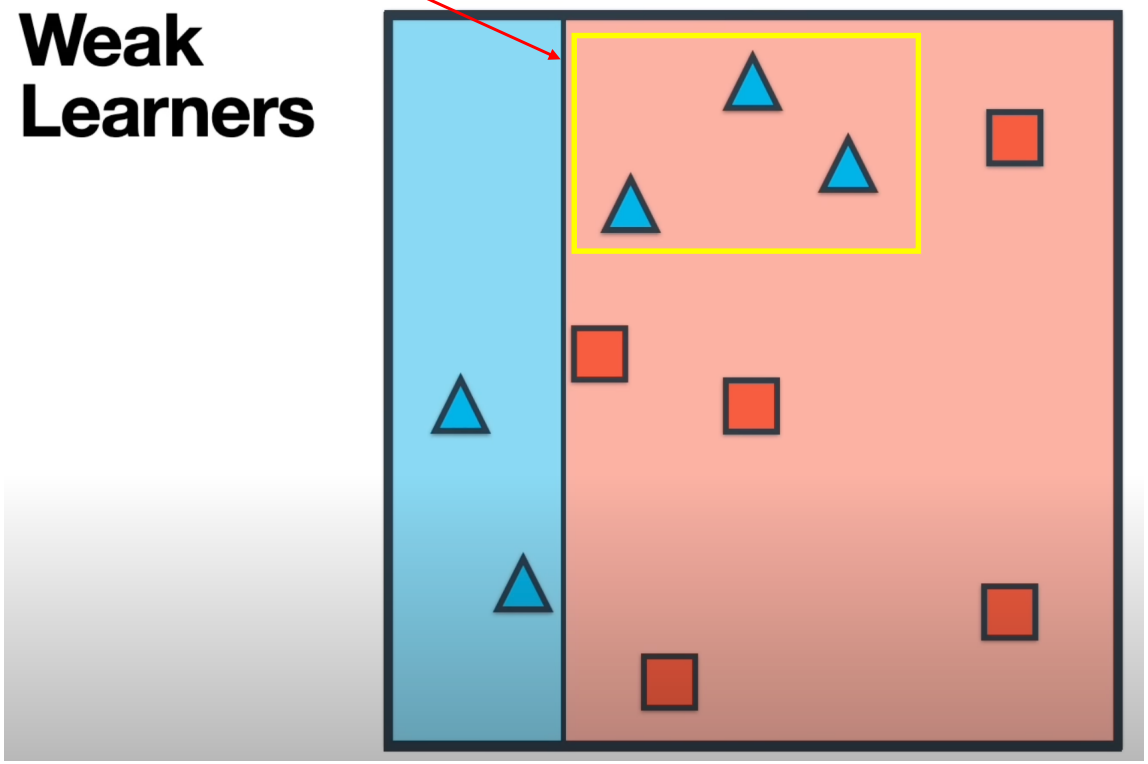
Gist of AdaBoost

Let's build some simple classifier, we are going to call this as weak learners

Let's say it's vertical line over here which classifies everything to its left as blue triangle and its right as a red square, this classifier is good but not perfect, we are going to need to build some more and this is the idea – each learners is going to focus on the weakness of the previous ones



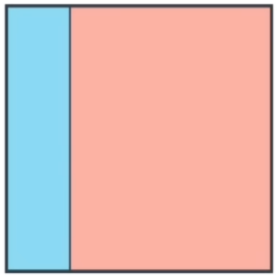
What are the weakness of this classifier, as you see from this it got most of the points correct but it made three mistakes which are highlighted in yellow box which is 3 blue triangle that are incorrectly classified as red squares

So we are going to make sure next classifier focuses on those three points which incorrectly classified triangle as red squares

