CS312 Lab 9 Report

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I. OVERVIEW

This report elaborates on the Goal Stack Planning algorithm implemented in Python, the output it produces for the sample inputs and a visualisation of the algorithm on a particular test case.

II. PSEUDO-CODE

relevant_action(*predicate*)

if *predicate* **is** "on x y":
    return "stack x y"

else if *predicate* **is** "ontable x":
    return "putdown x"

else if *predicate* **is** "hold x":
    if *ontable(x)* **is True**:
        return "pick x"
    else:
        return "unstack x y" **such that** *on(x, y)* **is true**

else if *predicate* **is** "clear x":
    if *hold(x)* **is True**:
        return "putdown x"
    else:
        return "unstack y x" **such that** *on(y, x)* **is true**

else if *predicate* **is** "AE":
    return "putdown x" **such that** *hold(x)* **is True**

goal_state_planning(*goal_state*)

push goal and its predicates individually to stack

plan **=** ϕ

while *stack* **not empty**:
    x **<-** *stack.pop()*

if *x* **is** *set of predicates* **and** *x*∩ *current_state* **!=** *x*:

push x and its predicates individually to stack

if *x* **is** *a predicate* **and** *x* **not in** *current_state*:

rel_act **<-** *relevant_action(x)*

push rel_act's precond and its predicates individually to stack

if *x* **is** *an action*:

add effects^{+} of rel_act to current_state and remove effects^{-} of rel_act from current_state

plan **<-** *plan* **+** *x*

return *plan*

III. I/O FOR SAMPLE FILES

Input1.txt	**Output1.txt**
4 (on b a)^(ontable a)^(ontable c)^(ontable d)^(AE) (on c a)^(on b d)^(ontable a)^(ontable d)	(unstack b a) (putdown b) (stack c a) (stack b d)

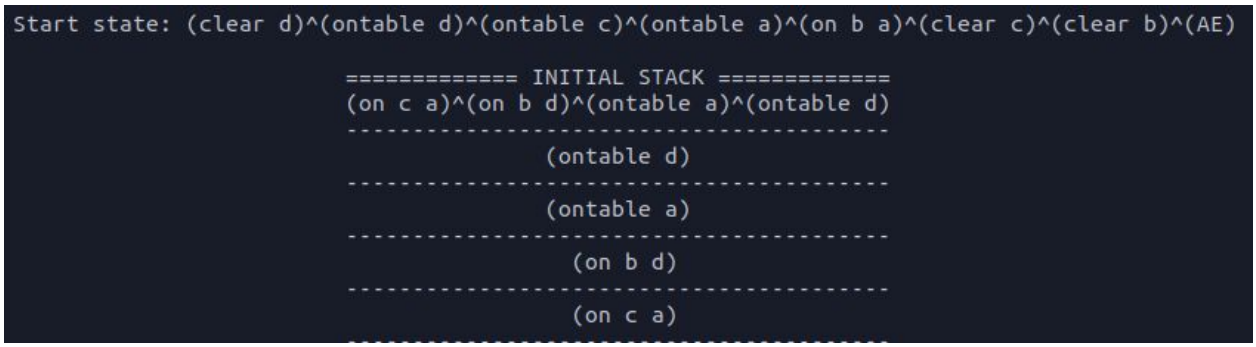
Input2.txt	**Output2.txt**
4 (ontable a)^(ontable b)^(ontable c)^(ontable d) (on a b)^(on b c)^(on c d)	(stack a b) (unstack a b) (putdown a) (stack b c) (unstack b c) (putdown b) (stack c d) (stack a b) (unstack a b) (putdown a) (stack b c) (stack a b)

Input3.txt	**Output3.txt**
3 (ontable a)^(ontable b)^(ontable c)	(stack a b) (unstack a b)

(on a b)^(on b c)	(putdown a) (stack b c) (stack a b)

