

### INTEGRATING ACTIVE RETRIEVAL AUGMENTED GENERATION (RAG) AND FINE-TUNING IN LARGE LANGUAGE MODELS FOR MARITIME DATA: A CASE STUDY OF 'AI4SEAS LAW', SPECIALIZING IN MARITIME LAWS

Presentación realizada por Fernando Cañavate





### AI4SEAS LAW

01 Introduction to Ai4seas Labs and Al4seas law

02 Concepts of deep learning applied to language

**O3** RAG and Fine tuning

**O4** Development of an assistant on maritime law

05 Additional services

# CHARACTERISTICS

O1 Chat assistant on updated legislation and presentation of sources.

**O2** Project compliance analysis

**O3** Allows the incorporation of other regulations without retraining.

O4 Both, texts using for training and inquiries made are confidential.

Context is provided in each response.

05





### **EMBEDDINGS**



fuente:Saber HQ



fuente:TFM master IA, Fernando Cañavate



### **TRANSFORMERS AND ATTENTION MECHANISM**





### Esquema red Transfomer original

Mecanismo de atención

fuente:Miguel Sotaquirá. Redes Trasnfomers, el fin de las redes recurrentes



### **RETRIEVAL AUGMENTED GENERATION**



fuente: Ben Lorica, Best Practices in Retrieval Augmented Generation



### FINE TUNING (QLORA)



Fuente: A B Vijay Kuma Parameter Efficient Fine Tuning





## SOLAS PROTOTYPE



Solas 2020, versión en español, web del Ministerio de Transportes y Movilidad sostenible

al4seas

### **SOLAS CHAPTERS** CHAPTER I General provisions CHAPTER VI Carriage of cargoes 0889 ... ..... oading/ Unloading/ **Construction - Subdivision and** Carriage of dangerous CHAPTER II-1 stability, machinery and electrical CHAPTER VII 5 ackaged/ Bulk CHAPTER VIII **Nuclear ships** Fire protection, fire detection **CHAPTER II -2** and fire extinction uclaer Ship Requirement 0 Management for the aafe CHAPTER IX operation of ships -Life-saving appliances and CHAPTER III arrangements Safety measures for CHAPTER X high-speed craft Muster D AR Code of Safe for High-Speed Craft ..... CHAPTER IV Radiocommunications Special measures to enhance CHAPTER XI maritime safety & security 12 1&1 Other Radio CHAPTER V Safety of navigation Additional safety CHAPTER XII measures for bulk carriers 1 Structural strength

## VECTORIZATION

O1 Source: Solas 2020, versión en español, web del Ministerior de Transportes y Movilidad sostenible

Metadata extracted with LLM: Chapter, scope of application, part, and rule

03

02

"Chinking into pages and paragraphs

04

Obtaining embeddings and recording in the database



## FINETUNING

- Generation of the question and answer dataset. For each paragraph, generate 01 a set of questions that would be asked by different roles such as legislation, inspection, engineering, certification, etc.
- If it needs to access the database, it generates the query to be performed 02 and retrieves all contexts taking into account the scope of application.
- $\mathbf{03}$ A training set is composed, consisting of questions and answers accompanied by contextual metadata.
- The dataset is split into training and test sets, and the model is fine-04 tuned using QLORA techniques.



## METRICS

Classic NLP metrics: F1 Exact Match (EM), F1 Score, Bleu Score.

O2 Metrics adapted to large language models that measure consistency, coherence, and understanding of context.



## RETRIEVAL

Prompt engineering: Retrieves the user's query and decides the action to take, which it converts into a JSON, and redirects to the database search or continues using the LLM.

If it needs to access the database, it generates the query to be performed and retrieves all contexts taking into account the scope of application, utilizing a commonly used vector database search algorithm such as Approximate Nearest Neighbors (ANN).

The information received from the database, along with the data generated on the first of the month, and the context of the entire conversation, is used to generate a response.

04

03

01

02

Provides a response to the user, contextualized with the sources retrieved from the database.

# OTHER ONGOING APP SOLUTIONS







# USE CASES

### Regulatory compliance

Assistant that provides clear interpretations of regulations. Analysis of complete projects. 02 Engineering

Assistant to engineers in incorporating IMO standards during the design process.

O4 Automated report generation

Generation of accurate and up-to-date documents that can be presented during inspections and audits. **05** Risk management platforms

Tools that integrate risk analysis and compliance management with IMO regulations.





ai4seas

### USERS \*\*\*

Shipping companies Engineering companies Shipyards Public institutions



![](_page_15_Picture_0.jpeg)

## THANK YOU

Ai4seas Labs, S.L.

![](_page_15_Picture_3.jpeg)

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