CSCI 2824 Written HW 2

Alex Garcia-Gonzalez

TOTAL POINTS

43 / 51

QUESTION 1

1 Knights and Knaves 6 / 10

+ **10 pts** Totally Correct
+ **1 pts** Aramis statement
+ **1 pts** Bertrand Statement
+ **1 pts** Charleston statement
+ **2 pts** p iff A statement column
+ **2 pts** q iff B statement column
+ **2 pts** r iff C statement column
+ **1 pts** final conclusion
+ **0 pts** No solution

+ 6 Point adjustment

Explain how you arrived at the solution in words or using a truth table.

QUESTION 2

Logical Equivalences 12 pts

2.1 (a)(i) Truth table 4 / 4

✓ **+ 4 pts All Correct**

+ **1 pts** (p implies q) and (q implies r) column correct
+ **2 pts** Correct final column showing tautology
+ **1 pts** p implies r column correct
- **1 pts** Correct idea, 1-2 minor truth value mistakes
- **2 pts** Half credit
- **3 pts** Mostly incorrect
- **4 pts** Incorrect

2.2 (a)(ii) Chain of equivalences 3 / 4

+ **4 pts** All Correct
+ **2 pts** Showing chain of logical equivalences- correctly
+ **2 pts** Naming logical equivalences - correctly
+ **1 pts** Chain of logical equivalence - a few significant errors
+ **1 pts** Naming logical equivalences - a few significant errors
+ **0 pts** Incorrect
+ **1 pts** Proof Incomplete

+ 3 Point adjustment

1 unclear from here

2.3 (b) Not logically equivalent 3 / 4

+ **4 pts** All Correct
+ **1 pts** (p implies q) implies r column correct
+ **1 pts** p implies (q implies r) column correct
+ **2 pts** Explanation of why these compound propositions are not LE
- **2 pts** Correct setup, a few major errors
- **4 pts** Incorrect

- 1 Point adjustment

Explanation unclear, Should have used truth table or an example truth values for proving the same

QUESTION 3

Quantifiers 6 pts

3.1 (a) 2 / 2

✓ **+ 2 pts Correct**

+ **1 pts** Including P(5), P(6), P(7), P(8)
+ **1 pts** Linking these propositions with a conjunction
+ **0 pts** Incorrect answer
+ **0 pts** No answer provided

3.2 (b) 2 / 2

✓ **+ 2 pts Correct**

+ **1 pts** Including all 4 propositions in statement
+ **1 pts** Negating propositions and linking with conjunction

- **- 1 pts** Partially correct
- **+ 0 pts** Incorrect answer
- **+ 0 pts** Answer not provided

3.3 (c) 0 / 2

- **+ 2 pts** Correct
- **+ 1 pts** Including all 4 propositions in statement
- **+ 1 pts** Negating propositions and linking with disjunction
- ✓ **+ 0 pts Incorrect answer**
- **+ 0 pts** Answer not provided

QUESTION 4

4 Base-3 Conversion 8 / 8

- ✓ **+ 8 pts Correct answer with supporting work**
- **+ 2 pts** Correct answer, no supporting work shown
- **+ 4 pts** Writing 163 as a sum of powers of 3
- **+ 2 pts** Identifying coefficients (0, 1, 2) of powers of 3
- **+ 2 pts** Concluding that 163 = 20001 in base 3
- **+ 4 pts** Alternatively-setting up valid algorithm
- **+ 4 pts** Alternatively-Correctly applying algorithm to 163
- **+ 0 pts** Incorrect answer
- **+ 4 pts** Not enough work shown
- **+ 0 pts** No answer provided

QUESTION 5

Satisfiability 9 pts

5.1 (a) translations to symbols 4 / 4

- ✓ **+ 4 pts All Correct or one minor mistake**
- **+ 1 pts** Translation of i
- **+ 1 pts** Translation of ii
- **+ 1 pts** Translation of iii
- **+ 1 pts** Translation of iv
- **- 1 pts** If function T(x) not used or one of the questions is not correct
- **- 2 pts** 2 incorrect
- **- 3 pts** one correct
- **- 4 pts** No solution

