

ROC Example

EE 361M

Introduction to Data Mining

Fall 2016

Receiver Operating Characteristic (ROC) curve

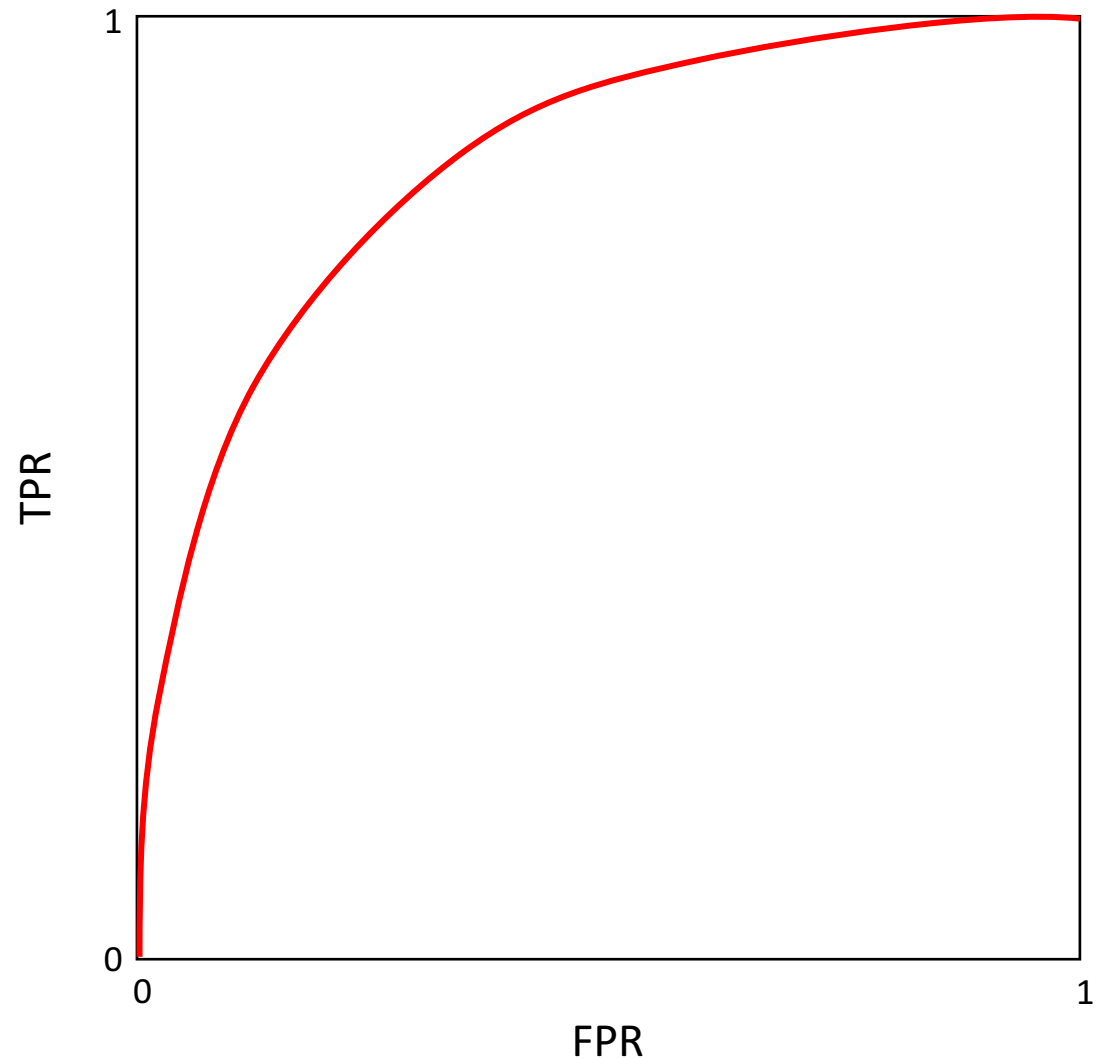
- Shows performance of binary classifier for varying decision threshold

- TPR (True Positive Rate):

$$\frac{TP}{P} = \frac{TP}{TP + FN}$$

- FPR (False Positive Rate):

