[1 cm, 2 cm] → J

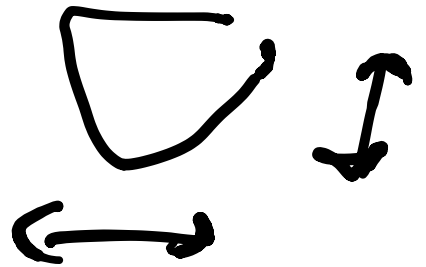
[1.5 cm, 5 cm] → R

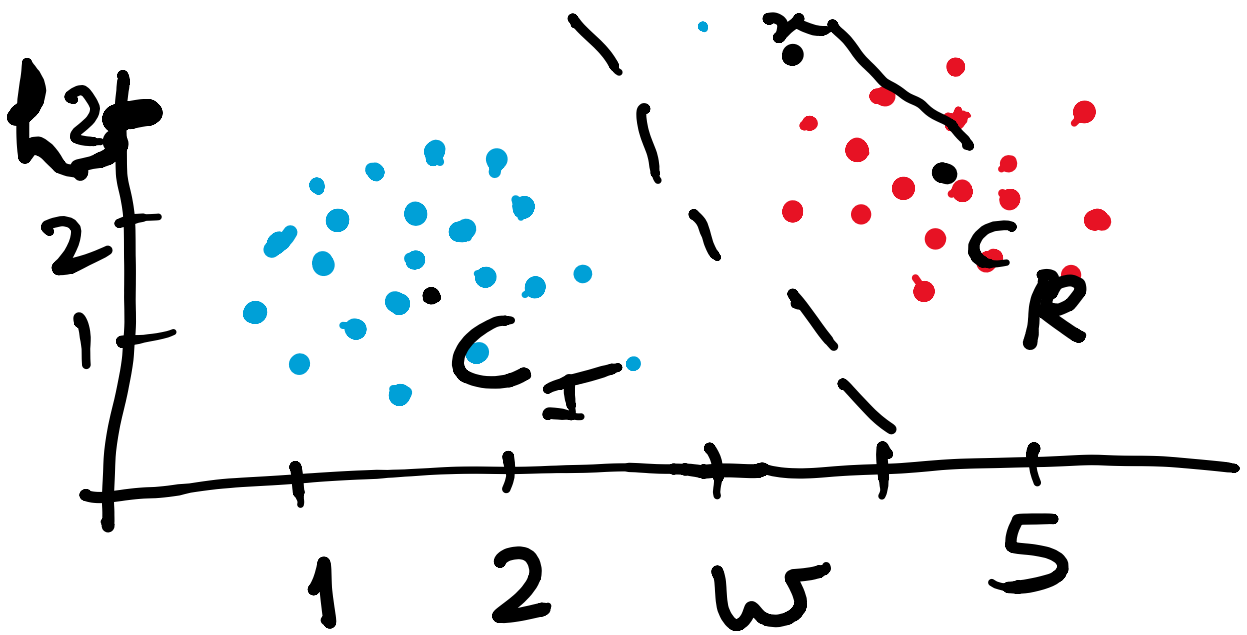
L  W

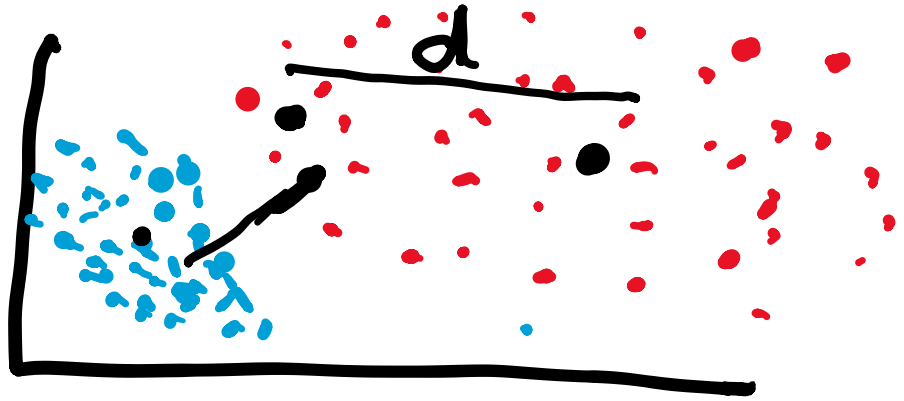
[1.1 cm, 1.9 cm] → J

[2 cm, 4 cm] → R

Rose
Jasmine






| J | R |
|---|---|
| $d(x, c_J)$ | $d(x, c_R)$ |

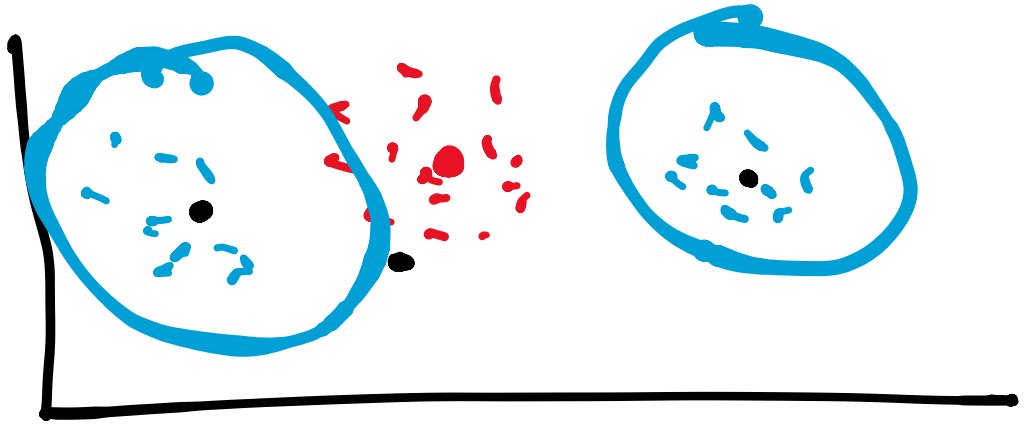
$$x = [3.5, 4]$$

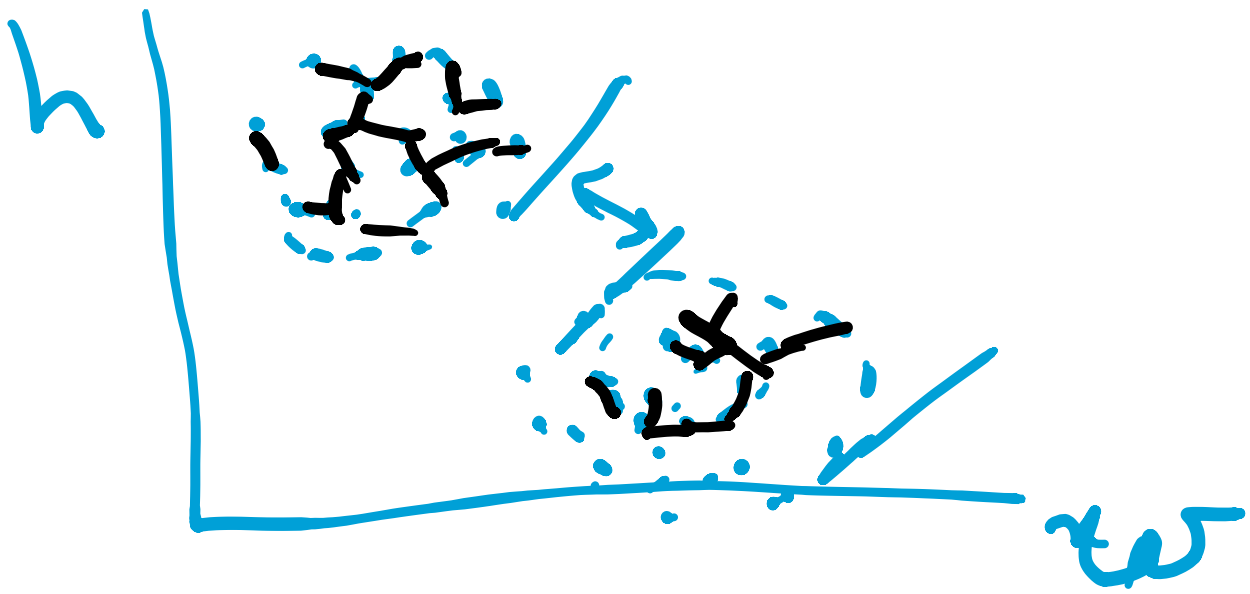
$$\left[\frac{d(x, c_J)}{\sigma_J} > \frac{d(x, c_R)}{\sigma_R}\right] \Rightarrow R$$

$$\Rightarrow J$$

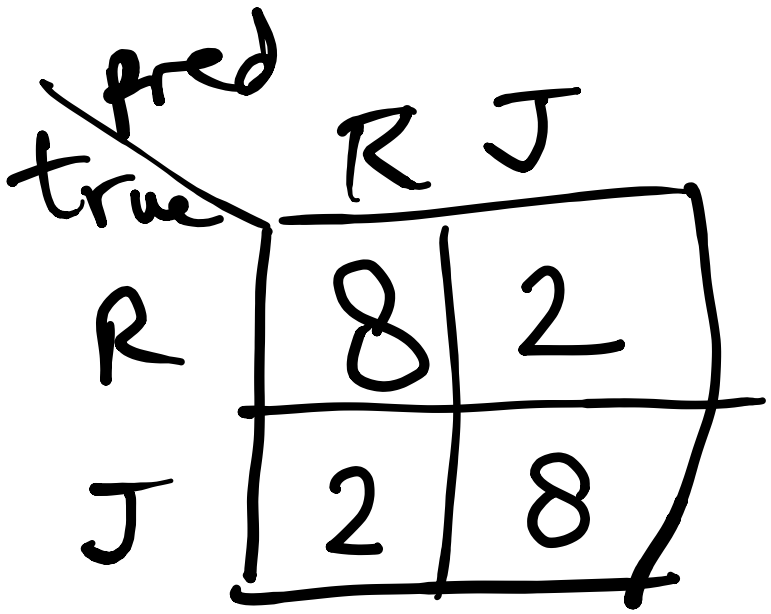
$$\sigma^2 = \sum_{i=1}^{I} \frac{(x_i^R - \mu^R)^2}{I}$$

