CS 156a Problem Set #3

1. where

The least number of examples from the given choices is 1000 so [b].

2. where

The least number of examples from the given choices is 1500 so [c].

3. where

The least number of examples from the given choices is 2000 so [d].

4. The break point is the amount of points that cannot be shattered by a separating plane. Starting with the breaking point of the 2D case, four points with any combination of +1 or -1 can be shattered by a plane in 3D. However, when we take the case with five points, we run into some problems. Take a pyramid for example, if the opposite corners diagonally of the base are +1 and the rest of the points are -1, there is no way to separate this condition with a plane. A plane cannot shatter a set of five points. With this counterexample, the answer is [b].

5. Explanations for why each growth function is valid or not:

i. This is a valid growth function. It is the given function for positive rays.

ii. This is a valid growth function since it is polynomial and less than 2­N.

iii. This is not a valid growth function. It is dependent on the square of N which is not polynomial.

iv. This is not a valid growth function since 2Nis the only valid non-polynomial growth function.

v. This is a valid growth function. It is a given function for convex sets.

So, the answer is [b].

6. The smallest break point can be calculated by the different sections of +1 and -1. Since there are two arbitrarily chosen intervals, h(x) can have five different sections. Since h(x) will be -1 outside the first interval to the left, outside the second interval to the right, and between the intervals, there will be 4 alternations, including the change from outside the two intervals to within:

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The image above shows the visual representation, as shown in the lecture slides, so k = 5. Thus, the answer is [c].

7. The growth function m­H(N) for the 2-intervals hypothesis set can be made from the choosing the intervals from the N + 1 spots. At first, there are a possible four spots where the four endpoints could be, so we choose from that. Next, we consider the chance where the two intervals overlap exactly, so we choose two spots from the N + 1 spots to create a single interval. At the end, we need to add one in case all the points are the same. Our final function:

The answer is [c].

8. The break point is dependent on the number of intervals. When there is a single interval, we have 3 break points. When there are two break points, there are 5 break points. Every time there is an interval, two alternations are added which adds two to the break point amount. From this, we can deduce:

The answer is [d].

9. The points that are shattered by convex sets are given by the equation mH(N) = 2N, and a triangle has three points. We have N = 3, so 2­3 = 8 points or fewer will be shattered. Thus, the largest number of points from the given options is 7, so the answer is [d].

10. This case is very similar to the positive intervals example. In this case, we must pick the two radii for the circles. We can think of determining the radii from a number line, which makes this case exactly like the positive intervals. We have two circles, so we must choose two points from the N + 1 spots:

The answer is [b].