$$\frac{FP}{N} = \frac{FP}{FP + TN}$$

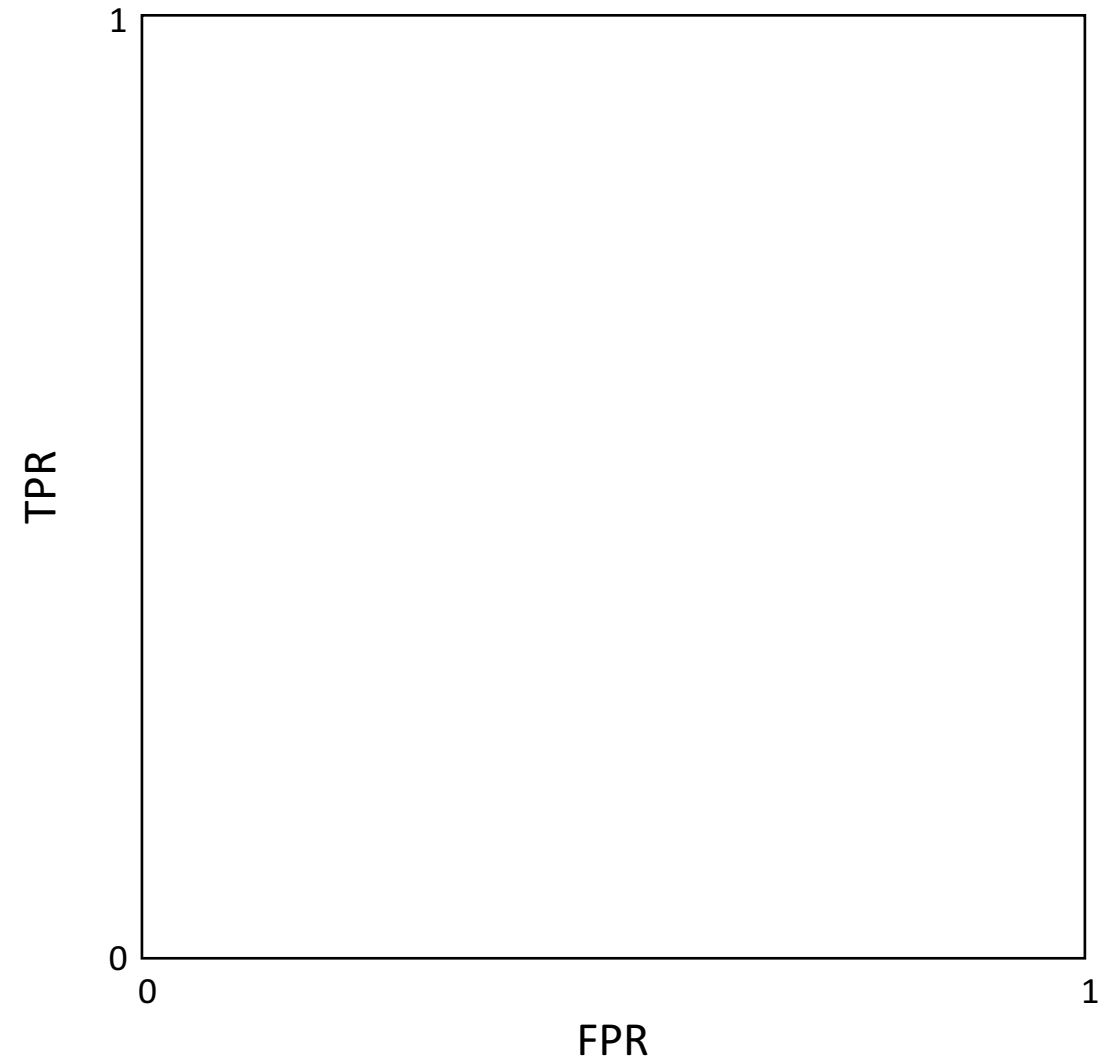


ROC Curve Example

True	$f(x)$
1	0.9
1	0.6
0	0
1	0.3
0	0.1
0	0.1
0	0
0	0.5
0	0
0	0.6

< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$



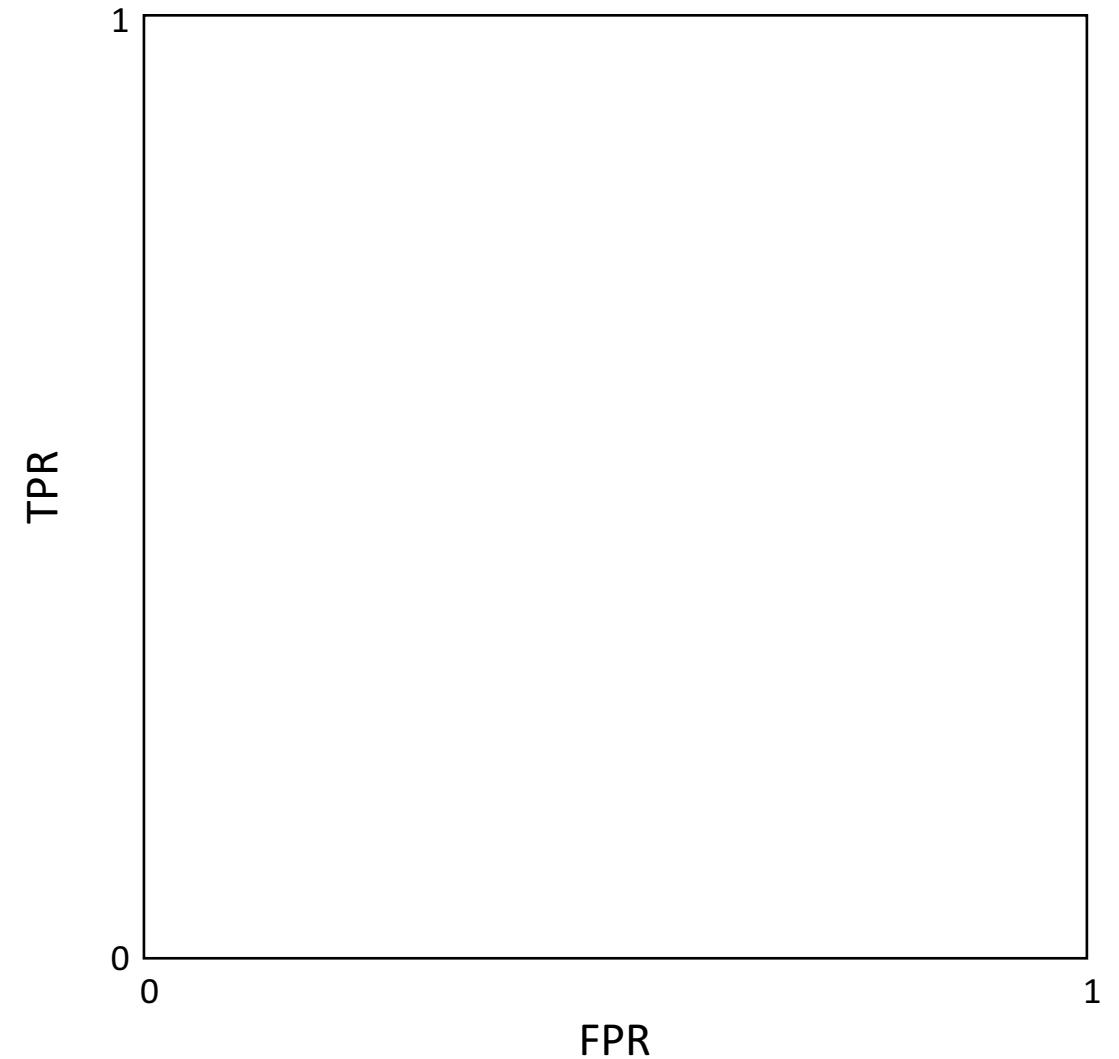
ROC Curve Example

True	$f(x)$	Decision
1	0.9	1
1	0.6	1
0	0	1
1	0.3	1
0	0.1	1
0	0.1	1
0	0	1
0	0.5	1
0	0	1
0	0.6	1

< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

$$T = 0$$



ROC Curve Example

True	$f(x)$	Decision
1	0.9	1
1	0.6	1
0	0	1 ✗
1	0.3	1
0	0.1	1 ✗
0	0.1	1 ✗
0	0	1 ✗
0	0.5	1 ✗
0	0	1 ✗
0	0.6	1 ✗

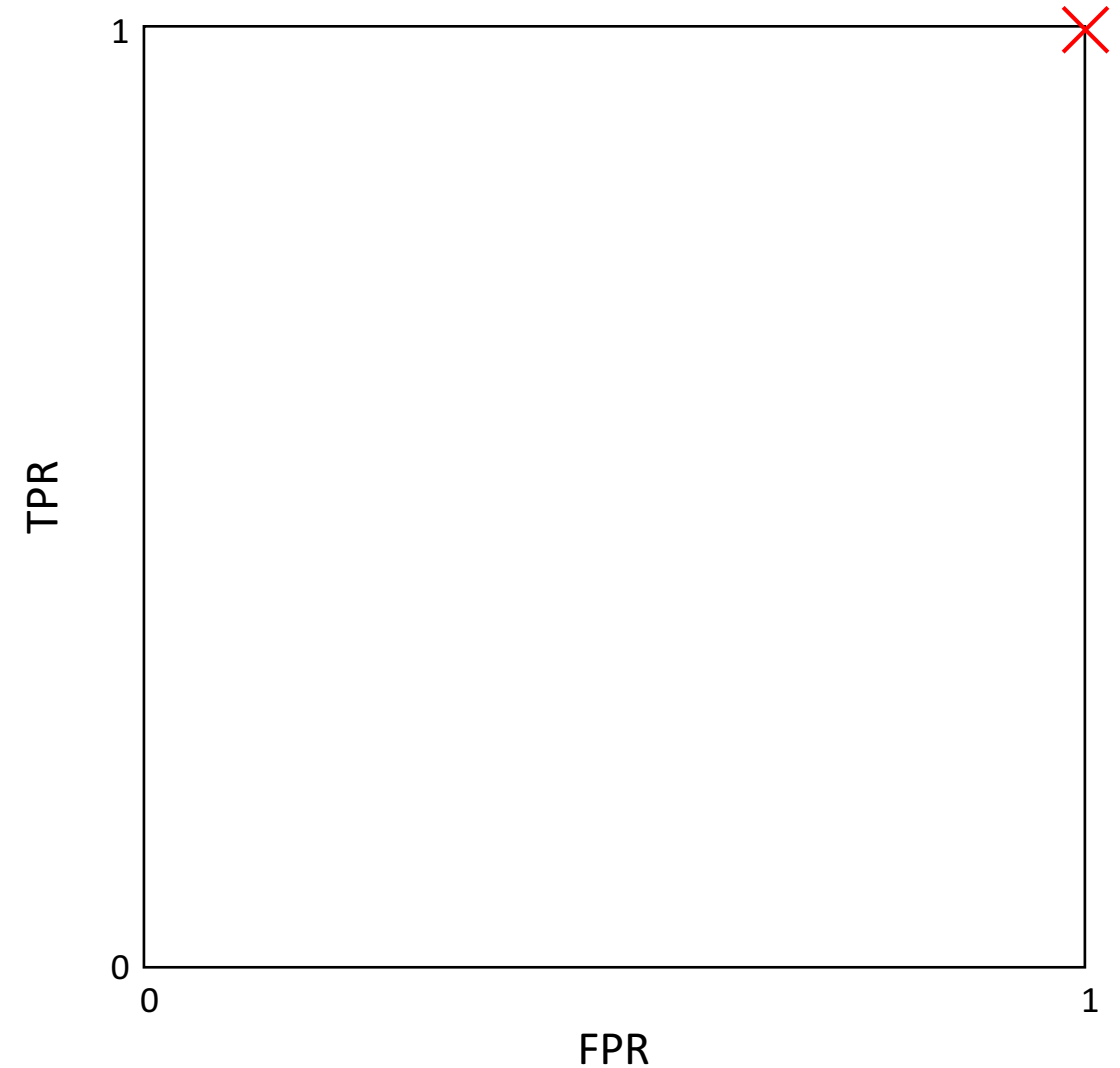
< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

$$T = 0$$

$$TPR = \frac{3}{3} = 1$$

$$FPR = \frac{7}{7} = 1$$



ROC Curve Example

True	$f(x)$	Decision
1	0.9	1
1	0.6	1
0	0	0
1	0.3	1
0	0.1	1 ✗
0	0.1	1 ✗
0	0	0
0	0.5	1 ✗
0	0	0
0	0.6	1 ✗

