Learning Classifiers for Target Domain with Limited or No Labels

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Resource-limited Classification

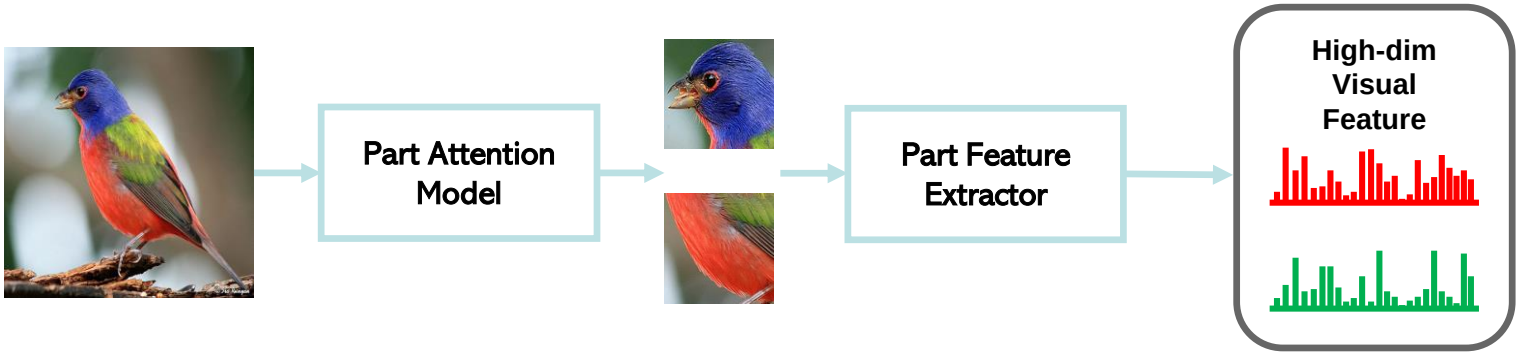
Task	Target Domain		
	What's new?	Example?	Label?
Domain Adaptation	input	Yes	No
Few-Shot Learning	class	Few	Few
Zero-Shot Learning	class	No	No

