人工智能作业三

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(a)

$$\forall s, \forall o \in \{b_1, b_2, shakey\}, \forall l_1, l_2 \in \{r_1, r_2, r_3\}\ \neg(l_1 \neq l_2 \wedge at(o, l_1, s) \wedge at(o, l_2, s))$$

(b)

$$\begin{gathered}S_0 : (\neg(lightOn(S_0))) \wedge at(shakey, r_1, S_0) \wedge at(b_1, r_2, S_0) \wedge at(b_2, r_3, S_0) \\ \exists s.\ lightOn(s) \wedge at(shakey, r_1, s) \wedge at(b_1, r_1, s) \wedge at(b_2, r_2, s)\end{gathered}$$

(c)

$$\begin{aligned}&walkTo(loc_1, loc_2) : at(shakey, loc_1, s) \wedge adj(loc_1, loc_2) \\ &\rightarrow at(shakey, loc_2, do(walkTo(loc_1, loc_2), s)) \wedge (\neg at(shakey, loc_1, do(walkTo(loc_1, loc_2), s))) \\ &push(box, loc_1, loc_2) : at(shakey, loc_1, s) \wedge at(box, loc_1, s) \wedge adj(loc_1, loc_2) \\ &\rightarrow at(lox, loc_2, do(push(box, loc_1, loc_2), s)) \wedge (\neg(at(lox, loc_1, do(push(box, loc_1, loc_2), s)))) \\ &turnOn() : at(shakey, r_1, s) \wedge at(b_1, r_1, s) \wedge at(b_2, r_2, s) \wedge (\neg(lightOn(s))) \\ &\rightarrow lightOn(do(turnOn(), s))\end{aligned}$$

(d)

$$\begin{aligned}\sigma = {} & do(turnOn(), do(walkTo(r_2, r_1), do(walkTo(r_3, r_2), do(push(b_2, r_3, r_2), \\ & do(walkTo(r_2, r_3), do(push(b_1, r_2, r_1), do(walkTo(r_1, r_2), S_0)))))))\end{aligned}$$

2

(a)

$$\begin{aligned}&move(x, a, b) \\ &Pre : \{clear(x), on(x, a), clear(b), smaller(x, b)\} \\ &Adds : \{on(x, b), clear(a)\} \\ &Dels : \{on(x, a), clear(b)\} \\ &moveTwo(x, y, a, b) \\ &Pre : \{clear(x), on(x, y), on(y, a), clear(b), smaller(y, b)\} \\ &Adds : \{on(y, b), clear(a)\} \\ &Dels : \{on(y, a), clear(b)\} \\ &KB : \\ &\{clear(d_1), on(d_1, d_2), on(d_2, d_3), on(d_3, p_1), clear(p_2), clear(p_3)\} \\ &goal : \\ &\{clear(p_1), clear(p_2), clear(d_1), on(d_1, d_2), on(d_2, d_3), on(d_3, p_3)\}\end{aligned}$$

(b)

reachability analysis :

