准确率（Accuracy）：分类器正确预测的样本数与总样本数之比。

$$Accuracy = \frac{\text{正确预测的样本数}}{\text{总样本数}}$$

精确率（Precision）：在所有预测为某个类别的样本中，真正属于该类别的样本数与所有预测为该类别的样本数之比。

$$Precision = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

召回率（Recall）：在所有真实为某个类别的样本中，被正确预测为该类别的样本数与所有真实为该类别的样本数之比。

$$Recall = \frac{True\ Positive}{True\ Positive + False\ Negative}$$

F1 分数：精确率和召回率的调和平均数。

$$F1 = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$

True_label = [0 2 1 1 2]

Predict = [0 2 0 0 1]

$Accuracy = \frac{2}{5}$

True \ Predict	0	1	2
0	1	0	0
1	2	0	0
2	0	1	1

class 0 TP = 1 FP = 2 FN = 0

Precision $\frac{TP}{TP+FP} = \frac{1}{3}$

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

class 1 TP = 0 FP = 1 FN = 2

$\frac{TP}{TP+FP} = 0$

$\frac{TP}{TP+FN} = 0$

class 2 TP = 1 FP = 0 FN = 1

$\frac{TP}{TP+FP} = 1$

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

F1 score $= 2 \times \frac{Precision \times Recall}{Precision + Recall}$

$\frac{1}{2}$ 0 $\frac{2}{3}$

Quiz 2 利用下降阶乘幂求$\sum_{k=0}^{n-1} k^2$

$$k^{\underline{1}} = k$$
$$k^{\underline{2}} = k(k-1) = k^2 - k = k^2 - k^{\underline{1}}$$
$$k^2 = k^{\underline{2}} + k^{\underline{1}}$$

$$\sum_{k=0}^{n-1} k^2$$
$$= \sum_{k=0}^{n-1} (k^{\underline{2}} + k^{\underline{1}})$$
$$= \sum_{k=0}^{n} k^{\underline{2}} \delta k + \sum_{k=0}^{n} k^{\underline{1}} \delta k$$
$$= \frac{k^{\underline{3}}}{3}\Big|_0^n + \frac{k^{\underline{2}}}{2}\Big|_0^n$$
$$= \frac{n(n-1)(n-2)}{3} + \frac{n(n-1)}{2}$$
$$= \frac{n(n-1)(2n-1)}{6}$$

下降阶乘幂(Decreasing Factorial Power):

$$x^{\underline{m}} = x(x-1)\cdots(x-m+1) \quad \text{整数 } m \geq 0$$

下降幂的求和:

有限微积分在下降幂求和上的应用:

$$\sum_{0 \leq k < n} k^{\underline{m}} = \sum_{0 \leq k \leq n} k^{\underline{m}} \delta k = \frac{k^{\underline{m+1}}}{m+1}\Big|_0^n = \frac{n^{\underline{m+1}}}{m+1}$$

$\sum_{k=0}^{n-1} k^2$

$x^{\underline{m}} = x(x-1)\cdots(x-m+1)$

$\Delta(x^{\underline{m}}) = m x^{\underline{m-1}}$

$\sum g(x)\delta(x) = f(x)$ $\quad \sum_a^b g(x)\delta(x) = f(b) - f(a)$

$\sum_{0 \leq k < n} k^{\underline{m}} = \sum_{0 \leq k \leq n} k^{\underline{m}} \delta k = \frac{k^{\underline{m+1}}}{m+1}\Big|_0^n = \frac{n^{\underline{m+1}}}{m+1}$

$k^{\underline{2}} = k \times (k-1)$

$k^{\underline{1}} = k$

$k^2 = k^{\underline{2}} + k^{\underline{1}}$

$\sum_{k=0}^{n} k^2 = \sum_{k=0}^{n} k^{\underline{2}} + k^{\underline{1}}$

$= \frac{k^{\underline{3}}}{3}\Big|_0^n + \frac{k^{\underline{2}}}{2}\Big|_0^n$

$= \frac{n(n-1)(2n-1)}{6}$