GUC BERLIN

Artificial Intelligence

Project

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1 Abstract

Text-based adventure games have recently emerged as a new challenge for creating an agent that can understand natural language and act intelligently in text-described environments. In this paper, a chatbot was developed to play a text based game. when a person talks with it, 3 categories of feeling are checked and by knowing those feelings and knowing the feeling of the person who plays the game the chatbot knows how to interact with the player and knows how to navigate with him in the map as the chatbot agent knows his environment (Top-down-right-left).The chatbot has the ability to navigate the player through the map and helps him escape from the map without using visualisation as it is a text based game.

2 Introduction

In the early days of graphical displays, text adventures were one of the few game genres that owed their existence exclusively to computers. The first text adventure was Colossal Cave (also known as Adventure), written in 1976 by Will Crowther for the PDP-10.[**?**]. In this game with the aid of AI technique of depth first search a chatbot was developed. This system is autonomous. Moreover, the system is a goal based agent that reaches its goal.while if it was a utility based agent the time aspect would be taken into consideration.

Background

3 Artificial Intelligence

Artificial intelligence (AI) has been defined in a number of ways over the last few decades, but John McCarthy defines it as ”the science and engineering of creating intelligent machines, particularly intelligent computer programs.”However, the birth of the artificial intelligence debate was marked decades before this definition by Alan Turing’s seminal work, ”Computing Machinery and Intelligence.” Turing, known as the ”Father of Computer Science,” poses the question, ”Can machines think?” in this paper. From there, he proposes the ”Turing Test,” in which a human interrogator attempts to distinguish between a computer and a human text response. While this test has been heavily scrutinized since its publication, it remains an important part of the history of AI as well as an ongoing concept within philosophy due to its use of linguistic ideas. Stuart Russell and Peter Norvig then went on to publish Artificial Intelligence: A Modern Approach, which quickly became one of the leading textbooks in the field of AI research. In it, they delve into four potential AI goals or definitions, distinguishing computer systems based on rationality and thinking vs. acting:

1. Human approach:
    (a) Systems that think like humans
    (b) Systems that act like humans
2. Ideal approach:
    (a) Systems that think rationally
    (b) Systems that act rationally

To conclude,The goal of artificial intelligence is to replicate the brain’s ability to solve problems and make decisions.

3.1 AI agents

Artificial intelligence is defined as the study of rational agents. A rational agent can be anything that makes decisions, such as a person, company, machine, or software. It executes the best action based on past and current percepts (agent's perceptual inputs at a given instance). An AI system is made up of an agent and its environment. The agents act in response to their surroundings. Other agents could be present in the environment.

An agent is anything that can be viewed as :

1. perceiving its environment through sensors and
2. acting upon that environment through actuators

Agents can be grouped into four classes based on their degree of perceived intelligence and capability :

1. Simple Reflex Agents
2. Model-Based Reflex Agents
3. Goal-Based Agents
4. Utility-Based Agents
5. Learning Agent

In this section, knowing the difference between the goal-based agents and the utility based agents is the most vital.

The most basic distinction between a goal-based agent and a utility-based agent is that a goal is specifically defined, whereas utility maximization is general. (Maximizing utility is a goal in and of itself, but it is generalized rather than specific.)

A goal-based navigation agent is tasked with getting from point A to point B. If the agent succeeds, the goal has been satisfied.

A utility-based navigation agent could seek to get from point A to point B in the shortest amount of time, with the minimum expenditure of fuel, or both.

The utility agent in the preceding example is also goal-based, but whereas the goal agent's performance measure is binary [success/fail], the utility agent can use real numbers and measure performance by degree. The utility agent allows for greater evaluation granularity.

3.2 PEAS Description

It is well understood that there are various types of agents in AI. The PEAS System is used to group similar agents together. The PEAS system provides the performance measure for the respective agent's environment, actuators, and sensors. The majority of the top-performing agents are Rational Agents. Rational Agent: The rational agent considers all options and chooses the most efficient action. For example, it selects the shortest path with the lowest cost for maximum efficiency. PEAS is an acronym that stands for Performance Measure, Environment, Actuator, and Sensor.

1. Performance Measure: Performance measure is the unit to define the success of an agent.Performance varies with agents based on their different precept.
2. Environment: Environment is the surrounding of an agent at every instant. It keeps changing with time if the agent is set in motion.There are 5 major types of environments:
   (a) Fully Observable Partially Observable
   (b) Episodic Sequential
   (c) Static Dynamic
   (d) Discrete Continuous
   (e) Deterministic Stochastic
3. Actuator: Actuator is a part of the agent that delivers the output of an action to the environment.
4. Sensor: Sensors are the receptive parts of an agent which takes in the input for the agent.

3.3 AI Techniques

3.3.1 Searches

The study of creating agents that act rationally is known as artificial intelligence. Most of the time, these agents use a search algorithm in the background to complete their tasks. A search problem consists of:

1. A State Space. Set of all possible states where you can be.
2. A Start State. The state from where the search begins.
3. A Goal Test. A function that looks at the current state returns whether or not it is the goal state.
4. The Solution to a search problem is a sequence of actions, called the plan that transforms the start state to the goal state. This plan is achieved through search algorithms

There are far too many powerful search algorithms out there to fit in a single article. Instead, this article will discuss six of the fundamental search algorithms, divided into two categories,informed search and uninformed search.

Uninformed search, also known as blind search, has no additional information on the goal node than what is provided in the problem definition. The only difference between the plans to reach the goal state from the start state is the order and/or length of actions.

The following are some types of uninformed search algorithms

1. Depth First Search
2. Breadth First Search
3. Uniform Cost Search

Informed Search Algorithms, on the other hand, have information on the goal state, which aids in more efficient searching. This information is obtained using a technique known as a heuristic.

Some types of informed Search Algorithms are:

1. Greedy Search
2. A* Tree Search
3. A* Graph Search

4 Natural language

Natural language in computing refers to a human language such as English, Russian, German, or Japanese as opposed to the typically artificial command or programming language with which one typically communicates with a computer. The term typically refers to written language, but it may also refer to spoken language.

4.1 Natural language generation and understanding

Artificial intelligence, defined as machine intelligence, has numerous applications in today's society.

