Deep learning e segmentazione per la biologia cellulare

Utilizzo del transfer learning in Matlab per l'identificazione di cellule in microscopia

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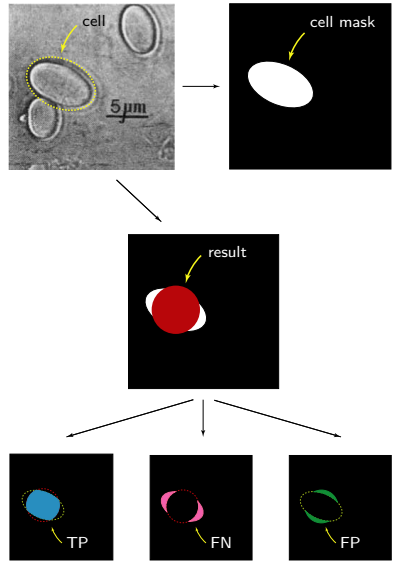
Image segmentation

- Pixel-based
- Edge-based
- Region-based
- Model-based
- **Supervised methods**

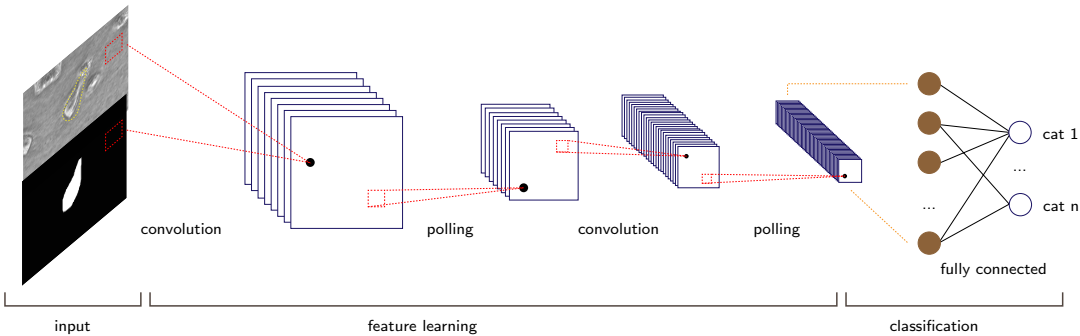
$$\text{CM} = \frac{TP}{TP+FN} = \frac{TP}{\text{Total arai in GT}}$$

