Artificial intelligence - Project 3
- Limbaje de planificare -

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1 PLANIFICARE RESTAURANT

1.1 Enuntul problemei

Problema de planificare aleasa consta in prepararea diferitelor feluri de mancare la un restaurant. Planificatorul are rolul de a gasi cea mai simpla varianta de preluare si prelucrare a ingredientelor astfel incat servirea preparatelor sa fie cat mai rapida. Preparatele restaurantului au retete asemanatoare si fiecare ingredient necesita preparare identica, anume toate legumele folosite trebuie taiate, toate garniturile trebuie fierte si toate mancarurile trebuie servite in farfurii curate. Fiecare mod de preparare necesita un tip de container diferit, iar fiecare preparat are in componenta sa ingrediente diferite. Am incorporat in problema costuri ale actiuniilor, astfel ca o actiune de maruntire a legumelor este desigur mai costisitoare decat o actiune de ridicare a tocatorului de pe masa.

Domeniul:

```
1   (define (domain restaurant)
2     (:requirements :strips :typing :action-costs)
3     (:types hand container food - object
4       salad  ingredient riceWithVegetables meatWithRice pastaWithVegetables meatWithSalad - food
5             vegetable garnish meat - ingredient
6             tomato onion cucumber garlic - vegetable
7             rice pasta - garnish
8             pot mixingbowl chopper plate - container)
9
10    (:predicates  (ontable ?c - container)
11                  (holding ?h - hand ?o - object)
12                  (chopped ?v - vegetable)
13                  (boiled ?g - garnish)
14                  (cooked ?m - meat)
15                      (handempty ?h - hand)
16                      (contains ?c - container ?f - food)
17                      (inFridge ?i - ingredient)
18                      (clean ?c - container)
19                      (readyToServe ?f - food))
20
21
22  (:functions (total-cost) - number)
23
24    (:action grab-from-table
25              :parameters (?h - hand ?c - container)
26              :precondition (and (ontable ?c)
27                                 (handempty ?h))
28              :effect (and (not (ontable ?c))
29                                     (not (handempty ?h))
30                                   (holding ?h ?c)
31                      (increase (total-cost) 1)))
32
33    (:action drop-on-table
34              :parameters (?h - hand ?c - container)
35              :precondition (holding ?h ?c)
36              :effect (and (not (holding ?h ?c))
37                                     (handempty ?h)
38                                   (ontable ?c)
39                      (increase (total-cost) 1)))
40
41        (:action grab-from-fridge
```

```
        :parameters (?h - hand ?i - ingredient)
        :precondition (and (inFridge ?i)
                           (handempty ?h))
        :effect (and (not (inFridge ?i))
                                 (not (handempty ?h))
                             (holding ?h ?i)
                      (increase (total-cost) 1)))

(:action drop-ingredient
        :parameters (?h1 ?h2 - hand ?i - ingredient ?c - container)
        :precondition (and (holding ?h1 ?i)
                           (holding ?h2 ?c))
        :effect (and (contains ?c ?i)
                                    (handempty ?h1)
                             (not (holding ?h1 ?i))
                      (increase (total-cost) 1)))

(:action switch-container
        :parameters (?h1 ?h2 - hand ?f - food ?c1 ?c2 - container)
        :precondition (and (holding ?h1 ?c1)
                           (holding ?h2 ?c2)
                           (contains ?c1 ?f)
                          ( not(contains ?c2 ?f)))
        :effect (and (contains ?c2 ?f)
                     (not (contains ?c1 ?f))
                     (increase (total-cost) 1)))

(:action chop-ingredient
        :parameters (?h1 ?h2 - hand ?v - vegetable ?c - chopper)
        :precondition (and (holding ?h1 ?c)
                           (contains ?c ?v)
                           (handempty ?h2)
                           (not(chopped ?v)))
        :effect (and (chopped ?v)
                     (increase (total-cost) 8)))

(:action boil-ingredient
        :parameters (?h1 ?h2 - hand ?g - garnish ?p - pot)
        :precondition (and (holding ?h1 ?p)
                           (contains ?p ?g)
                           (handempty ?h2)
                           )
        :effect (and (boiled ?g)
                     (increase (total-cost) 10)))

(:action cook-meat
         :parameters (?h1 ?h2 - hand ?m - meat ?p - pot)
         :precondition (and (holding ?h1 ?p)
                            (contains ?p ?m)
                            (handempty ?h2))
               :effect (and (cooked ?m)
                        (increase (total-cost) 15)))
```

```
96
97
98     (:action make-salad
99            :parameters (?h1 ?h2 - hand  ?t - tomato ?c - cucumber ?o - onion ?g - garlic ?mb - mixingl
100           :precondition (and (holding ?h1 ?mb)
101                              (contains ?mb ?t)
102                              (contains ?mb ?c)
103                              (contains ?mb ?o)
104                              (contains ?mb ?g)
105                              (chopped ?t)
106                              (chopped ?c)
107                              (chopped ?o)
108                              (chopped ?g)
109                              (handempty ?h2)

111                              )
112           :effect (and
113                         (contains ?mb ?f)
114                         (increase (total-cost) 3)))
115
116
117     (:action serve-salad
118           :parameters (?h1  - hand ?s - salad  ?p - plate)
119           :precondition (and (holding ?h1 ?p)
120                              (clean ?p)
121                              (contains ?p ?s))
122           :effect (and
123                         (not (clean ?p))
124                         (readyToServe ?s)
125                         (increase (total-cost) 1)))
126
127
128
129     (:action make-rice
130           :parameters (?h1 ?h2 - hand ?r - rice  ?o - onion ?g - garlic ?mb - mixingbowl ?f - riceWit
131           :precondition (and (holding ?h1 ?mb)
132                              (contains ?mb ?o)
133                              (contains ?mb ?g)
134                              (contains ?mb ?r)
135                              (boiled ?r)
136                              (chopped ?o)
137                              (chopped ?g)
138                              (handempty ?h2) )
139           :effect (and (contains ?mb ?f)
140                         (increase (total-cost) 3)))
141
142
143     (:action serve-rice
144           :parameters (?h1  - hand ?r - riceWithVegetables  ?p - plate)
145           :precondition (and (holding ?h1 ?p)
146                              (clean ?p)
147                              (contains ?p ?r))
148           :effect (and
149                         (not (clean ?p))
```