2 4th one neg T(P)

5.2 (b) satisfiable? or not 4 / 4

- ✓ **+ 4 pts All Correct - nice logical argument**
- **+ 3 pts** Reasonable argument, understands satisfiability, one small error
- **+ 2 pts** Correct conclusion but insufficient supporting work
- **+ 1 pts** Incorrect conclusion, misunderstanding of satisfiability
- **- 0 pts** Incorrect
- **- 1 pts** Minor error in argument
- **- 2 pts** No supporting argument
- **- 3 pts** Incorrect Conclusion
- **- 4 pts** No solution uploaded

5.3 (c) where to? 1 / 1

- ✓ **+ 1 pts Naming any location not given**
- **- 1 pts** Not naming a location

QUESTION 6

6 Style points 6 / 6

- ✓ **+ 1 pts Extra Credit for typed assignment**
- ✓ **+ 2 pts Complete**
- ✓ **+ 1 pts Neatness**
- ✓ **+ 2 pts Clear and concise**
- **+ 0 pts** No style points
- **- 3 pts** Not typed, not complete
- **- 2 pts** Click here to replace this description.
- **- 1 pts** Not complete
- **- 4 pts** Click here to replace this description.
- **- 6 pts** No style points

1. You decided to go on a spring break vacation! Your destination: the island of Knights & Knaves. On this island, there are only two types of native inhabitants; Knights, who always tell the truth, and Knaves, who always lie. As you are finding a nice spot on the beach to set up a picnic, you are approached by 3 of the native inhabitants. We'll call them Aramis, Bertrand, and Charleston. Aramis says, " Bertrand is a knave." Bertrand says, " Charleston is a knave or I am a knight, but not both." Charleston says, "Aramis is a knight and Bertrand is a knave." Determine the nature of each of these three inhabitants. Justify your answer with a truth table; showing all rows.

- 3 Natives
  - Aramis
  - Bertrand
  - Charleston

Case A:

- Aramis
- Bertrand
- Charleston

Aramis	TRUE	KNIGHT
Bertrand	FALSE	KNAVE
Charleston	TRUE	KNIGHT

Case B:

- Aramis
- Bertrand
- Charleston

Aramis	FALSE	KNAVE
Bertrand	TRUE	KNIGHT
Charleston	FALSE	KNAVE

1 Knights and Knaves 6 / 10

- + **10 pts** Totally Correct
- + **1 pts** Aramis statement
- + **1 pts** Bertrand Statement
- + **1 pts** Charleston statement
- + **2 pts** p iff A statement column
- + **2 pts** q iff B statement column
- + **2 pts** r iff C statement column
- + **1 pts** final conclusion
- + **0 pts** No solution

+ 6 **Point adjustment**

Explain how you arrived at the solution in words or using a truth table.

2. (a) Show that $((p \to q) \wedge (q \to r)) \to (p \to r)$ is a tautology using **both** (i) a truth table and (ii) a chain of logical equivalences. Note that you may only use logical equivalences from Table 6 (p. 27 of the Rosen textbook) and the other four starred equivalences given in lecture. At each step you should cite the name of the equivalence rule you are using, and please only use one rule per step. Is this compound proposition satisfiable? Why or why not?

(b) Show that $(p \to q) \to r$ and $p \to (q \to r)$ are not logically equivalent.

