

We are pleased to inform you that you have been invited to be part of Disney's prestigious 1 week CEO program, where you get to run Disney for one full week. Since one week is not a lot of time, we have sorted through the most pressing issues we are facing right now and have picked two tasks that we are confident you can help us with.

### Task 1: Redesigning a theme park

Experimental Prototype Community of Tomorrow (EPCOT) is one of Disney's popular theme parks located in Bay Lake, Florida, which opened in 1982. In the last few decades, we have redesigned the theme park several times. With an increasing number of travelers expected to visit the theme park in the next decade, we have decided to redesign some aspects of the theme park. The park manager was able to decide on almost everything about the new park layout except for one thing. She cannot seem to decide which of two attractions - (1) Attack of the Clones or (2) Return of the Jedi - she should include in the redesigned park. Your theme park advisor has conducted a study that involved several stakeholders including visitors, roller coaster engineers, and other theme park staff. From the study, you learned that the following factors are extremely important in determining how good a ride is:

1. *IsStandingRide* - Whether or not the rider is standing during the duration of the ride
2. *HasDrops&Loops* - Whether or not the roller coaster has loops and drops
3. *IsSlow* - Whether or not the ride is considered a slow ride
4. *IsLongerThan1min* - Whether or not the ride lasts longer than 1 minute

Unfortunately, you were not informed how the combination of these different factors determines whether or not a ride is fun. All is not lost, you remember that there is a FunDetermining machine locked away in your office. Since the safe also contains other top-secret information, you need a passcode to unlock the safe.

- a. Convert the following input sequence into its CNF (conjunctive normal form). The passcode is the CNF of the statement:  $\sim((\text{Elsa} \vee \text{Anna}) \Rightarrow \text{Elsa})$ . Yes, it is not a normal passcode. R2D2 was tasked to come up with a strong passcode for us. R2D2 got annoyed by all the restrictions around having an uppercase, special character, etc, so he got creative.

Write the passcode below with the applicable parentheses in ascending order from left to right with the negation symbol considered less than a regular literal.

$$\sim(\sim(\text{Elsa} \vee \text{Anna}) \vee \text{Elsa}) = ((\text{Elsa} \vee \text{Anna}) \wedge \sim \text{Elsa}) = ((\sim \text{Elsa} \wedge \text{Elsa}) \vee (\sim \text{Elsa} \wedge \text{Anna}))$$

$$= \sim \text{Elsa} \wedge (\text{Anna} \vee \text{Elsa}) = \sim \text{Elsa} \wedge \text{Anna}$$

Great! With the passcode, you were able to open the safe and retrieve the FunDetermining machine. Unfortunately, no one used in a while and hence has stopped working. However, you see the following drawing on the back of the machine. Phew!

