Return of Frustratingly Easy Domain Adaptation

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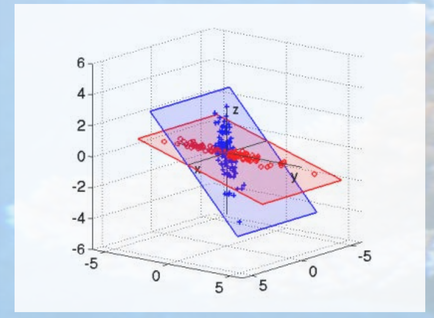
TASK-CV 2015

Domain Shift



Covs are likely low rank

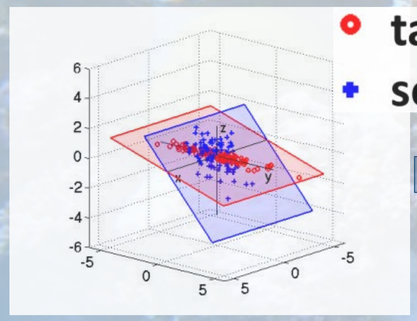
- Distributions are different
- Align Ds by aligning Covs

CORrelation ALignment (CORAL)

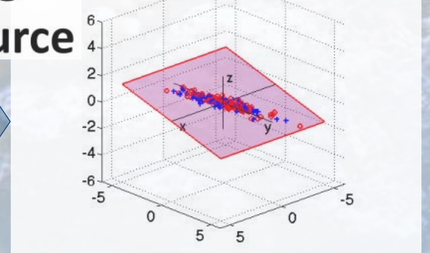
Algorithm 1 CORAL for Unsupervised Domain Adaptation

Input: Source Data D_S, Target Data D_T
Output: Adjusted Source Data D_S^*

$C_S = cov(D_S) + eye(size(D_S, 2))$
$C_T = cov(D_T) + eye(size(D_T, 2))$
$D_S = D_S * C_S^{\frac{-1}{2}}$ % whitening source
$D_S^* = D_S * C_T^{\frac{1}{2}}$ % re-coloring with target covariance



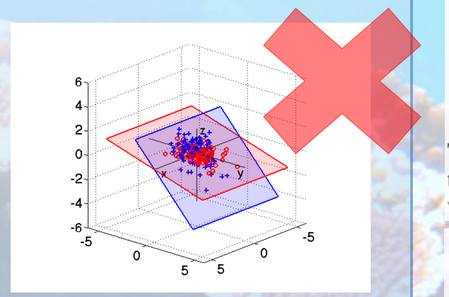
Whitening Source



Re-Coloring with Target Cov

- Closed form solution
- Whitening followed by re-coloring

Whitening both Domains



Fails to Align Covs

Train Classifier on Transformed Source and Test on Target

	C→I	C→S	I→C	I→S	S→C	S→I	AVG
NA	66.1	21.9	73.8	22.4	24.6	22.4	38.5
SA	43.7	13.9	52.0	15.1	15.8	14.3	25.8
GFK	52	18.6	58.5	20.1	21.1	17.4	31.3
TCA	48.6	15.6	54.0	14.8	14.6	12.0	26.6
CORAL	**66.2**	**22.9**	**74.7**	**25.4**	**26.9**	**25.2**	**40.2**

Table 4: Object recognition accuracies of all 6 domain shifts on the Testbed Cross-Dataset (Tommasi and Tuytelaars 2014) dataset with DECAF-fc7 features, using the *"full training"* protocol.

	A→D	A→W	D→A	D→W	W→A	W→D	AVG
NA-fc6	53.2	48.6	40.5	92.9	39.0	98.8	62.2
NA-fc7	55.7	50.6	46.5	93.1	43.0	97.4	64.4
NA-FT6	54.5	48.0	38.9	91.2	40.7	98.9	62.0
NA-FT7	58.5	53.0	43.8	94.8	43.7	99.1	65.5
SA-fc6	41.3	35	32.3	74.5	30.1	81.5	49.1
SA-fc7	46.2	42.5	39.3	78.9	36.3	80.6	54.0
SA-FT6	40.5	41.1	33.8	85.4	33.4	88.2	53.7
SA-FT7	50.5	47.2	39.6	89	37.3	93	59.4
GFK-fc6	44.8	37.8	34.8	81	31.4	86.9	49.1
GFK-fc7	52	48.2	41.8	86.5	38.6	87.5	59.1
GFK-FT6	48.8	45.6	40.5	90.4	36.7	96.3	59.7
GFK-FT7	56.4	52.3	43.2	92.2	41.5	96.6	63.7
TCA-fc6	40.6	36.8	32.9	82.3	28.9	84.1	50.9
TCA-fc7	45.4	40.5	36.5	78.2	34.1	84	53.1
TCA-FT6	40.8	37.2	30.6	79.5	36.7	91.8	52.8
TCA-FT7	47.3	45.2	36.4	80.9	39.2	92	56.8
DLID	-	26.1	-	68.9	-	84.9	-
DANN	34.0	34.1	20.1	62.0	21.2	64.4	39.3
DA-NBNN	-	23.3	-	67.2	-	67.4	-
DECAF-fc6	-	52.2	-	91.5	-	-	-
DECAF-fc7	-	53.9	-	89.2	-	-	-
DDC	-	59.4	-	92.5	-	91.7	-
DAN	-	66.0	-	93.5	-	95.3	-
ReverseGrad	-	**67.3**	-	94.0	-	93.7	-
CORAL-fc6	53.7	48.4	44.4	96.5	41.9	99.2	64.0
CORAL-fc7	57.1	53.1	**51.1**	94.6	47.3	98.2	66.9
CORAL-FT6	61.2	59.8	47.4	**97.1**	45.8	**99.5**	68.5
CORAL-FT7	**62.2**	61.9	48.4	96.2	**48.2**	**99.5**	**69.4**

Table 2: Object recognition accuracies of all 6 domain shifts on the standard Office dataset (Saenko et al. 2010) with deep features, following the protocol of (Donahue et al. 2014; Tzeng et al. 2014; Ganin and Lempitsky 2015).

	A→C	A→D	A→W	C→A	C→D	C→W	D→A	D→C	D→W	W→A	W→C	W→D	AVG
NA	41.7	**44.6**	31.9	53.1	47.8	41.7	26.2	26.4	52.5	27.6	21.2	78.3	41.1
SA	37.4	36.3	39.0	44.9	39.5	41.0	32.9	34.3	65.1	34.4	31.0	62.4	41.5
GFK	41.9	41.4	41.4	**56.0**	42.7	45.1	**38.7**	**36.5**	74.6	31.9	27.5	79.6	46.4
TCA	35.2	39.5	29.5	46.8	**52.2**	38.6	36.2	30.1	71.2	32.2	27.9	74.5	42.8
CORAL	**45.1**	39.5	**44.4**	52.1	45.9	**46.4**	37.7	33.8	**84.7**	**36.0**	**33.7**	**86.6**	**48.8**

Table 3: Object recognition accuracies of all 12 domain shifts on the Office-Caltech10 dataset (Gong et al. 2012) with SURF features, using the *"full training"* protocol.

Conclusion

- Improvement is consistent
- Larger improvement on strongly correlated features (e.g., deep features)

Full paper to appear in proceedings of AAAI-16, preprint is available on arXiv.

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