4. Linear Separation
Linear Separation

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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 $h\left(x\right)$ =sign($\theta \cdot x^{(i)}$), the output of h is given by sign($\theta \cdot x^{(i)}$).

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Answers are displayed within the problem

Basics 2

1/1 point (graded)

For the ith training data $\left(x^i, y^i\right)$, 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.

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Basics 3

1/1 point (graded)

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

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

✔

Solution:

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

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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.

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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.

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ℹ 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.

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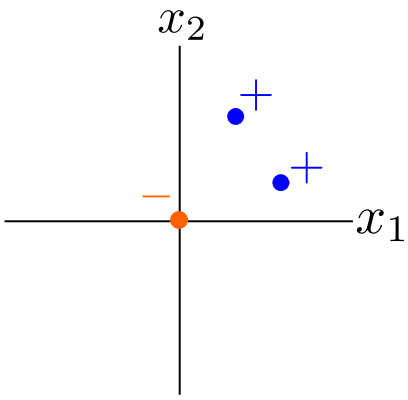
Linear Separation 1

1/1 point (graded)

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


x_2
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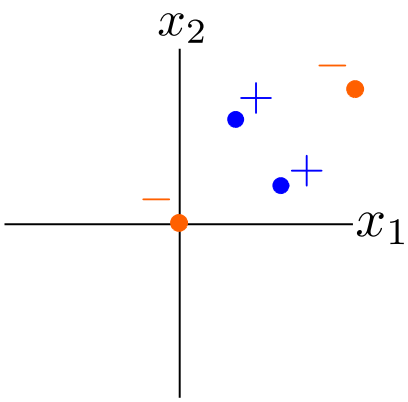
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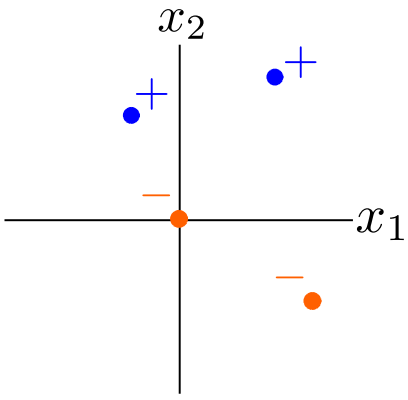
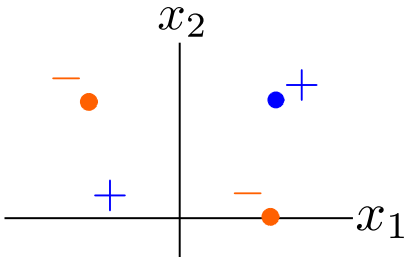

x_2
x_1


x_2
x_1

✔

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.

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? Linear separation and points on the decision boundary 2

Opinion to Linear Separation 2 4

I think there can be a third choice (wrong answer anyway): unknown. It is possible that the ta...

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