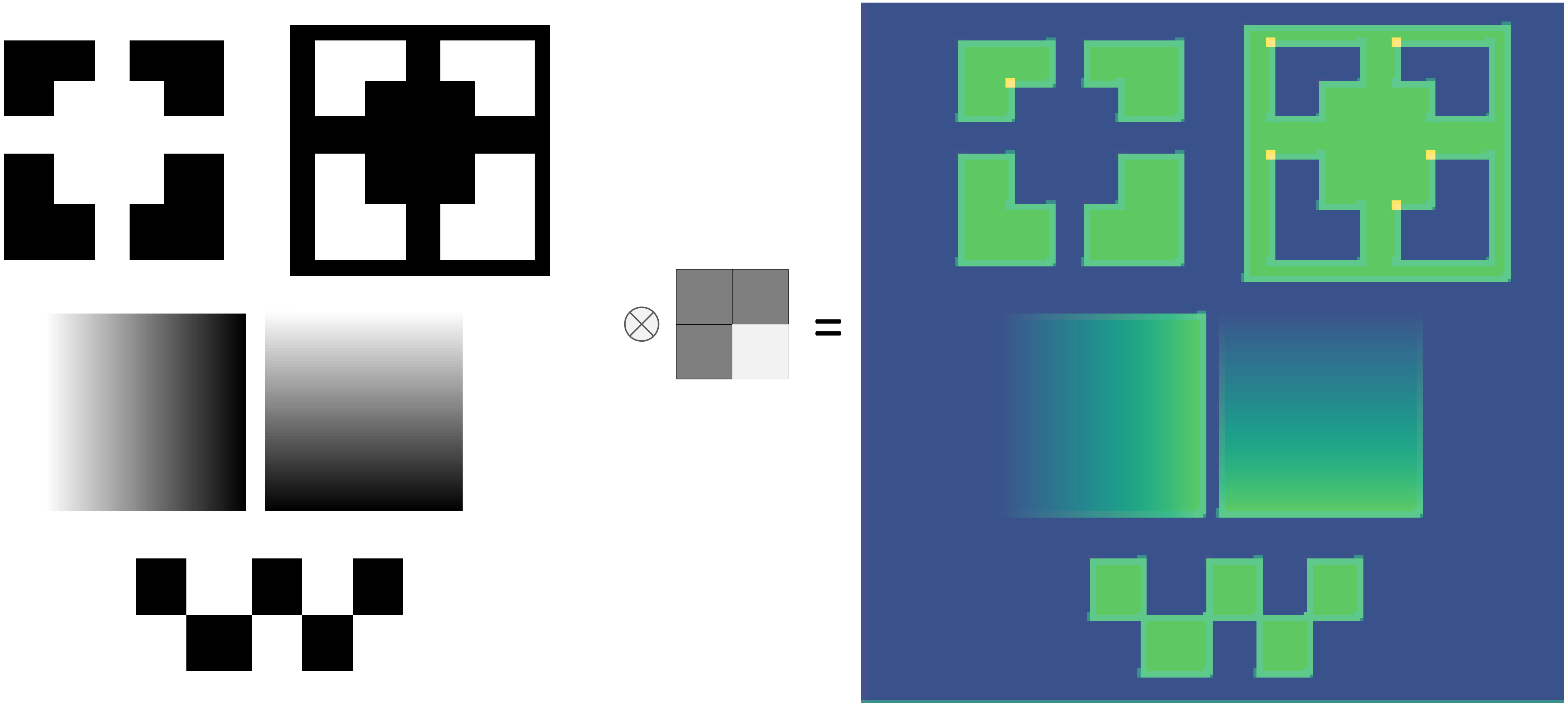
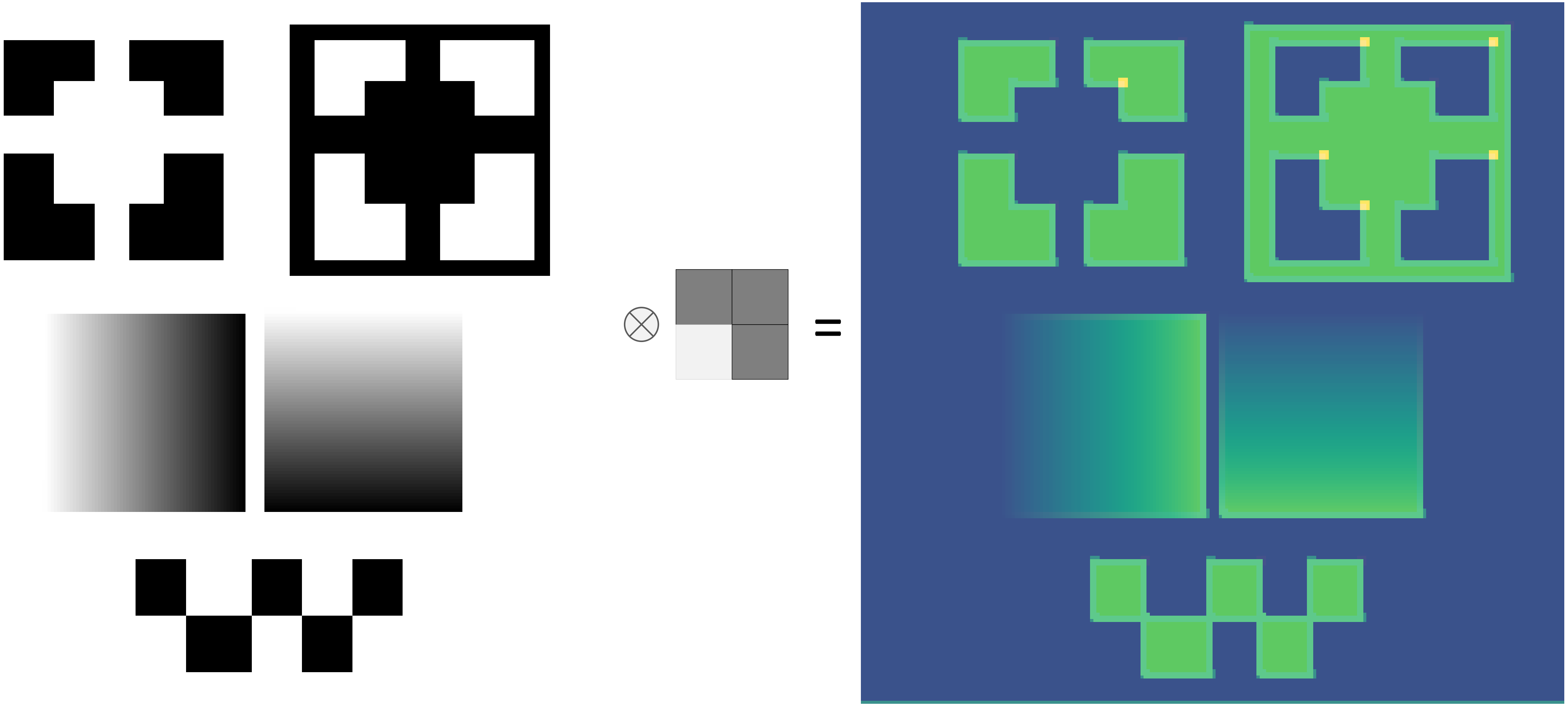


