**

**CAPSTONE PROJECT REGISTER**

Class: Duration time: from //2024 to //2024

(\*) Profession: <Artificial Intelligence> Specialty: <ES> <IS> <JS>

(\*) Kinds of person make registers: Lecturer: Students

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**1. Register information for supervisor** (if have)

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|  | **Full name** | **Phone** | **E-Mail** | **Title** |
| Supervisor 1 | Nguyễn Quốc Trung | 0979350707 | trungnq46@fe.edu.vn | Mr. Trung |
| Supervisor 2 | Trương Hoàng Vinh |  | vinh.th@ou.edu.vn | Mr. Vinh |

**2. Register information for students** (if have)

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|  | **Full name** | **Student code** | **Phone** | **E-mail** | **Role in Group** |
| Student 1 | Nguyễn Cao Hoài Sinh | SE151023 | 0822610477 | sinhnchse151023  @fpt.edu.vn | Leader |
| Student 2 | Nguyễn Liêm Trực | SE160880 | 0888573001 | trucnlse161876  @fpt.edu.vn | Member |

**3. Register content of capstone project**

**3.1. Capstone project name:**

English: GradBot - A unified dialogue state tracking and dialogue response model for Task Oriented Dialogues (TOD) and Open Domain Dialogues (ODD)

Vietnamese: GradBot - Mô hình theo dõi trạng thái đối thoại và phản hồi đối thoại thống nhất cho cả đối thoại theo định hướng nhiệm vụ (TOD) và đối thoại chung mọi miền (ODD)

Abbreviation: GradBot

**Description**

The task-oriented dialogue domain system requires classifying intent and replying to a specific goal domain. In the sub-module of Task-oriented, the Dialogue State Tracker (DST) is well-known as a variety processing tracker. However, existing DST models often specialize in only task-oriented domains (ToD), leading to limited performance when applied to scenarios. In this study, we propose GradBot, a unified DST model that predicts both two task types, task-oriented dialogue (TOD) and open-domain dialogue (ODD). Our model leverages the recent advances in prompt engineering and conditional generation to perform zero-shot learning.

**Objectives**

The main aim of this project is to establish a GradBot system that track user state (including intents and actions) through Dialogue State Tracker module and respond with appropriate action through Response Generator module to meet the needs of users both TOD and ODD.

**Proposed Solution**:

**Data Collection**: We use 3 datasets for training:

* Fusedchat Dataset is an essential dataset created by merging TOD and ODD. This amalgamation of ODD and TOD fosters a seamless connection and robust contextual interplay between the two dialogue modes. Hence, this dataset can support the backbone system to accelerate comprehension when dealing with reality. As an extension of the renowned MultiWoz dataset. Fusedchat integrates additional ODD turns either before or after the existing TOD turns, with 3670 and 4768 instances. Besides, due to the noise Fusedchat dataset itself, e.g. redundant domains, and inconsistency values, which were inherited from MultiWoz2.4.
* Schema-Guided Dialogue Dataset (SGD) is the largest multidomains for task-oriented dialogue datasets until now. It spans 45 diverse domains over hotels, banks, events, homes, travel, flights, media, movies, rental cars, and more. Each part continues to split into various forms, e.g., hotels decomposed as hotels\_1, hotels\_2, hotels\_3, and so on. This dataset utilizes 25 domains for training and reuses the identical domains combined with 10 more ones for validation. This large number of dialogues will offset the minor number one in the Fusedchat dataset. The test set also comprises these 35 domains to evaluate the model's zero-shot learning capabilities.
* MultiWoz2.4 Dataset is the last refinement for primarily evaluating metrics on TOD up-to-date. Statistics are the same as preceding MultiWoz versions. Because all annotation updates are refined mainly on the validation set and test set, as well as having large numbers of dialogues spanning many domains, we will use this dataset to evaluate zero-shot abilities and compare our model with other backbones. Though MultiWoz2.4 is built originally from version 2.1, which does not leverage versions 2.2 and 2.3, it still has a renowned publication and has been widely used when evaluating research in recent years.