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```
                              (readyToServe ?r)
                              (increase (total-cost) 1)))




    (:action make-pasta
            :parameters (?h1 ?h2 - hand ?p - pasta  ?t - tomato ?g - garlic ?mb - mixingbowl ?f - pasta
            :precondition (and (holding ?h1 ?mb)
                               (contains ?mb ?t)
                               (contains ?mb ?g)
                               (contains ?mb ?p)
                               (boiled ?p)
                               (chopped ?t)
                               (chopped ?g)
                               (handempty ?h2) )
            :effect (and (contains ?mb ?f)
                         (increase (total-cost) 3)))


      (:action serve-pasta
            :parameters (?h1  - hand ?f - pastaWithVegetables  ?p - plate)
            :precondition (and (holding ?h1 ?p)
                               (clean ?p)
                               (contains ?p ?f))
            :effect (and
                         (not (clean ?p))
                         (readyToServe ?f)
                         (increase (total-cost) 1)))



  (:action make-rice-with-meat
            :parameters (?h1 ?h2 - hand ?r - rice  ?o - onion ?g - garlic ?m - meat ?mb - mixingbowl ?:
            :precondition (and (holding ?h1 ?mb)
                               (contains ?mb ?o)
                               (contains ?mb ?g)
                               (contains ?mb ?r)
                               (contains ?mb ?m)
                               (cooked ?m)
                               (boiled ?r)
                               (chopped ?o)
                               (chopped ?g)
                               (handempty ?h2) )
            :effect (and (contains ?mb ?f)
                         (increase (total-cost) 3)))