(a.) i.

p	q	r	$(p \to q)$	$(q \to r)$	$(p \to r)$	$(p \to q) \wedge (q \to r)$	$(p \to q) \wedge (q \to r) \to (p \to r)$
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	T	F	T
T	F	F	F	T	F	F	T
F	T	T	T	T	T	T	T
F	T	F	T	F	T	F	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	T	T

ii.
((p → q)∧(q → r)) → (p → r)
As ((p → q) ≡ (¬p v r)
Thus ¬((P ->q) ∧ (q ->r) v (p ->r) by implication law
= ¬((¬P -> q) v ¬(¬q ->¬r) v (¬p v r) by demorgans law
= ¬(¬P v q) v ¬(¬q v r) v (¬p v r) by demorgans law
= ((P ¬ ¬q) v (q ∧ ¬r) v (¬p v r) by by communtative law
= A v ¬A=1
=1 ∧ (P ∧ ~q v ~r) v (~p v r) negation and identity law
=P ∧ ~q v ~r v ~p v r) communative and associative law
=1 ≡tautology

(b.)

The following is satisfiable.
(p → q) → r and p → (q → r)

= (p → q) → r
= ~(p → q) v r
= ~(p v q) v r
= (p ^ q) v r

= p → (q → r) = ~p v (q → r)
= ~p v (~q v r)
=~p v ~q v r

Using Demorgans law =(p ^ q) v r
(p ^ q) v r ≡ (p ^ q) v r

2.1 (a)(i) Truth table **4 / 4**

- ✓ **+ 4 pts All Correct**
- **+ 1 pts** (p implies q) and (q implies r) column correct
- **+ 2 pts** Correct final column showing tautology
- **+ 1 pts** p implies r column correct
- **- 1 pts** Correct idea, 1-2 minor truth value mistakes
- **- 2 pts** Half credit
- **- 3 pts** Mostly incorrect
- **- 4 pts** Incorrect

2. (a) Show that $((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$ is a tautology using **both** (i) a truth table and (ii) a chain of logical equivalences. Note that you may only use logical equivalences from Table 6 (p. 27 of the Rosen textbook) and the other four starred equivalences given in lecture. At each step you should cite the name of the equivalence rule you are using, and please only use one rule per step. Is this compound proposition satisfiable? Why or why not?

(b) Show that $(p \rightarrow q) \rightarrow r$ and $p \rightarrow (q \rightarrow r)$ are not logically equivalent.

(a.) i.

p	q	r	$(p \rightarrow q)$	$(q \rightarrow r)$	$(p \rightarrow r)$	$(p \rightarrow q) \wedge (q \rightarrow r)$	$(p \rightarrow q) \wedge (q \rightarrow r) \rightarrow (p \rightarrow r)$
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	T	F	T
T	F	F	F	T	F	F	T
F	T	T	T	T	T	T	T
F	T	F	T	F	T	F	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	T	T

ii.

$((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$

As $((p \rightarrow q) \equiv (\neg p \vee r)$

Thus $\neg((P \rightarrow q) \wedge (q \rightarrow r) \vee (p \rightarrow r)$ by implication law

$= \neg((\neg P \rightarrow q) \vee \neg(\neg q \rightarrow \neg r) \vee (\neg p \vee r)$ by demorgans law

$= \neg(\neg P \vee q) \vee \neg(\neg q \vee r) \vee (\neg p \vee r)$ by demorgans law

$= ((P \neg \neg q) \vee (q \wedge \neg r) \vee (\neg p \vee r)$ by by communtative law

$= A \vee \neg A = 1$

$= 1 \wedge (P \wedge \sim q \vee \sim r) \vee (\sim p \vee r)$ negation and identity law

$= P \wedge \sim q \vee \sim r \vee \sim p \vee r)$ communative and associative law

$= 1 \equiv$ tautology

(b.)

The following is satisfiable.

