2. Simple reasoning question (Precision & Recall)

Suppose you have to create a machine learning model that predicts whether or not a certain human has a particular type of fatal cancer. Is Precision or Recall a more important metric to optimize in this case? Explain your reasoning.

Answer:

So let's start the discussion with what each term is in a shortest way possible:

Accuracy: Accuracy of a model tells us how many times the model returns a right answer out of every all the predictions. It's formula is

$$accuracy = (TP+TN)/(TP+TN+FP+FN)$$

where:
TP: True Positives
TN: True Negatives
FP: False Positives
FN: False Negatives

Precision: Precision tells us how many times the model was right out of what it was actually right plus how many times it thought was right but was actually wrong. For our problem statement, that would be the measure of patients that we correctly identify having cancer out of all the patients actually having it.

$$Precision = TP/(TP+FP)$$

Recall: Recall tells us how many times the model was right out of what it predicted right plus the times when it fails to predict right. In this case, for all the patients who actually have cancer, recall tells us how many we correctly identified as having cancer. It's formula is:

$$Recall = TP/(TP+FN)$$

Using just accuracy makes sense as it simplifies results for us but it is very important to verify the results with other metrics rather then declaring cancer in the patient based on just one metric. Sometime, a result has more accuracy and precision and very low recall or vice versa so that patient is very likely to be placed in non-cancer patients because of low recall. Similarly relaying on more metrics lead to more perfect results during the training and as well as during testing or prediction. Just like we need a trade-off between *bias* and *variance* similarly we need trade-off between recall and precision. To better represent this trade-off f1-score is used to check with both precision and recall. As it's formula is:

$$f1\text{-}score = 2*(precision*recall)/(precision+recall)$$

In our case achieving high recall is better than achieving high precision i.e., we would like to detect as many cancer patients as we can so in this case f1-score is not much useful instead high recall and accuracy is more important.