Contents

1 Question 1

1.1 a.

1. $tea(BlackTea) \wedge (\forall x\, cheese(x) \Rightarrow \neg tea(x))$
2. $blend(BlackTea, GreenTea)$
3. $\forall x, y\ (\neg tea(x) \wedge tea(y)) \Rightarrow \neg blend(y, x)$
4. $\exists x\, tea(x) \wedge unoxidize(x) \wedge \neg wilted(x)$
5. $\exists x \forall y\, tea(x) \wedge ((tea(y) \wedge \neg unoxidize(y)) \Rightarrow blend(x, y))$

1.2 b.

1.2.1 1.

- $tea(BlackTea) \wedge (cheese(x) \Rightarrow \neg tea(x))$

- $tea(BlackTea) \wedge (\neg cheese(x) \vee \neg tea(x))$

1.2.2 2.

- $blend(BlackTea, GreenTea)$

1.2.3 3.

- $(\neg tea(x) \wedge tea(y)) \Rightarrow \neg blend(y, x)$
- $\neg(\neg tea(x) \wedge tea(y)) \vee \neg blend(y, x)$
- $(tea(x) \vee \neg tea(y)) \vee \neg blend(y, x)$
- $tea(x) \vee \neg tea(y) \vee \neg blend(y, x)$

1.2.4 4.

- $tea(T1) \wedge unoxidize(T1) \wedge \neg wilted(T1)$

1.2.5 5.

- $tea(T2) \wedge ((tea(y) \wedge \neg unoxidize(y)) \Rightarrow blend(T2, y))$
- $tea(T2) \wedge (\neg(tea(y) \wedge \neg unoxidize(y)) \vee blend(T2, y))$
- $tea(T2) \wedge ((\neg tea(y) \vee unoxidize(y)) \vee blend(T2, y))$
- $tea(T2) \wedge (\neg tea(y) \vee unoxidize(y) \vee blend(T2, y))$

1.3 c.

2 Question 2

Note that I use PL-FOL to refer to propositionalization.

2.1 a.

2.1.1 Provided Sentences in FOL

- Sentence 1: $\forall x\ o(x) \Rightarrow l(x)$
- Sentence 2: $\forall x\ o(x) \Rightarrow d(x)$
- Sentence 3: $\forall x\ (o(x) \wedge i(x)) \Rightarrow s(x)$

- Sentence 3 simplified: $\forall x\; i(x) \Rightarrow s(x)$
- The remaining sentences will take this simplified approach. It is a safe assumption that our model does not have any assignments that would complicate these simplifications.
- From Sentence 5: $\forall x\; o(x) \Rightarrow (g(x) \lor si(x))$
- From Sentence 8: $\forall x\; (g(x) \land i(x)) \Rightarrow pre(x)$
- From Sentence 8: $\forall x\; si(x) \Rightarrow \neg pre(x)$

2.1.2 Provided sentences that can be interpreted in terms of PL-FOL

- Sentence 4: $\neg s(C)$
- Sentence 6: $o(C)$
- Sentence 7: $g(C) \land \neg i(C) \land \neg s(C) \land \neg pre(C)$

2.1.3 FOL Sentences instantiated into PL (Carol is the only customer, so she is the only instatiation that matters)

- Sentence 1 PL-FOL: $o(C) \Rightarrow l(C)$
- Sentence 2 PL-FOL: $o(C) \Rightarrow d(C)$
- Sentence 3 PL-FOL: $i(C) \Rightarrow s(C)$
- Sentence 5 PL-FOL: $o(C) \Rightarrow (g(C) \lor si(C))$
- From Sentence 8 PL-FOL: $(g(C) \land i(C)) \Rightarrow pre(C)$
- From Sentence 8 PL-FOL: $si(C) \Rightarrow \neg pre(C)$

2.1.4 Example: Carol can collect loyalty points (Sentence 1. combined with Sentence 6.)

- Sentence 1. is a FOL statement: $\forall x\; o(x) \Rightarrow l(x)$
- Sentence 6. can be interpreted as a PL statement: $o(C)$ (This is true in our truth table for the consistent model.)

- Since Carol is the only object that's a customer in our model, the only instantiation of Sentence 1. that adds value is the following: $o(C) \Rightarrow l(C)$
- Thus, in our model's truth table, $l(C)$ is true.
- This is an example of how we will use the provided sentences to prove that a our model is consistent.
- Note that this example is not critical because there are no other statements that involve $l(C)$ in PL-FOL

2.1.5 Truth table to show a consistent model.

No statement contradicts another statement.

Ref	PL-FOL	T/F
S0	$\neg s(C)$	T
S1	$o(C)$	T
S2	$g(C) \wedge \neg i(C) \wedge \neg s(C) \wedge \neg pre(C)$	T
S3	$o(C) \Rightarrow l(C)$	T
S1 mp S3	$l(C)$	T
S4	$o(C) \Rightarrow d(C)$	T
S1 mp S4	\(d(C))	T
S5	$i(C) \Rightarrow s(C)$	T (S2)
S6	$o(C) \Rightarrow (g(C) \vee si(C))$	T (S2)
S7	$(g(C) \wedge i(C)) \Rightarrow pre(C)$	T (S2)
S8	$si(C) \Rightarrow \neg pre(C)$	T (S2)