Projet 1 :

Microsoft Office – Word

# Partie 1 : Mise en page

Computer science is a dynamic and multifaceted field that underpins nearly every aspect of our modern world. It is the study of algorithms, data structures, and the processes of computation, with a focus on the design, development, and analysis of software and **hardware1** systems. Computer science encompasses a vast array of topics, from programming languages and artificial intelligence to network security and database management. At its core, computer science is about problem-solving, utilizing logical and algorithmic thinking to address a wide range of challenges, from developing cutting-edge software applications to *optimizing* complex business processes2. This discipline has revolutionized the way we live, work, and communicate, shaping the very fabric of our digital age.

It has enabled remarkable innovations, such as the Internet, mobile computing, and machine learning, that have transformed industries, enriched our daily lives, and expanded the horizons of human knowledge. Computer science is not just a scientific and technological endeavor; it is a creative and ever-evolving journey that continues to push the boundaries of what is possible in our increasingly interconnected and data-driven world.

As the foundation of the information age, computer science holds the key to unlocking countless opportunities for innovation, problem-solving, and progress in the years to come.

Here are six important features of computer science:

* Algorithmic Thinking
  + Organigramme,
  + Structures,
* Abstraction
  + Example, high-level programming,
* Data Structures
  + Table,
  + Files,
* Programming
  + C,
  + Python
* Hardware and Software
* Interdisciplinary Nature

1 HW

2 Also called BI

# Partie 2 : Tables.

Table 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Matricule** | **Nom** | **Prénom** | **Date de naissance** |
| 222331706307 | AHMED | Sofiane | 23/04/2002 |
| 222331706307 | KAMEL | Salim | 11/05/2004 |
| 222331706307 | SAIDA | Soltana | 03/07/2003 |

Table 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Evaluation Metrics in % | | | | | | | |
| Dataset | Data split | mAP |  | Recall |  | Precision | |
| Before | After | Before | After | Before | After |
| DS1 | Test Data | 61.12 | 67.67 + | 34.56 | 27.89 | 34.56 \* | 34.56 |
| Vali. Data | 34.56 | 27.89 | 67.67 - | 34.56 | 27.89 | 67.67 |
| DS2 | Test Data | 67.67 | 34.56 + | 27.89 | 67.67 | 34.56 | 27.89 |
| Vali. Data | 27.89 | 22.56 | 34.56 | 27.89 | 27.89 | 34.56 |
| DS3 | Test Data | 34.56 | 27.89 + | 22.56 - | 34.56 | 34.56 \* | 22.56 |
| Vali. Data | 22.56 | 34.56 | 34.56 | 22.56 | 34.56 | 34.56 \* |

Table 3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sys.** | **Technique** | **Complexité** | **Valeur** | |
| **Système A** | Technique 1  Description de la première technique | O(n) | 22 | 23 |
| 45 | 67 |
| 45 | 78 |
| Conclusion 1. | | | |
| **Système B** | Technique 2  Description de la deuxième technique | O(n\*n) | 11 | 13 |
| 15 | 56 |
| 34 | 45 |
| 12 | 16 |
| Conclusion 2. | | | |

# Partie 3: Smart Art

Four key features of machine learning:

Automated

Learning

Generalization

ML

Data-Driven

Adaptability and

Flexibility

Machine learning stages:

data

Model

Verification

Testing

Operation

Continuous Integration (CI) is a software development practice that involves regularly integrating code changes from multiple contributors into a shared repository.

Automated Build and Testing

Code Commit

Feedback and Deploymen t

Integration into Main Branch

# Partie 4 : Forms

Input

Neural Network Model - NN

Step1.

Encoding the behavior of NN in term of linear arithmetic constraints

Use of BigM Method / MIP optimization problem

* Encoding ReLU function,
* Encoding Max-Pooling,
* Encoding Softmax function,

-1

Step2.

