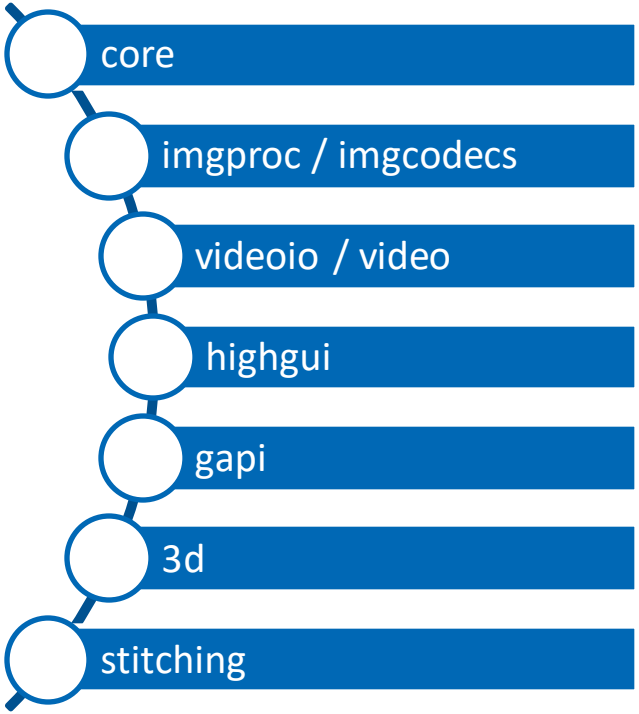
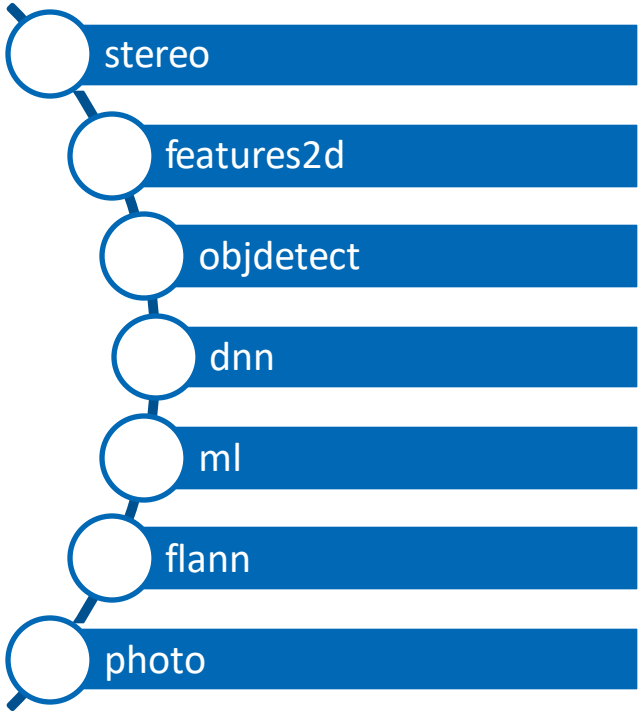
Курс лекций по компьютерному зрению

Введение в библиотеку OpenCV: Модуль DNN

Нестеров Александр, AI Frameworks Engineer

Main modules

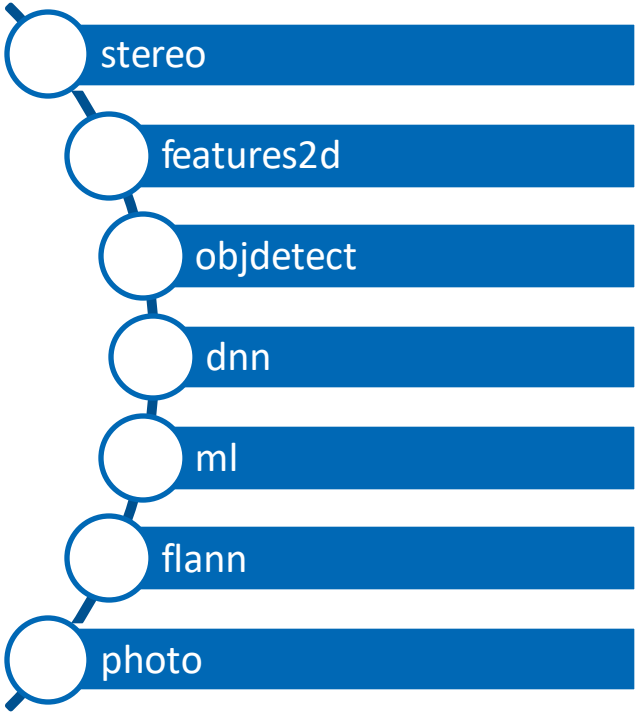




OpenCV

https://github.com/opencv/opencv

Main modules



- Поддержка глубоких сверточных нейронных сетей
- OpenVINO модуль

https://docs.opencv.org/5.x/d6/d0f/group__dnn.html

Main structure: **Mat**

cv::Mat A(h, w, CV_8UC3);

- Size, step
- Ref counter (=1)
- Data pointer

cv::Mat B = A;

- Size, step
- Ref counter (=2)
- Same data pointer

cv::Mat C=A(roi);

Size of the ROI, same step
Ref counter (=3)
Augmented data pointer

Main structure: **Mat**

cv::Mat C=A(roi);

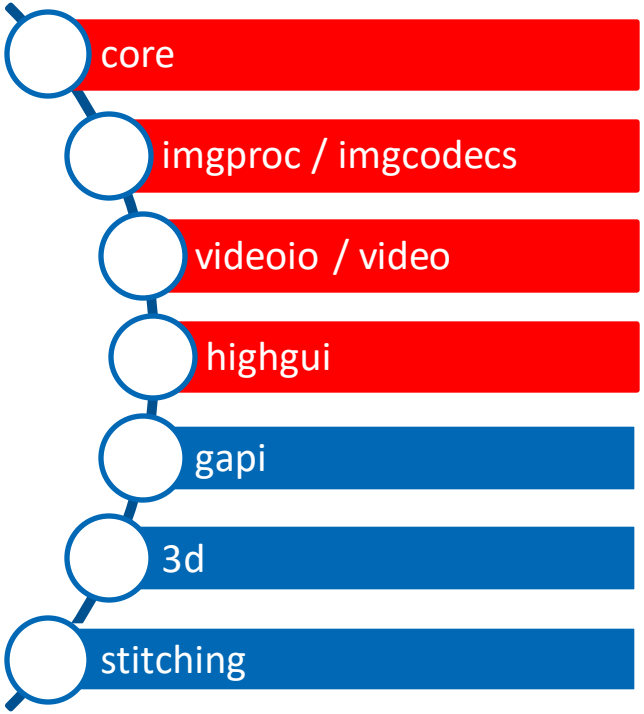
Size of the ROI, same step
Ref counter (=3)
Augmented data pointer