Basic operations

Convolution



Basic operations

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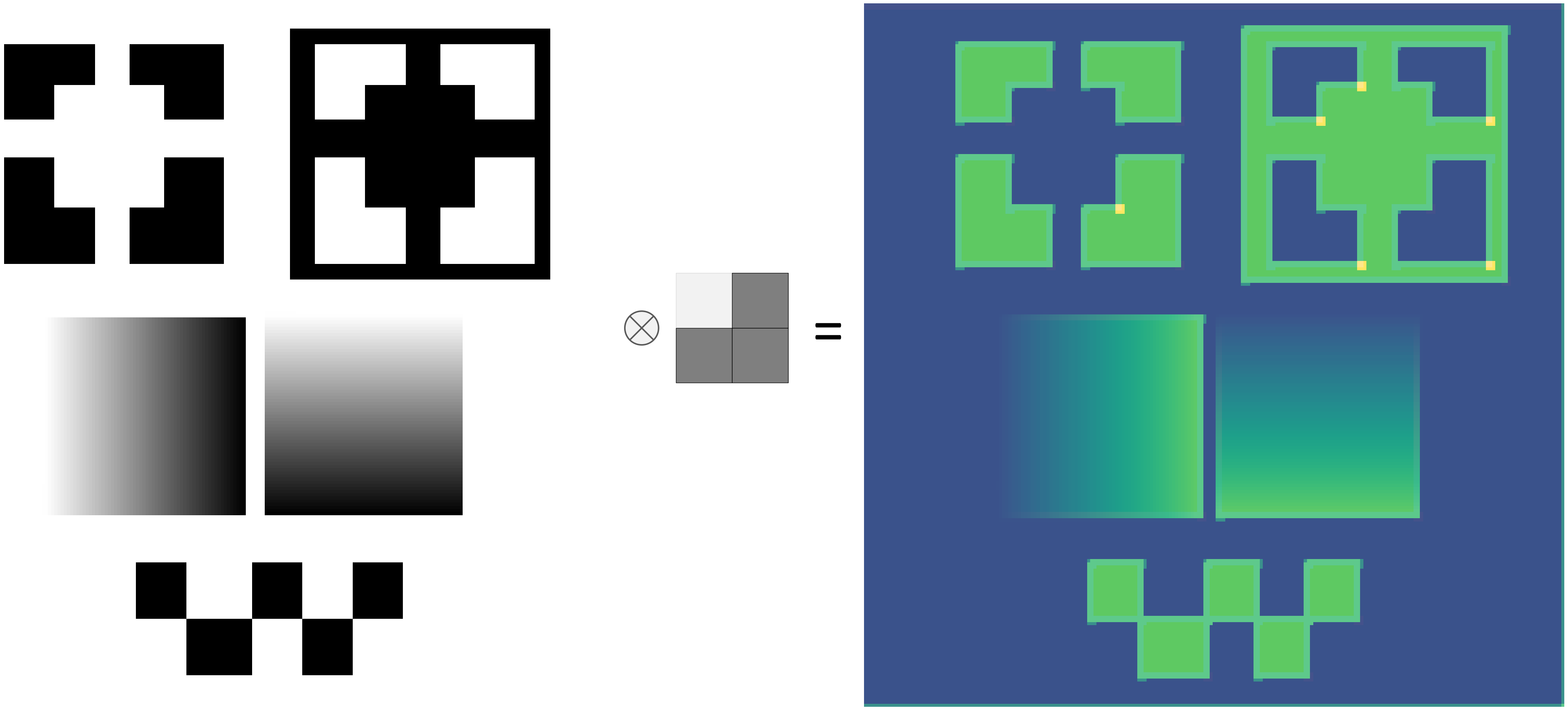
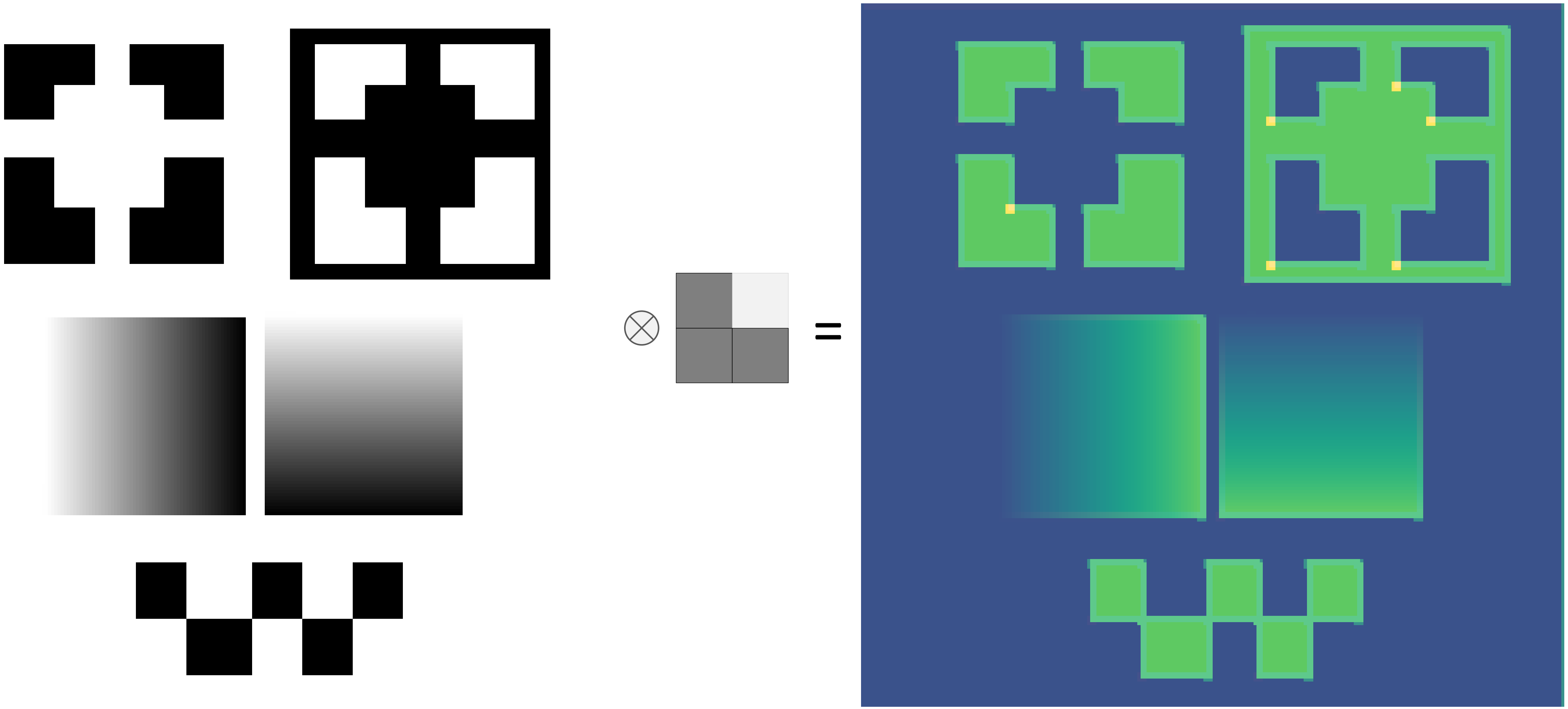


Basic operations

Convolution



Basic operations

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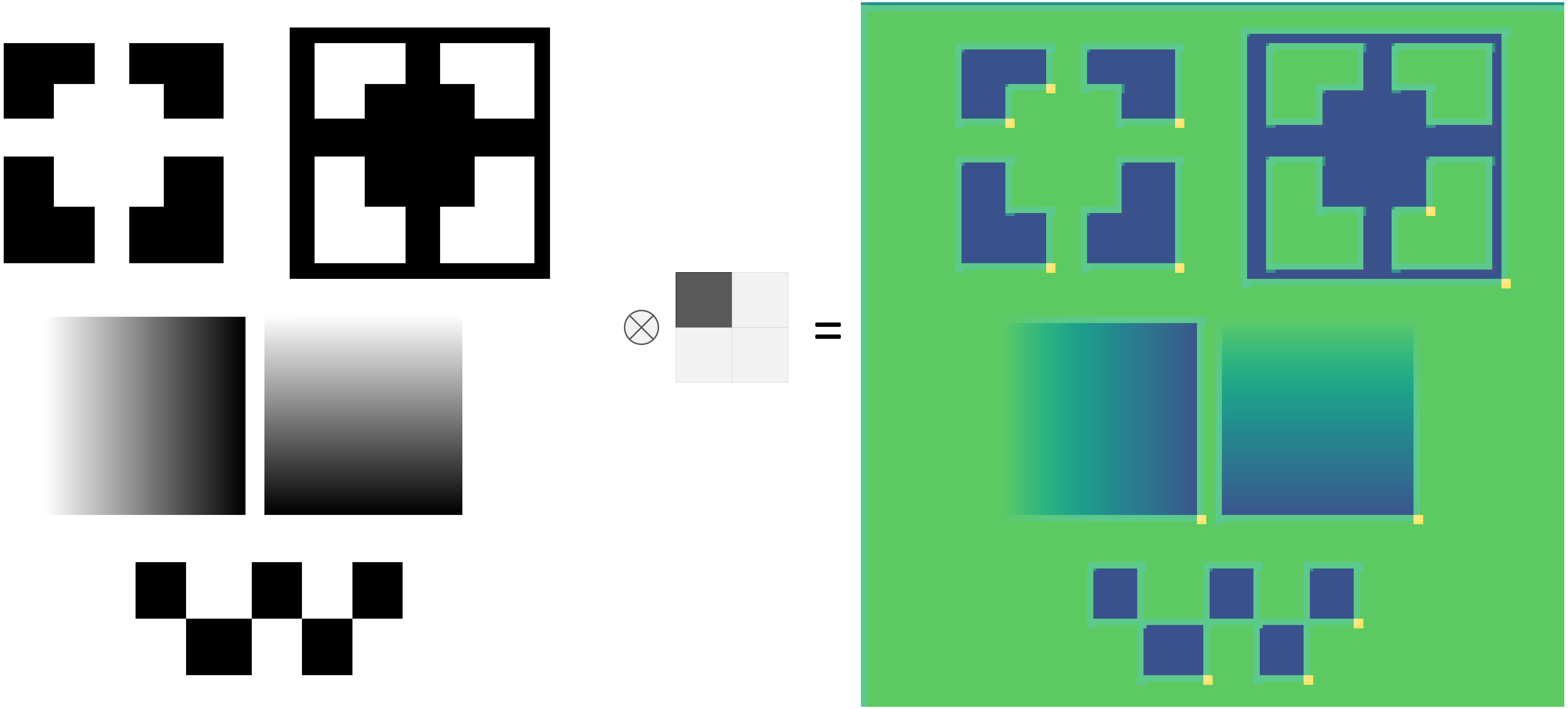

