AI2 Module 4
Tutorial 1: Notes on Solutions

Alan Bundy
School of Informatics

This tutorial is revision of material taught in modules 1 and 2. If you are struggling then read chaps 7 and 8 of Russell & Norvig 2nd edition (chaps 6 and 7 in 1st edition), esp §7.3-4 and §8.1-3 (§6.3-4 and §7.1-3 1st edition).

1. No answer to this required.

2. $S_{1,1} \Leftrightarrow W_{1,2} \vee W_{2,1}$, where $S_{i,j}$ means there is a stench in square (i, j) and $W_{i,j}$ means there is a Wumpus in square (i, j).

3. The truth table is:

OK	W	P	$\neg W$	$\neg P$	$\neg W \wedge \neg P$	$OK \Leftrightarrow (\neg W \wedge \neg P)$
0	0	0	1	1	1	0
0	0	1	1	0	0	1
0	1	0	0	1	0	1
0	1	1	0	0	0	1
1	0	0	1	1	1	1
1	0	1	1	0	0	0
1	1	0	0	1	0	0
1	1	1	0	0	0	0

   The formula is true when OK is false and one of W or P is true, or when OK is true and both W and P are false.

4. $\forall p, t.\ At(p, t) \wedge G(p) \wedge Pickup(p, t) \Rightarrow HasGold(t+1)$ where $At(p, t)$ means the agent is at square p at time t, $G(p)$ means there is a glitter in square p, $Pickup(p, t)$ means the agent picks-up in square p at time t, $HasGold(t)$ means the agent has the gold at time t and $t + 1$ is the successor time to t. Any reasonable variations of predicate/function name, representation of successor time and argument dependency is acceptable. However, note that §6.2 should tell them that G is independent of time.

5. This yields three clauses:

$$
\begin{aligned}
Adj(p, q) \wedge P(q) &\Rightarrow B(p) \\
B(p) &\Rightarrow Adj(p, a(p)) \\
B(p) &\Rightarrow P(a(p))
\end{aligned}
$$

by the following process:

Skolemize p :	$B(p) \Leftrightarrow \exists q.\ Adj(p,q) \wedge P(q)$
Remove $\Leftrightarrow$:	$(B(p) \Rightarrow \exists q.\ Adj(p,q) \wedge P(q)) \wedge (\exists q.\ Adj(p,q) \wedge P(q)) \Rightarrow B(p))$
Skolemize q :	$(B(p) \Rightarrow Adj(p,a(p)) \wedge P(a(p))) \wedge (Adj(p,q) \wedge P(q)) \Rightarrow B(p))$
Split into clauses:	$Adj(p,q) \wedge P(q) \Rightarrow B(p)$
	$B(p) \Rightarrow Adj(p,a(p))$
	$B(p) \Rightarrow P(a(p))$

Note that the $\exists q$ cannot be skolemized until the $\Leftrightarrow$ is removed, and that it then yields a Skolem function, $a(p)$, in one conjunct and a free variable, q, in the other.

6. The derivation is:

Resolve (4) and (5):	(6) $Adj(p, <2,2>) \Rightarrow S(p)$
Resolve (1) and (6):	(7) $Adj(<1,2>, <2,2>) \Rightarrow$
Resolve (2) and (7):	(8) $\Rightarrow$