Unsupervised Multi-Task Domain Adaptation

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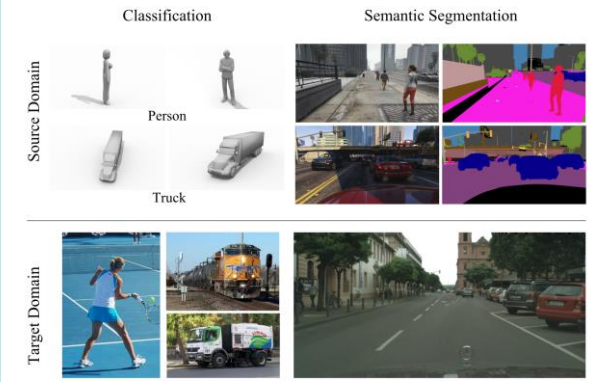
Unsupervised domain adaptation aims to generalize a model's capability applied on the target domain (without labels) with the model trained using labeled data from the source domain. Multi-task learning aims to learn multiple tasks jointly by exploiting their relatedness to improve the generalization performance for each task.

Does MTL further improve the generalization ability of a model for domain adaptation?

MTL-DA SETTING

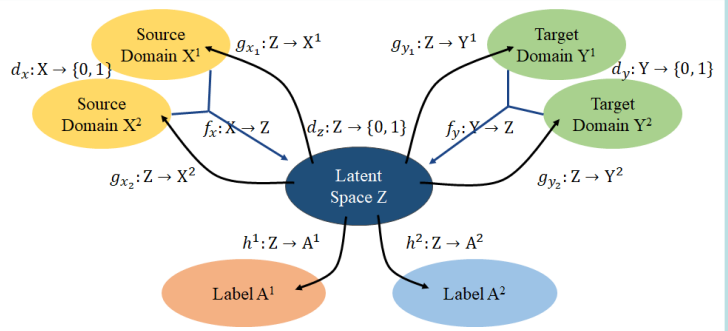


VidDA2017 dataset

- The dataset contains samples and ground truth labels for more than one task.
- Each task contains samples of the source and the target domains.

X. Peng, B. Usman, N. Kaushik, J. Hoffman, D. Wang and K. Saenko, "VisDA: The Visual Domain Adaptation Challenge," 2017.

APPROACH



Developed upon the I2I Adapt framework

- Not designed for a specific task; should accommodate more tasks such as object detection.
- Allow the customization of the model's complexity to meet specific needs.
- Simultaneously adapt multiple tasks using a single adaptation architecture.

Z. Murez, S. Kolouri, D. Kriegman, R. Ramamoorthi, and K. Kim, " Image to Image Translation for Domain Adaptation," *IEEE CVPR*, 2018.

RESULTS

Image Classification

Setup	Source only	MTL	Single-task adaptation	Multi-task adaptation
aeroplane	70.39	65.32	69.71	**71.21**
bicycle	26.91	26.91	**80.79**	69.71
bus	52.51	43.07	65.03	**75.75**
car	**69.40**	60.43	65.72	66.47
horse	77.67	75.64	83.26	**87.10**
knife	4.22	5.18	28.19	**39.88**
motorcycle	82.06	**84.69**	74.99	81.16
person	38.31	46.69	55.19	**64.56**
plant	77.25	71.10	79.34	**82.25**
skateboard	21.60	**26.10**	25.77	22.59
train	83.24	**86.37**	78.47	75.52
truck	9.10	13.83	**16.53**	15.45
accuracy	51.05	50.44	60.25	**62.64**

- Source only method performs the worst, MTL does not reduce domain shift. Domain adaptation can help.
- Unsupervised multi-task domain adaptation can further enhance the ability of domain adaptation.

Semantic Segmentation

Setup	Source only	MTL	Single-task adaptation	Multi-task adaptation
road	23.42	20.06	71.26	**79.17**
sidewalk	22.32	20.68	27.76	**34.69**
building	40.54	53.89	70.82	**78.40**
wall	2.88	5.39	9.75	**20.30**
fence	4.99	8.55	11.07	**14.08**
pole	10.50	19.36	19.29	**30.69**
traffic light	12.79	16.14	8.01	**20.21**
traffic sign	0.26	0.16	0.34	**1.14**
vegetation	73.40	**77.95**	77.09	75.95
terrain	**26.91**	21.62	24.23	19.91
sky	35.01	72.04	67.13	**76.45**
person	43.88	30.94	37.91	**52.95**
rider	**0.08**	0.07	0.02	0.07
car	68.44	31.59	65.84	**75.26**
truck	9.83	5.41	7.35	**13.99**
bus	3.86	6.51	9.10	**17.64**
train	0.00	0.06	0.15	**0.53**
motorcycle	0.18	0.41	0.07	**1.14**
bicycle	0.00	0.00	0.00	0.00
mIoU	19.96	20.57	26.69	**32.24**