AI Übung

ÜB1

Ex 1.1) a) Yes, because it perceives (some aspects of) the environment and acts on it.

Percepts: pressed buttons

Actions: serve a floor = $\underbrace{\{\text{move} \ldots \text{switch}\}}_{\text{one compound action}}$

Goals: serve all requests, safety, effecient, cf. b)

Environment: the building, particularly the elevator shaft and adjacent floors, people, ...

It is a reflexive agent with states:

- "with state" because it keeps track of the current floor (since it has no "floor sensor")
- "reflexive" because it has no explicit goals/utilities (they are coded/hard-wired in Φ^u_v)

b) ~~maximal minimize~~ · maximum/average waiting time

power consumption, covered distances

comfort/safety for passengers

finite-wait property (outside and inside)

Ex 1.1) c) $F := \{f \mid v \le f \le u\} \subseteq \mathbb{Z}$

$\Phi : \mathcal{P}ot(F) \times \mathcal{P}ot(F) \times F \to F$

$$\tilde{\Phi}(M, W, f) = \begin{cases} u, & \text{if } f = v \\ f-1, & \text{otherwise} \end{cases} \qquad \tilde{\Phi}(M, W, f) = \Phi(F, \emptyset, f)$$

$\hat{=}$ „Pater-Noster-Aufzug"

better:

$$\Phi(M, W, f) = \begin{cases} \max X < f, & \text{if } \emptyset \ne X = \{x \in M \cup W \mid x < f\} \subseteq M \cup W \\ \max M \cup W \ge f, & \text{if } \emptyset = X, \text{ but } \emptyset \ne M \cup W \\ 0 \ [\text{or } f] & \text{if } \emptyset = M \cup W \end{cases}$$

This function does „a good job" in the sense that every floor whose button is ON is served eventually and only such floors are served whose button is ON. Moreover, when going down, the elevator will not pass over such a floor.

Proof: of finite-wait property:

$M_l = \{x \mid$ button x in the elevator is ON at the beginning of loop iteration $l\}$

$W_l = \{x \mid$ button on floor x is ON — " — $\}$

$A_l = \{x \mid$ — " — is pressed during iteration $l\}$

$B_l = \{x \mid$ button x in the elevator is pressed — " — $\}$

f_l = current floor at the beginning of loop iteration l

$\Rightarrow f_{l+1} = \Phi_v^u(M_l, W_l, f_l)$

$M_{l+1} = (M_l \cup B_l) \setminus \{f_{l+1}\}$

$W_{l+1} = (W_l \cup A_l) \setminus \{f_{l+1}\}$

Φ_v^u has the finite-wait property iff for every $M_1, W_1, A_1, A_2, \dots, B_1, B_2, \dots, l$ and all $x \in M_l \cup W_l$, there exists $n > 0$, s.t. $x \notin M_{l+n} \cup W_{l+n}$

$\Downarrow$

AI Übung

$\Rightarrow$ Ex 1.1) c)

$X_\ell := \{x \in M_\ell \cup W_\ell \mid x < f_\ell\}$

$x \in M_\ell \cup W_\ell$

$$a_\ell(x) := \begin{cases} f_\ell - x & \text{, if } x < f_\ell \\ \underbrace{f_\ell - v}_{\text{down to } v} + \underbrace{1}_{\text{going up to } u} + \underbrace{u - x}_{\text{down to } x} & \text{, otherwise} \end{cases}$$

Prop.: $a_\ell(x) \geq 1$

Proof: $\cdot\ x < f_\ell \Leftrightarrow x \leq f_\ell - 1 \Leftrightarrow f_\ell - x \geq 1$

$\cdot\ v \leq f_\ell$ and $x \leq u \Leftrightarrow f_\ell - v \geq 0$ and $u - x \geq 0$

$\Rightarrow f_\ell - v + 1 + u - x \geq 1$ $\square$

Prop.: $a_{\ell+1}(x) < a_\ell(x)$ or $x \notin M_{\ell+1} \cup W_{\ell+1}$

Proof: I) $\underline{x < f_\ell}$ $\Rightarrow a_\ell(x) = f_\ell - x$ and $x \in X_\ell$

$\Rightarrow X_\ell \neq \emptyset \Rightarrow f_{\ell+1} = \Phi(M_\ell, W_\ell, f_\ell) = \max X_\ell \geq x$

1) $f_{\ell+1} = x \Rightarrow M_{\ell+1} \cup W_{\ell+1} = (M_\ell \cup W_\ell \cup A_\ell \cup B_\ell) \setminus \{x\}$

$\Rightarrow x \notin M_{\ell+1} \cup W_{\ell+1}$

2) $f_{\ell+1} > x \Rightarrow a_{\ell+1}(x) = f_{\ell+1} - x < f_\ell - x = a_\ell(x)$

$f_{\ell+1} = \max X_\ell < f_\ell$

II) $\underline{x \geq f_\ell}$ $\Rightarrow a_\ell(x) = f_\ell - v + 1 + u - x$

a) $X_\ell \neq \emptyset \Rightarrow f_{\ell+1} = \max X_\ell < f_\ell \leq x$

$\Rightarrow a_{\ell+1}(x) = f_{\ell+1} - v + 1 + u - x$

$< f_\ell - v + 1 + u - x = a_\ell(x)$

b) $X_\ell = \emptyset \Rightarrow f_{\ell+1} = \max M_\ell \cup W_\ell \geq x$

$M_\ell \cup W_\ell \neq \emptyset \Leftarrow x \leq M_\ell \cup W_\ell$

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1) $f_{\ell+1} = x \Rightarrow$ I) 1)

2) $f_{\ell+1} > x \Rightarrow a_{\ell+1}(x) = f_{\ell+1} - x \underset{\substack{\uparrow \\ f_{\ell+1} \leq u \\ v \leq f_\ell \Leftrightarrow f_\ell - v \geq 0}}{<} f_\ell - v + 1 + u - x = a_\ell(x)$

Thus, $a_{\ell+1}(x) \leq a_\ell(x) - 1$.

Therefore, $a_{\ell+k}(x) \leq a_\ell(x) - k$ or there is a n with $1 \leq n \leq k$ and $x \notin M_{\ell+n} \cup W_{\ell+n}$