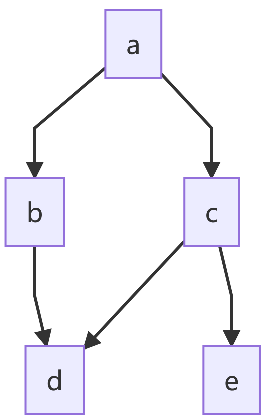
$S_0:\{\forall i,j\in\{1,2,3\},i<j,smaller(d_i,d_j),\forall i,j\in\{1,2,3\},smaller(d_i,p_j),$
$clear(d_1),on(d_1,d_2),on(d_2,d_3),on(d_3,p_1),clear(p_2),clear(p_3)\}$
$A_0:\{move(d_1,d_2,p_2),move(d_1,d_2,p_3),moveTwo(d_1,d_2,d_3,p_2),moveTwo(d_1,d_2,d_3,p_3)\}$
$S_1:\{\forall i,j\in\{1,2,3\},i<j,smaller(d_i,d_j),\forall i,j\in\{1,2,3\},smaller(d_i,p_j),$
$clear(d_1),on(d_1,d_2),on(d_2,d_3),on(d_3,p_1),clear(p_2),clear(p_3),$
$clear(d_2),on(d_1,p_2),on(d_1,p_3),clear(d_3),on(d_2,p_2),on(d_2,p_3)\}$
$A_1:\{move(d_1,d_2,d_3),move(d_1,p_2,p_3),move(d_1,p_2,d_2),move(d_1,p_2,d_3),move(d_1,p_3,p_2),move(d_1,p_3,d_2),$
$move(d_1,p_3,d_3),move(d_2,d_3,p_2),move(d_2,d_3,p_3),move(d_2,p_2,d_3),move(d_2,p_2,p_3),move(d_2,p_3,d_3),$
$move(d_2,p_3,p_2),move(d_3,p_1,p_2),move(d_3,p_1,p_3),moveTwo(d_1,d_2,p_2,d_3),moveTwo(d_1,d_2,p_2,p_3),$
$moveTwo(d_1,d_2,p_3,d_3),moveTwo(d_1,d_2,p_3,p_2),moveTwo(d_2,d_3,p_1,p_2),moveTwo(d_2,d_3,p_1,p_3)\}$
$S_2:\{\forall i,j\in\{1,2,3\},i<j,smaller(d_i,d_j),\forall i,j\in\{1,2,3\},smaller(d_i,p_j),$
$clear(d_1),on(d_1,d_2),on(d_2,d_3),on(d_3,p_1),clear(p_2),clear(p_3),$
$clear(d_2),on(d_1,p_2),on(d_1,p_3),clear(d_3),on(d_2,p_2),on(d_2,p_3),$
$clear(p_1),on(d_1,d_3),on(d_3,p_2),on(d_3,p_3)\}$
$S_2\supset goal,$终止

CountActions :

$$goal=\{clear(p_1),clear(p_2),clear(d_1),on(d_1,d_2),on(d_2,d_3),on(d_3,p_3)\}$$
$$G_P=\{clear(p_2),clear(d_1),on(d_1,d_2),on(d_2,d_3)\}$$
$$G_N=\{clear(p_1),on(d_3,p_3)\}$$
$$A=\{move(d_3,p_1,p_3)\}$$
$$goal_1=\{clear(p_2),clear(d_1),on(d_1,d_2),on(d_2,d_3),on(d_3,p_1),clear(p_3),clear(d_3)\}$$
$$G_P=\{clear(p_2),clear(d_1),on(d_1,d_2),on(d_2,d_3),on(d_3,p_1),clear(p_3)\}$$
$$G_N=\{clear(d_3)\}$$
$$A=\{moveTwo(d_1,d_2,d_3,p_2)\}$$
$$goal_2=\{clear(p_2),clear(d_1),on(d_1,d_2),on(d_2,d_3),on(d_3,p_1),clear(p_3)\}$$
到达S_0,返回0
最后返回$1+1+0=2$

3

(a)



(b)

给定c，a和e是条件独立的。

(c)

$$
\begin{aligned}
&P(abc\neg de)=P(a)P(b|a)P(c|a)P(\neg d|bc)P(e|c)=0.00392\\
&P(ab\neg c\neg de)=P(a)P(b|a)P(\neg c|a)P(\neg d|b\neg c)P(e|\neg c)=0.02016\\
&P(a\neg bc\neg de)=P(a)P(\neg b|a)P(c|a)P(\neg d|\neg bc)P(e|c)=0.00252\\
&P(a\neg b\neg c\neg de)=P(a)P(\neg b|a)P(\neg c|a)P(\neg d|\neg b\neg c)P(e|\neg c)=0.02736\\
&P(\neg abc\neg de)=P(\neg a)P(b|\neg a)P(c|\neg a)P(\neg d|bc)P(e|c)=0.00112\\
&P(\neg ab\neg c\neg de)=P(\neg a)P(b|\neg a)P(\neg c|\neg a)P(\neg d|b\neg c)P(e|\neg c)=0.02736\\
&P(\neg a\neg bc\neg de)=P(\neg a)P(\neg b|\neg a)P(c|\neg a)P(\neg d|\neg bc)P(e|c)=0.00672\\
&P(\neg a\neg b\neg c\neg de)=P(\neg a)P(\neg b|\neg a)P(\neg c|\neg a)P(\neg d|\neg b\neg c)P(e|\neg c)=0.34656
\end{aligned}
$$

