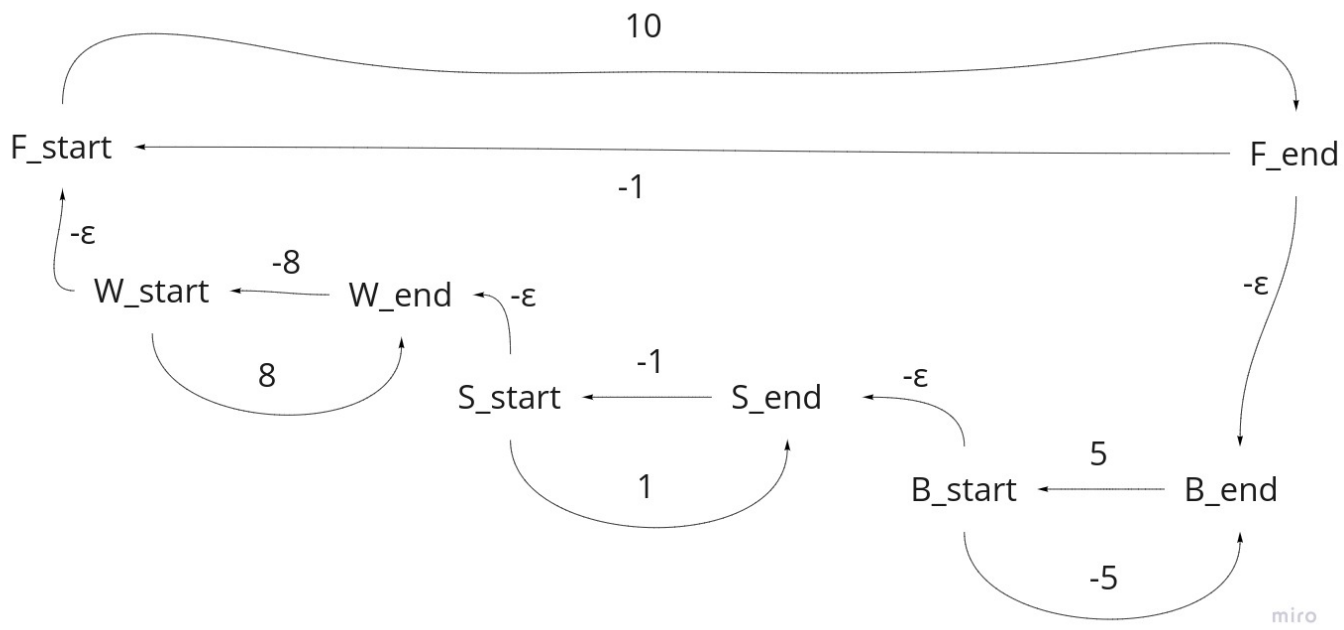
AIP Exam January 2017

Question 1

a

i

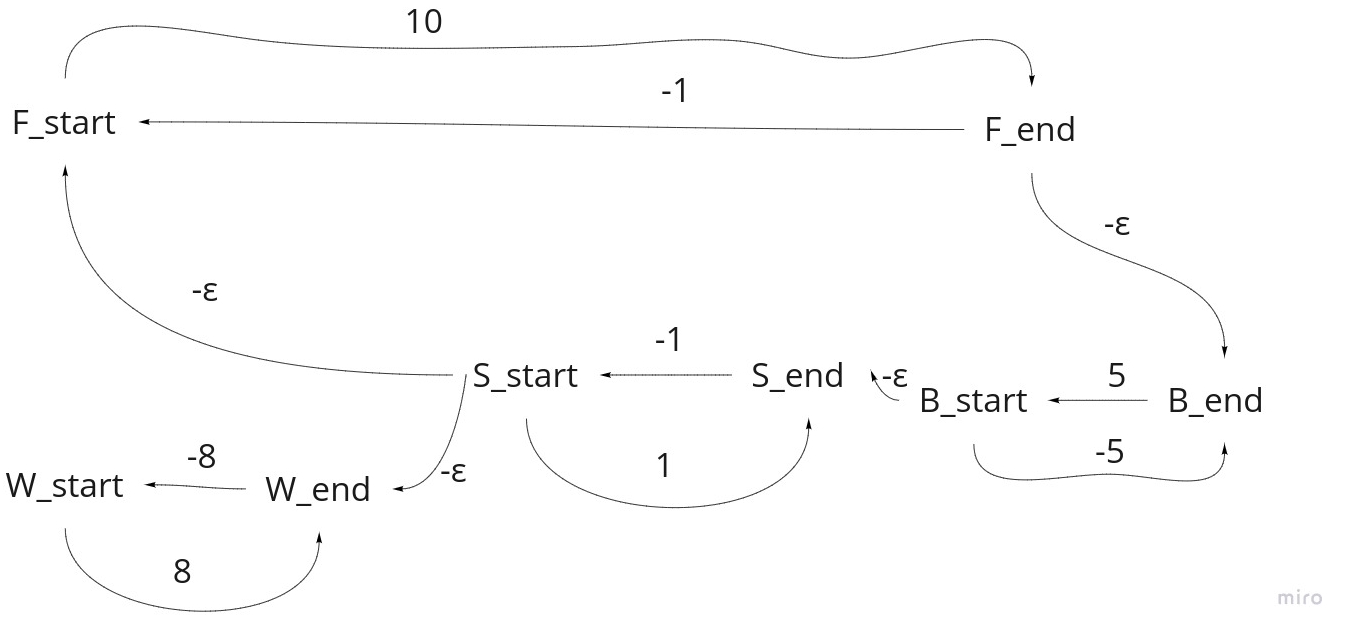


ii

The plan is not valid because of the presence of a negative cycle with a value of -4.04:

```
F_end -> B_end -> B_start -> S_end -> S_start -> W_end -> W_start -> F_start -> F_end
```

iii



iv

POPF is able to create a solution because it can take into consideration the option of running actions concurrently. The W action (`write_email`) can be run at any time and POPF can use this to start the action before F_start1. This removes the negative cycle as mentioned in the previous answer. Therefore, the plan is not pruned and POPF finds a solution.

v

n this domain, some actions depend on the state of `connection-free`. It is set to true at the start of `free-wifi` and false at the end. If we were to collapse the `free-wifi` action by removing its durative property, we could not use the `send-email` action, which is necessary to achieve the `email-sent` goal, as well as the `browse-internet` action, which is necessary to achieve `have-info`. Both actions contain `connection-free` as a preconditions and the FF planner could not call them since its value would never become true.

b

i

a) `(preference a (got-opening-times))`

b) `(preference b (sometime-before (bought-expensive-gift) (checked-balance)))`

c) `(preference c (sometime-after (connected) (not-connected)))`

