EMBEDDED AI

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Part A: Topic Description

Artificial intelligence (AI) is at the heart of many innovations today, thanks to its ability to solve complex problems and adapt to a wide range of applications. In the context of the Internet of Things (IoT), AI provides significant added value, particularly by enabling the analysis of behaviors and recurring patterns. However, IoT devices often operate with limited resources in terms of computational power and energy.

Through this course, we explored the foundations of AI and learned how to design models that can adapt to the constraints of these environments. The primary objective was to understand how to balance efficiency and lightweight design while maintaining acceptable performance for practical applications.

Part B: Implementation

The course was accompanied by practical work that allowed us to transition from theory to practice. Each lab was designed to strengthen our skills in developing and analyzing systems based on artificial intelligence. Below is an overview of our work:

First Experiment: Human Activity Recognition

We worked on a dataset collected from nine sensors (accelerometers, gyroscopes, etc.) positioned on different parts of the human body. These sensors measured movements associated with various activities such as lying down, walking, or running. Our task was to design a model capable of predicting the activity based on the data provided by the sensors.

- Utilized tools such as **Scikit-learn** to train machine learning models.
- Prepared and analyzed the data, including normalization and segmentation steps.
- Validated model performance using indicators such as accuracy and confusion matrices.

Second Experiment: Object and Fall Recognition

We also worked on another dataset for specific tasks: the classification of geometric shapes (ellipse, rectangle, triangle) and the detection of events such as falls.

- Using **TensorFlow Lite**, we trained a Convolutional Neural Network (CNN) to identify these shapes and detect falls.

- The process helped us understand the steps involved in training a model, from optimization to result analysis.
- We studied metrics such as loss and accuracy to evaluate the quality of our predictions.

These labs also encouraged us to take a critical look at the results obtained, reflecting on the strengths and limitations of the approaches used.

Part C: Analysis

This course was an enriching experience, combining theory and practice in a balanced way. Here are some key points:

- **Pedagogical Approach:** The practical activities helped bring to life concepts that could sometimes be complex. Using well-established tools such as Python and its libraries facilitated our understanding and helped us develop skills transferable to other projects.
- **Potential Applications:** The methods learned can be applied to a wide range of fields, such as healthcare (patient monitoring), transportation (behavior analysis), and home automation.
- **Impact of Constraints:** Considering hardware constraints, especially in the context of IoT, pushed us to think creatively about solutions to optimize model performance while reducing their footprint.

In conclusion, this course not only allowed us to acquire technical skills in artificial intelligence but also helped us better understand how to adapt these technologies to the realities of embedded systems. These lessons open exciting perspectives for addressing challenges related to AI and IoT, two rapidly growing fields.

Matrice D'évaluation

Skill	Expected	Estimated
Understand the characteristics of supervised and unsupervised learning problems.	4	4
Understand the main basic methods and algorithms to deal with these problems.	4	3
Understand the specificities of AI at the edge.	4	3
Understand The main optimization methods enabling the embedding of AI algorithms.	4	4
Be able to use these methods through Python libraries to solve practical problems with IoT data.	4	3