$(p \rightarrow q) \rightarrow r$ and $p \rightarrow (q \rightarrow r)$

$= (p \rightarrow q) \rightarrow r$

$= \sim(p \rightarrow q) \vee r$

$= \sim(p \vee q) \vee r$

$= (p \wedge q) \vee r$

$= p \rightarrow (q \rightarrow r) = \sim p \vee (q \rightarrow r)$

$= \sim p \vee (\sim q \vee r)$

$= \sim p \vee \sim q \vee r$

Using Demorgans law $= (p \wedge q) \vee r$

$(p \wedge q) \vee r \equiv (p \wedge q) \vee r$

2.2 (a)(ii) Chain of equivalences 3 / 4

- + **4 pts** All Correct
- + **2 pts** Showing chain of logical equivalences-correctly
- + **2 pts** Naming logical equivalences - correctly
- + **1 pts** Chain of logical equivalence - a few significant errors
- + **1 pts** Naming logical equivalences - a few significant errors
- + **0 pts** Incorrect
- + **1 pts** Proof Incomplete

+ **3 Point adjustment**

1 unclear from here

2. (a) Show that $((p \to q) \wedge (q \to r)) \to (p \to r)$ is a tautology using **both** (i) a truth table and (ii) a chain of logical equivalences. Note that you may only use logical equivalences from Table 6 (p. 27 of the Rosen textbook) and the other four starred equivalences given in lecture. At each step you should cite the name of the equivalence rule you are using, and please only use one rule per step. Is this compound proposition satisfiable? Why or why not?

(b) Show that $(p \to q) \to r$ and $p \to (q \to r)$ are not logically equivalent.

(a.) i.

p	q	r	$(p \to q)$	$(q \to r)$	$(p \to r)$	$(p \to q) \wedge (q \to r)$	$(p \to q) \wedge (q \to r) \to (p \to r)$
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	T	F	T
T	F	F	F	T	F	F	T
F	T	T	T	T	T	T	T
F	T	F	T	F	T	F	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	T	T

ii.

((p → q)∧(q → r)) → (p → r)

As ((p → q) ≡ (¬p v r)

Thus ¬((P ->q) ∧ (q ->r) v (p ->r) by implication law

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= (p ^ q) v r

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= ~p v (~q v r)

=~p v ~q v r

Using Demorgans law =(p ^ q) v r

(p ^ q) v r ≡ (p ^ q) v r

2.3 (b) Not logically equivalent 3 / 4

- + **4 pts** All Correct
- + **1 pts** (p implies q) implies r column correct
- + **1 pts** p implies (q implies r) column correct
- + **2 pts** Explanation of why these compound propositions are not LE
- - **2 pts** Correct setup, a few major errors
- - **4 pts** Incorrect

- 1 Point adjustment

Explanation unclear, Should have used truth table or an example truth values for proving the same

3. Suppose that the domain of the propositional function $P(x)$ consists of the integers 5, 6, 7, and 8. Express the following statements without using quantifiers, instead using negations, disjunctions, and conjunctions. [e.g. $\exists x P(x)$ would be $P(5) \vee P(6) \vee P(7) \vee P(8)$]

(a) $\forall x P(x)$

(b) $\neg \exists x P(x)$

(c) $\neg \forall x P(x)$

(a.) $\forall xP(x)$

Here "$\forall x$" translates over for all "x." Given P(x) consists of integers 5,6,7,8 there fore $\forall xP(x)$ is a conjunction of integers.

$\forall xP(x)=P(5) \wedge P(6) \wedge P(7) \wedge P(8)$

(b.) $\neg\exists xP(x) = \neg(\exists xP(x))$

$= \forall x\neg P(x)$

CONJUNCTION OF NEGATIOn

$= \neg P(5) \wedge P(6) \wedge \neg(P(7)) \wedge \neg(P(8))$

(c.) $\neg\forall xP(x) = \neg(\forall xP(x))$

$=\exists x \neg(P(x))$

Give the "universe" integers is 5,6,7,8 so to get some x meaning we take has disjunction

$=\exists x \neg(P(x))$

$= \neg(P(5)) \wedge \neg(P(6)) \wedge \neg(P(7)) \wedge \forall\neg(P(8))$

3.1 (a) **2 / 2**

- ✓ **+ 2 pts** Correct
- **+ 1 pts** Including P(5), P(6), P(7), P(8)
- **+ 1 pts** Linking these propositions with a conjunction
- **+ 0 pts** Incorrect answer
- **+ 0 pts** No answer provided