  (:action serve-rice-with-meat
            :parameters (?h1  - hand ?m - meatWithRice  ?p - plate)
            :precondition (and (holding ?h1 ?p)
                               (clean ?p)
                               (contains ?p ?m))
```

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```
204              :effect (and (not (clean ?p))
205                            (readyToServe ?m)
206                            (increase (total-cost) 1)))
207
208
209    (:action make-salad-with-meat
210            :parameters (?h1 ?h2 - hand  ?t - tomato ?c - cucumber ?o - onion ?g - garlic ?m - meat ?mb
211            :precondition (and (holding ?h1 ?mb)
212                                (contains ?mb ?t)
213                                (contains ?mb ?c)
214                                (contains ?mb ?o)
215                                (contains ?mb ?g)
216                                (contains ?mb ?m)
217                                (cooked ?m)
218                                (chopped ?t)
219                                (chopped ?c)
220                                (chopped ?o)
221                                (chopped ?g)
222                                (handempty ?h2)
223
224                                )
225            :effect (and
226                        (contains ?mb ?f)
227                        (increase (total-cost) 3)))
228
229
230      (:action serve-salad-with-meat
231            :parameters (?h1  - hand ?s - meatWithSalad ?p - plate)
232            :precondition (and (holding ?h1 ?p)
233                                (clean ?p)
234                                (contains ?p ?s))
235            :effect (and
236                        (not (clean ?p))
237                        (readyToServe ?s)
238                        (increase (total-cost) 1)))
239
240
241
242    (:action clean-container
243                :parameters (?h1 ?h2 - hand ?c - container)
244          :precondition (and (holding ?h1 ?c)
245                              ;(handempty ?h2)
246                              (not (empty ?c))
247                              (not (clean ?c)))
248          :effect (and (clean ?c)
249                      (empty ?c)
250                      (increase (total-cost) 5)))
251  )
```

Implementare:

- Am introdus tipurile in domeniu pentru a putea implementa cu usurinta actiunile necesare.
  Am implementat 3 tipuri de baza, anume mana container-ul si mancarea care sunt de tipul obiect,
  iar container-ul are mai multe subtipuri anume oala, bol pentru amestecarea ingredientelor, tocator si
  farfurie. De asemenea mancarea are si ea subtipul ingredient si preparatele finale. Subtipul ingredient

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contine si el mai multe subtipuri care reprezinta tipurile de ingrediente folosite legume, garnitura si carne. Am specificat in subtipul de legume rosia, ceapa , castravetele si usturloiul, iar ca si garnituri am ales pastele si orezul.

Predicatele folosite sunt onTable folosit pentru tipul container, holding pentru a stii daca intr-o mana avem un container, chopped pentru legume, boiled pentru garnituri, cooked pentru carne, handempty pentru mana , empty pentru container , contains pentru a verifica daca mancarea se afla in continer, in fridge daca ingredientul este in firgider, clean daca continerul e curat si readyToServe daca mancarea este pregatita.

Am implementat urmatoarele actiuni :

- grab-from-table: verifica daca containerul este pe masa, iar daca exista o mana libera va lua continerul in mana.(cost 1)

-drop-on-table: daca in mana se afla un container, acesta va fi lasat pe masa si mana se va elibera.(cost 1)

-grab-from-fridge: daca exista o mana libera si ingredientul este in frigider atunci acesta va fi luat in mana libera.(cost 1)

-drop-ingredient daca intr-o mana avem un container si in cealata un ingredient vom plasa ingredientul in containerrezultand o mana libera.(cost 1)

-switch-continer: se va muta un ingredient dintr-un container in celalat.(cost 1)

-chop-ingredient: daca leguma se afla in tocator si o mana este libera, atunci ingredientul v-a fi maruntit(cost 8).

-boil-ingredient: daca garnitura se afla in oala si o mana este libera, atunci ingredientul v-a fi fiert(cost 10).

-cook-meat: daca carnea se afla in oala si o mana este libera, atunci ingredientul v-a fi gatit(cost 15).

