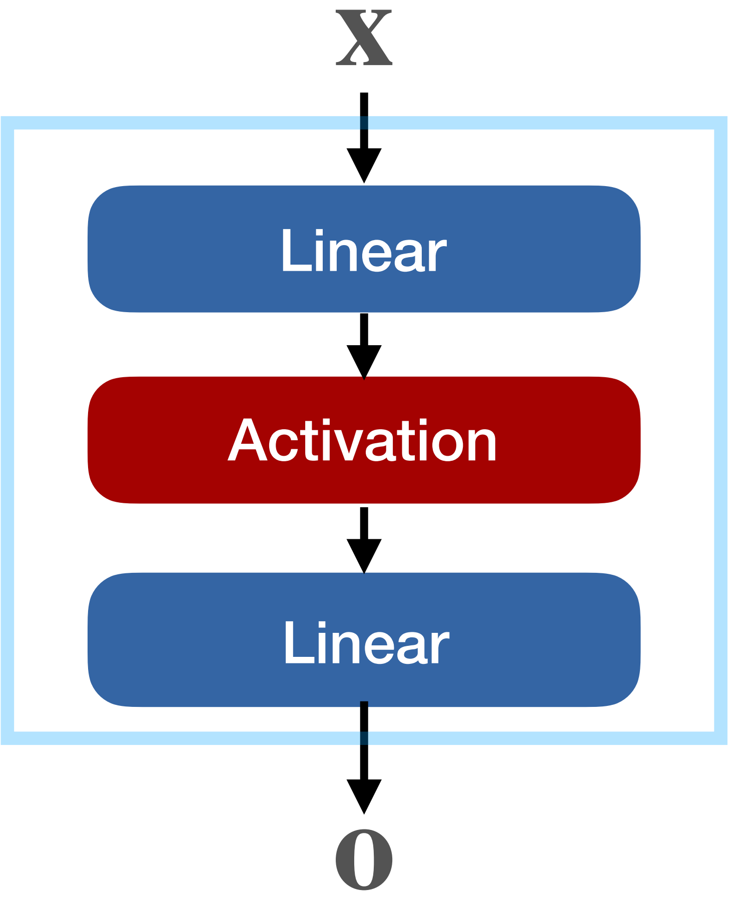
Activation functions

Non-linearities

- Allow a deep network to model arbitrary differentiable functions

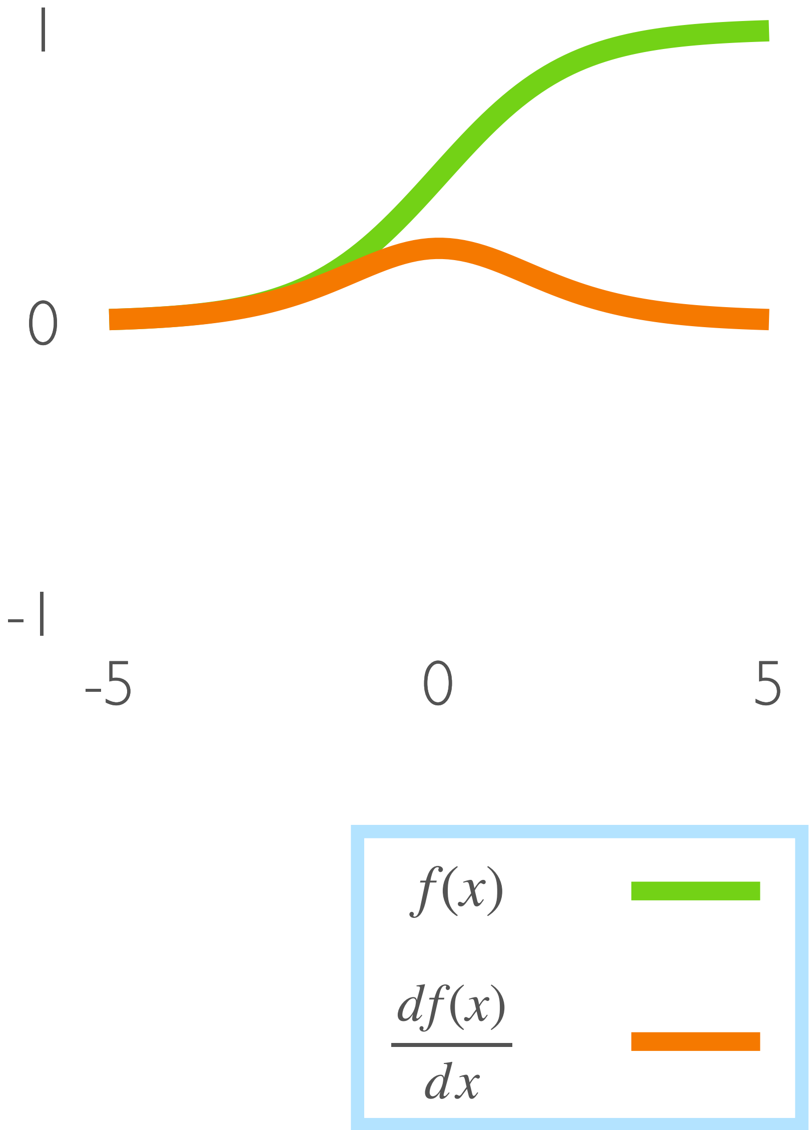


