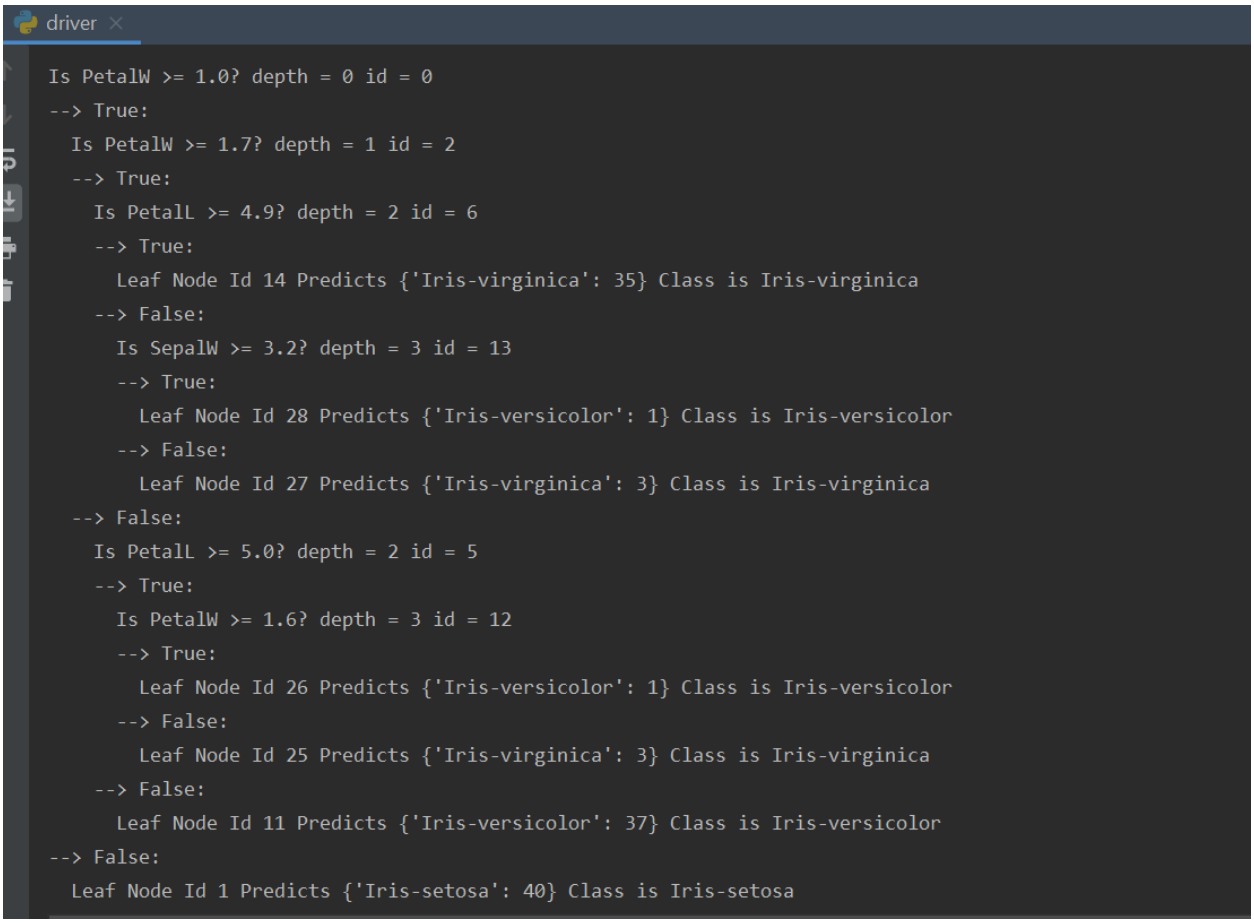
Output Report

For the pruning strategy we have used batch pruning technique. First the tree was created on Iris Data set. For the given tree accuracy was calculated on the test data and later using the pruning strategy tree was pruned. For Pruned tree accuracy was calculated in order to track if accuracy increased or not.