IV. STACK VISUALISATION

Note - Goal and its predicates have been pushed to stack, start state has been defined. Also, clear(x) for every x is added by default. If on(y, x) is true, clear(x) is removed.



```
                                    Iteration: 1
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on b a)^(clear b)

                                Stack popped: (on c a)

      (on c a) doesn't hold, push relevant action (stack c a) and its preconds to stack

                          ================= STACK =================
                          (on c a)^(on b d)^(ontable a)^(ontable d)
                          ----------------------------------------
                                        (ontable d)
                          ----------------------------------------
                                        (ontable a)
                          ----------------------------------------
                                         (on b d)
                          ----------------------------------------
                                        (stack c a)
                          ----------------------------------------
                                 (clear c)^(clear a)^(AE)
                          ----------------------------------------
                                           (AE)
                          ----------------------------------------
                                        (clear a)
                          ----------------------------------------
                                        (clear c)
                          ----------------------------------------
```

```
                                    Iteration: 2
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on b a)^(clear b)

                                Stack popped: (clear c)

                               (clear c) holds, do nothing

                          ================= STACK =================
                          (on c a)^(on b d)^(ontable a)^(ontable d)
                          ----------------------------------------
                                        (ontable d)
                          ----------------------------------------
                                        (ontable a)
                          ----------------------------------------
                                         (on b d)
                          ----------------------------------------
                                        (stack c a)
                          ----------------------------------------
                                 (clear c)^(clear a)^(AE)
                          ----------------------------------------
                                           (AE)
                          ----------------------------------------
                                        (clear a)
                          ----------------------------------------
```

```
                                    Iteration: 3
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on b a)^(clear b)

                                Stack popped: (clear a)

     (clear a) doesn't hold, push relevant action (unstack b a) and its preconds to stack

                           ================= STACK =================
                           (on c a)^(on b d)^(ontable a)^(ontable d)
                           ----------------------------------------
                                        (ontable d)
                           ----------------------------------------
                                        (ontable a)
                           ----------------------------------------
                                          (on b d)
                           ----------------------------------------
                                        (stack c a)
                           ----------------------------------------
                                 (clear c)^(clear a)^(AE)
                           ----------------------------------------
                                           (AE)
                           ----------------------------------------
                                      (unstack b a)
                           ----------------------------------------
                                 (on b a)^(clear b)^(AE)
                           ----------------------------------------
                                           (AE)
                           ----------------------------------------
                                        (clear b)
                           ----------------------------------------
                                         (on b a)
                           ----------------------------------------
```

```
                                    Iteration: 4
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on b a)^(clear b)

                                  Stack popped: (on b a)

                                (on b a) holds, do nothing

                           ================= STACK =================
                           (on c a)^(on b d)^(ontable a)^(ontable d)
                           ----------------------------------------
                                        (ontable d)
                           ----------------------------------------
                                        (ontable a)
                           ----------------------------------------
                                          (on b d)
                           ----------------------------------------
                                        (stack c a)
                           ----------------------------------------
                                 (clear c)^(clear a)^(AE)
                           ----------------------------------------
                                           (AE)
                           ----------------------------------------
                                      (unstack b a)
                           ----------------------------------------
                                 (on b a)^(clear b)^(AE)
                           ----------------------------------------
                                           (AE)
                           ----------------------------------------
                                        (clear b)
                           ----------------------------------------
```

```
                                    Iteration: 5
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on b a)^(clear b)

                                Stack popped: (clear b)

                               (clear b) holds, do nothing

                            ================ STACK ================
                            (on c a)^(on b d)^(ontable a)^(ontable d)
                            ---------------------------------------
                                          (ontable d)
                            ---------------------------------------
                                          (ontable a)
                            ---------------------------------------
                                            (on b d)
                            ---------------------------------------
                                          (stack c a)
                            ---------------------------------------
                                   (clear c)^(clear a)^(AE)
                            ---------------------------------------
                                              (AE)
                            ---------------------------------------
                                        (unstack b a)
                            ---------------------------------------
                                   (on b a)^(clear b)^(AE)
                            ---------------------------------------
                                              (AE)
                            ---------------------------------------
```

```
                                    Iteration: 6
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on b a)^(clear b)

                                   Stack popped: (AE)

                                  (AE) holds, do nothing

                            ================ STACK ================
                            (on c a)^(on b d)^(ontable a)^(ontable d)
                            ---------------------------------------
                                          (ontable d)
