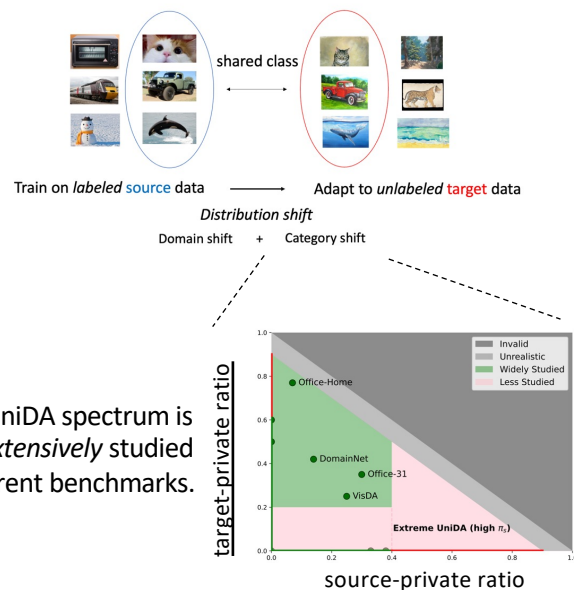# Tackling Dimensional Collapse toward Comprehensive Universal Domain Adaptation

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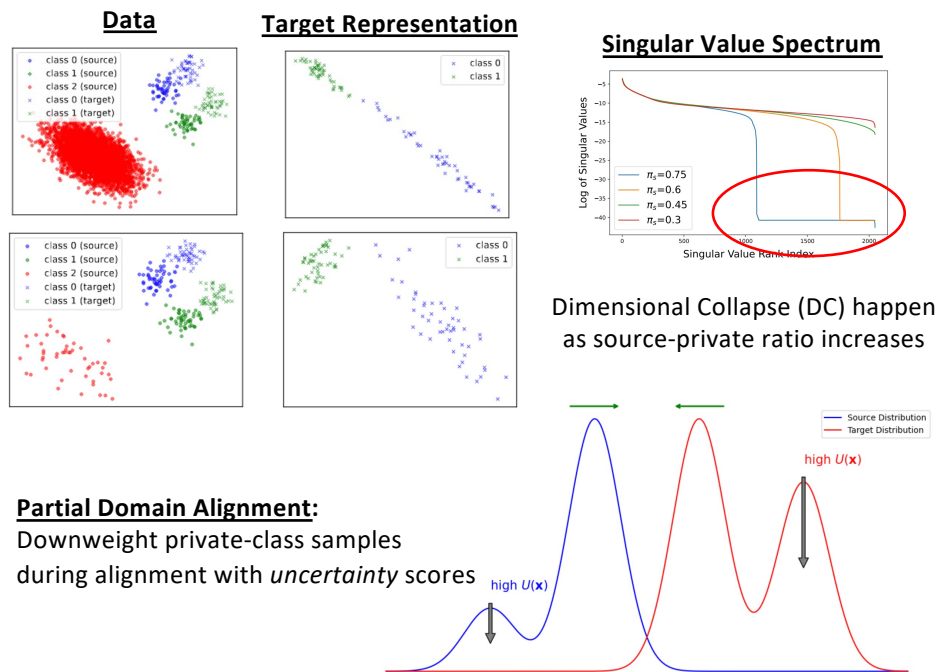
Comprehensive Universal Domain Adaptation

Train on *labeled* source data → Adapt to *unlabeled* target data

Distribution shift

Domain shift + Category shift

The UniDA spectrum is not *extensively* studied in current benchmarks.

Existing methods relying on partial domain alignment worse than *Source Only* under Extreme UniDA!
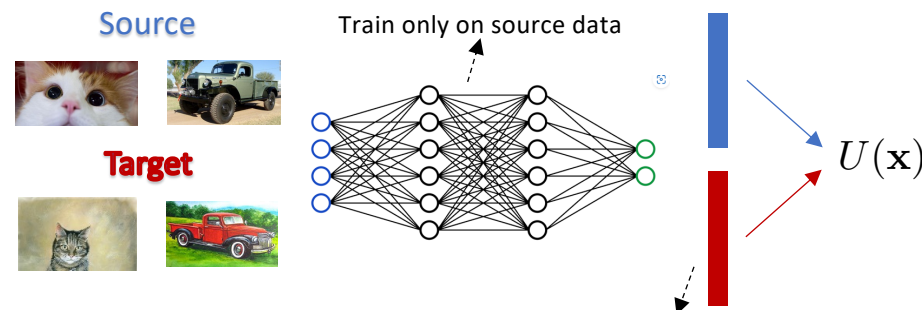
Our contributions:

- Reveal the overlooked extreme UniDA problem, advancing comprehensive UniDA.
- Identify and fix the dimensional collapse issue with SSL
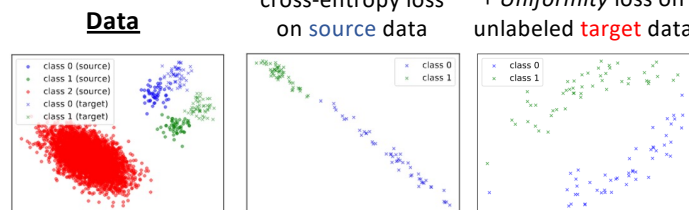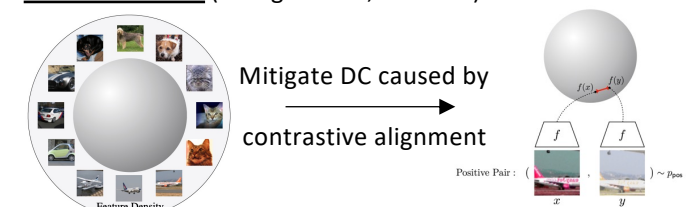
Dimensional Collapse under *Extreme* UniDA

Data   **Target Representation**   **Singular Value Spectrum**

Dimensional Collapse (DC) happen as source-private ratio increases

Partial Domain Alignment:
Downweight private-class samples during alignment with *uncertainty* scores

high $U(\mathbf{x})$

Source

Target

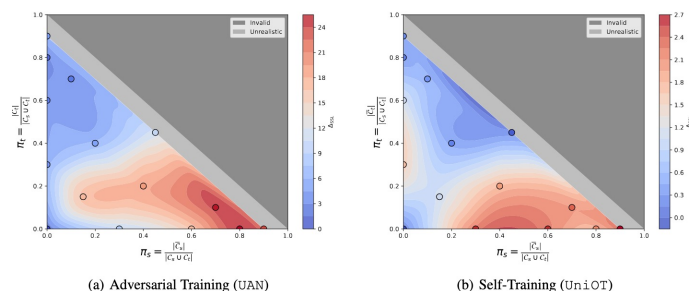Train only on source data

$U(\mathbf{x})$

Poor representations result in imprecise uncertainty estimates, leading to significant negative transfer

Address DC without Labels

In SSL literature (Wang & Isola, ICML'20):

Mitigate DC caused by contrastive alignment

Data   cross-entropy loss on source data   + *Uniformity* loss on unlabeled target data

Uniformity loss on target data mitigate DC

Results

(a) Adversarial Training (UAN)   (b) Self-Training (UniOT)

Improves across the whole spectrum, with significant gains under extreme UniDA
- DC is severe in extreme UniDA
- SSL addresses DC