So, we are going to make sure next classifier focuses on those three points

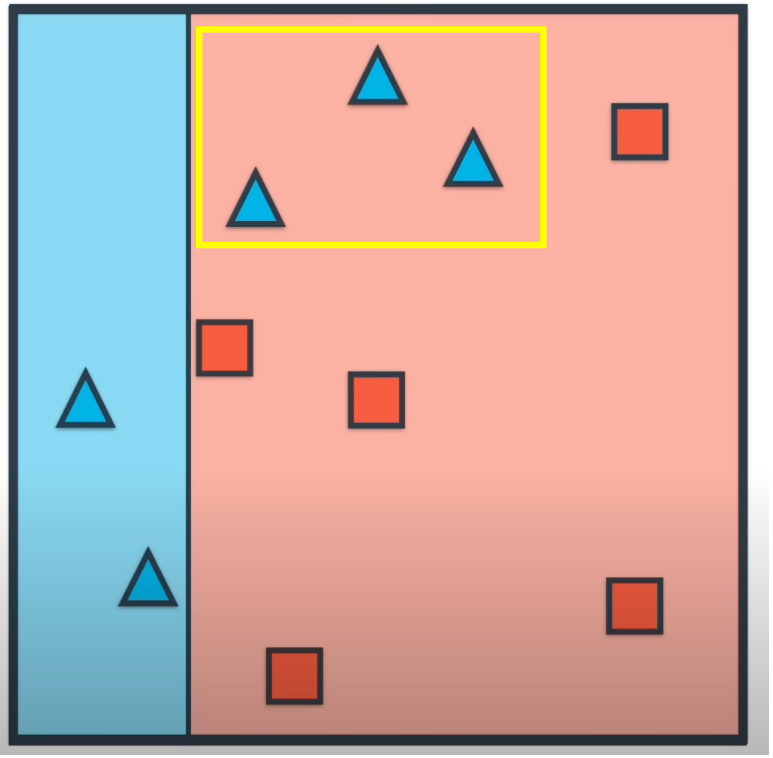
Weak Learner 1

We are going to store this patter over here for later use



Weak Learner 1

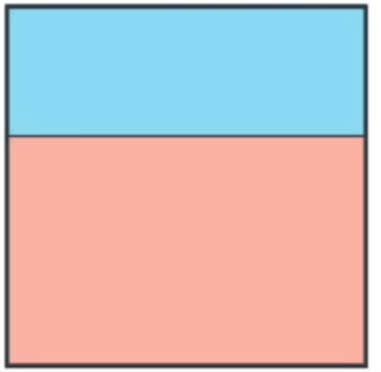
Weak Learners



Now we are going to build a new Weak Learner 2 on this new Weighted Data set

Weak Learner 2

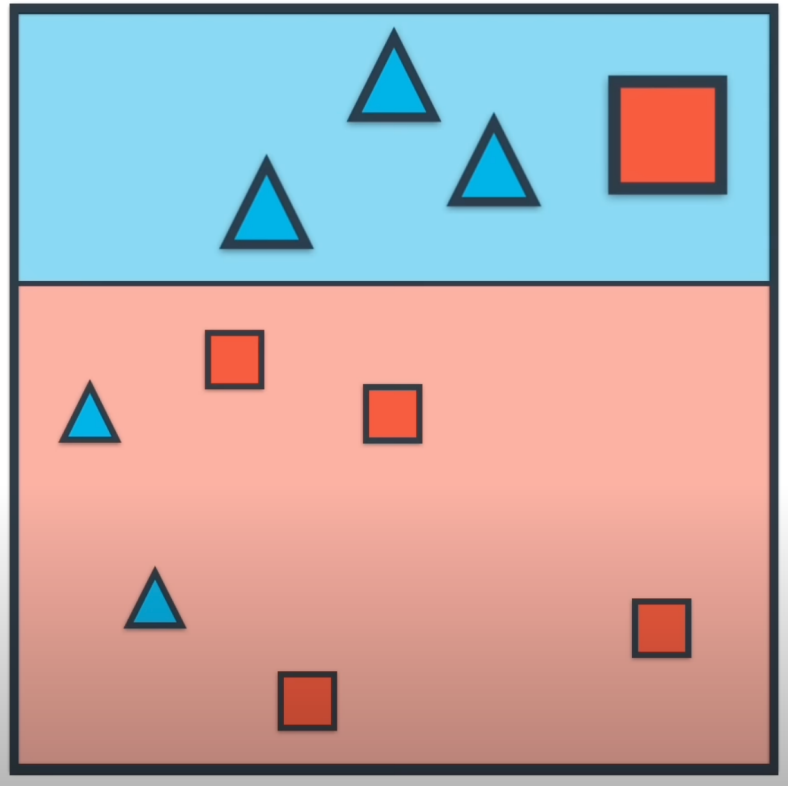
We are going to store this patter over here for later use



Weak Learner 2

Weak Learners

Each learner focuses on the weaknesses of the previous ones

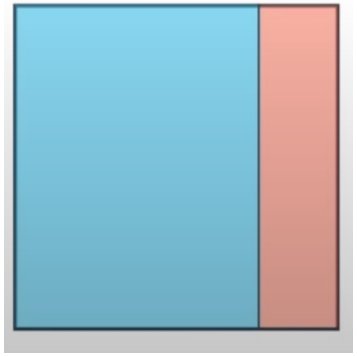


Red Square over the top classified as Blue Triangle and there are 2 blue triangles here got classified as red squares.. So it made 3 mistakes but that's okay.

