Assignment6: MDP, Decision Trees

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Exercise 6.3 (Loss)

Our goal is to find a linear approximation $h(x) = ax$ for the series of square numbers 0, 1, 4, 9, 16.

1. Model this situation as an inductive learning problem.
   - hypothesis space $H = ax$
   - consistent training set of examples $f = \{\{0, 0\}, \{1, 1\}, \{2, 4\}, \{3, 9\}, \{4, 16\}\}$
2. Assuming all 5 possible examples are equality probable, compute the generalized loss using the squared error loss function. (This is a function of h.)

   $GenLoss_L(h) = \sum_{x,y \in E} L(y, h(x)) \cdot P(x, y)$. Since 5 possible examples are equality probable, $P(x, y) = \frac{1}{5} \forall x, y \in f . L(y, h(x)) = (y - ax)^2$. However, we don't choose a yet. So, we can't compute it.
3. Find $h^\star$

   $a^\star = (X^T X)^{-1} X^T y$, where $X = (0, 1, 2, 3, 4)^T, y = (0, 1, 4, 9, 16)^T$.
   Hence $a^\star = 3.3 \Rightarrow h^\star = 3.3x$
4. What is the error rate of $h^\star$?

   $error(h) = GenLoss_{L_{0/1}}(h) = \frac{1}{5} \cdot (0 + 1 + 1 + 1 + 1) = \frac{4}{5}$