Planning for Storytelling

Nisha Simon

Christian Muise

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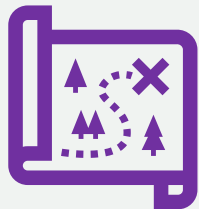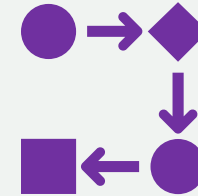**Julie Porteous**

R. Michael Young

Patrik Haslum

Why Planning for Storytelling?

A story can be conceptualized as the sequence of events that take place within some virtual world.

It can therefore be well-modeled by a plan.

The Plan

The plan can represent:

(i) the sequence of events that *actually happen* in the story i.e. the **plot**, or,

(ii) the sequence of events are they are *told* to the audience i.e. the **narrative**.

States

The *states* that the plan traverses can encompass:

(i) the **physical** state of the story world;

(ii) the **state of mind** of the characters in the story world (their beliefs, motivations, plans, etc.);

(iii) the **state of the audience's knowledge**/understanding of the world and events of the story; or

(iv) any combination of the above.

States

The **physical** state of the story world:

** "The Way Home for Wolf" images courtesy: Bright, R.; and Field, J., 2020, "The Way Home for Wolf", volume 1, Scholastic Press.

States

The **state of mind** of the characters in the story world:

* "Robin Hood" images courtesy: San Souci, R. D.; and Lewis, E., 2010, "Robin Hood and the Golden Arrow", volume 1, Scholastic Press.

Our Plan

The plan becomes:

(i) the representation of the story, and

(ii) also, that of the story world

Thus, we use Planning to create logical, believable, and coherent stories (narratives) in a variety of domains.

Our Plan

We will demonstrate the role that planning, or planning-based representations, can play in narrative generation methods.

We will cover several techniques, including modern approaches that make use of Large Language Models (LLMs)

Storytelling + Planning Task

+

Who did What? – the plot thickens...

Storytelling is a `design' task

– Which phenomenon to model?

- Logic

- Mistaken belief

- Suspense etc.

Who did What? – the plot thickens...

Storytelling is a `design' task

– Which layer to model?

- **Plot**

- Discourse

- Narration

# *Who did What? – the plot thickens...*

- Neural based approaches
- Story Skeletons
- Compilation to Classical Planning
- Neurosymbolic approaches
- Story Variations
- Directed graphs and branching story trees
- Large Language Models
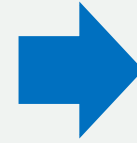
Who did What? – the plot thickens...

- Neural based approaches
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- Story Variations
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- Large Language Models

The Storyteller

Large Input Datasets
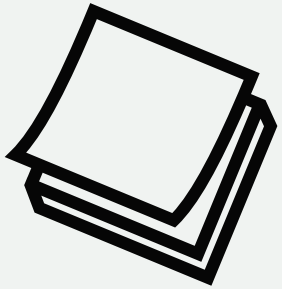
LLM

Generated Text

If you fail to plan….

What are some challenges in generating text using LLMs?

- Display bias

- Produce toxic or offensive outputs

- Dissolve into repetition

- Produce illogical output

What's my Line?

- Prompt engineering for LLMs.
- LLMs are constantly improving, but their outputs are still dependent on their inputs.