"train from scratch" is impossible

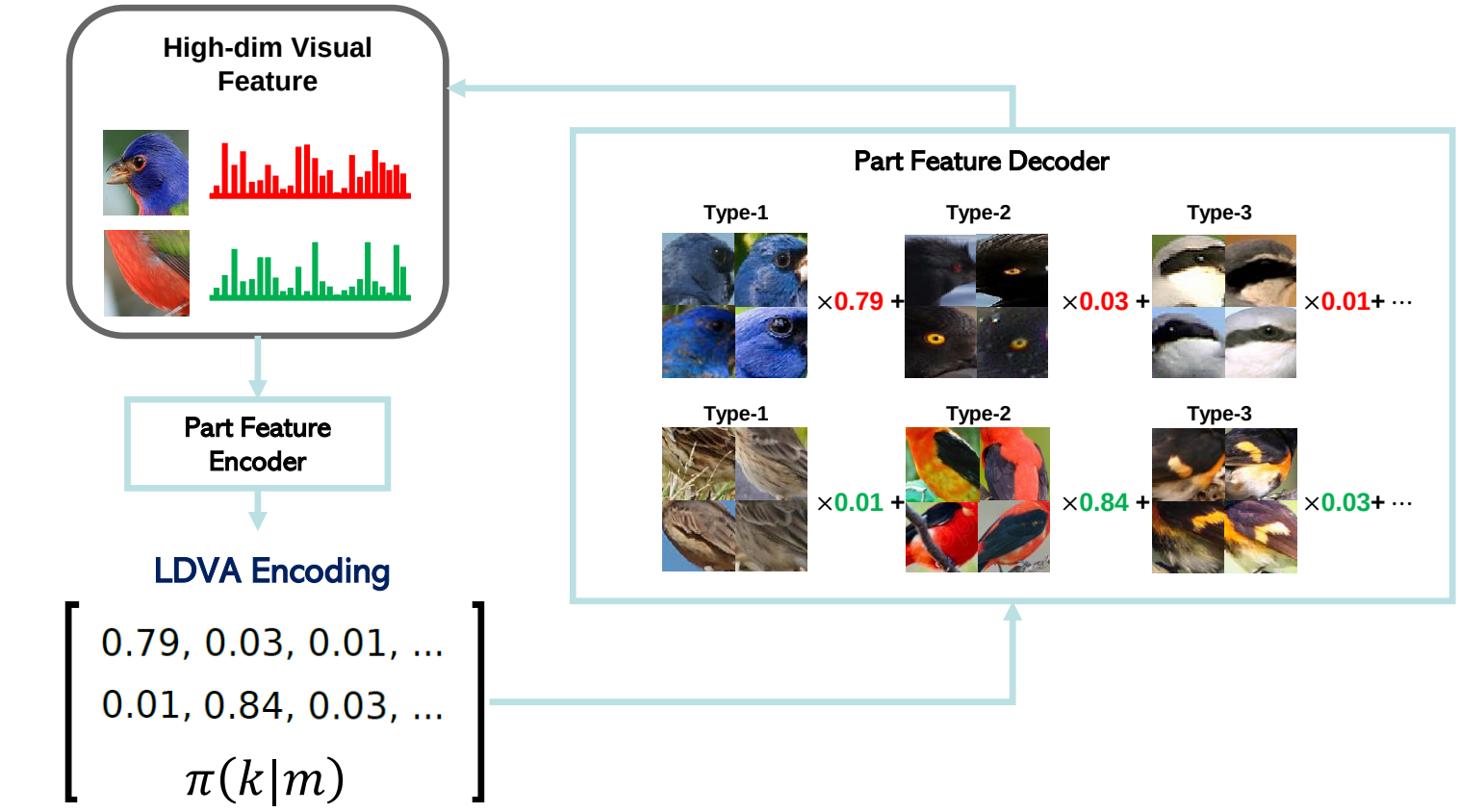
→ Adapt existing models to new environment ✓