Natural language generation is one of its most common applications.Natural Language Generation (NLG) is simply the process of creating text from computer data. It serves as a translator, transforming computerized data into natural language representation. In this case, a conclusion or text is generated based on the collected data and user input. It is the task of generating natural language from a machine representation system in natural language processing. In some ways, Natural Language Generation contradicts Natural Language Understanding.

In natural language understanding, the system must disambiguate the input sentence in order to generate the machine representation language, whereas in natural language generation, the system must decide how to express a concept in words.

Text generation can be as simple as keeping a list of ready made text that is copied and pasted. Consequences can be satisfactory in simple applications such as horoscope machines or personalized business letter generators. However, in a sophisticated NLG system, it is necessary to include stages of planning and information merging to generate text that appears natural and does not become repetitive.

4.2 Chatbots

ChatBots are artificial intelligence (AI) software that can understand and communicate in human language via various platforms such as web and mobile applications.

Conversational UI Subdivisions

1. **Conversational User Interface:** This is an interface that allows for more personalized interaction with users, i.e. it mimics human conversation.
2. **Voice User Interface (VUI):** This is an interface that allows users to interact with it through speech or voice-based commands. Amazon Alexa, Echo Dot, Google Home, Google Mini, Siri, Cortana, and the Google Assistant are examples of VUI devices that accept voice/speech input and respond in the same way.

4.2.1 Types of Chatbots

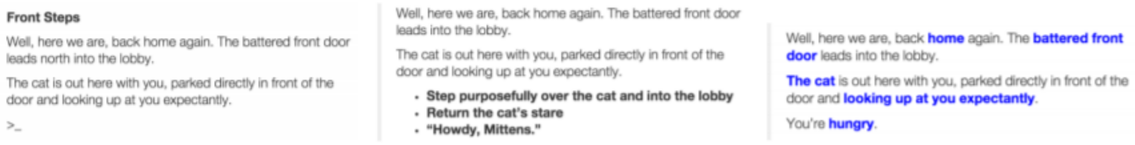
Mainly, chatbots are classified into three types: Rule-Based, AI-Based and Hybrid.

1. **Rule Based Chatbot:**It is also referred to as Decision treebots. It has a set of predefined database responses for a specific query based on the keywords uttered in the query. As a result, extracting a lengthy and informative response from the bot can be time-consuming. It's similar to a decision tree. It responds to the keywords extracted from the user's utterance. The majority of them do not employ NLP/NLU. The benefit of using this type is that it is cost effective.
2. **AI Based Chatbot:**They are built with ML and NLP/NLU. It, too, provides answers from a database, but what distinguishes it is that it becomes more intelligent over time as a result of previous interactions with users.
3. **Hybrid Chatbot:** This is the most common kind of chatbot. It is essentially a hybrid of rule-based and AI-based chatbots. They interact with humans and respond in a personalized manner, i.e. It can initiate a conversation with the user, but as the conversation progresses, the chatbot can be replaced by a human.

5 Text Based games

Text-based games are turn-based games that are typically played using a command line terminal. Several lines of text describe the state of the game at each turn, and the player may enter a text command to change this state in a desirable way (i.e., to move towards a goal). The built-in parser or interpreter of a game deciphers player commands and maps them to state changes (game events).[?]

Text-based games can be divided into three types based on how the player issues commands. In parser-based games, the player types text commands character by character; in choice-based games, the player selects from a predefined list of command options; and in hypertext-based games, the player clicks on one of several links in the description.



Front Steps

Well, here we are, back home again. The battered front door leads north into the lobby.

The cat is out here with you, parked directly in front of the door and looking up at you expectantly.

>_

Well, here we are, back home again. The battered front door leads into the lobby.

The cat is out here with you, parked directly in front of the door and looking up at you expectantly.

- **Step purposefully over the cat and into the lobby**
- **Return the cat's stare**
- **"Howdy, Mittens."**

Well, here we are, back **home** again. The **battered front door** leads into the lobby.

The cat is out here with you, parked directly in front of the door and **looking up at you expectantly**.

You're **hungry**.

(a) Parser-based (b) Choiced-based (c) Hypertext-based

Figure 1: Types of text Based Games

5.1 Text Based games using AI

An example of Text Based games using AI are demonestrated below.

In the field of text-based adventure games, a new challenge has emerged: creating an agent capable of understanding natural language and acting intelligently in text-described environments. A solution to the problem was presented in a paper.[?] Golovin, an agent, takes advantage of the limited game domain. And it creates language models for this domain using genre-related corpora (such as fantasy books and decompiled games). Furthermore, mechanisms were embedded to allow the specification and execution of critical tasks such as fighting opponents, managing inventory, and navigating the game map. The usefulness of these mechanisms was then validated by measuring the agent's performance on a set of 50 interactive fiction games.Finally, it demonstrated that the agent performed at a level comparable to the winner of the previous year's Text-Based Adventure AI Competition.

In this research,aided by the depth first search technique of AI a chatbot combind by a text based game was developed with the use of python as an environment .Aided by multiple libraries,which are cmd, textwrap, sys, os,time and random libaries.