What's my Line?

```
Output:

But, Wilf has to travel home on his own. He has to travel through the Tundra.
He needs to cross the river.
 He needs to cross the river. He needs to cross the river. He needs to cross the river.
 He needs to cross the river. He needs to cross the river. He needs to cross the river.
 He needs to cross the river. He needs to cross the river. He needs to cross the river.
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```
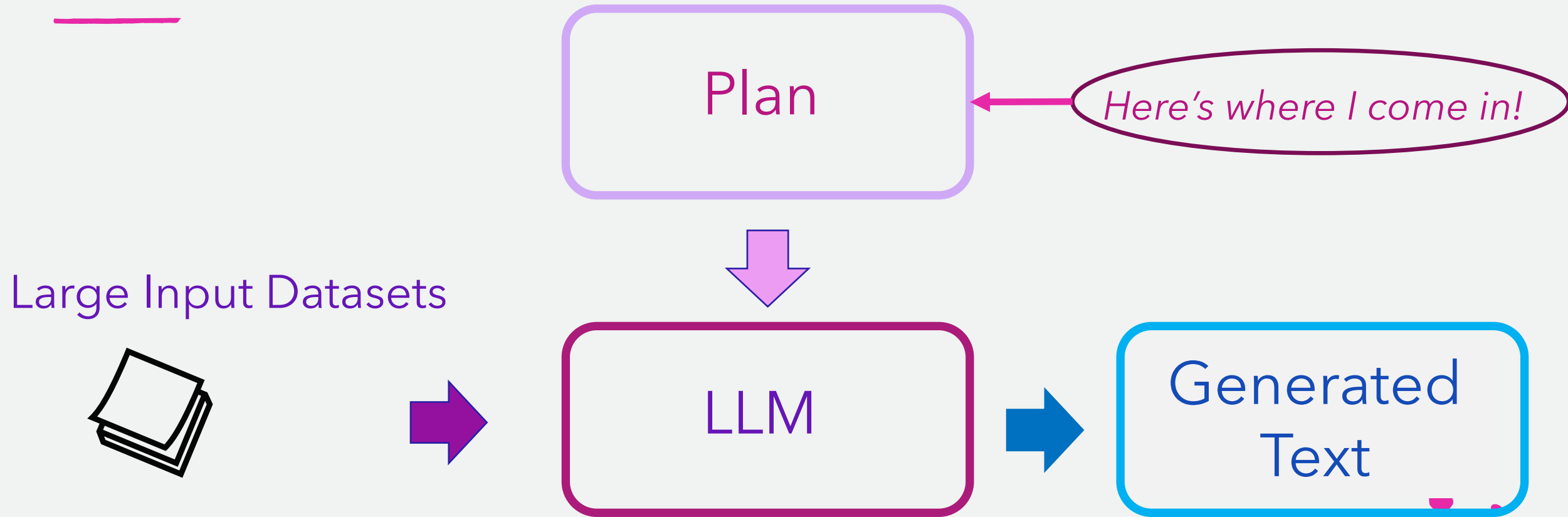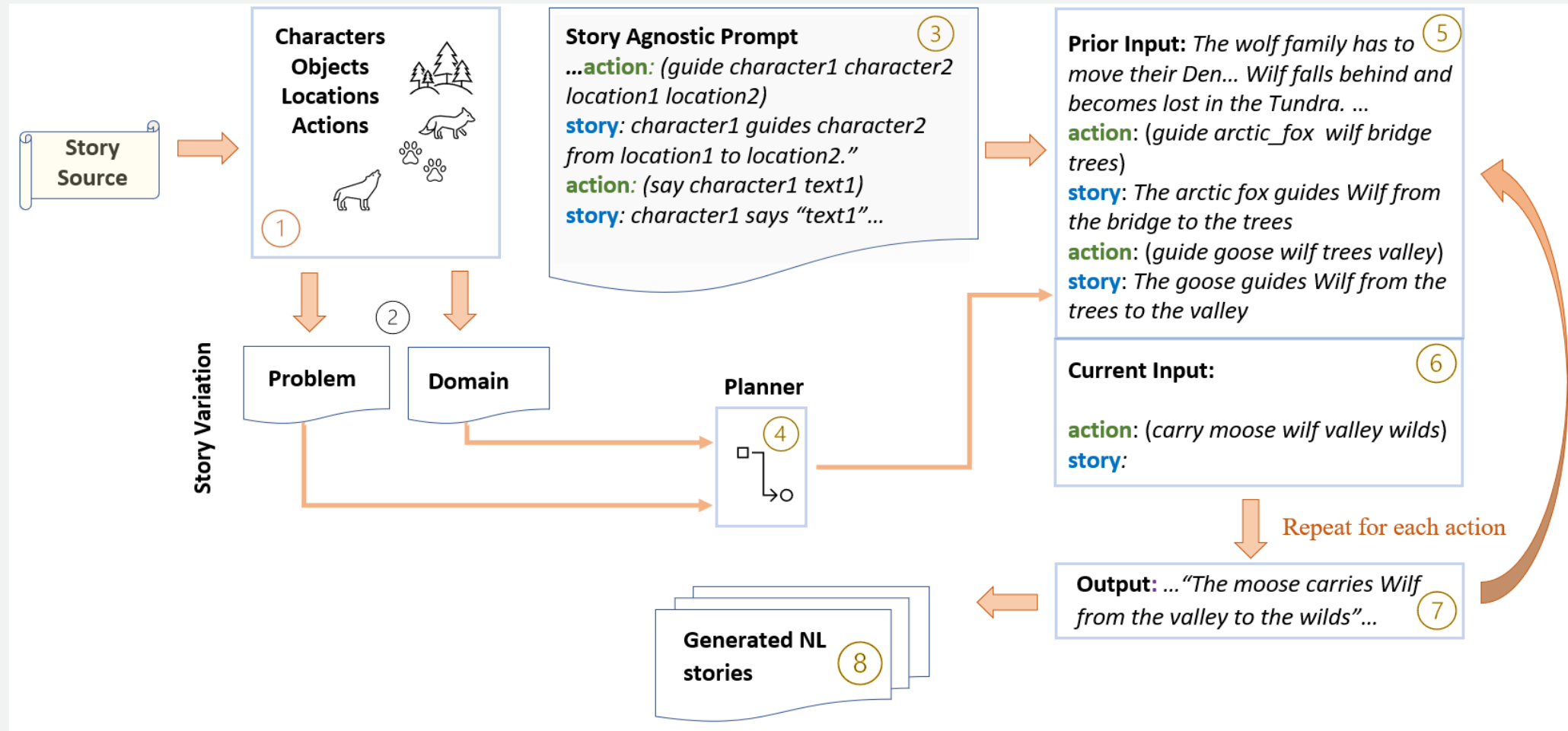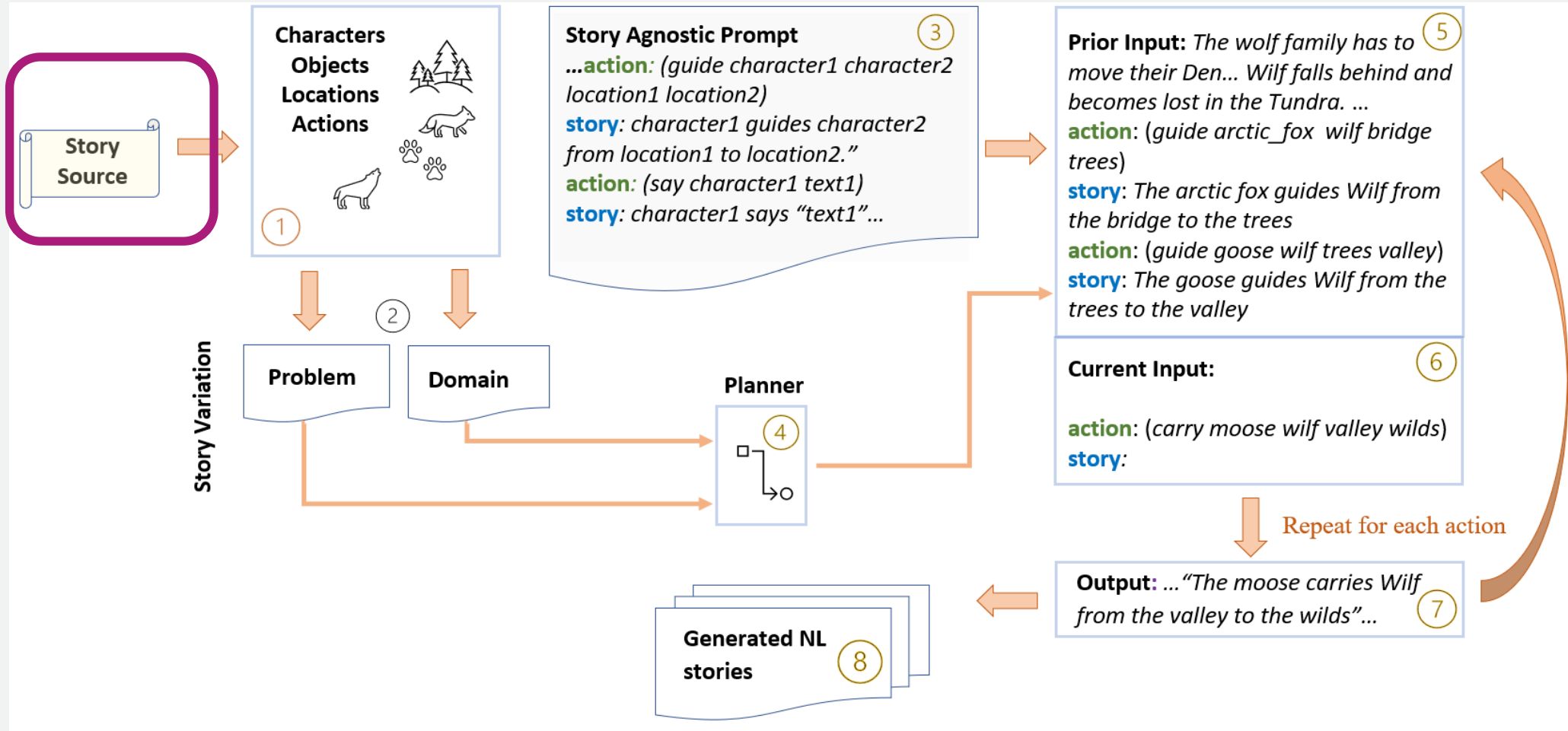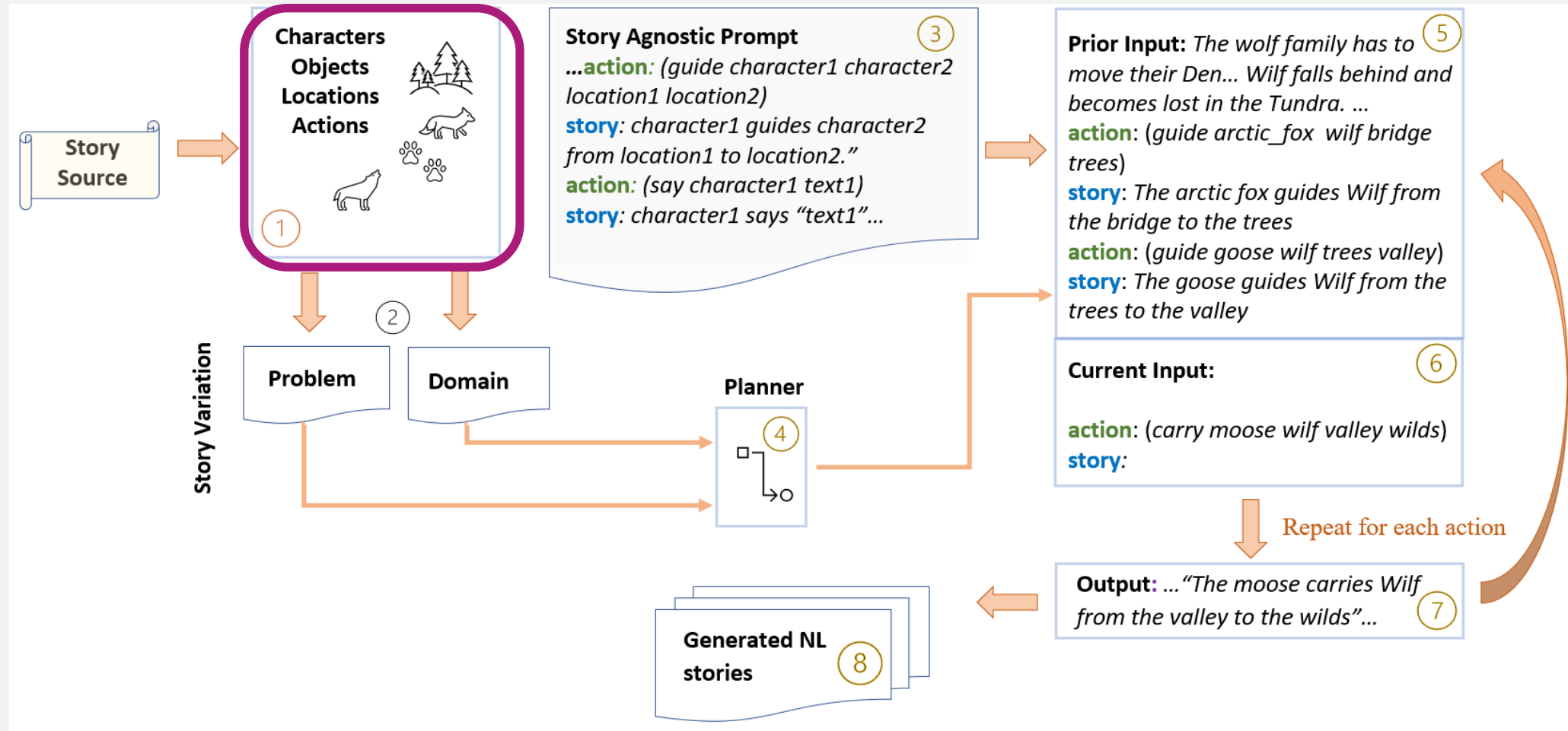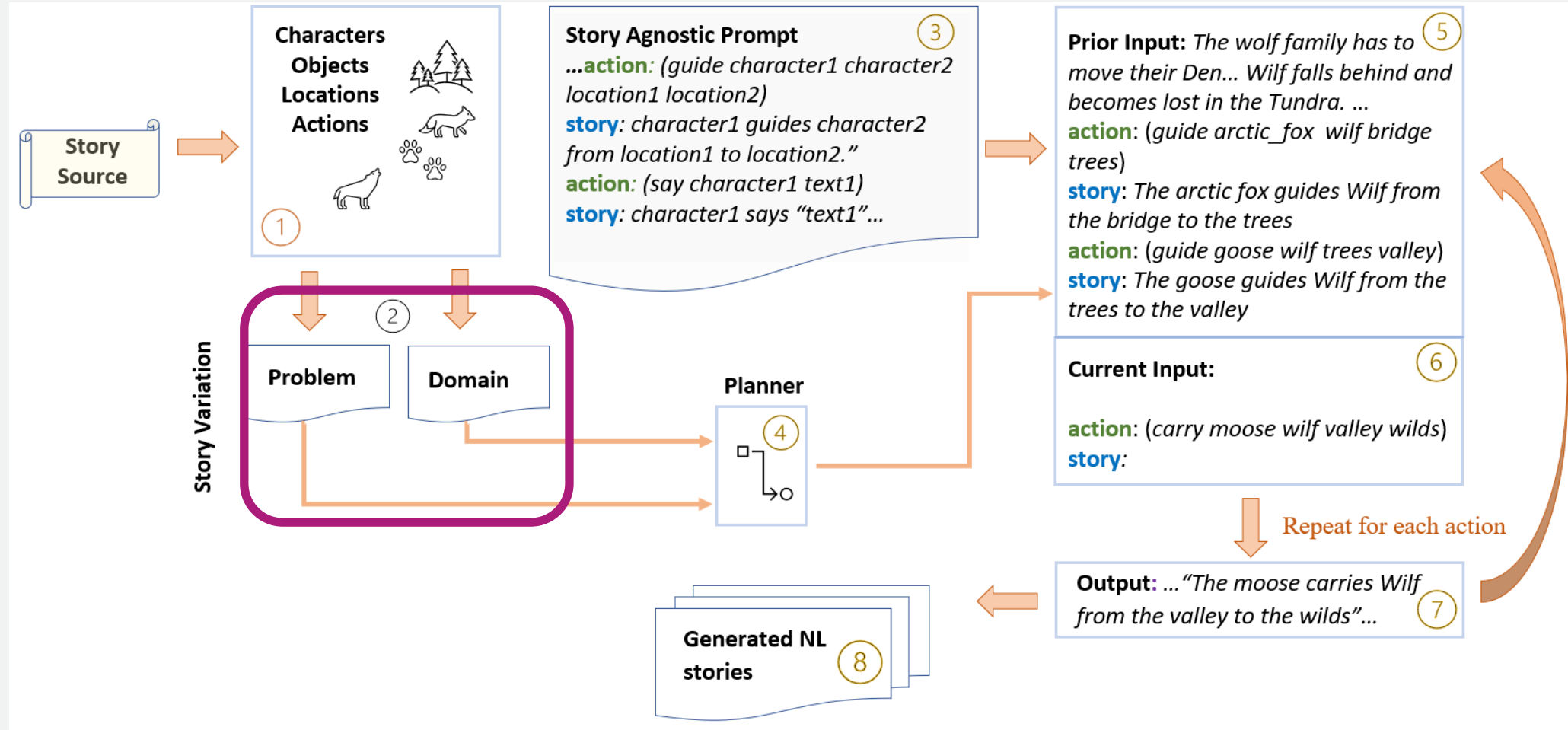
The Storyteller

Plan

Here's where I come in!

Large Input Datasets

LLM

Generated Text

The Storyteller

Characters Objects Locations Actions ①

Story Source

Story Agnostic Prompt ③
...**action**: *(guide character1 character2 location1 location2)*
story: *character1 guides character2 from location1 to location2."*