3. Suppose that the domain of the propositional function $P(x)$ consists of the integers 5, 6, 7, and 8. Express the following statements without using quantifiers, instead using negations, disjunctions, and conjunctions. [e.g. $\exists x P(x)$ would be $P(5) \vee P(6) \vee P(7) \vee P(8)$]

(a) $\forall x P(x)$

(b) $\neg \exists x P(x)$

(c) $\neg \forall x P(x)$

(a.) $\forall x P(x)$
Here "$\forall x$" translates over for all "x." Given P(x) consists of integers 5,6,7,8 there fore $\forall x P(x)$ is a conjunction of integers.

$\forall x P(x) = P(5) \wedge P(6) \wedge P(7) \wedge P(8)$

(b.) $\neg \exists x P(x) = \neg(\exists x P(x))$
$= \forall x \neg P(x)$

CONJUNCTION OF NEGATIOn
$= \neg P(5) \wedge P(6) \wedge \neg(P(7)) \wedge \neg(P(8))$

(c.) $\neg \forall x P(x) = \neg(\forall x P(x))$
$= \exists x \neg(P(x))$
Give the "universe" integers is 5,6,7,8 so to get some x meaning we take has disjunction

$= \exists x \neg(P(x))$
$= \neg(P(5)) \wedge \neg(P(6)) \wedge \neg(P(7)) \wedge \forall \neg(P(8))$

3.2 (b) **2 / 2**

- ✓ **+ 2 pts** Correct
- **+ 1 pts** Including all 4 propositions in statement
- **+ 1 pts** Negating propositions and linking with conjunction
- **- 1 pts** Partially correct
- **+ 0 pts** Incorrect answer
- **+ 0 pts** Answer not provided

3. Suppose that the domain of the propositional function $P(x)$ consists of the integers 5, 6, 7, and 8. Express the following statements without using quantifiers, instead using negations, disjunctions, and conjunctions. [e.g. $\exists x P(x)$ would be $P(5) \vee P(6) \vee P(7) \vee P(8)$]

(a) $\forall x P(x)$

(b) $\neg \exists x P(x)$

(c) $\neg \forall x P(x)$

(a.) $\forall$xP(x)

Here "$\forall$x" translates over for all "x." Given P(x) consists of integers 5,6,7,8 there fore $\forall$xP(x) is a conjunction of integers.

$\forall$xP(x)=P(5) $\wedge$ P(6) $\wedge$ P(7) $\wedge$ P(8)

(b.) $\neg\exists$xP(x) = $\neg$($\exists$xP(x))

= $\forall$x$\neg$P(x)

CONJUNCTION OF NEGATIOn

= $\neg$P(5) $\wedge$ P(6) $\wedge$ $\neg$(P(7)) $\wedge$ $\neg$(P(8))

(c.) $\neg\forall$xP(x) = $\neg$($\forall$xP(x))

=$\exists$x $\neg$(P(x))

Give the "universe" integers is 5,6,7,8 so to get some x meaning we take has disjunction

=$\exists$x $\neg$(P(x))

= $\neg$(P(5)) $\wedge$ $\neg$(P(6)) $\wedge$ $\neg$(P(7)) $\wedge$ $\forall\neg$(P(8))

3.3 (c) **0 / 2**

+ **2 pts** Correct
+ **1 pts** Including all 4 propositions in statement
+ **1 pts** Negating propositions and linking with disjunction

✓ + **0 pts** **Incorrect answer**

+ **0 pts** Answer not provided

4. We spent time in lecture talking about how to convert base-10 numbers to binary. Use the same principles to convert 163 to base-3. Make sure to show all of your steps.

