Improving Predictors via Combination Across Diverse Task Categories

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Predictor combination problem

(sportiness estimator)
target predictor

(comfort estimator) (formality estimator)
reference predictors

$$f \qquad g^1 \quad \dots \quad g^R$$

[Shoe Database]

Input
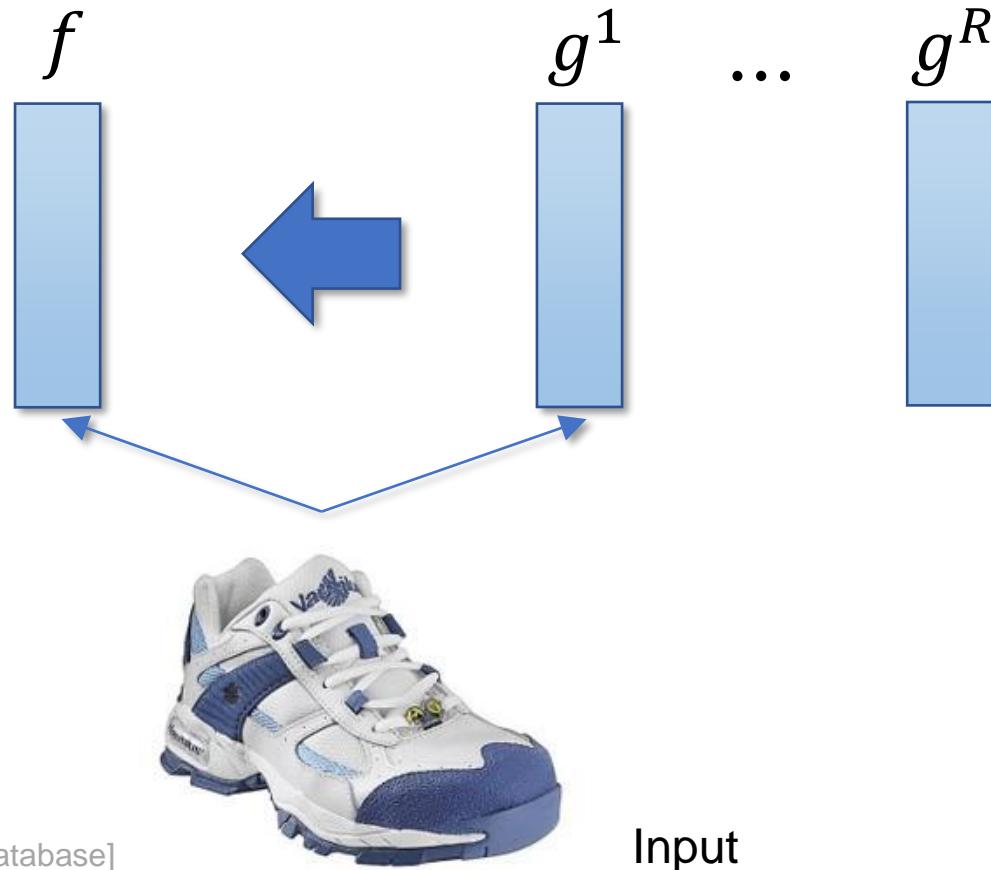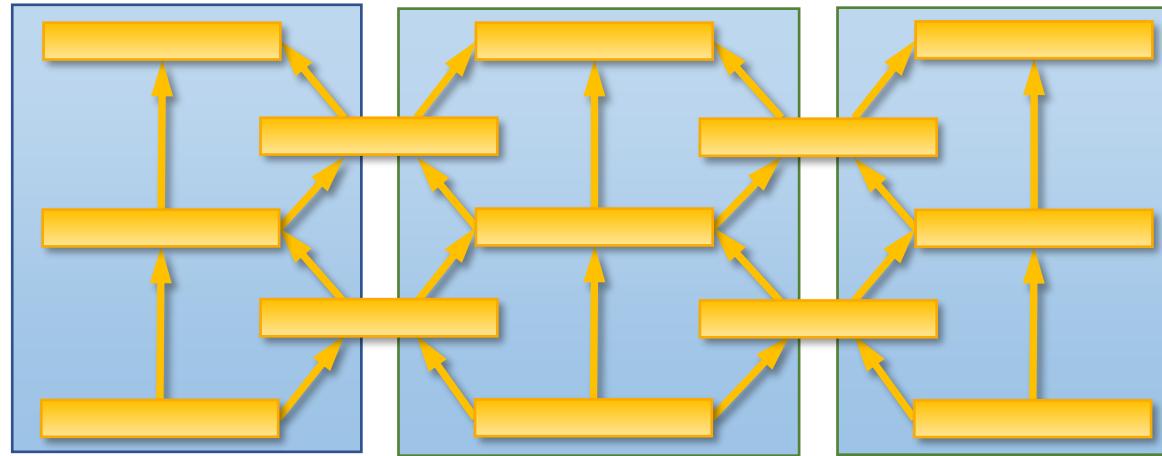
Multi-task and transfer learning