$$\mu = \sum_{i=0}^{I} x_{i,R} / I$$






# Gaussian Mixture Models



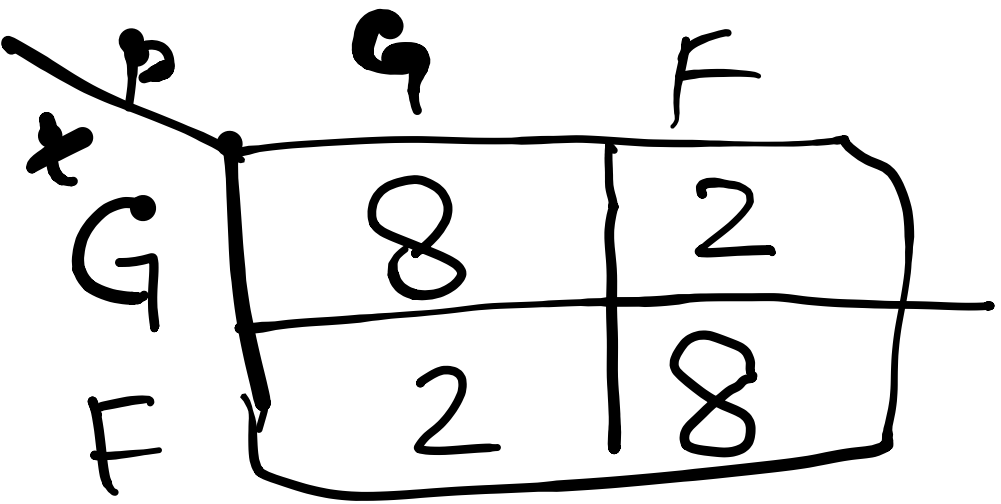

$$Acc = \frac{8+8}{20} = \frac{16}{20} = 80\%$$

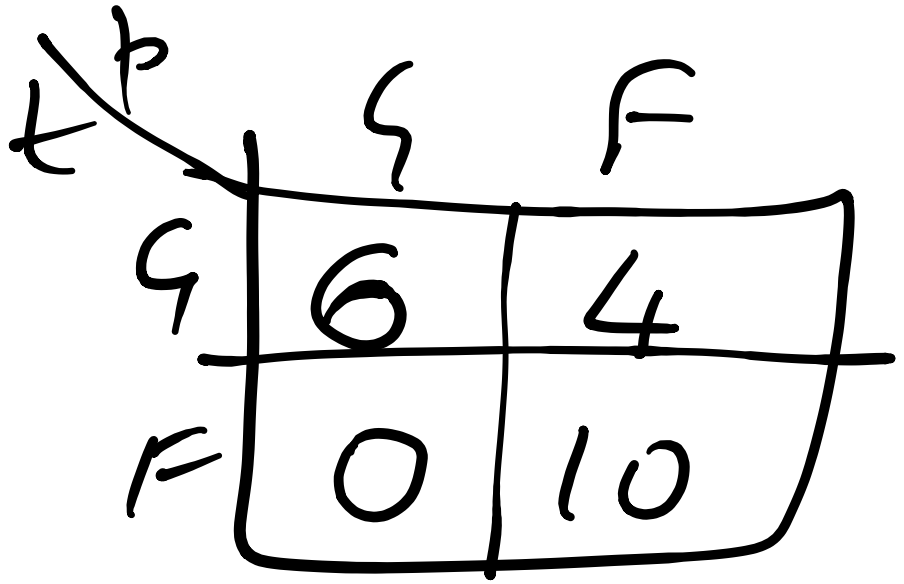
$$Prec_R = \frac{8}{8+2} = 80\%$$

$$Rec_R = \frac{8}{8+2} = 80\%$$

$$F = \frac{2(.8)(.8)}{.8+.8}$$

$$= 80\%.$$