Perturbation Bounds

Compute maximum resilience of NN by solving MIP/MIQCP Problem :

* Define the Maximum Perturbation Bounds for m-th classifier
* Define the Perturbation Bounds for NN
* Encode the problem of finding bounds for NN as optimizition problem
* Transform optimization problem into MIP

Partie 5 : Equations

|  |  |
| --- | --- |
| Fonction | Encoding |
| ReLU  𝑥(𝑙) = max (0, 𝑖𝑚(𝑙))  𝑖 𝑖 | Big-M Method  𝑥(𝑙) = max (0, 𝑖𝑚(𝑙)) iff the constaints below holds.  𝑖 𝑖  𝑥(𝑙) ≥ 0 (1)  ﻟ  𝑥(𝑙) ≥ 𝑖𝑚(𝑙) (2)  I 𝑖 𝑖  𝑖𝑚(𝑙) − 𝑏(𝑙) 𝑀(𝑙) ≤ 0 (3)  𝑖 𝑖 𝑖  ❪ (𝑙) (𝑙) (𝑙) (𝑙)  𝑥𝑖 ≤ 𝑖𝑚𝑖 + (1 − 𝑏𝑖 ) 𝑀𝑖 (4)  I  𝗅 𝑥(𝑙) ≤ 𝑏(𝑙) 𝑀(𝑙) (5)  𝑖 𝑖 𝑖 |
| Max-Pooling  𝑥(𝑙) =  𝑖  max(𝑖𝑚1, 𝑖𝑚2) , 𝑤ℎ𝑒𝑟𝑒  𝑖𝑚 = max (𝑥(𝑙−1), 𝑥(𝑙−1))  1 𝑗1 𝑗2  𝑖𝑚 = max (𝑥(𝑙−1), 𝑥(𝑙−1))  2 𝑗3 𝑗4  Please note that in this  work, they used amax pool with 2\*2 filters | Using Big-M Method -if/else statement - they encode the Max-Pooling using the same process as for ReLU encoding.  Thus, they introduced three binary integer variables to encode.(𝑙) =  𝑖  max(𝑖𝑚 , 𝑖𝑚 ), 𝑖𝑚 = max (𝑥(𝑙−1), 𝑥(𝑙−1)) 𝑎𝑛𝑑 𝑖𝑚 =  1 2 1 𝑗1 𝑗2 2  max(𝑥(𝑙−1), 𝑥(𝑙−1)). Following the same process of encoding 𝑦 =  𝑗3 𝑗4  max (𝑥1, 𝑥2) |
| Max-Pooling  𝑥(𝐿−1)  𝑓 (𝑥(𝑙)) = 𝑒 𝑖  𝑖 (𝐿−1)  𝑥  ∑𝑗=1,……, 𝑒 𝑗 | Since the 𝑒 cannot be encoded into linear MIP, they propose to omit  the output layer (L) and rewrite the property by replacing each 𝑥𝑙 by  𝑖  𝑥(𝑙−1)  𝑖  The ide is :  If : 𝑥(𝑙) ≥ 𝛼𝑥(𝑙) 𝑤ℎ𝑒𝑟𝑒 𝛼 𝑖𝑠 𝑎 𝑐𝑜𝑛𝑠𝑡𝑎𝑛𝑡 𝛼 > 0  𝑖1 𝑖2  𝑒𝑥(𝐿−1) 𝑒𝑥(𝐿−1)  𝑖1 𝑖2  - (𝐿−1) ≥ 𝛼 (𝐿−1)  ∑ 𝐿 𝑒𝑥𝑗 ∑ 𝐿 𝑒𝑥𝑗  𝑗=1,……, 𝑗=1,……,𝑑  - 𝑥(𝑙−1) ≥ ln(𝛼) 𝑥(𝑙−1)  𝑖1 𝑖2 |
| ArcTanh  𝑓(𝑥) = 𝑡𝑎𝑛−1(𝑥) | To encode *tan*-1 they used a digital signal processing for piece-wise  approximating *tan*-1 with quadratic constants and error bounds – based on the work of [1] 1.  𝑡𝑎𝑛−1 (𝑖𝑚) ≈ 𝜋 𝑖𝑚 + 0.273 𝑖𝑚(1 − |𝑖𝑚|)  4  To remove |𝑖𝑚| they encode case splits between 𝑖𝑚 ≥ 0  and 𝑖𝑚 < 0  To handle the encoding of *tan*-1, the authors used  𝑴𝑰𝓠𝑪𝑷 𝑚𝑖𝑥𝑒𝑑 𝑖𝑛𝑡𝑒𝑔𝑒𝑟 𝑞𝑢𝑎𝑑𝑟𝑎𝑡𝑖𝑐 𝑐𝑜𝑛𝑠𝑡𝑎𝑖𝑛𝑡 𝑝𝑟𝑜𝑏𝑙𝑒𝑚. |

# Partie 6 : Vos Informations

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| Section | Ingenieur Informatique section B |