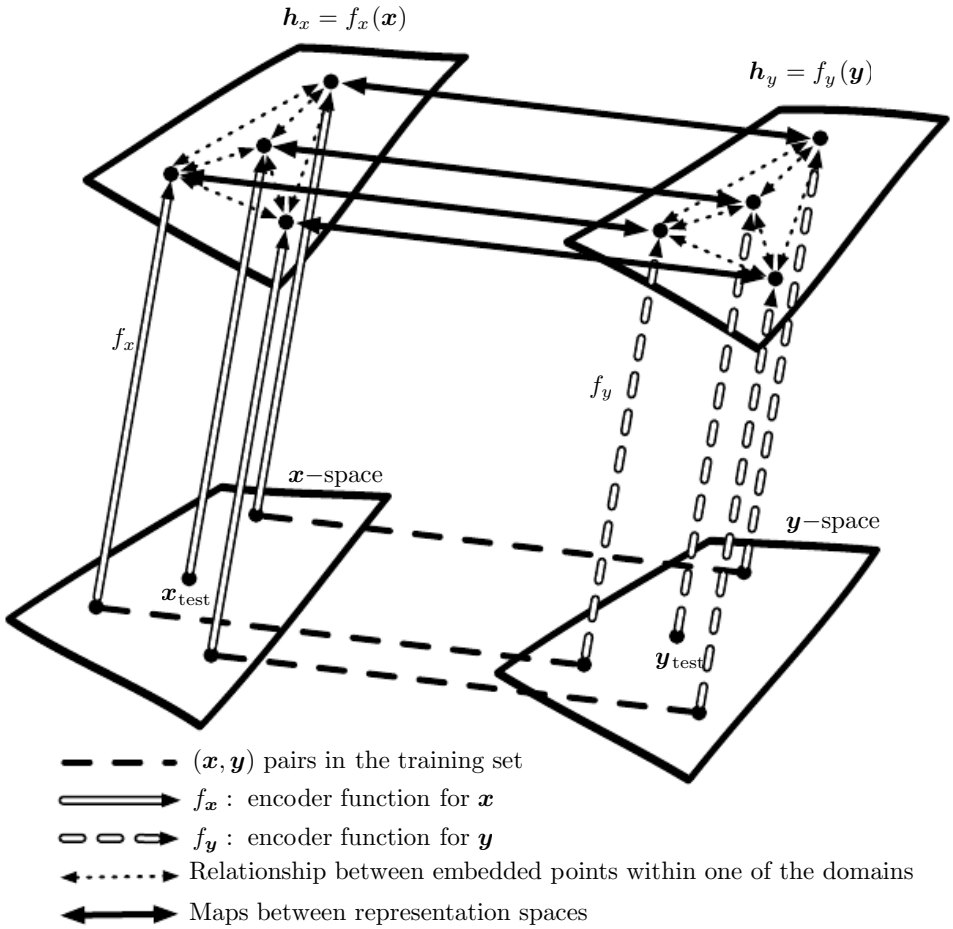

Figure 15.3: Transfer learning between two domains $\boldsymbol{x}$ and $\boldsymbol{y}$ enables zero-shot learning. Labeled or unlabeled examples of $\boldsymbol{x}$ allow one to learn a representation function f_x and similarly with examples of $\boldsymbol{y}$ to learn f_y. Each application of the f_x and f_y functions appears as an upward arrow, with the style of the arrows indicating which function is applied. Distance in $\boldsymbol{h}_x$ space provides a similarity metric between any pair of points in $\boldsymbol{x}$ space that may be more meaningful than distance in $\boldsymbol{x}$ space. Likewise, distance in $\boldsymbol{h}_y$ space provides a similarity metric between any pair of points in $\boldsymbol{y}$ space. Both of these similarity functions are indicated with dotted bidirectional arrows. Labeled examples (dashed horizontal lines) are pairs $(\boldsymbol{x}, \boldsymbol{y})$ which allow one to learn a one-way or two-way map (solid bidirectional arrow) between the representations $f_x(\boldsymbol{x})$ and the representations $f_y(\boldsymbol{y})$ and anchor these representations to each other. Zero-data learning is then enabled as follows. One can associate an image $\boldsymbol{x}_{\text{test}}$ to a word $\boldsymbol{y}_{\text{test}}$, even if no image of that word was ever presented, simply because word-representations $f_y(\boldsymbol{y}_{\text{test}})$ and image-representations $f_x(\boldsymbol{x}_{\text{test}})$ can be related to each other via the maps between representation spaces. It works because, although that image and that word were never paired, their respective feature vectors $f_x(\boldsymbol{x}_{\text{test}})$ and $f_y(\boldsymbol{y}_{\text{test}})$ have been related to each other. Figure inspired from suggestion by Hrant Khachatrian.