**Data Processing**: In this phase we convert the original data into interim data, which will train the model. Each sample in iterim data will include two main parts: input model and label. The input model will include a list of user actions (the user's actions that can occur for the model to predict are not outside that list), current user (the content of the user's text at the current turn), context (the entire content of both the user and system’s text before the current user), and the ontology (which contains information about the domain the user and system are talking to, including: domain name, slots belonging to that domain, and descriptions so that the DST module can understand those slots). The label will include: user actions, domains, slots, values extracted from the input model and system response. For example, user input is "I want to book 4 star hotel at District 1", then the label will be "inform>hotel-star-4, inform>hotel-destination-district 1 || CayXanh is a 4 star hotel at District 1. Do you want to book this hotel?"

**Framework Architecture Development:** Building upon prior research in Dialogue State Tracking (DST), we take advantage of Flan-T5's instruction-fine-tuning capabilities as our foundation. Leveraging the checkpoint Flan-T5 model's strength in instruction-based training, we seamlessly integrate Machine Reading Comprehension with detailed task explanations. These instructions, formatted with the aforementioned context, current user, ontology, and list user actions, ensure the model clearly grasps its objectives and execution methods. Flan-T5 stands out as a T5 variant that not only robustly improves the generality of instruction fine-tuning but also boasts zero-shot capabilities. This latter aspect significantly impacted our hybrid dialogue experiments

**Evaluation**: We use 3 metrics for evaluation:

* Joint Goal Accuracy (JGA) is one of the most common metrics used to evaluate the task of dialogue state tracking and is also defined widely as in SGD. With the JGA metric, correct is counted when the belief state prediction exactly matches the truth label. It is also a limitation of these metrics because the label also contains all states of the previous state, which requires the model to predict even slots in previous dialogue turns.
* Slot accuracy (SA) is also another standard metric existing along with joint accuracy. This metric is quite naive and calculated by comparing each tuple (domain, slot, value) with its label correspondingly. However, this can be problematic if the number of slot values scales as in multi-domain circumstances.
* F1 Score is well-known metrics for measuring model's prediction. Because this metric captures both precision and recall, we can ensure whether there is confusion between the dialogue's type of current turn (ODD or TOD) when computing the F1-score for each classes to check.

**Deployment**: As part of the deployment process, we consider the possibility of deploying the GradBot model as a web or local application. This application will connect to our database and leverage the assistance of a the Retrieval System. Users will just need to give a text and the system will respond immediately.

**Continuous Improvement**: Currently our prototype performs quite better than its predecessors from other research groups in the DST field. However, we expect to achieve higher results based on Flan-T5's instruction fine-tuning and zero-shot learning capabilities, so we are continuing to research how to optimize the input model and label or find new training techniques for GradBot to achieve better results in the next version.

**3.2 Main Proposal Content** (Including Results and Products):

**a. Theory and Practice** (Document):

* Key Theory: Unified dialogue state tracking and dialogue response model for TOD and ODD.
* Application of knowledge from previous courses: Students will apply their knowledge acquired from AIG201c, AIP39, AIL302m, DPL301m and NLP301c in the execution of this project.
* Research: The project involves the exploration of machine learning and deep learning models to augment the framework's performance.
* Development: The central focus is on constructing an DST model.
* Utilized Artificial Intelligence Technologies:
  + Framework: PyTorch.
  + Programming Languages: Python.

**b. Products**:

* GradBot - A unified dialogue state tracking and dialogue response model for Task Oriented Dialogues (TOD) and Open Domain Dialogues (ODD).
* A comprehensive research paper detailing the project.

**4. Other comment** (propose all relative thing if have)

* Students are willing to learn new research topics, especially machine learning and deep learning for NLP.
* Students are willing to work hard such as report every week with new progress, read and present knowledge from the documents in the field.
* There is at least one student in the group who has solid background in software engineering for implementing the tool.
* The number of students for this project varies from 2 to 3. The project output may differ depending on this number.

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| **Supervisor (If have)**  *(Sign and full name)* | Ho Chi Minh city, date //2023  **On behalf of Registers**  *(Sign and full name)* |