Lets move on the build a new classifier (weak learner 3) on these same data sets these better get the big points correct... details on next slide

Weak Learner 3

We are going to store this patter over here for later use

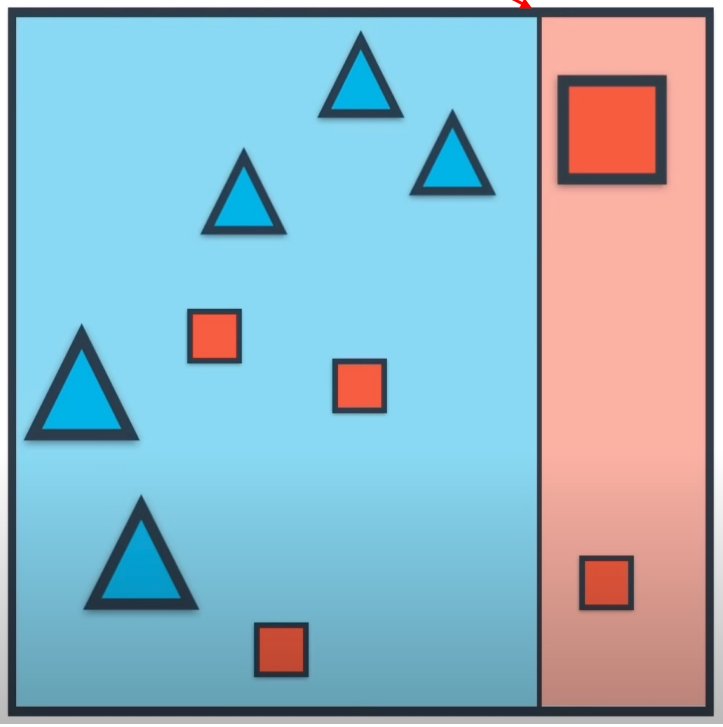


Weak Learner 3

And this one could be this vertical line over here which classifies everything to the left

Weak Learners

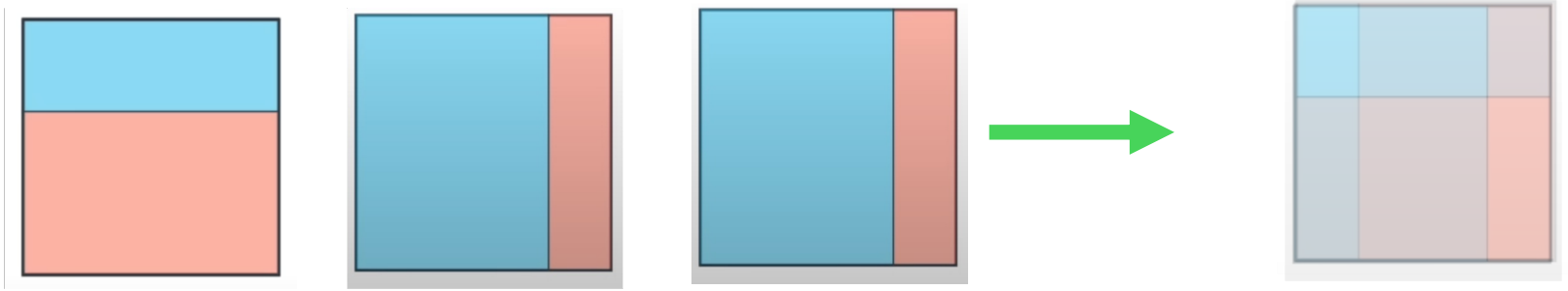
Each learner focuses on the weaknesses of the previous ones



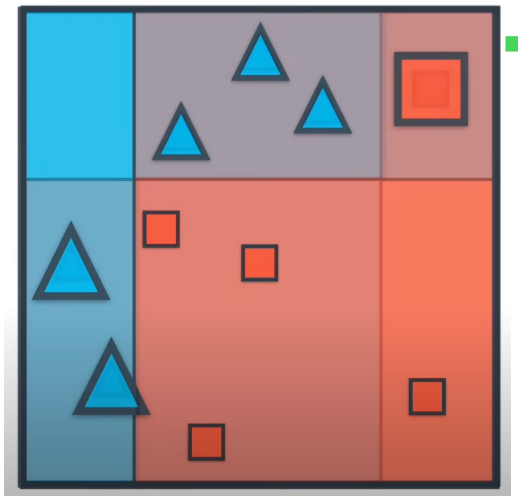
Our final step is just that we combine the three Weak Learners 1, 2,3 - details on the next slide

Our final step is just that we combine the three Weak Learners 1, 2,3 - to get this strong classifier over here