Basic operations

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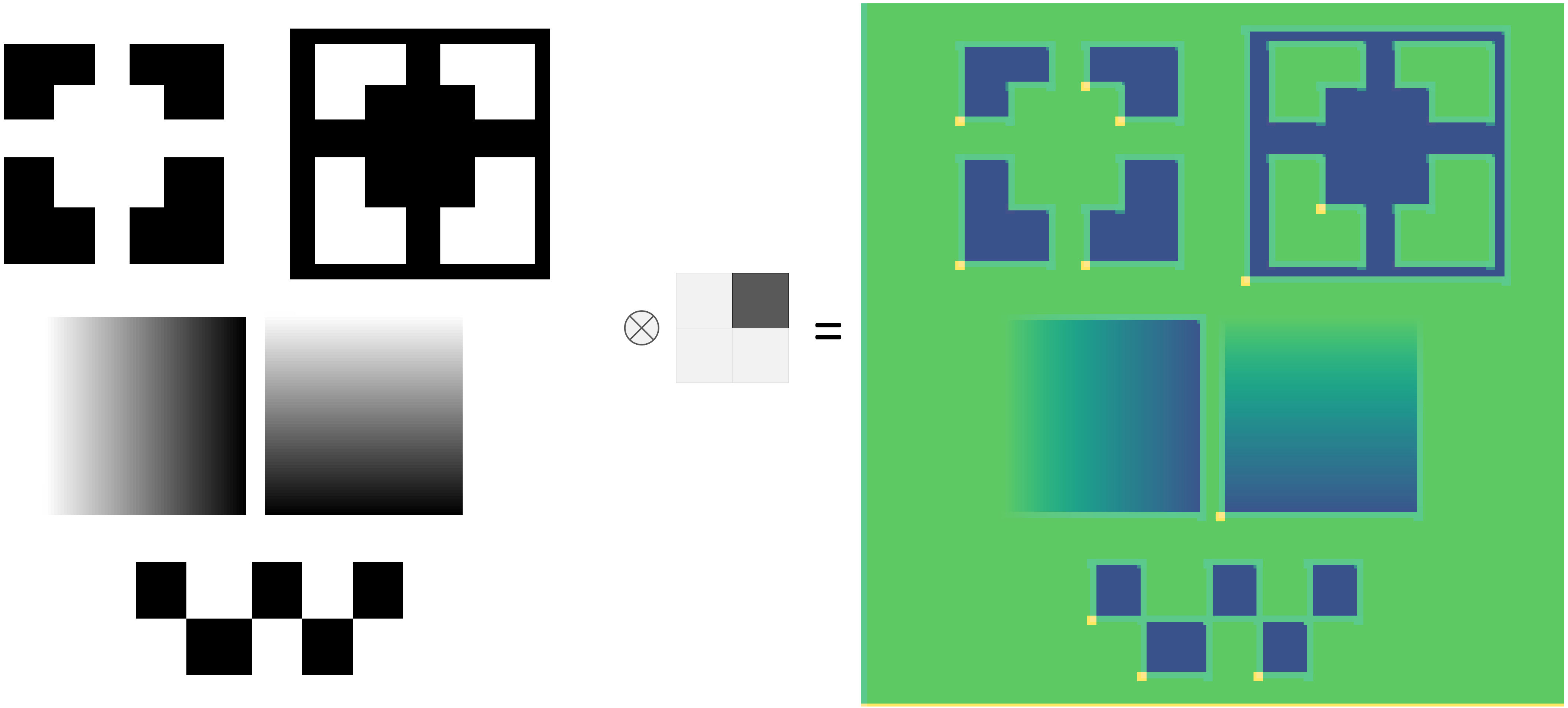

Basic operations

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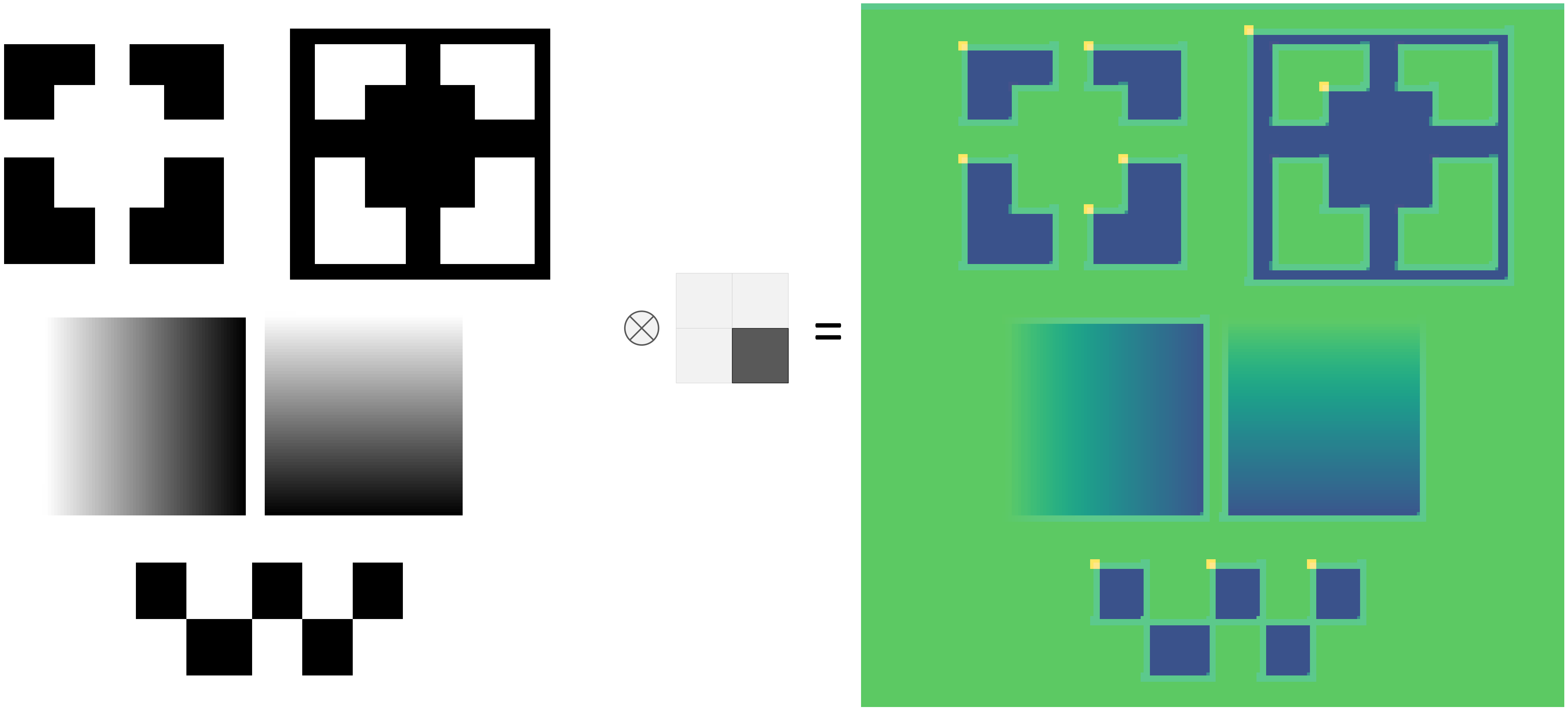

