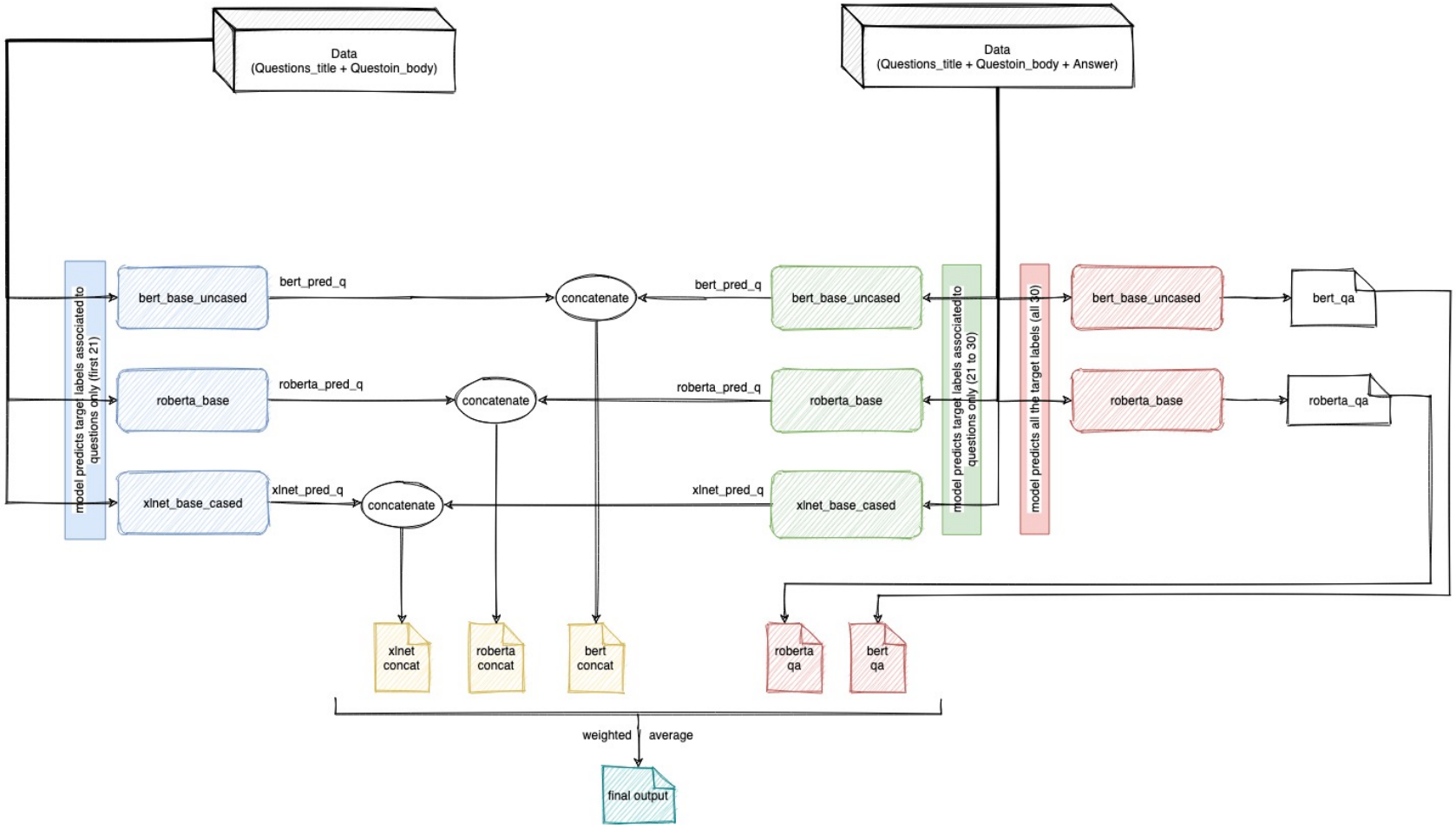
In [1]:
```
# importing necessary libraries
import numpy as np
import pandas as pd
import tensorflow as tf
from scipy.stats import spearmanr
import os

%matplotlib inline
from IPython.display import Image
```