f : target predictor, $\{g^1, ..., g^R\}$: reference predictors

Kim et al.'s predictor combination algorithm

$$\mathbf{f} = \{f(\mathbf{x}_1), ..., f(\mathbf{x}_N)\}$$

$$\mathbf{g}^1 = \{g^1(\mathbf{x}_1), ..., g^1(\mathbf{x}_N)\}$$

$$\mathbf{g}^R = \{g^R(\mathbf{x}_1), ..., g^R(\mathbf{x}_N)\}$$

f

g^1

$...$

g^R

?   ?   ?

$$X = \{\mathbf{x}_1, ..., \mathbf{x}_N\}$$
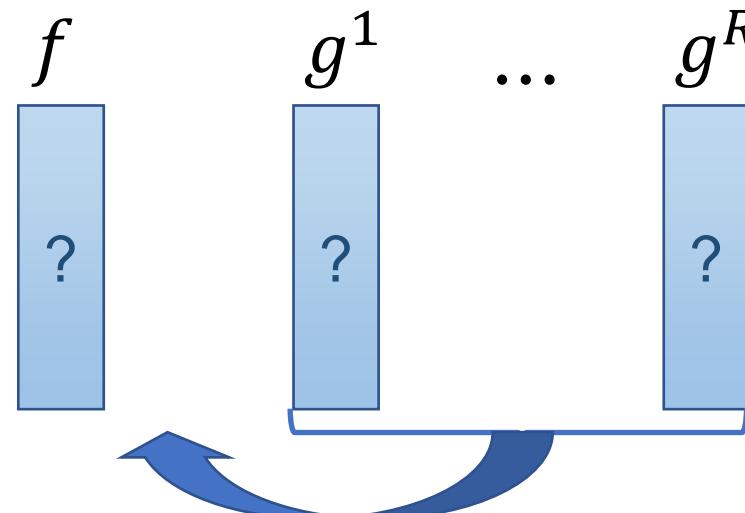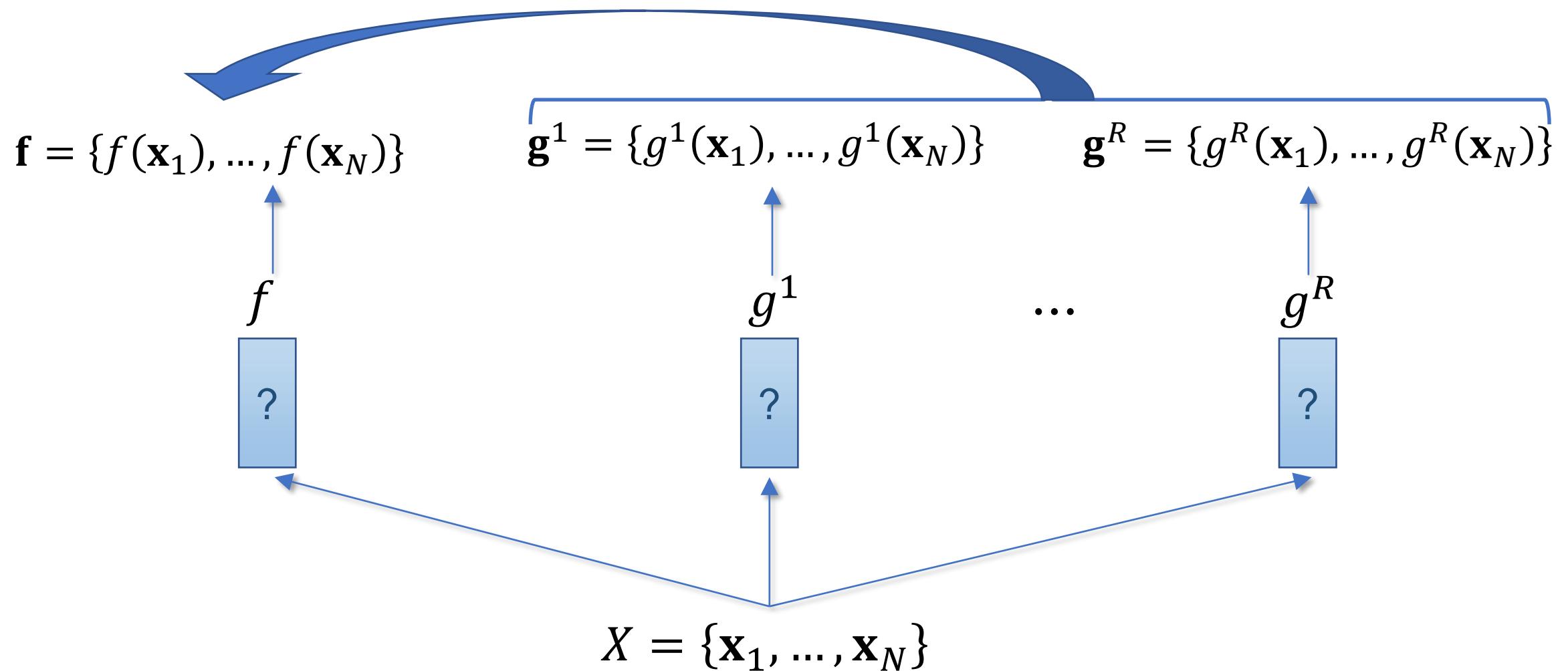
Kim et al.'s predictor combination algorithm

