Combinatorial Geometry, Learning and Algorithms **Caltech CS101.1 (units 3-0-6), Winter 2009.**
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Problem set 4 **Out Wednesday February 18.**

Oral (due Wednesday February 25):

1. 10.1.5
2. 10.2.1 (Note: two sets in the plane are isometric if one is carried to the other by translation, reflection and rotation.)

Written (due Monday March 2):

1. 8.1.2
2. 8.2.1
3. 10.1.2
4. A homothety in $\mathbb{R}^2$ is a mapping $h_{a,y} : \mathbb{R}^2 \to \mathbb{R}^2$ (a is a nonzero real, and $y \in \mathbb{R}^2$), which has the form $h_{a,y}(x) = ax + y$.

   For a centrally symmetric convex body $C \subset \mathbb{R}^2$, let H_C be the set of homothetic images of C, i.e., $H_C = \{h_{a,y}(C)\}$. Show that VCdim$(H_C) \leq 3$. [5 pts]
5. *Fault-tolerant Caratheodory Theorem.* Let conv S denote the convex hull of a set S. For $S \subseteq \mathbb{R}^2$ let interior $(S) = \bigcap\{\text{conv}\, T : \ T \subseteq S, |S - T| \leq 1\}$. Show that for any finite $S \subseteq \mathbb{R}^2$ and $x \in$ interior S, there is a $U \subseteq S$ with $|U| \leq 6$ and $x \in$ interior U. [5 pts]