Random Variable:

← Corr tion (RStudio)

ex: Bernouli Random Variable.
 (Discrete)
 Expectation: ←
 Variance: ←

ex: Uniform Random Variable. ← X
 (Discrete)
 Expectation ?
 Variance. ?   } ← Do it in R / Google

Transformation of random variables.

Assume $X \sim N(u, \sigma^2)$ ← this means X comes from
            normal distribution with mean u
            and variance σ^2

Examples of transformation:
$$X + 1 \sim N(u+1, \sigma^2)$$
$$2X \sim N(2u, 4\sigma^2)$$

Special example: "convolution": we illustrate use matrix of

random variable: average
          standard deviation

✓ Uni to c
✓ bell-shape cur

Transformation of Random Variable:

X : $\{1, \sqrt{2}\}$ ← $\{0, 1\}$ ← average 0.5
$2X$: $\{0, 2\}$ ← (1)
Y: = $\{0, 2\}$ Transf. of X.
            1. 2. 3
            0   2   0. · · · ·

average $\neq$ 0.5
   = 1

Special: "Convolution": element-wise multiplicate

3×3   2×2

detail $\begin{pmatrix} 1 & 0 \\ 1 & 0 \end{pmatrix}$

$\begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix} \cdot \begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix} = \quad 1 \times 1 + 2 \times 1 + 4 \times 0 + 5 \times 0 = 1 + 2 + 0 + 0 = 3$
      ↑
   conv. operation.

$\begin{pmatrix} 2 & 3 \\ 5 & 6 \end{pmatrix} \cdot \begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix} = 2 \times 1 + 3 \times 1 + 0 + 0 = 5$

$\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} \xrightarrow{\text{filter: } \begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix}} \begin{pmatrix} 3 & 5 \\ 9 & 11 \end{pmatrix}$

Convolution : Special type of Transform
         of Random Variable

Application :

X

f_1: $\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$ → Y_1 eyes

f_2: $\begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 0 \end{pmatrix}$ → Y_2 nose

f_{100} → lips

algorithm (NN)