ii

d) `(preference d (bough-expensive-gift))`

#1:

- `look-up-opening-times` (preference a) -5 cost
- `check-bank-balance`
- `connect`
- `send-email`
- `buy-cheap-gift`

distance: 5 actions

cost: 7 (preference d and c are violated)

#2:

- `connect`
- `send-email`
- `buy-expensive-gift` (preference d) -4 cost
- `disconnect` (preference c) - 3 cost

distance: 4 actions

cost: 15 (preference a and b are violated)

#3:

- `look-up-opening-times` (preference a) -5 cost
- `check-bank-balance`
- `connect`
- `send-email`
- `buy-expensive-gift` (preference d and b) -14 cost
- `disconnect` (preference c) - 3 cost

distance: 5 actions

cost: 0 (no preferences are violated)

Question 2

a

in **bold** goal facts

Fact Layer 0:

`at truck1 locA`

`at truck2 locA`

`at P1 locA`

Action Layer 0:

`move truck1 locA locB`

`move truck2 locA locB`

`load P1 truck1 locA`

`load P1 truck2 locA`

Fact Layer 1: (only new facts)

`at truck1 locB`

`at truck2 locB`

`in P1 truck1`

`in P1 truck2`

Action Layer 1: (only actions that create new facts)

`unload P1 truck1`

`unload P1 truck2`

Fact Layer 2: (only new facts)

`at P1 locB`

b

The heuristic value of the initial state is *the number of actions used to solve the relaxed version of the problem starting from the initial state.*

In the plan above, the heuristic value is 3 (the number of actions in italic)

c through f

Haven't done it?