(d)

$$
\begin{gathered}
P(a|\neg de)=\frac{P(a\neg de)}{P(a\neg de)+P(\neg a\neg de)}\\
\text{由}(c)\text{有}P(a\neg de)=0.00392+0.02016+0.00252+0.02736=0.05396\\
P(\neg a\neg de)=0.00112+0.02736+0.00672+0.34656=0.38176\\
\text{得}P(a|\neg de)=\frac{0.05396}{0.05396+0.38176}=0.1238<0.2=P(a)
\end{gathered}
$$

所以该条件下，更倾向于相信该学生没有对游戏上瘾。

4

(a)

$$
\begin{aligned}
&P(e)=\frac{\sum_{ABCDF}P(ABCDeF)}{\sum_{ABCDF}P(ABCDeF)+\sum_{ABCDF}P(ABCD\neg eF)}\\
&\sum_{ABCDF}P(ABCDeF)\\
&=\sum_A P(A)\sum_B P(B)\sum_C P(C|AB)\sum_D P(D|B)P(e|C)\sum_F P(F|C)\\
&=\sum_A P(A)\sum_B P(B)\sum_C P(C|AB)P(e|C)\sum_D P(D|B)\sum_F P(F|C)\\
&=\sum_A P(A)\sum_B P(B)\sum_C P(C|AB)P(e|C)\times 1\times 1\\
&=\sum_A P(A)\sum_B P(B)\sum_C P(C|AB)P(e|C)
\end{aligned}
$$

f1(A)	f2(B)	f3(A,B,C)	f5(B,C) Eli A	f6(C) Eli B	f4(C,E)	f7(E)=f4xf6 Eli C
a 0.8	b 0.2	abc 0.2	bc 0.32	c 0.576	ce 0.8	e 0.5032
!a 0.2	!b 0.8	ab!c 0.8	b!c 0.68	!c 0.424	c!e 0.2	!e 0.4968
		a!bc 0.7	!bc 0.64		!ce 0.1	
		a!b!c 0.3	!b!c 0.36		!c!e 0.9	
		!abc 0.8				
		!ab!c 0.2				
		!a!bc 0.4				
		!a!b!c 0.6				

由上表有P(e)=0.5032。

(b)

$$P(e|\neg f)=\frac{\sum_{ABCD}P(ABCDe\neg f)}{\sum_{ABCD}P(ABCDe\neg f)+\sum_{ABCD}P(ABCD\neg e\neg f)}$$

$$\begin{aligned}
&\sum_{ABCD}P(ABCDe\neg f)\\
&=\sum_A P(A)\sum_B P(B)\sum_C P(C|AB)\sum_D P(D|B)P(e|C)P(\neg f|C)\\
&=\sum_A P(A)\sum_B P(B)\sum_C P(C|AB)P(e|C)P(\neg f|C)\sum_D P(D|B)\\
&=\sum_A P(A)\sum_B P(B)\sum_C P(C|AB)P(e|C)P(\neg f|C)\times 1\\
&=\sum_A P(A)\sum_B P(B)\sum_C P(C|AB)P(e|C)P(\neg f|C)
\end{aligned}$$

$f_3(A,B,C)$消除A,B获得$f_6(C)$的过程可以重用。

f8(C,F)	f9(C) restrict F=!f	f10(E)=f4xf6xf9 Eli C
cf 0.2	c 0.8	e 0.37712
c!f 0.8	!c 0.2	!e 0.16848
!cf 0.8		
!c!f 0.2		

$$P(e|\neg f)=\frac{0.37712}{0.37712+0.16848}=0.69120$$