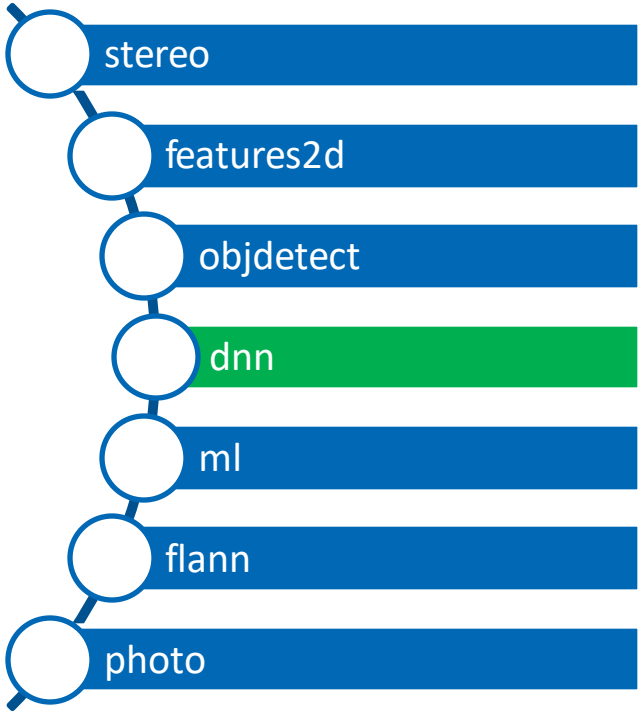
Раскладка памяти матрицы C

RGBRGBRGBRGB**********RGBRGBRGBRGB**********
…

OpenCV

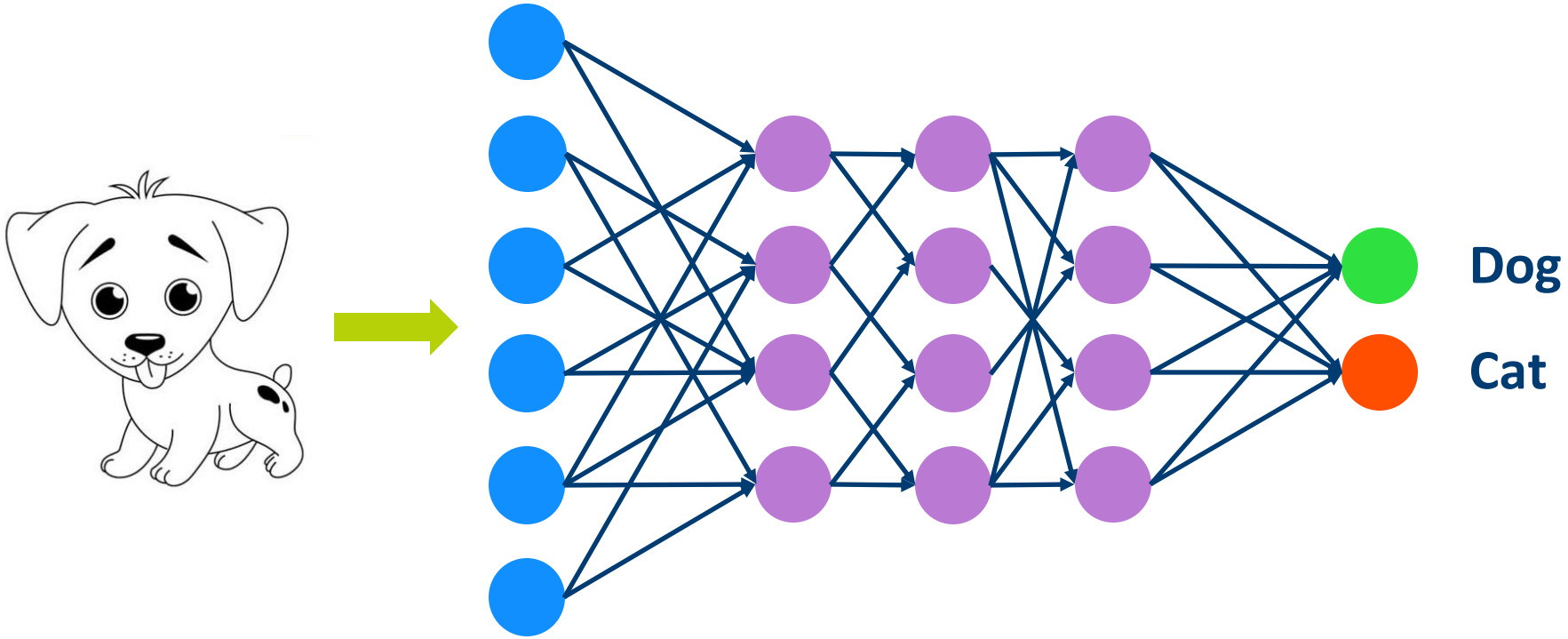
Main modules





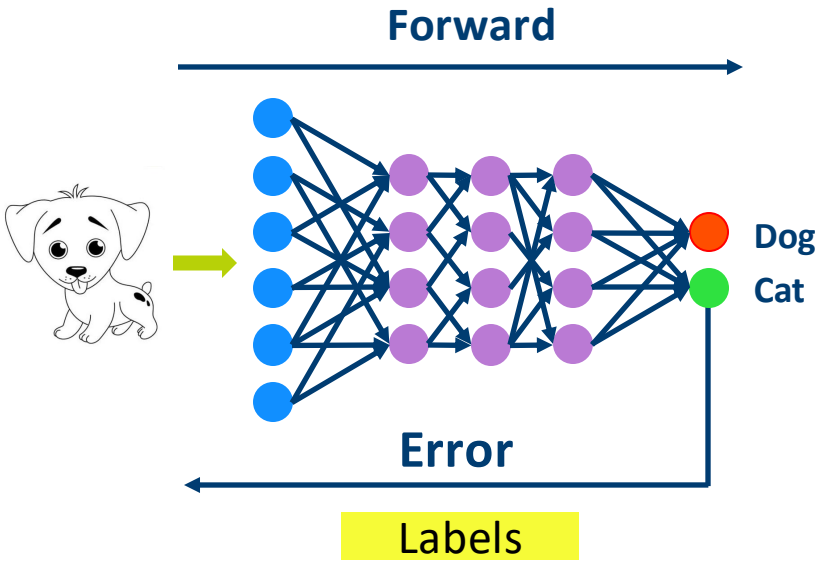
https://github.com/learning-process/opencv_practice

Deep neural network

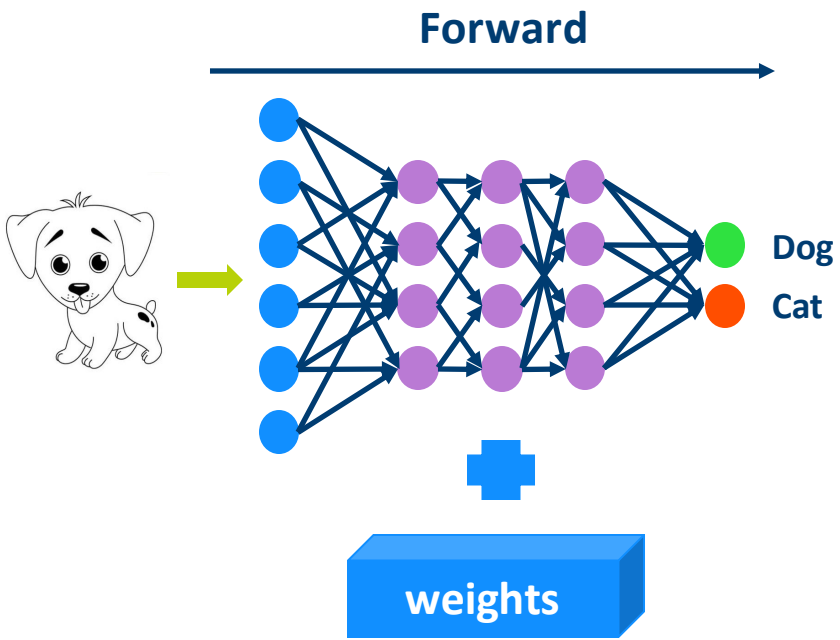


What can be done with DNN?