action: *(say character1 text1)*
story: *character1 says "text1"...*

Prior Input: *The wolf family has to move their Den... Wilf falls behind and becomes lost in the Tundra. ...*
action: *(guide arctic_fox wilf bridge trees)*
story: *The arctic fox guides Wilf from the bridge to the trees*
action: *(guide goose wilf trees valley)*
story: *The goose guides Wilf from the trees to the valley* ⑤

Story Variation

Problem | **Domain** ②

Planner ④

Current Input: ⑥

action: *(carry moose wilf valley wilds)*
story:

Repeat for each action

Output: *..."The moose carries Wilf from the valley to the wilds"...* ⑦

Generated NL stories ⑧

The Storyteller

Story Source

Characters Objects Locations Actions ①

Story Agnostic Prompt ③
...**action**: *(guide character1 character2 location1 location2)*
story: *character1 guides character2 from location1 to location2."*
action: *(say character1 text1)*
story: *character1 says "text1"...*

Prior Input: *The wolf family has to move their Den... Wilf falls behind and becomes lost in the Tundra. ...* ⑤
action: *(guide arctic_fox wilf bridge trees)*
story: *The arctic fox guides Wilf from the bridge to the trees*
action: *(guide goose wilf trees valley)*
story: *The goose guides Wilf from the trees to the valley*

Current Input: ⑥

action: *(carry moose wilf valley wilds)*
story:

② **Problem** **Domain**

Planner ④

Repeat for each action

Output: ..."*The moose carries Wilf from the valley to the wilds"...* ⑦

Generated NL stories ⑧

Story Variation

The Storyteller

The Storyteller

The Storyteller

The Storyteller

The Storyteller
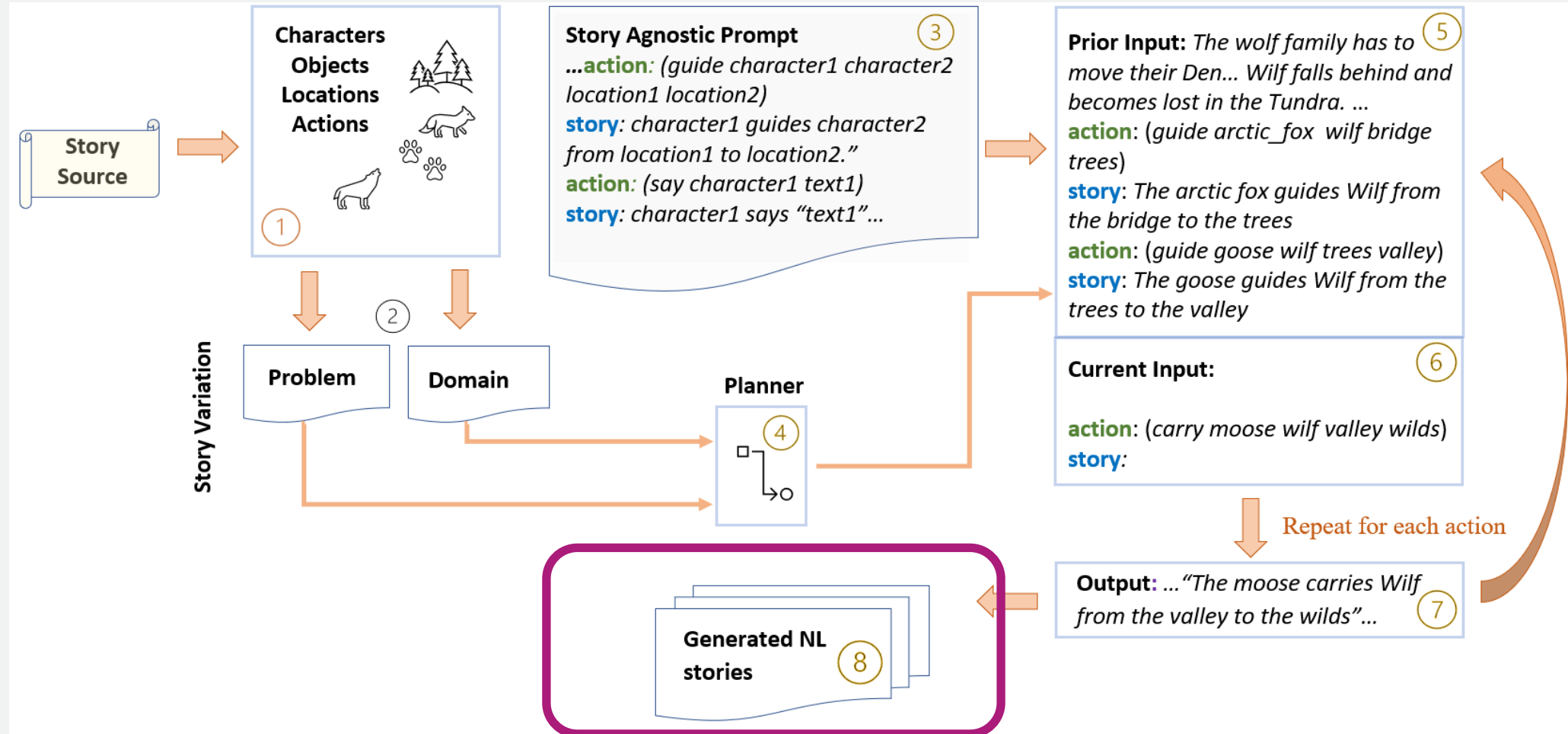
The Storyteller

The Storyteller

The Storyteller

Tell me a Story

Interactive Session!

Tell me a Story

Initial Story: The Way Home for Wolf

Let's hear a story about Wilf:
https://www.youtube.com/watch?v=Sqq8Hoz37VQ   *

(The authors claim no responsibility for the content of external sites)*

