

A Generic Dialog Agent for Information Retrieval Based on Automated Planning Within a Reinforcement Learning Platform

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Introduction

Finding relevant information in large data sets is often challenging - as one either needs knowledge of query languages or put manual effort. Our work makes use of natural language queries to help the user look for information. A chatbot is designed to assist the user in leading him towards his desired goal using Planning and RL. The user might ask the chatbot, "Give me the code associated with pliers" and our system used RL to identify the relevant data source and use planning approaches to control the conversation flow towards the goal. We show a system which can do this and demonstrate the viability of our approach on large datasets of UNSPSC (D1), ICD-10 (D2), and a small phone directory (D3).

Problem

The research problem is to make information lookup easy and accessible by making use of a chatbot. However, the current approach for building a chatbot is learning based which

- require large training data
- once trained and deployed, there is no control over the flow of conversations
- hard to scale

Contribution

We present a generic and controlled dialog system interleaved with planning and RL for information retrieval. The major contributions are

- Incorporating planning based dialog response generation in a RL based dialog framework.
- Demonstrating a general, planning based approach for creating chatbots for information lookup
- Exploring multiple RL and planning integration strategies.
- Creating a test-bed to evaluate conversations between user and the chatbot

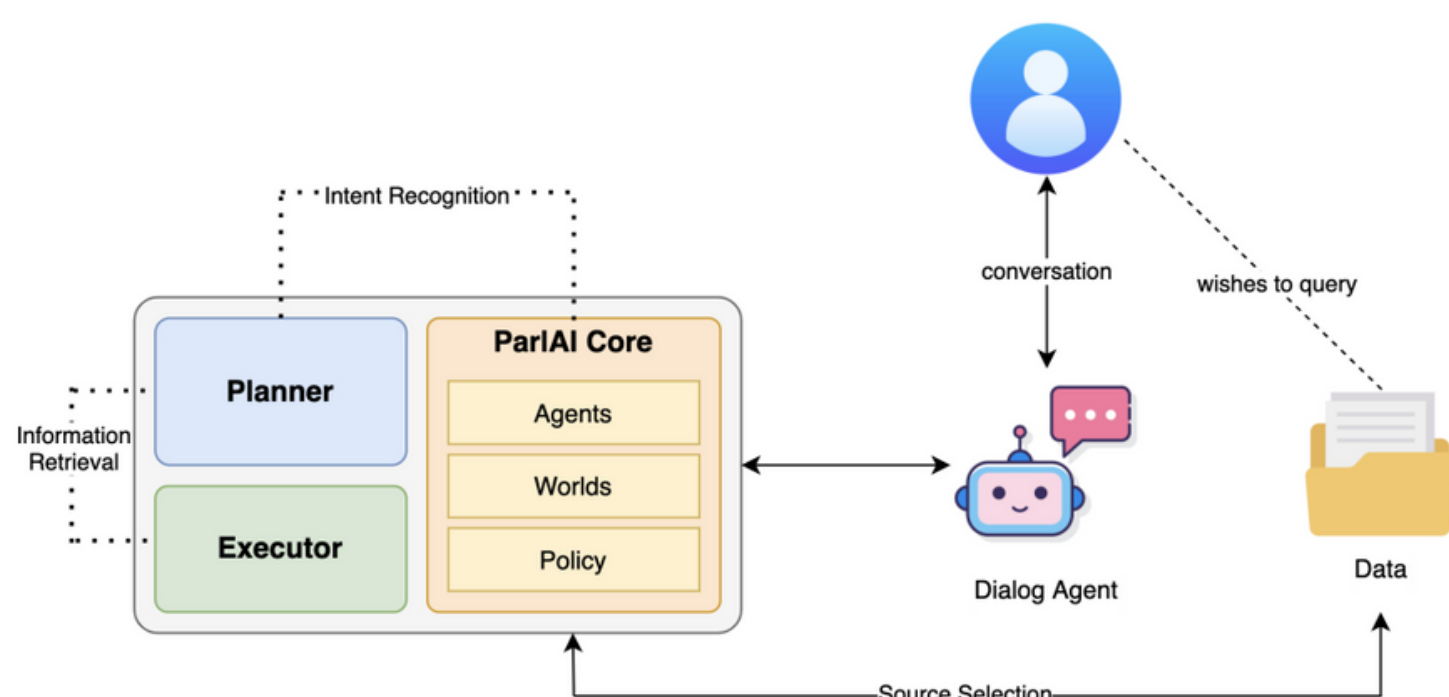


Figure 1. Proposed System Architecture

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Enter [DONE] if you want to end the episode, [EXIT] to quit.
17:35:02 | creating task(s): internal:dpbot
Enter Your Message: hey there!
[DpbotAgent]: hi there
I am DialogPlan, here to help you query a directory (UNSPSC / ICD10).
If you want to exit, type Bye!
Type PROCEED to continue
Enter Your Message: proceed
[DpbotAgent]: Enter your query
Enter Your Message: i want the code for injury of ulnar artery at wrist and hand level
[DpbotAgent]: The code for injury of ulnar artery at wrist and hand level is - S65.0
Do you want to go more specific? Yes/No:
Enter Your Message: yes
[DpbotAgent]: Codes that belong to the category you are looking at:
1. Unspecified injury of ulnar artery at wrist and hand level S65.00
2. Laceration of ulnar artery at wrist and hand level S65.01
3. Other specified injury of ulnar artery at wrist and hand level S65.09

Enter Your Message: 2
[DpbotAgent]: The code for Laceration of ulnar artery at wrist and hand level is - S65.01
Do you want to go more specific? Yes/No:
Enter Your Message: yes
[DpbotAgent]: Codes that belong to the category you are looking at:
1. Laceration of ulnar artery at wrist and hand level of right arm S65.011
2. Laceration of ulnar artery at wrist and hand level of left arm S65.012
3. Laceration of ulnar artery at wrist and hand level of unspecified arm S65.019

Enter Your Message: 1