Zoo of activation functions

- ReLU
- Leaky ReLU
- PReLU
- ELU
- tanh
- Sigmoid
- Maxout

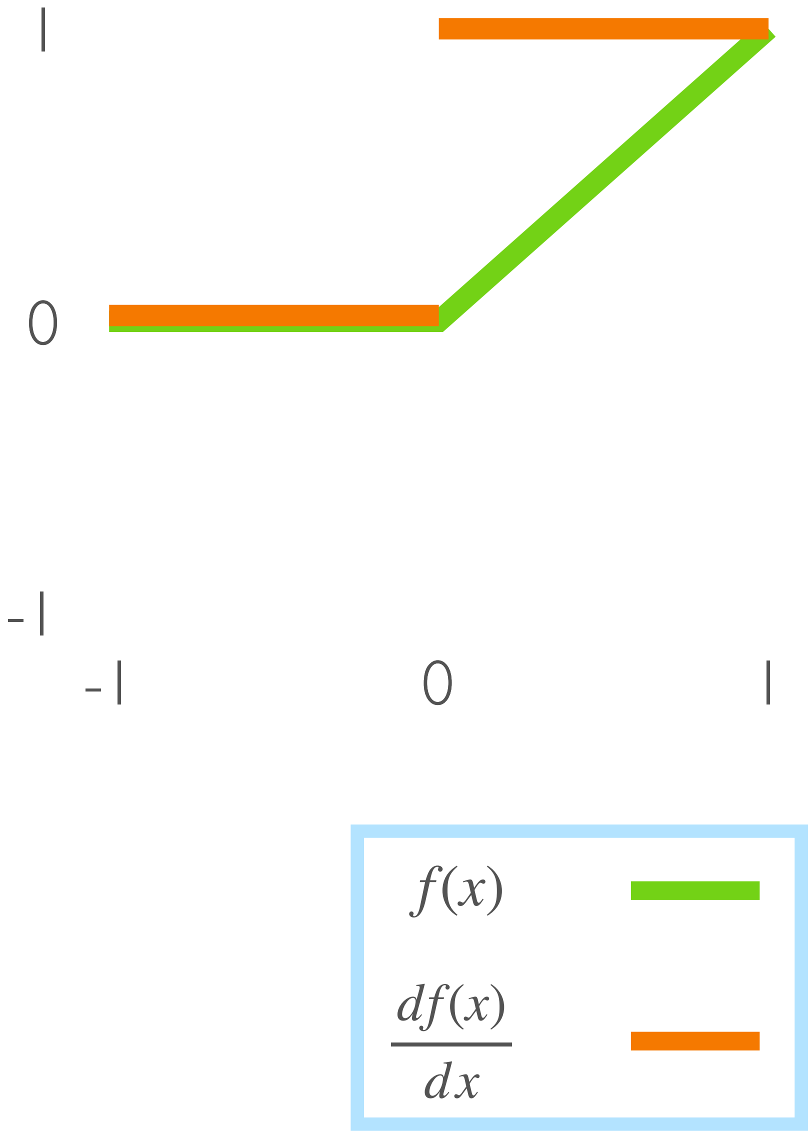
Sigmoid

- $\frac{1}{1+e^{-x}}$
- Same as tanh
