CSE215
Foundations of Computer Science

Instructor: Zhoulai Fu

State University of New York, Korea

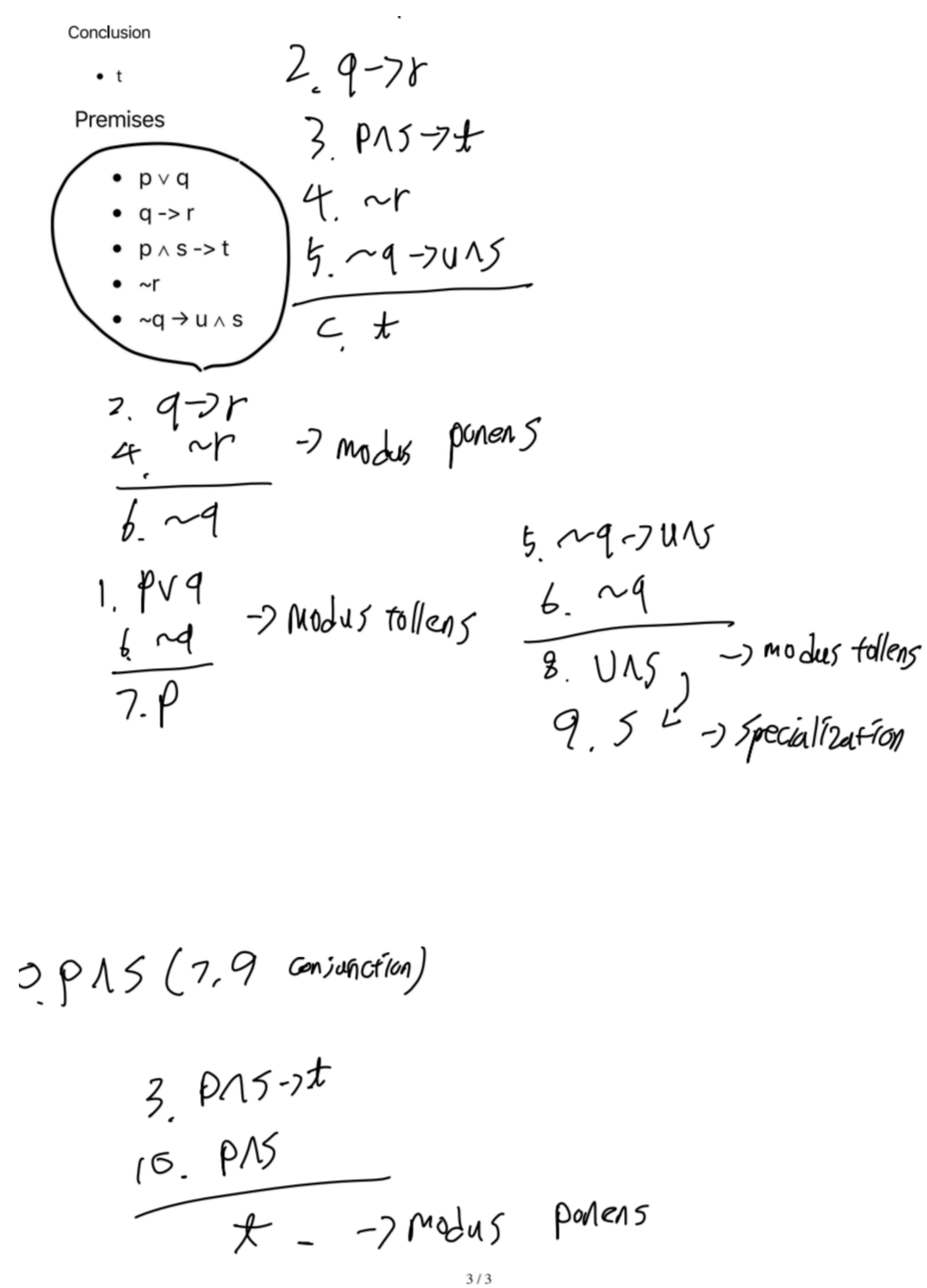
Plan

- Homework 03

About homework grading

- Factual grading error will be corrected
- How many points should be deducted is subjective and non-negotiable.
- Scribbled solution, without legible text explanation, automatically gets 0 point

Example of “scribbled solution, without legible text explanation”



Exercise 1 (points = 50)

Below are some arguments. For each argument, determine whether or not it is valid. If it is valid, your answer needs to be "Valid". If it is invalid, your answer needs to be "Invalid". Explanation is not needed.

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. I like chocolates
2. Therefore, we like chocolates

G.

1. If the Professor is sick, the class will be canceled
2. If the class is canceled, the students will be happy
3. Therefore, if the 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. I like Bulgogi
2. Therefore, I like Bibimbap and Bulgogi

Exercise 2 (points = 25)

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 but you do need to figure out the hidden quantifiers from the English meaning of each sentence.

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. All that glitters is not gold.

Issues

3. The sum of two positive integers is a positive number
→ For every positive n, there exist two positive integers x and y such that n equals x + y.

5. All that glitters is not gold.
→ for each object o, if o glitters, then o is not gold

Issues

1. For every 2 leaves ℓ, ℓ are not alike.
2. For each integer i, if i is an even integer, then the quotient of i and 2 is some integer.
3. For all 2 positive integers i, i is a positive number.

Exercise 3 (points = 25)

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

Solution

Exercise 1

A. valid

C : Jane has a cat
P : Jane has a pet

$$\begin{array}{l} C \to P \\ \underline{C} \\ \therefore P \end{array}$$

(Modus Ponens)

B. invalid

$$\begin{array}{l} C \to P \\ \underline{P} \\ \therefore C \end{array}$$

(wrong - converse error)

C. valid

$$\begin{array}{l} C \to P \\ \underline{\neg P} \\ \therefore \neg C \end{array}$$

(Modus tollens)

D. invalid

$$\begin{array}{l} C \to P \\ \underline{\neg C} \\ \therefore \neg P \end{array}$$

(wrong - inverse error)

E. valid

P : Pigs fly
H : Hell has frozen over

$$\begin{array}{l} P \to H \\ \underline{P} \\ \therefore H \end{array}$$

(Modus Ponens)

F. invalid

G. valid

P : Professor is sick
C : class is cancelled
S : students are happy

$$\begin{array}{l} P \to C \\ \underline{C \to S} \\ \therefore P \to S \end{array}$$

(transitivity)

H. invalid

H : Rufus is a human being
L : Rufus has a right to life

$$\begin{array}{l} H \to L \\ \underline{\neg H} \\ \therefore \neg L \end{array}$$

(wrong - inverse error)

I. valid

A : Amy joins the Army
M : Mary joins the Marines

$$\begin{array}{l} A \lor M \\ \underline{\neg M} \\ \therefore A \end{array}$$

(elimination)

J. invalid

Exercise 2

1. For all leaves a and b, a and b are different.
   $\forall$ leaves a, $\forall$ leaves b, $a \neq b$

2. For all even integers x, there exists an integer y such that x equals 2y.
   $\forall$ even integers x, $\exists$ integer y, $x = 2y$

3. For all positive integers a and b, a+b is a positive number.
   $\forall$ positive integer a, $\forall$ positive integer b, a+b is a positive number

4. All people love ice cream.
   $\forall$ person p, p loves ice cream

5. There exists a thing x, such that it glitters but is not gold.
   $\exists$ thing x, x glitters $\land$ x is not gold

Exercise 3

1) $p \vee q$
2) $q \to r$
3) $p \wedge s \to t$
4) $\neg r$
5) $\neg q \to u \wedge s$
6) From 2, 4, we have $\neg q$ following Modus Tollens.
7) From 1, 6, we have p following elimination.
8) From 5, 6, we have $u \wedge s$ following Modus Ponens.
9) From 8, we have s following specialization.
10) From 7, 9, we have $p \wedge s$ following conjunction.
11) From 3, 10, we have t following Modus Ponens.

Conclusion:
t