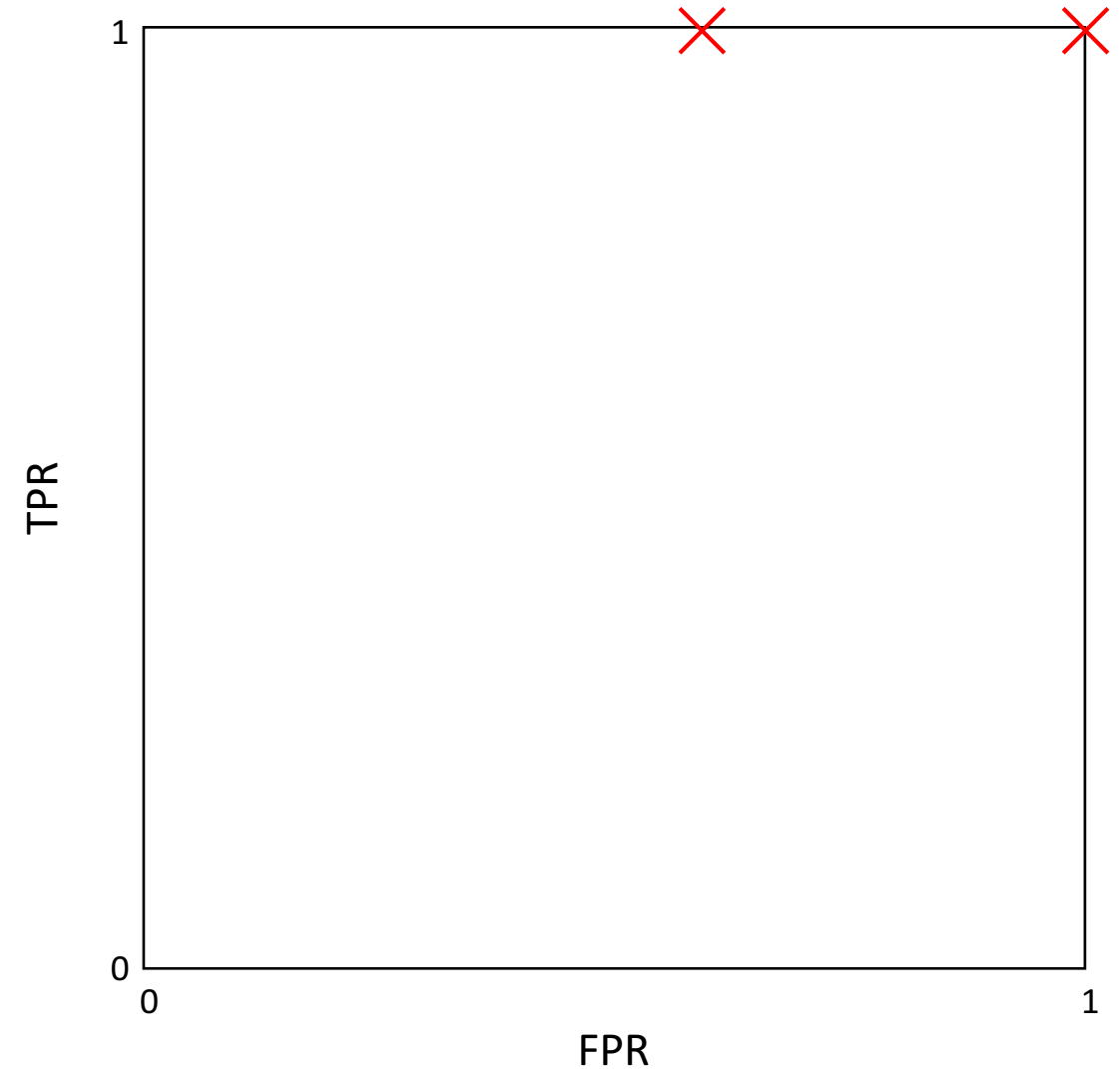
< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

$$T = 0.1$$

$$TPR = \frac{3}{3} = 1$$

$$FPR = \frac{4}{7}$$



ROC Curve Example

True	$f(x)$	Decision
1	0.9	1
1	0.6	1
0	0	0
1	0.3	1
0	0.1	0
0	0.1	0
0	0	0
0	0.5	1 ✗
0	0	0
0	0.6	1 ✗

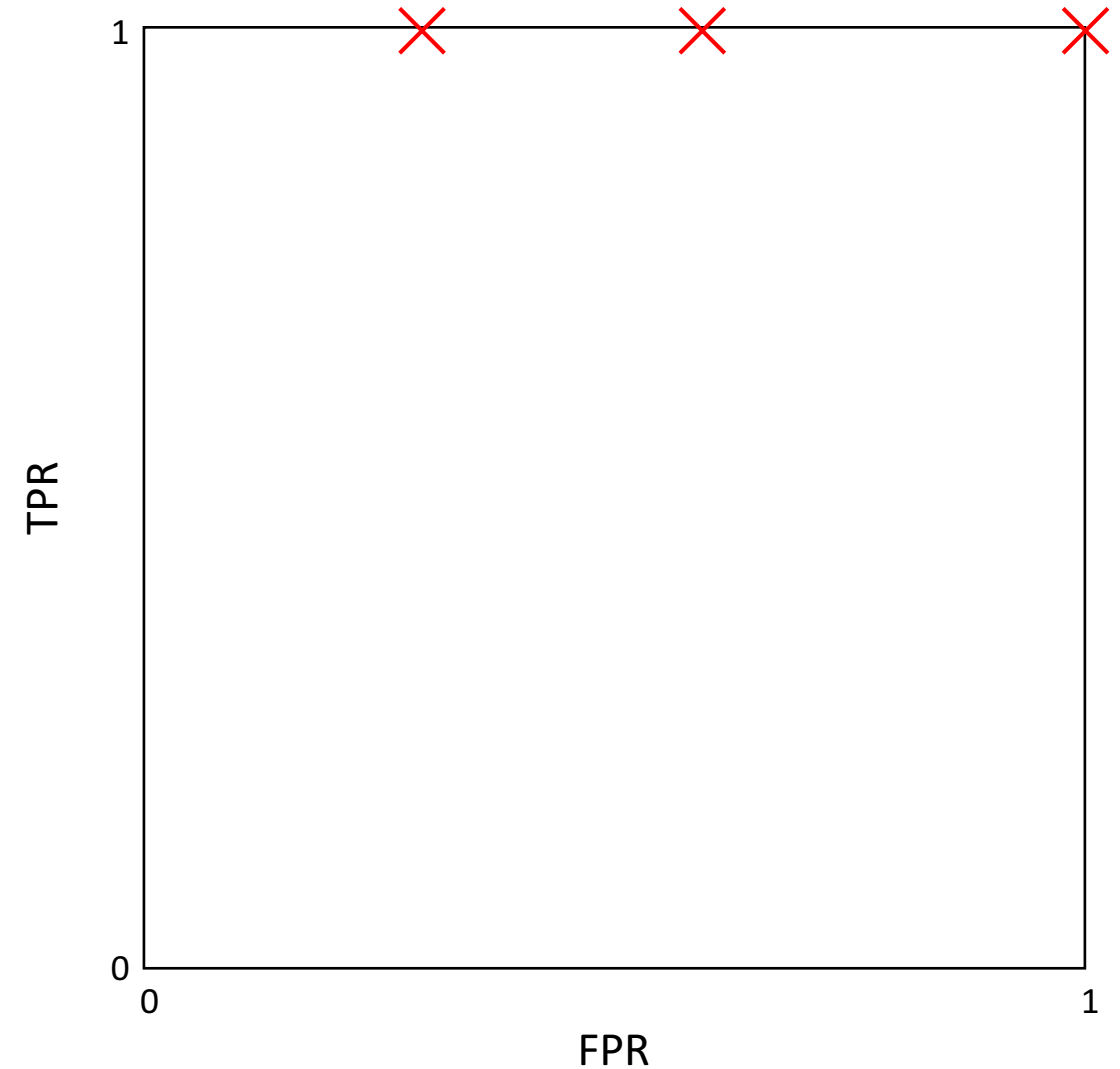
< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

