

$$\text{Pick } \lambda = \frac{|d|}{|d| + |V|}$$

$$\hat{p}(w|d) = \lambda \frac{tf_{w,d}}{|d|} + (1 - \lambda) \frac{1}{|V|}$$

$$= \left(\frac{|d|}{|d| + |V|} \right) \frac{tf_{w,d}}{|d|} + \left(\frac{|V|}{|d| + |V|} \right) \frac{1}{|V|}$$

$$= \frac{tf_{w,d}}{|d| + |V|} + \frac{1}{|d| + |V|}$$

$$= \frac{tf_{w,d} + 1}{|d| + |V|}$$