$$\text{CR} = \frac{TP}{TP+FP} = \frac{TP}{\text{Total area in BW}}$$

$$\text{FM} = \frac{2 \cdot CM \cdot CR}{CM+CR} \in [0;1]$$



Transfer learning

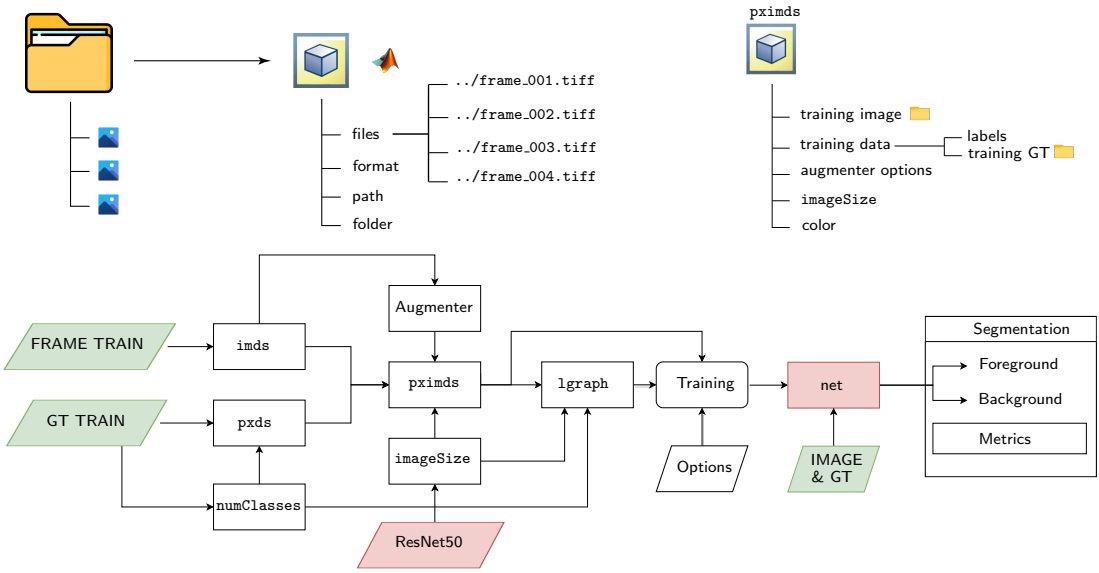


{B}==1
{N}==0

```
pxds=pixelLabelDatastore(...
strcat(newPath,'dataset\GT_TRAIN'),...
["N","B"],[0 1]);
```

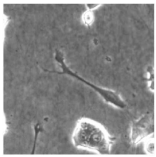
```
pxLayer = pixelClassificationLayer(...
'Name','labels','Classes',tbl.Name,...
'ClassWeights',classWeights);
```

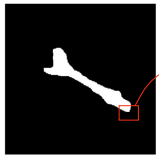
Training dataset



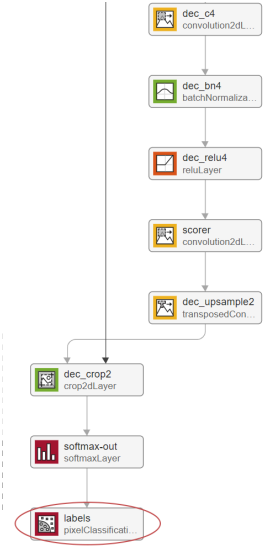
Classification layer

```
lgraph = deeplabv3plusLayers(imageSize,numClasses,"resnet50");
% balance predominance of 0
tbl = countEachLabel(pximds);
totalNumberOfPixels = sum(tbl.PixelCount);
frequency = tbl.PixelCount / totalNumberOfPixels;
classWeights = 1./frequency;
pxLayer = pixelClassificationLayer('Name','labels','Classes',...
tbl.Name,'ClassWeights',classWeights);
lgraph = replaceLayer(lgraph,"classification",pxLayer);
options = trainingOptions('sgdm','MaxEpochs',30, ...
'MiniBatchSize',8, 'Plots','training-progress');
[net, info]= trainNetwork(pximds,lgraph,options);
```

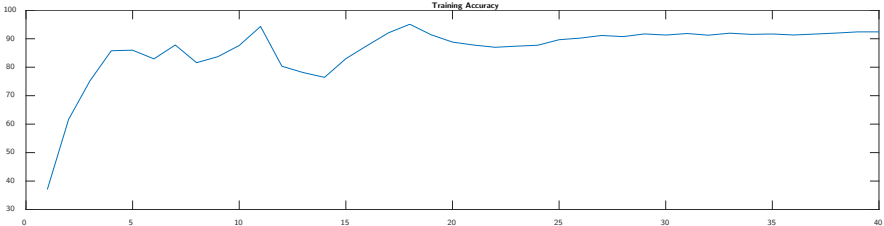




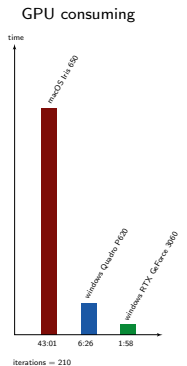
outputSize



Training

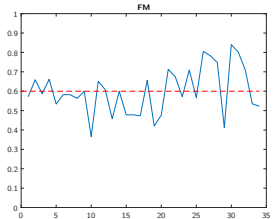

Training Accuracy
100
90
80
70
60
50
40
30
0
5
10
15
20
25
30
35
40

Training Loss
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5
10
15
20
25
30
35
40