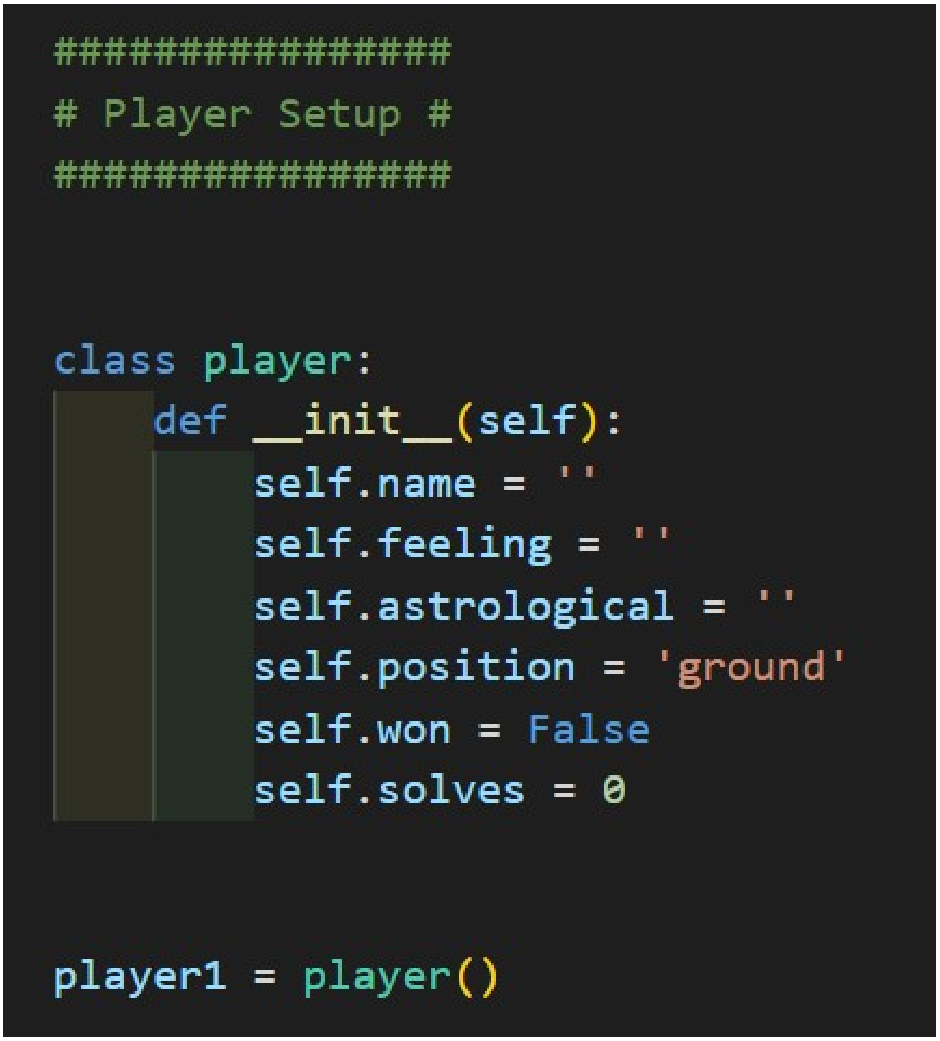
6 Methodology

Using python commands, methods and functions this game was created. The algorithm prompts the method $titlescreenoptions()$: which allows the player to first choose between the menu options which consist of play, help and quit.Furthermore, the player's choice between the 3 options prompts one of three actions by the chatbot, if the player chooses quit, it terminates the game and if they choose help, it prompts another method called $helpmenu()$: which mainly tells the player overall game rules and tips. However, if the player chooses play from the menu, it prompts the chatbot to go to the method $setupgame()$:

To begin with, as seen in fig2 the chatbot creates a class for the player called $player1$ which then starts filling its six parameters through asking he player a set of questions. After asking and filling the player's name parameter, it then goes on to ask about the player's feeling, which based on the player's answer, it compares their answer with the set of the 3 arrays of adjectives that was entered to to the algorithm. To put it more clearly, the algorithm has 3 arrays of 3 sets of feelings, $good_adj$, hmm_adj and bad_adj . These three arrays each contain a numerous number of adjectives that might be the answer of the player to the feeling question. Furthermore, these arrays were created to categorize the player's possible feeling into three categories. However, if the players answer is not found in any of the three arrays then the algorithm prints that he does not know how to feel.

Moving on, as seen in fig it then starts asking for the player's astrological sign to fill the parameter of astrological sign of player1. Moreover, the class player1 has parameters of a flag called "won" which is initialized with false and also a parameter that counts the number of solved puzzles that is initialized with a zero and keeps getting incremented as he player solves puzzles later in the game. Furthermore,the last parameter and most complicated one is the initial position of player1 which is initialized with *ground*. This *ground* represents one of six rooms that each have 8 keys.

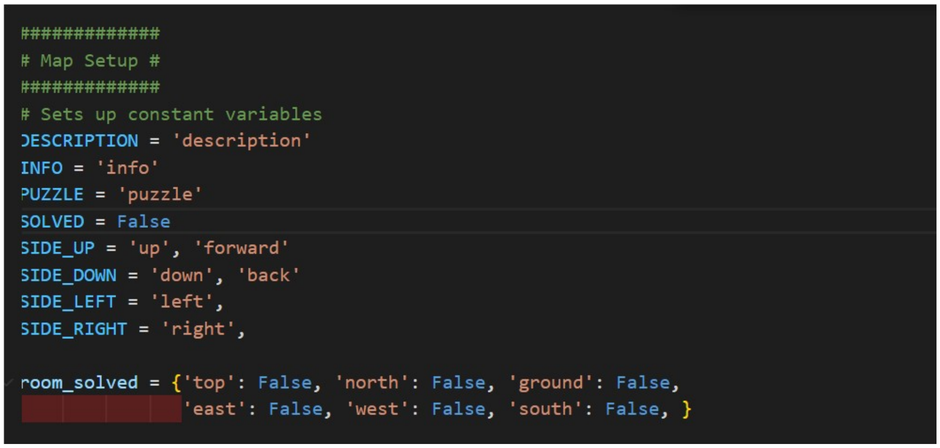
Moreover, each room represents a place in the cube that the player wants to open, where as seen in fig3 each room has its own set of 8 keys which are $DESCRIPTION$, $INFO$, $PUZZLE$, $SOLVED$,$SIDEUP$, $SIDEDOWN$, $SIDELEFT$ and $SIDERIGHT$. To begin with, each key of those 8 keys are variables initialized with 'description','info','puzzle', False,'up and forward', 'down and back' and 'left and right' respectively. The description is first given to the player the moment they "enter" into a room



```
################
# Player Setup #
################


class player:
    def __init__(self):
        self.name = ''
        self.feeling = ''
        self.astrological = ''
        self.position = 'ground'
        self.won = False
        self.solves = 0


player1 = player()
```

Figure 2: player class parameters

and the algorithm waits for the player to ask to ”examine” which is a defined method where if prompted, the info and puzzle is outputed to the player, Furthermore, if the player solves the puzzle the parameter mentioned earlier that counts the number of solved puzzle is incremented and the boolean $SOLVED$ is changed to ”True” of the room that the player is then in.