163 -> to base 3

---

3 | 163 (remainder)
3 | 54 - 1
3 | 18 - 0
3 | 6 - 0
3 | 2 - 2

163 = 54 * 3 + 1
54 = 10 * 3 + 0
18 = 3*6+0
6 = 4*2+0
2 = 3*0+2

163(base3)= 20001

2*3^4 +0.3^3+0.3^2+0.3^1+1.3^0
2*81+0+0+0+1
162 +1
=3

4 Base-3 Conversion **8 / 8**

- ✓ **+ 8 pts** **Correct answer with supporting work**
- **+ 2 pts** Correct answer, no supporting work shown
- **+ 4 pts** Writing 163 as a sum of powers of 3
- **+ 2 pts** Identifying coefficients (0, 1, 2) of powers of 3
- **+ 2 pts** Concluding that 163 = 20001 in base 3
- **+ 4 pts** Alternatively-setting up valid algorithm
- **+ 4 pts** Alternatively-Correctly applying algorithm to 163
- **+ 0 pts** Incorrect answer
- **+ 4 pts** Not enough work shown
- **+ 0 pts** No answer provided

5. Consider the following **satisfiability** problem: The Scooby Doo gang: Fred, Daphne, Shaggy, Velma, and Scooby are going on vacation. However, before they can book their travel, they need to all agree on where to go. Their trip may involve one or more destinations. They must all travel together to all of the places as one group (so part of the group cannot go to one location while the others go somewhere else).

i Shaggy wants to go to Venice, or not to Shanghai.

ii If the gang goes to Paris, then Velma does not want to go to Venice.

iii Daphne wants to go to Brussels if and only if the gang also goes to London and Paris.

iv Fred does not want to go to Paris.

v Scooby just wants to leave the house and does not care where the gang goes.

Let $T(x)$ represent the propositional function "the trip must include destination x", where the domain for x is the set of possible travel locations: Venice (V), Shanghai (S), Paris (P), Brussels (B), and London (L). Note that statements such as "Shaggy want to go to Venice" does *not* imply that Shaggy only wants to go to Venice. For example, Shaggy would be perfectly happy going to Venice and Shanghai.

(a) Translate each of the group's travel requirements $i - iv$ from English into a proposition using the given propositional function. [No need to translate Scooby's wishes!]

(b) Are the group's travel wishes satisfiable? If they are, provide a list of destinations that satisfies the requirements. If they are not, provide a **concise** written argument explaining why not. Do **not** use a truth table.

(c) What travel destination should we have included in the list? [Note, this is for fun.]

(a.)

i. T(V) ∨ ¬T(S)
ii. T(P) → ¬ T(V)
iii. T(B) ⇔ (T(L) ∨ T(P))
iv. ¬ T(V,S,P,B,L)

(b.)
The trip destination requirements are satisfiable. A trip to Venice and not including shanghai, and not Paris would satisfy the entire group.
The Venice answer can be found by starting with the strictest requirement and working backwards, to reduce the requirements of the most satisfiable travel destination. For example, Shanghai and Paris or neither travel destinations is our option.
This would imply that the holiday does not include Venice but implies it does, which is a contradiction thus the trip cannot include both Venice and Shanghai or Paris because of the restrictions.

(c.) New York, Barcelona, Rome and Hawaii are some examples that would be fun if included.

5.1 (a) translations to symbols 4 / 4

- ✓ + **4 pts** **All Correct or one minor mistake**
- \+ **1 pts** Translation of i
- \+ **1 pts** Translation of ii
- \+ **1 pts** Translation of iii
- \+ **1 pts** Translation of iv
- \- **1 pts** If function T(x) not used or one of the questions is not correct
- \- **2 pts** 2 incorrect
- \- **3 pts** one correct
- \- **4 pts** No solution

2 4th one neg T(P)

5. Consider the following **satisfiability** problem: The Scooby Doo gang: Fred, Daphne, Shaggy, Velma, and Scooby are going on vacation. However, before they can book their travel, they need to all agree on where to go. Their trip may involve one or more destinations. They must all travel together to all of the places as one group (so part of the group cannot go to one location while the others go somewhere else).