1

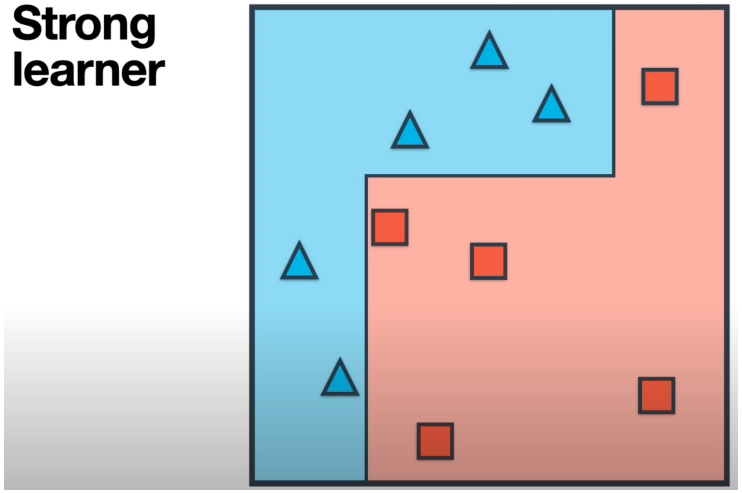


2



This is the Strong Learner that AdaBoost build for us, but this is the gist of Ada boost but there few details add to it such as – by how much do you scale the mistakes

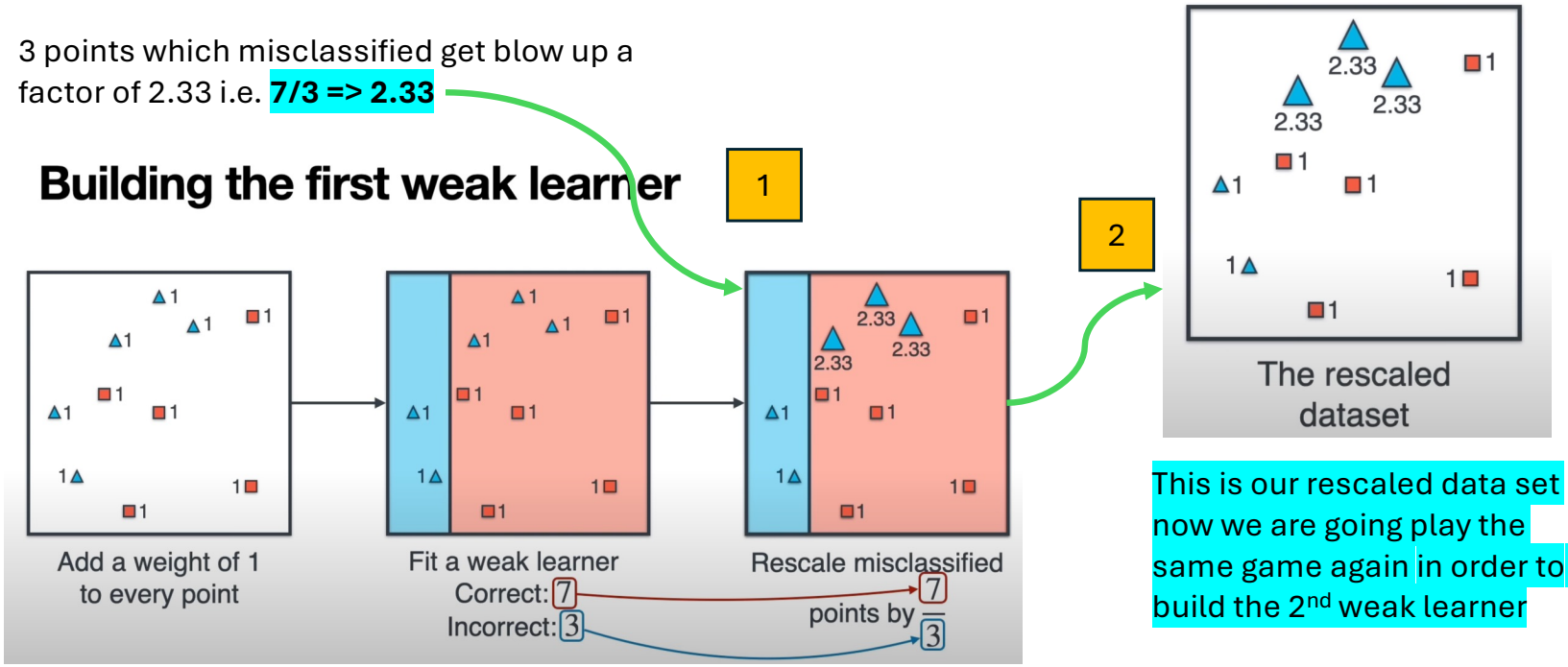
Strong learner



by how much do you scale the mistakes **or** **How to you combine the classifier**

