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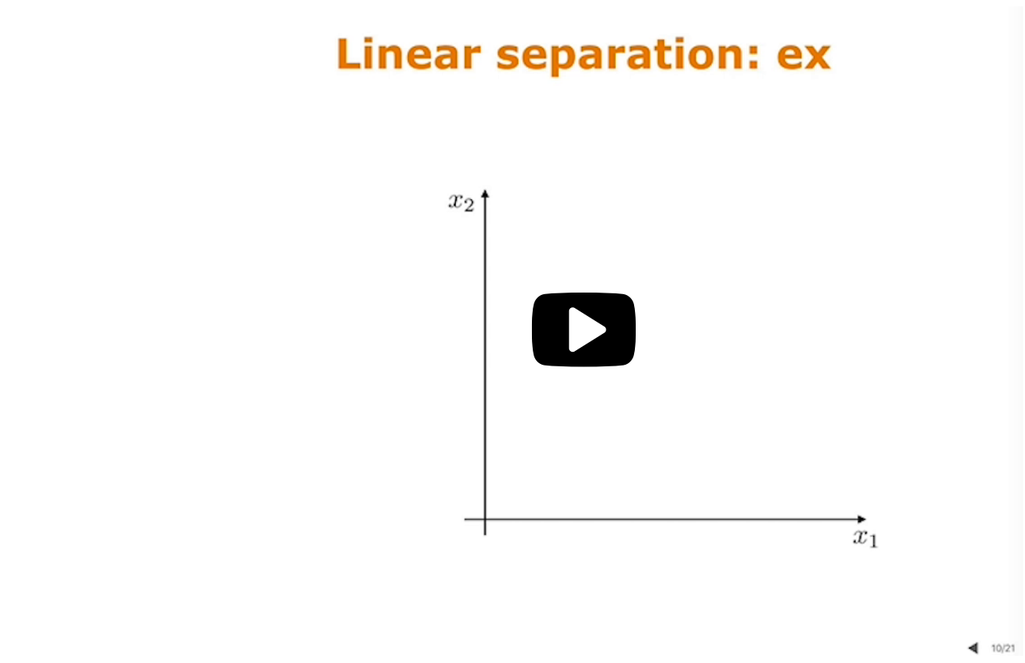
4. Linear Separation
Linear Separation



0:00 / 0:00 Speed 1.50x

Start of transcript. Skip to the end.

Let's understand through examples

how constrained a set of linear classifiers really is.

So if we take a set of examples, the training

set, and ask whether it's separable,

whether there exists a linear classifier that correctly

classifies all the training examples.

If our training set looks like this--

these are positively labeled points

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Given θ and θ_0, a **linear classifier** $h : X \to \{-1, 0, +1\}$ is a function that outputs $+1$ if $\theta \cdot x + \theta_0$ is positive, 0 if it is zero, and -1 if it is negative. In other words, $h(x) = \text{sign}(\theta \cdot x + \theta_0)$.

Basics 1

1/1 point (graded)

As described in the lecture above, h is a linear classifier which is defined by the boundary $\theta \cdot x = 0$ (where theta is a vector perpendicular to the plane.) The ith training data is $(x^{(i)}, y^{(i)})$, where $x^{(i)}$ is a vector and $y^{(i)}$ is a scalar quantity. If θ is a vector of the same dimension as $x^{(i)}$, what are $y^{(i)}$ and sign($\theta \cdot x^{(i)}$) respectively?

- output of the classifier h, label
- label, dimension of the feature vector
- label, distance of the point from the linear classifier
- label, output of the classifier h ✔

Solution:

By definition, $y^{(i)}$ is the label of $x^{(i)}$. Also, by the definition of a linear classifier $h(x)$ =sign($\theta \cdot x^{(i)}$), the output of h is given by sign($\theta \cdot x^{(i)}$).

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

Basics 2

1/1 point (graded)

For the ith training data (x^i, y^i), what values can $y^{(i)}$ take, **conventionally** (in the context of linear classifiers)? Choose all those apply.

- [x] -1 ✔

- [x] $+1$ ✔
- [ ] 0
- [ ] $+10$

✔

Solution:

By the convention of linear classification, because $y^{(i)}$ is a label, it can take -1 or $+1$. Note that 0 is not a possible value.

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

Basics 3

1/1 point (graded)

For the ith training data (x^i, y^i), what values can $sign\,(\theta \cdot x^{(i)})$ take? Choose all those apply.

- [x] -1 ✔
- [x] $+1$ ✔
- [x] 0 ✔
- [ ] $+10$

✔

Solution:

By definition the $sign\,(\theta \cdot x^{(i)})$ function can only take one of $0, -1, +1$ as its value. Remember that a linear classifier outputs one of $-1, 0, 1$.

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

When the Product is Positive

1/1 point (graded)

When does $y^{(i)}\left(\theta \cdot x^{(i)}\right) > 0$ happen? Choose all those apply.

- [x] $y^{(i)} > 0$ and $\theta \cdot x^{(i)} > 0$ ✔
- [ ] $y^{(i)} < 0$ and $\theta \cdot x^{(i)} > 0$
- [ ] $y^{(i)} > 0$ and $\theta \cdot x^{(i)} < 0$
- [x] $y^{(i)} < 0$ and $\theta \cdot x^{(i)} < 0$ ✔

✔

Solution:

$y^{(i)}\left(\theta \cdot x^{(i)}\right) > 0$ is true if and only if $y^{(i)}$ and $\left(\theta \cdot x^{(i)}\right)$ are both positive both negative. In other words, they have the same sign.

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

Intuitive Meanings of Positive Product

1/1 point (graded)

What is the intuitive meaning of $y^{(i)}\left(\theta \cdot x^{(i)}\right) > 0$?

- (•) x^i label and classified result match ✔
- ( ) x^i label and classified result do not match

- x^i is on the boundary of the classifier
- training error is positive

Solution:

$y^{(i)}\left(\theta \cdot x^{(i)}\right) > 0$ is true if and only if $y^{(i)}$ and $\left(\theta \cdot x^{(i)}\right)$ are both positive both negative. In other words, they have the same sign.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

Intuitive Meanings of Negative Product

1/1 point (graded)

What is the intuitive meaning of $y^{(i)}\left(\theta \cdot x^{(i)}\right) < 0$?

- x^i label and classified result match
- x^i label and classified result do not match ✔
- x^i is on the boundary of the classifier
- training error is negative

Solution:

$y^{(i)}\left(\theta \cdot x^{(i)}\right) < 0$ is true if and only if $y^{(i)}$ and $\left(\theta \cdot x^{(i)}\right)$ have different signs.

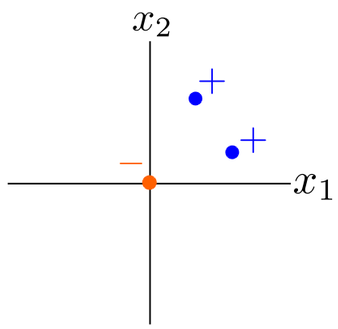
Submit You have used 1 of 1 attempt

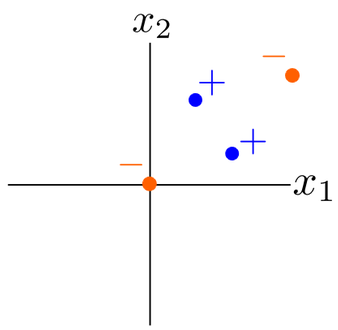
Answers are displayed within the problem

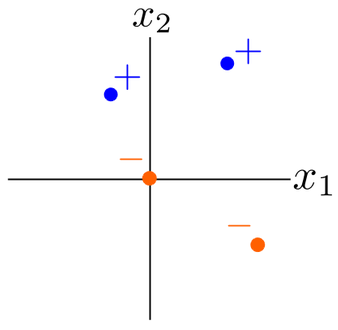
Linear Separation 1

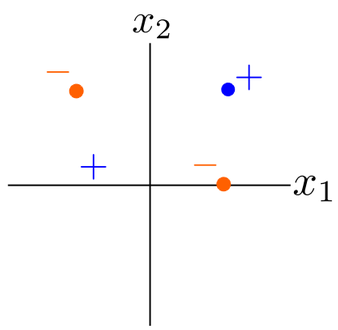
1/1 point (graded)

Of the following, which is linearly separable? Choose all those apply.









✔

Solution:

Linearly separable data can be separated with $+$ labels on one side of the line and $-$ labels on the other side, by some line on the plane.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

Linear Separation 2

1/1 point (graded)

A set of Training examples is illustrated in the table below, with the classified result by some linear classifier h and the label y^i. Is it linearly separable?

	$h\left(x^i\right)$	y^i
example 1	-1	-1
example 2	1	1
example 3	1	1
example 4	-1	-1
example 5	-1	-1

yes ✔

no

Solution:

For linearly separable data, a linear classifier can perfectly separate the data. The provided classifier $h\left(x\right)$ classifies all the given points correctly.

Submit You have used 1 of 1 attempt

Answers are displayed within the problem

Discussion

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Topic: Unit 1 Linear Classifiers and Generalizations (2 weeks):Lecture 2. Linear Classifier and Perceptron / 4. Linear Separation

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[Staff] [Typo] Intuitive Meanings of Negative Product
Community TA 4

[Staff] Basics 2 I was correct
Staff, Please take a look of history of my answers. My first attempt was the correct answer, however it was marked as wrong by the grater. Now that I finish all my 3 attempts I... 2

[Staff]possible typo in the slide 2

Zero is negative or positive?
There is a lot of controversial in this subject. 4

Cannot understand what does the question 2 mean
can anyone explain this to me? my english is not good enough. thanks 4

U1 - L2 - Intuitive Meanings of Negative Product 4

Typo in Basic 1? 3

Basics 2

I am trying to understand why does the question say 'conventionally'. Can anyone please share what is this question trying to ask? 3

Might be a typo 2

In the question "Intuitive Meanings of Positive/Negative Product", would the answer be "y^i label and classified result match /do not match".

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