[DpbotAgent]: The code for laceration of ulnar artery at wrist and hand level of left arm is - S65.012
Do you want to go more specific? Yes/No:
Enter Your Message: Yes
[DpbotAgent]: Codes that belong to the category you are looking at:
1. Laceration of ulnar artery at wrist and hand level of left arm, initial encounter S65.012A
2. Laceration of ulnar artery at wrist and hand level of left arm, subsequent encounter S65.012D
3. Laceration of ulnar artery at wrist and hand level of left arm, sequela S65.012S

Enter Your Message: 2
[DpbotAgent]: You have reached a Billed ICD-10 code
Laceration of ulnar artery at wrist and hand level of left arm, subsequent encounter S65.012D
----- END OF EPISODE -----

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Figure 2. Information Lookup on ICD10.

The user is searching for *laceration of ulnar artery at wrist and hand level*.

Approach

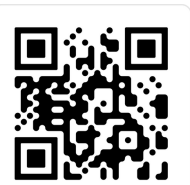
Figure 1 shows main components - ParIAI Core, Planner, and an Executor. The ParIAI core provides the interface for the dialog agent to interact with the user. The Planner, along with ParIAI core, helps in IntentIdentification. The policy learnt helps in automatic source selection based on the user's query. The Planner then generates a plan for the Executor, to perform Information Retrieval from the selected data source. Figure 2 shows the sample conversation between user and the chatbot. The system has been evaluated using various metrics such as accuracy, intent recognition and task length. Figure 3 captures the evaluation of the system.

User Query	Final Bot Response	Task Length	Task Completion
What is the code for lighters?	Lighters is associated with code - 12131707	1	Yes (in-scope)
I want the code for pliers	Surgical pliers is associated with code - 42292303	2	Yes (in-scope)
I want the code for pliers	Jewellers pliers is associated with code - 27112150	3	Yes (in-scope)
Code for taps?	Surgical taps is associated with code - 42292401	2	Yes (in-scope)
What is the code for nut cracker?	Nut cracker isn't present in the data-source.	1	No (out-of-scope)
Get me the code for hammers?	Claw Hammers is associated with code - 27111618	2	Yes (in-scope)
I want the code for injury of deep palmar arch	The code for injury of deep palmar arch is - S65.3	1	Yes (in-scope)
I want the code for injury of deep palmar arch	You have reached a Billed ICD-10 code. Laceration of deep palmar arch of unspecified hand, initial encounter S65.319A.	6	Yes (in-scope)
What is the code for heart attack?	Heart attack isn't present in the data-source.	1	No (out-of-scope)
What is the code for acute myocardial infarction?	The code for acute myocardial infarction is - I21	1	Yes (in-scope)
What is the phone number for Adam?	Adam's phone number is +1-902-453-xxxx	1	Yes (in-scope)
What is the phone number for John?	John is not present in the directory. Do you want to add his number?	1	No (out-of-scope)

Figure 3. System Evaluation

Future Work

- The future steps involve
- Exploring more interleaved RL and Planning strategies for dialogs
 - Performing a comprehensive evaluation of the approach.



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