Building Weak Learner 1

3 points which misclassified get blow up a factor of 2.33 i.e. **7/3 => 2.33**



This is our rescaled data set now we are going play the same game again in order to build the 2nd weak learner

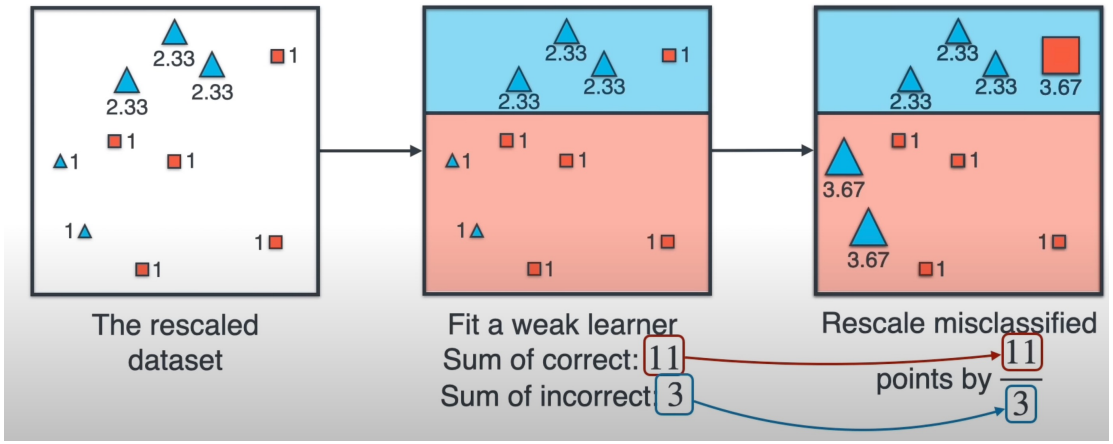
by how much do you scale the mistakes **or** **How to you combine the classifier**

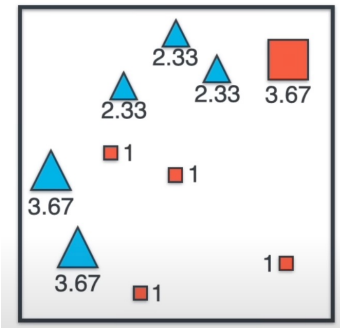
Building Weak Learner 2

5 points which misclassified get blow up a factor of 3.67 i.e. **11/3 => 3.67**

2.33 + 2.33 + 2.33 + 1 + 1 + 1 +1 => 11

Building the second weak learner





This is our rescaled data set now we are going play the same game again in order to build the 3rd weak learner

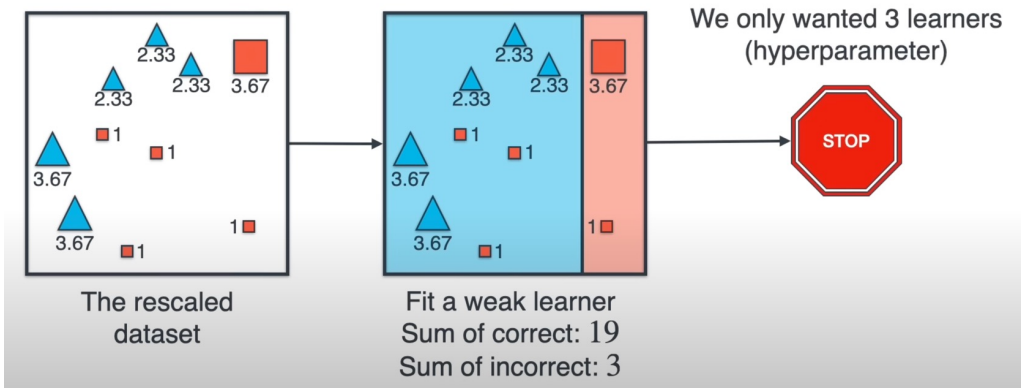
by how much do you scale the mistakes **or** **How to you combine the classifier**