Learning



Inference



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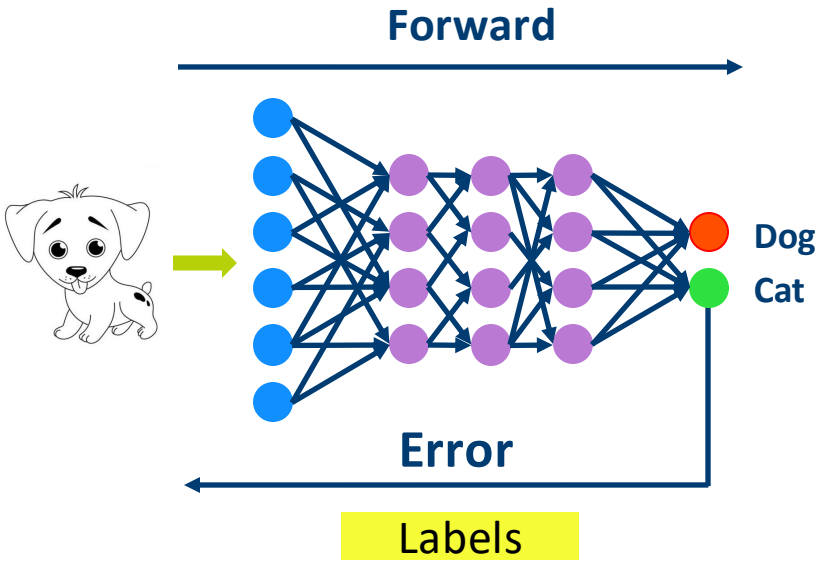
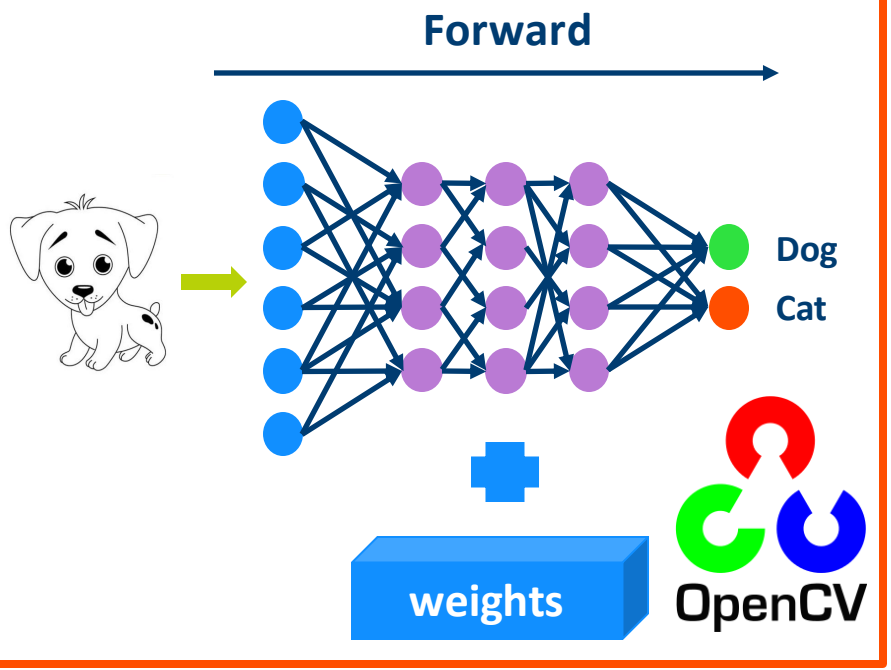
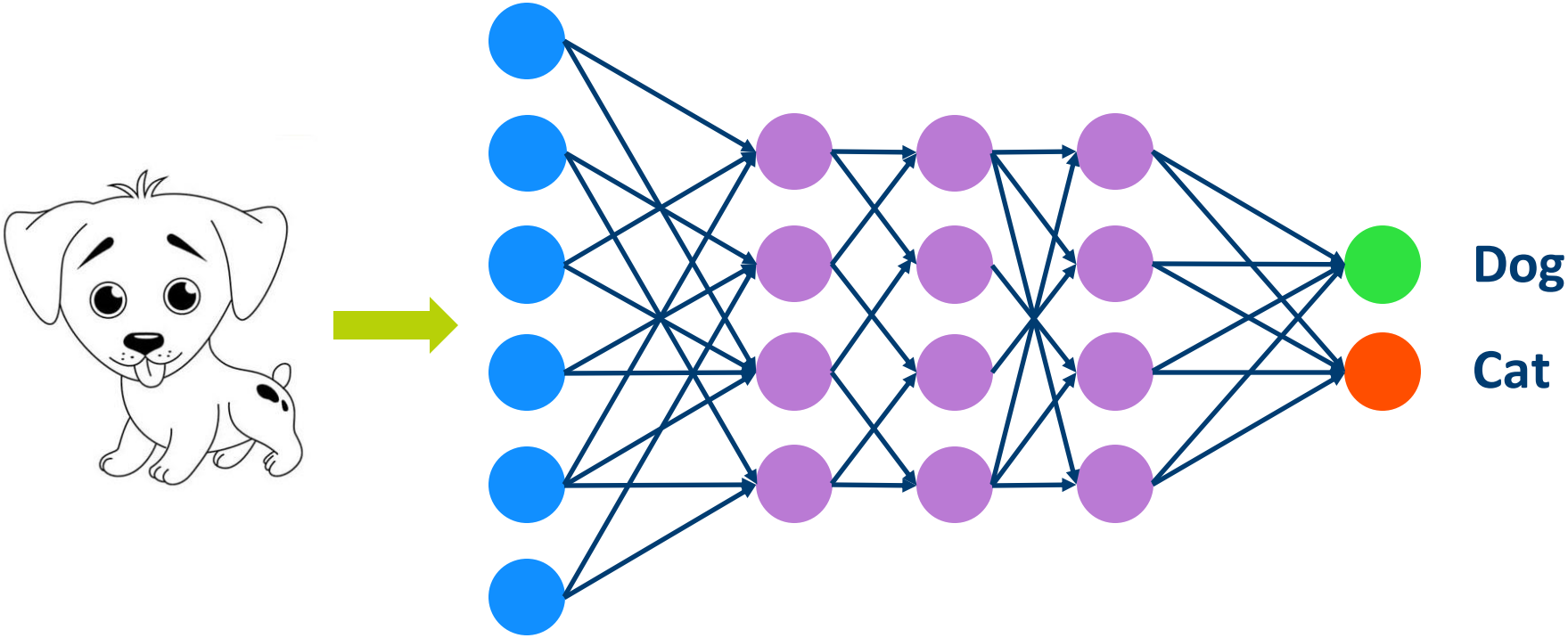