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   (c) What travel destination should we have included in the list? [Note, this is for fun.]

(a.)

i. $T(V) \vee \neg T(S)$
ii. $T(P) \rightarrow \neg T(V)$
iii. $T(B) \Leftrightarrow (T(L) \vee T(P))$
iv. $\neg T(V,S,P,B,L)$

(b.)
The trip destination requirements are satisfiable. A trip to Venice and not including shanghai, and not Paris would satisfy the entire group.
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(c.) New York, Barcelona, Rome and Hawaii are some examples that would be fun if included.

5.2 (b) satisfiable? or not 4 / 4

- ✓ **+ 4 pts** **All Correct - nice logical argument**
- **+ 3 pts** Reasonable argument, understands satisfiability, one small error
- **+ 2 pts** Correct conclusion but insufficient supporting work
- **+ 1 pts** Incorrect conclusion, misunderstanding of satisfiability
- **- 0 pts** Incorrect
- **- 1 pts** Minor error in argument
- **- 2 pts** No supporting argument
- **- 3 pts** Incorrect Conclusion
- **- 4 pts** No solution uploaded

5. Consider the following **satisfiability** problem: The Scooby Doo gang: Fred, Daphne, Shaggy, Velma, and Scooby are going on vacation. However, before they can book their travel, they need to all agree on where to go. Their trip may involve one or more destinations. They must all travel together to all of the places as one group (so part of the group cannot go to one location while the others go somewhere else).

i Shaggy wants to go to Venice, or not to Shanghai.

ii If the gang goes to Paris, then Velma does not want to go to Venice.

iii Daphne wants to go to Brussels if and only if the gang also goes to London and Paris.

iv Fred does not want to go to Paris.

v Scooby just wants to leave the house and does not care where the gang goes.

Let $T(x)$ represent the propositional function "the trip must include destination x", where the domain for x is the set of possible travel locations: Venice (V), Shanghai (S), Paris (P), Brussels (B), and London (L). Note that statements such as "Shaggy want to go to Venice" does *not* imply that Shaggy only wants to go to Venice. For example, Shaggy would be perfectly happy going to Venice and Shanghai.

(a) Translate each of the group's travel requirements $i - iv$ from English into a proposition using the given propositional function. [No need to translate Scooby's wishes!]

(b) Are the group's travel wishes satisfiable? If they are, provide a list of destinations that satisfies the requirements. If they are not, provide a **concise** written argument explaining why not. Do **not** use a truth table.

(c) What travel destination should we have included in the list? [Note, this is for fun.]

(a.)

i. $T(V) \vee \neg T(S)$

ii. $T(P) \rightarrow \neg T(V)$

iii. $T(B) \Leftrightarrow (T(L) \vee T(P))$

iv. $\neg T(V,S,P,B,L)$

(b.)
The trip destination requirements are satisfiable. A trip to Venice and not including shanghai, and not Paris would satisfy the entire group.
The Venice answer can be found by starting with the strictest requirement and working backwards, to reduce the requirements of the most satisfiable travel destination. For example, Shanghai and Paris or neither travel destinations is our option.
This would imply that the holiday does not include Venice but implies it does, which is a contradiction thus the trip cannot include both Venice and Shanghai or Paris because of the restrictions.

(c.) New York, Barcelona, Rome and Hawaii are some examples that would be fun if included.

5.3 (c) where to? 1 / 1

✓ **+ 1 pts** **Naming any location not given**

- 1 pts Not naming a location

6 Style points 6 / 6

- ✓ + 1 pts **Extra Credit for typed assignment**
- ✓ + 2 pts **Complete**
- ✓ + 1 pts **Neatness**
- ✓ + 2 pts **Clear and concise**
- + 0 pts No style points
- - 3 pts Not typed, not complete
- - 2 pts Click here to replace this description.
- - 1 pts Not complete
- - 4 pts Click here to replace this description.
- - 6 pts No style points