Building Weak Learner 3

3 points which misclassified get blow up a factor of 3.67 i.e. **19/3 => 3.67**

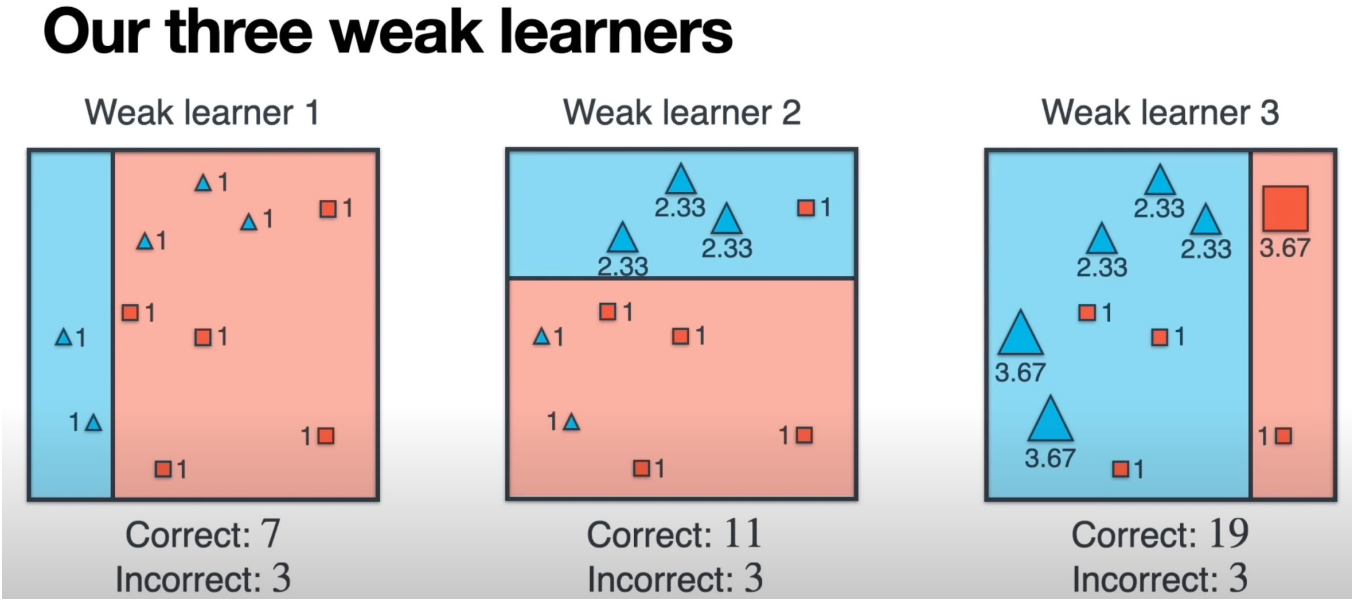
2.33 + 2.33 + 2.33 + 3.67 + 3.67 + 3.67 +1 => 19

Building the third weak learner



Since we are stopping here in this case, we choose 3 classifier as hyperparameter