In [2]:
```
Image('diagram_ensemble.jpg')
```

Out[2]:



In [3]:
```
# performance comparasion of the transformers used in the final ensemble

from prettytable import PrettyTable
x = PrettyTable()
x.field_names = ["model","dataset","train loss","cv loss","train rhos","cv rhos"]
x.add_row(['bert_base_uncased','questions',0.3393, 0.3302, 0.5543, 0.6013])
x.add_row(['bert_base_uncased','answer',0.3320, 0.3278, 0.4967, 0.5438])
x.add_row(['bert_base_uncased','question+answer',0.3287, 0.3166, 0.5511, 0.6109])

x.add_row(['roberta_base','questions',0.3542, 0.3400, 0.4953, 0.5674])
x.add_row(['roberta_base','answer',0.3430, 0.3253, 0.3927, 0.4993])
x.add_row(['roberta_base','question+answer',0.3546, 0.3397, 0.4305, 0.5082])

x.add_row(['xlnet_base_cased','questions',0.3662, 0.3412, 0.4679, 0.5685])
x.add_row(['xlnet_base_cased','answer',0.3611, 0.3401, 0.3531, 0.4702])
print(x)
```

```
+-------------------+-----------------+------------+---------+------------+---------+
|       model       |     dataset     | train loss | cv loss | train rhos | cv rhos |
+-------------------+-----------------+------------+---------+------------+---------+
| bert_base_uncased |    questions    |   0.3393   |  0.3302 |   0.5543   |  0.6013 |
| bert_base_uncased |      answer     |   0.332    |  0.3278 |   0.4967   |  0.5438 |
| bert_base_uncased | question+answer |   0.3287   |  0.3166 |   0.5511   |  0.6109 |
|    roberta_base   |    questions    |   0.3542   |   0.34  |   0.4953   |  0.5674 |
|    roberta_base   |      answer     |   0.343    |  0.3253 |   0.3927   |  0.4993 |
|    roberta_base   | question+answer |   0.3546   |  0.3397 |   0.4305   |  0.5082 |
|  xlnet_base_cased |    questions    |   0.3662   |  0.3412 |   0.4679   |  0.5685 |
|  xlnet_base_cased |      answer     |   0.3611   |  0.3401 |   0.3531   |  0.4702 |
+-------------------+-----------------+------------+---------+------------+---------+
```

In [4]:
```
def get_data():
  if 'transformers_data' not in os.listdir():
    print('downloading data...')
    !wget 'https://github.com/SarthakV7/Kaggle_google_quest_challenge/blob/master/transformers_data.zip?raw=true'
    !mv 'transformers_data.zip?raw=true' 'transformers_data.zip'
    !unzip transformers_data

  # Importing the test data and sample submission data
  print('collecting kaggle data...')
  train = pd.read_csv('transformers_data/train.csv')
  test = pd.read_csv('transformers_data/test.csv')
  submission = pd.read_csv('transformers_data/sample_submission.csv')

  # Importing the predicted labels of bert
  print('collecting bert_base_uncased data...')
  bert_test_q = pd.read_csv('transformers_data/bert_pred_q_test.csv')
  bert_test_a = pd.read_csv('transformers_data/bert_pred_a_test.csv')
  bert_test_qa = pd.read_csv('transformers_data/bert_pred_qa_test.csv')
  bert_test_concat = pd.concat([bert_test_q, bert_test_a], axis=1)

  # Importing the predicted labels of roberta
  print('collecting roberta_base data...')
  roberta_test_q = pd.read_csv('transformers_data/roberta_pred_q_test.csv')
  roberta_test_a = pd.read_csv('transformers_data/roberta_pred_a_test.csv')
  roberta_test_qa = pd.read_csv('transformers_data/roberta_pred_qa_test.csv')
  roberta_test_concat = pd.concat([roberta_test_q, roberta_test_a], axis=1)

  # Importing the predicted labels of xlnet
  print('collecting xlnet_base_cased data...')
  xlnet_test_q = pd.read_csv('transformers_data/xlnet_pred_q_test.csv')
  xlnet_test_a = pd.read_csv('transformers_data/xlnet_pred_a_test.csv')
  xlnet_test_concat = pd.concat([xlnet_test_q, xlnet_test_a], axis=1)

  return bert_test_q, bert_test_a, bert_test_qa, bert_test_concat, roberta_test_q, roberta_test_a, roberta_test_qa, roberta_test_concat, xlnet_test_q, xlnet_test_a, xlnet_test_concat, train, test, submission
```