-actiunile de tip make-food (make-salad, make-salad-with-meat,etc.) verifica daca o mana e libera si daca in cealata se afla un bol cu ingredientele necesare fiecareii retete si daca acestea au fost preparate corespunzator si executa reteta specificata, in bol aflandu-se acum preparatul final.(cost 3)

-actiunile de tip serve-food (serve-salad, serve-salad-with-meat,etc.)

verifica daca se afla in farfurie mancarea respectiva si daca farfuria este sau nu curata, in caz afirmativ mancarea este gata de a fi servita(cost 1)

-clean-container- se verifica daca exista containerul dorit intr-o mana si daca cealata e goala, daca este murdar atunci actiunea va rezulta in curatarea acestuia (cost 5)

Problema 1:

```
1  (define (problem prob)
2    (:domain restaurant)
3    (:objects
4
5      left right - hand
6      chopper1  - chopper
7      mixingbowl1  - mixingbowl
8      pot1 - pot
9      plate1 plate2 - plate
10     tomato1 - tomato
11     onion1 onion2 - onion
12     garlic1 garlic2 - garlic
13     pasta1 - pasta
14     rice1 - rice
15     riceWithVegetables1 - riceWithVegetables
16     pastaWithVegetables1 - pastaWithVegetables
17
18 )
19   (:init
20     (= (total-cost) 0)
```

```
21    (ontable pot1)
22    (ontable chopper1)
23    (ontable mixingbowl1)
24    (ontable plate1)
25    (ontable plate2)
26    (clean plate1)
27    (clean plate2)
28    (handempty left)
29    (handempty right)
30    (inFridge tomato1)
31    (inFridge onion1)
32    (inFridge onion2)
33    (inFridge garlic1)
34    (inFridge garlic2)
35    (inFridge rice1)
36    (inFridge pasta1)
37
38
39  )
40   (:goal
41    (and
42
43
44      (readyToServe pastaWithVegetables1)
45      (readyToServe riceWithVegetables1)
46
47
48
49  ))
50  (:metric minimize (total-cost)))
```

Solutia pentru problema 1 folosind Weighted Astar: . –heuristic "h=ff()" –search "astar(weight(h, 3))" Solutia gasita are 43 de pasi si costul 86.

```
1   grab-from-table left chopper1 (1)
2   grab-from-fridge right garlic1 (1)
3   drop-ingredient right left garlic1 chopper1 (1)
4   chop-ingredient left right garlic1 chopper1 (8)
5   grab-from-fridge right onion1 (1)
6   drop-ingredient right left onion1 chopper1 (1)
7   chop-ingredient left right onion1 chopper1 (8)
8   grab-from-fridge right tomato1 (1)
9   drop-ingredient right left tomato1 chopper1 (1)
10  chop-ingredient left right tomato1 chopper1 (8)
11  grab-from-fridge right pasta1 (1)
12  drop-ingredient right left pasta1 chopper1 (1)
13  grab-from-table right mixingbowl1 (1)
14  switch-container left right pasta1 chopper1 mixingbowl1 (1)
15  switch-container left right tomato1 chopper1 mixingbowl1 (1)
16  switch-container left right onion1 chopper1 mixingbowl1 (1)
17  switch-container left right garlic1 chopper1 mixingbowl1 (1)
18  drop-on-table left chopper1 (1)
19  grab-from-fridge left rice1 (1)
20  drop-ingredient left right rice1 mixingbowl1 (1)
```

```
21  grab-from-table left pot1 (1)
22  switch-container right left rice1 mixingbowl1 pot1 (1)
23  drop-on-table right mixingbowl1 (1)
24  boil-ingredient left right rice1 pot1 (10)
25  grab-from-table right mixingbowl1 (1)
26  switch-container left right rice1 pot1 mixingbowl1 (1)
27  drop-on-table left pot1 (1)
28  make-rice right left rice1 onion1 garlic1 mixingbowl1 ricewithvegetables1 (3)
29  grab-from-table left plate1 (1)
30  switch-container right left ricewithvegetables1 mixingbowl1 plate1 (1)
31  serve-rice left ricewithvegetables1 plate1 (1)
32  drop-on-table left plate1 (1)
33  grab-from-table left pot1 (1)
34  switch-container right left pasta1 mixingbowl1 pot1 (1)
35  drop-on-table right mixingbowl1 (1)
36  boil-ingredient left right pasta1 pot1 (10)
37  grab-from-table right mixingbowl1 (1)
38  switch-container left right pasta1 pot1 mixingbowl1 (1)
39  drop-on-table left pot1 (1)
40  make-pasta right left pasta1 tomato1 garlic1 mixingbowl1 pastawithvegetables1 (3)
41  grab-from-table left plate2 (1)
42  switch-container right left pastawithvegetables1 mixingbowl1 plate2 (1)
43  serve-pasta left pastawithvegetables1 plate2 (1)
```