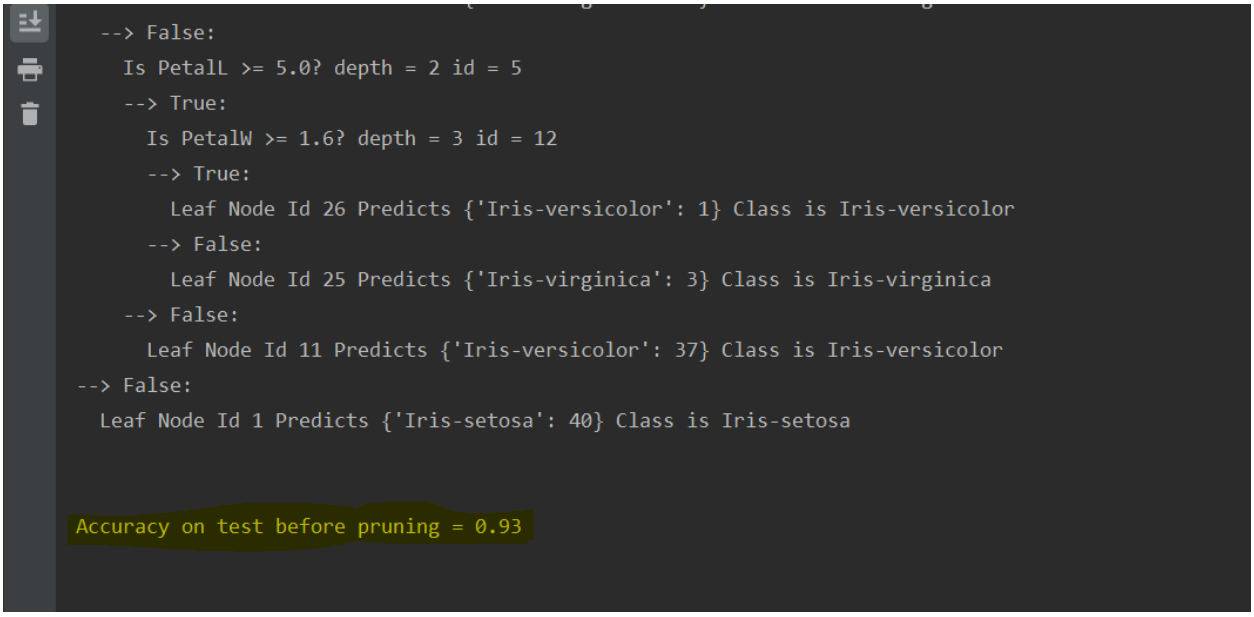
Later above set of steps were again executed for Tic Tac Toe dataset.

Iris Data Set:

Tree before pruning:



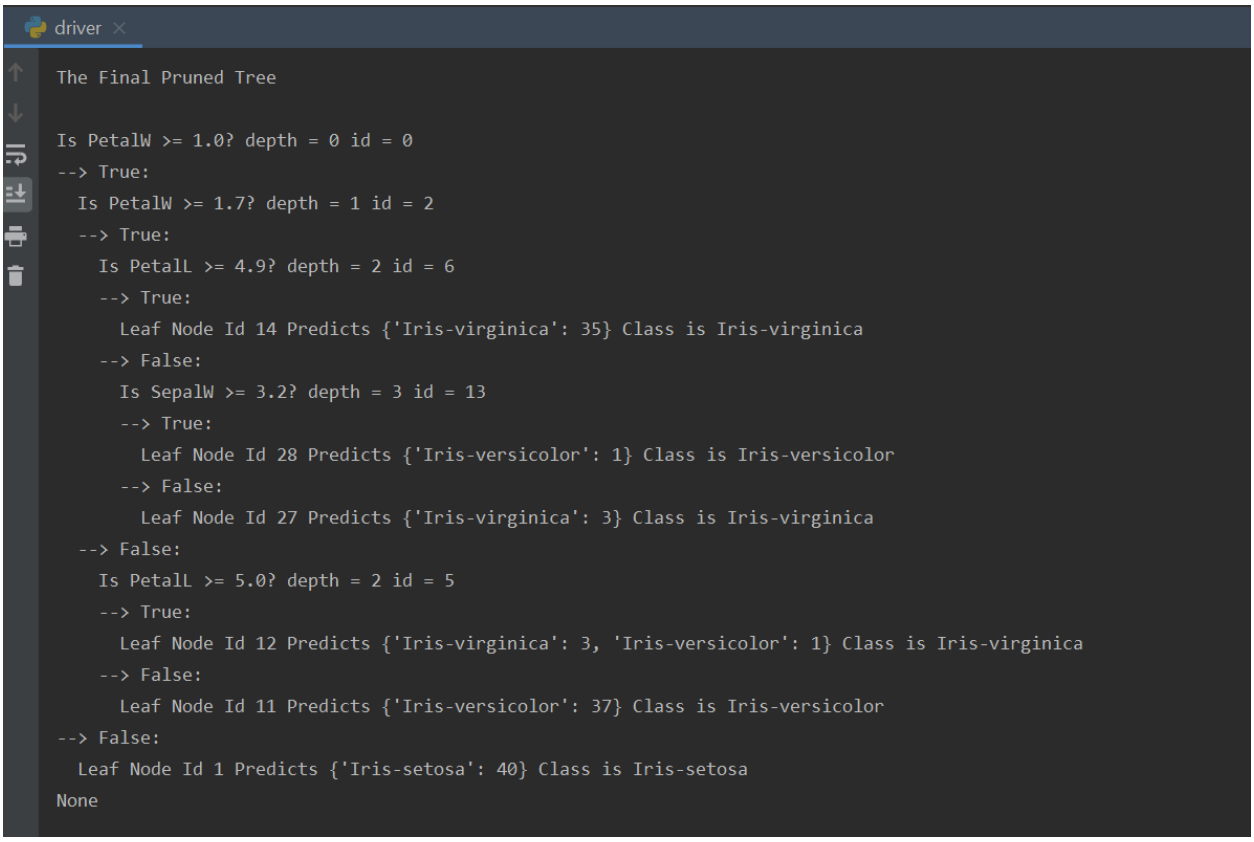
Accuracy on Test:



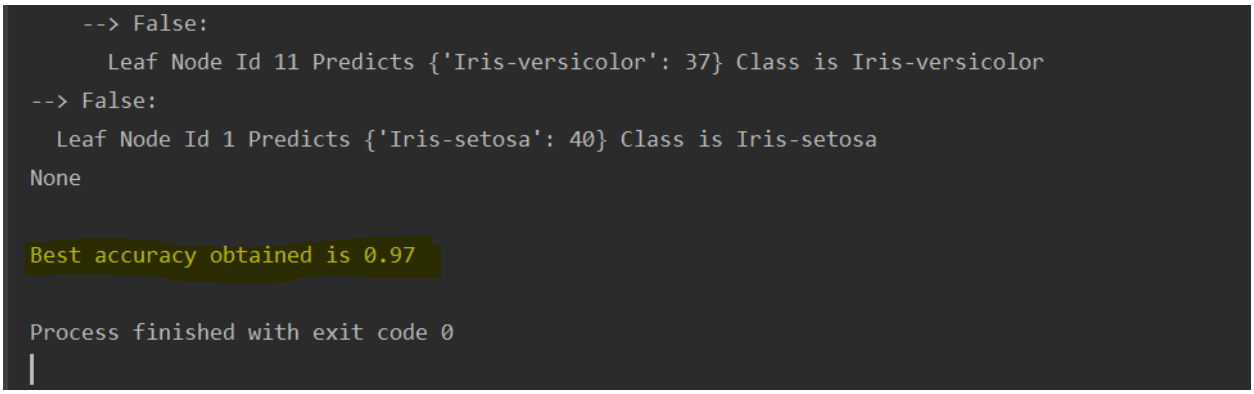
```
  --> False:
    Is PetalL >= 5.0? depth = 2 id = 5
    --> True:
      Is PetalW >= 1.6? depth = 3 id = 12
      --> True:
        Leaf Node Id 26 Predicts {'Iris-versicolor': 1} Class is Iris-versicolor
      --> False:
        Leaf Node Id 25 Predicts {'Iris-virginica': 3} Class is Iris-virginica
    --> False:
      Leaf Node Id 11 Predicts {'Iris-versicolor': 37} Class is Iris-versicolor
--> False:
  Leaf Node Id 1 Predicts {'Iris-setosa': 40} Class is Iris-setosa


Accuracy on test before pruning = 0.93
```

Tree after pruning:



Accuracy on test of Pruned Tree:



Tic Tac Toe Data Set:

Tree before pruning:

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**********Tree before pruning*******

Is middle-middle-square == o? depth = 0 id = 0
--> True:
 Is top-left-square == x? depth = 1 id = 2
 --> True:
  Is top-right-square == x? depth = 2 id = 6
  --> True:
   Is top-middle-square == x? depth = 3 id = 14
   --> True:
    Leaf Node Id 30 Predicts {'positive': 32} Class is positive
   --> False:
    Is bottom-middle-square == b? depth = 4 id = 29
    --> True:
     Is middle-right-square == o? depth = 5 id = 60
     --> True:
      Is middle-left-square == o? depth = 6 id = 122
      --> True:
       Leaf Node Id 246 Predicts {'negative': 3} Class is negative
      --> False:
       Leaf Node Id 245 Predicts {'positive': 2} Class is positive
     --> False:
      Leaf Node Id 121 Predicts {'positive': 3} Class is positive
    --> False:
     Is top-middle-square == o? depth = 5 id = 59
     --> True:
      Is bottom-right-square == o? depth = 6 id = 120
      --> True:
       Is middle-right-square == o? depth = 7 id = 242
       --> True:
        Leaf Node Id 486 Predicts {'positive': 1} Class is positive
       --> False:
        Leaf Node Id 485 Predicts {'negative': 2} Class is negative
      --> False:
       Leaf Node Id 241 Predicts {'negative': 12} Class is negative
     --> False:
      Is bottom-middle-square == o? depth = 6 id = 119
      --> True:
       Is bottom-right-square == b? depth = 7 id = 240
       --> True:
        Leaf Node Id 482 Predicts {'positive': 1} Class is positive
       --> False:
        Is middle-right-square == o? depth = 8 id = 481
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          --> True:
            Leaf Node Id 964 Predicts {'negative': 1} Class is negative
          --> False:
            Is bottom-right-square == o? depth = 9 id = 963
            --> True:
              Is bottom-left-square == o? depth = 10 id = 1928
              --> True:
                Leaf Node Id 3858 Predicts {'negative': 1} Class is negative
              --> False:
                Leaf Node Id 3857 Predicts {'positive': 1} Class is positive