Tell me a Story

Initial Story: The Way Home for Wolf

Now let's extract the story elements:

Characters:
Objects:
Verbs:

Tell me a Story

Initial Story: The Way Home for Wolf

Characters: wilf, goose, moose...
Objects: --
Verbs: guide, carry...

Tell me a Story

Let's use the story elements to write some pddl using the Online Planning Editor:

In a browser, open the pddl online editor (load your own files):
https://editor.planning.domains/

Or

In a browser, open the session:
https://editor.planning.domains/#read_session=wO492qnhbg
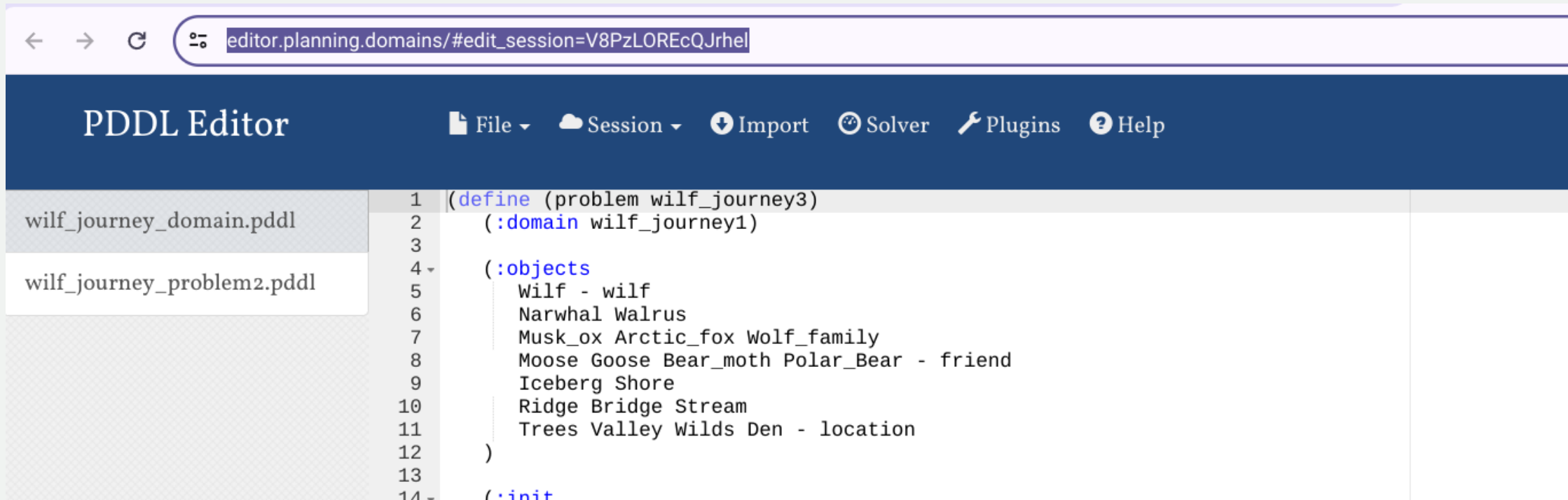
Tell me a Story
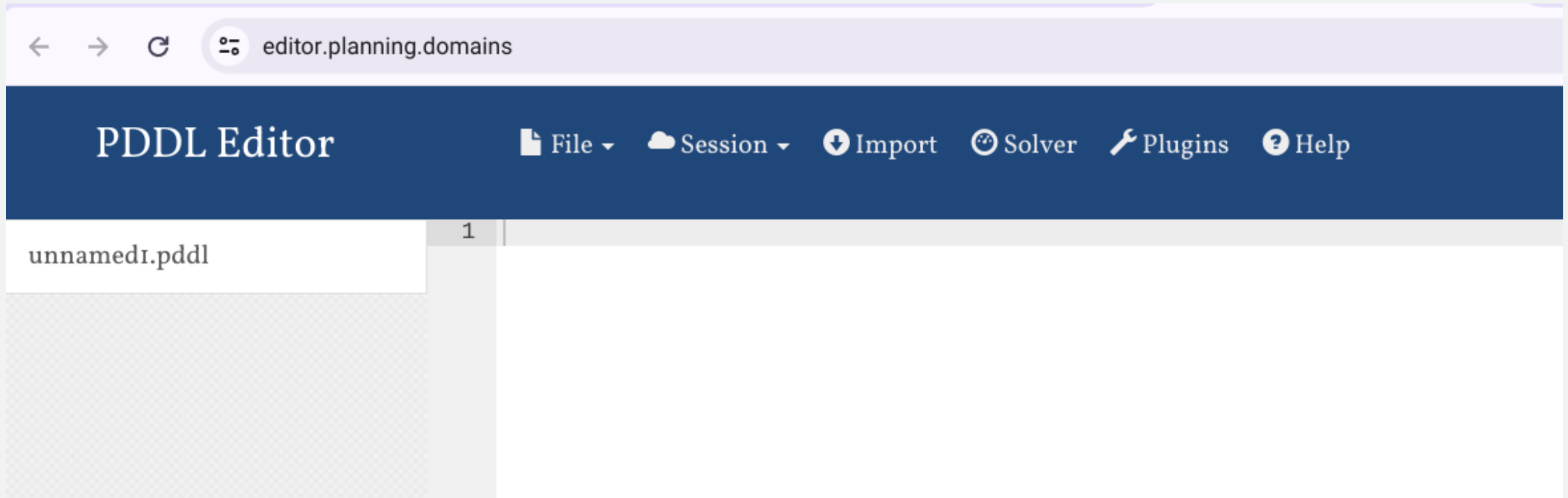
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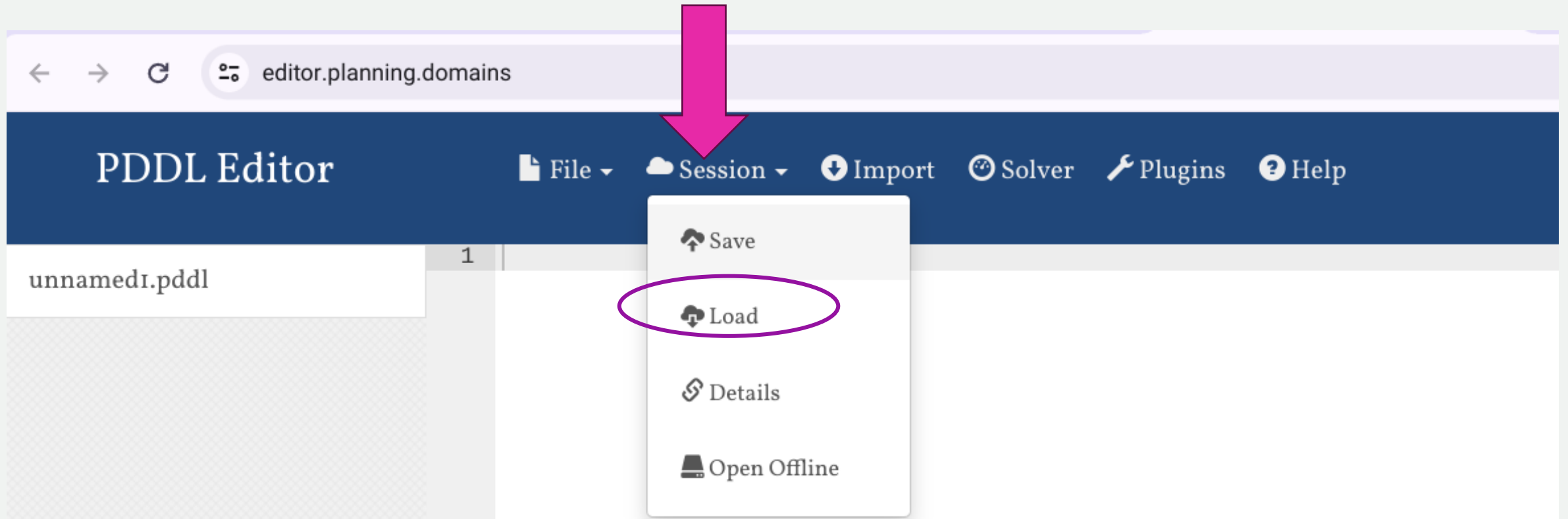
Tell me a Story

editor.planning.domains/#edit_session=V8PzLOREcQJrhel

PDDL Editor

📄 File ▾   ☁ Session ▾   ⬇ Import   ◎ Solver   🔧 Plugins   ❓ Help

wilf_journey_domain.pddl

wilf_journey_problem2.pddl

