Contextual Classification Using Self-Supervised Auxiliary Models for Deep Neural Networks

By: Sebastian Palacio, Phillip Engler, Jörn Hees, Andreas Dengel
Contextual Classification

What's the right context for the original goal?

Requirements:
- Related to the goal
- No additional labels
Self-Supervised Auxiliary Learning (SSAL) task

Solve an Additional Task
Solve an Additional Task

Multi-Task Learning Problem with an auxiliary task that is more directly related to the main task
How to Group

More details in our paper...

```
c = confusion_matrix()
c[i,i] = 0
c[i,j] /= sum(c)
c = (d + d.T) / 2
```

1. (A, B)
2. (B, D)
3. ...

Group 1
Group 2
Group 3

1. A
2. B
3. C
4. D
5. E
6. F

ResNet (pre-trained)
Training

Joint Training:

\[ \mathcal{L} = \lambda_1 \mathcal{L}_f + \lambda_2 \mathcal{L}_g \]

Objective

Context

Self-Supervised Auxiliary Learning (SSAL) Task

Main Task

\[ f(x) \]

\[ g(x) \]

\[ \text{NLL}(f(x)_i) \]

\[ \text{NLL}(g(x)_{\gamma(i)}) \]

\[ \theta^{(1)} \]

\[ \theta^{(2)} \]

\[ \theta^{(3)} \]

\[ x \]
Joint Prediction:

Inference

Self-Supervised Auxiliary Learning (SSAL) Task

\[ f_i(x) \cdot g_\gamma(i)(x) \]

softmax
Accuracy on ResNet-50

CIFAR-100
78.9 80.6

ImageNet
75.5 76.9

Baseline
SSAL (Ours)
**Baseline**

Nr. Parameters: **11.2M**
Val. Accuracy: **39.9 %**

**Wider**

Nr. Parameters: **25.3M**
Val. Accuracy: **42.3 %**

**Deeper & Wider**

Nr. Parameters: **19.0M**
Val. Accuracy: **43.7 %**

**SSAL (Ours)**

Nr. Parameters: **15.6M**
Val. Accuracy: **50.0 %**

*ResNet18 trained on TinyImageNet

Don’t forget to check our paper!
Class-Activation-Maps (CAM)

Advantage: More Structured Predictions

Why that area
Why not elsewhere?
What is the salient feature?

slide rule

Pill bottle
Remote
Ruler
Slide Rule

slide rule

gf
gl
More Structured Predictions: False Positives

Class-Activation-Maps (CAM)

Class-Activation-Maps (CAM)

“Pool table”

Croquet ball
Golf ball
Joystick
Maraca
Pool Table

spatula
SSAL models are more explainable thanks to the grouping criterion

* They also converge faster and with higher accuracy!
Thank you!

Paper Title:
- “Contextual Classification with Self-Supervised Autogenous Learning”. ICPR 2020

In collaboration with:
- Philipp Engler
- Jörn Hees
- Andreas Dengel

Paper’s website:
https://spalaciob.github.io/ssal.html

DFKI Kaiserslautern

Some images have been taken from www.pexels.com and www.openclipart.org

This work was supported by the BMBF projects ExplAINN (01IS19074), DeFuseNN (01IW17002) and the NVIDIA AI Lab program.