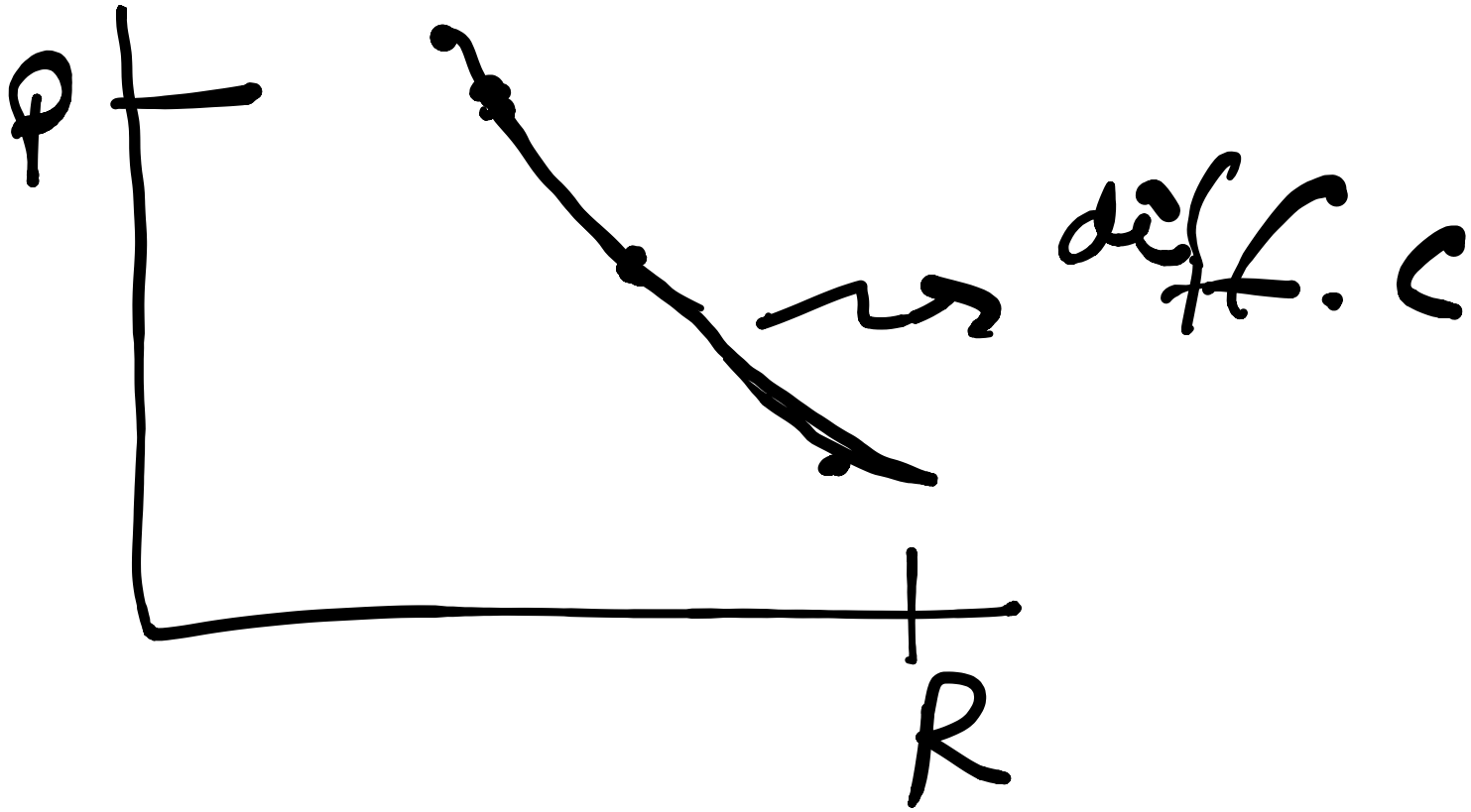

$$A = \frac{10+6}{20} = 80\%$$

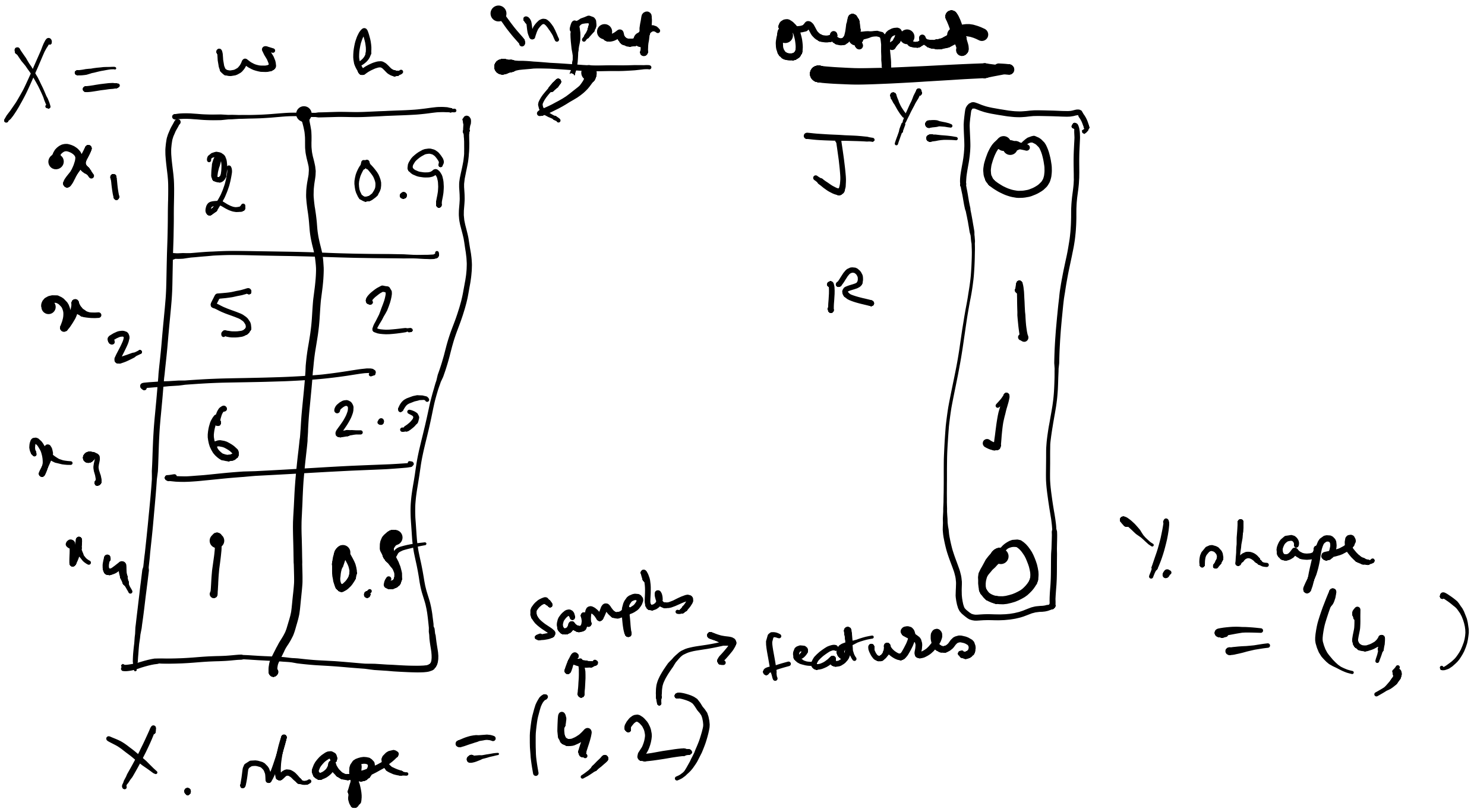
very

$$P_G = \frac{6}{6+0} = 100\%$$

secure

$$R_G = \frac{6}{6+4} = 60\%$$


P
R
diff. c


X =
w
h
Input
Output
$x_1$
2
0.9
$x_2$
5
2
$x_3$
6
2.5
$x_4$
1
0.5
Y =
J
R
0
1
1
0
Samples
features
X.shape = (4, 2)
Y.shape = (4, )