            --> False:
              Leaf Node Id 1927 Predicts {'positive': 2} Class is positive
      --> False:
        Leaf Node Id 239 Predicts {'negative': 2} Class is negative
  --> False:
    Is bottom-left-square == x? depth = 3 id = 13
    --> True:
      Is middle-left-square == x? depth = 4 id = 28
      --> True:
        Leaf Node Id 58 Predicts {'positive': 22} Class is positive
      --> False:
        Is bottom-right-square == x? depth = 5 id = 57
        --> True:
          Is bottom-middle-square == x? depth = 6 id = 116
          --> True:
            Leaf Node Id 234 Predicts {'positive': 5} Class is positive
          --> False:
            Leaf Node Id 233 Predicts {'negative': 4} Class is negative
        --> False:
          Leaf Node Id 115 Predicts {'negative': 6} Class is negative
    --> False:
      Leaf Node Id 27 Predicts {'negative': 37} Class is negative
--> False:
  Is bottom-right-square == x? depth = 2 id = 5
  --> True:
    Is top-middle-square == b? depth = 3 id = 12
    --> True:
      Is bottom-left-square == x? depth = 4 id = 26
      --> True:
        Leaf Node Id 54 Predicts {'positive': 11} Class is positive
      --> False:
        Is top-right-square == o? depth = 5 id = 53
        --> True:
          Leaf Node Id 108 Predicts {'negative': 2} Class is negative
        --> False:
          Is middle-right-square == o? depth = 6 id = 107
          --> True:
            Leaf Node Id 216 Predicts {'negative': 1} Class is negative
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      --> False:
        Leaf Node Id 215 Predicts {'positive': 8} Class is positive
  --> False:
    Is middle-left-square == x? depth = 4 id = 25
    --> True:
      Is bottom-middle-square == x? depth = 5 id = 52
      --> True:
        Is bottom-left-square == o? depth = 6 id = 106
        --> True:
          Is middle-right-square == x? depth = 7 id = 214
          --> True:
            Is top-right-square == o? depth = 8 id = 430
            --> True:
              Leaf Node Id 862 Predicts {'negative': 1} Class is negative
            --> False:
              Leaf Node Id 861 Predicts {'positive': 1} Class is positive
          --> False:
            Leaf Node Id 429 Predicts {'negative': 3} Class is negative
        --> False:
          Leaf Node Id 213 Predicts {'positive': 3} Class is positive
      --> False:
        Is bottom-left-square == o? depth = 6 id = 105
        --> True:
          Is top-right-square == o? depth = 7 id = 212
          --> True:
            Leaf Node Id 426 Predicts {'negative': 3} Class is negative
          --> False:
            Leaf Node Id 425 Predicts {'positive': 1} Class is positive
        --> False:
          Leaf Node Id 211 Predicts {'negative': 10} Class is negative
    --> False:
      Is middle-right-square == x? depth = 5 id = 51
      --> True:
        Is top-right-square == x? depth = 6 id = 104
        --> True:
          Leaf Node Id 210 Predicts {'positive': 10} Class is positive