- Do not use



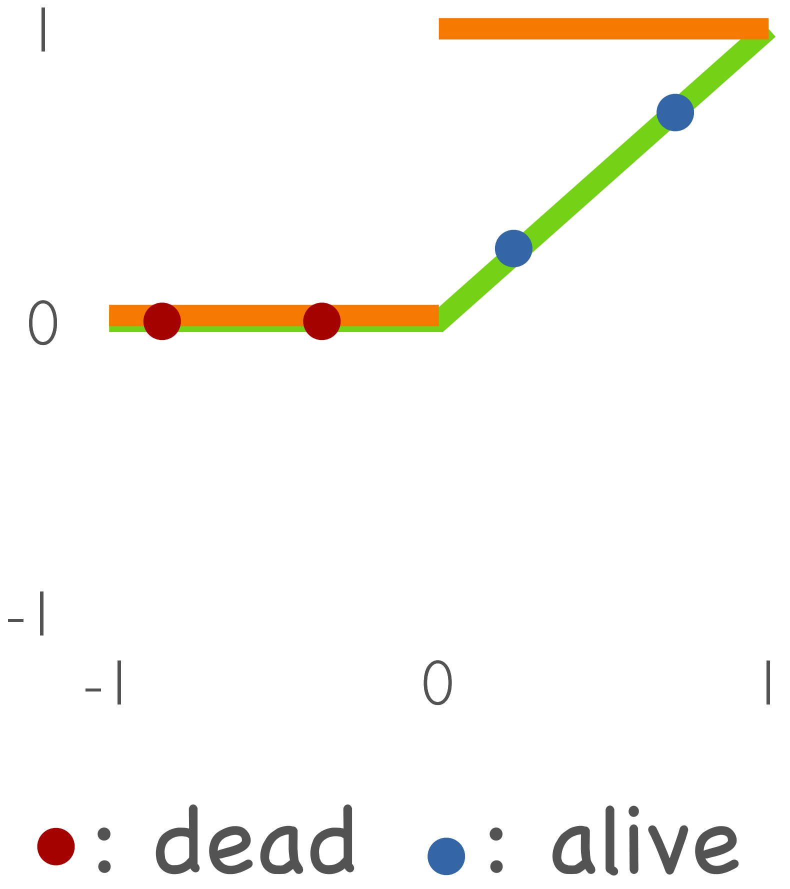
ReLU

- $\max(x, 0)$



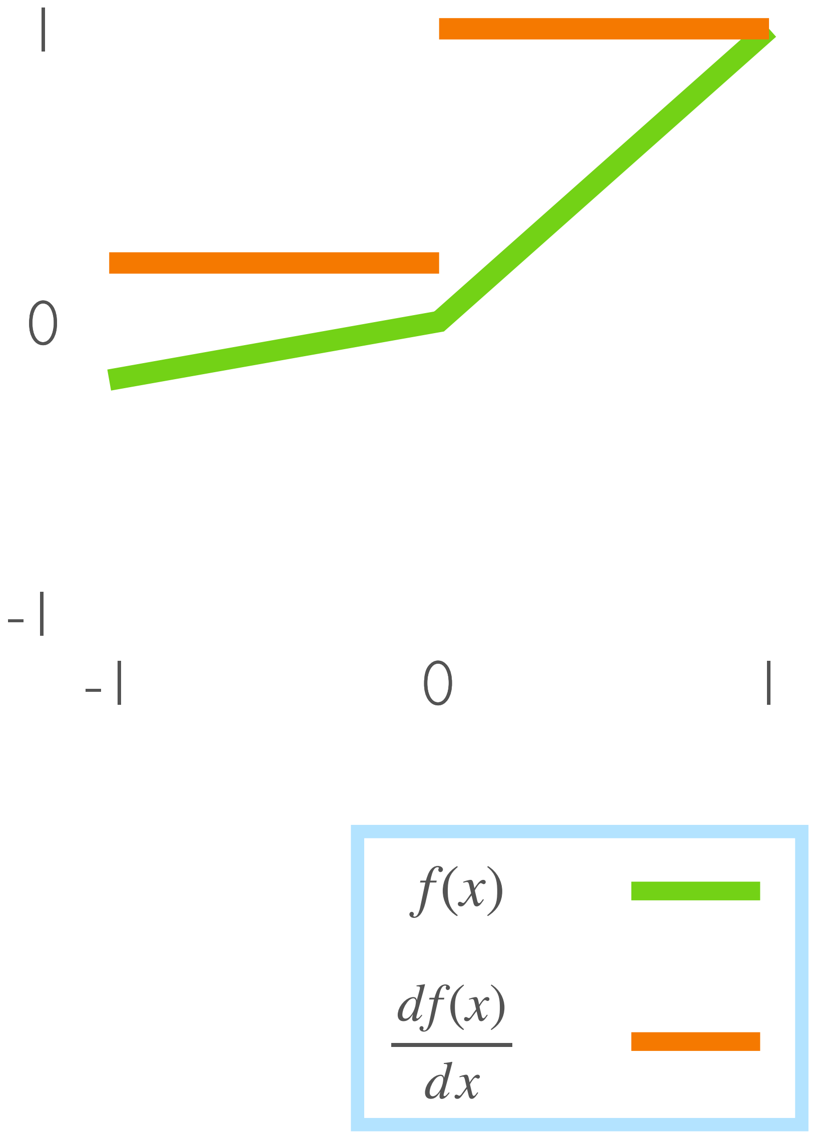
Dead ReLUs

- Prevent dead ReLUs:
    - Initialize Network carefully