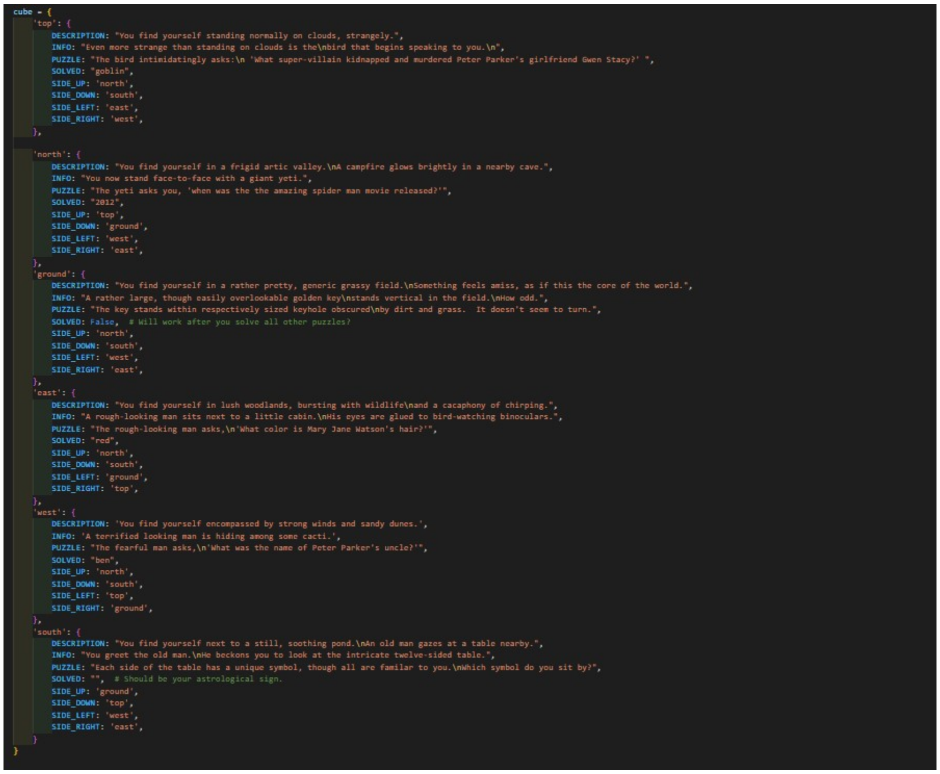
```
#############
# Map Setup #
#############
# Sets up constant variables
DESCRIPTION = 'description'
INFO = 'info'
PUZZLE = 'puzzle'
SOLVED = False
SIDE_UP = 'up', 'forward'
SIDE_DOWN = 'down', 'back'
SIDE_LEFT = 'left',
SIDE_RIGHT = 'right',

room_solved = {'top': False, 'north': False, 'ground': False,
               'east': False, 'west': False, 'south': False, }
```

Figure 3: room

Not only that but the player an choose to move to a different room by writing one of the commands to do so like ”walk” and ”move” . Moreover, the keys ,$SIDEUP$, $SIDEDOWN$, $SIDELEFT$ and $SIDERIGHT$ allow the algorithm to know the location of the room that the player is in within the cube, so that when they ask to move, the algorithm goes to the right room as per requested by the player.

As seen in fig4, there are 6 maps with each map has its own set of 8 keys.

Lastly,this keeps going on until the variable that counts the number of solved puzzles is greater than or equal to 5, through an if condition, the algorithm knows to change the parameter ”won” of the player to ”True” and prints out a message to the player that they won.