```
1  (define (problem wilf_journey3)
2      (:domain wilf_journey1)
3
4      (:objects
5          Wilf - wilf
6          Narwhal Walrus
7          Musk_ox Arctic_fox Wolf_family
8          Moose Goose Bear_moth Polar_Bear - friend
9          Iceberg Shore
10         Ridge Bridge Stream
11         Trees Valley Wilds Den - location
12     )
13
14     (:init
```
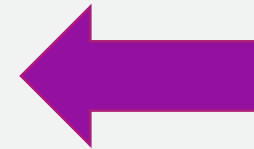
Tell me a Story

Tell me a Story

Tell me a Story

Initial Story: The Paper-bag Princess
(Robert Munsch, Annick Press, 1980)

Characters: princess, prince, dragon …
Objects: castle, clothes, paper bag…
Verbs: follow, breathe fire, burn, …

Tell me a Story

(attack_castle dragon clothes ronald)
(follow_dragon dragon clothes elizabeth paper_bag)
(charm_dragon dragon elizabeth)
(flatter_dragon dragon elizabeth)
(breathe_large_fire dragon)
(fly_fast dragon)
(fall_asleep dragon)
(rescue_prince ronald dragon)
(insult ronald elizabeth paper_bag)
(call_off_wedding elizabeth paper_bag)

Valid Plan

Tell me a Story

Interface to the LLM

Tell me a Story