Question 3

i

cost_0 = 0

temp_0 = 19

(daytime) start t_0 = 0

cost'_0 = cost_0

temp'_0 = temp_0

18 <= temp'_0 <= 22

---

t1 - t0 = ϵ

cost_1 = cost'_0

temp_1 = temp'_0 + 0.5 x (t1 - t0)

18 <= temp_1 <= 22

(air-conditioner) start

temp'_1 = temp_1

cost'_1 = cost_1

18 <= temp'_1 <= 22

---

t2 - t1 >= 1

t2 - t1 <= 12

cost_2 = cost'_1 + 1 x (t2 - t1)

temp_2 = temp'_1 + 0.5 x (t2 - t1) - 2 x (t2 - t1)

18 <= temp_2 <= 22

(air-conditioner) end

cost'_2 = cost_2

temp_'2 = temp_2

18 <= temp'_2 <= 22

---

cost_3 = cost'_2

temp_3 = temp'_2 + 0.5 x (t3 - t2)

18 <= temp_3 <= 22

(daytime) end

cost'_3 = cost_3

temp'_3 = temp_3

ii

`(daytime) start` **[0.000]**

`(air-conditioner) start` **[4.000]**

`(air-conditioner) end` **[5.000]**

`(air-conditioner) start` **[7.000]**

`(air-conditioner) end` **[9.000]**

`(daytime) end` **[12.000]**

iii

It is important to use linear change becaus for each (snap) action, A_i , in the (partial) plan, COLIN creates the δv_i LP variable which represents the rate of change of every numerical variable v after A_i is executed. δv_i LP is calculated under the assumption that the rate is linear.

b

A domain independent planner is fit for multiple domains. It gives users the choice to specify heuristics and/or search algorithms and is therefore meant to be used with any domain.

The main **advantage** of a domain independent planner is the flexibility and relatively good performance that it gives for any kind of domain.

On the other hand, its main **disadvantage** is that it might perform worse than most non domain independent planners since they are designed for specific domains.

It is a tradeoff between flexibility and performance.

c

i

A dial open list approach keeps a copy of the the open list. This allows the planner to *alternate* between the use of two heuristics. In case the planner finds a plateau, it can decide to instead try to explore the search space using the other heuristic and its open list. Another approach could be to alternate the two heuristics for every state expanded. Either way, the dual open-list allows to take advantage of more than one heuristic.

ii

- **Diversification** – try lots of different things, to try to brute- force around the weaknesses of the heuristic
- **Intensification** – explore lots of options around a given state (e.g. near to where the goal might be)

When using **diversification**, we are probing the search space more in depth, with a greedier approach (similar to Enforced Hill Climbing).

Intensification is aimed at the opposite, it evaluates states close to each other more and makes more informed decisions about possible approaches.

Question 4

a

We need to allow a minimum speed of 0 and a maximum speed of 170.

We add the following proposition:

and extend the actions as such:

```
(:action accelerate
  :parameters()
  :precondition (and (running) (v <= 170))
  :effect(and increase (a) 1)
)
```

```
  (:action accelerate
    :parameters()
    :precondition (and (running) (v >= 1))
    :effect(and decrease (a) 1)
  )
```

b

We can achieve such specification with an event

```
  (:event reach-goal
    :parameters ()
    :precondition (and (d >= 100))
    :effect (and (goal_reached) (not (running)))
  )
```

c

```
  (:event exceeded-velocity
    :parameters ()
    :precondition (and (v >= 200))
    :effect (and (not (running)))
  )
```

d and e

Not done?