Basic operations

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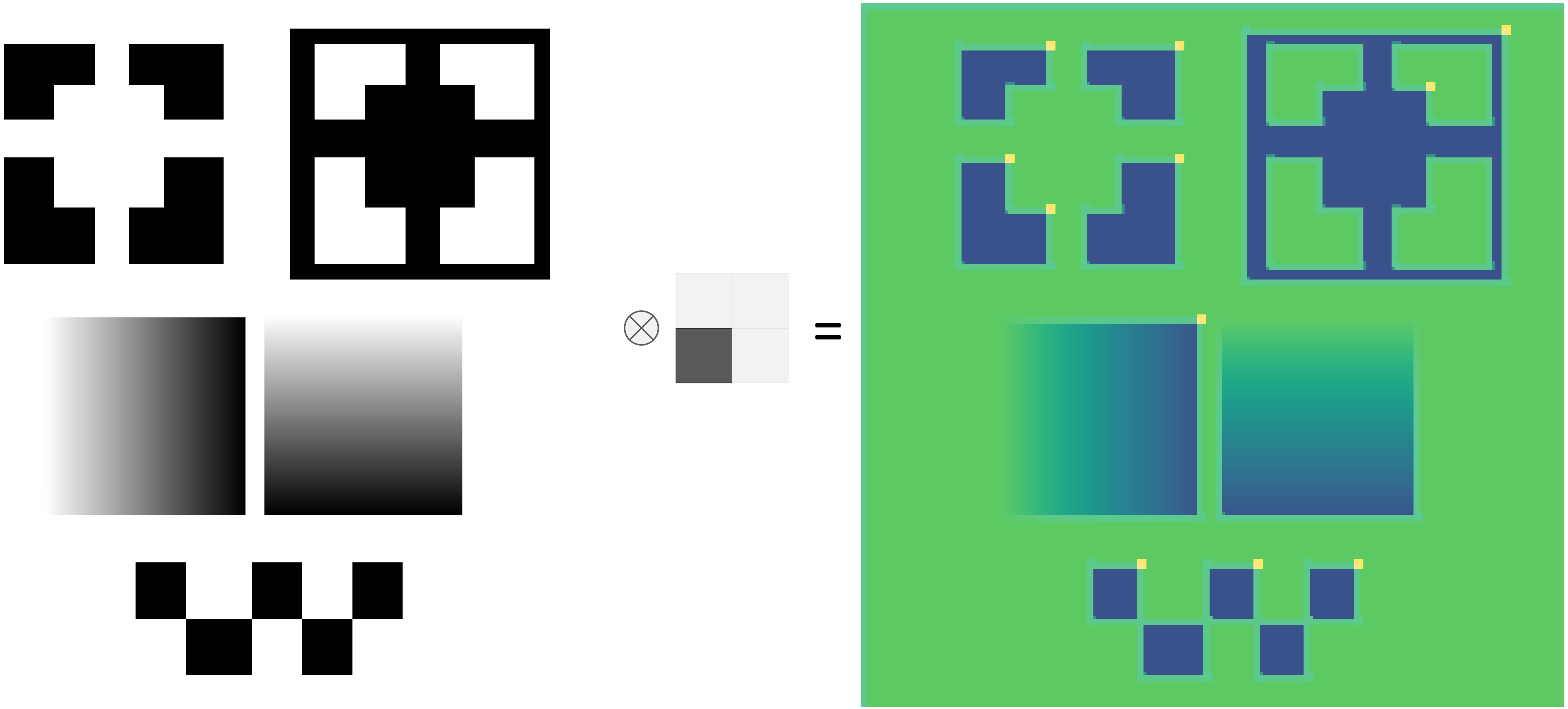
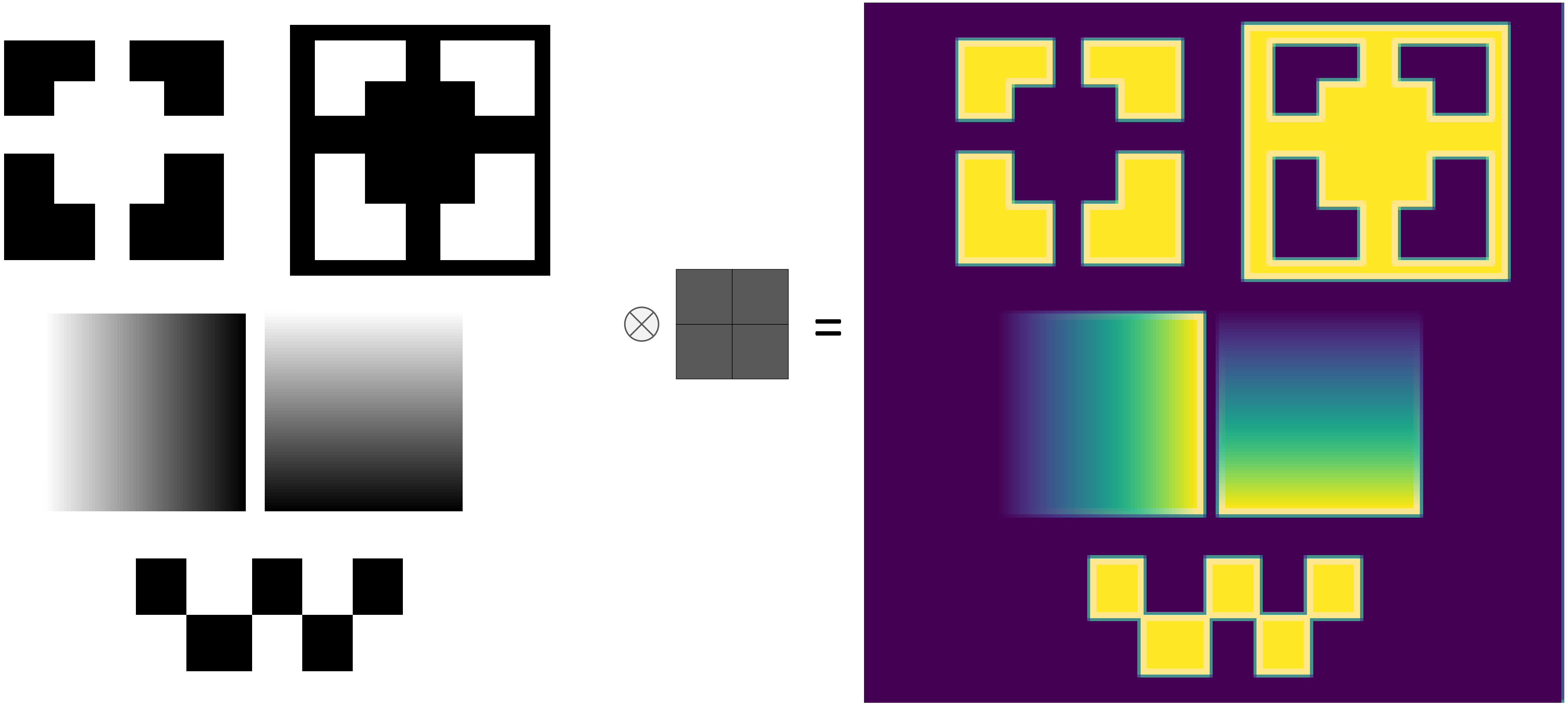