$$T = 0.3$$

$$TPR = \frac{3}{3} = 1$$

$$FPR = \frac{2}{7}$$



ROC Curve Example

True	$f(x)$	Decision
1	0.9	1
1	0.6	1
0	0	0
1	0.3	0
0	0.1	0
0	0.1	0
0	0	0
0	0.5	1 ✗
0	0	0
0	0.6	1 ✗

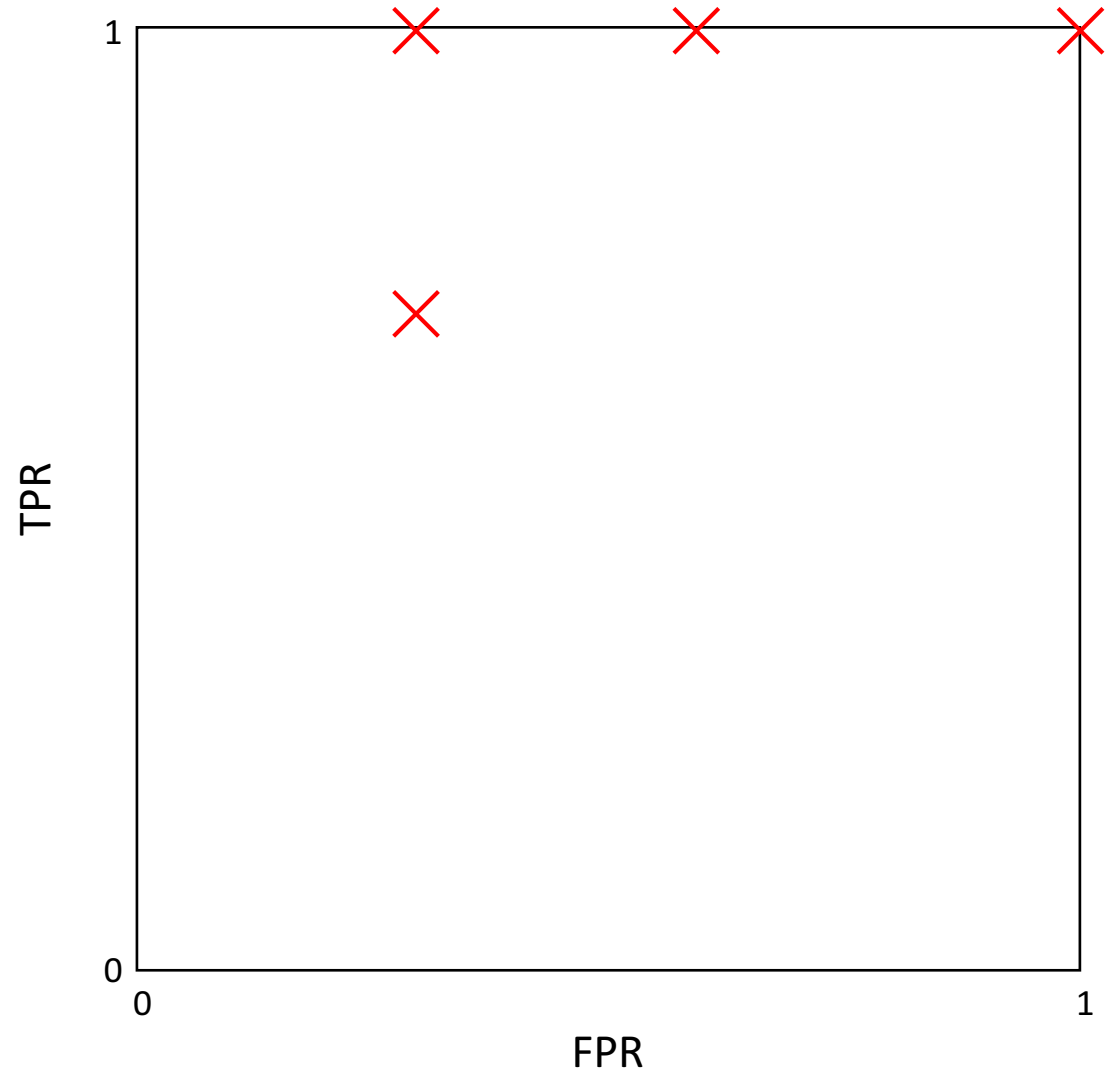
< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

$$T = 0.5$$

$$TPR = \frac{2}{3}$$

$$FPR = \frac{2}{7}$$



ROC Curve Example

True	$f(x)$	Decision
1	0.9	1
1	0.6	1
0	0	0
1	0.3	0
0	0.1	0
0	0.1	0
0	0	0
0	0.5	0
0	0	0
0	0.6	1 ✗