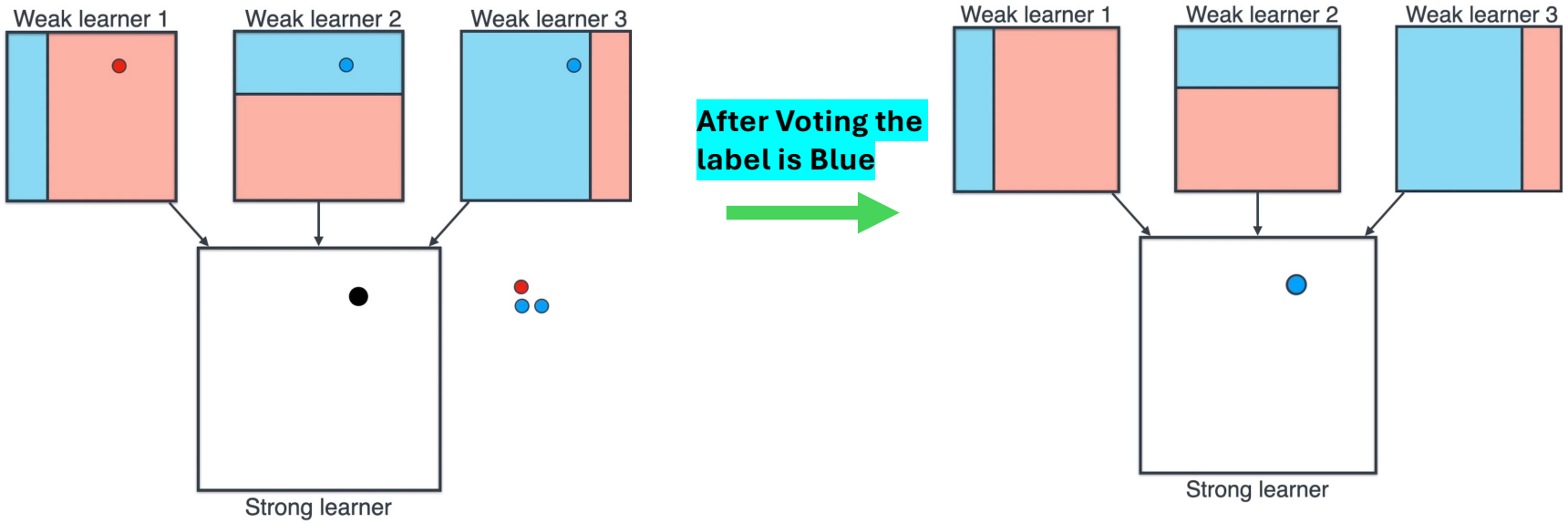
Finally, here are 3 Weak Learners



These numbers will be important when it comes to combining these three Weak Learners into a Strong Leaner which is in next slide…

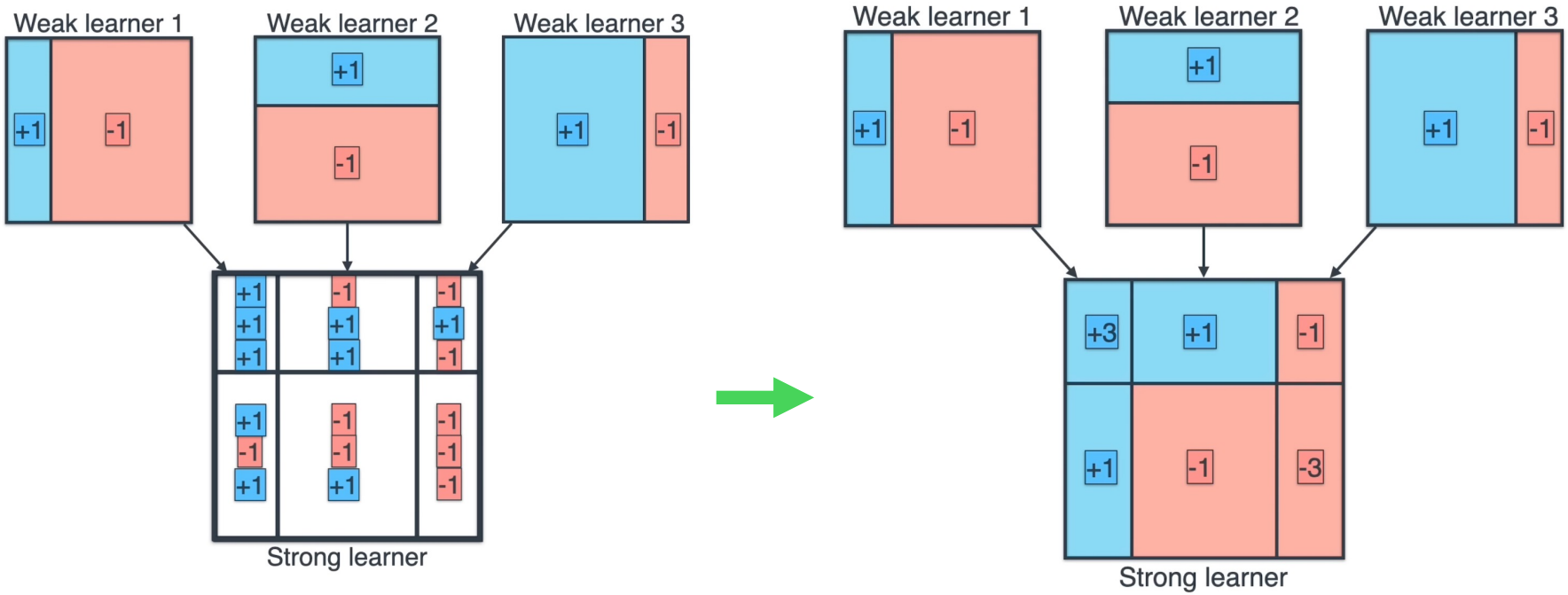
Combine the Weak Learners to Strong Leaners

Frist lets check what label is given to that point by the 3 – weak learners and the labels given are Red for the First one, Blue for the second one and Blue for the 3 one – so when we make them vote



