Università degli Studi di Messina, Italia
Dipartimento di scienze matematiche e informatiche,
scienze fisiche e scienze della terra

Soggetto: proposta di tirocinio

ID	PTI_Ravi Daniele_14/10/2024 13.01.00
Data	14/10/2024 13.01.00

Supervisore del progetto

Cognome	Ravi
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Co-Supervisore del progetto

Cognome	
Nome	
Posizione	
Dipartimento	

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Laboratorio	
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Dettagli de progetto

Titolo	Application of Deep Learning and Federated Learning Techniques for MRI-Based Neuroimaging: Analysis of Neurodegenerative Diseases and Pathological Progression

Descrizione dettagliata: 1. Context and Motivation:
Neurodegenerative diseases, such as Alzheimer's, Parkinson's disease, and multiple sclerosis, represent a growing challenge for the global healthcare system. Early diagnosis and assessment of disease progression are crucial to improving therapeutic strategies and patient care quality. However, the collection and analysis of medical imaging data, such as magnetic resonance imaging (MRI), can present obstacles to data sharing among medical institutions due to privacy regulations and logistical challenges.

Federated Learning (FL), an innovative paradigm, enables training artificial intelligence models on data distributed across various medical facilities without the need to transfer the data itself. Instead of centralizing data, deep learning algorithms are trained locally, sharing only the learned models (weights). This approach respects patient privacy while harnessing the power of distributed learning, making it particularly suitable for the medical field.

The integration of federated learning with deep learning applied to neuroimaging allows the development of highly performant and generalizable models for the diagnosis and monitoring of neurodegenerative diseases, without compromising the security and confidentiality of patient data.

2. Internship Objectives:
The main goal of this project is to develop a system based on deep learning and federated learning to analyze MRI images, identify early signs of neurodegenerative diseases, and monitor disease progression in already diagnosed patients.

The objectives may include one or more of the following tasks:

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-State-of-the-art analysis: Review current neuroimaging and AI techniques for diagnosing and monitoring neurodegenerative diseases, with a particular focus on deep learning and federated learning applications.

-Development of deep learning models: Design AI models capable of detecting and classifying structural and functional brain abnormalities using distributed MRI data.

-Integration of Federated Learning: Implement federated learning to enable training models on MRI data from multiple hospitals or research centers without the need to centralize the data.

-Model interpretability and transparency: Explore deep learning interpretability techniques to ensure that the results are understandable by physicians.

3. Project Evaluation:

The success of the project will be assessed through the completion of one or more of the following tasks:

-Deep learning model quality: Accuracy and ability of the model to identify early signs of neurodegenerative diseases, evaluated on metrics such as accuracy, precision, sensitivity, and AUC-ROC.

-Federated Learning implementation: The system's ability to handle distributed data securely and effectively. Efficiency and quality of predictions in distributed scenarios will be evaluated and compared with a centralized approach.

-Innovation and clinical impact: Effective use of federated learning as a solution to enhance privacy and collaboration among institutions while improving clinical diagnosis and monitoring of neurodegenerative diseases.

-Interpretability and comprehensibility: The system's ability to provide predictions interpretable by physicians, increasing trust in the model's adoption in clinical settings.

Durata (mesi – max 12)	<<Durata in mesi>>
Durata (ore)	<<Durata in ore>>

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Numero di posizioni aperte	2

Internship Skills

Requisiti tecnici: Machine Learning and Programming

Altri requisiti	