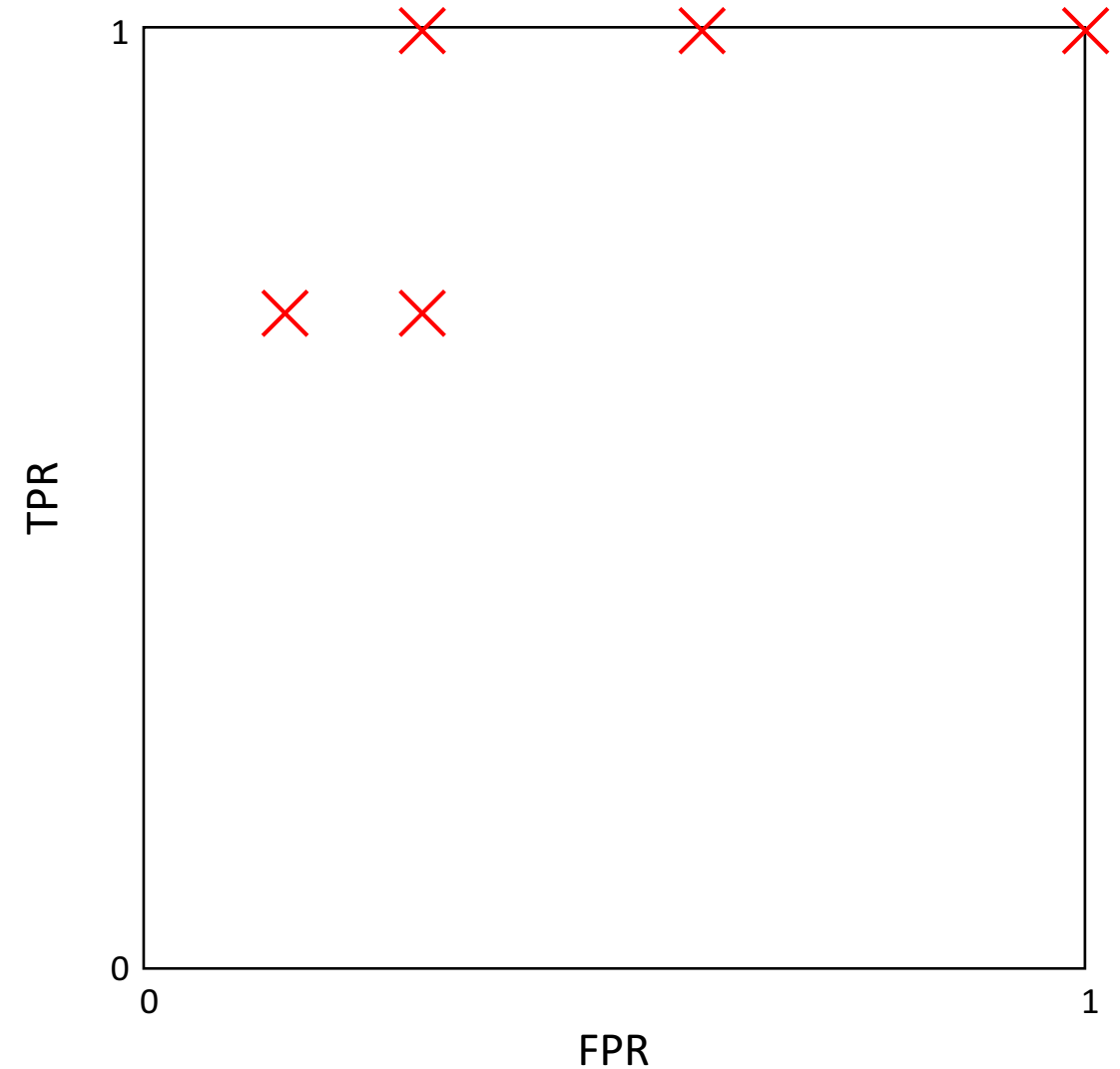
< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

$$T = 0.6$$

$$TPR = \frac{2}{3}$$

$$FPR = \frac{1}{7}$$



ROC Curve Example

True	$f(x)$	Decision
1	0.9	1
1	0.6	0
0	0	0
1	0.3	0
0	0.1	0
0	0.1	0
0	0	0
0	0.5	0
0	0	0
0	0.6	0