$$\underline{\mu} = \frac{(2, 0.9) + (5, 2) + (6, 2.5) + (1, 5)}{4}$$

$$= \frac{1}{4} \sum_{i=1}^{4} \underline{x}_i$$

$$\sigma^2 = \frac{1}{4} \sum_{i} \left( \underline{x}_i - \underline{\mu} \right)^2$$

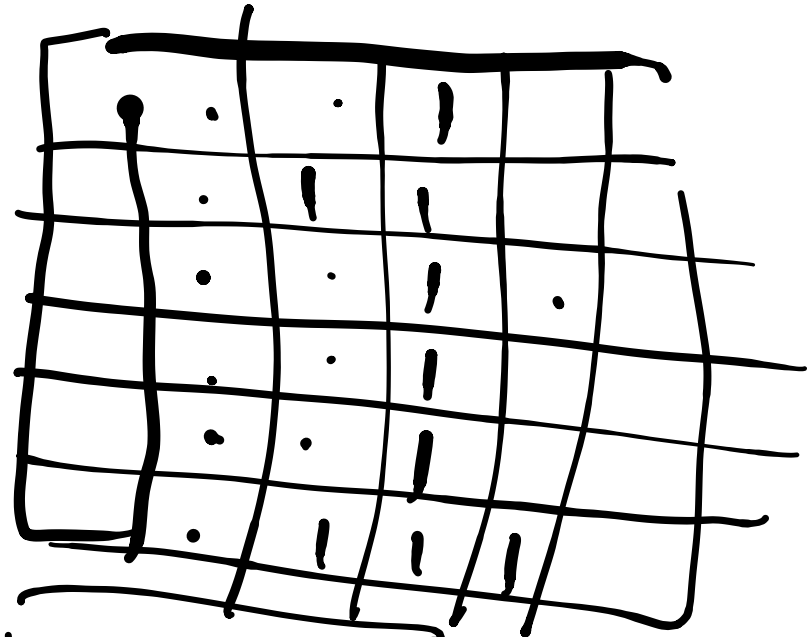
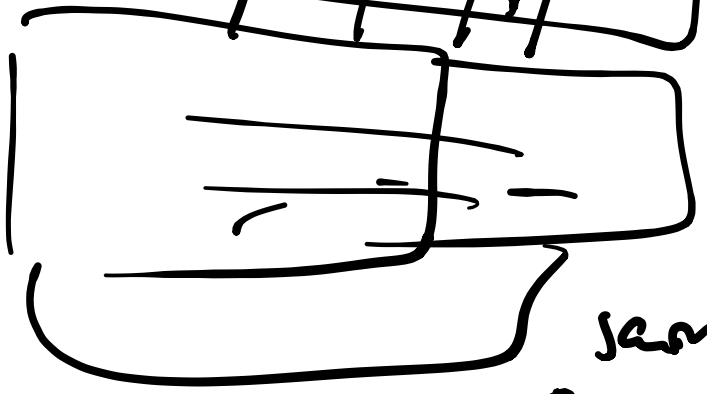
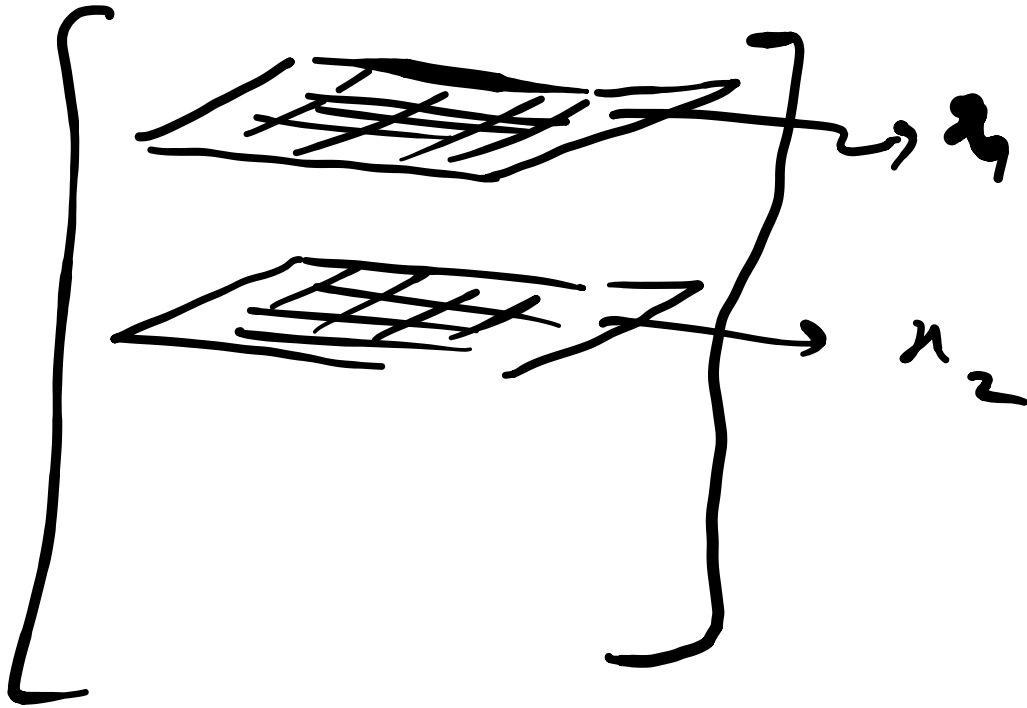
$x_1 =$ 