                            ---------------------------------------
                                          (ontable a)
                            ---------------------------------------
                                            (on b d)
                            ---------------------------------------
                                          (stack c a)
                            ---------------------------------------
                                   (clear c)^(clear a)^(AE)
                            ---------------------------------------
                                              (AE)
                            ---------------------------------------
                                        (unstack b a)
                            ---------------------------------------
                                   (on b a)^(clear b)^(AE)
                            ---------------------------------------
```

```
                                    Iteration: 7
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on b a)^(clear b)

                          Stack popped: (on b a)^(clear b)^(AE)

                           Popped conjunction holds, do nothing

                        ================= STACK =================
                        (on c a)^(on b d)^(ontable a)^(ontable d)
                        ----------------------------------------
                                      (ontable d)
                        ----------------------------------------
                                      (ontable a)
                        ----------------------------------------
                                        (on b d)
                        ----------------------------------------
                                      (stack c a)
                        ----------------------------------------
                                (clear c)^(clear a)^(AE)
                        ----------------------------------------
                                          (AE)
                        ----------------------------------------
                                     (unstack b a)
                        ----------------------------------------
```

```
                                    Iteration: 8
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on b a)^(clear b)

                                 Stack popped: (unstack b a)

                               Popped action (unstack b a) added to plan

                               ================= STACK =================
                               (on c a)^(on b d)^(ontable a)^(ontable d)
                               ----------------------------------------
                                             (ontable d)
                               ----------------------------------------
                                             (ontable a)
                               ----------------------------------------
                                               (on b d)
                               ----------------------------------------
                                             (stack c a)
                               ----------------------------------------
                                       (clear c)^(clear a)^(AE)
                               ----------------------------------------
                                                 (AE)
                               ----------------------------------------
```

```
                                    Iteration: 9
Current state: (ontable c)^(clear d)^(hold b)^(clear a)^(ontable a)^(ontable d)^(clear c)

                                Stack popped: (AE)

      (AE) doesn't hold, push relevant action (putdown b) and its preconds to stack

                        ================= STACK =================
                        (on c a)^(on b d)^(ontable a)^(ontable d)
                        ----------------------------------------
                                    (ontable d)
                        ----------------------------------------
                                    (ontable a)
                        ----------------------------------------
                                      (on b d)
                        ----------------------------------------
                                    (stack c a)
                        ----------------------------------------
                                (clear c)^(clear a)^(AE)
                        ----------------------------------------
                                    (putdown b)
                        ----------------------------------------
                                      (hold b)
                        ----------------------------------------
                                      (hold b)
                        ----------------------------------------
```

```
                                Iteration: 11
Current state: (ontable c)^(clear d)^(hold b)^(clear a)^(ontable a)^(ontable d)^(clear c)

                            Stack popped: (hold b)

                        Popped conjunction holds, do nothing

                       ================ STACK ================
                       (on c a)^(on b d)^(ontable a)^(ontable d)
                       ---------------------------------------
                                    (ontable d)
                       ---------------------------------------
                                    (ontable a)
                       ---------------------------------------
                                      (on b d)
                       ---------------------------------------
                                    (stack c a)
                       ---------------------------------------
                              (clear c)^(clear a)^(AE)
                       ---------------------------------------
                                    (putdown b)
                       ---------------------------------------
```

```
                                Iteration: 12
Current state: (ontable c)^(clear d)^(hold b)^(clear a)^(ontable a)^(ontable d)^(clear c)

                            Stack popped: (putdown b)

                        Popped action (putdown b) added to plan

                       ================ STACK ================
                       (on c a)^(on b d)^(ontable a)^(ontable d)
                       ---------------------------------------
                                    (ontable d)
                       ---------------------------------------
                                    (ontable a)
                       ---------------------------------------
                                      (on b d)
                       ---------------------------------------
                                    (stack c a)
                       ---------------------------------------
                              (clear c)^(clear a)^(AE)
                       ---------------------------------------
```

```
                                Iteration: 13
Current state: (ontable c)^(clear d)^(clear a)^(ontable a)^(AE)^(ontable d)^(clear c)^(clear b)^(ontable b)

                            Stack popped: (clear c)^(clear a)^(AE)

                          Popped conjunction holds, do nothing

                         ================ STACK ================
                         (on c a)^(on b d)^(ontable a)^(ontable d)
                         ---------------------------------------
                                      (ontable d)
                         ---------------------------------------
                                      (ontable a)
                         ---------------------------------------
                                        (on b d)
                         ---------------------------------------
                                      (stack c a)
                         ---------------------------------------
```

```
                                        Iteration: 14
Current state: (ontable c)^(clear d)^(clear a)^(ontable a)^(AE)^(ontable d)^(clear c)^(clear b)^(ontable b)

                                  Stack popped: (stack c a)

                                Popped action (stack c a) added to plan

                               ================ STACK ================
                               (on c a)^(on b d)^(ontable a)^(ontable d)
                               ---------------------------------------