Solutia pentru problema 1 folosind aStar : . −heuristic "h=ff()" −search "astar(h)"
Solutia gasita are 36 de pasi si costul 79.

```
1   grab-from-table left chopper1 (1)
2   grab-from-fridge right garlic1 (1)
3   drop-ingredient right left garlic1 chopper1 (1)
4   chop-ingredient left right garlic1 chopper1 (8)
5   grab-from-fridge right onion1 (1)
6   drop-ingredient right left onion1 chopper1 (1)
7   chop-ingredient left right onion1 chopper1 (8)
8   grab-from-fridge right tomato1 (1)
9   drop-ingredient right left tomato1 chopper1 (1)
10  chop-ingredient left right tomato1 chopper1 (8)
11  drop-on-table left chopper1 (1)
12  grab-from-table left pot1 (1)
13  grab-from-fridge right pasta1 (1)
14  drop-ingredient right left pasta1 pot1 (1)
15  boil-ingredient left right pasta1 pot1 (10)
16  grab-from-fridge right rice1 (1)
17  drop-ingredient right left rice1 pot1 (1)
18  boil-ingredient left right rice1 pot1 (10)
19  grab-from-table right mixingbowl1 (1)
20  switch-container left right rice1 pot1 mixingbowl1 (1)
21  switch-container left right pasta1 pot1 mixingbowl1 (1)
22  drop-on-table left pot1 (1)
23  grab-from-table left chopper1 (1)
24  switch-container left right tomato1 chopper1 mixingbowl1 (1)
25  switch-container left right onion1 chopper1 mixingbowl1 (1)
26  switch-container left right garlic1 chopper1 mixingbowl1 (1)
27  drop-on-table left chopper1 (1)
```

```
28   make-pasta right left pasta1 tomato1 garlic1 mixingbowl1 pastawithvegetables1 (3)
29   make-rice right left rice1 onion1 garlic1 mixingbowl1 ricewithvegetables1 (3)
30   grab-from-table left plate1 (1)
31   switch-container right left ricewithvegetables1 mixingbowl1 plate1 (1)
32   serve-rice left ricewithvegetables1 plate1 (1)
33   drop-on-table left plate1 (1)
34   grab-from-table left plate2 (1)
35   switch-container right left pastawithvegetables1 mixingbowl1 plate2 (1)
36   serve-pasta left pastawithvegetables1 plate2 (1)
```

Problema 2:

```
1    (define (problem prob)
2     (:domain restaurant)
3     (:objects
4
5       left right - hand
6       chopper1  - chopper
7       mixingbowl1  - mixingbowl
8       pot1 - pot
9       plate1 plate2 - plate
10      tomato1 - tomato
11      onion1 onion2 - onion
12      garlic1 garlic2 - garlic
13      cucumber1 - cucumber
14      pasta1 - pasta
15      rice1 - rice
16      salad1 salad2 - salad
17      riceWithVegetables1 - riceWithVegetables
18      pastaWithVegetables1 - pastaWithVegetables
19
20   )
21    (:init
22    (= (total-cost) 0)
23    (ontable pot1)
24    (ontable chopper1)
25    (ontable mixingbowl1)
26    (ontable plate1)
27    (ontable plate2)
28    (clean plate1)
29    (clean plate2)
30    (handempty left)
31    (handempty right)
32    (inFridge tomato1)
33    (inFridge onion1)
34    (inFridge onion2)
35    (inFridge garlic1)
36    (inFridge garlic2)
37    (inFridge cucumber1)
38    (inFridge rice1)
39    (inFridge pasta1)
40    (inFridge meat1)
41
42   )
43    (:goal
```

```
44    (and
45
46
47      (readyToServe pastaWithVegetables1)
48      (readyToServe riceWithVegetables1)
49      (readyToServe salad1)
50      (readyToServe salad2)
51
52
53
54    ))
55    (:metric minimize (total-cost)))
```

