3. Decision Boundaries

In this problem, we will investigate the decision boundary of different classifiers.

3. (a)

2/2 points (graded)

Consider the function defined over three binary variables: $f(x_1, x_2, x_3) = (\neg x_1 \wedge \neg x_2 \wedge \neg x_3)$.

We aim to find a θ such that, for any $x = [x_1, x_2, x_3]$, where $x_i \in \{0, 1\}$:

$$\theta \cdot x + \theta_0 > 0 \text{ when } f(x_1, x_2, x_3) = 1, \text{ and}$$

$$\theta \cdot x + \theta_0 < 0 \text{ when } f(x_1, x_2, x_3) = 0.$$

If $\theta_0 = 0$ (no offset), would it be possible to learn such a θ?

- Yes
- No ✔

Would it be possible to learn the pair θ and θ_0?

- Yes ✔
- No

Solution:

- Since $\theta \cdot 0 = 0$, it is impossible to obtain $\theta \cdot x + \theta_0 > 0$ for $f(0, 0, 0) = 1$.
- $\theta_1 = \theta_2 = \theta_3 = -1$ and $\theta_0 = 0.5$ is a valid solution.

You have used 2 of 3 attempts

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Answers are displayed within the problem

3. (b-1)

1/1 point (graded)
You are given the following labeled data points:

- Positive examples: $[-1, 1]$ and $[1, -1]$,
- Negative examples: $[1, 1]$ and $[2, 2]$.

For each of the following parameterized families of classifiers, identify which parameterized family has a family member that can correctly classify the above data and find the corresponding parameters of a family member that can correctly classify the above data.

Note: If there is no family member inside the parameterized family that can correctly classify the above data, just enter 0 for all the parameters.

Inside (positive) or outside (negative) of an origin-centered circle with radius r. Enter a scalar for r. If there is no such r, just enter 0.

0 ✔ **Answer:** 0

Solution:

- Any circle that correctly classifies $[-1, 1]$ and $[1, -1]$ would incorrectly classify $[1, 1]$

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

3. (b-2)

2/2 points (graded)
Inside (positive) or outside (negative) of an $[x, y]$-centered circle with radius r.

$[x, y]$: [-0.5,-0.5] ✔ **Answer:** See solution

r: 1.732 ✔ **Answer:** See solution

Solution:

- A valid solution is $[x, y] = [-1, -1], r = 2.1$

Submit You have used 2 of 3 attempts

Answers are displayed within the problem

3. (b-3)

1.0/1 point (graded)
Strictly above (positive) or below (negative) a line through the origin with normal θ. Here we define "above" as $\theta \cdot x > 0$, and define "below" similarly. **Note:** Please enter a list for θ as $[\theta_1, \theta_2]$. If there is no solution, enter $[0, 0]$

[0,0] ✔ **Answer:** [0, 0]

Solution:

- There is no line through the origin that can simultaneously be strictly below $[1, -1]$ and $[-1, 1]$

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

3. (b-4)

2/2 points (graded)
Strictly above (positive) or below (negative) a line with normal θ and offset θ_0. Here we define "above" as $\theta \cdot x + \theta_0 > 0$, and define "below" similarly. **Note:** If there is no solution, enter $\theta = [0, 0]$ and $\theta_0 = 0$.

$[\theta_1, \theta_2]$: [-1,-1] ✔ **Answer:** See solution

θ_0: 1 ✔ **Answer:** See solution

Solution:

- A valid solution is $[\theta_1, \theta_2, \theta_0] = [-1, -1, 0.5]$

Submit You have used 3 of 3 attempts

Answers are displayed within the problem

3. (b-5)

1/1 point (graded)

Which of the below are families of linear classifiers?

(Choose all that apply.)

- [ ] Inside or outside of an origin-centered circle with radius r.
- [ ] Inside or outside of an $[x, y]$-centered circle with radius r.
- [x] Strictly above or below a line through the origin with normal θ. ✔

☑ Strictly above or below a line with normal θ and offset θ_0. ✔

✔

Solution:

- The first two families are nonlinear (circles), and the last two families are linear classifiers (lines).

Submit You have used 1 of 2 attempts

ℹ Answers are displayed within the problem

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☑ [Staff] 3(b-2) number of solutions. 4

? Explanation of wrong answer 3
My answer for 3.(b-4) is wrong, I submitted (theta)->[1,-1] and offset theta as -1.(Posting answer, which obviously is wrong, also deadline has pass...

☑ [Staff] 3. (b-4) The definition of strictly above (positive) or below (negative)

	Hope I am not revealing too much even though I may have the wrong answer. Based on the definition, theta = [1/sqrt(2), 1/sqrt(2)] and theta_0 =...	8
💬	[staff] Solution to 3b-2 We would also like to know how to get these answers.	5
💬	[staff] grader for 3b-4 when one part of my answer is right, can I not get a part grade?	3
💬	3. (b-4) Staff, Can I have a detailed solution for 3. (b-4) ? Thank you	2
☑	Course Provided Solutions to Homeworks? My dumb self saw "Homework due Jun 27, 2019 05:29 IST" and automatically thought it was 5:29 PM. Well, I was wrong, it was AM, and it all locke...	2
?	Staff : 3b - error Hi, when entering the values for x,y, I m getting below error \'ascii\' codec can\'t encode character u\'\\xb7\' in position 1: ordinal not in range(128)	4
?	[Staff] Please check my solution i have entered the right radius but x,y are wrong	2
💬	Type of math What is the general name for the type of math being used in the course so far? Most of this is new to me. Trying to pick it up on the fly but often I...	5
💬	Concerned about the quality here Hi, This is a message to staff mainly. So far the questions were ok, with some small mistakes/vague points here and there. I had a serious proble...	30
💬	b-4 Dear Staff, Could you check my answer for b-4. It seems ok for me. Thanks	1
?	About above/below with signs Do we decide by ourselves which direction should be + or -? Do we have any calculation about sign convention on linear classifiers? Also what ab...	2