CS540 Introduction to Artificial Intelligence
Lecture 1

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Based on lecture slides by Jerry Zhu, Yingyu Liang, and Charles Dyer

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Socrative

Admin

- Download the Socrative App or go to the Socrative.
- Use Room CS540C log in with wisc ID.
- Choose "D" for the first question Q1.
- If you cannot login, private message to the person named "Questions" (also me).

Lecture Format

Admin

- Pre-recorded lectures will be posted on the course website.
- University-assigned lecture time will be used to go over examples and for participation quizzes.
- The remaining lecture time will be used as office hours.

Lecture Recording

Admin

- These BBCU sessions will not be recorded.
- All course materials will be covered in the pre-recorded lectures on YouTube.
- The screen shots of the examples and quiz questions will be posted.
- Use these sessions either as a review or preview of the materials of the week.

Grading

Admin

- Quizzes: best 10 of ~~12~~ 24 or double exam weights.
- Math homework: best 10 of 10 + 2.
- Programming homework: best 5 of 5 + 1.
- Exams: one midterm and one final, 10 points each.

Quizzes

Admin

- Download Socrative, the room number is CS540C.
- Default login for Socrative is your wisc email ID.
- If someone else tries to hack your account, please email or private post on Piazza.
- Quiz questions can show up any time during the lecture.
- Missing one or two questions due to technical difficulty is okay.
- If you select obviously false answers, you might lose points.

Socrative Test

Quiz

CS540C

- A: Don't choose this
- B: Don't choose this
- C: Don't choose this
- D: Choose this
- E: Don't choose this

Math Homework

Admin

- Officially: due in 1 week Sunday.
- Unofficially: any time before the midterm or the final.
- Auto-graded: submit the output on Canvas.

Programming Homework

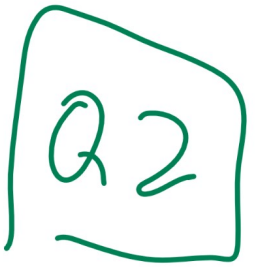
Admin

- Officially: due in 2 weeks Sunday.
- Unofficially: any time before the final.
- Solution: posted in 1 week Sunday.
- Auto-graded: submit the output on Canvas.
- Code: any language.

P1 - P6

Favorite Programming Language

Quiz



- What is your favorite programming language (choose one)?
- A: Java
- B: Python
- C: Matlab
- D: C++
- E: Other

Midterm and Final

Admin

- Synchronous exam: morning and evening one, choose one to take.

Textbook

Admin

- Lecture slides and videos will be sufficient.
- RN is a good background reading, does not cover everything.
- SS is very theoretical, useful if you are planning to take 760, 761, 861.

Questions

Admin

- Questions?
- Raise your hand, or just interupt me.
- Private message to the person named "Questions".
- Do not message me.

Is This Face Real

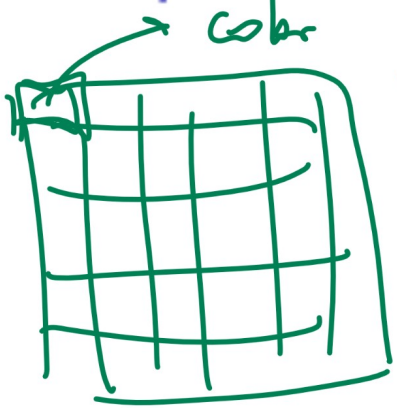
Quiz

Q3 - Q6

- Which face is real?
- A: Left
- B: Right
- C: Do not choose this
- D: Do not choose this
- E: Do not choose this

Supervised Learning Example 1

Motivation



RGB

0~255

$\frac{1}{3}(R+G+B)$

255

Data	images of cats and dogs
Features (Input)	height, length, eye color, ...
	pixel intensity
Output	cat or dog

Linear Classifier

Motivation

- One possible guess is in the form of a linear classifier.