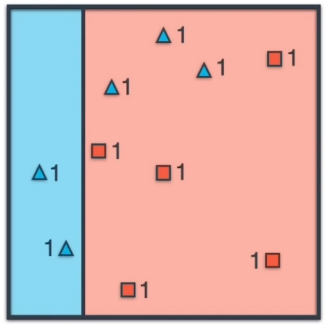
Now we will do that for every point…

Let's put +1's into blue regions and -1's into red regions



Now let's combine them using weighted voting

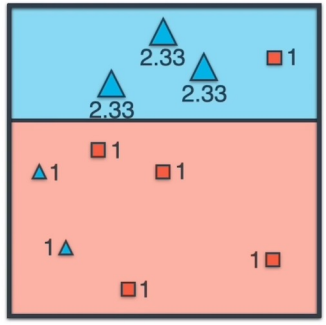
Our three weak learners



Correct: 7
Incorrect: 3

Odds: $\frac{7}{3}$

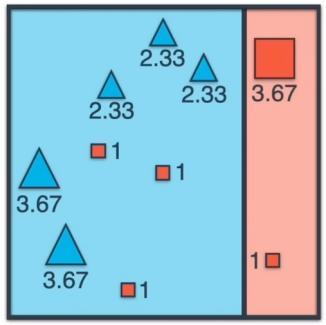
Log odds: $\ln\left(\frac{7}{3}\right) = 0.85$



Correct: 11
Incorrect: 3

Odds: $\frac{11}{3}$

Log odds: $\ln\left(\frac{11}{3}\right) = 1.3$



Correct: 19
Incorrect: 3

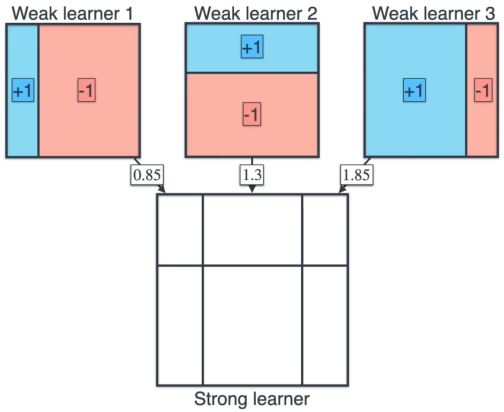
Odds: $\frac{19}{3}$

Log odds: $\ln\left(\frac{19}{3}\right) = 1.85$

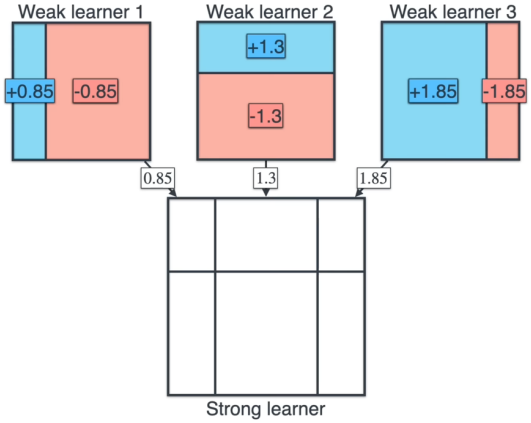
For the symmetrical distribution we are using **Logarithmic**

Now we are multiplying with +1's and -1's with assigned weights before with quality score of each one of the weak learners - After combining the all the 3 weaker learners it combines the Strong learner.

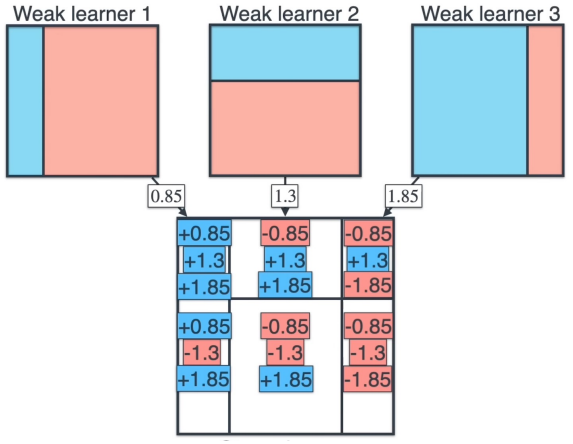
1



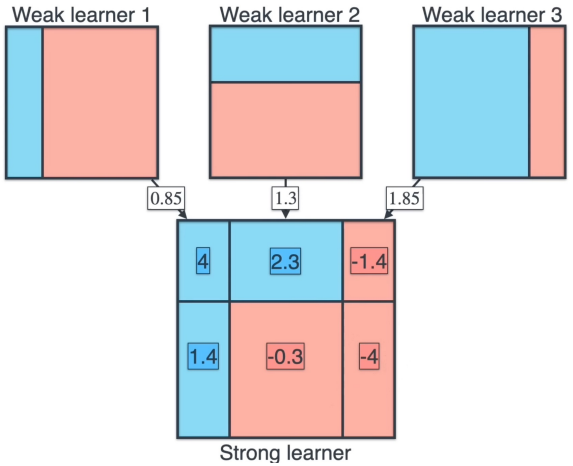
2



3



4



Notice that this stronger leaner does well because it manages to classify the entire data set correctly

5

Strong Learner