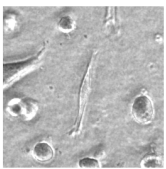
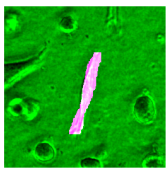

GPU consuming
time
macOS Iris 690
windows Quadro P630
windows RTX GeForce 3060
43:01
6:26
1:58
iterations = 210

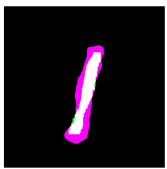
Application

```
for I = 1:length(f_test)
  testImage=imread([strcat(dataPath,'/FRAME_TEST_SEG/'),f_test(I).name]);
  C_test = semanticseg(testImage,net);
  D=C_test=='B';
  GTImage=imread([strcat(dataPath,'/GT_TEST/'),gt_train(I).name]);
  [TP,FP,FN,CR,CM,FM_test(I)]=evaluation_segmentation(...
  bwareafilt(D,1),GTImage);
  imshowpair(testImage,bwareafilt(D,1),'montage');
  pause(0.5); drawnow;
  clear C_test D testImage;
end
```

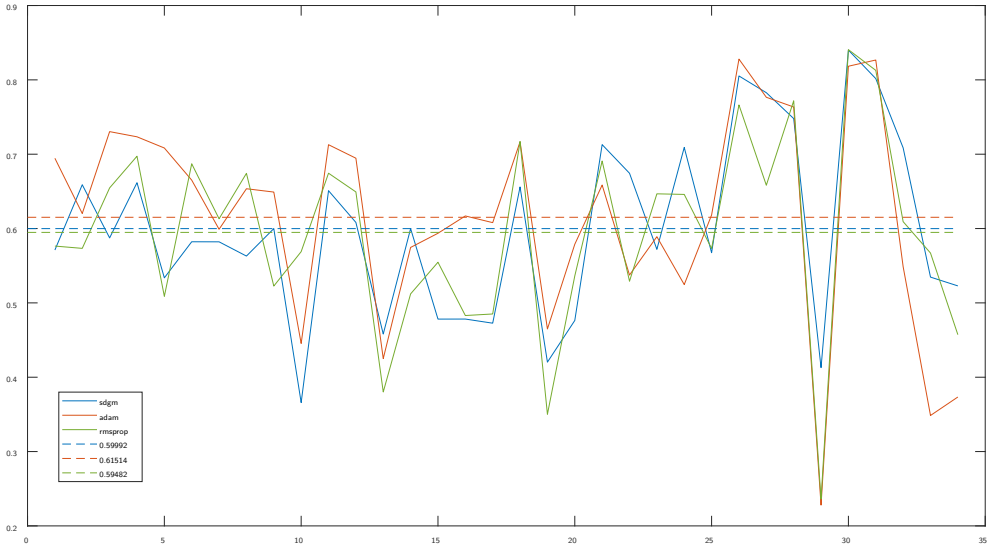


n. 25:

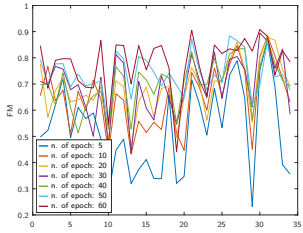


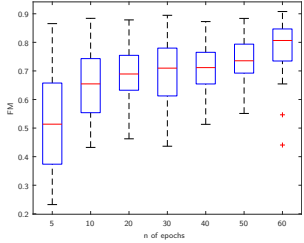
Solver


0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
5
10
15
20
25
30
35
sdgm
adam
rmsprop
0.59992
0.61514
0.59482

