Gait Recognition applying Incremental Learning

International Workshop on Human Identification at a Distance

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Motivation

Trained model + New class = New model

Without training from scratch!
Introduction

≈10800 Km
Introduction

Córdoba????

Catastrophic forgetting!!!
Introduction

• It is the same for computers...

Image: Rebuffi et al. iCaRL: Incremental Classifier and Representation Learning. CVPR2017
Incremental learning

Requirements:
1. Faster than training from scratch
2. Use few information from previous classes
Gait Recognition + Incremental Learning

• Adding new classes

Images from Casia-B, Casia-C and TUM-GAID datasets.
Incremental learning on TUM-GAID

- 305 subjects:
  - 150 for training with N, B and S
  - 155 for testing:
    - 4 - N sequences for training
    - 2 - N, B, and S sequences for testing
Incremental learning on TUM-GAID

• Preliminary results with ResNet32 + OF
  • Pretrained model with 150 subjects (N+B+S)
  • Incremental learning of 155 subjects (N) + test with N,B,S samples

<table>
<thead>
<tr>
<th>Model / #Classes</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>31</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ours</td>
<td>85.2</td>
<td>74.8</td>
<td>78.5</td>
<td>77.4</td>
<td>80.4</td>
</tr>
<tr>
<td>From scratch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>87.4</td>
</tr>
</tbody>
</table>
End-to-End Incremental Learning - Overview

**Representative memory**
- Stores $N$ most representative samples from old classes
- $\text{#samples}_\text{class} = \frac{N}{\text{#old}_\text{classes}}$

**Main steps**
- Balanced fine-tuning
  - Less bias problem and better acc
- Update representative memory
  - Include samples from new classes
  - Builds a class prototype

**Memory**
- New samples
- Construction of the training set
- Training process
- Balanced fine-tuning
- Representative memory updating
End-to-End Incremental Learning - Model

\[ L(\omega) = L_C(\omega) + \sum_{f=1}^{F} L_D(f, \omega) \]

Cross-entropy loss applied to all samples

Total number of classification layers for the old classes (grey boxes)

Distillation loss of the classification layer \( f \)

Distillation 1

Cross-distilled Loss

Castro et al. End-to-End Incremental Learning. ECCV2018
Gait Recognition + Incremental Learning

• Adding new walking scenarios

Images from Casia-B Dataset.
Gait Recognition + Incremental Learning

• Adding new view-points

Images from Casia-B Dataset.
Take-away ideas

- There are different ways of training a deep model
- Incremental learning can help to update a model
- Gait recognition + incremental learning is underexplored
谢谢！
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