Shoe attributes:

Formal

f

Sporty

g^1

...

Comfort

g^R
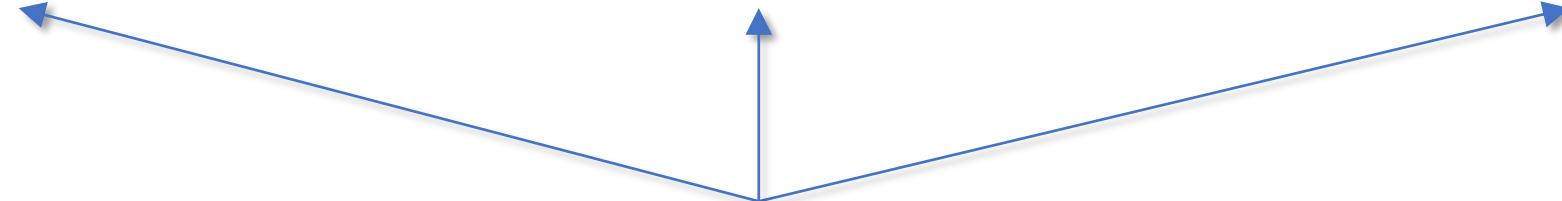
Predictor combination across domains

Shoe attributes

f

Natural scene attributes

g^1

...
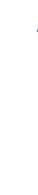
Animal attributes

g^R

Kim et al.'s predictor combination algorithm
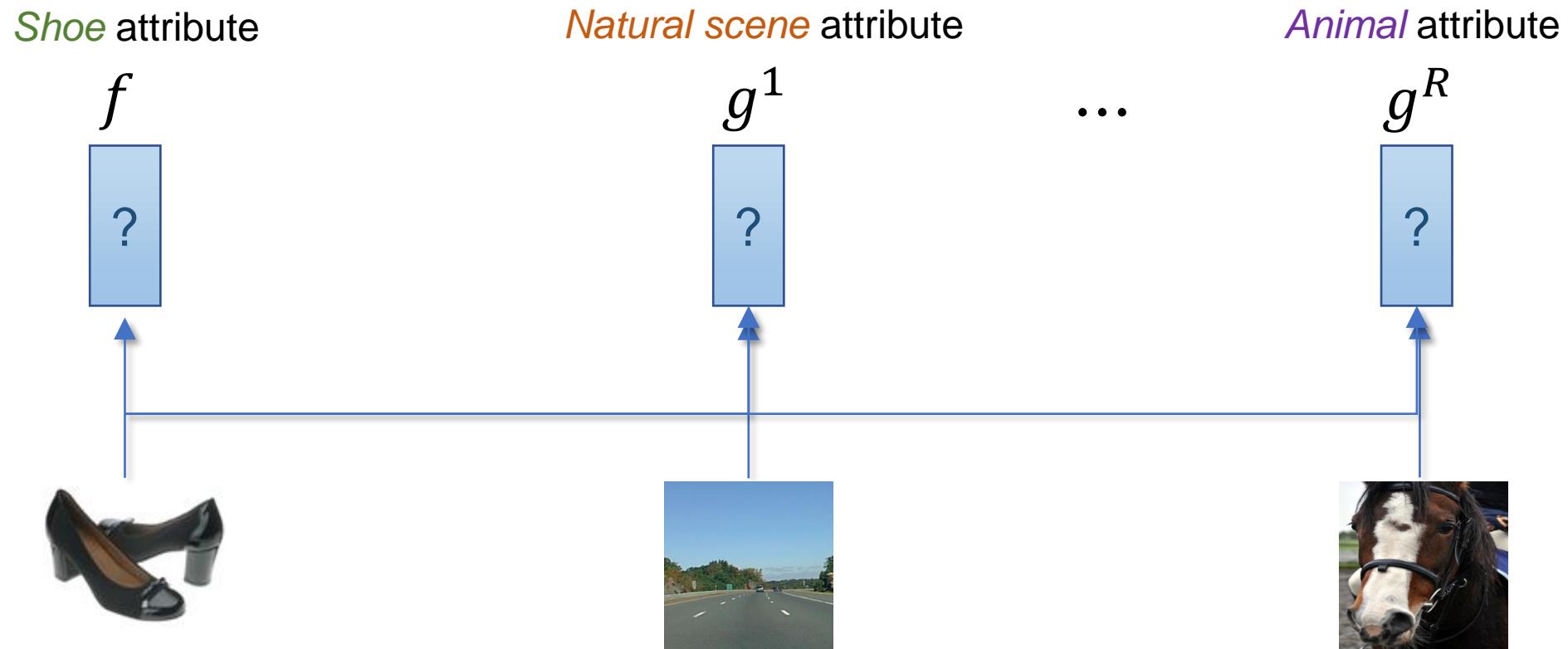
$$\mathbf{f} = \{f(\mathbf{x}_1), \dots, f(\mathbf{x}_N)\} \qquad \mathbf{g}^1 = \{g^1(\mathbf{x}_1), \dots, g^1(\mathbf{x}_N)\} \qquad \mathbf{g}^R = \{g^R(\mathbf{x}_1), \dots, g^R(\mathbf{x}_N)\}$$

f g^1 ... g^R

| ? | ? | ? |

$$X = \{\mathbf{x}_1, \dots, \mathbf{x}_N\}$$

# Predictor combination across domains

Shoe attribute

f

?

Natural scene attribute

g^1

?

...

Animal attribute

g^R

?

Predictor combination across domains

Shoe attribute

f

?

?

Natural scene attribute

g^1

?

...

?

Animal attribute

g^R

?