        --> False:
          Is bottom-middle-square == x? depth = 7 id = 209
          --> True:
            Is bottom-left-square == o? depth = 8 id = 420
            --> True:
              Leaf Node Id 842 Predicts {'negative': 1} Class is negative
            --> False:
              Leaf Node Id 841 Predicts {'positive': 3} Class is positive
          --> False:
            Leaf Node Id 419 Predicts {'negative': 2} Class is negative
      --> False:
        Is top-right-square == x? depth = 6 id = 103
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        --> True:
          Leaf Node Id 208 Predicts {'negative': 6} Class is negative
        --> False:
          Is bottom-left-square == x? depth = 7 id = 207
          --> True:
            Is bottom-middle-square == x? depth = 8 id = 416
            --> True:
              Leaf Node Id 834 Predicts {'positive': 5} Class is positive
            --> False:
              Leaf Node Id 833 Predicts {'negative': 1} Class is negative
          --> False:
            Leaf Node Id 415 Predicts {'negative': 2} Class is negative
  --> False:
    Leaf Node Id 11 Predicts {'negative': 58} Class is negative
--> False:
 Is top-left-square == o? depth = 1 id = 1
 --> True:
  Is top-right-square == o? depth = 2 id = 4
  --> True:
    Is top-middle-square == o? depth = 3 id = 10
    --> True:
      Leaf Node Id 22 Predicts {'negative': 30} Class is negative
    --> False:
      Is bottom-right-square == b? depth = 4 id = 21
      --> True:
        Leaf Node Id 44 Predicts {'positive': 11} Class is positive
      --> False:
        Is middle-right-square == b? depth = 5 id = 43
        --> True:
          Leaf Node Id 88 Predicts {'positive': 6} Class is positive
        --> False:
          Is bottom-left-square == b? depth = 6 id = 87
          --> True:
            Leaf Node Id 176 Predicts {'positive': 4} Class is positive
          --> False:
            Is middle-left-square == b? depth = 7 id = 175
            --> True:
              Leaf Node Id 352 Predicts {'positive': 1} Class is positive
            --> False:
              Is top-middle-square == b? depth = 8 id = 351
              --> True:
                Is bottom-middle-square == x? depth = 9 id = 704
                --> True:
                  Is middle-middle-square == b? depth = 10 id = 1410
                  --> True:
                    Leaf Node Id 2822 Predicts {'positive': 2} Class is positive
                  --> False:
                    Leaf Node Id 2821 Predicts {'negative': 2} Class is negative
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            --> False:
              Leaf Node Id 1409 Predicts {'positive': 2} Class is positive
           --> False:
            Is bottom-middle-square == b? depth = 9 id = 703
            --> True:
              Leaf Node Id 1408 Predicts {'negative': 2} Class is negative
            --> False:
              Is middle-middle-square == b? depth = 10 id = 1407
              --> True:
                Leaf Node Id 2816 Predicts {'negative': 2} Class is negative
              --> False:
                Is bottom-middle-square == o? depth = 11 id = 2815
                --> True:
                  Is bottom-right-square == o? depth = 12 id = 5632
                  --> True:
                    Leaf Node Id 11266 Predicts {'positive': 1} Class is positive
                  --> False:
                    Leaf Node Id 11265 Predicts {'negative': 2} Class is negative
                --> False:
                  Leaf Node Id 5631 Predicts {'positive': 3} Class is positive
  --> False:
    Is bottom-left-square == o? depth = 3 id = 9
    --> True:
      Is middle-left-square == o? depth = 4 id = 20
      --> True:
        Leaf Node Id 42 Predicts {'negative': 27} Class is negative
      --> False:
        Is middle-right-square == x? depth = 5 id = 41
        --> True:
          Leaf Node Id 84 Predicts {'positive': 16} Class is positive
        --> False:
          Is bottom-middle-square == o? depth = 6 id = 83
          --> True:
            Leaf Node Id 168 Predicts {'negative': 2} Class is negative
          --> False:
            Leaf Node Id 167 Predicts {'positive': 4} Class is positive
    --> False:
      Leaf Node Id 19 Predicts {'positive': 75} Class is positive
--> False:
  Is bottom-right-square == o? depth = 2 id = 3
  --> True:
    Is bottom-left-square == o? depth = 3 id = 8
    --> True:
      Is bottom-middle-square == o? depth = 4 id = 18
      --> True:
        Leaf Node Id 38 Predicts {'negative': 22} Class is negative
      --> False:
        Is top-middle-square == b? depth = 5 id = 37
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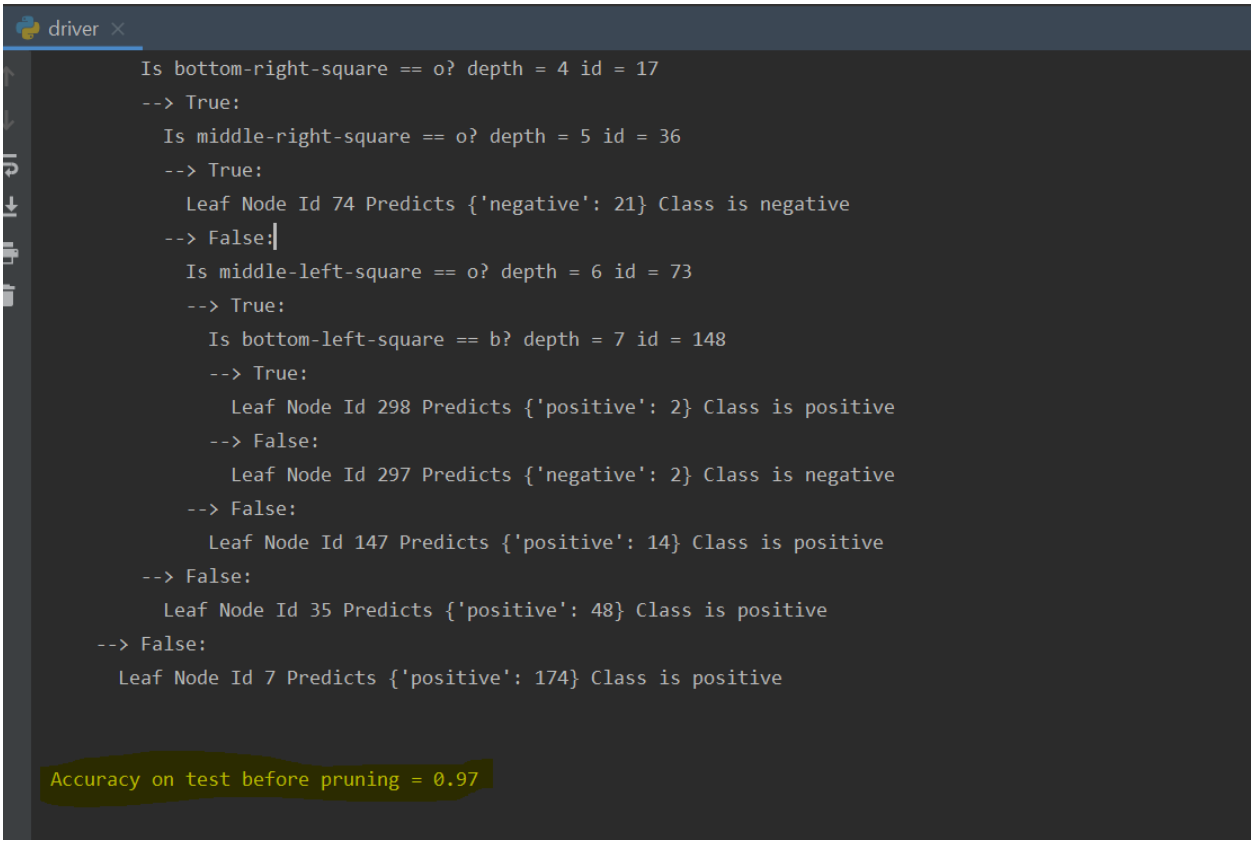
      --> True:
        Is bottom-middle-square == x? depth = 6 id = 76
        --> True:
          Leaf Node Id 154 Predicts {'negative': 1} Class is negative
        --> False:
          Leaf Node Id 153 Predicts {'positive': 2} Class is positive
      --> False:
        Leaf Node Id 75 Predicts {'positive': 21} Class is positive
    --> False:
      Is top-right-square == o? depth = 4 id = 17
      --> True:
        Is middle-right-square == o? depth = 5 id = 36
        --> True:
          Leaf Node Id 74 Predicts {'negative': 19} Class is negative
        --> False:
          Is middle-left-square == o? depth = 6 id = 73
          --> True:
            Is bottom-middle-square == o? depth = 7 id = 148
            --> True:
              Leaf Node Id 298 Predicts {'negative': 1} Class is negative
            --> False:
              Leaf Node Id 297 Predicts {'positive': 3} Class is positive
          --> False:
            Leaf Node Id 147 Predicts {'positive': 14} Class is positive
      --> False:
        Leaf Node Id 35 Predicts {'positive': 49} Class is positive
  --> False:
    Leaf Node Id 7 Predicts {'positive': 173} Class is positive
```

Accuracy on Test:



Tree after pruning:

The Final Pruned Tree

Is middle-middle-square == o? depth = 0 id = 0
--> True:
Is bottom-left-square == x? depth = 1 id = 2
--> True:
Is bottom-right-square == x? depth = 2 id = 6
--> True:
Is bottom-middle-square == x? depth = 3 id = 14
--> True:
Leaf Node Id 30 Predicts {'positive': 33} Class is positive
--> False:
Is top-middle-square == b? depth = 4 id = 29
--> True:

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      Is middle-right-square == o? depth = 5 id = 60
      --> True:
       Is middle-left-square == x? depth = 6 id = 122
       --> True:
        Leaf Node Id 246 Predicts {'positive': 1} Class is positive
       --> False:
        Leaf Node Id 245 Predicts {'negative': 1} Class is negative
      --> False:
       Leaf Node Id 121 Predicts {'positive': 3} Class is positive
    --> False:
     Leaf Node Id 59 Predicts {'negative': 18, 'positive': 6} Class is negative
  --> False:
   Is top-left-square == x? depth = 3 id = 13
   --> True:
    Is middle-left-square == x? depth = 4 id = 28
    --> True:
     Leaf Node Id 58 Predicts {'positive': 27} Class is positive
    --> False:
     Is bottom-middle-square == x? depth = 5 id = 57
     --> True:
      Leaf Node Id 116 Predicts {'negative': 8} Class is negative
     --> False:
      Is top-middle-square == x? depth = 6 id = 115
      --> True:
       Is top-right-square == b? depth = 7 id = 232
       --> True:
        Leaf Node Id 466 Predicts {'negative': 1} Class is negative
       --> False:
        Leaf Node Id 465 Predicts {'positive': 6} Class is positive
      --> False:
       Leaf Node Id 231 Predicts {'negative': 3} Class is negative
   --> False:
    Leaf Node Id 27 Predicts {'negative': 31} Class is negative
--> False:
 Is top-right-square == x? depth = 2 id = 5
 --> True:
  Is bottom-middle-square == x? depth = 3 id = 12
  --> True:
   Is middle-right-square == x? depth = 4 id = 26
   --> True:
    Is bottom-right-square == x? depth = 5 id = 54
    --> True:
     Leaf Node Id 110 Predicts {'positive': 7} Class is positive
    --> False:
     Is top-left-square == x? depth = 6 id = 109
     --> True:
      Is middle-left-square == x? depth = 7 id = 220
      --> True:
```

```
            Leaf Node Id 442 Predicts {'negative': 1} Class is negative
          --> False:
            Leaf Node Id 441 Predicts {'positive': 1} Class is positive
        --> False:
          Leaf Node Id 219 Predicts {'negative': 5} Class is negative
      --> False:
       Is top-left-square == x? depth = 5 id = 53
       --> True:
        Is top-middle-square == x? depth = 6 id = 108
        --> True:
          Leaf Node Id 218 Predicts {'positive': 4} Class is positive
        --> False:
          Leaf Node Id 217 Predicts {'negative': 4} Class is negative
       --> False:
        Leaf Node Id 107 Predicts {'negative': 9} Class is negative
    --> False:
     Is top-middle-square == o? depth = 4 id = 25
     --> True:
      Is bottom-middle-square == b? depth = 5 id = 52
      --> True:
       Leaf Node Id 106 Predicts {'positive': 3} Class is positive
      --> False:
       Leaf Node Id 105 Predicts {'negative': 5} Class is negative
     --> False:
      Is bottom-right-square == o? depth = 5 id = 51
      --> True:
       Is top-left-square == x? depth = 6 id = 104
       --> True:
        Is top-middle-square == b? depth = 7 id = 210
        --> True:
          Leaf Node Id 422 Predicts {'negative': 1} Class is negative
        --> False:
          Leaf Node Id 421 Predicts {'positive': 4} Class is positive
       --> False:
        Leaf Node Id 209 Predicts {'negative': 4} Class is negative
      --> False:
       Is middle-right-square == o? depth = 6 id = 103
       --> True:
        Is middle-left-square == o? depth = 7 id = 208
        --> True:
          Leaf Node Id 418 Predicts {'negative': 2} Class is negative
        --> False:
          Leaf Node Id 417 Predicts {'positive': 4} Class is positive
       --> False:
        Leaf Node Id 207 Predicts {'positive': 22} Class is positive
  --> False:
   Leaf Node Id 11 Predicts {'negative': 56} Class is negative
--> False:
```

```
Is bottom-left-square == o? depth = 1 id = 1
--> True:
 Is bottom-right-square == o? depth = 2 id = 4
 --> True:
  Is bottom-middle-square == o? depth = 3 id = 10
  --> True:
   Leaf Node Id 22 Predicts {'negative': 30} Class is negative
  --> False:
   Is top-left-square == b? depth = 4 id = 21
   --> True:
    Leaf Node Id 44 Predicts {'positive': 10} Class is positive
   --> False:
    Is middle-right-square == b? depth = 5 id = 43
    --> True:
     Leaf Node Id 88 Predicts {'positive': 4} Class is positive
    --> False:
     Is top-right-square == b? depth = 6 id = 87
     --> True:
      Leaf Node Id 176 Predicts {'positive': 3} Class is positive
     --> False:
      Is top-middle-square == x? depth = 7 id = 175
      --> True:
       Is top-right-square == x? depth = 8 id = 352
       --> True:
        Is middle-right-square == x? depth = 9 id = 706
        --> True:
         Is middle-middle-square == b? depth = 10 id = 1414
         --> True:
          Leaf Node Id 2830 Predicts {'positive': 1} Class is positive
         --> False:
          Leaf Node Id 2829 Predicts {'negative': 1} Class is negative
        --> False:
         Leaf Node Id 1413 Predicts {'positive': 4} Class is positive
       --> False:
        Is middle-right-square == x? depth = 9 id = 705
        --> True:
         Leaf Node Id 1412 Predicts {'positive': 2} Class is positive
        --> False:
         Leaf Node Id 1411 Predicts {'negative': 2} Class is negative
      --> False:
       Is middle-right-square == o? depth = 8 id = 351
       --> True:
        Leaf Node Id 704 Predicts {'negative': 2} Class is negative
       --> False:
        Is middle-left-square == x? depth = 9 id = 703
        --> True:
         Leaf Node Id 1408 Predicts {'positive': 3} Class is positive
        --> False:
```

```
            Leaf Node Id 1407 Predicts {'negative': 2} Class is negative