Solutia pentru problema 2 folosind Weighted Astar: . –heuristic "h=ff()" –search "astar(weight(h, 3))" Solutia gasita are 62 de pasi si costul 124.

```
1    grab-from-table left chopper1 (1)
2    grab-from-fridge right garlic1 (1)
3    drop-ingredient right left garlic1 chopper1 (1)
4    chop-ingredient left right garlic1 chopper1 (8)
5    grab-from-fridge right onion1 (1)
6    drop-ingredient right left onion1 chopper1 (1)
7    chop-ingredient left right onion1 chopper1 (8)
8    grab-from-fridge right cucumber1 (1)
9    drop-ingredient right left cucumber1 chopper1 (1)
10   chop-ingredient left right cucumber1 chopper1 (8)
11   grab-from-fridge right tomato1 (1)
12   drop-ingredient right left tomato1 chopper1 (1)
13   chop-ingredient left right tomato1 chopper1 (8)
14   grab-from-fridge right pasta1 (1)
15   drop-ingredient right left pasta1 chopper1 (1)
16   grab-from-table right mixingbowl1 (1)
17   switch-container left right pasta1 chopper1 mixingbowl1 (1)
18   switch-container left right tomato1 chopper1 mixingbowl1 (1)
19   switch-container left right onion1 chopper1 mixingbowl1 (1)
20   switch-container left right garlic1 chopper1 mixingbowl1 (1)
21   switch-container left right cucumber1 chopper1 mixingbowl1 (1)
22   drop-on-table left chopper1 (1)
23   make-salad right left tomato1 cucumber1 onion1 garlic1 mixingbowl1 salad1 (3)
24   make-salad right left tomato1 cucumber1 onion1 garlic1 mixingbowl1 salad2 (3)
25   grab-from-fridge left rice1 (1)
26   drop-ingredient left right rice1 mixingbowl1 (1)
27   grab-from-table left plate1 (1)
28   switch-container right left salad2 mixingbowl1 plate1 (1)
29   serve-salad left salad2 plate1 (1)
30   drop-on-table left plate1 (1)
31   grab-from-table left plate2 (1)
32   switch-container right left salad1 mixingbowl1 plate2 (1)
33   drop-on-table left plate2 (1)
34   grab-from-table left pot1 (1)
35   switch-container right left rice1 mixingbowl1 pot1 (1)
36   drop-on-table right mixingbowl1 (1)
37   boil-ingredient left right rice1 pot1 (10)
38   grab-from-table right mixingbowl1 (1)
```

```
39  switch-container left right rice1 pot1 mixingbowl1 (1)
40  drop-on-table left pot1 (1)
41  make-rice right left rice1 onion1 garlic1 mixingbowl1 ricewithvegetables1 (3)
42  grab-from-table left plate2 (1)
43  switch-container right left ricewithvegetables1 mixingbowl1 plate2 (1)
44  drop-on-table left plate2 (1)
45  grab-from-table left pot1 (1)
46  switch-container right left pasta1 mixingbowl1 pot1 (1)
47  drop-on-table right mixingbowl1 (1)
48  boil-ingredient left right pasta1 pot1 (10)
49  grab-from-table right mixingbowl1 (1)
50  switch-container left right pasta1 pot1 mixingbowl1 (1)
51  drop-on-table left pot1 (1)
52  make-pasta right left pasta1 tomato1 garlic1 mixingbowl1 pastawithvegetables1 (3)
53  grab-from-table left plate2 (1)
54  switch-container right left pastawithvegetables1 mixingbowl1 plate2 (1)
55  drop-on-table right mixingbowl1 (1)
56  grab-from-table right plate1 (1)
57  switch-container left right salad1 plate2 plate1 (1)
58  clean-container right left plate1 (5)
59  serve-rice left ricewithvegetables1 plate2 (1)
60  clean-container left left plate2 (5)
61  serve-pasta left pastawithvegetables1 plate2 (1)
62  serve-salad right salad1 plate1 (1)
63  Plan length: 62 step(s).
64  Plan cost: 124
```

