MEDICAL IMAGE SEGMENTATION WITH DIGITS

Overview

Prepare Dataset

Configure DL Model

DL Training

Segmentation
Segmentation
SEGMENTATION
Pascal VOC 2012 dataset

http://host.robots.ox.ac.uk/pascal/VOC/
SEGMENTATION

MS COCO dataset

What is COCO?

COCO is a new image recognition, segmentation, and captioning dataset. COCO has several features:

- Object segmentation
- Recognition in Context
- Multiple objects per image
- More than 300,000 images
- More than 2 Million instances
- 80 object categories
- 5 captions per image
- Keypoints on 100,000 people

http://mscoco.org/
SEGMENTATION
ITK-SNAP

Kidney-Liver Segmentation

Brain Segmentation

http://www.itksnap.org/
SEGMENTATION
Medical Image

Cancer Cell

Vessel Segmentation
Dataset
CARDIAC MR LEFT VENTRICLE SEGMENTATION

MIDAS Journal - Cardiac MR Left Ventricle Segmentation Challenge

http://hdl.handle.net/10380/3070
http://smial.sri.utoronto.ca/LV_Challenge/Home.html
SLICE VIEW

from wikipedia
DICOM VIEWER

ezDICOM

https://sourceforge.net/projects/ezdicom
## DATASET WITH CONTOUR

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DATASET WITH CONTOUR
DIGITS PLUGINS

DIGITS Plugins
Image : Sunnybrook LV Segmentation
plugins/data/sunnybrook

DIGITS Plugins
Image : Regression
plugins/data/imageGradients

DIGITS Plugins
Text
plugins/data/textClassification
PREPARE DATA
DATASET
CONFIGURE DL MODEL
CONFIGURE DL MODEL
VISUALIZE
MONITOR TRAIN

Job Directory
job/run20170314-1341034-R643
Disk Size
8.0

Network (train/val)
train_val.prototxt
Network (deploy)
deploy.prototxt
Network (original)
original.prototxt
Solver
solver.prototxt
Raw caff output
caffe_output.log

Dataset
Sunnybrook
Done 01 39:52 PM
- DB backend: Imdb
- Create_train_db DB
  - Entry Count: 234
  - Feature shape: (1, 256, 256)
  - Label shape: (1, 256, 256)
- Create_val_db DB
  - Entry Count: 26
  - Feature shape: (1, 256, 256)
  - Label shape: (1, 256, 256)

Hardware
GRID K520 (#0)
Memory
1.13 GB / 3.94 GB (28.6%)
GPU Utilization
100%
Temperature
45 °C

Process #181
CPU Utilization
101.9%
Memory
896 MB (6.0%)

Related jobs
- Generic Dataset
  - Sunnybrook train
- Sunnybrook test
- Sunnybrook valid

View Large
### Trained Models

**Select Model**
- **Epoch #5**
- Download Model
- Make Pretrained Model

**Select Visualization Method**
- Image Segmentation

**Visualization Options**
- Display segmented image
- Colormap

**Inference Options**
- Do not resize input image(s)

**Test an image**
- Image file
- Check: Show visualizations and statistics

**Test a record from validation set**
- Record from validation set
- SC-HF-NI-3

### Inference

**Image Inference**
- fcn_alexnet-sunnybrook

**Summary**
- Output visualizations
REASON

Cine MR

Same Object, time variance
PRACTICE 2
DICE METRIC
DICE METRIC

\[ DM = \frac{2A_{am}}{A_a + A_m} \]

Manual contour (Expert)  Automatic (DL)
DICE METRIC
import random
import numpy as np
import caffe

class Dice(caffe.Layer):
    """
    A layer that calculates the Dice coefficient
    """
    def setup(self, bottom, top):
        if len(bottom) != 2:
            raise Exception("Need two inputs to compute Dice coefficient.")

    def reshape(self, bottom, top):
        # check input dimensions match
        if bottom[0].count != 2*bottom[1].count:
            raise Exception("Prediction must have twice the number of elements of the input.")
        # loss output is scalar
        top[0].reshape(1)

    def forward(self, bottom, top):
        label = bottom[1].data[:,0,:,0]
        # compute prediction
        prediction = np.argmax(bottom[0].data, axis=1)
        # area of predicted contour
        a_p = np.count_nonzero(prediction)
        # area of contour in label
        a_l = np.count_nonzero(label)
        # area of intersection
        a_pl = np.count_nonzero(prediction * label)
        # dice coefficient
        dice_coeff = 2.*a_pl/(a_p + a_l)
        top[0].data[...] = dice_coeff

    def backward(self, top, propagate_down, bottom):
        pass
Type: Python
ENABLE DICE LAYER
DL TRAINING WITH DICE
RESULT2 WITH DICE

Summary

Output visualizations
PRACTICE 3
USE PRE-TRAINED PARAMETERS
NEW SUNNYBROOK LV SEGMENTATION DATASET

Channel conversion
RGB

% for validation
10
CONFIGURE DL MODEL WITH PRE-TRAINED
DICE(VAL)
RESULT WITH PRE-TRAIN

Summary

Output visualizations

☐ left ventricle.
PRACTICE 4
MORE FINE DL MODEL
FCN-8S

Alexnet -> VGG -> googlenet -> inception -> Resnet
DIFF

VGG style  Alexnet
Alxenet

VGG style
RESULT

Summary

Output visualizations

☐ left ventricle
MEDICAL IMAGE SEGMENTATION WITH DIGITS

**summary**

- Prepare Dataset
- Configure DL Model
- DL Training
- Segmentation

With python layer (DICE metric)
WHAT’S NEXT

**TAKE SURVEY**

**ACCESS ONLINE LABS**
Check your email to access more DLI training online.

**ATTEND WORKSHOP**
Visit www.nvidia.com/dli for workshops in your area.

**JOIN DEVELOPER PROGRAM**