Predictor combination across domains via domain adaptation
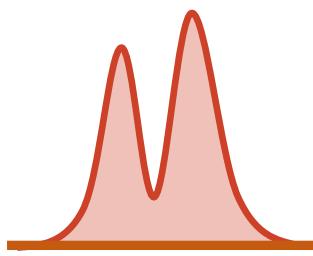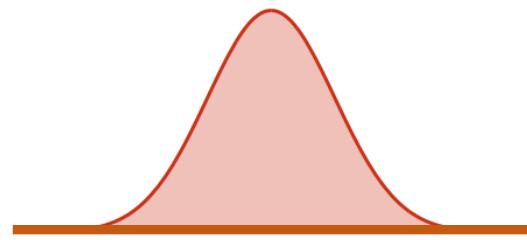
MMD-based domain adaptation

Target domain
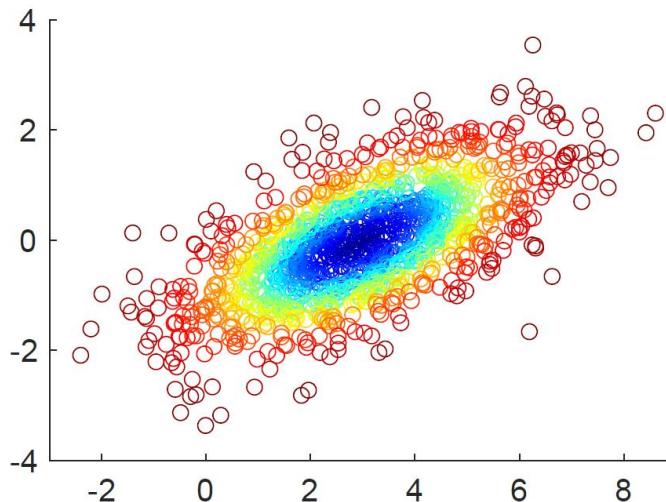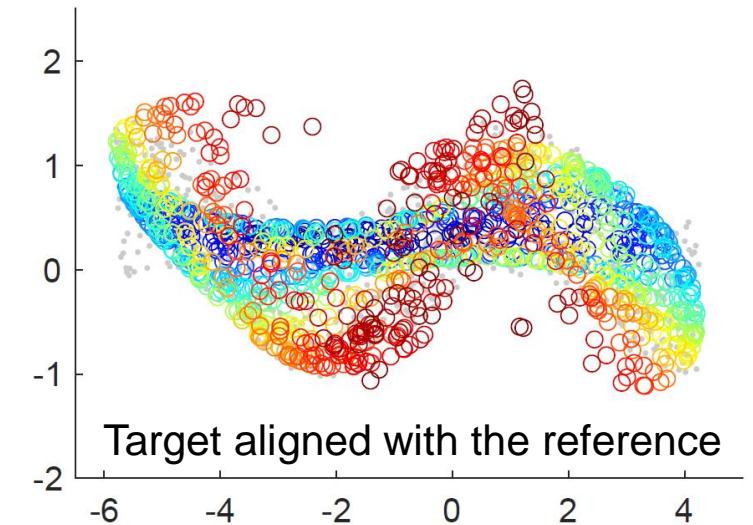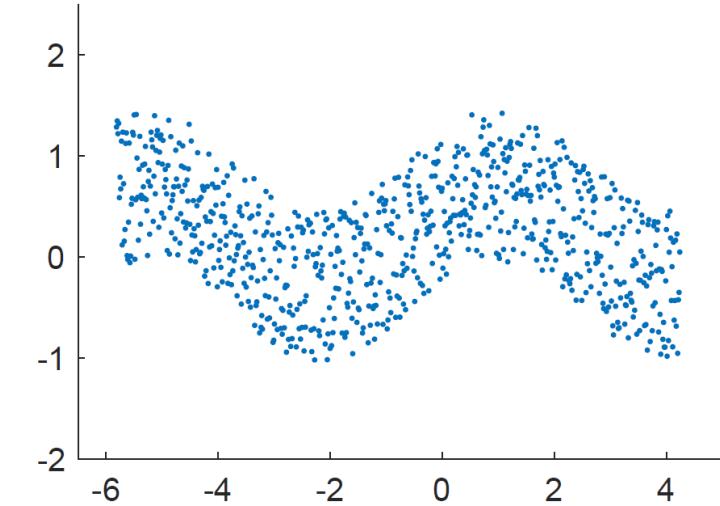
Reference domain

Maximum mean discrepancy (MMD)-based domain adaptation algorithms can fail to preserve the structure of the original data