Problema 3:

```
1   (define (problem prob)
2    (:domain restaurant)
3    (:objects
4
5      left right - hand
6      chopper1  - chopper
7      mixingbowl1  - mixingbowl
8      pot1 - pot
9      plate1 plate2 - plate
10     tomato1 - tomato
11     onion1 onion2 - onion
12     garlic1 garlic2 - garlic
13     pasta1 - pasta
14     rice1 - rice
15     riceWithVegetables1 - riceWithVegetables
16     pastaWithVegetables1 - pastaWithVegetables
17
18  )
19   (:init
20    (= (total-cost) 0)
21    (ontable pot1)
22    (ontable chopper1)
23    (ontable mixingbowl1)
24    (ontable plate1)
25    (ontable plate2)
26    (clean plate1)
```

```
27    (clean plate2)
28    (handempty left)
29    (handempty right)
30    (inFridge tomato1)
31    (inFridge onion1)
32    (inFridge onion2)
33    (inFridge garlic1)
34    (inFridge garlic2)
35    (inFridge rice1)
36    (inFridge pasta1)
37
38
39  )
40   (:goal
41    (and
42
43
44     (readyToServe pastaWithVegetables1)
45     (readyToServe riceWithVegetables1)
46
47
48
49  ))
50  (:metric minimize (total-cost)))
```

Solutia pentru problema 3 folosind Weighted Astar: . –heuristic "h=ff()" –search "astar(weight(h, 3))" Solutia gasita are 24 de pasi si costul 49.

```
1   grab-from-table left chopper1 (1)
2   grab-from-fridge right garlic1 (1)
3   drop-ingredient right left garlic1 chopper1 (1)
4   chop-ingredient left right garlic1 chopper1 (8)
5   grab-from-fridge right tomato1 (1)
6   drop-ingredient right left tomato1 chopper1 (1)
7   chop-ingredient left right tomato1 chopper1 (8)
8   grab-from-table right mixingbowl1 (1)
9   switch-container left right tomato1 chopper1 mixingbowl1 (1)
10  switch-container left right garlic1 chopper1 mixingbowl1 (1)
11  drop-on-table left chopper1 (1)
12  grab-from-fridge left pasta1 (1)
13  drop-ingredient left right pasta1 mixingbowl1 (1)
14  grab-from-table left pot1 (1)
15  switch-container right left pasta1 mixingbowl1 pot1 (1)
16  drop-on-table right mixingbowl1 (1)
17  boil-ingredient left right pasta1 pot1 (10)
18  grab-from-table right mixingbowl1 (1)
19  switch-container left right pasta1 pot1 mixingbowl1 (1)
20  drop-on-table left pot1 (1)
21  make-pasta right left pasta1 tomato1 garlic1 mixingbowl1 pastawithvegetables1 (3)
22  grab-from-table left plate1 (1)
23  switch-container right left pastawithvegetables1 mixingbowl1 plate1 (1)
24  serve-pasta left pastawithvegetables1 plate1 (1)
25  Plan length: 24 step(s).
26   Plan cost: 49
```

