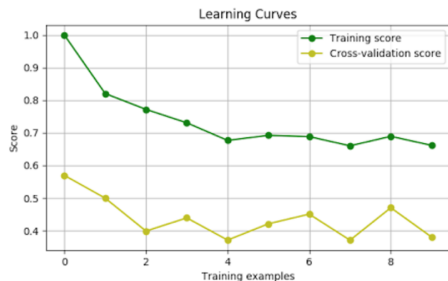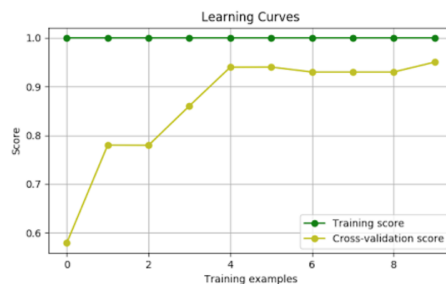# Solution: Using Learning Curves to Detect Overfitting and Underfitting
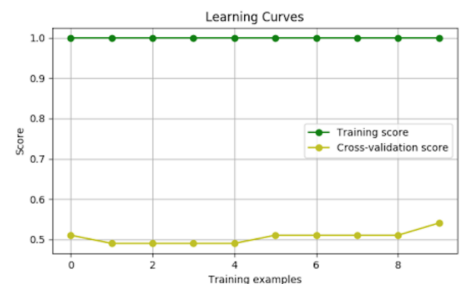
Congratulations! That was not an easy quiz. Here are the curves you should have obtained:
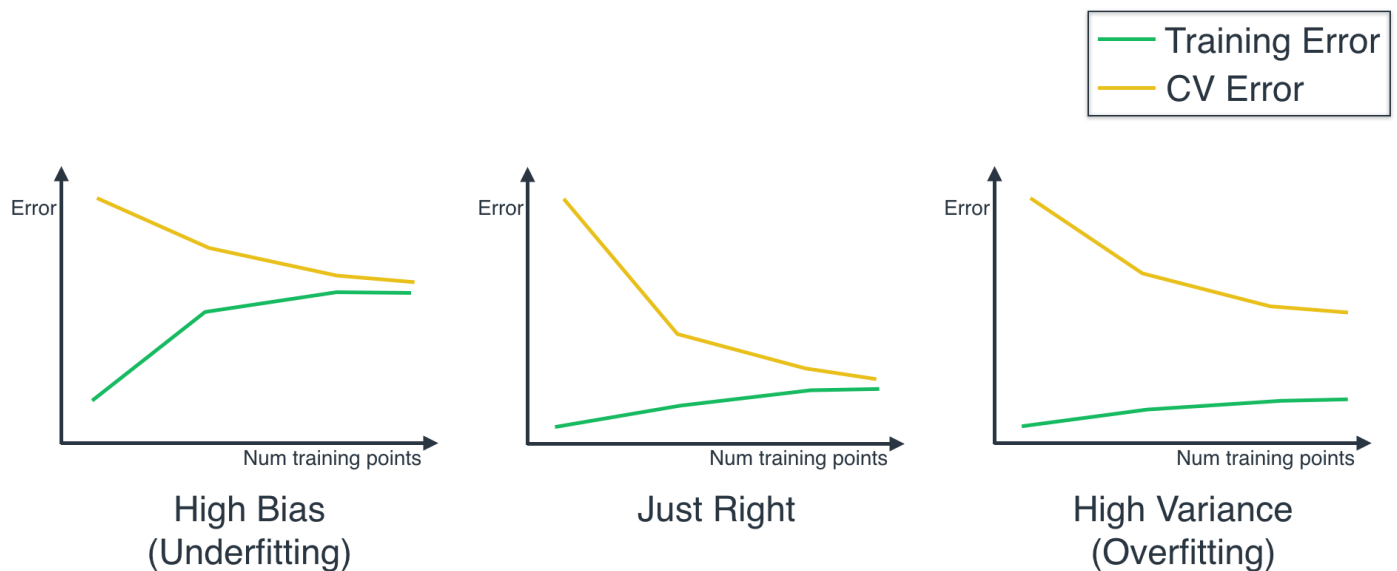

| Logistic Regression | Decision Tree | Support Vector Machine |

We can observe from the curves that:

- The **Logistic Regression** model has a low training and testing score.
- The **Decision Tree** model has a high training and testing score.
- The **Support Vector Machine** model has a high training score, and a low testing score.

From here, we can determine that the Logistic Regression model underfits, the SVM model overfits, and the Decision Tree model is just right.

Equivalently, we can flip this curves (as they measure score, and our original curves measure error), and compare them with the following three curves, we can see that they look a lot like the three curves we saw before. (*Note: The fact that we flip the curves doesn't mean that the error is 1 minus the score. It only means that as the model gets better, the error decreases, and the score increases.*)

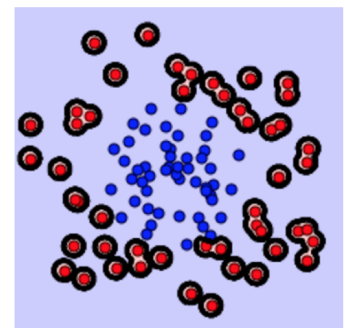| High Bias (Underfitting) | Just Right | High Variance (Overfitting) |

Now, we should check if this is visible in the actual model. When we plot the boundary curves for each one of these models, we get the following:
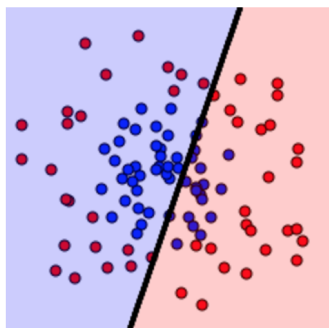
Logistic Regression
(Underfitting)
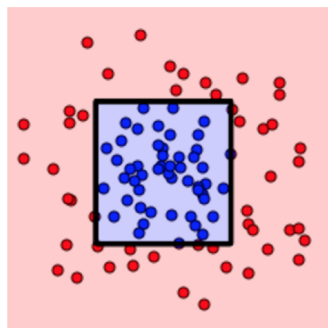
Decision Tree
Just Right

Support Vector Machine
(Overfitting)

When we look at the models above, does it make sense that the first one underfits, the second one is right, and the third one overfits? It does, right? We can see that the data is correctly bounded by a circle, or a square. What our models do, is the following:

- The **Logistic Regression** model uses a line, which is too simplistic. It doesn't do very well on the training set. Thus, it **underfits**.
- The **Decision Tree** model uses a square, which is a pretty good fit, and generalizes well. Thus, this model is **good**.
- The **Support Vector Machine** model actually draws a tiny circle around each point. This is clearly just memorizing the training set, and won't generalize well. Thus, it **overfits**.

It's always good to do a reality check when we can, and see that our models actually do have the behavior that the metrics tell us.