Basic operations

Convolution



Basic operations

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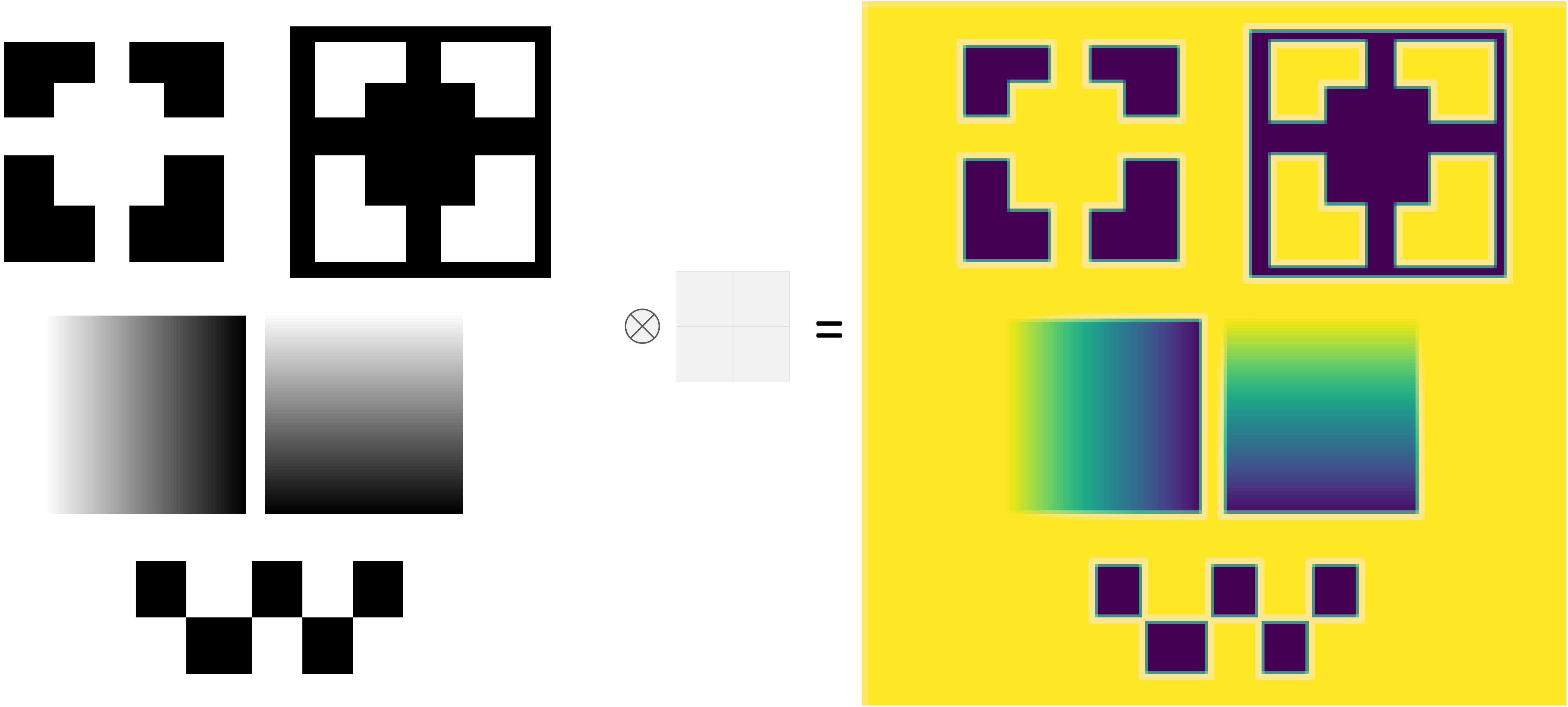
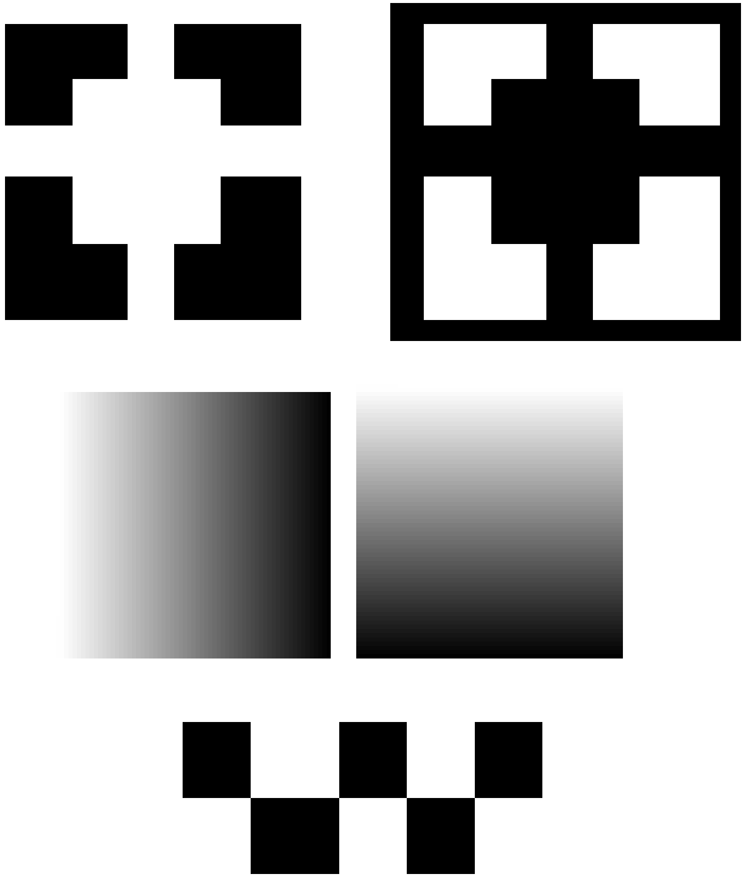
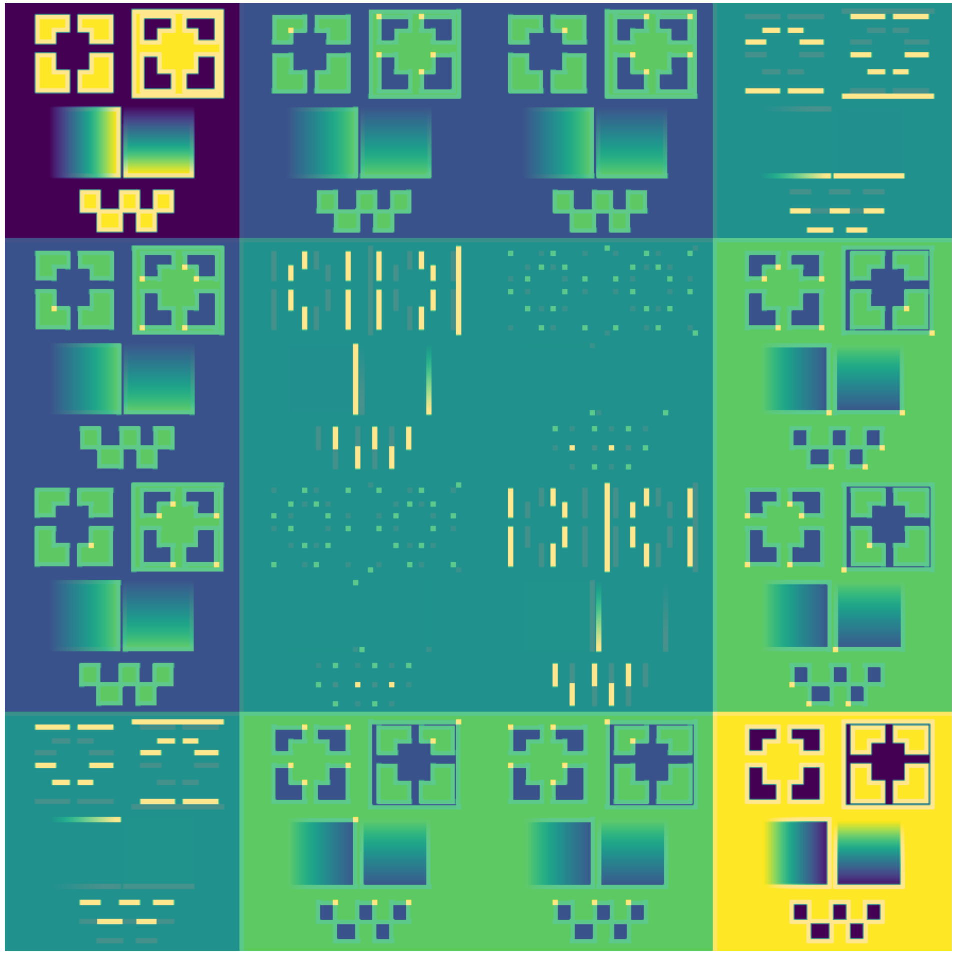


