

## CS4780 Lec16 Empirical Risk Minimization

Squared loss  $\ell_2(h_w(x_i) - y_i)^2$  estimates mean  
so not good for scenarios like income prediction one guy with million \$

Absolute loss  $|h_w(x_i) - y_i|$  estimates median  
good for income (outliers)

Not differentiable at zero, so difficult

Huber loss: combines above two

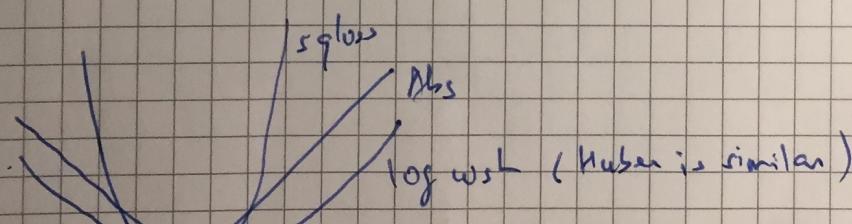
$$\begin{cases} \frac{1}{2}(h(x_i) - y_i)^2 & \text{if } |h(x_i) - y_i| \leq \delta \\ \delta(|h(x_i) - y_i| - \frac{\delta}{2}) & \text{otherwise} \end{cases} \Rightarrow \text{makes quadratic around zero}$$

log-wsh:

$$\log(\text{wsh}(h(x_i) - y_i))$$

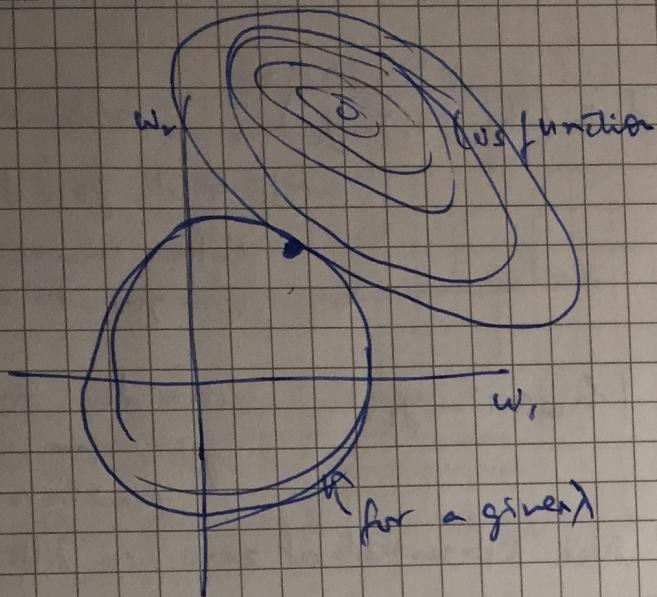
- differentiable everywhere

$$\text{cosh}(u) = \frac{e^u + e^{-u}}{2}$$



Regularization:

$w^T w$  with this constraint minimize loss.



minimize loss function  
but  $w, w_r$  must  
lie in this circle