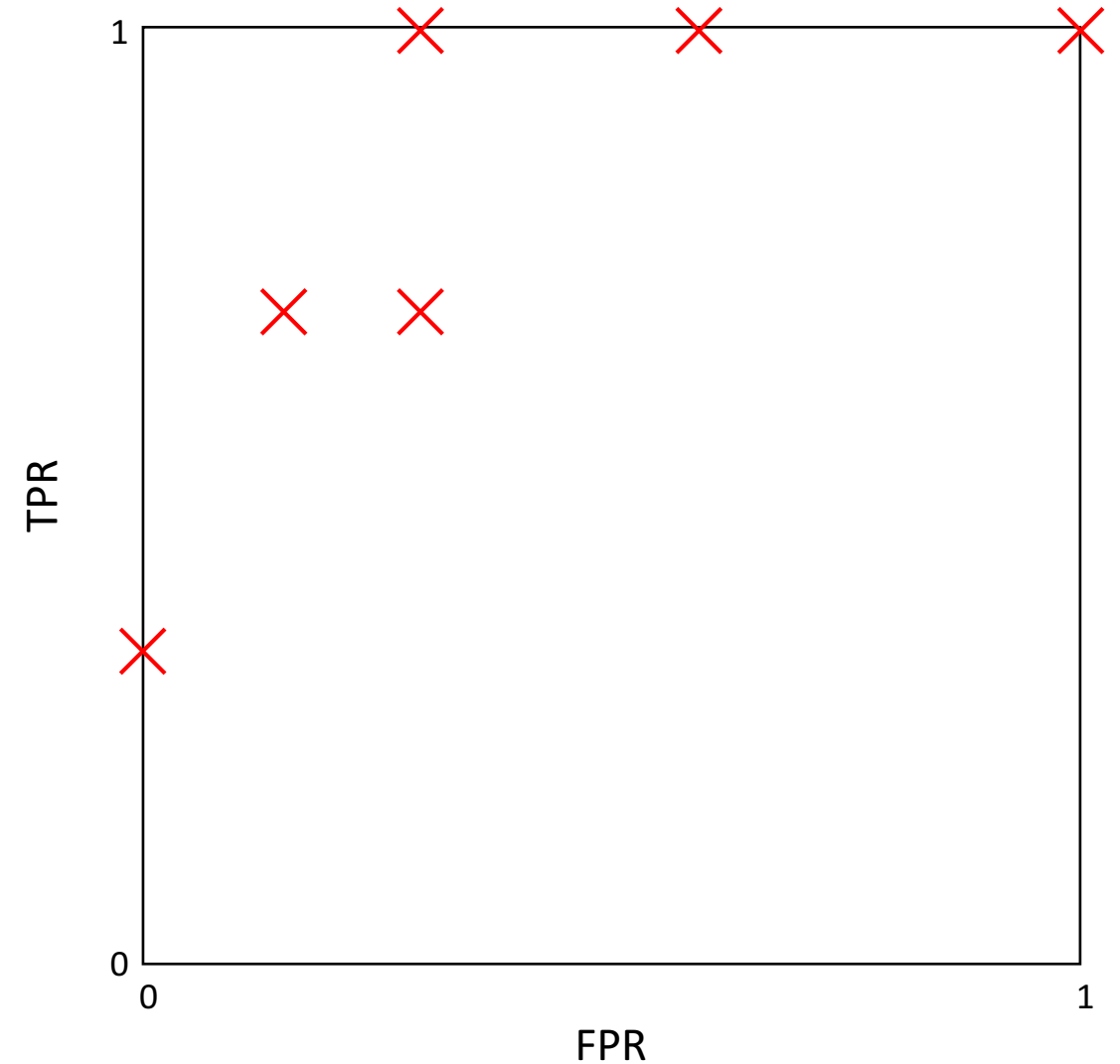
< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

$$T = 0.9$$

$$TPR = \frac{1}{3}$$

$$FPR = \frac{0}{7} = 0$$



ROC Curve Example

True	$f(x)$	Decision
1	0.9	0
1	0.6	0
0	0	0
1	0.3	0
0	0.1	0
0	0.1	0
0	0	0
0	0.5	0
0	0	0
0	0.6	0

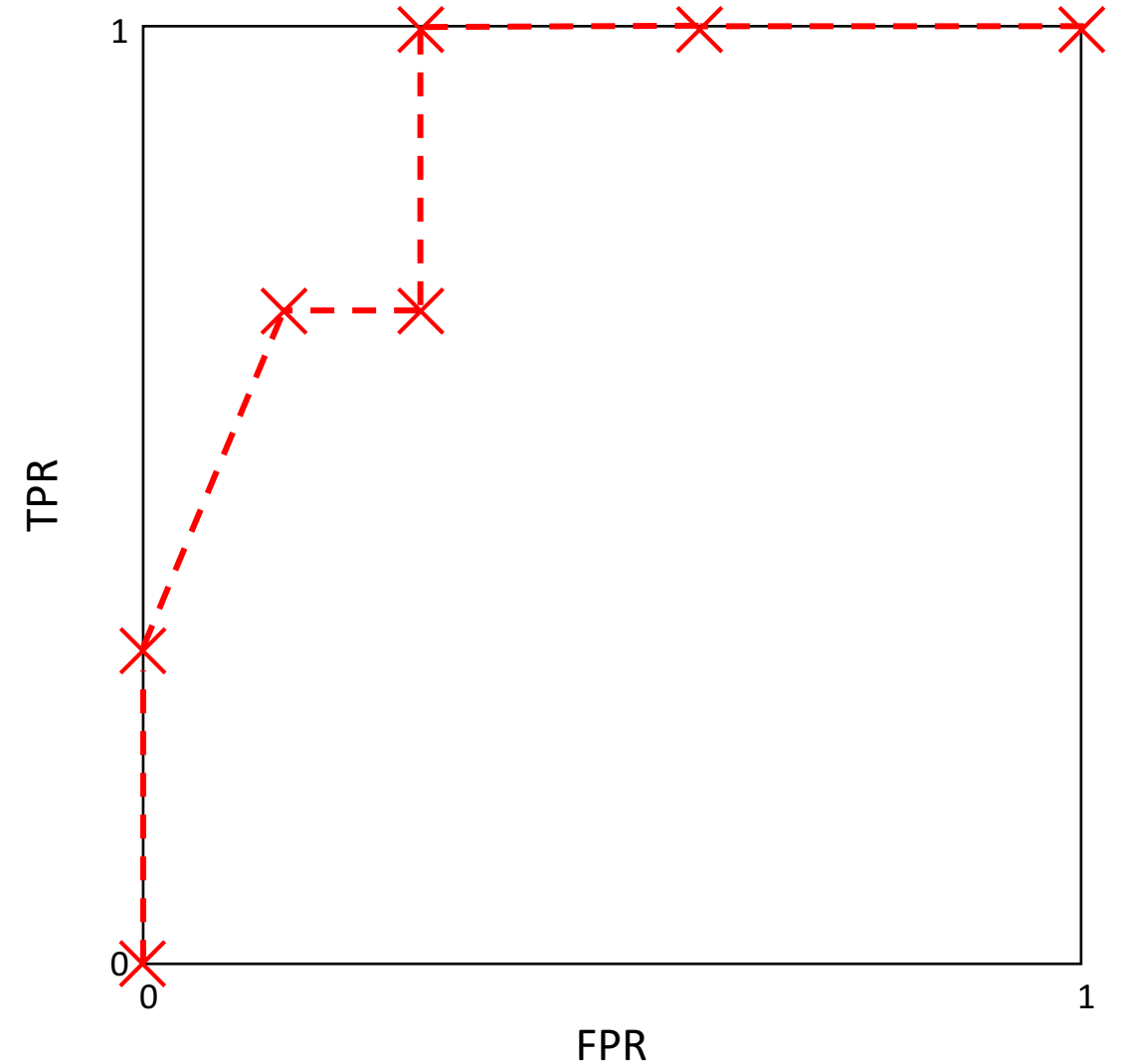
< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