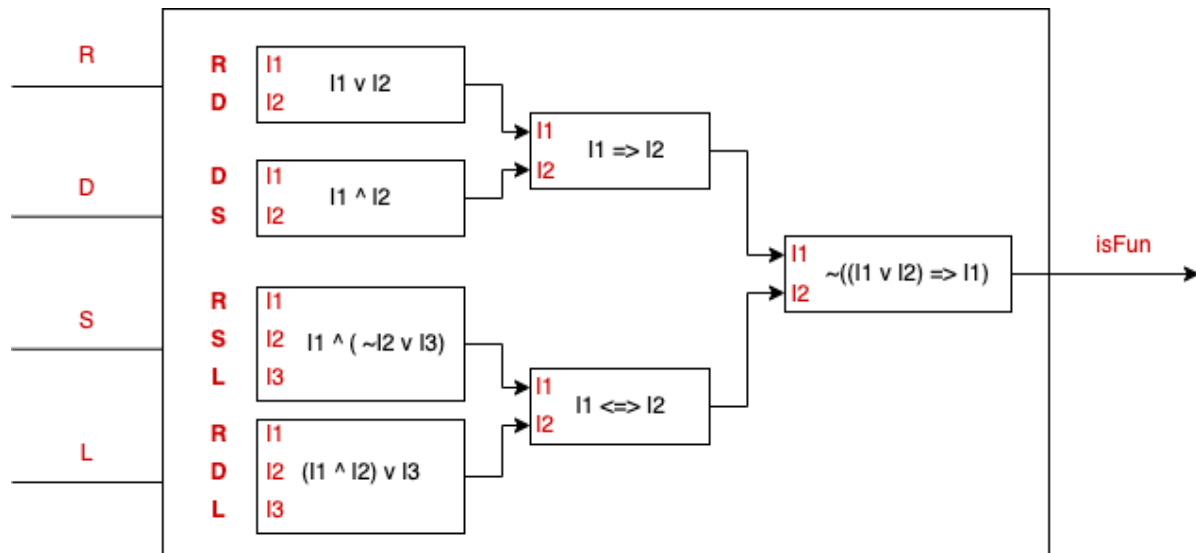


Figure 1: Layout on the back of the FunDetermining machine

Given your background in computer science, you decide to pick the ride that is “better” by working out the following truth table based on the drawing. Suppose T = True and F = False. Inputs R, D, S, & L are either T or F inputs. ‘~’ is equivalent to ‘not.’ Each of the inputs can be mapped to the factors discussed earlier as follows:

Factor	Symbol in Figure 1
isStandingRide	R
hasDrops&Loops	D
isSlow	S
isLongerThan1Min	L

b. Fill out the output for all possible inputs to the FunDetermining machine as **T** or **F**.

isStandingRide	hasDrops&Loops	isSlow	isLongerThan1Min	isFun
F	F	F	F	F
F	F	F	T	F
F	F	T	F	F
F	F	T	T	F
F	T	F	F	T
F	T	F	T	F
F	T	T	F	F

F	T	T	T	F
T	F	F	F	F
T	F	F	T	T
T	F	T	F	T
T	F	T	T	T
T	T	F	F	T
T	T	F	T	T
T	T	T	F	F
T	T	T	T	F

The roller coaster engineers and EPCOT's park manager told you that:

1. Attack of the Clones is a 30sec ride that is slow, and has no loops or drops. Given the spaceship theme of the ride, everyone is seated as though they are on a spaceship.
2. Return of the Jedi is a 2 minute fast ride that has drops and loops. This is a ride for all thrill seeking visitors of the theme park who like to stand during the ride.

c. Refer to the truthtable you have filled above and determine which ride should the park manager go with?

- ☐ Attack of the Clones  
☒ Return of the Jedi

## Task 2: Automated story generation

As a decade of highly successful Marvel movies have come to an end, we are looking to explore new ways to tell stories. The team at Disney Research has developed several technologies in the area of Artificial Intelligence (AI) story generation. You can check them out at our public facing website [here](#). Note: Going through the research available on this link is **not** necessary for you to be able to help us on this task.

Automated story generation is the use of an intelligent system to produce a fictional story from a minimal set of inputs. There are multiple ways to use systems to generate stories. With the recent advances in deep learning, especially in natural language processing, deep learning based approaches leveraging [GPT](#) have become extremely popular. This was not always the case. Prior to the proliferation of deep learning, non-learning story generation approaches such as those leveraging [story grammars](#) and [story planners](#) were extremely popular.

While all the engineers at Disney research have been exploring deep learning based approaches, we are not sure if relying solely on deep language models is the best way forward. Given your knowledge in Artificial Intelligence, we would like you to improve the work of the engineers on the research team to generate a proof-of-concept story by leveraging PDDL (Planning Domain Definition Language). This would be one way of using generating stories using planners.

Since you are the 31st CEO-for-a-week, the team has decided to pick the 31st Disney animated feature film for the proof-of-concept - [Aladdin](#), with a twist.

#### Revised and abridged version of Aladdin

Jafar, the Royal Vizier of the fictional city of Agrabah, seeks a lamp hidden within the Cave of Wonders. He is told that only one person is worthy to enter: "the diamond in the rough," whom Jafar later identifies as Jasmine, an Agrabah street urchin. Meanwhile, Prince Aladdin of Agrabah becomes upset that the law requires him to marry a princess instead of marrying for love. Jasmine is placed behind bars for stealing. Disguised as an aging man, Jafar frees Jasmine and Abu and brings them to the cave, ordering them to retrieve a lamp with a Genie.

After being told to touch nothing but the lamp, Jasmine finds a magic carpet inside, and obtains the lamp. Forgetting the cave's rule, Abu grabs a jewel. Jasmine, Abu, and the carpet rush to escape the cave as it collapses. Jasmine gives the lamp to Jafar, who throws him and Abu back into the cave, though not before Abu steals the lamp back. Trapped, Jasmine rubs the lamp and meets the Genie who lives inside it. The Genie grants Jasmine three wishes.

Two wishes later, the genie in the lamp mysteriously disappears and Agrabah is in pandemonium. Rumour had it that he went back to the Cave of Wonders to eat some ice cream. Afraid to leave the city and head back into the Cave, ...

