MuCaLe-Net: Multi Categorical-Level Networks to Generate More Discriminating Features
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**Context & Contributions**
Goal: Image classification on small datasets (few data)

- **Transfer-Learning (T.L.)**
  - Select large source-task
  - Learn a CNN on source-task
  - Extract features from target-data

- **Contributions**
  - Goal: Increasing universality of representations
  - New universalizing method (D.P.V with Semantic Grouping)
  - Why our method works? Learns diverse and relevant features
  - Experimental validation on 6 target-datasets

**Proposed Method**

**MuCaLe-Net:** Universalizing method with same data
- Discriminative Problem Variation (D.P.V)
- D.P.V with Semantic Grouping

**Discriminative Problem Variation**
CNV that solves DPF = set of Y-categories \(\left\{ c_1, c_2, \ldots, c_Y \right\}\) 
P.D.V - Train CNV on a DPF = set of \( \begin{array}{c} \text{Y} \\ \text{DPF} \end{array} \) categories \(\left\{ c_{DPF}^1, c_{DPF}^2, \ldots, c_{DPF}^Y \right\}\) with \( \text{Y} \gg \text{N} \)
- Variation: add, remove, group, etc.

**D.P.V by Grouping Categories**
Specific + Grouping + Random Clustering + Generic

**Independent Training**
Train one network per categorical-level label set

**Image of Target-Task**
Extract layer from each categorical-level network
Normalize layers independently
Fuse (concatenation) the representations

**Why Does It Work?**

**Do different categorical-level networks learn different representations?**
Statistical analysis of the filters learned by the two networks through Cross-Network Correlation

**Visualization of unique filters**
Net 5 & Net 6

**Does the difference comes from a bad similarity metric?**

Two visually-similar filters gives high scores of similarity

**Conclusion**

1) Goal: Increasing universality of representations
2) New universalizing method (D.P.V with Semantic Grouping)
3) Why our method works? Learns diverse & relevant features
Code available at: http://perso.ece.cnrs.fr/~tamaazousti/