Basic operations

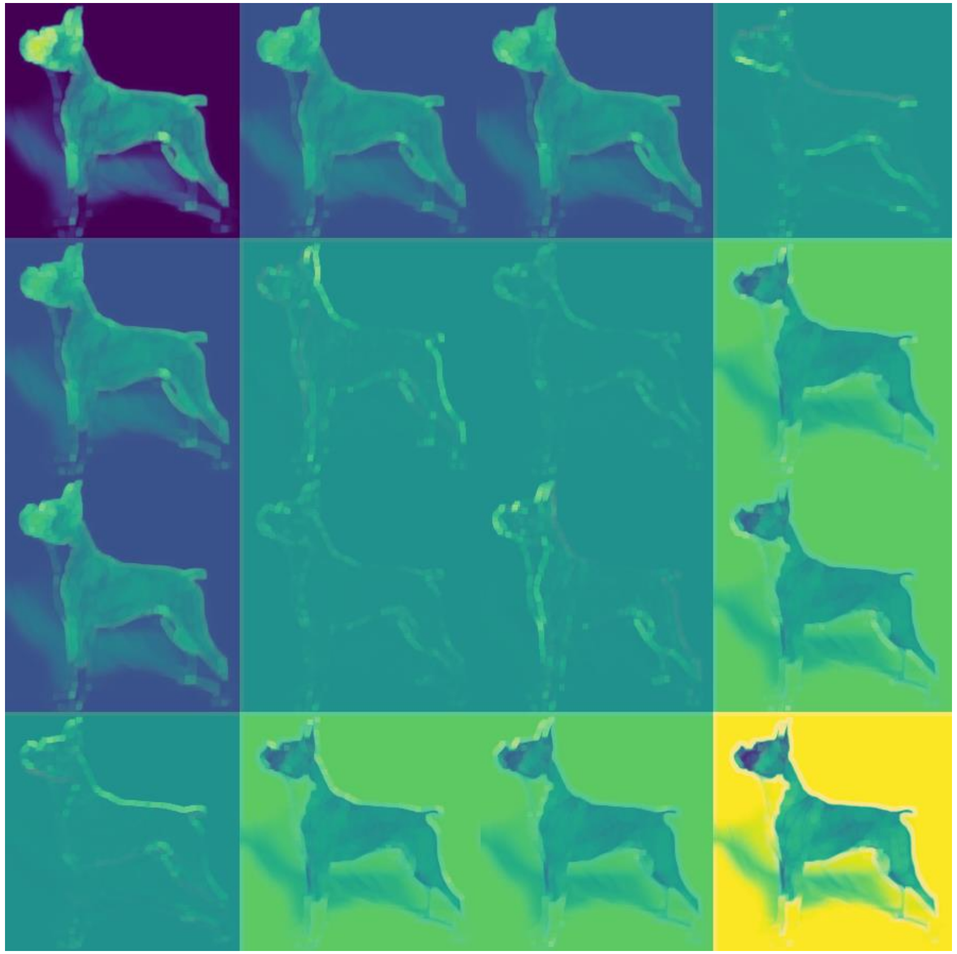
Convolution





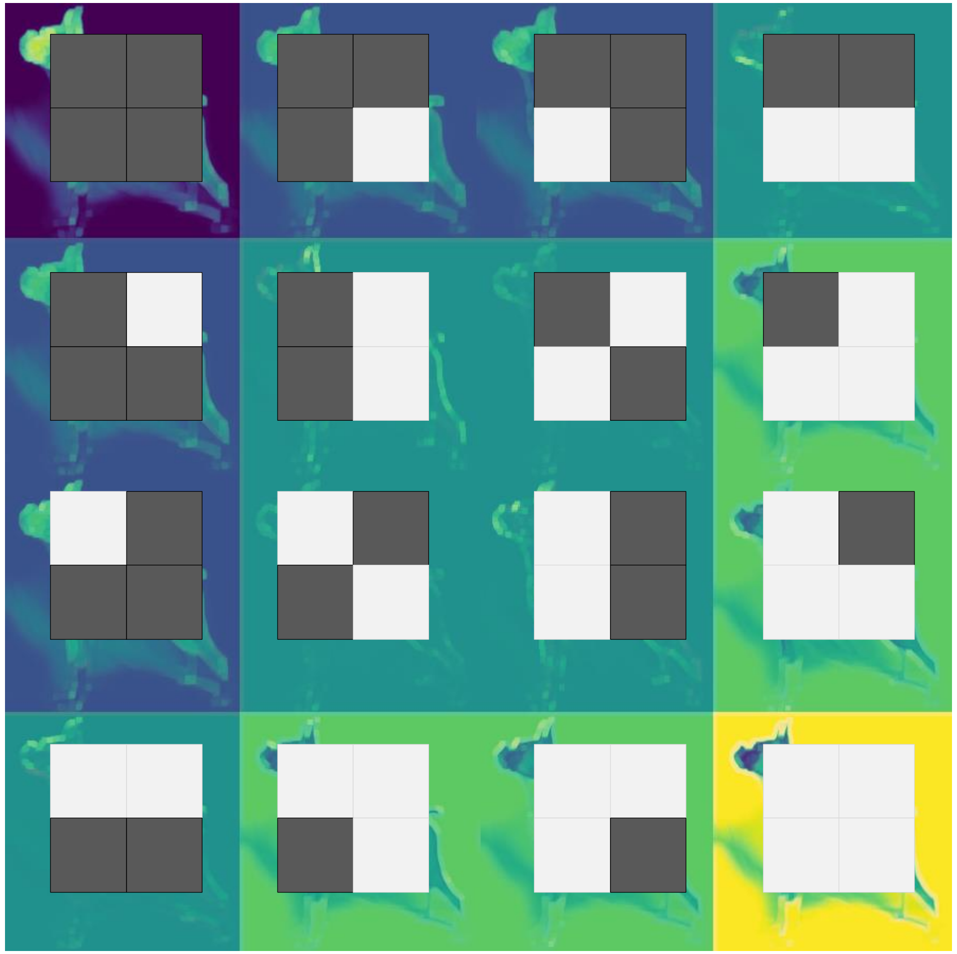
Basic operations

Convolution



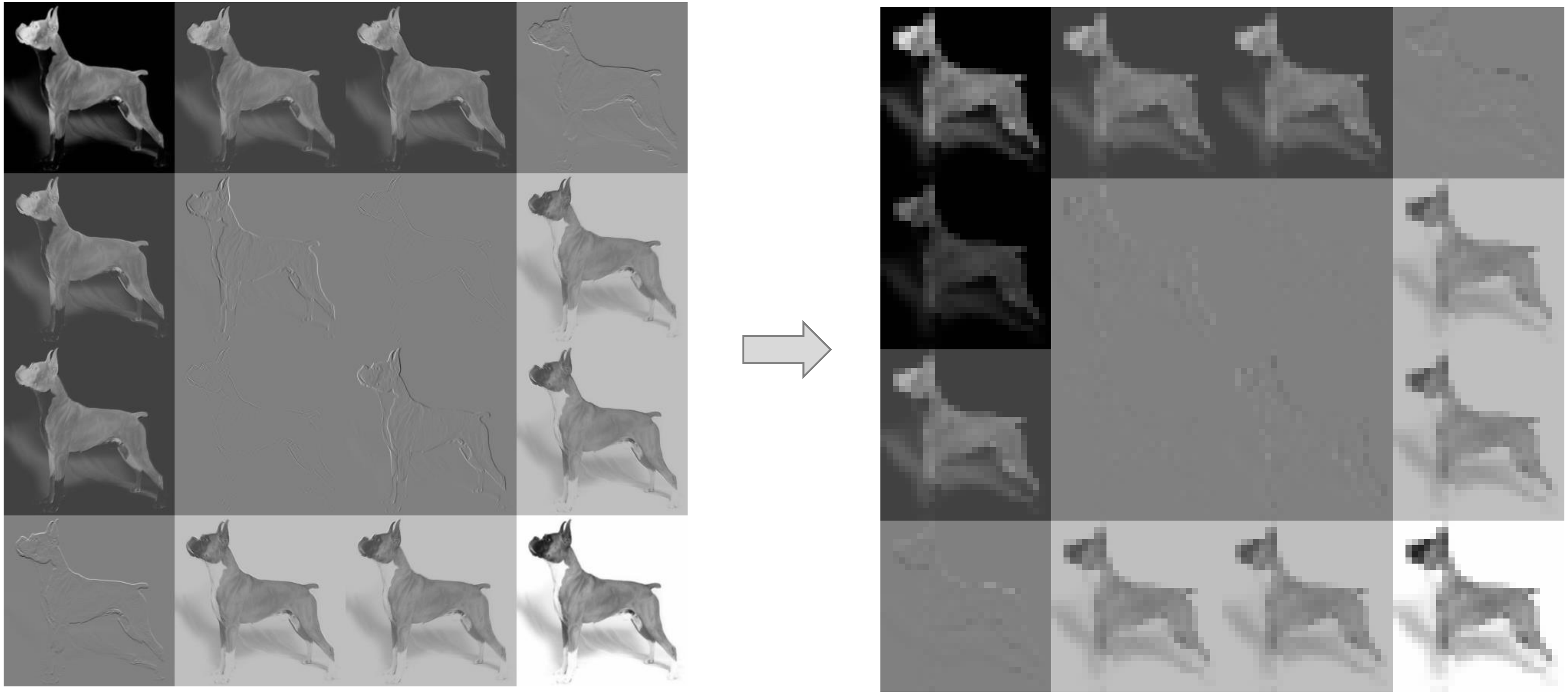
Basic operations

De-Convolution



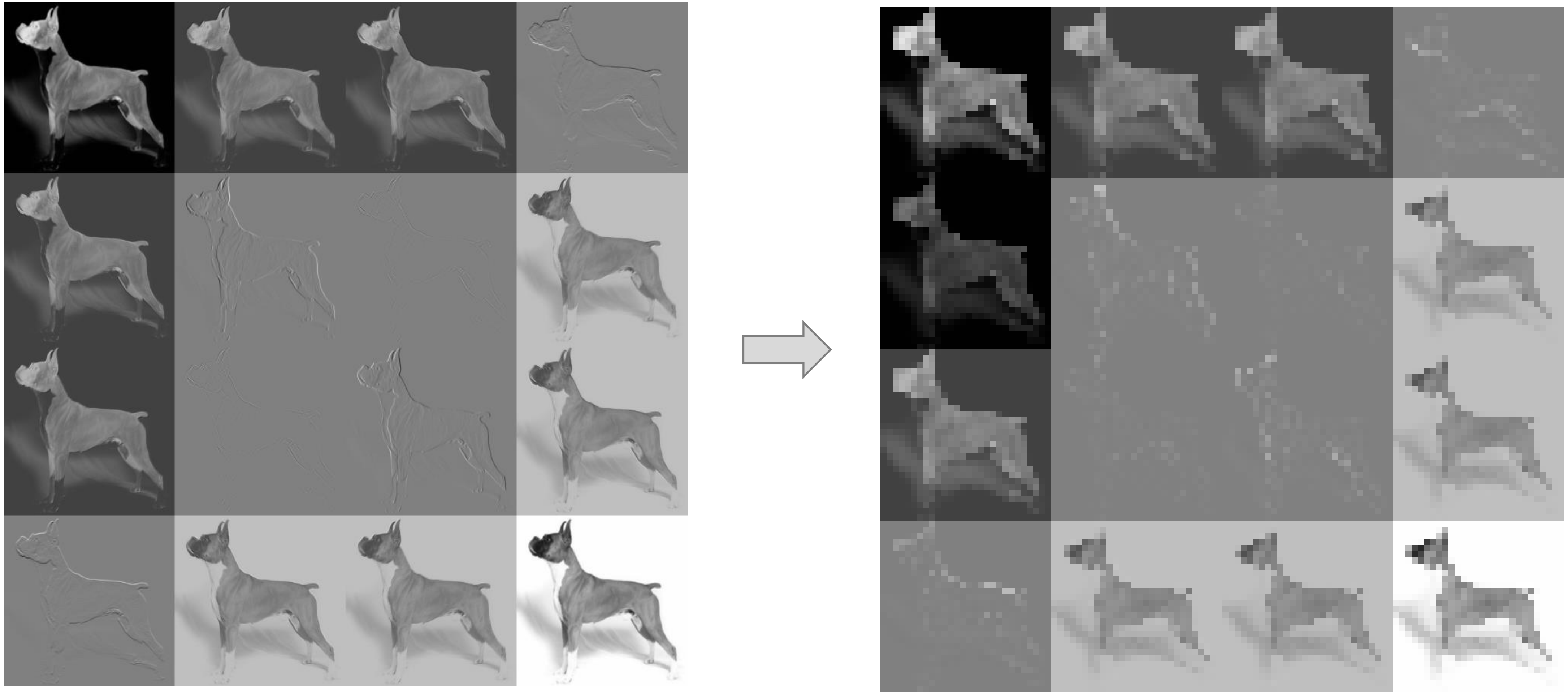