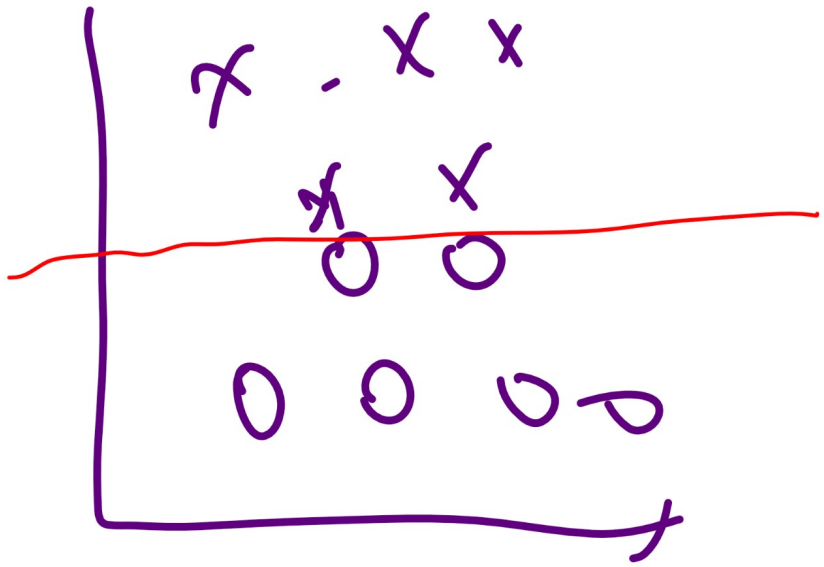
$$\begin{aligned}\hat{y} &= \mathbb{1}_{\{w_1x_1+w_2x_2+\ldots+w_mx_m+b\geqslant 0\}} \\ &= \mathbb{1}_{\{w^Tx+b\geqslant 0\}}\end{aligned}$$

- The $\mathbb{1}$ (open number 1) is the indicator function.

$$\mathbb{1}_E = \begin{cases} 1 & \text{if } E \text{ is true} \\ 0 & \text{if } E \text{ is false} \end{cases}$$

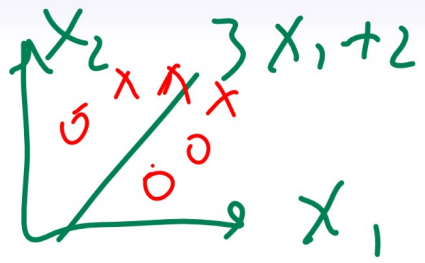
Brute Force LTU Learning

Motivation



Perceptron Algorithm

Description



$w_1 x_1 + w_2 x_2 + b = 0$

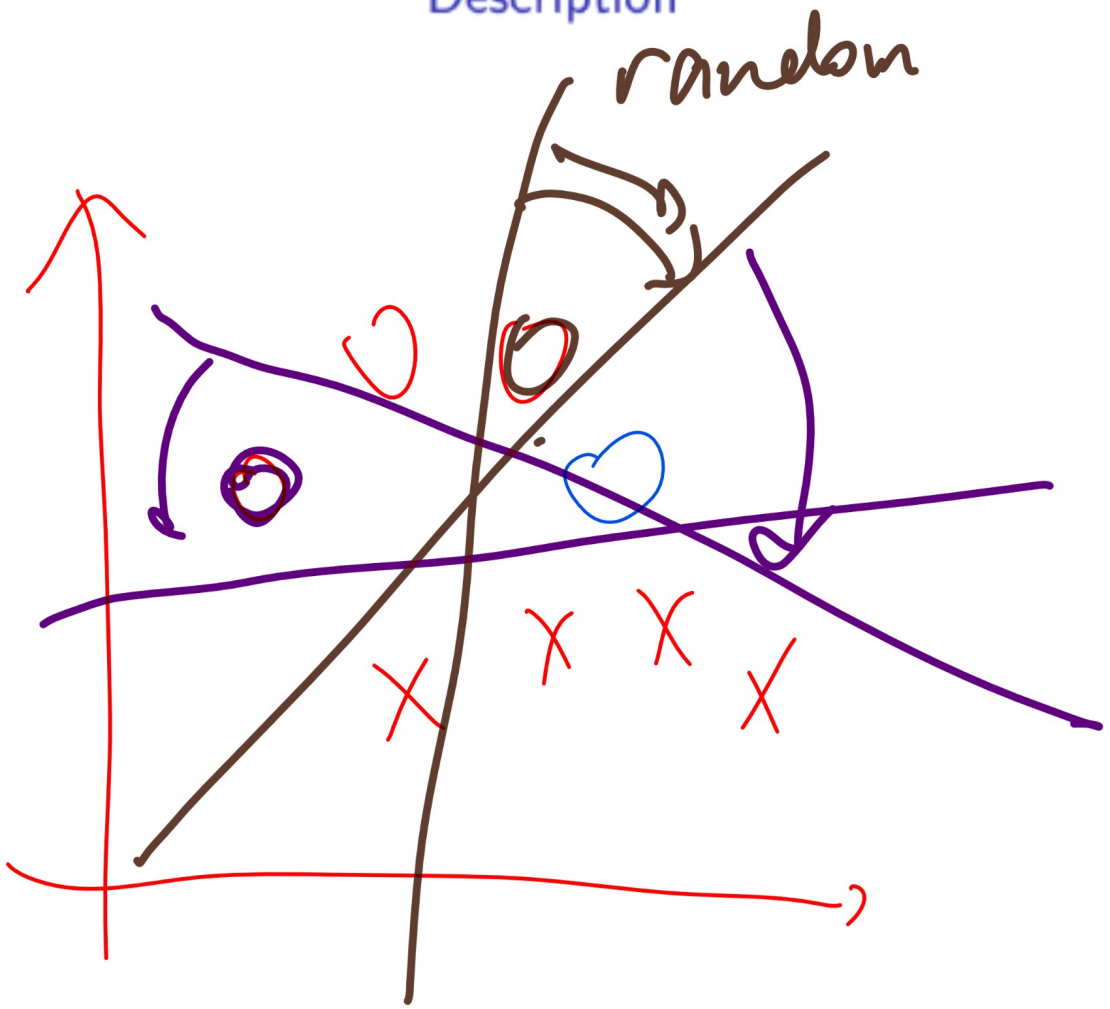
$x_2 = \frac{b}{w_2} - \frac{w_1}{w_2} x_1$

$w \sim [-1, 1]$

- Initialize random weights.
- Evaluate the activation function at one instance x_i to get $\hat{y}_i$.
- If the prediction $\hat{y}_i$ is 0 and actual y_i is 1, increase the weights by x_i.
- If the prediction $\hat{y}_i$ is 1 and actual y_i is 0, decrease the weights by x_i.
- Repeat for all data points and until convergent.

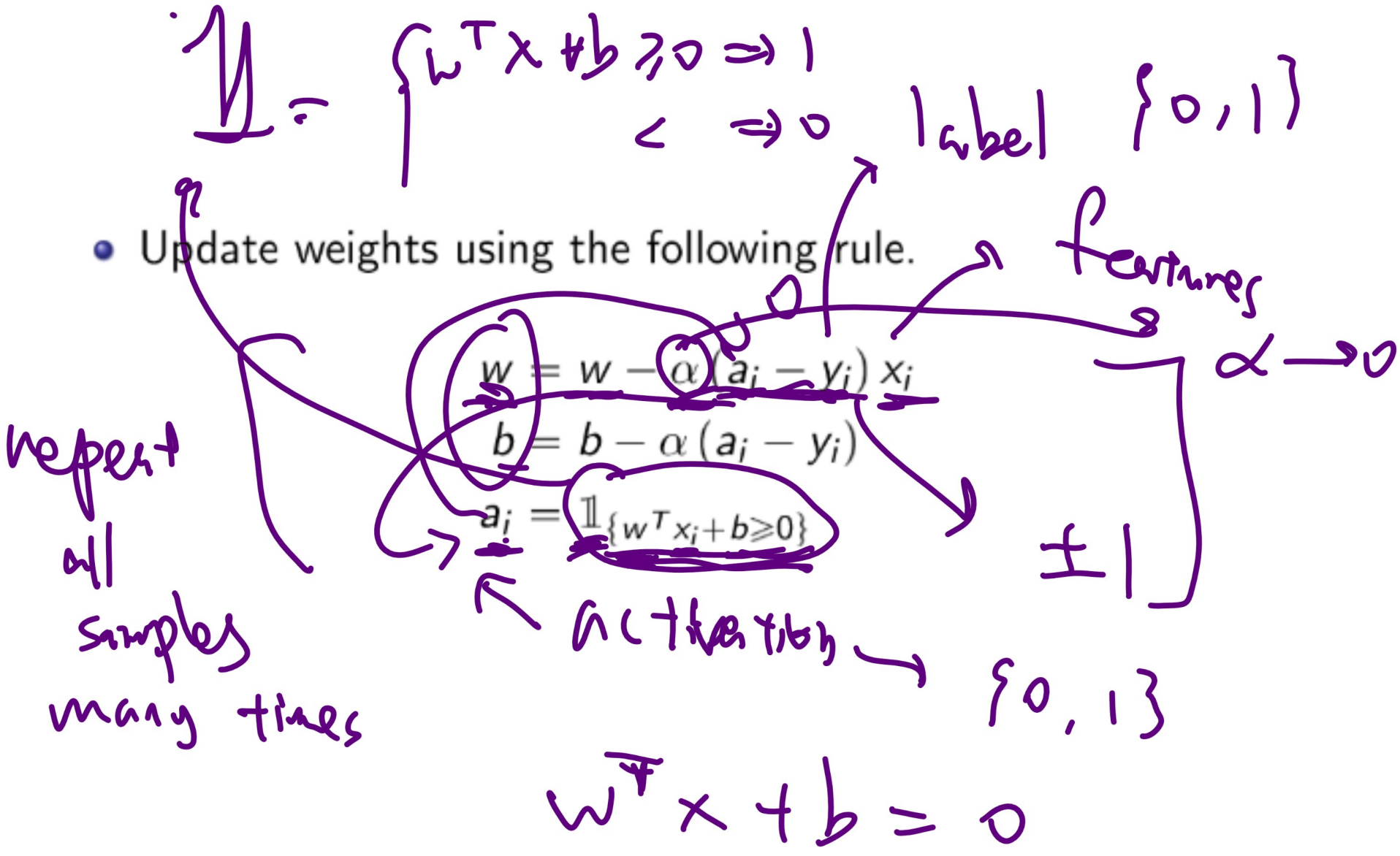
Perceptron Algorithm Diagram, 0 Example

Description



Perceptron Algorithm

Definition



Perceptron Algorithm

Quiz

- Spring 2017 Final Exam Q3
- Let the learning rate be $\alpha = 0.2$. Currently $w = \begin{bmatrix} 0.2 & 0.7 & 0.9 \end{bmatrix}^T$, $b = -0.7$, and $x_i = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}^T$ and $y_i = 0$. What is the updated weights $\begin{bmatrix} w \\ b \end{bmatrix}$?

$$a_i = \mathbb{1}_{\{w^T x_i + b \geq 0\}}$$

$$= \mathbb{1}_{\{(0.2, 0.7, 0.9)\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} - 0.7 \geq 0\}}$$

Perceptron Algorithm, Answer

Quiz

$= \mathbb{1}\{\underbrace{0.9 - 0.7 \geq 0}_{\text{true}}\}$

$= 1$ ← based on w this is classified incorrectly

$$\begin{cases} w = w - \alpha(a_i - y_i)x_i \\ \quad = \begin{pmatrix} 0.2 \\ 0.7 \\ 0.9 \end{pmatrix} - 0.2(1-0)\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} 0.2 \\ 0.7 \\ 0.7 \end{pmatrix} \\ b = b - \alpha(a_i - y_i) = -0.7 - 0.2 = -0.9 \end{cases}$$

Perceptron Algorithm, Another One

Quiz

- Let the learning rate be $\alpha = 0.1$. Currently $w = \begin{bmatrix} 0.2 \\ -0.3 \end{bmatrix}$, $b = 0.4$, and $x_i = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ and $y_i = 1$. What is the updated weights $\begin{bmatrix} w \\ b \end{bmatrix}$?
- A: $\begin{bmatrix} 0.2 \\ -0.3 \\ 0.4 \end{bmatrix}$, $B: \begin{bmatrix} 0.2 \\ -0.2 \\ 0.5 \end{bmatrix}$, $C: \begin{bmatrix} 0.2 \\ -0.4 \\ 0.3 \end{bmatrix}$
- D: $\begin{bmatrix} 0.2 \\ -0.2 \\ 0.3 \end{bmatrix}$, $E: \begin{bmatrix} 0.2 \\ -0.4 \\ 0.5 \end{bmatrix}$

Q7

$a_i = 1$

$a_i = \mathbb{1}\{w^T x_i + b \geq 0\}$

$w = w - \alpha(a_i - y_i)x_i$

$b = b - \alpha(a_i - y_i)$

$(0.2, -0.3)\begin{pmatrix} 0 \\ 1 \end{pmatrix} + 0.4$

$(-0.3 + 0.4) \geq 0$

Perceptron Algorithm, Another One, Answer

Quiz