```
Princess Elizabeth is a beautiful princess who lives in a magnificent castle.
Princess Elizabeth is engaged to marry Prince Ronald.

action: (attack_castle dragon clothes ronald)
story: The Dragon attacks and destroys the castle and Princess Elizabeth's
       clothes and the Dragon kidnaps Prince Ronald.

action: (follow_dragon dragon clothes elizabeth paper_bag)
story: Princess Elizabeth wears a paper bag because her clothes are destroyed,
       and she follows the Dragon.

action: (charm_dragon dragon elizabeth)
story:
```

Tell me a Story

```
Princess Elizabeth is a beautiful princess who lives in a magnificent castle.
Princess Elizabeth is engaged to marry Prince Ronald.

action: (attack_castle dragon clothes ronald)
story: The Dragon attacks and destroys the castle and Princess Elizabeth's
       clothes and the Dragon kidnaps Prince Ronald.

action: (follow_dragon dragon clothes elizabeth paper_bag)
story: Princess Elizabeth wears a paper bag because her clothes are destroyed,
       and she follows the Dragon.

action: (charm_dragon dragon elizabeth)
story:
```

Actions from the generated plan

Tell me a Story

```
Princess Elizabeth is a beautiful princess who lives in a magnificent castle.
Princess Elizabeth is engaged to marry Prince Ronald.

action: (attack_castle dragon clothes ronald)
story: The Dragon attacks and destroys the castle and Princess Elizabeth's
       clothes and the Dragon kidnaps Prince Ronald.

action: (follow_dragon dragon clothes elizabeth paper_bag)
story: Princess Elizabeth wears a paper bag because her clothes are destroyed,
       and she follows the Dragon.

action: (charm_dragon dragon elizabeth)
story:
```
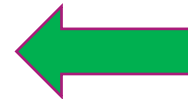
NL text or 'story' line

Can the LLM generate the next line of the story?

Tell me a Story

RESULT

Princess Elizabeth is a beautiful princess who lives in a magnificent castle. Princess Elizabeth is engaged to marry Prince Ronald.

action: (attack_castle dragon clothes ronald)
story: The Dragon attacks and destroys the castle and Princess Elizabeth's clothes and the Dragon kidnaps Prince Ronald.

action: (follow_dragon dragon clothes elizabeth paper_bag)
story: Princess Elizabeth wears a paper bag because her clothes are destroyed, and she follows the Dragon.

action: (charm_dragon dragon elizabeth)
story: Princess Elizabeth chases the Dragon, and it is charmed by Princess Elizabeth.

Tell me a Story

Princess Elizabeth is a beautiful princess who lives in a magnificent castle. Princess Elizabeth is engaged to marry Prince Ronald.
The Dragon attacks and destroys the castle and Princess Elizabeth's clothes and the Dragon kidnaps Prince Ronald.
Princess Elizabeth wears a paper bag because her clothes are destroyed, and she follows the Dragon.
Princess Elizabeth chases the Dragon, and it is charmed by Princess Elizabeth.
Princess Elizabeth flatters the Dragon, and the Dragon likes Princess Elizabeth.
The Dragon breathes large flames.
The Dragon flies fast.
The Dragon falls asleep.
Princess Elizabeth saves Prince Ronald from the Dragon.
Prince Ronald insults Princess Elizabeth, and she wears a paper bag because she is wearing no clothes.
Princess Elizabeth calls off the wedding, and she is wearing a paper bag.

The proof of the pudding….

Evaluation

Story	POS tag	Plan	LLM story
The Way Home for Wolf	Noun	18	18
	Verb	2	3
Robin Hood and the Golden Arrow	Noun	8	7
	Verb	6	7
Paper Bag Princess	Noun	6	7
	Verb	10	19

Table 3.3: Number of nouns and verbs found in the PDDL plan that are successfully captured in the LLM output

The proof of the pudding….

Evaluation

$$Precision = \frac{\#TotalRight}{\#TotalTagged}, \quad Recall = \frac{\#TotalRight}{\#TotalTruth}$$

$$F_1 = \frac{2 \times precision \times recall}{precision + recall}$$

(1)

"Common automated evaluation metrics for story generation such as perplexity and BLEU … only measure whether a generator can recreate the ground truth corpus."

(Castricato et al. 2021)

The proof of the pudding….

1. This story exhibits CORRECT GRAMMAR.

2. This story's events occur in a PLAUSIBLE ORDER.

3. This story's sentences MAKE SENSE given sentences before and after them.

4. This story AVOIDS REPETITION.

5. This story uses INTERESTING LANGUAGE.

6. This story is of HIGH QUALITY.

7. This story is ENJOYABLE.

8. This story REMINDS ME OF A SOAP OPERA.

9. This story FOLLOWS A SINGLE PLOT.

Likert scale
1. Strongly Disagree,
5. Strongly Agree

(Martin. 2018)

The proof of the pudding....

- Which story's events occur in a more PLAUSIBLE ORDER?

- Which story's sentences MAKE MORE SENSE given sentences before and after them?

- Which story better follows a SINGLE PLOT?

- Which story is of HIGHER QUALITY?

- Which story is more ENJOYABLE?

Pick between two stories

(Castricato et al. . 2021)
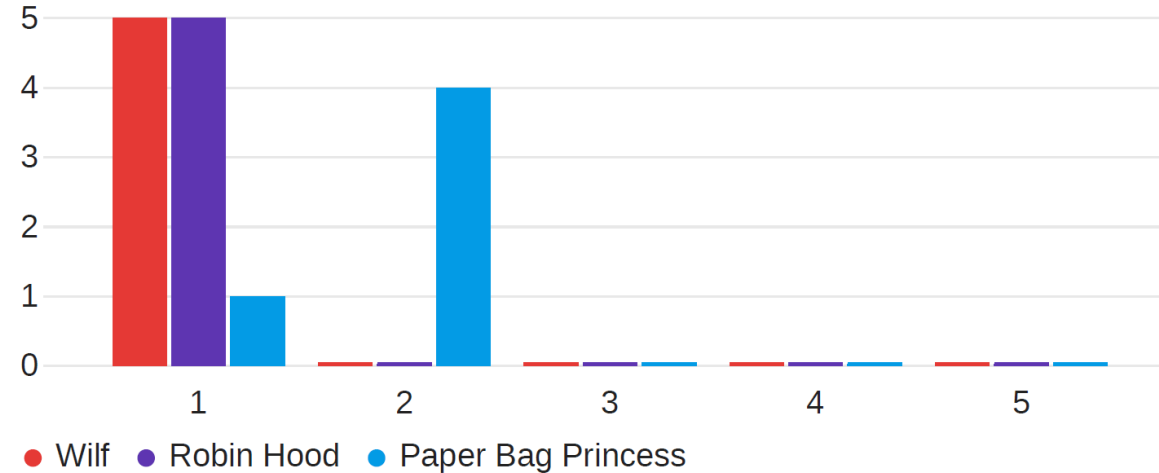
The proof of the pudding....