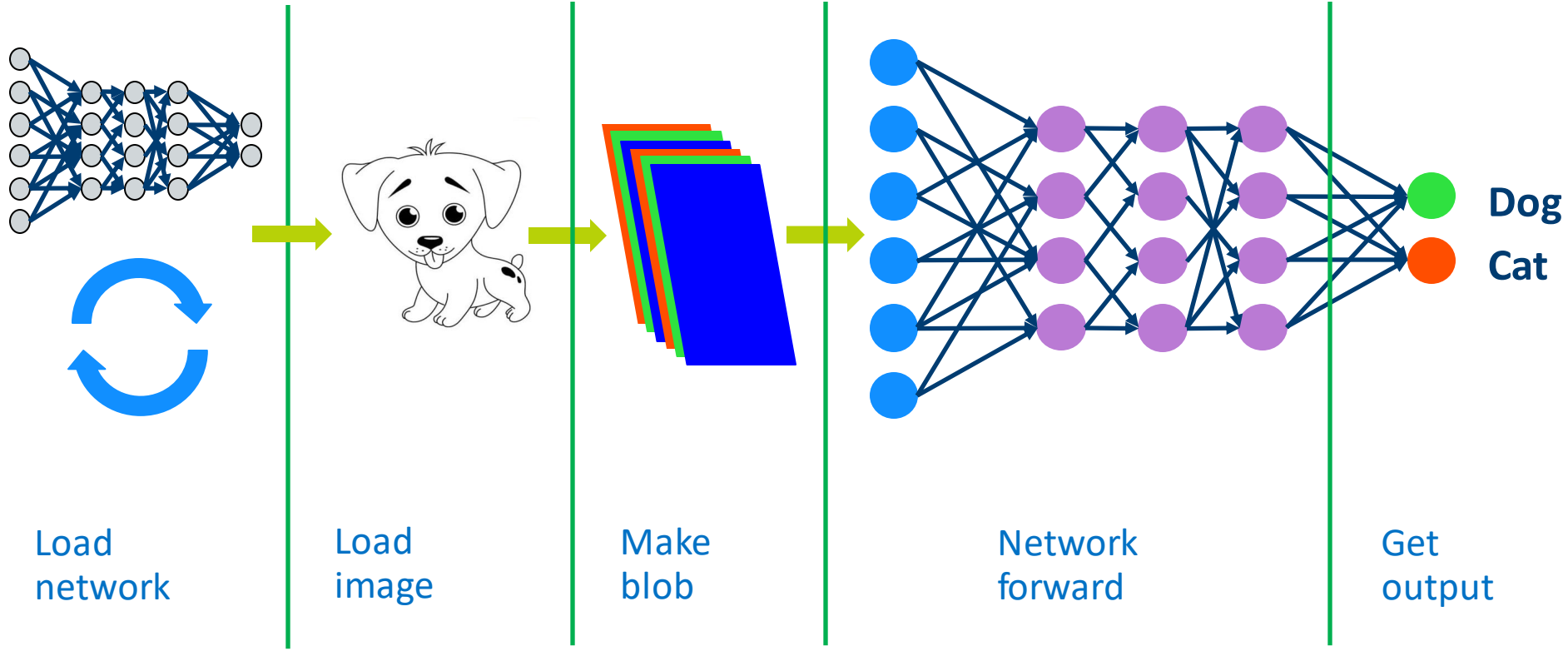
Inference



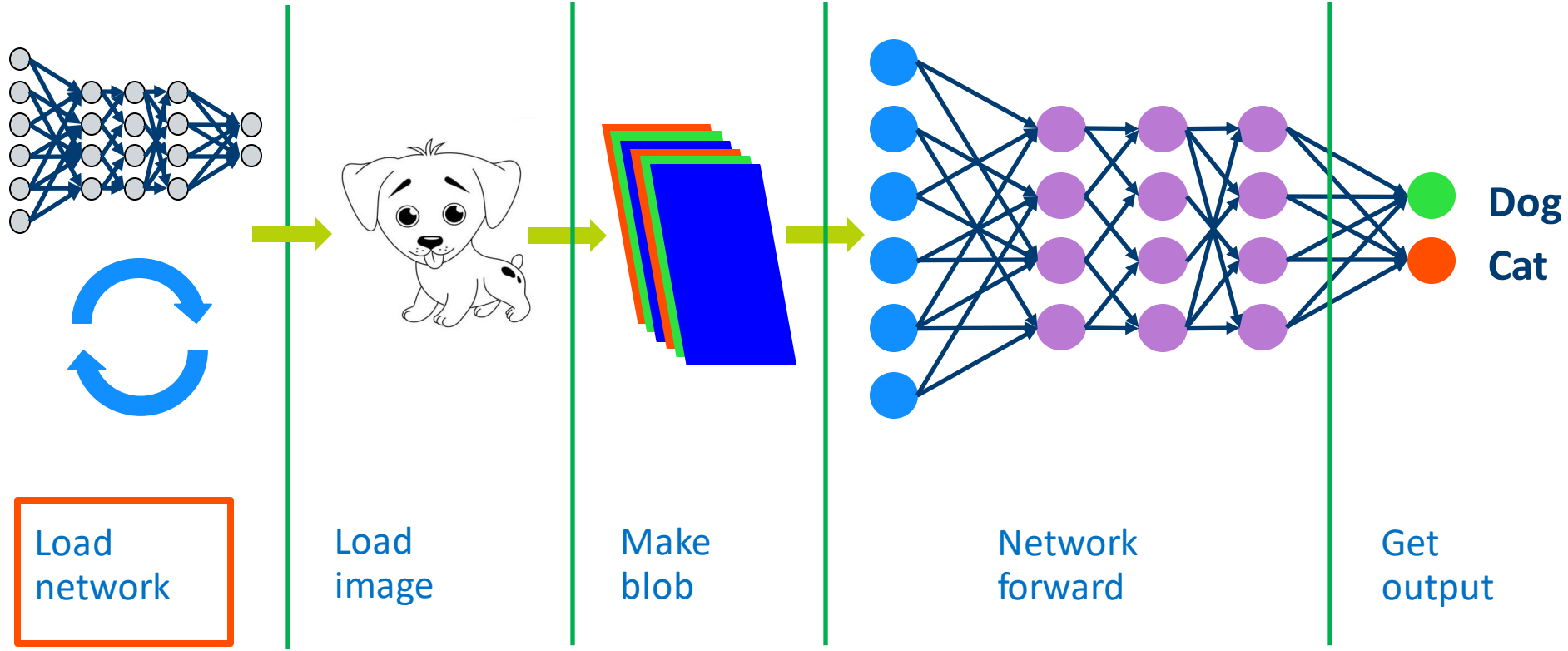
Deep neural network



Deep neural network

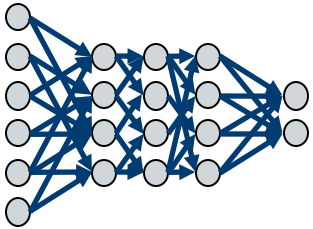


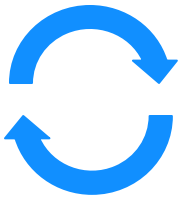
OpenCV DNN module



OpenCV DNN module

Load network



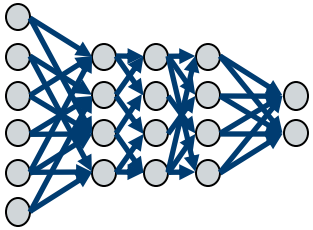


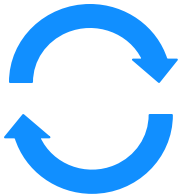
```
Net net = readNet(model, config);
net.setPreferableBackend(backendId);
net.setPreferableTarget(targetId);
```

Load network

OpenCV DNN module

Load network





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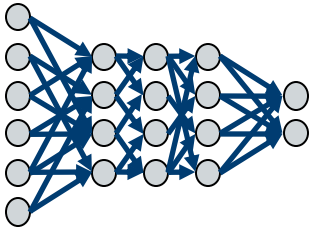
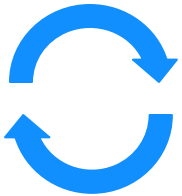
OpenCV DNN module

Load network





Load network

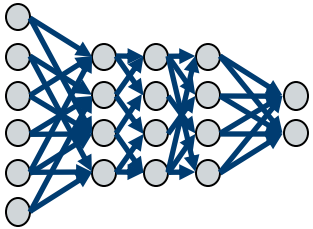
```
Net net = readNet(model, config);
net.setPreferableBackend(backendId);
net.setPreferableTarget(targetId);
```

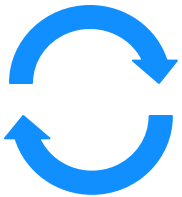
Caffe

ONNX

OpenCV DNN module

Load network





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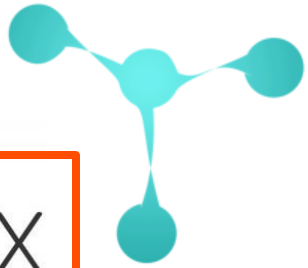
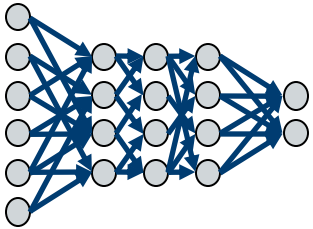
Caffe