In [5]:
```
# For binning, I've used the below code from:
# https://www.kaggle.com/markpeng/ensemble-5models-v4-v7-magic/notebook?select=submission.csv#Do-Inference
'''
Here the author has created 60 bins that correspond to 60 euqally spaced percentile values (between 1-100)
of the 25 distinct target labels. The idea is to take the predicted values as an input and then preprocess
them such that the final values are all from the 60 bins. This helps in making the predicted data much more
structured/ordered.
'''
def optimize_ranks(preds, unique_labels):
    new_preds = np.zeros(preds.shape)
    for i in range(preds.shape[1]):
        interpolate_bins = np.digitize(preds[:, i],
                                       bins=unique_labels,
                                       right=False)

        if len(np.unique(interpolate_bins)) == 1:
            new_preds[:, i] = preds[:, i]
        else:
            new_preds[:, i] = unique_labels[interpolate_bins]

    return new_preds
```

In [6]:
```
def get_exp_labels(train):
  X = train.iloc[:, 11:]
  unique_labels = np.unique(X.values)
  denominator = 60
  q = np.arange(0, 101, 100 / denominator)
  exp_labels = np.percentile(unique_labels, q) # Generating the 60 bins.

  return exp_labels
```

In [7]:
```
def predict_labels():
  bert_test_q, bert_test_a, bert_test_qa, bert_test_concat, roberta_test_q, roberta_test_a, roberta_t
est_qa, roberta_test_concat, xlnet_test_q, xlnet_test_a, xlnet_test_concat, train, test, submission =
get_data()
  bert_weight = 1
  roberta_weight = 1
  xlnet_weight = 1
  print('calculating weighted average...')
  predicted_labels = ((bert_test_qa + bert_test_concat) * bert_weight
                      + (roberta_test_qa + roberta_test_concat) * roberta_weight
                      + (xlnet_test_concat * xlnet_weight)) / (2*bert_weight + 2*roberta_weight + xln
et_weight)

  exp_labels = get_exp_labels(train)
  print('optimizing the predicted labels...')
  optimized_predicted_labels = optimize_ranks(predicted_labels.values, exp_labels)
  print('generating predicted labels dataframe...')
  df = pd.concat([test['qa_id'], pd.DataFrame(optimized_predicted_labels, columns=submission.columns[
1:])], axis=1)
  print('done..!')

  return df
```

In [8]:
```
output = predict_labels()
```

```
collecting kaggle data...
collecting bert_base_uncased data...
collecting roberta_base data...
collecting xlnet_base_cased data...
calculating weighted average...
optimizing the predicted labels...
generating predicted labels dataframe...
done..!
```