  --> False:
   Is top-left-square == o? depth = 3 id = 9
   --> True:
    Is middle-left-square == o? depth = 4 id = 20
    --> True:
     Leaf Node Id 42 Predicts {'negative': 23} Class is negative
    --> False:
     Is middle-right-square == x? depth = 5 id = 41
     --> True:
      Leaf Node Id 84 Predicts {'positive': 15} Class is positive
     --> False:
      Is top-middle-square == o? depth = 6 id = 83
      --> True:
       Leaf Node Id 168 Predicts {'negative': 2} Class is negative
      --> False:
       Is bottom-middle-square == o? depth = 7 id = 167
       --> True:
        Leaf Node Id 336 Predicts {'negative': 1} Class is negative
       --> False:
        Leaf Node Id 335 Predicts {'positive': 6} Class is positive
   --> False:
    Leaf Node Id 19 Predicts {'positive': 70} Class is positive
--> False:
  Is top-right-square == o? depth = 2 id = 3
  --> True:
   Is top-left-square == o? depth = 3 id = 8
   --> True:
    Is top-middle-square == o? depth = 4 id = 18
    --> True:
     Leaf Node Id 38 Predicts {'negative': 27} Class is negative
    --> False:
     Is bottom-left-square == b? depth = 5 id = 37
     --> True:
      Leaf Node Id 76 Predicts {'positive': 10} Class is positive
     --> False:
      Is bottom-middle-square == x? depth = 6 id = 75
      --> True:
       Is middle-left-square == x? depth = 7 id = 152
       --> True:
        Is bottom-right-square == o? depth = 8 id = 306
        --> True:
         Leaf Node Id 614 Predicts {'negative': 1} Class is negative
        --> False:
         Leaf Node Id 613 Predicts {'positive': 1} Class is positive
       --> False:
        Leaf Node Id 305 Predicts {'positive': 9} Class is positive
      --> False:
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```
        Is middle-right-square == x? depth = 7 id = 151
        --> True:
          Is bottom-right-square == x? depth = 8 id = 304
          --> True:
            Leaf Node Id 610 Predicts {'negative': 1} Class is negative
          --> False:
            Leaf Node Id 609 Predicts {'positive': 3} Class is positive
        --> False:
          Leaf Node Id 303 Predicts {'negative': 2} Class is negative
  --> False:
    Is bottom-right-square == o? depth = 4 id = 17
    --> True:
      Is middle-right-square == o? depth = 5 id = 36
      --> True:
        Leaf Node Id 74 Predicts {'negative': 21} Class is negative
      --> False:
        Is middle-left-square == o? depth = 6 id = 73
        --> True:
          Is bottom-left-square == b? depth = 7 id = 148
          --> True:
            Leaf Node Id 298 Predicts {'positive': 2} Class is positive
          --> False:
            Leaf Node Id 297 Predicts {'negative': 2} Class is negative
        --> False:
          Leaf Node Id 147 Predicts {'positive': 14} Class is positive
    --> False:
      Leaf Node Id 35 Predicts {'positive': 48} Class is positive
--> False:
  Leaf Node Id 7 Predicts {'positive': 174} Class is positive
```

Accuracy on test of Pruned Tree: