CSE215
Foundations of Computer Science

Instructor: Zhoulai Fu

State University of New York, Korea

Agenda

- Revision based on Homework week 03

Homework week 03

Exercise 1 (points = 36)

Below are some arguments. For each argument try to determine whether or not it is valid. If it is valid, you answer needs to be "Valid (<specify-inference-rule>)". If it is invalid, your answer needs to be "Invalid", for which you do not need to explain.

For example, your answer to the following arguments should be "Valid (Modus Ponens)".

- If it rains, the ground is wet.
- It rains.
- Therefore, the ground is wet.

A.

1. If Jane has a cat, then Jane has a pet
2. Jane has a cat
3. Therefore, Jane has a pet

B.

1. If Jane has a cat, then Jane has a pet
2. Jane has a pet
3. Therefore, Jane has a cat

C.

1. If Jane has a cat, then Jane has a pet
2. It is not the case that Jane has a pet
3. Therefore, it is not the case that Jane has a cat

D.

1. If Jane has a cat, then Jane has a pet
2. It is not the case that Jane has a cat
3. Therefore, it is not the case that Jane has a pet

E.

1. If pigs fly, then hell has frozen over
2. Pigs fly
3. Therefore, hell has frozen over

F.

1. It is not the case that Yoda is green
2. If Darth Vader is Luke's Dad, then Yoda is green
3. Therefore, it is not the case that Darth Vader is Luke's dad

G.

1. If Professor is sick, the class will be cancelled
2. If the class is cancelled, the students will be happy
3. Therefore, if Professor is sick, students will be happy

H.

1. If Rufus is a human being, then Rufus has a right to life
2. It is not the case that Rufus is a human being
3. Therefore, it is not the case that Rufus has a right to life

I.

1. Amy joins the Army, or Mary joins the Marines
2. It is not the case that Mary joins the Marines
3. Therefore, Amy joins the Army

J.

1. Ariel joins the Air Force or Nancy joins the Navy
2. Nancy joins the Navy
3. Therefore, Ariel joins the Air Force

K.

1. I like chocolates
2. Therefore, We like chocolates

L.

1. I like Bulgogi and Bibimbap
2. Therefore, I like Bibimbap

Exercise 2 (points = 16)

Use inference rules to show the following argument is valid. To assist your writing, you can provide a list of sentences that look like this: `From "...", we have "..." following "..."`. Example: From premises "p" and "p->q", we have "q" following the inference rule "Modus Ponens".

Premises

- p ∨ q
- q -> r
- p ∧ s -> t
- ~r
- ~q → u ∧ s

Conclusion

- t

Exercise 3 (points = 30)

Rewrite the statements below using quantifiers and variables. For example, a statement like "Even numbers are divisible by 2" becomes: "for each even number n, n is divisible by 2", or "for each number n, if n is an even number, then n is divisible by 2". You do not necessarily need to use the exact words or patterns as above.

1. No two leaves are alike.
2. Even integers equals twice some integer.
3. The sum of two positive integers is a positive number.
4. Everyone loves ice cream.
5. At least one student has finished the homework.
6. No cats are reptiles.
7. There exists a number which is both even and prime.
8. There's no place like home.
9. All that glitters is not gold.
10. All men are mortal.

Issues

3. Two leaves A and B. A is not alike B.

For each even ~~number~~ n, n is ~~divisible~~ doubled by some integer.

If Integers are positive, sum of two Integers is positive number.

For Everyone E, E loves Icecream

For students S, no S not finished homework

For all cats C, ~~not~~ ~~reptile~~ C is not reptile.

~~For number n~~ For even number n, n is prime number.

For all place P, p is not like home

For all glitters g, g is not gold.

No men are not mortal.

Exercise 4 (points = 18)

Determine whether the statements below are true or false. You do not need to give the reasons.

1. 42k is an even number for any integer k.

2. For each integer n with $2 <= n <= 6$, $n^2 - n + 11$ is a prime number.

3. The average of any two odd integers is odd.

4. For any real number x, if $x * x >= 4$, then $x >= 2$.

5. For any real numbers x and y, $x^2 - 2xy + y^2 >= 0$.

6. There exists an integer x, such that $(2x + 1)^2$ is even.

Solution

A.