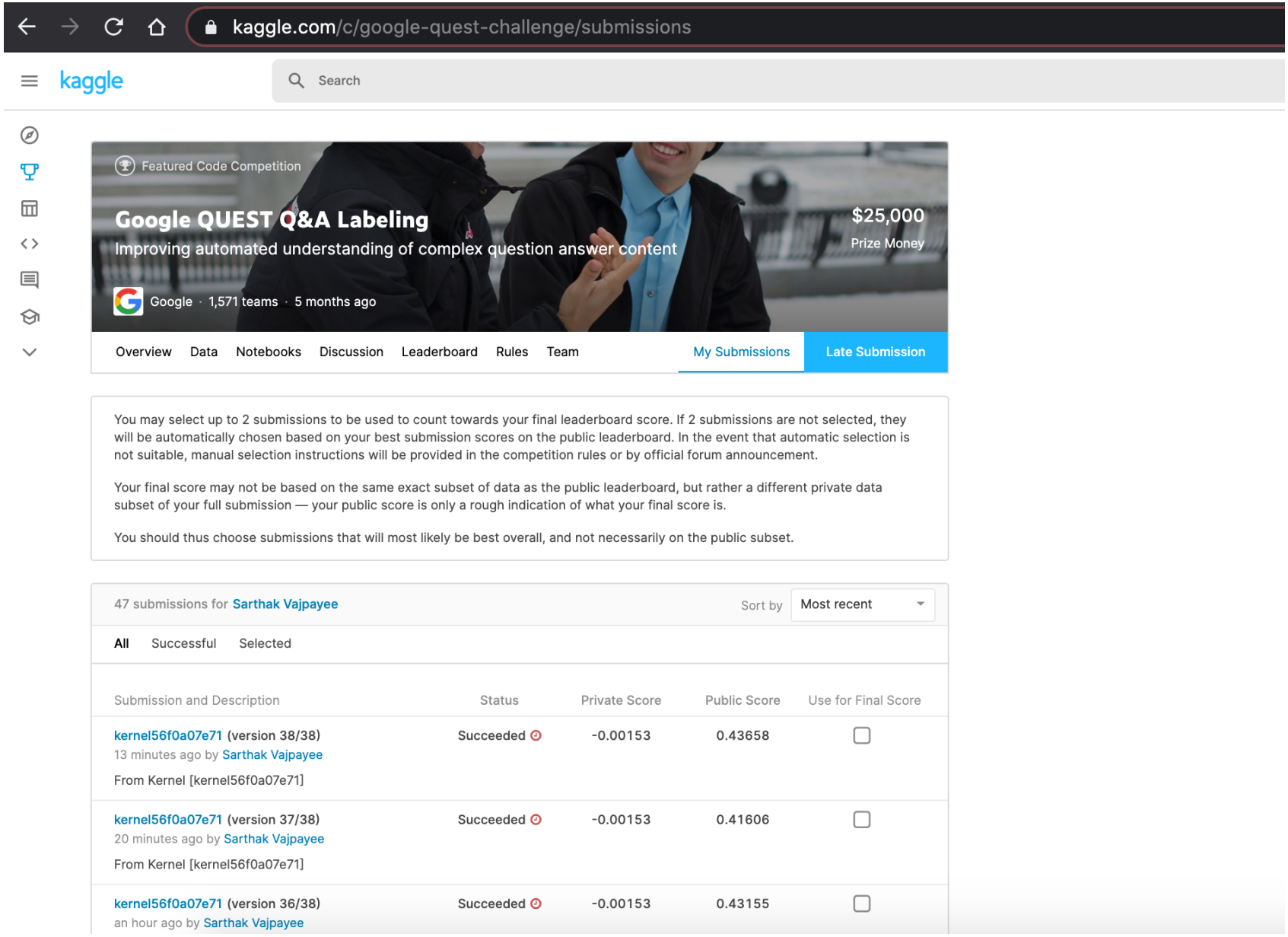
In [9]:
```
output.head()
```

Out[9]:

	qa_id	question_asker_intent_understanding	question_body_critical	question_conversational	question_expect_short_answer	question_fa
0	39	0.973333	0.733333	0.16	0.551111	
1	46	0.866667	0.520000	0.08	0.768889	
2	70	0.913333	0.733333	0.08	0.840000	
3	132	0.913333	0.533333	0.08	0.720000	
4	200	0.946667	0.506667	0.08	0.782222	

In [10]:
```
Image('score.png', width=1000, height=740)
```

Out[10]:



Using the above architecture, I was able to achieve a score of 0.43658 (top 4.4% in the kaggle leaderboard).

In [10]: