Function Encoders: A Principled Approach to Transfer Learning in Hilbert Spaces

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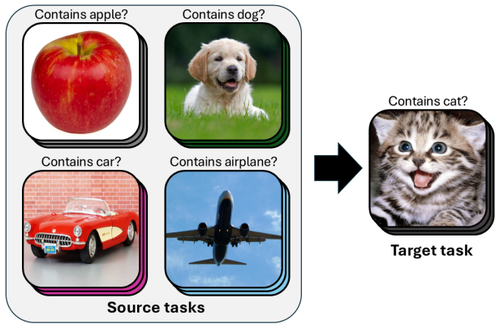
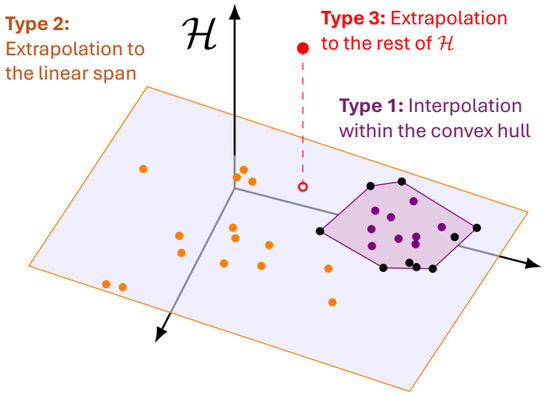
Inductive Transfer Learning



Leverage a diverse dataset of source tasks to improve performance on downstream target tasks.

A Geometric Characterization



Training Functions: Each source task is a function in $\mathcal{H}$

Empirical Results

Few-Shot Image Classification

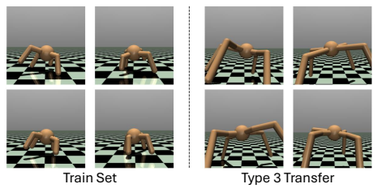
Identify new classes from examples

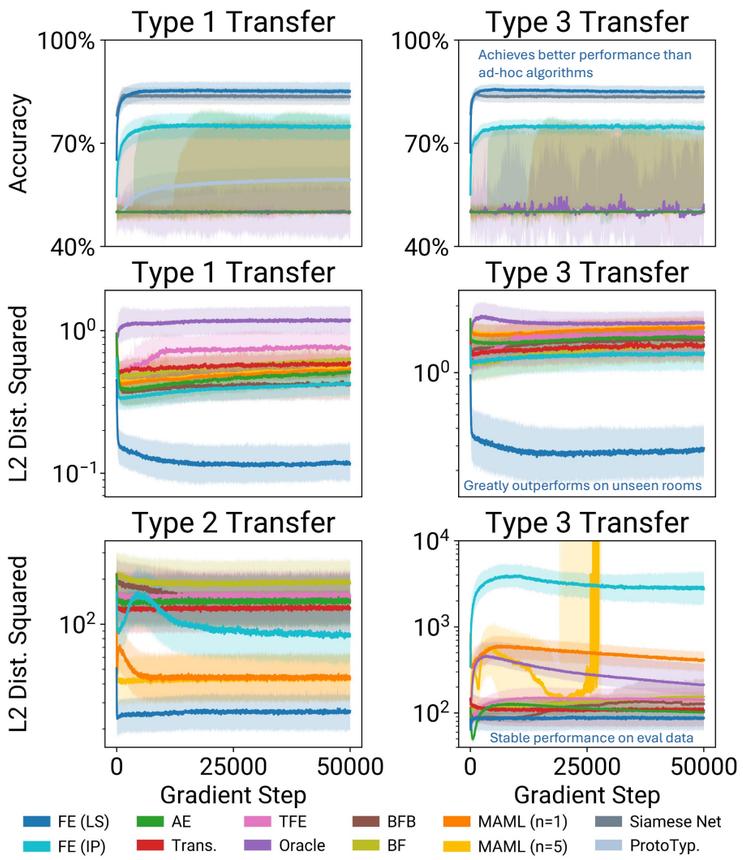
Pose Estimation

Predict the location of the camera

Dynamics Modeling

Model dynamics with varying morphology



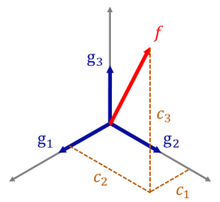


Our Approach

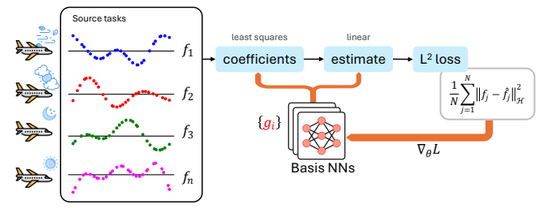
Learn a minimal set $\{g_1, ..., g_k\}$ of **neural network basis functions** to span the training data.

$$f = \sum_{i=1}^{k} c_i g_i$$

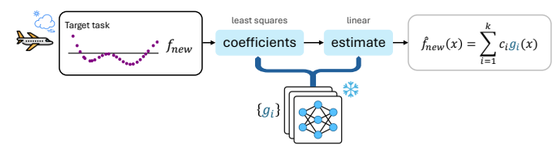
$$c = \begin{bmatrix} \langle g_1, g_1 \rangle & \dots \langle g_1, g_k \rangle \\ \vdots & \ddots & \vdots \\ \langle g_k, g_1 \rangle & \dots \langle g_k, g_k \rangle \end{bmatrix}^{-1} \begin{bmatrix} \langle f, g_1 \rangle \\ \vdots \\ \langle f, g_k \rangle \end{bmatrix}$$



Offline training

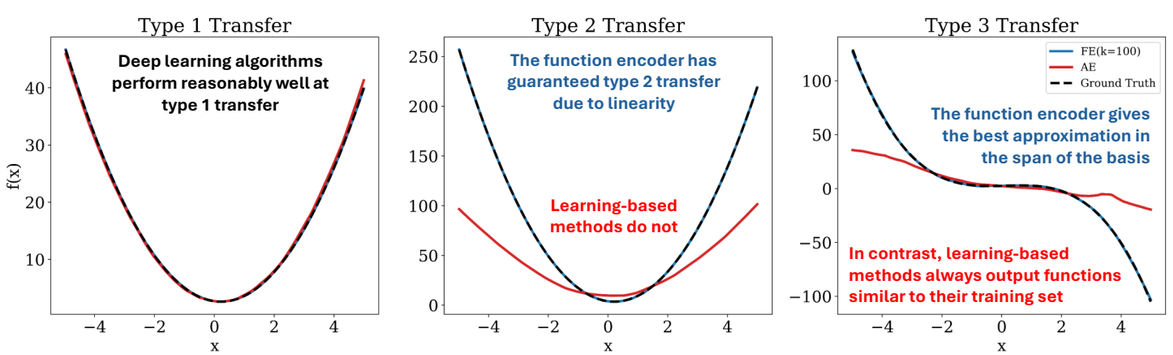


Online inference

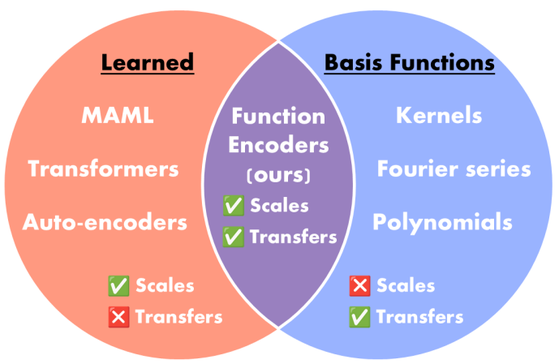


Takeaway: Neural network basis functions yield efficient and powerful transfer learning.

1-Dimensional Visualization



Relation to Prior Work



For More Information...

Paper

Python Package