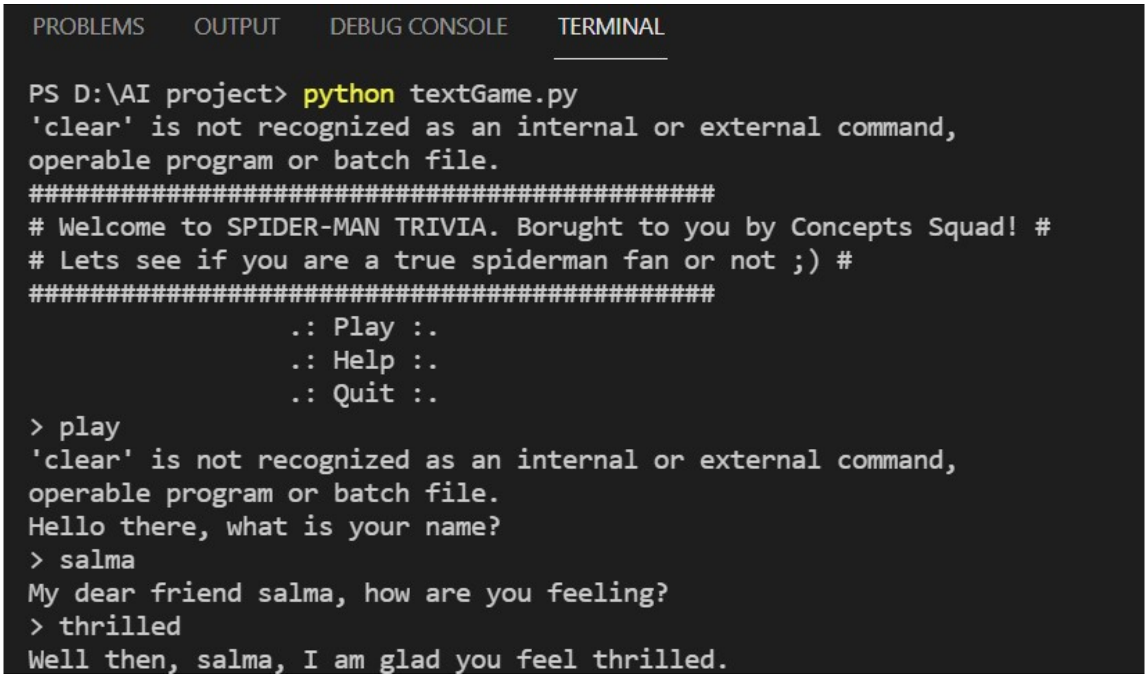


```
cube = {
    'top': {
        DESCRIPTION: "You find yourself standing normally on clouds, strangely.",
        INFO: "Even more strange than standing on clouds is the\nbird that begins speaking to you.\n",
        PUZZLE: "The bird intimidatingly asks:\n 'What super-villain kidnapped and murdered Peter Parker's girlfriend Gwen Stacy?' ",
        SOLVED: "goblin",
        SIDE_UP: 'north',
        SIDE_DOWN: 'south',
        SIDE_LEFT: 'east',
        SIDE_RIGHT: 'west',
    },

    'north': {
        DESCRIPTION: "You find yourself in a frigid artic valley.\nA campfire glows brightly in a nearby cave.",
        INFO: "You now stand face-to-face with a giant yeti.",
        PUZZLE: "The yeti asks you, 'when was the the amazing spider man movie released?'",
        SOLVED: "2012",
        SIDE_UP: 'top',
        SIDE_DOWN: 'ground',
        SIDE_LEFT: 'west',
        SIDE_RIGHT: 'east',
    },
    'ground': {
        DESCRIPTION: "You find yourself in a rather pretty, generic grassy field.\nSomething feels amiss, as if this the core of the world.",
        INFO: "A rather large, though easily overlookable golden key\nstands vertical in the field.\nHow odd.",
        PUZZLE: "The key stands within respectively sized keyhole obscured\nby dirt and grass.  It doesn't seem to turn.",
        SOLVED: False,  # Will work after you solve all other puzzles?
        SIDE_UP: 'north',
        SIDE_DOWN: 'south',
        SIDE_LEFT: 'west',
        SIDE_RIGHT: 'east',
    },
    'east': {
        DESCRIPTION: "You find yourself in lush woodlands, bursting with wildlife\nand a cacaphony of chirping.",
        INFO: "A rough-looking man sits next to a little cabin.\nHis eyes are glued to bird-watching binoculars.",
        PUZZLE: "The rough-looking man asks,\n'What color is Mary Jane Watson's hair?'",
        SOLVED: "red",
        SIDE_UP: 'north',
        SIDE_DOWN: 'south',
        SIDE_LEFT: 'ground',
        SIDE_RIGHT: 'top',
    },
    'west': {
        DESCRIPTION: 'You find yourself encompassed by strong winds and sandy dunes.',
        INFO: 'A terrified looking man is hiding among some cacti.',
        PUZZLE: "The fearful man asks,\n'What was the name of Peter Parker's uncle?'",
        SOLVED: "ben",
        SIDE_UP: 'north',
        SIDE_DOWN: 'south',
        SIDE_LEFT: 'top',
        SIDE_RIGHT: 'ground',
    },
    'south': {
        DESCRIPTION: "You find yourself next to a still, soothing pond.\nAn old man gazes at a table nearby.",
        INFO: "You greet the old man.\nHe beckons you to look at the intricate twelve-sided table.",
        PUZZLE: "Each side of the table has a unique symbol, though all are familar to you.\nWhich symbol do you sit by?",
        SOLVED: "",  # Should be your astrological sign.
        SIDE_UP: 'ground',
        SIDE_DOWN: 'top',
        SIDE_LEFT: 'west',
        SIDE_RIGHT: 'east',
    }
}
```

Figure 4: The maps and its keys

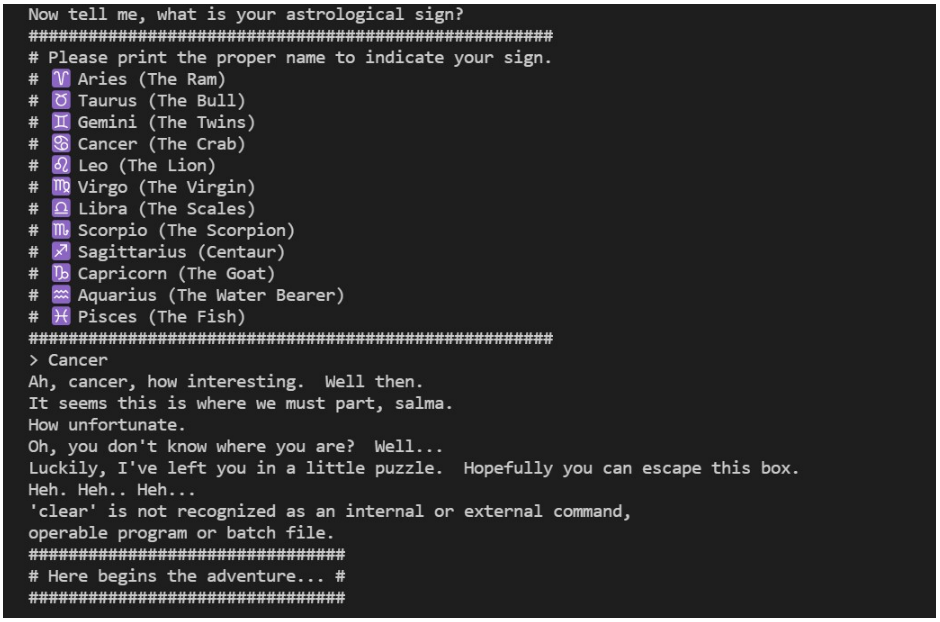
7 Results

In this section, the results of the developed chat-bot will be shown down. As the chat-bot succeeded in navigating the player through the map and asked him questions in order to solve the puzzles. So, the player could escape from the map.



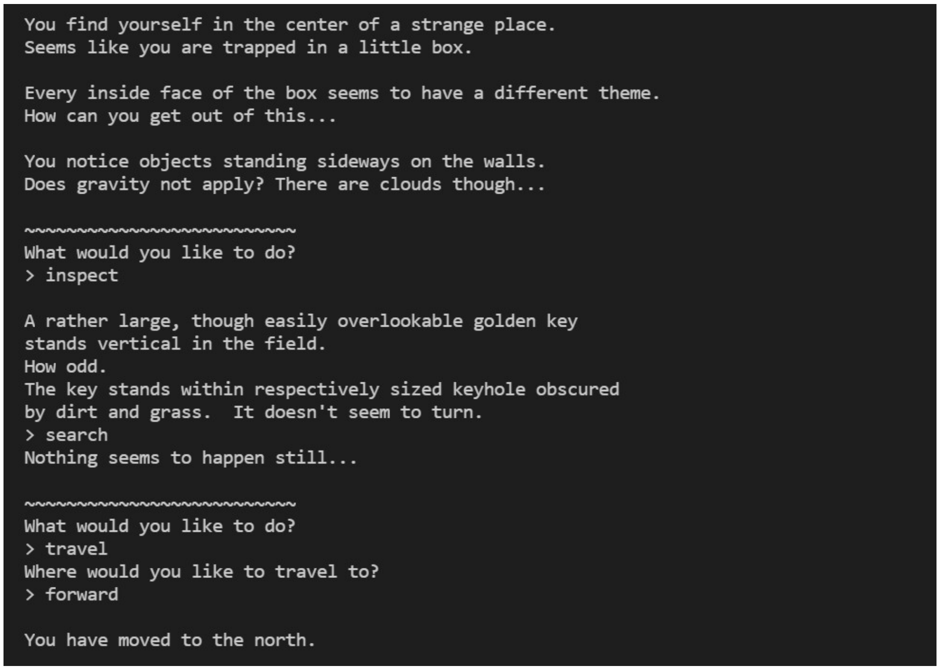
```
PS D:\AI project> python textGame.py
'clear' is not recognized as an internal or external command,
operable program or batch file.
#############################################
# Welcome to SPIDER-MAN TRIVIA. Borught to you by Concepts Squad! #
# Lets see if you are a true spiderman fan or not ;) #
#############################################
                 .: Play :.
                 .: Help :.
                 .: Quit :.
> play
'clear' is not recognized as an internal or external command,
operable program or batch file.
Hello there, what is your name?
> salma
My dear friend salma, how are you feeling?
> thrilled
Well then, salma, I am glad you feel thrilled.
```

Figure 5: The first scene of the game



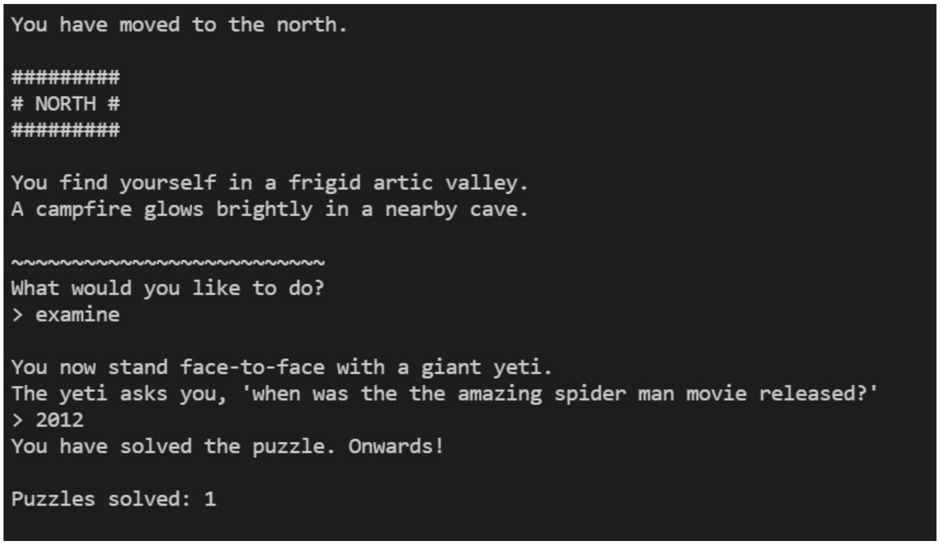
```
Now tell me, what is your astrological sign?
#####################################################
# Please print the proper name to indicate your sign.
# ♈ Aries (The Ram)
# ♉ Taurus (The Bull)
# ♊ Gemini (The Twins)
# ♋ Cancer (The Crab)
# ♌ Leo (The Lion)
# ♍ Virgo (The Virgin)
# ♎ Libra (The Scales)
# ♏ Scorpio (The Scorpion)
# ♐ Sagittarius (Centaur)
# ♑ Capricorn (The Goat)
# ♒ Aquarius (The Water Bearer)
# ♓ Pisces (The Fish)
#####################################################
> Cancer
Ah, cancer, how interesting.  Well then.
It seems this is where we must part, salma.
How unfortunate.
Oh, you don't know where you are?  Well...
Luckily, I've left you in a little puzzle.  Hopefully you can escape this box.
Heh. Heh.. Heh...
'clear' is not recognized as an internal or external command,
operable program or batch file.
################################
# Here begins the adventure... #
################################
```

Figure 6: Chat-bot asking the player about his astrological sign.



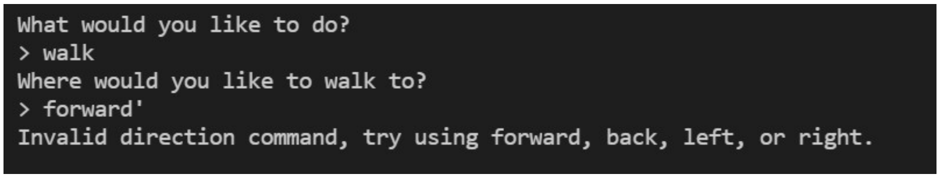
```
You find yourself in the center of a strange place.
Seems like you are trapped in a little box.

Every inside face of the box seems to have a different theme.
How can you get out of this...

You notice objects standing sideways on the walls.
Does gravity not apply? There are clouds though...

~~~~~~~~~~~~~~~~~~~~~~~~~~
What would you like to do?
> inspect

A rather large, though easily overlookable golden key
stands vertical in the field.
How odd.
The key stands within respectively sized keyhole obscured
by dirt and grass.  It doesn't seem to turn.
> search
Nothing seems to happen still...

~~~~~~~~~~~~~~~~~~~~~~~~~~
What would you like to do?
> travel
Where would you like to travel to?
> forward

You have moved to the north.
```

Figure 7: Chat-bot helping the player navigating through the map.