Solutia pentru problema 3 folosind aStar : . −heuristic "h=ff()" −search "astar(h)"
Solutia gasita are 23 de pasi si costul 48.

```
1   grab-from-fridge left garlic1 (1)
2   grab-from-table right chopper1 (1)
3   drop-ingredient left right garlic1 chopper1 (1)
4   chop-ingredient right left garlic1 chopper1 (8)
5   grab-from-fridge left tomato1 (1)
6   drop-ingredient left right tomato1 chopper1 (1)
7   chop-ingredient right left tomato1 chopper1 (8)
8   grab-from-table left pot1 (1)
9   drop-on-table right chopper1 (1)
10  grab-from-fridge right pasta1 (1)
11  drop-ingredient right left pasta1 pot1 (1)
12  boil-ingredient left right pasta1 pot1 (10)
13  grab-from-table right mixingbowl1 (1)
14  switch-container left right pasta1 pot1 mixingbowl1 (1)
15  drop-on-table left pot1 (1)
16  grab-from-table left chopper1 (1)
17  switch-container left right tomato1 chopper1 mixingbowl1 (1)
18  switch-container left right garlic1 chopper1 mixingbowl1 (1)
19  drop-on-table left chopper1 (1)
20  make-pasta right left pasta1 tomato1 garlic1 mixingbowl1 pastawithvegetables1 (3)
21  grab-from-table left plate1 (1)
22  switch-container right left pastawithvegetables1 mixingbowl1 plate1 (1)
23  serve-pasta left pastawithvegetables1 plate1 (1)
24   Plan length: 23 step(s).
25  Plan cost: 48
```

Solutia pentru problema 3 folosind goal count si eager greedy
Solutia gasita are 32 de pasi si costul 57.

```
1   grab-from-table left plate1 (1)
2   grab-from-fridge right garlic1 (1)
3   drop-ingredient right left garlic1 plate1 (1)
4   grab-from-fridge right tomato1 (1)
5   drop-ingredient right left tomato1 plate1 (1)
6   grab-from-table right pot1 (1)
7   drop-on-table left plate1 (1)
8   grab-from-fridge left pasta1 (1)
9   drop-ingredient left right pasta1 pot1 (1)
10  boil-ingredient right left pasta1 pot1 (10)
11  grab-from-table left plate1 (1)
12  switch-container right left pasta1 pot1 plate1 (1)
13  drop-on-table right pot1 (1)
14  grab-from-table right chopper1 (1)
15  switch-container left right tomato1 plate1 chopper1 (1)
16  switch-container left right garlic1 plate1 chopper1 (1)
17  drop-on-table left plate1 (1)
18  chop-ingredient right left tomato1 chopper1 (8)
19  chop-ingredient right left garlic1 chopper1 (8)
20  grab-from-table left plate1 (1)
21  switch-container right left tomato1 chopper1 plate1 (1)
```

```
22  switch-container right left garlic1 chopper1 plate1 (1)
23  drop-on-table right chopper1 (1)
24  grab-from-table right mixingbowl1 (1)
25  switch-container left right tomato1 plate1 mixingbowl1 (1)
26  switch-container left right pasta1 plate1 mixingbowl1 (1)
27  switch-container left right garlic1 plate1 mixingbowl1 (1)
28  drop-on-table left plate1 (1)
29  make-pasta right left pasta1 tomato1 garlic1 mixingbowl1 pastawithvegetables1 (3)
30  grab-from-table left plate1 (1)
31  switch-container right left pastawithvegetables1 mixingbowl1 plate1 (1)
32  serve-pasta left pastawithvegetables1 plate1 (1)
33   Plan length: 32 step(s).
34  Plan cost: 57
```

Concluzii:

- In toate cazurile testate folosirea euristicii aStar a condus la un rezultat cu cost minim. Weighted aAstar a produs rezultate asemanatoare cu aStar si in unele cazuri, cum ar fi pentru problema 2 a ajuns mult mai repede la rezultat ca si aStar deoarece a expandat mai putine noduri, insa am putut observa ca de multe ori face actiunii inutile . Euristica cu goalCount si eagerGreedy nu a excelant nici din punct de vedere al costului obtinut nici din punct de vedere al timpului de rulare.