Target aligned with the reference

Domain adaptation for predictor combination

Target domain
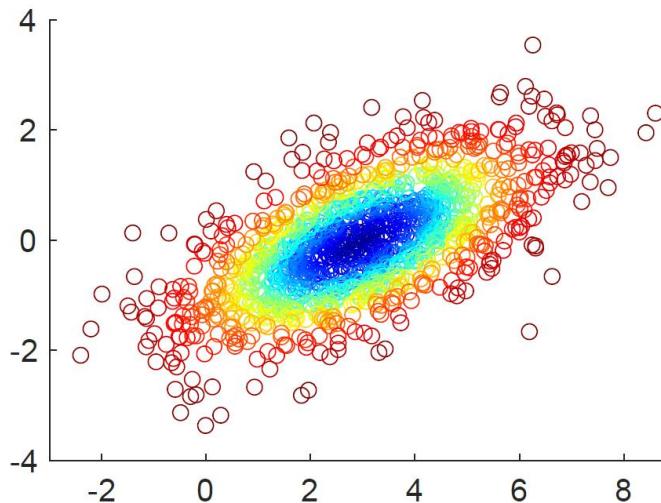
Reference domain
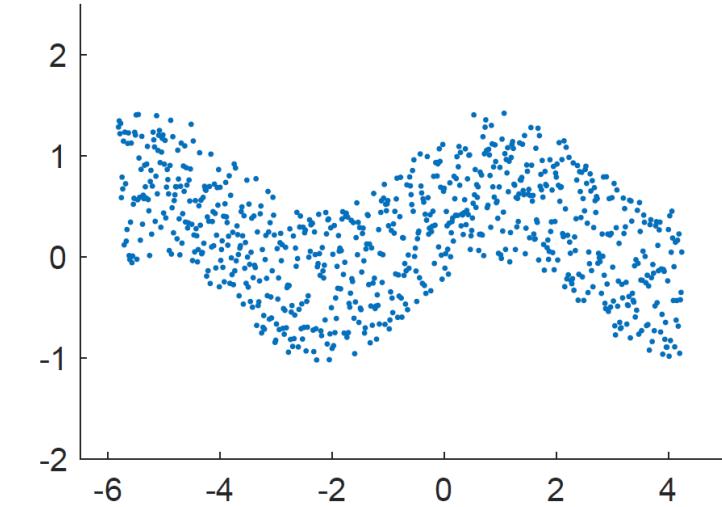
MMD-HSIC adaptation

Target aligned with the reference
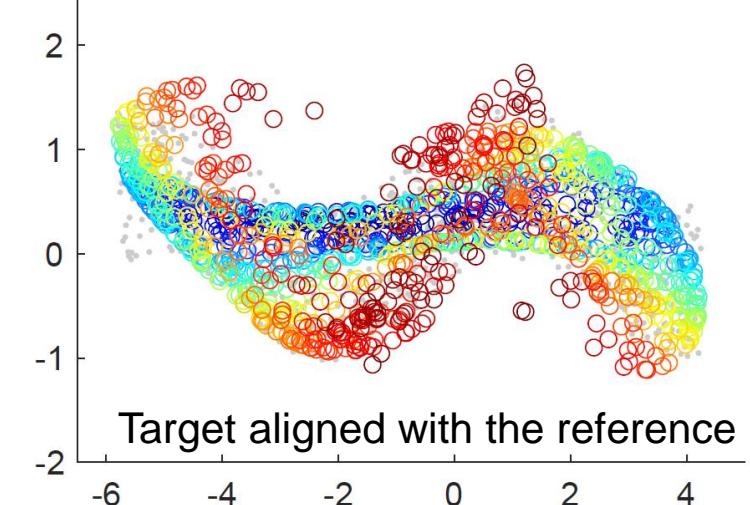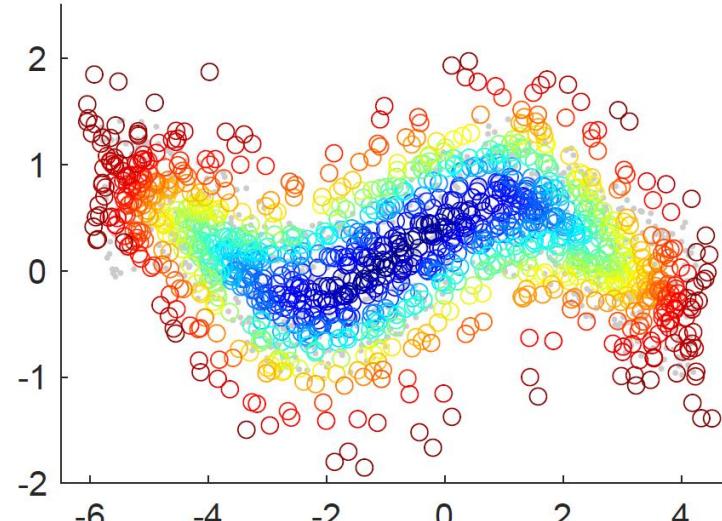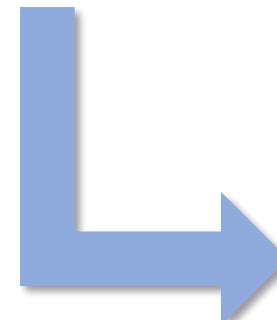
Experiments: visual attribute ranking