image of handwritten digit 1

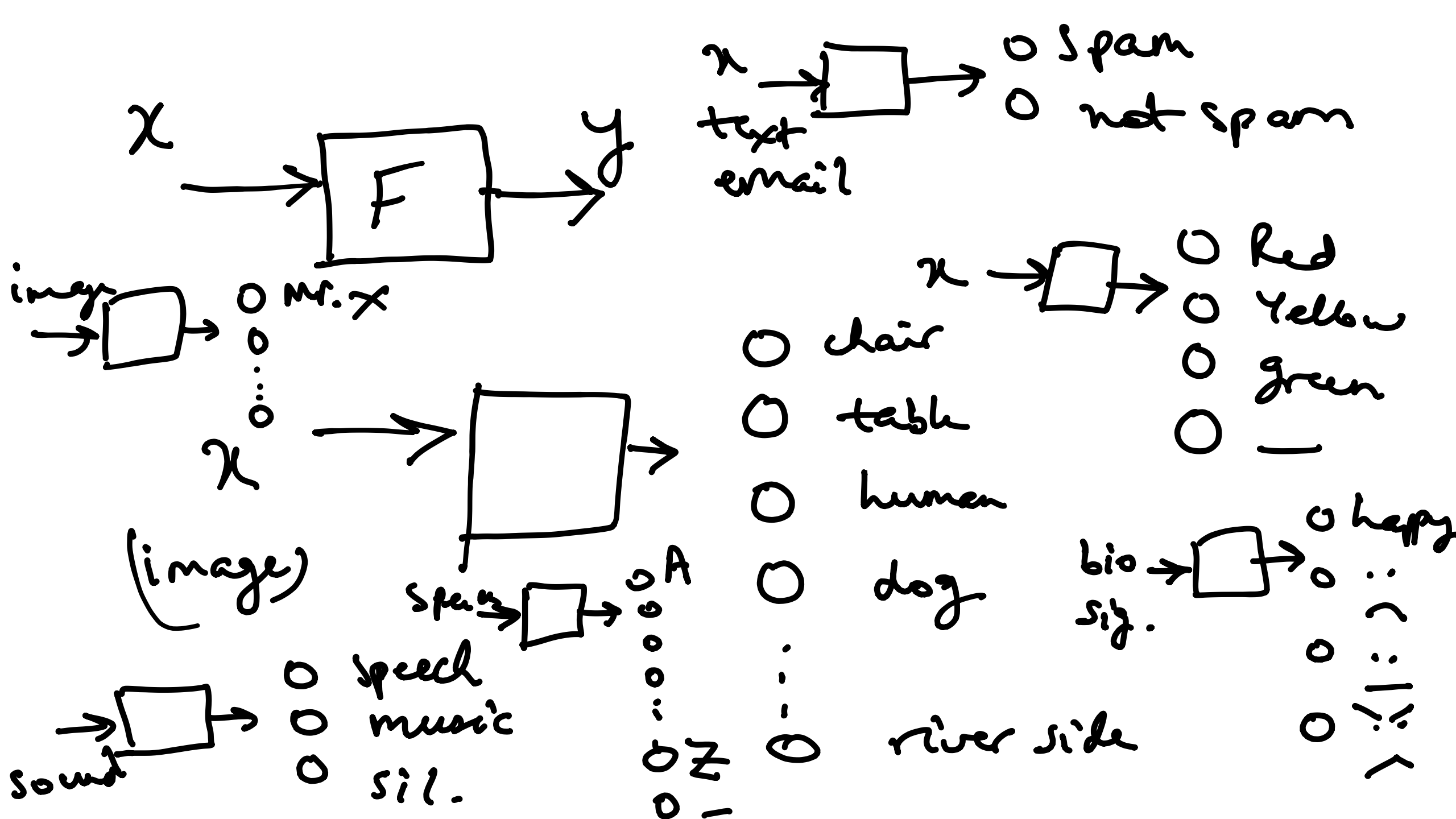
$x_1.shape = (6, 6)$

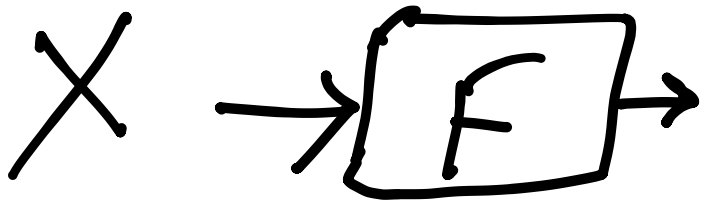
$x_2 =$ 

$X =$ 

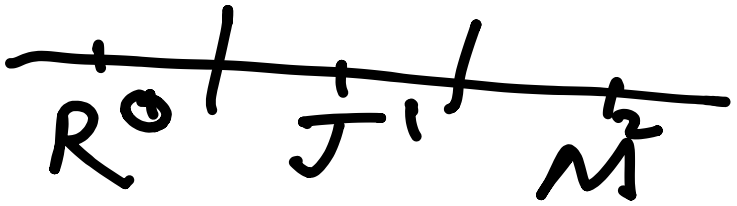

sample

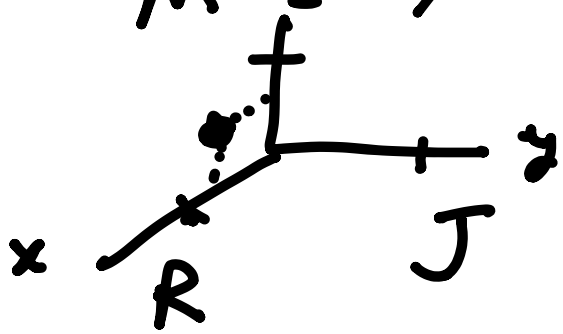
$X.shape = (2, 6, 6)$


x
F
y
x
text
email
spam
not spam
image
Mr. x
x
Red
Yellow
green
—
chair
table
human
dog
river side
(image)
sparse
A
Z
—
bio
sig.
happy
sound
speech
music
sil.




- Rose
- Jasmine
- Marigold
- ⋮
- Lily




$P(R) = 0.5$

$P(M) = .5$

$P(J) = 0$

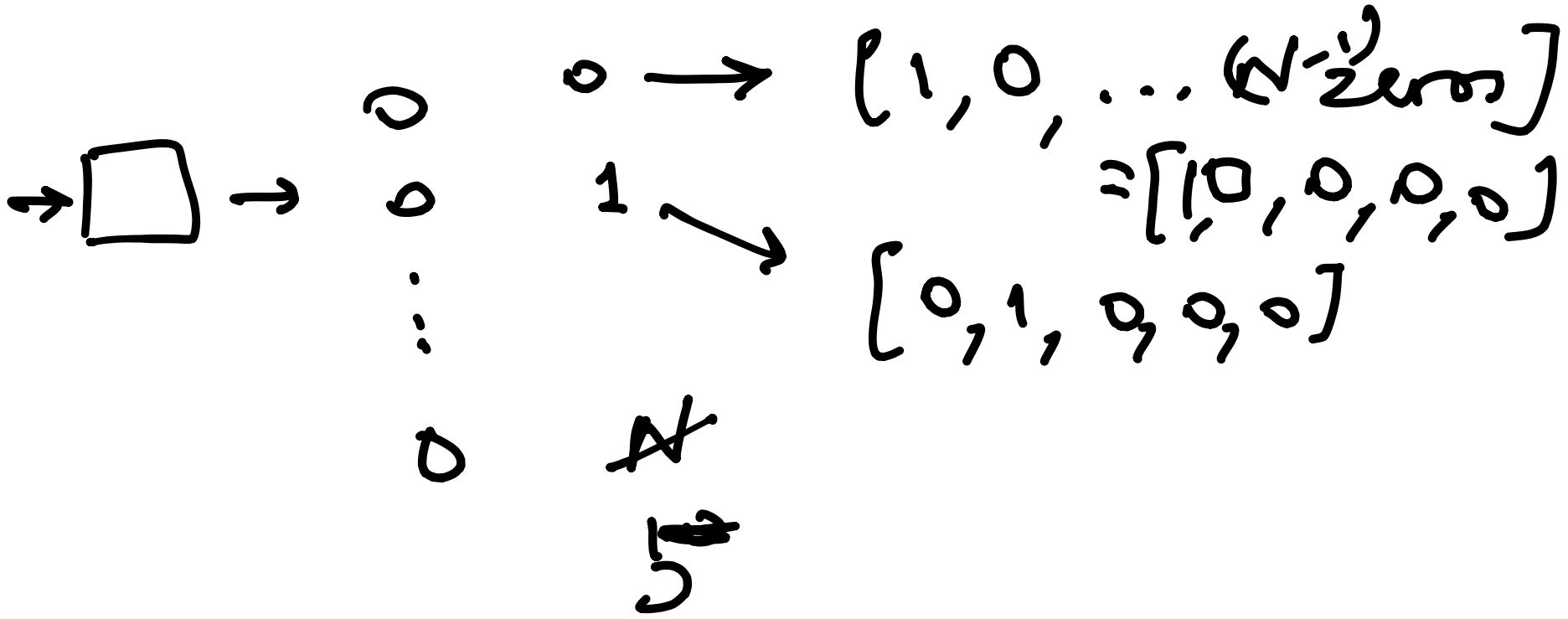
$y \in \{R, J, M\}$

$\{0, 1, 2\}$

$\{[1,0,0], [0,1,0], [0,0,1]\}$

$[0.7, .2, .1]$

$[0.1, .2, .6]$




onehot $(y, N_y)$:

$y = 2 \quad N_y = 5 \longrightarrow [0, 0, 1, 0, 0]$

$y = 1 \quad N_y = 3 \longrightarrow [0, 1, 0]$

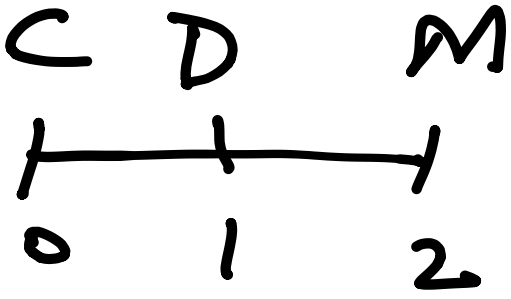
$x = [C, D, M, C, C, M]$

$0 - 2$

$0, 2 \sim 1$

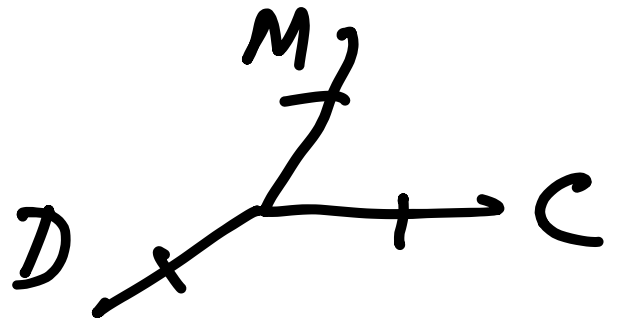
$N_y = 3$

$x\_ind = [0, 1, 2, 0, 0, 2]$ ←




$x\_1hot = [[1,0,0], [0,1,0], [0,0,1], [1,0,0], [1,0,0], [0,0,1]]$

$y = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$



No. of batches $b = \left\lfloor \frac{X.shape[0]}{m} \right\rfloor + 1$

$X = \begin{bmatrix} 0 & 6 & 1 \\ 1 & 1 & 0 \\ 2 & 3 & 1 \\ 7 & 1 & 3 \\ 9 & 4 & 8 \\ 5 & 6 & 4 \\ 3 & 3 & 0 \end{bmatrix}$