Basic operations

Pool: avg



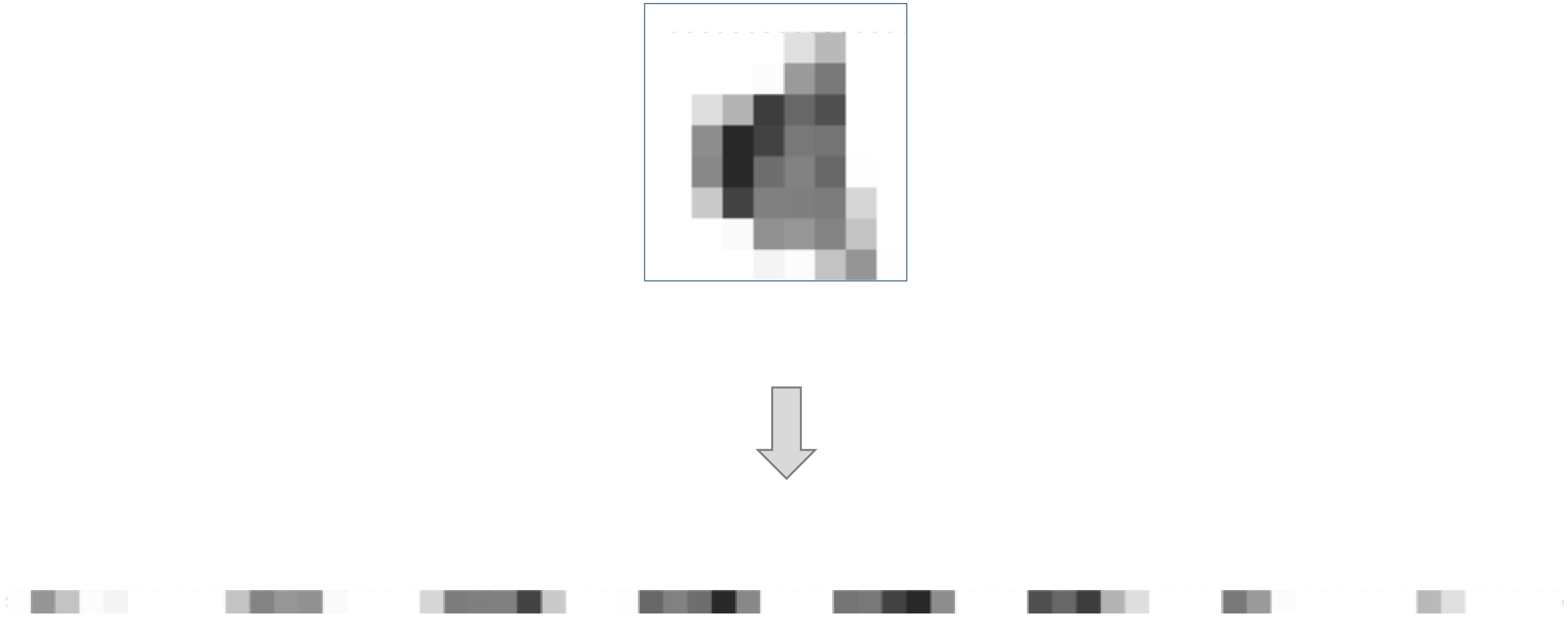
Basic operations

Pool: max



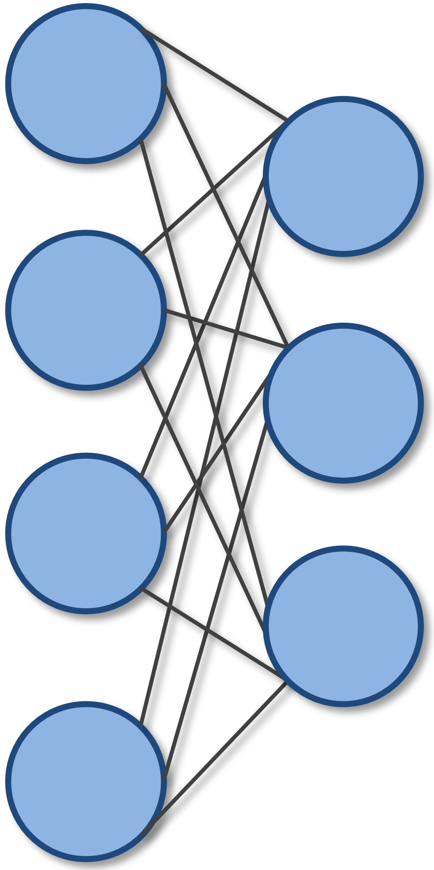
Basic operations

Flatten



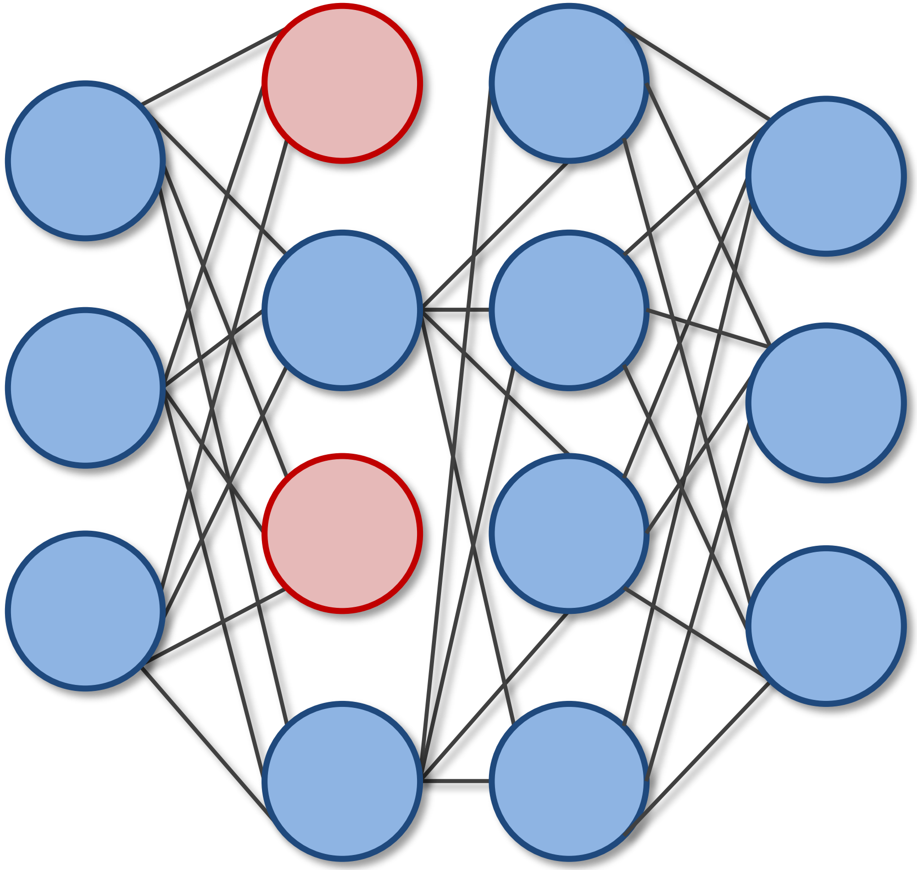
Basic operations

Fully Connected



