Constraint based learning

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\[ f: \text{Image} \rightarrow \text{Real number(s)} \]
- Parameters are optimized over
- Features are optimized over
- Collect many, many label pairs \((x_i, y_i) \rightarrow f(x_i) = y_i\)
• Train neural net to predict pillow height in each image
• \( y = y_o + v_o \cdot t + 9.8t^2 \)
• no labels required
Constraint based Learning

Goal is to recover the transformation, $f$, without providing labels, $y$. Instead, use prior knowledge to describe the structure, $z$, of the outputs, and require

$$f(x) \in g^{-1}(z)$$

We explore cases where $g$ is necessary, but not sufficient.
• Train neural net to predict horizontal position in each image
• \( h = h_o + v_o \cdot t \)
• Unfortunately, this is solved trivially by \( f(x) = c \)
• We boost variance and limit range
• Train neural net to find two objects, $y_1, y_2$, such that $y_1 \Rightarrow y_2$
• Add sufficiency constraints, including rotational invariance, high entropy
Future Ideas

• Constraints based on PDEs (temperature equation, wave equation)

• Constraints based on gravitational laws in space

• Have system guess physics and then test for convergence