**HW5 – Theory + SVM**

1. PAC Learning and VC dimension (30 pts)

Let . Let   
, for ,

the set of all origin-centered rings.

* 1. (8 pts) What is the ? Prove your answer.
  2. (14 pts) Describe a polynomial sample complexity algorithm that learns using . State the time complexity and the sample complexity of your suggested algorithm. Prove all your steps.

In class we saw a bound on the sample complexity when is finite.  
When is infinite, we have a different bound:

* 1. (8 pts) You want to get with 95% confidence a hypothesis with at most 5% error. Calculate the sample complexity with the bound that you found in b and the above bound for infinite . In which one did you get a smaller ? Explain.

1. VC dimension (20 pts)

Let and .

Define “x-node decision tree” for any to be a full binary decision tree with x nodes (including the leaves).   
Let be the hypothesis space of all “x-node decision tree” with .

* 1. (5 pts) What is the ? Prove your answer.
  2. (15 pts) What is the ? Prove your answer.

1. Kernels and mapping functions (25 pts)
   1. (20 pts) Let be a function over (i.e., ).

Find for which is a kernel. (It may help to first expand the above term on the right-hand side).

* 1. (2 pts) What did we call the function in class if we remove all coefficients?
  2. (3 pts) How many multiplication operations do we save by using versus ?

1. Lagrange multipliers (15 pts)

Let . Find the minimum and the maximum points for under the constraint .

1. See notebook exercise (10 pts)