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In [1]: import matplotlib.pyplot as plt
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In [2]: import numpy as np
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```
In [3]: pp=[['T', 0.9], ['T', 0.42], ['N', 0.20], ['T', 0.60], ['N', 0.50], ['N', 0.41], ['T', 0.70],  
       ['N', 0.40], ['N', 0.65], ['N', 0.35]]
```

```
In [4]: sort_pp=sorted(pp, key=lambda x:x[1], reverse=True)
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```
In [5]: sort_pp
```

```
Out[5]: [[T, 0.9],  
          [T, 0.7],  
          [N, 0.65],  
          [T, 0.6],  
          [N, 0.5],  
          [T, 0.42],  
          [N, 0.41],  
          [N, 0.4],  
          [N, 0.35],  
          [N, 0.2]]
```

```
In [6]: aa=[0.90, 0.42, 0.20, 0.60, 0.50, 0.41, 0.70, 0.40, 0.65, 0.35]
```

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In [7]: sort_aa=sorted(aa, reverse=True)
```

```
In [8]: sort_aa
```

```
Out[8]: [0.9, 0.7, 0.65, 0.6, 0.5, 0.42, 0.41, 0.4, 0.35, 0.2]
```

```
In [9]: recall=[]
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In [10]: precision=[]
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In [11]: TPR=[]
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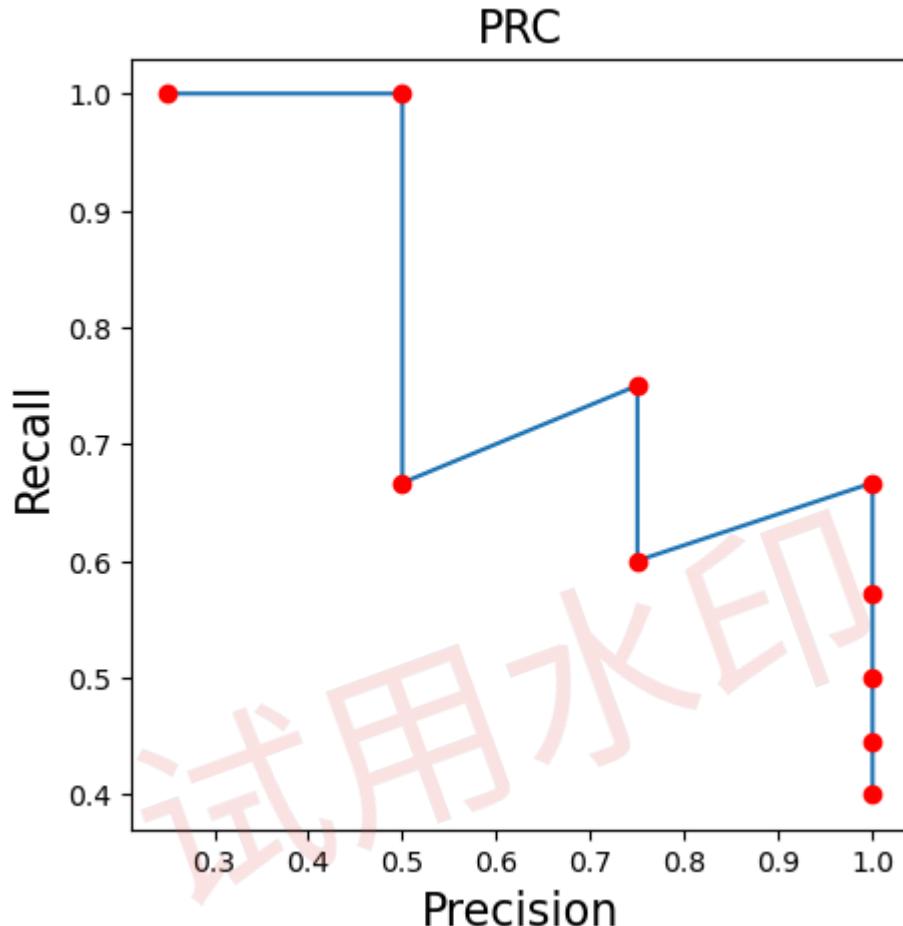
```
In [12]: FPR=[]
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In [13]: for a in sort_aa:  
    tp=0  
    fn=0  
    fp=0  
    tn=0  
    x=0  
    y=0  
  
    for p in pp:  
        if (p[0]=='T') and (p[1]>=a):  
            tp=tp+1  
        elif (p[0]=='T') and (p[1]<a):  
            fn=fn+1  
        elif (p[0]=='N') and (p[1]>=a):  
            fp=fp+1  
        elif (p[0]=='N') and (p[1]<a):  
            tn=tn+1  
  
    x=float(tp)/(tp+fn)  
    y=float(tp)/(tp+fp)  
    fpr=float(fp)/(tn+fp)  
  
    recall.append(x)  
    precision.append(y)  
    TPR.append(x)  
    FPR.append(fpr)
```

试用水印

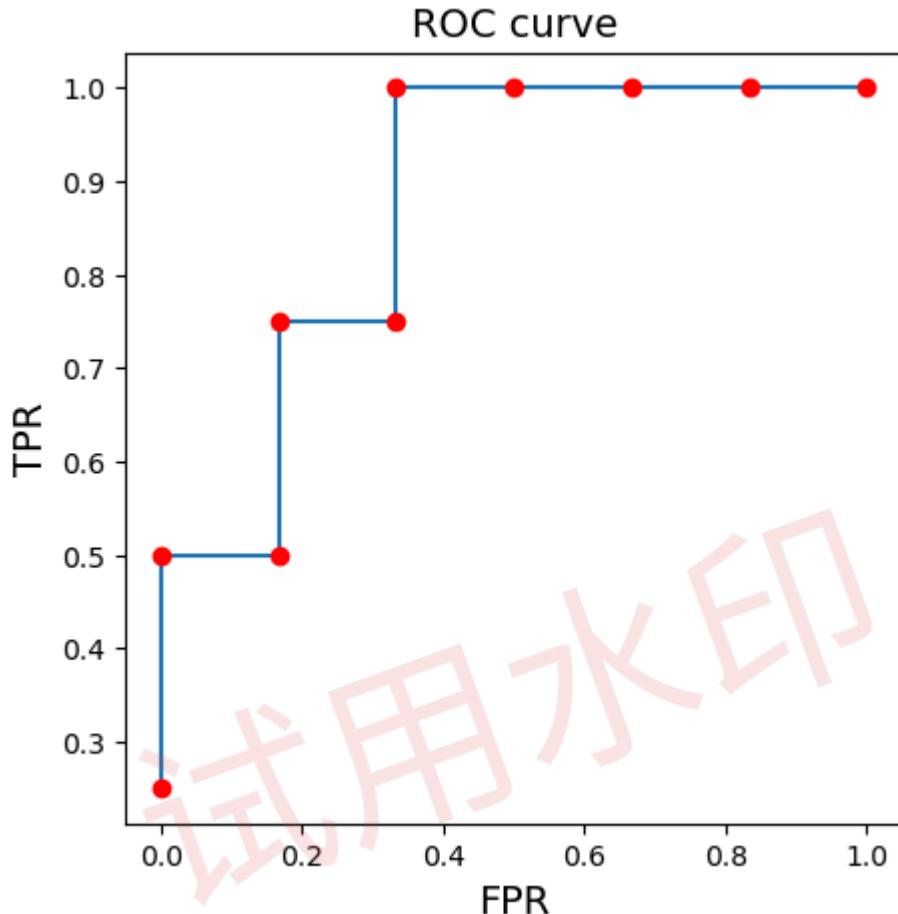
```
In [24]: plt.figure(figsize=(5, 5))
plt.title('PRC', fontsize=16)
plt.plot(recall, precision)
plt.plot(recall, precision, 'ro')
plt.xlabel('Precision', fontsize=16)
plt.ylabel('Recall', fontsize=16)
```

Out[24]: Text(0, 0.5, 'Recall')



```
In [25]: plt.figure(figsize=(5, 5))
plt.title('ROC curve', fontsize=14)
plt.plot(FPR, TPR)
plt.plot(FPR, TPR, 'ro')
plt.ylabel('TPR', fontsize=14)
plt.xlabel('FPR', fontsize=14)
```

Out[25]: Text(0.5, 0, 'FPR')



```
In [27]: i=0
auc=0
while(i<9):
    auc=auc+(FPR[i+1]-FPR[i])*(TPR[i]+TPR[i+1])
    i=i+1
auc=float(auc/2)
print(' auc=% .2f' %auc)
```

auc=0.88

In []:

① $\exists \text{ th} = 0.9$

Confusion matrix:

	predict 0	predict 1
True 0	$TN = 6$	$FP = 0$
True 1	$FN = 3$	$TP = 1$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{1}{1+0} = 1$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{1}{1+3} = \frac{1}{4}$$

$$fPr = \frac{FP}{TN+FP} = 0$$

② $\exists \text{ th} = 0.7$

Confusion matrix:

	predict 0	predict 1
True 0	$TN = 6$	$FP = 0$
True 1	$FN = 2$	$TP = 2$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{2}{2+0} = 1$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{2}{2+2} = \frac{1}{2}$$

$$fPr = \frac{FP}{TN+FP} = 0$$

③ $\exists \text{ th} = 0.65$

Confusion matrix

	predict 0	predict 1
True 0	$TN = 5$	$FP = 1$
True 1	$FN = 2$	$TP = 2$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{2}{2+1} = \frac{2}{3}$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{2}{2+2} = \frac{1}{2}$$

$$fPr = \frac{FP}{TN+FP} = \frac{1}{5+1} \text{ (marked with a circled 2)} \frac{1}{6}$$

④ $\exists \text{ th} = 0.6$

Confusion matrix

	predict 0	predict 1
True 0	$TN = 5$	$FP = 1$
True 1	$FN = 1$	$TP = 3$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{3}{3+1} = \frac{3}{4}$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{3}{3+1} = \frac{3}{4}$$

$$fPr = \frac{FP}{TN+FP} = \frac{1}{5+1} = \frac{1}{6}$$

⑤ $\exists \text{ th} = 0.5$

Confusion matrix

	predict 0	predict 1
True 0	$TN = 4$	$FP = 2$
True 1	$FN = 1$	$TP = 3$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{3}{3+2} = \frac{3}{5}$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{3}{3+1} = \frac{3}{4}$$

$$fPr = \frac{FP}{TN+FP} = \frac{2}{4+2} = \frac{1}{3}$$

⑥ $\exists \text{ th} = 0.42$

Confusion matrix

	predict 0	predict 1
True 0	$TN = 3$	$FP = 3$
True 1	$FN = 0$	$TP = 4$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{4}{4+3} = \frac{4}{7}$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{4}{4+0} = 1$$

$$fPr = \frac{FP}{TN+FP} = \frac{3}{3+3} = \frac{1}{2}$$

⑦ $\exists \text{ th} = 0.41$

Confusion matrix

	predict 0	predict 1
True 0	$TN = 4$	$FP = 2$
True 1	$FN = 0$	$TP = 4$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{4}{4+2} = \frac{2}{3}$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{4}{4+0} = 1$$

$$fPr = \frac{FP}{TN+FP} = \frac{2}{4+2} = \frac{1}{3}$$

⑧ $\exists \text{ th} = 0.4$

Confusion matrix

	predict 0	predict 1
True 0	$TN = 2$	$FP = 4$
True 1	$FN = 0$	$TP = 4$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{4}{4+4} = \frac{1}{2}$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{4}{4+0} = 1$$

$$fPr = \frac{FP}{TN+FP} = \frac{4}{2+4} = \frac{2}{3}$$

⑨ $\exists \text{ th} = 0.35$
Confusion matrix

	predict 0	predict 1
True 0	$TN = 1$	$FP = 5$
True 1	$FN = 0$	$TP = 4$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{4}{4+5} = \frac{4}{9}$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{4}{4+0} = 1$$

$$fpr = \frac{FP}{TN+FP} = \frac{5}{1+5} = \frac{5}{6}$$

⑩ $\exists \text{ th} = 0.2$
Confusion matrix

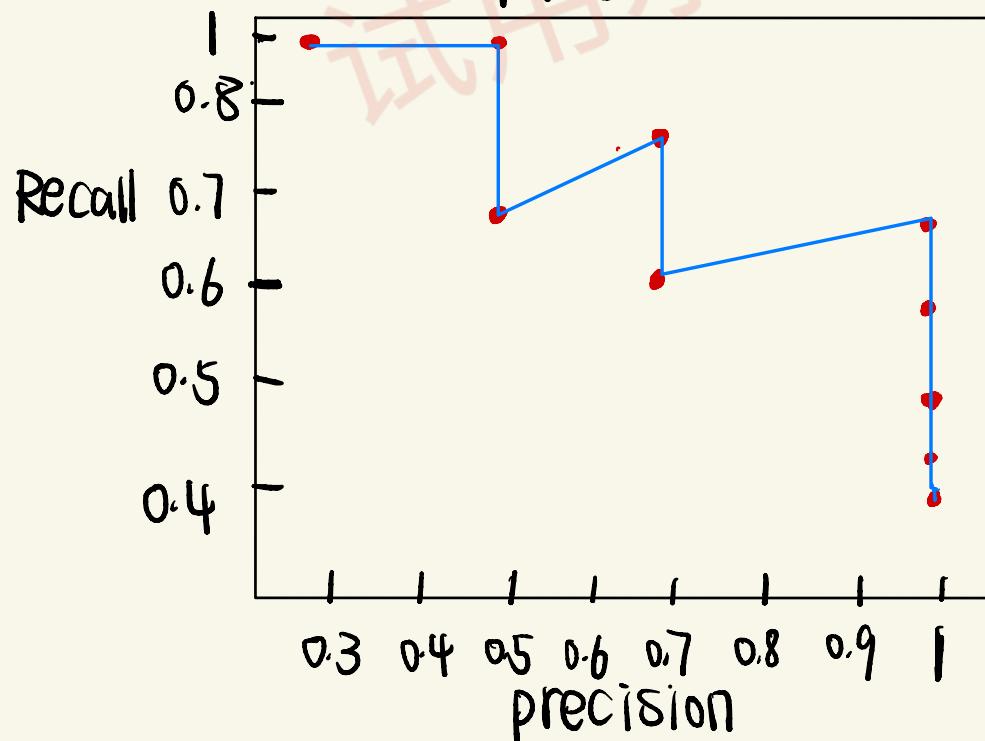
	predict 0	predict 1
True 0	$TN = 0$	$FP = 6$
True 1	$FN = 0$	$TP = 4$

$$\text{precision} = \frac{TP}{TP+FP} = \frac{4}{4+6} = \frac{4}{10}$$

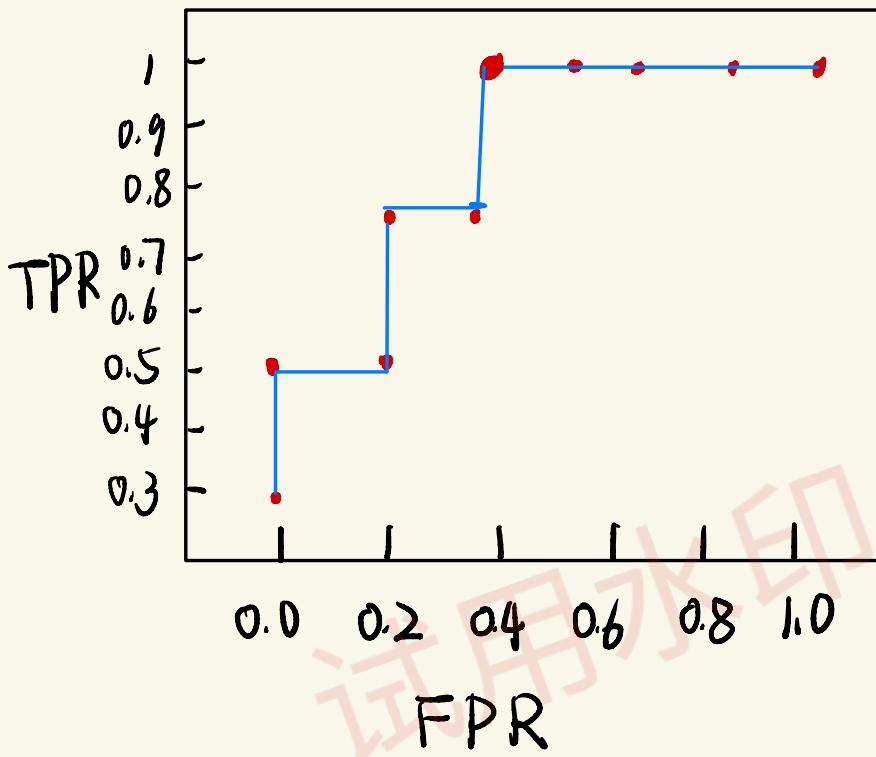
$$\text{Recall} = \frac{TP}{TP+FN} = \frac{4}{4+0} = 1$$

$$fpr = \frac{FP}{TN+FP} = \frac{6}{0+6} = 1$$

PRC



ROC



AUC :

$$\text{AUC} = \left[\left(1 - \frac{5}{6}\right) \times (1+1) + \left(\frac{5}{6} - \frac{2}{3}\right) \times (1+1) + \left(1 \frac{2}{3} - \frac{1}{2}\right) \times (1+1) + \left(\frac{1}{2} - \frac{1}{3}\right) \times (1+1) + \left(\frac{1}{3} - \frac{1}{4}\right) \times (1+1) + \left(\frac{1}{3} - \frac{1}{6}\right) \times \left(\frac{3}{4} + \frac{3}{4}\right) + \left(\frac{1}{6} - 0\right) \times \left(\frac{1}{2} + \frac{1}{2}\right) + (0-0) \times \left(\frac{1}{2} + \frac{1}{4}\right) \right] \div 2$$

≈ 0.88