

$$W_0 = 0$$

AIN SHAMS UNIVERSITY FACULTY OF ENGINEERING

Specialized Credit Hours Engineering Programs
Mechatronics Engineering Program



Midterm – Spring 2023

Course Code: CSE473

Time allowed: 60 mins.

Computational Intelligence

The Exam Consists of THREE Questions in ONE Pages.

Maximum Marks: 20 Marks 1 / 1

Important Rules:

- Having a "turned ON" mobiles inside the examination hall is forbidden and is considered as a cheating behavior. If you should have your mobile with you, it must be turned off in your own bag.
- Any kind of devices with wired/wireless connectivity is forbidden.
- It is forbidden to have any materials even if it is not related to the exam content with you in the examination hall.
- Clarify your answer with all data, sketches, and annotations.

تعليمات هامة

- حيازة التليفون المحمول مفتوحا داخل لجنة الامتحان يعتبر حالة فشل تستوجب العقاب وإذا كان ضروري الدخول بالمحمول فيوضع مغلق في الحقيبة.
- لا يسمح بدخول الأجهزة أو الملحقات ذات خاصية الإتصال السلكي/اللاسلكي.
- لا يسمح بدخول أي كتب أو ملازم أو أوراق داخل اللجنة والمخالفة تعتبر حالة فشل.
- وضح جميع إجاباتك بذكر كافة المعلومات والأعداد اللازمة.

Try All Questions and Assume Any Missing Information

Question 1:

[5 Marks: 3 + 2]

For the binary classification problem using a linear classifier:

- Derive and write an expression for the closed form solution of the least squares training loss assuming a regularization term that is proportional to $(||W||^2)$ where W is the weighting coefficient parameters vector.
- Show the disadvantages of overfitting in the training process.

Question 2:

[10 Marks]

Given an eight labelled vectors data set shown in the opposite table: -

- Use the gradient descent optimization, estimate the parameters of a linear classifier system using the logistic regression criterion. You must visualize the steady state classification boundary.
- Use the gradient descent optimization, estimate the parameters of a linear classifier system using the SVM criterion. You must visualize the steady state classification boundary.

| i | x ₁ | x ₂ | y |
|---|----------------|----------------|----|
| 1 | 0 | 0 | -1 |
| 2 | 6 | 0 | -1 |
| 3 | 0 | 10 | -1 |
| 4 | 6 | 10 | +1 |

In both cases, initialize the weighting coefficients vector by zeros.

Question 3:

[5 Marks]

Solve the following optimization problem:

$$\text{Min } ((w_1)^2 + (w_2)^2) / 2$$

$$\text{S.t. } f(-1, -1) = -3 \text{ \& } f(-1, 1) = -1 \text{ \& } f(1, -1) = -1 \text{ \& } f(1, 1) = 1$$

Where $f(x_1, x_2) = [x_1 \ x_2 \ 1] * [w_1 \ w_2 \ w_0]^T$. You need to find $[w_1 \ w_2 \ w_0]^T$. What are the corresponding Lagrange's parameters?

END of Exam, Good Luck

Examination Committee

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Engineering Department.

Exam. Date : 3rd of April, 2023