Goal: A universal, static representation robust to domain shift

Low-Dimensional Visual Attributes (LDVA) Encoding

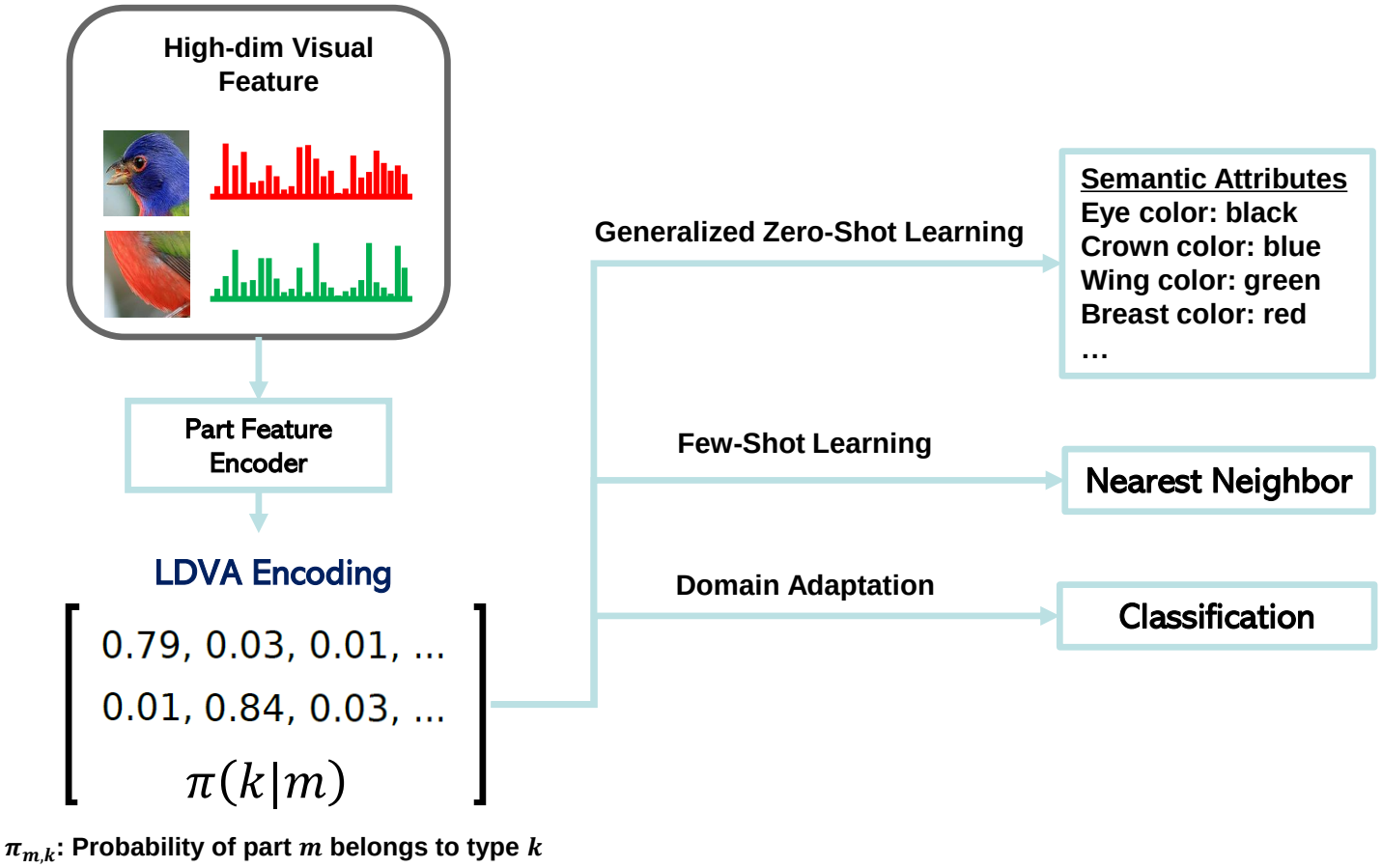


LDVA Train



$\pi_{m,k}$: **Probability of part m belongs to type k**

LDVA - Inference



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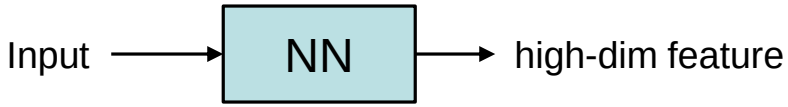
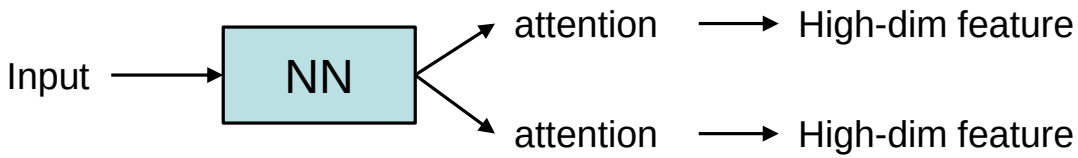
Comparison with other methods

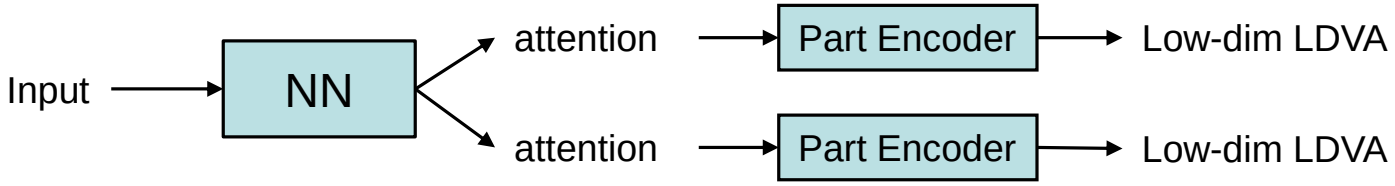
- Vanilla DNN:



- Attention Methods:

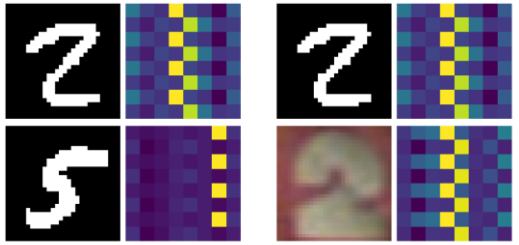


- Ours:



Low-Dimensional Visual Attributes (LDVA) Encoding

- Every object is encoded into a mixture of part types
- Benefits:
  - Low-dimensional: proto-types in each part is limited
  - Compositional Uniqueness: every class is represented uniquely
  - Small intra-class variance and large inter-class variance
  - Robust to domain shift



(a) MNIST '2' vs. MNIST '5' (b) MNIST '2' vs. SVHN '2'

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  - Small intra-class variance and large inter-class variance
  - Robust to domain shift
  - Mirrors human-labeled semantic vector
  - Encode unseen class by seen part-types
  - Requires less data and feedback

Semantic Attributes
Eye color: black
Crown color: blue
Wing color: green
Breast color: red
...

Experiments

Generalized Zero-Shot Learning

Methods	CUB			AWA2			aPY		
	ts	tr	H	ts	tr	H	ts	tr	H
SSE(Zhang & Saligrama, 2015)	8.5	46.9	14.4	8.1	82.5	14.8	0.2	**78.9**	0.4
ALE(Akata et al., 2016)	23.7	62.8	34.4	14.0	81.8	23.9	4.6	73.7	8.7
SYNC(Changpinyo et al., 2016)	11.5	70.9	19.8	10.0	90.5	18.0	7.4	66.3	13.3
DEVISE(Frome et al., 2013)	23.8	53.0	32.8	17.1	74.7	27.8	4.9	76.9	9.2
PSRZSL(Annadani & Biswas, 2018)	24.6	54.3	33.9	20.7	73.8	32.3	13.5	51.4	21.4
SP-AEN(Chen et al., 2018)	34.7	70.6	46.6	23.3	**90.9**	37.1	13.7	63.4	22.6
GDAN(Huang et al., 2018)	39.3	66.7	49.5	32.1	67.5	43.5	**30.4**	75.0	**43.4**
CADA-VAE(Schönfeld et al., 2018)	51.6	53.5	52.4	**55.8**	75.0	**63.9**	-	-	-
SE-GZSL(Kumar Verma et al., 2018)	41.5	53.3	46.7	**58.3**	68.1	62.8	-	-	-
LSD(Dong et al., 2018)	**53.1**	59.4	**56.1**	-	-	-	22.4	**81.3**	35.1
Ours	33.4	**87.5**	48.4	41.6	**91.3**	57.2	24.5	72.0	36.6
Ours + CS	**59.2**	**74.6**	**66.0**	54.6	87.7	**67.3**	**41.1**	68.0	**51.2**

Experiments

- Few-Shot Learning

Methods	Omniglot				*mini*ImageNet	
	5-way Acc.		20-way Acc.		5-way Acc.	
	1-shot	5-shot	1-shot	5-shot	1-shot	5-shot
MAML	98.7	**99.9**	95.8	98.9	48.7	63.1
Prototypical Nets	98.8	99.7	96.0	98.9	49.4	68.2
Relation Nets	**99.6**	99.8	**97.6**	99.1	50.4	65.3
TADAM	-	-	-	-	58.5	76.7
LEO	-	-	-	-	61.7	77.6
EA-FSL	-	-	-	-	**62.6**	78.4
Ours	98.9	99.8	96.5	**99.3**	61.7	**78.7**

- Domain Adaptation

Methods	M → U	U → M	S → M
CoGAN	91.2	89.1	-
ADDA	89.4	90.1	76.0
UNIT	96.0	93.6	90.5
CyCADA	95.6	96.5	90.4
MSTN	92.9	-	91.7
Ours (source π)	94.8	96.1	82.4
Ours (joint π)	**98.8**	**96.8**	**95.2**

Thank you!

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Welcome to our poster today!