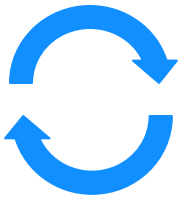


ONNX

OpenCV DNN module

Load network





Load network

```
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net.setPreferableBackend(backendId);
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```

PYTORCH

mxnet

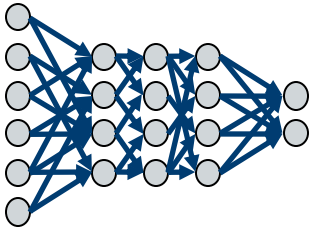
ONNX

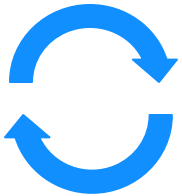
Caffe2

Microsoft CNTK

OpenCV DNN module

Load network





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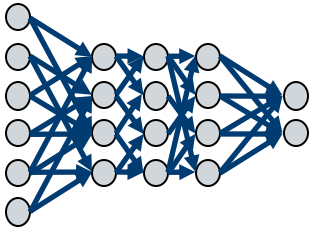
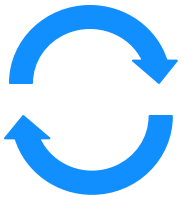
OpenCV DNN module

Load network





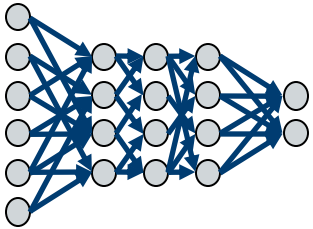
Load network

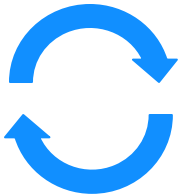
```
Net net = readNet(model, config);
net.setPreferableBackend(backendId);
net.setPreferableTarget(targetId);
```

```
int backendId = DNN_BACKEND_DEFAULT;
int backendId = DNN_BACKEND_OPENCV;
int backendId = DNN_BACKEND_INFERENCE_ENGINE;
int backendId = DNN_BACKEND_HALIDE;
```

OpenCV DNN module

Load network





Load network

OpenCV

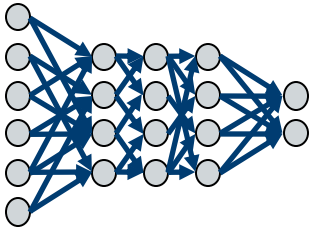
OpenVINO™

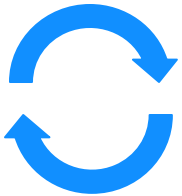
Halide

```
int backendId = DNN_BACKEND_DEFAULT;
int backendId = DNN_BACKEND_OPENCV;
int backendId = DNN_BACKEND_INFERENCE_ENGINE;
int backendId = DNN_BACKEND_HALIDE;
```

OpenCV DNN module

Load network





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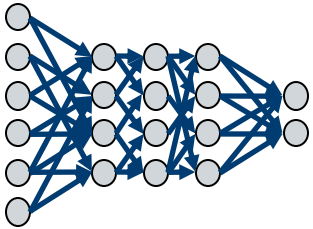
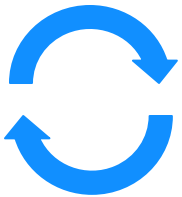
```

OpenCV DNN module

Load network





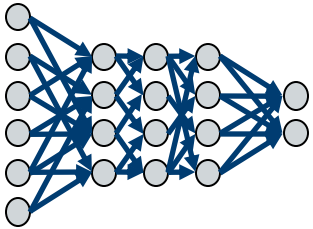
Load network

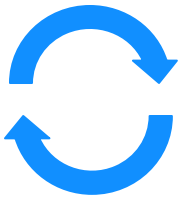
```
Net net = readNet(model, config);
net.setPreferableBackend(backendId);
net.setPreferableTarget(targetId);
```

```
int targetId = DNN_TARGET_CPU;
int targetId = DNN_TARGET_OPENCL;
int targetId = DNN_TARGET_OPENCL_FP16;
int targetId = DNN_TARGET_MYRIAD;
int targetId = DNN_TARGET_FPGA;
```

OpenCV DNN module

Load network





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int targetId = DNN_TARGET_OPENCL;
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```
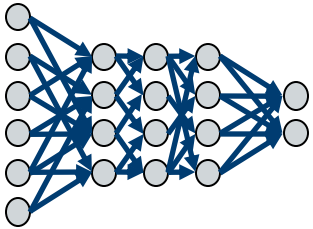
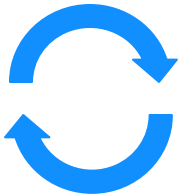

OpenCV DNN module

Load network





Load network

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net.setPreferableBackend(backendId);
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```

OpenVINO™

```
int targetId = DNN_TARGET_CPU;
int targetId = DNN_TARGET_OPENCL;
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int targetId = DNN_TARGET_MYRIAD;
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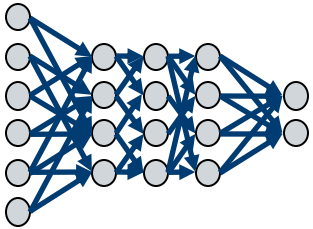
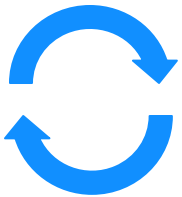
```

OpenCV DNN module

Load network





Load network

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```
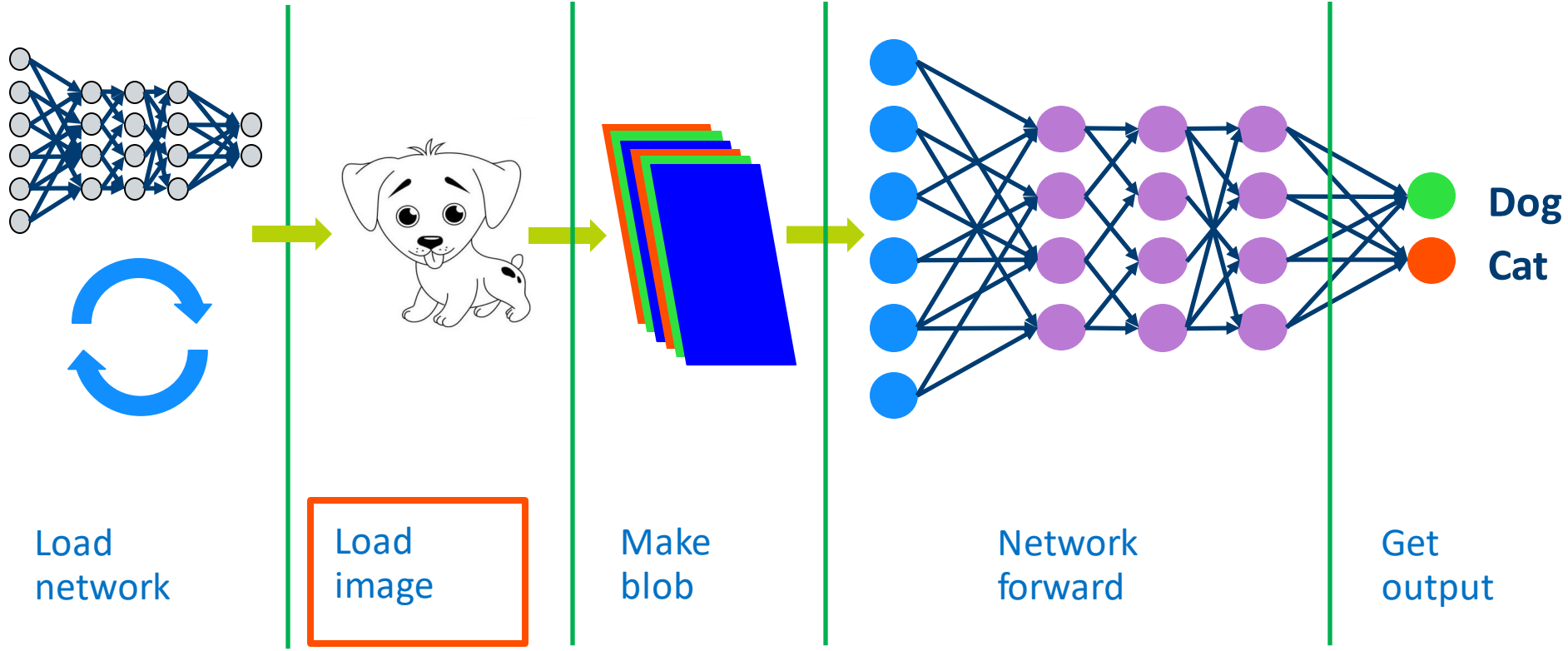

```
int targetId  = DNN_TARGET_CPU;
int targetId  = DNN_TARGET_OPENCL;
int targetId  = DNN_TARGET_OPENCL_FP16;
int targetId  = DNN_TARGET_MYRIAD;
int targetId  = DNN_TARGET_FPGA;
```