- Ranking function for *formal* attribute

$$f(\text{\includegraphics{}}) > f(\text{\includegraphics{}})$$

- Ranking function for *animal* attribute

$$g^1(\text{\includegraphics{}}) < g^1(\text{\includegraphics{}})$$

- Ranking function for *bird* attribute

$$g^R(\text{\includegraphics{}}) > g^R(\text{\includegraphics{}})$$

Accuracy improvements (higher is better)
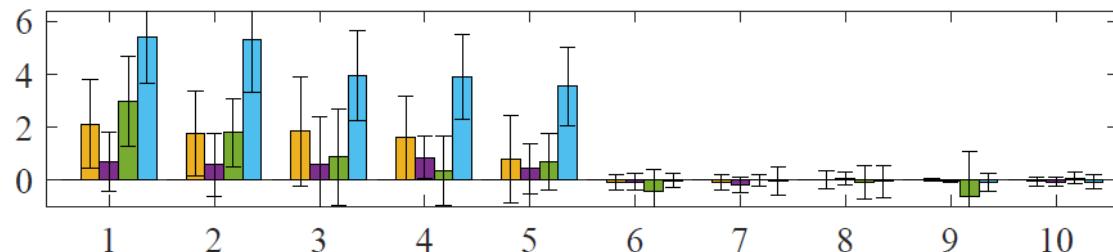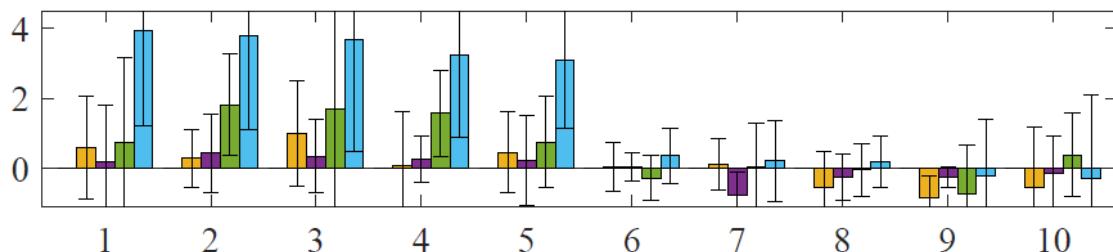