

# The Polynomial Kernel

The **Polynomial Kernel** in the previous sleep vs. happiness example

$$K(a, b) = (a \cdot b + r)^d \quad \text{where } r \text{ is the coefficients and } d \text{ the degree}$$

we set  $r = \frac{1}{2}$  and  $d = 2$ :

$$\begin{aligned} (a \cdot b + \frac{1}{2})^2 &= (a \cdot b + \frac{1}{2})(a \cdot b + \frac{1}{2}) \\ &+ a^2b^2 + \frac{1}{2}ab + \frac{1}{2}ab + \frac{1}{4} \\ &= \boxed{ab + a^2b^2 + \frac{1}{4}} = \underbrace{(a, a^2, \frac{1}{2}) \cdot (b, b^2, \frac{1}{2})}_{\text{dot product}} \end{aligned}$$

gives us the high dimensional coordinates for the data



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$$(a, a^2, \frac{1}{2}) \cdot (b, b^2, \frac{1}{2})$$