Halide

OpenCV DNN module



OpenCV DNN module

Load image

Load image

```
Mat frame = imread(path_image);
```

// comment

```
#include <opencv2/dnn.hpp>
#include <opencv2/highgui.hpp>
```

```
using namespace cv;
using namespace dnn;
using namespace std;
```

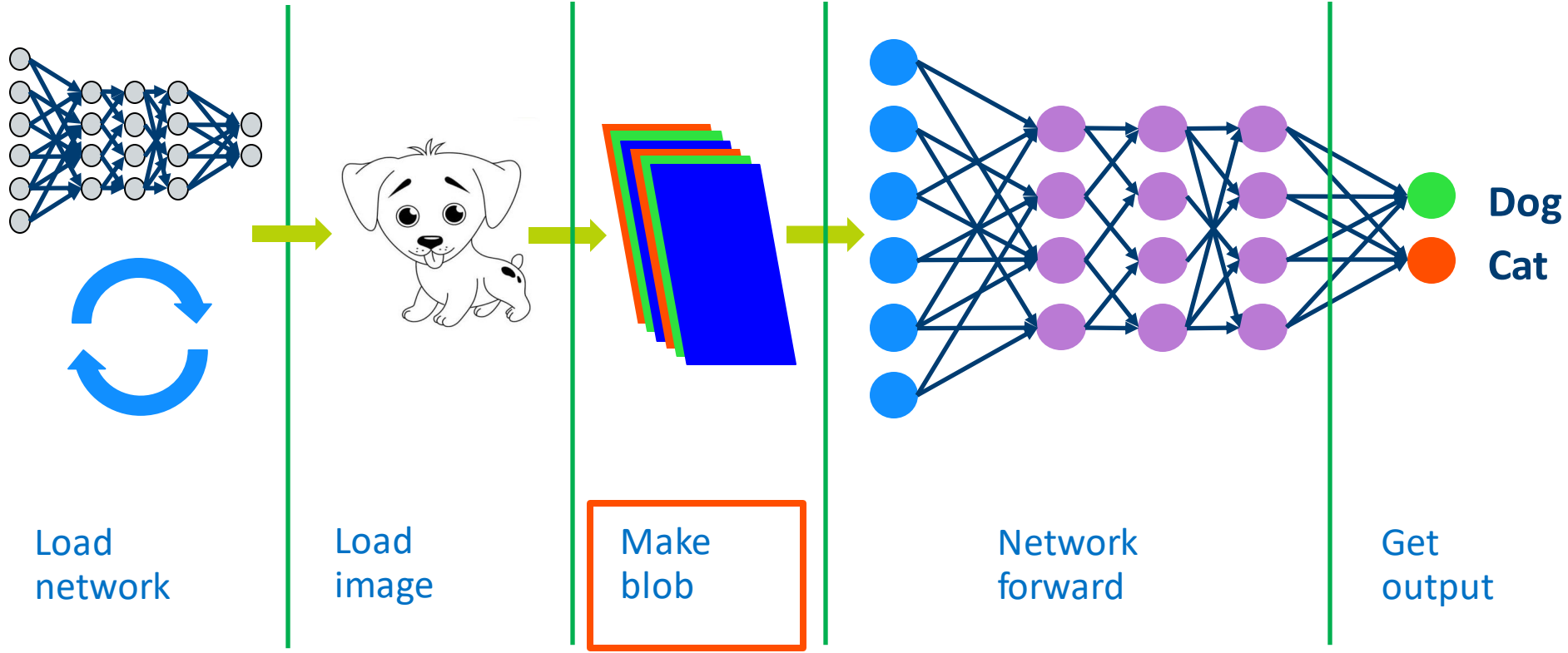
OpenCV DNN module

Load image from video

Load image

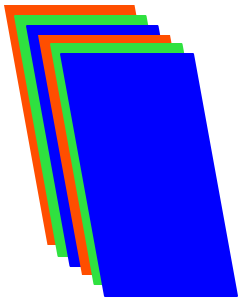
```
Mat frame;
string win_name = "Deep learning in OpenCV";
namedWindow(win_name, WINDOW_NORMAL);

VideoCapture cap;
cap.open(0);
while (waitKey(1) < 0)
{
    cap >> frame;
    imshow(win_name, frame);
}
```