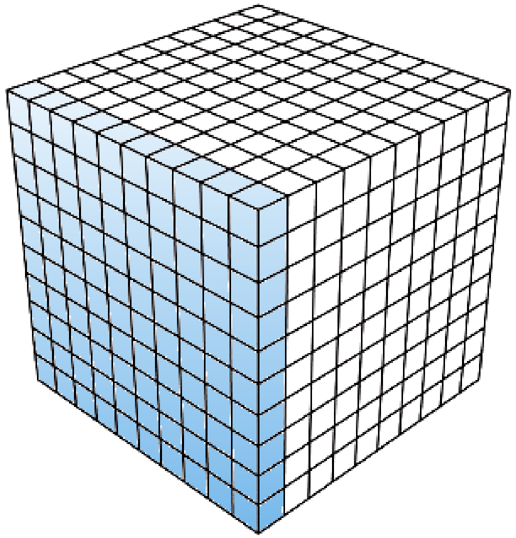
Basic operations

Dropout

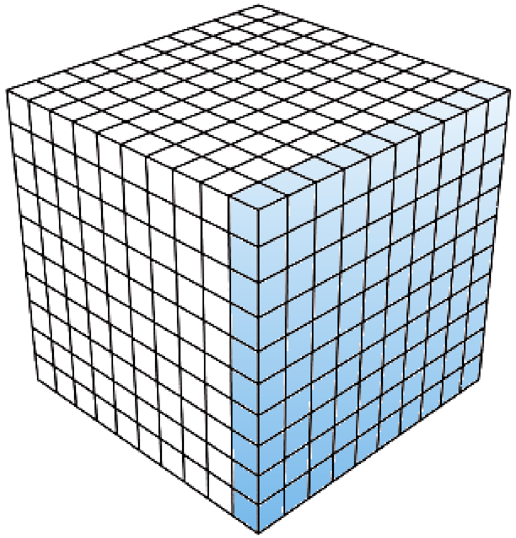


Basic operations

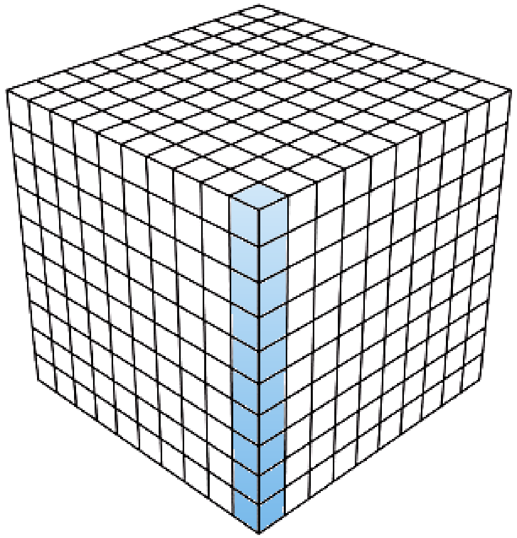
Normalization



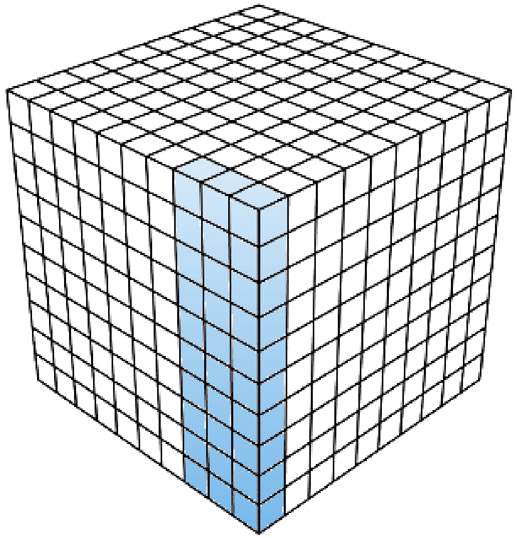
layer



batch



instance



group