```
Please indicate your level of familiarity with the English Language:
     Beginner/Intermediate/Advanced:
1.   Story A is more believable than Story B.
2.   Story A uses language that is more fluent and coherent (flows
     better grammatically) than Story B.
3.   Story A is more enjoyable than Story B.
4.   Variation #1 on Story A seems consistent (stems logically from
     the original story).
5.   Variation #2 on Story A seems consistent.
6.   Variation #1 on Story B seems consistent.
7.   Variation #2 on Story B seems consistent.
8.   How could story A have been made more believable?
9.   How could story B have been made more believable?
10.  The author goal is the main goal of the story e.g. After being
     lost in the forest, the heroine of the story eventually finds her
     way back home.
          Story A achieves the author goal.
11.  Story B achieves the author goal.
```
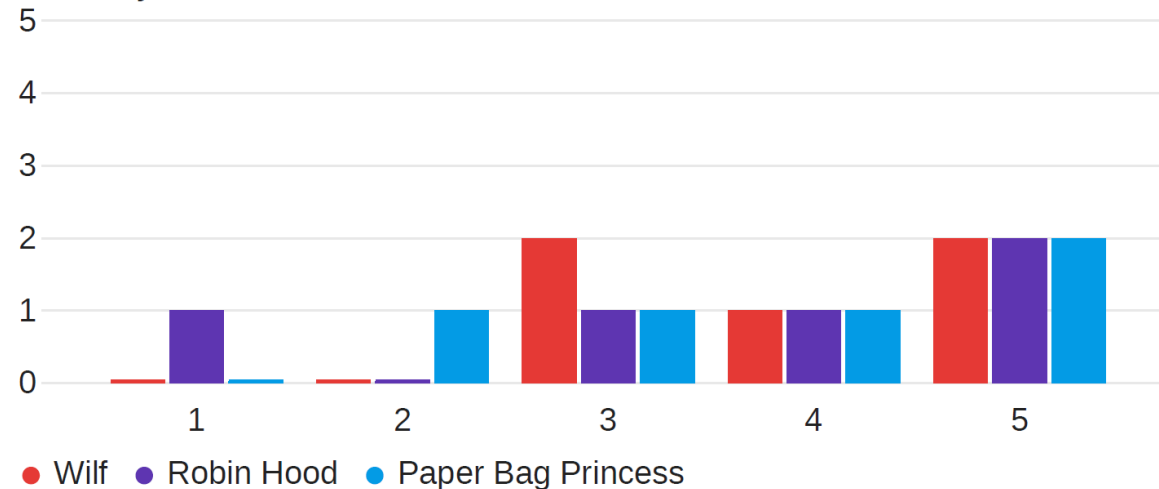
The proof of the pudding....
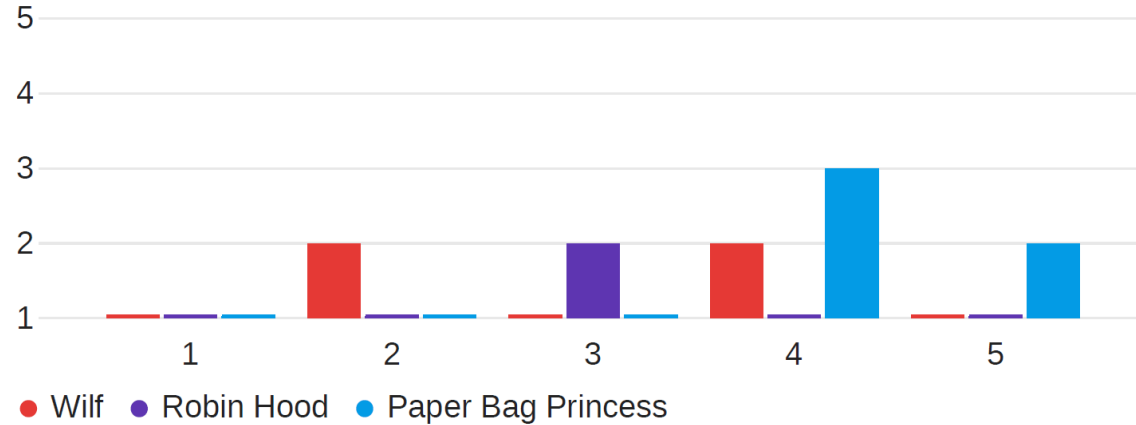

This story AVOIDS REPETITION - LLM only
- Wilf
- Robin Hood
- Paper Bag Princess

This story AVOIDS REPETITION - Plan and LLM
- Wilf
- Robin Hood
- Paper Bag Princess

The proof of the pudding....

This story's events occur in a PLAUSIBLE ORDER. - LLM only

● Wilf ● Robin Hood ● Paper Bag Princess

This story's events occur in a PLAUSIBLE ORDER.- Plan and LLM

● Wilf ● Robin Hood ● Paper Bag Princess
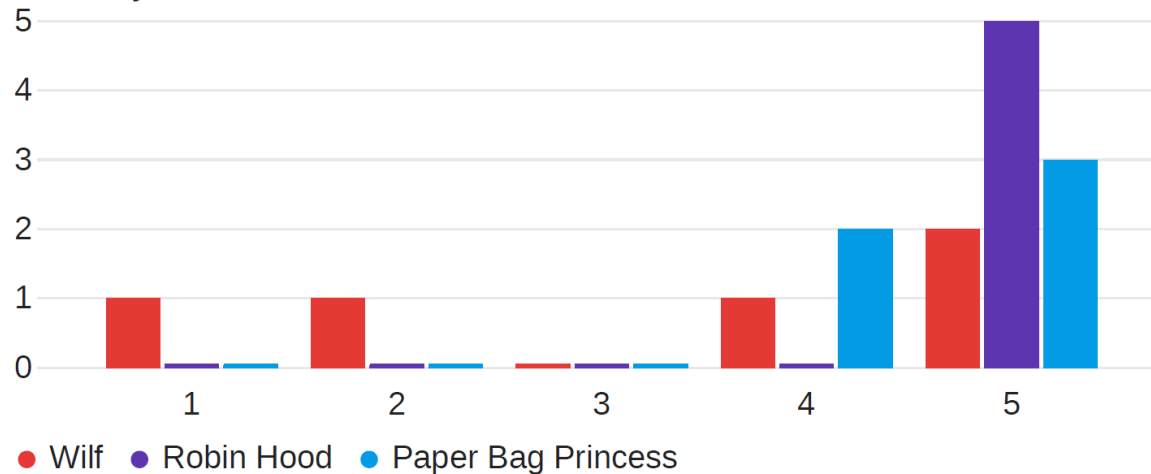
The proof of the pudding....

This story is of HIGH QUALITY. - LLM only

● Wilf ● Robin Hood ● Paper Bag Princess
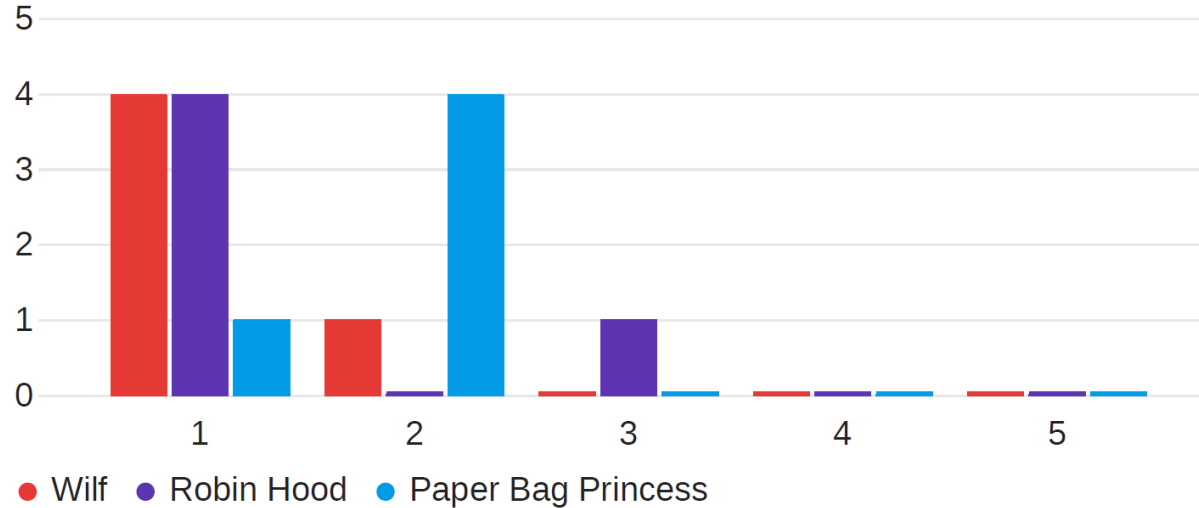
This story is of HIGH QUALITY. - Plan and LLM

● Wilf ● Robin Hood ● Paper Bag Princess
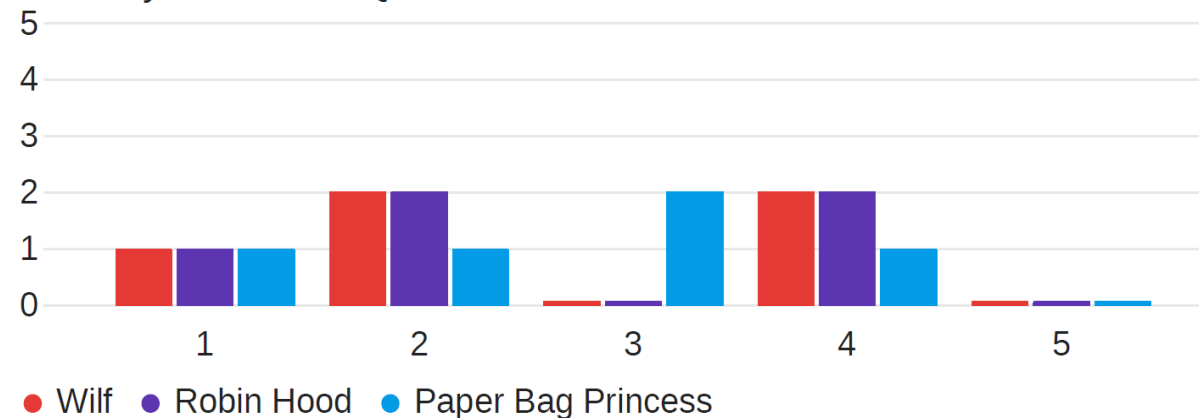
Stay Tuned!
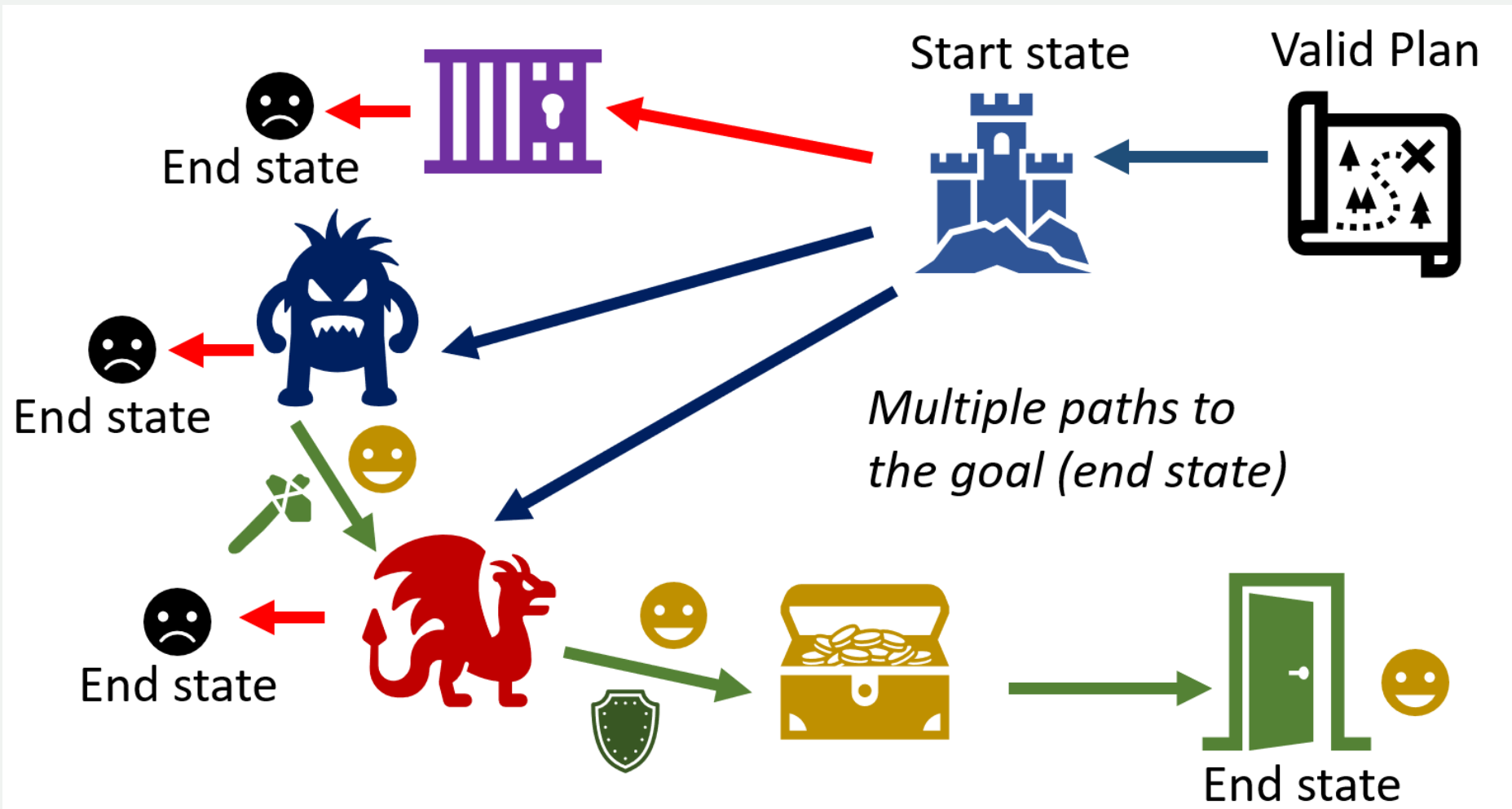
That's a Wrap...for now!

Overview

Part I - Presentation

Presenter : *Rogelio E. Cardona-Rivera*:

- Module 2 : FROM CLASSICAL TO NARRATIVE PLANNING

- Module 3 : MODELING CHARACTERS WITH INTENTION AND CONFLICT

- Module 4 : NARRATIVE DOMAINS AND EXPRESSIVE RANGE

Overview

Part II - Presentation

Presenter : *Nisha Simon*, Contributor : *Patrik Haslum*

- Module 5 : PLANNING FROM A FOCALIZED PERSPECTIVE – INTENTIONALITY

Presenter : *Nisha Simon*

- Module 6 : PLANNING FROM A CHARACTER'S POINT-OF-VIEW (CYOA)

Part III - Demo

Presenters : *Nisha Simon, Christian Muise, Rogelio E. Cardona-Rivera*

We hope you enjoy today's story!

Nisha Simon   https://nisimon48.github.io/

Christian Muise   https://www.haz.ca/

Rogelio E. Cardona-Rivera   http://rogel.io/

Arnav Jhala   https://arnav.wordpress.ncsu.edu/

Julie Porteous   https://porteousjulie.bitbucket.io/

R. Michael Young   https://liquidnarrative.eae.utah.edu/rmy/

Patrik Haslum   https://comp.anu.edu.au/people/patrik-haslum/