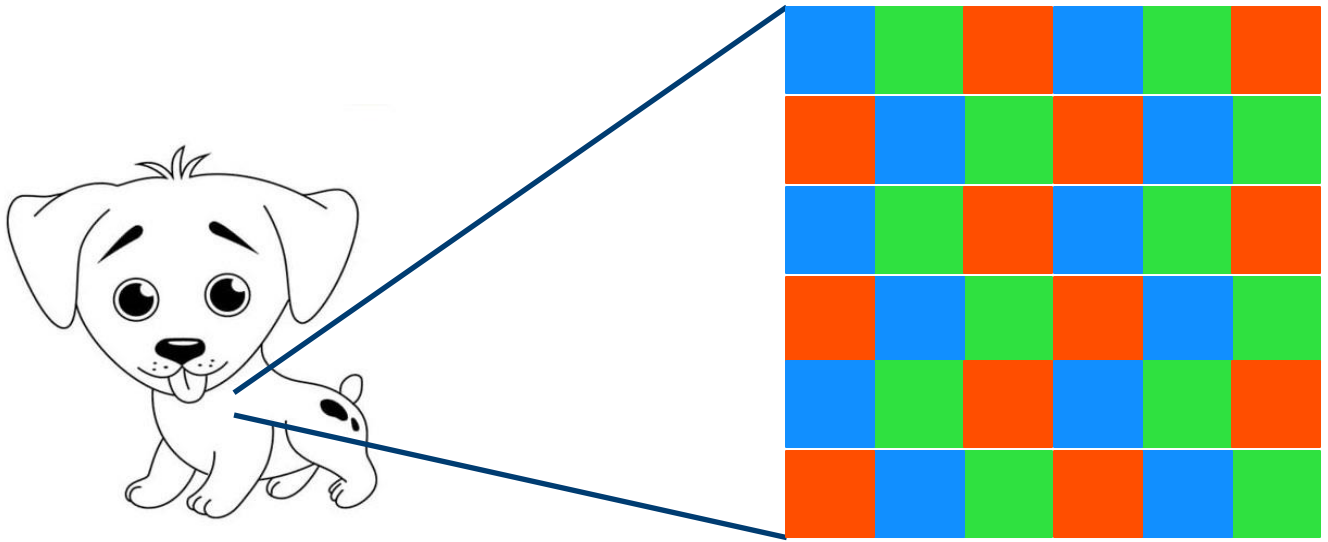
OpenCV DNN module



OpenCV DNN module

Make blob

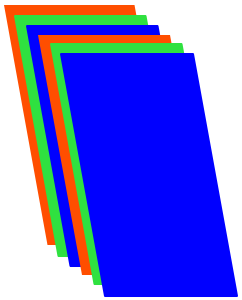




Make blob

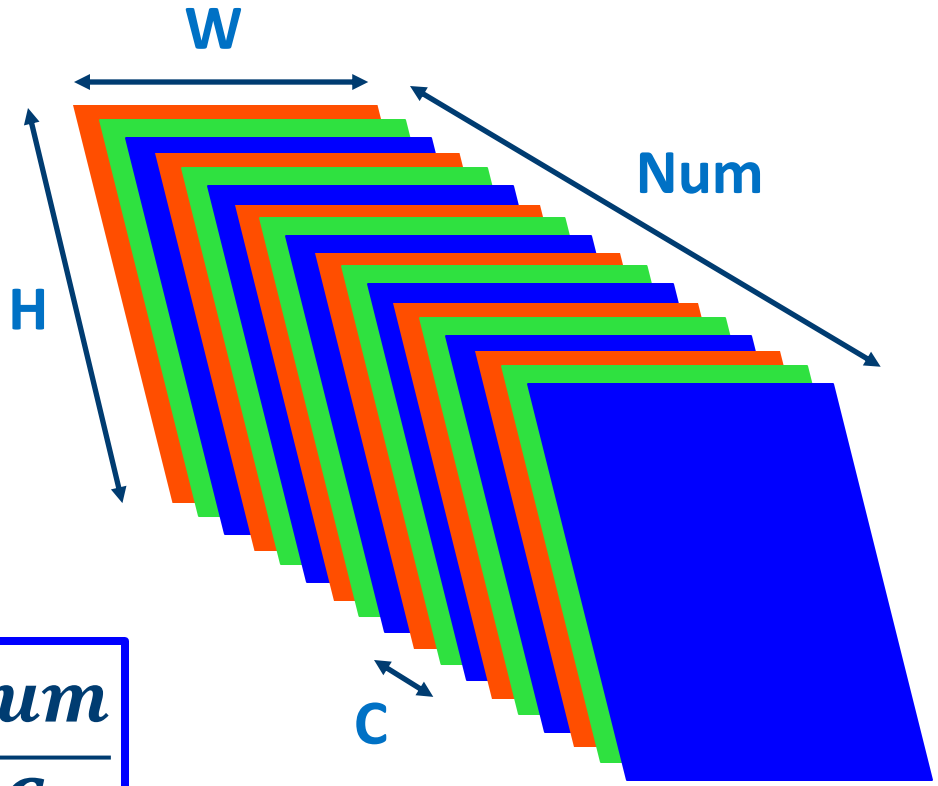
OpenCV DNN module

Make blob



Make blob

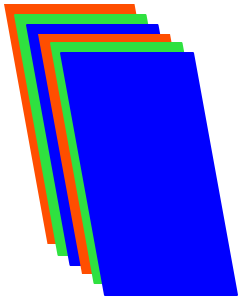
NCHW



$$N = \frac{Num}{C}$$

OpenCV DNN module

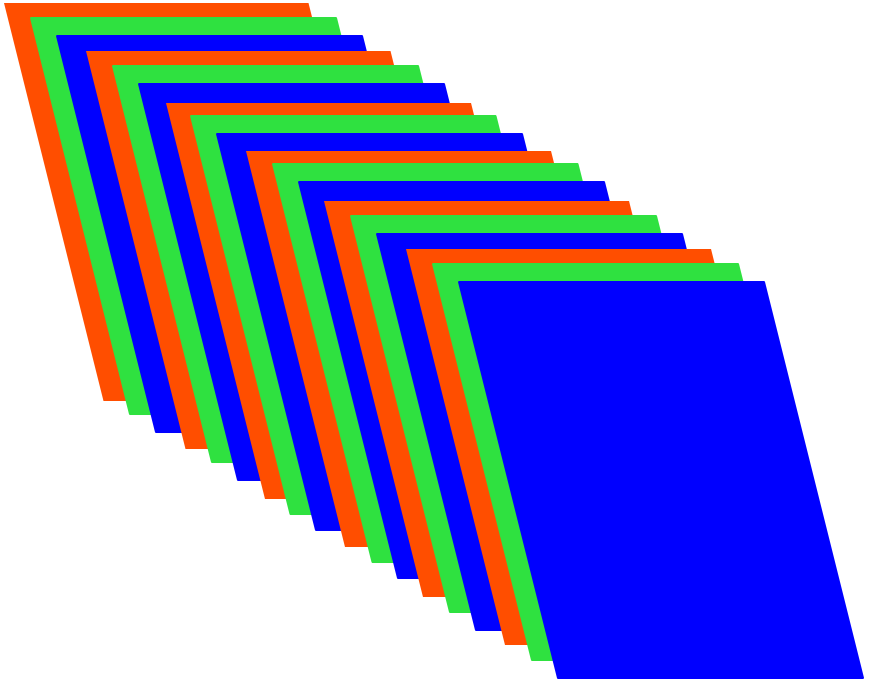
Make blob



Make blob

$[3 \times 128 \times 128]$

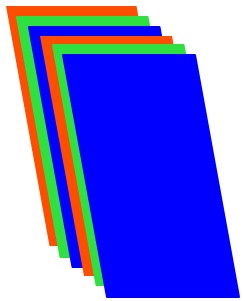
NCHW



$[1 \times 3 \times 128 \times 128]$

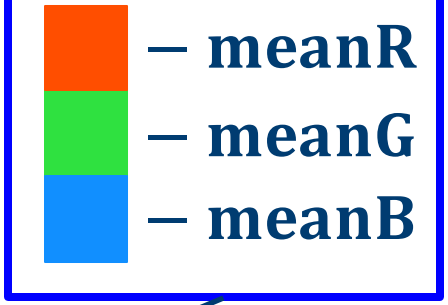
OpenCV DNN module

Make blob

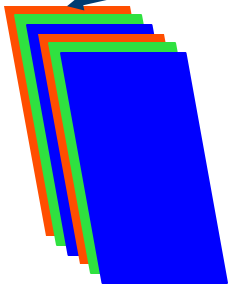


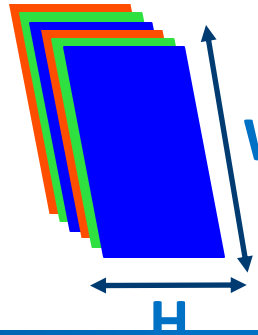
Make blob

$scale \times$



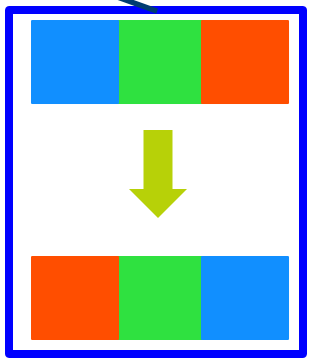

```
blobFromImage(frame, blob, scale, spatial_size, mean, swapRB, crop, ddepth);
```