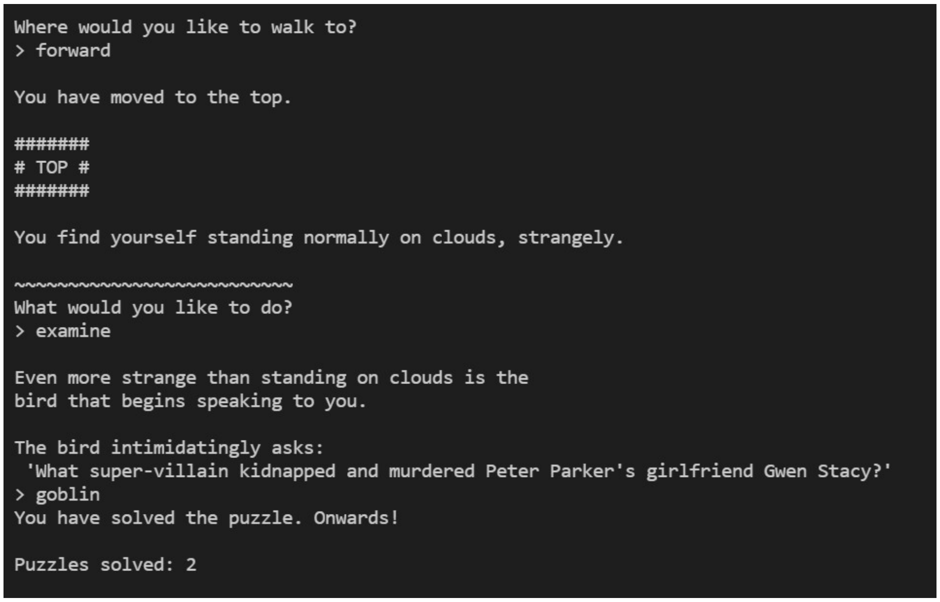
```
You have moved to the north.

#########
# NORTH #
#########

You find yourself in a frigid artic valley.
A campfire glows brightly in a nearby cave.

~~~~~~~~~~~~~~~~~~~~~~~~~~
What would you like to do?
> examine

You now stand face-to-face with a giant yeti.
The yeti asks you, 'when was the the amazing spider man movie released?'
> 2012
You have solved the puzzle. Onwards!

Puzzles solved: 1
```

Figure 8: Player solving the first puzzle



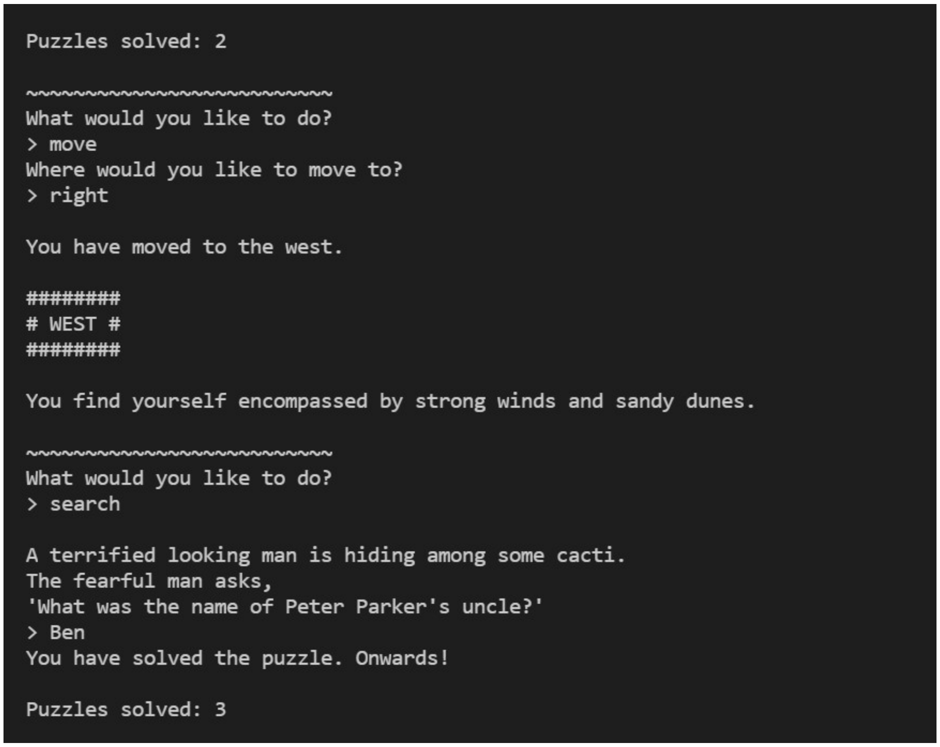
```
What would you like to do?
> walk
Where would you like to walk to?
> forward'
Invalid direction command, try using forward, back, left, or right.
```

Figure 9: Chat-bot asking the player how he would like to navigate through the map.



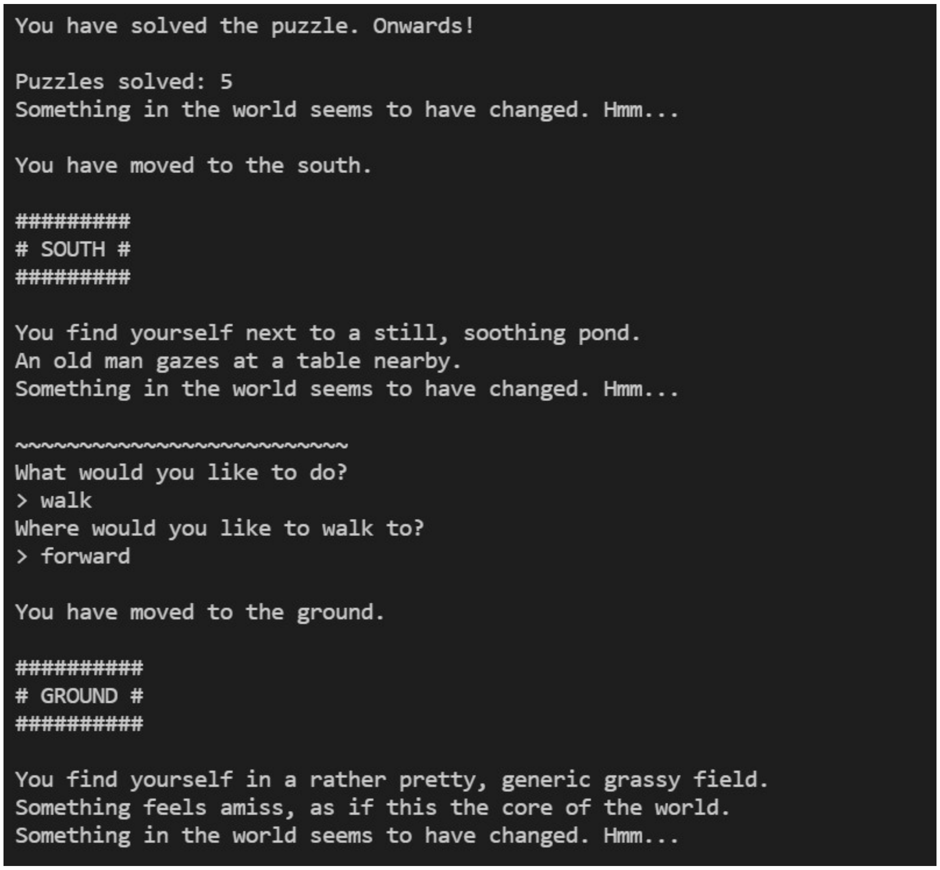
```
Where would you like to walk to?
> forward