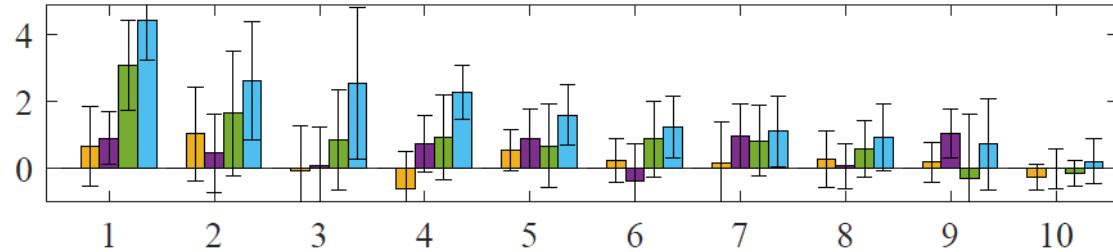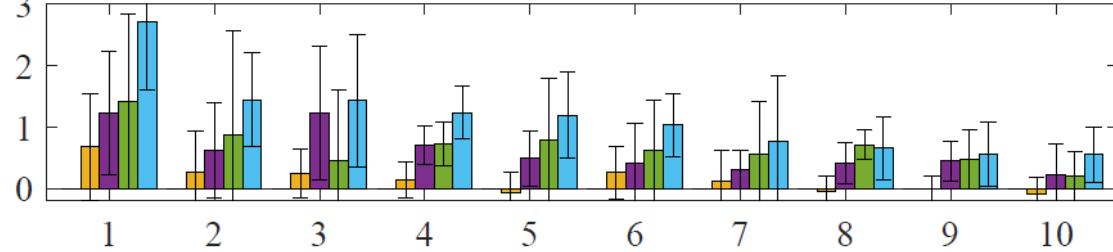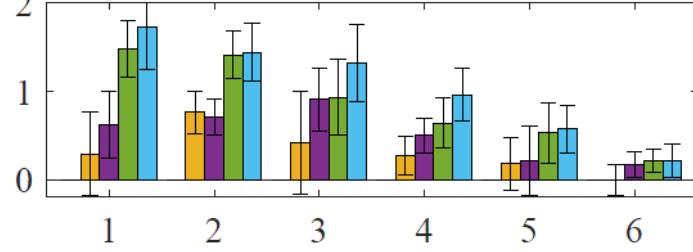
Conclusion: predictor combination across domains
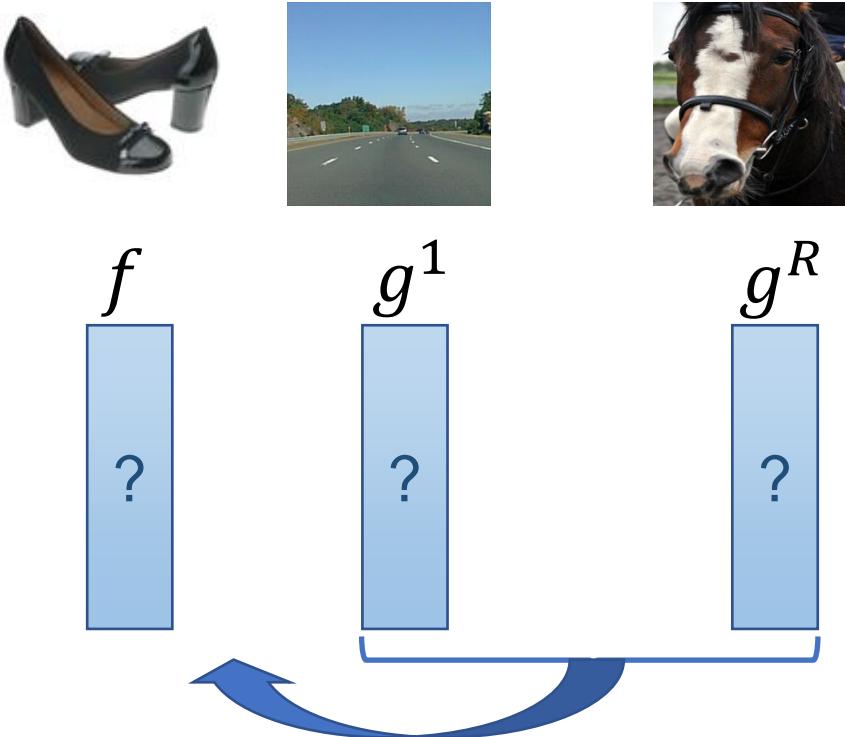
- Predictor combination improves a target predictor using the reference predictors without having access to their internals.

- Our algorithm enables predictor combination across heterogeneous domains via domain adaptation.