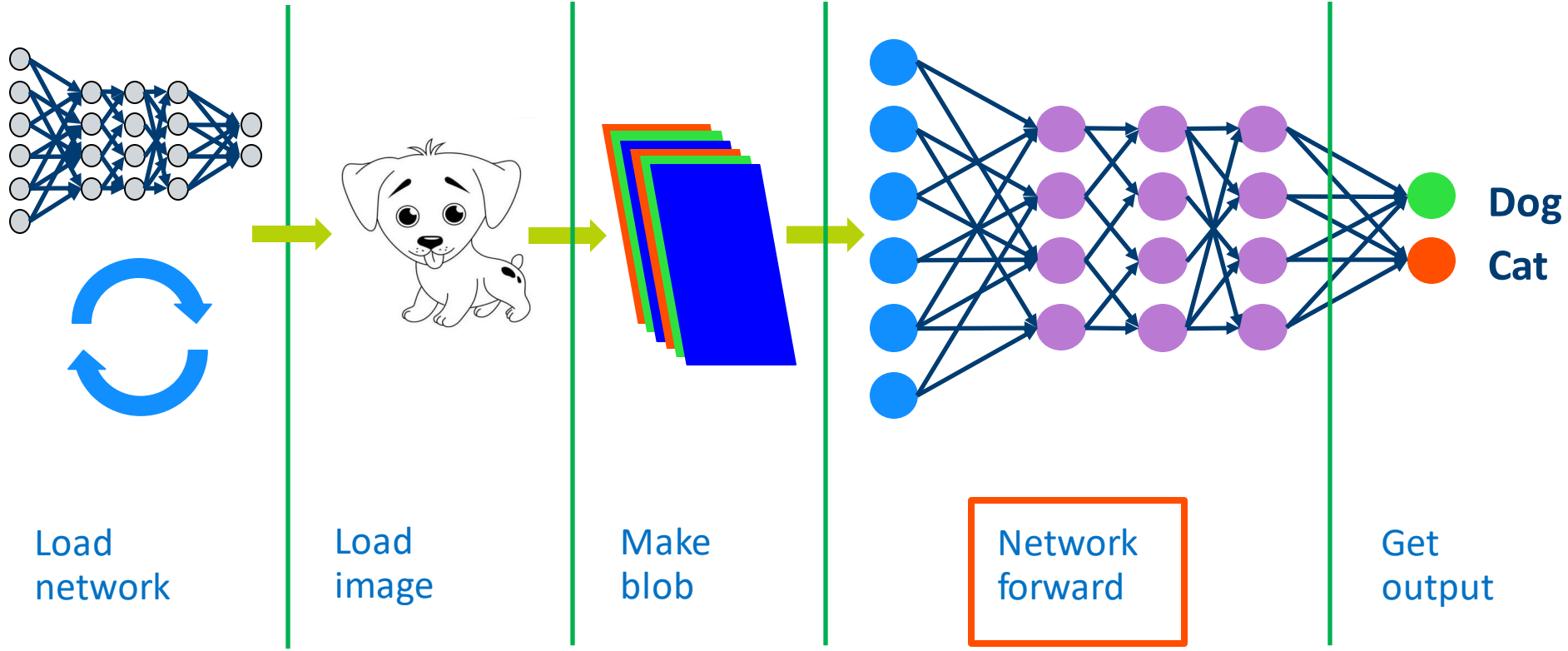


W → (H, W)

H

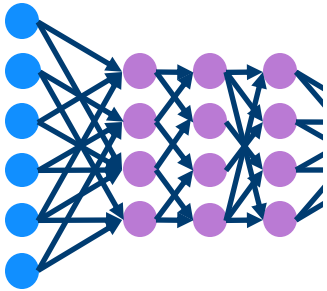


OpenCV DNN module



OpenCV DNN module

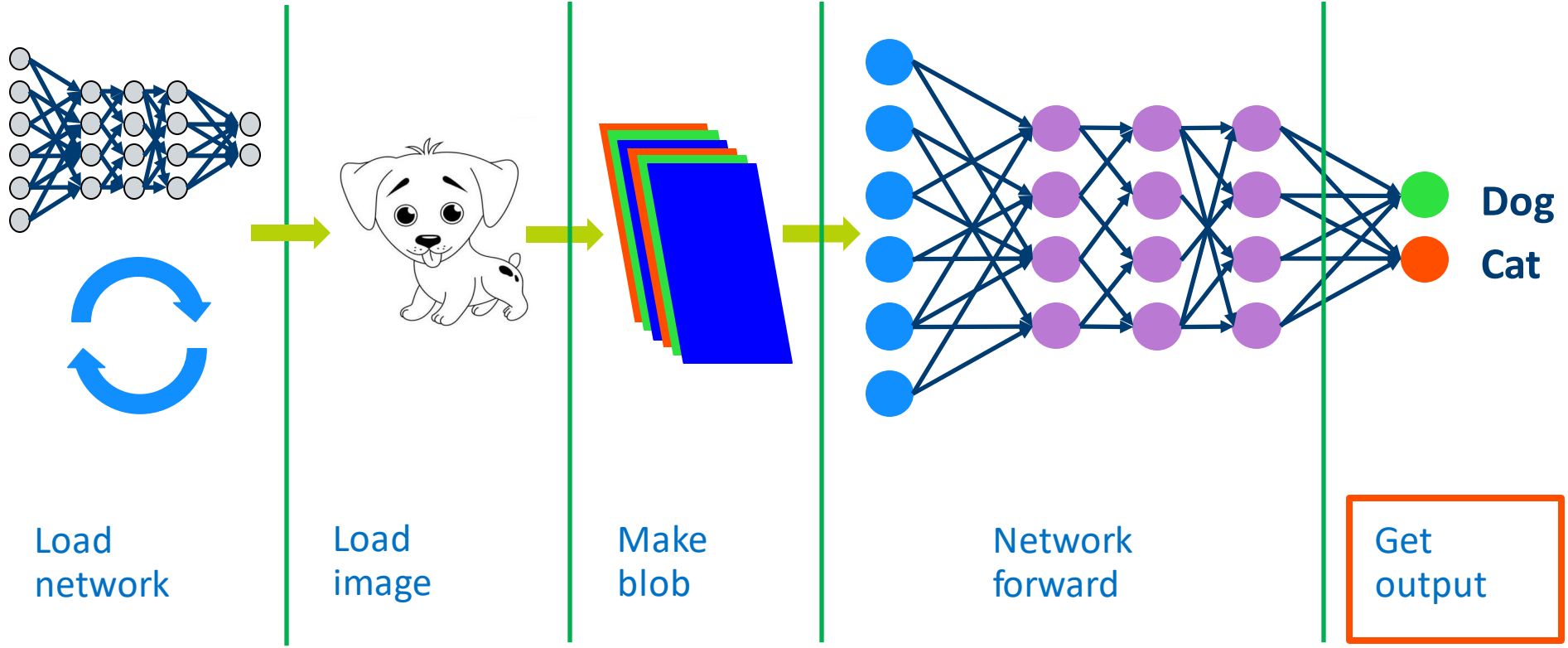
Network forward



```
net.setInput(blob);
Mat prob = net.forward();
```

Network forward

OpenCV DNN module

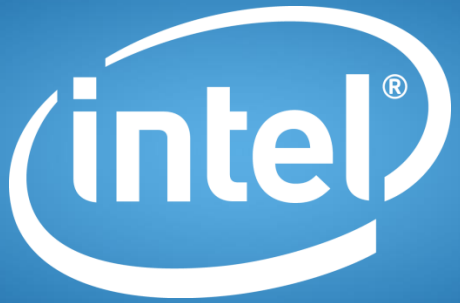


OpenCV DNN module

Get output for classification


```
Point classIdPoint;
double confidence;
minMaxLoc(prob.reshape(1, 1), 0, &confidence, 0, &classIdPoint);
int classId = classIdPoint.x;

cout << "Class: " << classId << '\n';
cout << "Confidence: " << confidence << '\n';
```

Get output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