$$T = 1 (+\epsilon)$$

$$TPR = \frac{0}{3}$$

$$FPR = \frac{0}{7} = 0$$



Precision-Recall curve

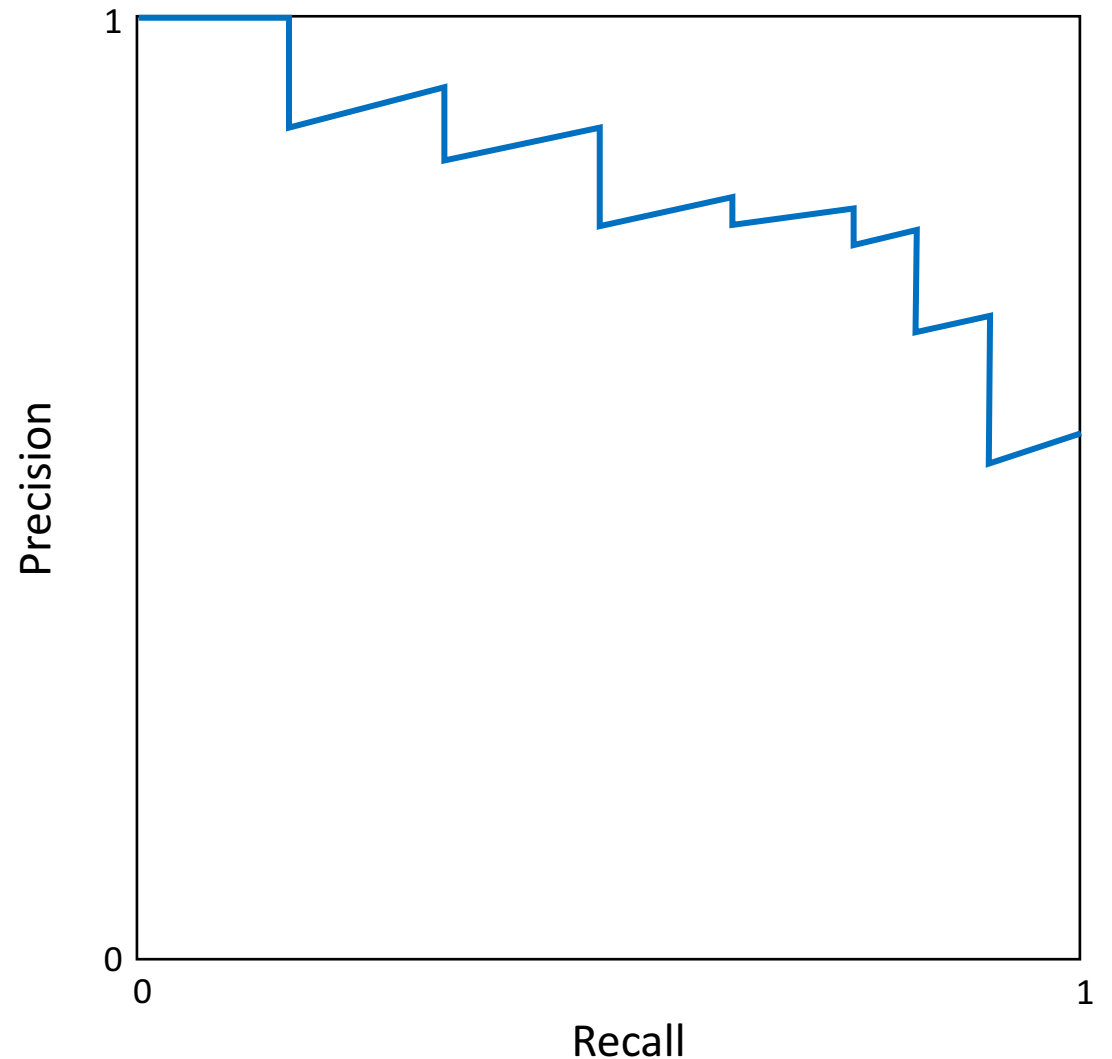
- Shows performance of binary classifier for varying decision threshold

- Precision (PPV):

$$\frac{TP}{TP + FP}$$

- Recall (TPR):

$$\frac{TP}{TP + FN}$$



Precision-Recall curve Example

True	$f(x)$
1	0.9
1	0.6
0	0
1	0.3
0	0.1
0	0.1
0	0
0	0.5
0	0
0	0.6

< Decision Rule >

$$Decision = \begin{cases} 1 & \text{if } f(x) \geq T \\ 0 & \text{if } f(x) < T \end{cases}$$