#### <MISSING SECTION OF THE STORY>

With the genie receiving the message, he returns to Jasmine immediately and helps Jasmine to return Agrabah to normalcy. With Agrabah returned to normal, the Genie advises Jasmine to use her third wish to regain her royal title, so the law will allow her to stay with Aladdin. Jasmine instead decides to keep her promise, and frees the Genie. Realizing Jasmine's nobility, the Sultan changes the law to allow Aladdin to marry whom he chooses. The Genie bids the group a fond farewell and leaves to explore the world, while Aladdin and Jasmine start their new life together.

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Your task would be to help complete the story by designing some aspects of the planner using PDDL. The missing section has the following three sequence of events:

(1) Jasmine gives a message for the genie to Abu, and then (2) Abu will have to pass Jafar's home without getting noticed, then (3) he should reach the Cave of Wonders where he hands the message to the genie.

**Notations:**

Jasmine - character (c1)

Abu - character (c2)

Jafar - character (c3)

Genie - character (c4)

Message - m

Place1, Place2, Place3 - p1,p2,p3

**Actions:**

1. MessageAbu(c1,m,p1,c2)
2. PassJafar(c2,m,p2,p3,c3)
3. MessageGenie(c2,m,c4,p3)

**Types:** <Subtype - Supertype> (a type with no Superclass is the Supertype of all types)

Object

**Location** - Object

**Place** - Location

**Character** - Object

**Message** - Object

**Predicates:**

**Object(o)** - returns true if **o** is an object.

**Message(m)** - returns true if **m** is a message.

**Place(p)** - returns true if **p** is a planet.

**Character(c)** - returns true if **c** is a character.

**MeetFriend(c,f)** - returns true if a character **c** meets a character **f**, and **f** is a friend of **c**.

**SeeVillain(c,v)** - returns true if a character **v** is a villain, and character **c** gets noticed by the villain **v**.

**Hold(m,c)** - returns true if **m** is a message, **c** is a character and character **c** is holding the message **m**.

**At(c,p)** - returns true if **p** is a place, **c** is a character and character **c** is on the place **p**.

**Pass(m,c)** - returns true if **m** is a message, **c** is a character and message **m** is being passed to character **c**.

**Initializations:**

init(character(c1)  $\wedge$  character(c2)  $\wedge$  character(c3)  $\wedge$  character(c4)  $\wedge$  message(m)  $\wedge$  place(p1)  $\wedge$  place(p2)  $\wedge$  place(p3))

a. You want to add the action MessageAbu(c1,m,p1,c2), this action will cause Jasmine (c1) to pass the message (m) to Abu (c2) in Place1 (p1). Given the Preconditions, you have to select the effects from the options below.

**Preconditions:**  $At(c1,p1) \wedge Hold(m,c1) \wedge At(c2,p1) \wedge MeetFriend(c1,c2)$

**Select the applicable clauses for the effect from the below options.**

- ☐  $\sim At(c2,p1)$
- ☒  $Pass(m,c2)$
- ☐  $\sim SeeVillain(c1,c2)$
- ☒  $Hold(m,c2)$
- ☐  $Pass(m,c3)$
- ☒  $\neg Hold(m,c1)$

**b:** You want to add the action  $PassJafar(c2,m,p2,p3,c3)$ , this action will cause Abu (c2) to pass the Jafar's place (p2) without getting noticed by Jafar (c3), and finally reaching the Cave of Wonders (p3) while holding the message(m). Given the Preconditions, you have to select the effects.

**Preconditions:**  $\sim At(c3,p2) \wedge Hold(m,c2) \wedge \sim SeeVillain(c2,c3)$

**Select the applicable clauses for the effect from the below options.**

- ☒  $Hold(m,c2)$
- ☐  $\sim Hold(m,c2)$
- ☐  $SeeVillain(c2,c3)$
- ☐  $At(c3,p2)$
- ☒  $At(c2,p3)$

**c:** you want to add the action  $MessageGenie(c2,m,c4,p3)$ , which will cause Abu (c2) to pass the message(m) to Genie(c4) in the Cave of Wonders(p3). Given the effects, you have to select Preconditions.

**Effect :**  $\sim Hold(m,c2) \wedge Pass(m,c4) \wedge Hold(m,c4)$

**Select the applicable clauses for the PreConditions from the below options.**

- ☒  $MeetFriend(c2,c4)$
- ☒  $At(c2,p3)$
- ☒  $At(c4,p3)$
- ☐  $Hold(m,c3)$
- ☐  $Hold(m,c4)$
- ☐  $SeeVillain(c2,c3)$