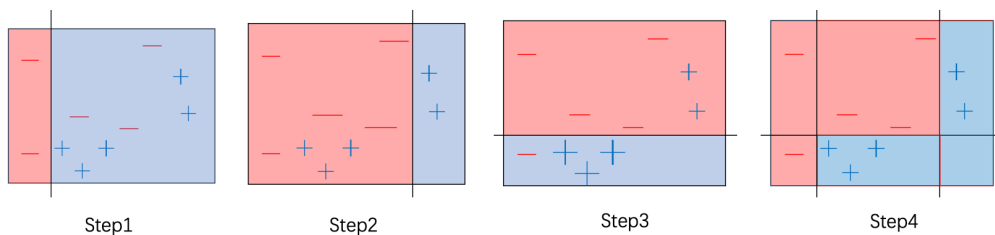


Homework 6

Problem1:

- (1) **Adaboost algorithm:** The first three images are steps of the Adaboost algorithm, and the last image is the final classification of the ensemble.



- (2) A strong learner is PAC learnable. Given sufficient number of training examples, the error $L_D(H_s) \leq \epsilon$ with probability of at least $1 - \delta$ for arbitrary ϵ and δ .

A weak learner is γ -learnable. The error $L_D(H_s) \leq \frac{1}{2} - \gamma$, for fixed $\gamma \leq \frac{1}{2}$.

In other words, for a weak learner, the error doesn't have to be smaller than a very small number ϵ . The upper bound of the error can be a number smaller than 0.5, just a little better than pure guess.

- (3) When $T = 1$, the only learner is a weak learner. Therefore, the bound of error is $\frac{1}{2} - \gamma$, for fixed $\gamma \leq \frac{1}{2}$.

When $T = \text{inf}$, we can combine all the weak learner into a strong learner. In this case, the bound of error is ϵ , which is an arbitrary small number.

This is how the Adaboost algorithm works. It can help us to generate a strong learner out of multiple weak learners. As a result, the boosting increase the complexity of the hypothesis class, and make the model less underfitting.