Support Vector Machines
Homework 02

Due February 17, 2016

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Problem 3.2

number	property	name
1	$q(\vec{a}+\vec{b}) = q\vec{a} + q\vec{b}$	distributivity I
2	$(p+q)\vec{a} = p\vec{a} + q\vec{a}$	distributivity II
3	$p(q\vec{a}) = (pq)\vec{a}$	associativity
4	$1\vec{a} = \vec{a}$	identity

1. Consider the i^{th} element of $\vec{a}+\vec{b}$: $q(a_i + b_i) = qa_i + qb_i$. Since scalar multiplication distributes the same $\forall a_i \in \vec{a}$, the property $q(\vec{a}+\vec{b}) = q\vec{a} + q\vec{b}$ follows $\square$

2. consider the i^{th} element of $\vec{a}$: $(p+q)a_i = pa_i + qa_i$. Since scalar multiplication distributes the same $\forall a_i \in \vec{a}$, the property $\vec{a}$, $p\vec{a} + q\vec{a}$ follows $\square$

3. consider the i^{th} element of $\vec{a}$: $p(qa_i) = (pq)a_i$. Since scalar multiplication distributes the same $\forall a_i \in \vec{a}$, the property $p(q\vec{a}) = (pq)\vec{a}$ follows $\square$

4. consider the i^{th} element of $\vec{a}$: $1(a_i) = a_i$. Since scalar multiplication distributes the same $\forall a_i \in \vec{a}$, the property $1\vec{a} = \vec{a}$ follows $\square$

Problem 3.4

$$\begin{gathered}
\vec{w} \cdot \vec{x} = b \\
\vec{w} \cdot \vec{x} - b = 0 \\
\sum_{i=1}^{n} w_i x_i - b = 0 \\
\sum_{i=1}^{n+1} w_i x_i = 0
\end{gathered}$$

Where $w_{n+1} = -1$ and $x_{n+1} = b$. Representing our sum as a vector, we are left with a new form $\vec{w} \cdot \vec{x} = 0$ that is equivalent to $\vec{w} \cdot \vec{x} = b$, with our bias unit b fixed inside of $\vec{x}$. Now $\vec{w}$ is clearly orthogonal to $\vec{x}$ by the definition of orthogonality ($\vec{w} \cdot \vec{x} = 0$). $\square$.