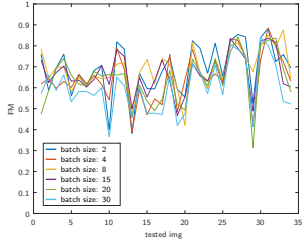
Training options

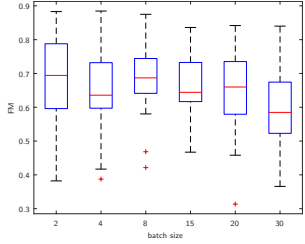
numbers of epochs



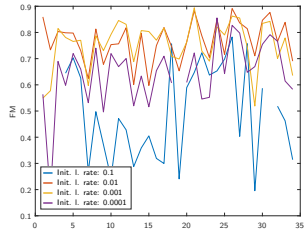


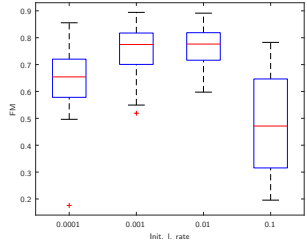
mini batch size





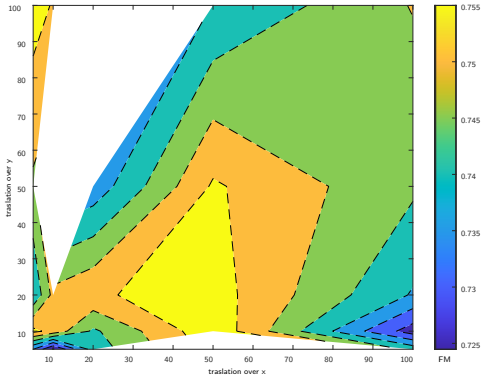
numbers of epochs



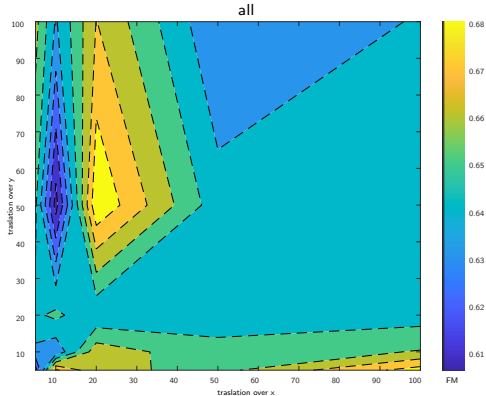


Augmenter

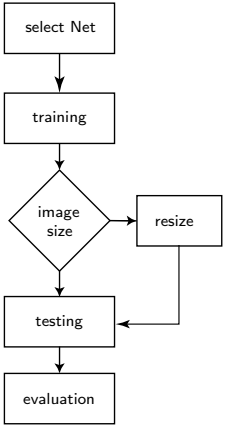
only rotation
mean: 0.4659

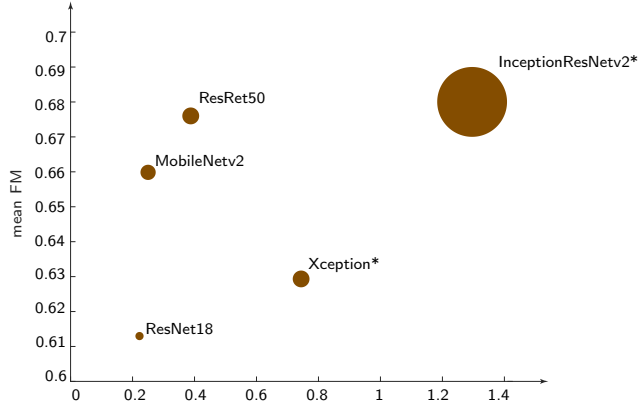


only reflection
mean: 0.7989



Pretrained networks





**images require scaling size ∝ layers*

```
clear pximds lgraph
[pximds,lgraph]=prepareMyNet(net,'netName',imds,pxds);
[net_net,info_net,FM_test_net,compTime_net]=trainAndTest(pximds,lgraph,...
dataPath,f_test,gt_train);
[accuracy_net,loss_net,FM_mean_net]=figureAccAndLoss(info_net,FM_test_net)
```