1. If Jane has a cat, then Jane has a pet
2. Jane has a cat
3. Therefore, Jane has a pet

valid (Modus Ponens)

B.

1. If Jane has a cat, then Jane has a pet
2. Jane has a pet
3. Therefore, Jane has a cat

invalid

C.

1. If Jane has a cat, then Jane has a pet
2. It is not the case that Jane has a pet
3. Therefore, it is not the case that Jane has a cat

valid (Modus Tollens)

D.

1. If Jane has a cat, then Jane has a pet
2. It is not the case that Jane has a cat
3. Therefore, it is not the case that Jane has a pet

invalid

E.

1. If pigs fly, then hell has frozen over
2. Pigs fly
3. Therefore, hell has frozen over

valid (Modus Ponens)

F.

1. It is not the case that Yoda is green
2. If Darth Vader is Luke's Dad, then Yoda is green
3. Therefore, it is not the case that Darth Vader is Luke's dad

valid (Modus Tollens)

G.

1. If Professor is sick, the class will be cancelled
2. If the class is cancelled, the students will be happy
3. Therefore, if Professor is sick, students will be happy

valid (Transitivity)

H.

1. If Rufus is a human being, then Rufus has a right to life
2. It is not the case that Rufus is a human being
3. Therefore, it is not the case that Rufus has a right to life

invalid

I.

1. Amy joins the Army, or Mary joins the Marines
2. It is not the case that Mary joins the Marines
3. Therefore, Amy joins the Army

valid (Elimination)

J.

1. Ariel joins the Air Force or Nancy joins the Navy
2. Nancy joins the Navy
3. Therefore, Ariel joins the Air Force

invalid

K.

1. I like chocolates
2. Therefore, We like chocolates

invalid

L.

1. I like Bulgogi and Bibimbap
2. Therefore, I like Bibimbap

valid (Specialization)

1) $q \to r$
$\sim r$
$\therefore \sim q$
From the premises "$q \to r$" and "$\sim r$", we have "$\sim q$" following the inference rule, "Modus Tollens."

2) $p \vee q$
$\sim q$
$\therefore p$
From the premises "$p \vee q$" and "$\sim q$", we have "p" following the inference rule "Elimination".

3) $\sim q \to u \wedge s$
$\sim q$
$\therefore u \wedge s$
From the premises "$\sim q \to u \wedge s$" and "$\sim q$", we have "$u \wedge s$" following the inference rule "Modus Ponens."

4) $p \wedge s \to t$
p
s
$\therefore t$
From the premises "$p \wedge s \to t$", "p" and "s", we have "t" following the inference rule "Modus Ponens."

A bit of jumping in the end. To explain u /\s -> s would be great

1. No two leaves are alike. Any leaves are different. $\forall$ leaves l_1, $\forall$ leaves l_2, $l_1 \neq l_2$
2. Even integers equals twice some integer. $\forall$ even integer x, $\exists$ integer y, $x = 2y$
3. The sum of two positive integers is a positive number. $\forall$ positive integer x, $\forall$ positive integer y, $x+y$ is a positive number.
4. Everyone loves ice cream. $\forall$ person x, x loves ice cream.
5. At least one student has finished the homework. $\exists$ student x, x has finished the homework.
6. No cats are reptiles. $\forall$ cat x, x are not a reptile
7. There exists a number which is both even and prime.
8. There's no place like home. $\exists$ number x, x is even $\wedge$ x is prime
Every place is not like home. $\forall$ place x, x is not like home.
9. All that glitters is not gold. $\exists x$, x glitter $\wedge$ x is not gold.
10. All men are mortal.
$\forall$ man x, x is mortal.

3). 1. For all leaves a and b, if both a and b is a leaf, then a is not equal to b.

2. For all even integers n, there exists an integer m that n equals 2m.

3. For all positive integers n and m, n+m is a positive number.

4. For all people p, p loves ice cream.

5. There exists at least one student s who finished the homework.

6. For all cats c, c is not a reptile.

7. There exists a number n that n is both even and prime.

8. For all places p, p is not like home.

---

9. For all things t, if t glitters, t is not gold.

10. For all men m, m is mortal.

1. a bit of redundancy

9. wrong. Should be: There exists a thing t, t glitters and t is not gold

Exercise 4-

1. True
2. True
3. False
4. False
5. True
6. False.