$m = 3$ → `[ np.array([[0,6,1],[1,1,0],[2,3,1]]), np.array([[7,1,3],[9,4,8],[5,6,4]]), [3,3,0] ]`

list, np, np, np

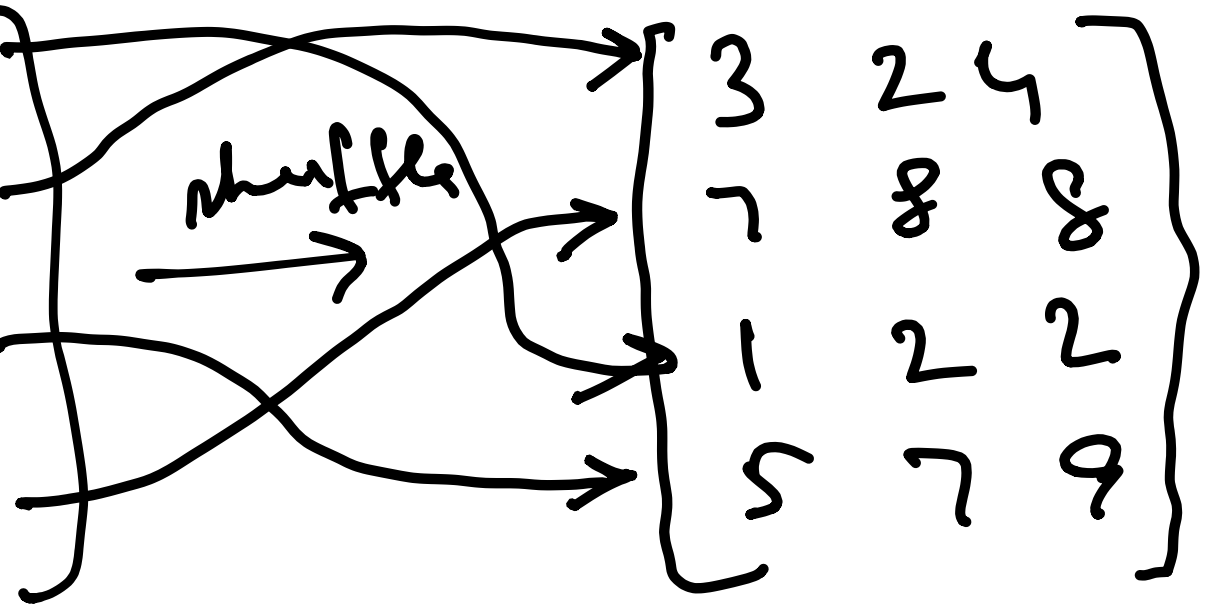
`X[0:3, :]` `X[3:6, :]` `X[6:7, :]`

`X[0:m, :]` `X[m:2m, :]` `X[2m:, :]`

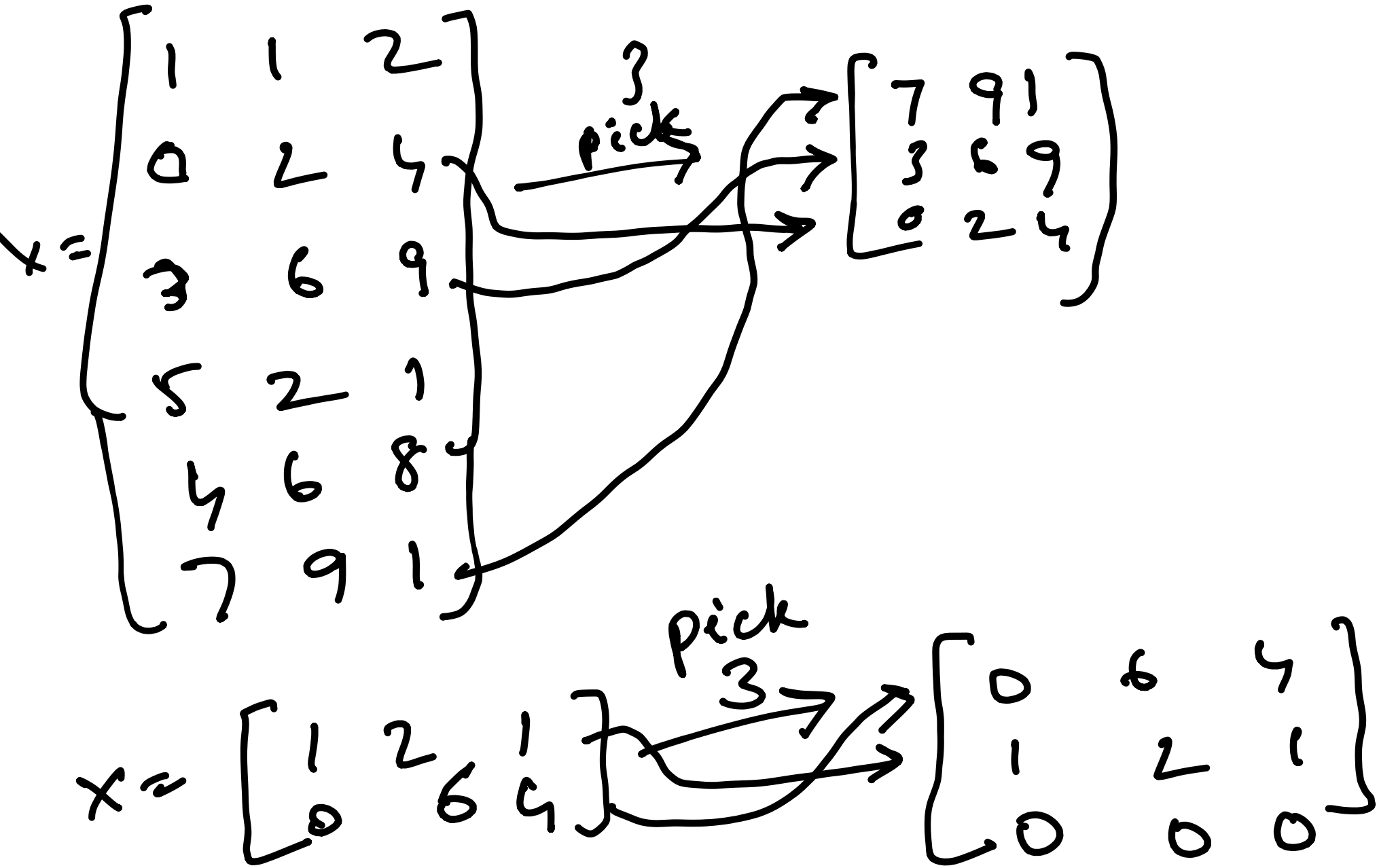
for b in range

```
Xbatches = [ ]
Nb = np.ceil ( X.shape [0] / m)
for b in range(Nb):
    batch = X [b * m : (b+1) m, :]
```