    - Decrease the learning rate



Leaky ReLU

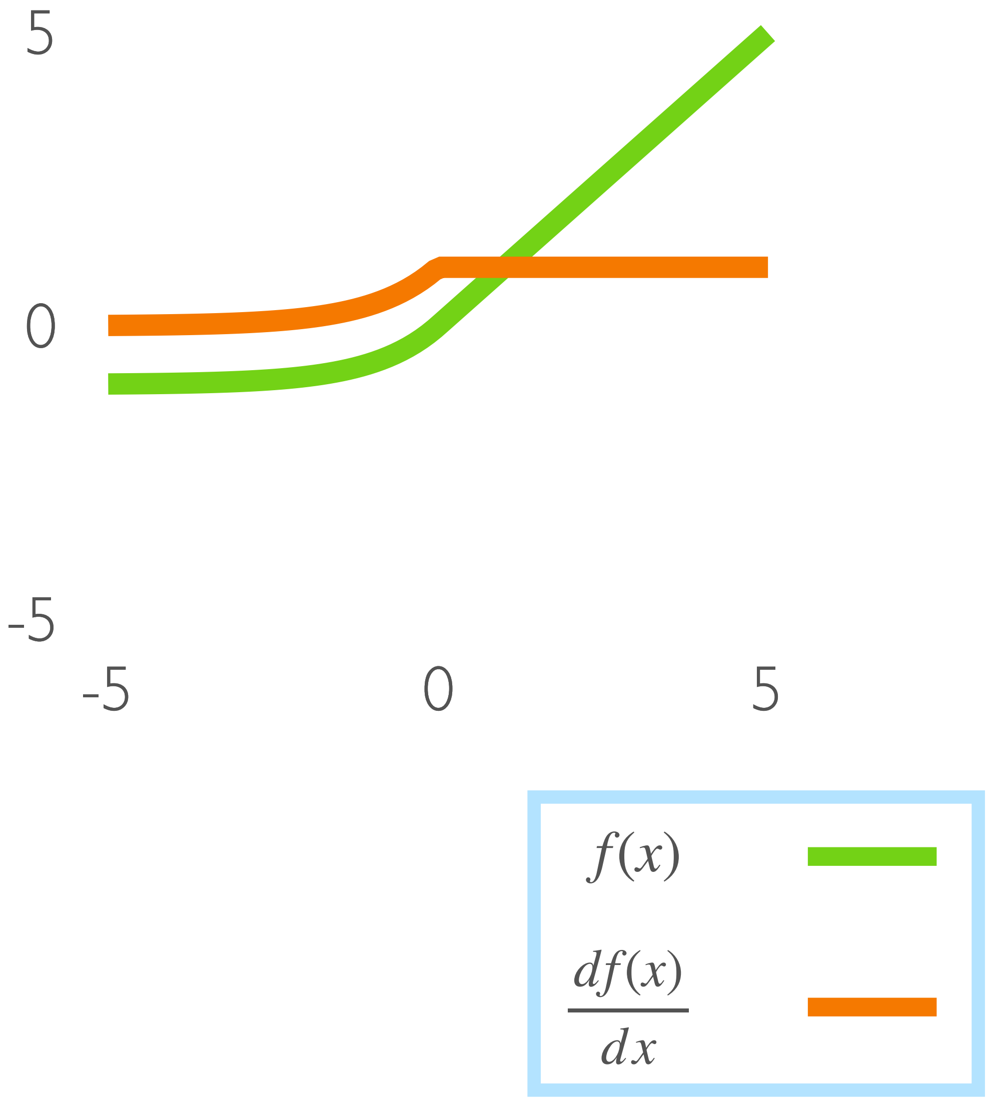
- $\max(x, \alpha x)$
- For $0 < \alpha < 1$
- Called PReLU if α is learned