You have moved to the top.

#######
# TOP #
#######

You find yourself standing normally on clouds, strangely.

~~~~~~~~~~~~~~~~~~~~~~~~~~
What would you like to do?
> examine

Even more strange than standing on clouds is the
bird that begins speaking to you.

The bird intimidatingly asks:
 'What super-villain kidnapped and murdered Peter Parker's girlfriend Gwen Stacy?'
> goblin
You have solved the puzzle. Onwards!

Puzzles solved: 2
```

Figure 10: Player solving the second puzzle



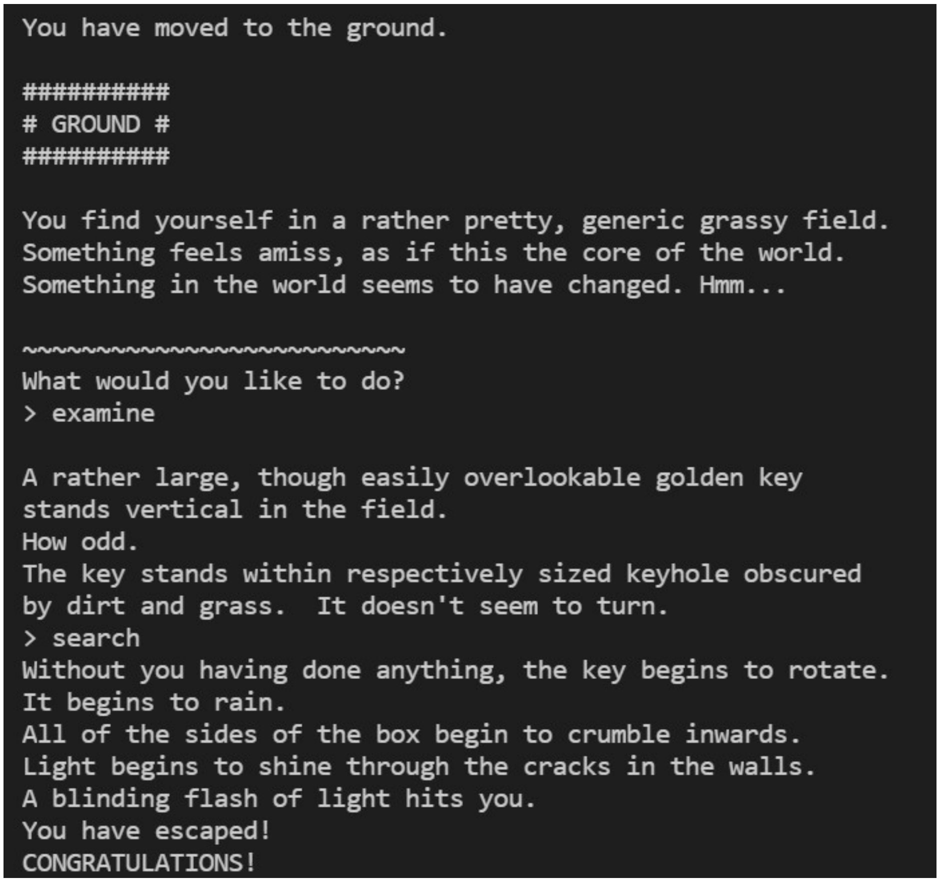
```
Puzzles solved: 2

~~~~~~~~~~~~~~~~~~~~~~~~~~
What would you like to do?
> move
Where would you like to move to?
> right

You have moved to the west.

########
# WEST #
########

You find yourself encompassed by strong winds and sandy dunes.

~~~~~~~~~~~~~~~~~~~~~~~~~~
What would you like to do?
> search

A terrified looking man is hiding among some cacti.
The fearful man asks,
'What was the name of Peter Parker's uncle?'
> Ben
You have solved the puzzle. Onwards!

Puzzles solved: 3
```

Figure 11: Player solving the third puzzle



```
You have solved the puzzle. Onwards!

Puzzles solved: 5
Something in the world seems to have changed. Hmm...

You have moved to the south.

#########
# SOUTH #
#########

You find yourself next to a still, soothing pond.
An old man gazes at a table nearby.
Something in the world seems to have changed. Hmm...

~~~~~~~~~~~~~~~~~~~~~~~~~~
What would you like to do?
> walk
Where would you like to walk to?
> forward

You have moved to the ground.

##########
# GROUND #
##########

You find yourself in a rather pretty, generic grassy field.
Something feels amiss, as if this the core of the world.
Something in the world seems to have changed. Hmm...
```

Figure 12: Player solving the fifth puzzle



```
You have moved to the ground.

##########
# GROUND #
##########

You find yourself in a rather pretty, generic grassy field.
Something feels amiss, as if this the core of the world.
Something in the world seems to have changed. Hmm...

~~~~~~~~~~~~~~~~~~~~~~~~~~
What would you like to do?
> examine

A rather large, though easily overlookable golden key
stands vertical in the field.
How odd.
The key stands within respectively sized keyhole obscured
by dirt and grass.  It doesn't seem to turn.
> search
Without you having done anything, the key begins to rotate.
It begins to rain.
All of the sides of the box begin to crumble inwards.
Light begins to shine through the cracks in the walls.
A blinding flash of light hits you.
You have escaped!
CONGRATULATIONS!
```

Figure 13: Player winng and escaping from the map.