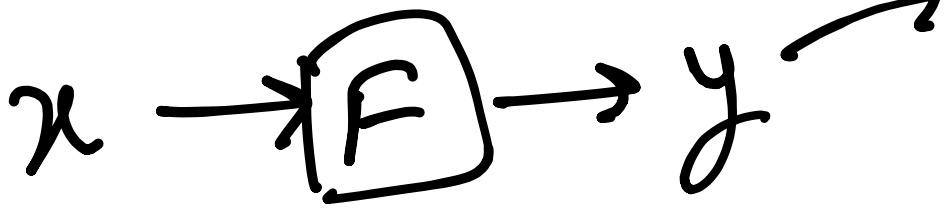
$$X = \begin{bmatrix} 1 & 2 & 2 \\ 3 & 2 & 4 \\ 5 & 7 & 9 \\ 7 & 8 & 8 \end{bmatrix}$$




$$\begin{bmatrix} 3 & 2 & 4 \\ 7 & 8 & 8 \\ 1 & 2 & 2 \\ 5 & 7 & 9 \end{bmatrix}$$


x=
1 1 2
0 2 4
3 6 9
5 2 1
4 6 8
7 9 1
3
pick
7 9 1
3 6 9
0 2 4


x=
1 2 1 7
0 6 4
pick
3
0 6 4
1 2 1
0 0 0




not categorical

it is continuous

$(x^2)$

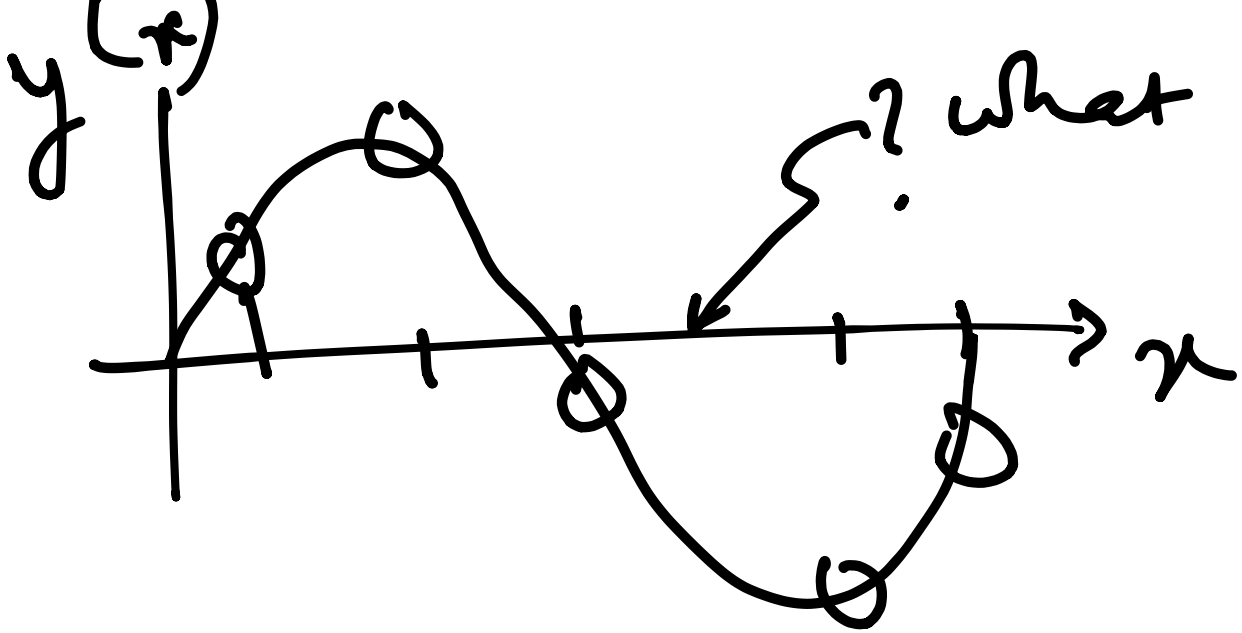
| x | y |
|---|---|
| 0.1 | 0.01 |
| 0.3 | 0.09 |
| 0.7 | 0.49 |
| 0.9 | 0.81 |
| 1 | 1 |

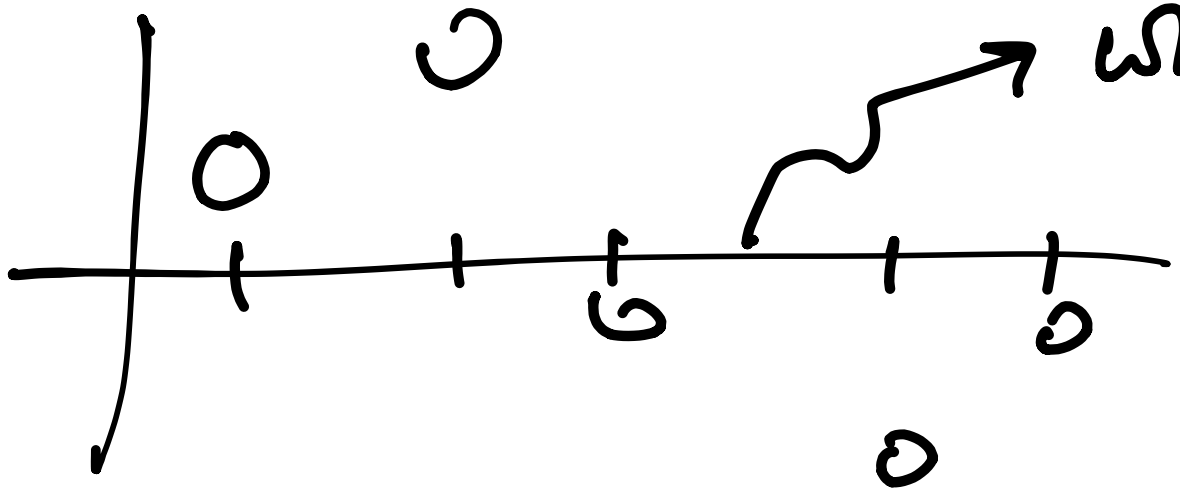
REGRESSION

| $s$ | $v_i$ |
|---|---|

$$a_0 + s a_1 + a_2 s^2 = v_i$$

$$\begin{bmatrix} s^2 & s & 1 \\ \vdots & \vdots & \vdots \end{bmatrix} \begin{bmatrix} a_2 \\ a_1 \\ a_0 \end{bmatrix} = \begin{bmatrix} v_i \\ \vdots \end{bmatrix}$$


y
x
? what is f(x) here ?


what is f(x) here ?