CS 173 (B), Spring 2015, Examlet 1, Part A

NAME:	NETID:

Discussion Section: BDA:1PM BDB:2PM BDC:3PM BDD:4PM BDE:5PM

1. State the negation and the contrapositive of the following claim (as English statements), moving all negations (e.g. "not") so that they are on individual predicates.

   Claim: For every dinosaur d, if d is huge, then d is an adult and d is a sauropod.

   (a) Negation [6 points]

   Solution: There exists a huge dinosaur that is either not an adult or not a sauropod.

   (b) Contrapositive [6 points]

   Solution: For every dinosaur d, if d is not an adult or d is not a sauropod, then d is not huge.

2. **Equivalent Operator.** (Continued overleaf.) [8 points]

   Margaret is rewriting a program (in pseudocode) to improve its readability. She comes across the following function on the left, and rewrites it as shown on the right, using a single binary operator `op`. (All functions here are predicates – i.e., they return a boolean value, `true` or `false`.)

```
function VERIFY(student s)
    if ELIGIBLE(s) then
        if ADMITTED(s) then
            return true
        else
            return false
        end if
    else
        if not ADMITTED(s) then
            return true
        else
            return false
        end if
    end if
end function
```

Original version

```
function VERIFY(student s)
    return ELIGIBLE(s) op ADMITTED(s)
end function
```

Margaret's version

(a) Give the truth table for the operator `op` she used:

p	q	p `op` q
T	T	T
T	F	F
F	T	F
F	F	T

(b) What is the common mathematical name (or symbol) for `op`? iff/xnor ($\leftrightarrow$ or $=$)

3. For which values of (p, q, r) does the following expression evaluate to True? Write your answer as a list of triplets of the form (T, T, T) (meaning $p = T, q = T$ and $r = T$) etc. [5 points]

$$(\neg p \wedge \neg q \wedge r) \vee (\neg p \wedge \neg q \wedge \neg r).$$

Solution:

(F, F, T) and (F, F, F).

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1. State the negation and the contrapositive of the following claim (as English statements), moving all negations (e.g. "not") so that they are on individual predicates.

   Claim: For every cat c, if c is not fierce or c wears a collar, then c is a pet.

   (a) Negation [6 points]

   Solution: There exists a cat that is either not fierce or wears a collar, and is not a pet.

   (b) Contrapositive [6 points]

   Solution: For every cat c, if c is not a pet, then c is fierce and c does not wear a collar.

2. **Equivalent Operator.** (Continued overleaf.) [8 points]

   Margaret is rewriting a program (in pseudocode) to improve its readability. She comes across the following function on the left, and rewrites it as shown on the right, using a single binary operator `op`. (All functions here are predicates – i.e., they return a boolean value, `true` or `false`.)

```
function VERIFY(student s)
    if ELIGIBLE(s) then
        if TURNEDDOWN(s) then
            return false
        else
            return true
        end if
    else
        if not TURNEDDOWN(s) then
            return false
        else
            return true
        end if
    end if
end function
```

Original version

```
function VERIFY(student s)
    return ELIGIBLE(s) op TURNEDDOWN(s)
end function
```

Margaret's version

(a) Give the truth table for the operator `op` she used:

p	q	p `op` q
T	T	F
T	F	T
F	T	T
F	F	F

(b) What is the common mathematical name (or symbol) for `op`? xor ($\oplus$ or $\neq$)

3. For which values of (p, q, r) does the following expression evaluate to True? Write your answer as a list of triplets of the form (T, T, T) (meaning $p = T, q = T$ and $r = T$) etc. [5 points]

$$(\neg p \wedge q \wedge r) \vee (p \wedge \neg q \wedge \neg r).$$

Solution:

(F, T, T) and (T, F, F).