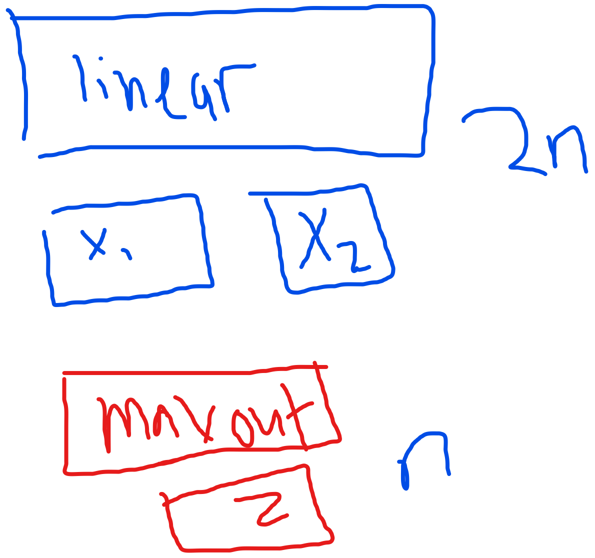
ELU

ELU more expensive to compute

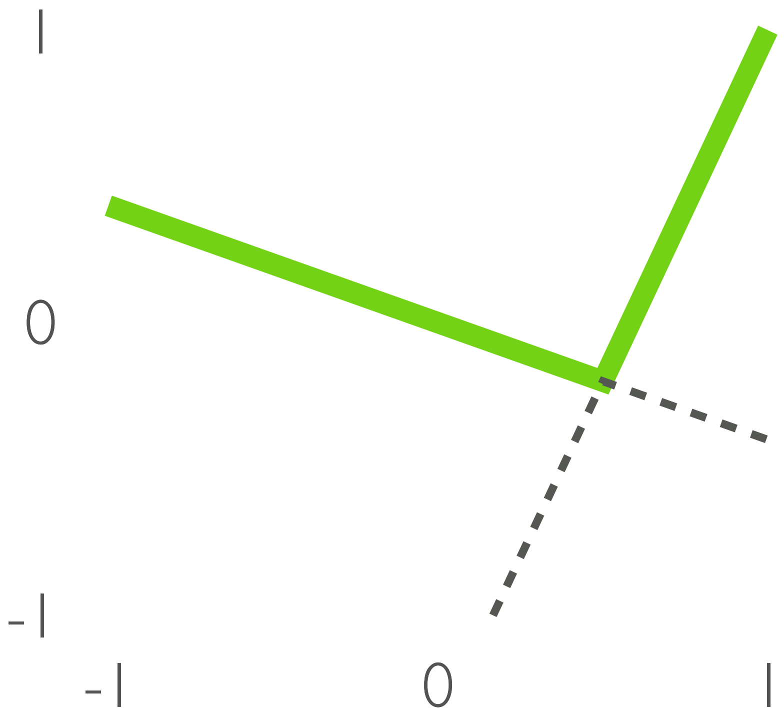
- $\begin{cases} x & \text{for } x \geq 0 \\ \alpha(e^x - 1) & \text{for } x < 0 \end{cases}$



Maxout



- $\max(x_1, x_2)$



Which activation to choose?

- ReLU
  - Carefully initialize
  - Small enough learning rate
- If ReLU fails, try:
  - Leaky ReLU / PReLU
- Avoid sigmoid and tanh