CIS 700 HW4 Write-Up

[redacted]

March 3rd, 2022

1. **What wikiHow article did you pick and why?**

   We chose the wikiHow article *How to Make Papyrus*. The article has a very clear end goal in mind, to make papyrus, and the steps to complete the task are also very straightforward. Also, one of our group members has previously taken a Roman history class, and in ancient Roman times papyrus was extensively used.

2. **What portions of the article did you select to translate to PDDL?**

   The article is split up into four parts: *Preparing to Make Papyrus*, *Making Papyrus*, *Finishing Papyrus*, and *Making Papyrus with Children*. We decided not to include anything from *Making Papyrus with Children* since we felt it was less relevant to the goal of making legitimate papyrus, and maybe could have been a separate wikiHow article. Because the steps for each part were very simple (e.g. Obtain a papyrus plant, cut the stalks, peel away the outer layer of the papyrus plant, etc.), we decided to combine some of the steps in each part, and have each of the three main parts of the article each be a separate problem.

   For the first part, *Preparing to Make Papyrus*, we combine the steps *obtain a papyrus plant (step1)*, *lay the papyrus plant strips on a hard, flat surface (step 2)*, and *roll the excess water and sugar out of the plant (step 3)* into the problem *preparing papyrus*.

   For the second part, *Making Papyrus*, we combine the steps *place the papyrus plant strips in water (step 1)*, *roll the excess water and sugar out of the plant (step 3)*, *weave the strips together (step 4)*, and *place the bundle between 2 wooden boards (step 5)* into the problem *soak and flatten papyrus strips*.

   For the third part, *Finishing the Papyrus*, we combine the steps *flatten the sheet (step 1)*, *polish the papyrus (step 2)*, and *cut the paper (step 3)* into the problem *finishing papyrus*.

3. **Give some example of the actions, types, and predicates you used in your domain.**

   Action Examples:

   (a) Pour Water:

```
(:action pour_water ; pour water into bowl
    :parameters (?p - player)
    :precondition (and (inventory ?p water) (inventory ?p bowl))
    :effect (and (inventory ?p bowl_of_water) (not (inventory ?p water)) (not (
    inventory ?p bowl)))
)

```

   This action represents the player pouring water into a bowl, which needs to be completed in order for the papyrus strips to be soaked. The player must have both water and a bowl in their inventory in order to perform the action. The action results in the player having a bowl of water added to their inventory, while the water and bowl items are removed from their inventory (since they combine to form the bowl of water).

   (b) Cut Papyrus:

```
(:action cut_papyrus ; Use a scissor to cut the papyrus paper.
    :parameters (?p - player ?pap - papyrus ?s - scissors)
    :precondition (and (inventory ?p ?pap) (inventory ?p ?s) (paper_flattened ?pap
    ))
    :effect  (cut ?pap)
)

```

This action represents the player cutting the papyrus paper so that it is properly shaped as a rectangle. For this action to be performed by the player, they must have the papyrus paper and scissors in their inventory. The almost finished papyrus paper must also be flattened before this action can be performed. The action results in the papyrus being cut and trimmed into a rectangular shape.

Type Examples:

(a) roller: item that is used to flatten papyrus strips

(b) scissors: item used to cut papyrus into strips

(c) bowl_of_water combination of water and bowl items after water is poured into the bowl

(d) player: the person who is making the papyrus strips

Predicate Examples:

(a) (strips_between_boards): checks if papyrus strips have been placed between the wooden boards

(b) (strips_woven): checks if the papyrus strips have been woven together, which needs to be true before the strips are placed between the wooden boards

(c) (polished ?papyrus): checks that the papyrus has been polished

(d) (cut ?papyrus): checks that the finished papyrus paper has been trimmed

4. **Explain what goal you selected for your problem, and give the initial state and solution that you created.**
The goals for the first problem was (and (inventory npc papyrus_strips)).
The initial state was
(:objects
npc - player
kitchen refrigerator cabinet - location
east west north south - direction
papyrus_tree - papyrus_tree
bowl - bowl

water - water
bowl_of_water - bowl_of_water
refrigerator - item
scissors - scissors
papyrus_stalks - papyrus_stalks
papyrus_strips - papyrus_strips

) (:init
(connected kitchen east refrigerator)
(connected refrigerator west kitchen)
(connected kitchen north cabinet)
(connected cabinet south kitchen)
(at npc kitchen)
(at water refrigerator)
(at bowl cabinet)

(at papyrus_tree kitchen)
(at scissors kitchen)
)

and the generated solution was
get scissors npc kitchen
cut_stalks npc papyrus_tree kitchen papyrus_stalks
papyrus_strips npc papyrus_tree kitchen papyrus_stalks papyrus_strips

5. **What limitations of PDDL did you encounter that makes it difficult to precisely convert a wikiHow description into PDDL?**

   One difficulty we faced was taking multiple options to doing a task and then converting it to one specific action in the PDDL. For example, one of our tasks involves polishing the papyrus to make it look smoother. This task can use ivory, stones and shells, which constitute multiple actions. However, saying that polishing by shell and polishing by stone are so similar that PDDL should merge these actions into one. But these actions are not so similar that they fit neatly to a single object. Therefore, PDDL has a hard time representing similar, but not quite the same actions.

6. **Could your PDDL be used as an interesting challenge for a text-adventure-style game? If so, how? If not, what would needed to create an interesting challenge?**

   Making papyrus would likely be a fun challenge for text adventure style games, especially if they are set during or before the middle ages. However, the wikiHow article itself does not make for a particularly interesting challenge, since it just describes the steps necessary to make papyrus. It would be more interesting, for example, if there was a challenge in the game to find all of the items required making papyrus. The items could be scattered throughout the game's locations and could perhaps be initially hidden. Essentially, finding the items necessary for making papyrus could be turned into puzzles.

7. **Discuss how you might use GPT-3 to automatically or semi-automatically convert a wikiHow article to PDDL?**

   One conversion method would be training two different GPT-3 models: one that takes in the entire wikiHow description and returns possible domains based on the article. The other model would take in a domain and a description of a step, then generate a relevant problem appropriate to the domain. The domain model is trained on a dataset that features WikiHow articles as input, as well as various parameters such as number of actions, number of objects etc. Then the output would be a provisional domain.

   The problem generating model takes in a domain and a WikiHow step as an input. The expected input consists of objects, initialized properties and finally a goal all based on what is happening in the WikiHow step.