                                           (ontable d)
                               ---------------------------------------
                                           (ontable a)
                               ---------------------------------------
                                             (on b d)
                               ---------------------------------------
```

```
                                        Iteration: 15
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                                    Stack popped: (on b d)

          (on b d) doesn't hold, push relevant action (stack b d) and its preconds to stack

                               ================ STACK ================
                               (on c a)^(on b d)^(ontable a)^(ontable d)
                               ---------------------------------------
                                           (ontable d)
                               ---------------------------------------
                                           (ontable a)
                               ---------------------------------------
                                           (stack b d)
                               ---------------------------------------
                                      (clear b)^(clear d)^(AE)
                               ---------------------------------------
                                             (AE)
                               ---------------------------------------
                                           (clear d)
                               ---------------------------------------
                                           (clear b)
                               ---------------------------------------
```

```
                                        Iteration: 16
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                                    Stack popped: (clear b)

                                  (clear b) holds, do nothing

                               ================ STACK ================
                               (on c a)^(on b d)^(ontable a)^(ontable d)
                               ---------------------------------------
                                           (ontable d)
                               ---------------------------------------
                                           (ontable a)
                               ---------------------------------------
                                           (stack b d)
                               ---------------------------------------
                                      (clear b)^(clear d)^(AE)
                               ---------------------------------------
                                             (AE)
                               ---------------------------------------
                                           (clear d)
                               ---------------------------------------
```

```
                                        Iteration: 17
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                                  Stack popped: (clear d)

                                 (clear d) holds, do nothing

                                ================ STACK ================
                                (on c a)^(on b d)^(ontable a)^(ontable d)
                                ---------------------------------------
                                            (ontable d)
                                ---------------------------------------
                                            (ontable a)
                                ---------------------------------------
                                            (stack b d)
                                ---------------------------------------
                                     (clear b)^(clear d)^(AE)
                                ---------------------------------------
                                                (AE)
                                ---------------------------------------
```

```
                                        Iteration: 18
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                                     Stack popped: (AE)

                                   (AE) holds, do nothing

                                ================ STACK ================
                                (on c a)^(on b d)^(ontable a)^(ontable d)
                                ---------------------------------------
                                            (ontable d)
                                ---------------------------------------
                                            (ontable a)
                                ---------------------------------------
                                            (stack b d)
                                ---------------------------------------
                                     (clear b)^(clear d)^(AE)
                                ---------------------------------------
```

```
                                        Iteration: 19
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                                Stack popped: (clear b)^(clear d)^(AE)

                                  Popped conjunction holds, do nothing

                                ================ STACK ================
                                (on c a)^(on b d)^(ontable a)^(ontable d)
                                ---------------------------------------
                                            (ontable d)
                                ---------------------------------------
                                            (ontable a)
                                ---------------------------------------
                                            (stack b d)
                                ---------------------------------------
```

```
                                        Iteration: 20
Current state: (ontable c)^(clear d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                                  Stack popped: (stack b d)

                                 Popped action (stack b d) added to plan

                                ================ STACK ================
                                (on c a)^(on b d)^(ontable a)^(ontable d)
                                ---------------------------------------
                                            (ontable d)
                                ---------------------------------------
                                            (ontable a)
                                ---------------------------------------
```

```
                                    Iteration: 21
Current state: (ontable c)^(on b d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                                Stack popped: (ontable a)

                               (ontable a) holds, do nothing

                             ================= STACK =================
                             (on c a)^(on b d)^(ontable a)^(ontable d)
                             ----------------------------------------
                                          (ontable d)
                             ----------------------------------------
```

```
                                    Iteration: 22
Current state: (ontable c)^(on b d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                                Stack popped: (ontable d)

                               (ontable d) holds, do nothing

                             ================= STACK =================
                             (on c a)^(on b d)^(ontable a)^(ontable d)
                             ----------------------------------------
```

```
                                    Iteration: 23
Current state: (ontable c)^(on b d)^(ontable a)^(AE)^(ontable d)^(clear c)^(on c a)^(clear b)^(ontable b)

                        Stack popped: (on c a)^(on b d)^(ontable a)^(ontable d)

                           Popped conjunction holds, do nothing

                             ================= STACK =================
```

Plan Obtained

```
================== PLAN ==================
                (unstack b a)
------------------------------------------
                (putdown b)
------------------------------------------
                (stack c a)
------------------------------------------
                (stack b d)
------------------------------------------
```