

CSE215: Lecture 05

Foundations of Computer Science

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Course materials and Info available here:
https://github.com/zhoulaifu/22_cse215_spring

Logistic things

- Attendance check. If possible, send me an email before class if you cannot attend.
- Health and safety related absences will be excused
- Try to subscribe to Discussion board (our Q&A Forum) to get email notification

Previous lectures

- Truth Table
- Logic Equivalence
- How to evaluate truthfulness of something like (true \wedge tase) \rightarrow false

Today

Problem 1. [5 points]

Determine if the following deduction rule is valid.

$$\begin{aligned} p \rightarrow (q \vee r) \\ \sim(p \rightarrow q) \\ \therefore r \end{aligned}$$

Today's Objectives

- Know how to use truth table to check if a **logic argument is valid**

Concepts

What is a logical argument?

Definitions

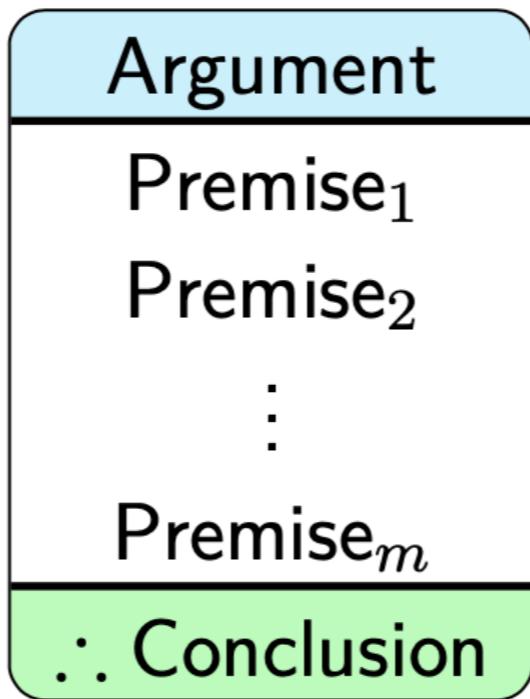
- **Logical argument.** Sequence of statements aimed at demonstrating the truth of an assertion
- **Conclusion.** Last statement in an argument
- **Premises.** Last-but-one statements in an argument

Problem 1. [5 points]

Determine if the following deduction rule is valid.

$$\begin{aligned} p \rightarrow (q \vee r) \\ \sim(p \rightarrow q) \\ \therefore r \end{aligned}$$

A general logic argument looks like this



If Premise₁ and Premise₂ and ... and Premise_{*m*}, then Conclusion.

What is a valid argument?

Definition

- An argument is **valid** if the conclusion follows necessarily from the premises
- Every person will die
- Socrates is a person
- So, Socrates will die
- Every person will live forever
- Socrates is a person
- So, Socrates will live forever

Valid or Not?

- All cups are blue
- Socrates is blue
- So, Socrates is blue

Valid or not?

Examples

Valid

- If Socrates is a man, then Socrates is mortal.
Socrates is a man.
Therefore, Socrates is mortal.

Invalid

- If Socrates is a man, then Socrates is mortal.
Socrates is mortal.
Therefore, Socrates is a man.

Valid

- If Socrates is a man, then Socrates is mortal.
Socrates is not mortal.
Therefore, Socrates is not a man.

Invalid

- If Socrates is a man, then Socrates is mortal.
Socrates is not a man.
Therefore, Socrates is not mortal.

Logically speaking

Examples

- If p , then q .

p .

Therefore, q .

▷ Valid argument

- If p , then q .

q .

Therefore, p .

▷ Invalid argument

- If p , then q .

$\sim q$.

Therefore, $\sim p$.

▷ Valid argument

- If p , then q .

$\sim p$.

Therefore, $\sim q$.

▷ Invalid argument

Quiz-1: Valid or not

Examples

- If it is raining, then it is cloudy.

It is raining.

Therefore, it is cloudy.

- If it is raining, then it is cloudy.

It is cloudy.

Therefore, it is raining.

- If it is raining, then it is cloudy.

It is not cloudy.

Therefore, it is not raining.

- If it is raining, then it is cloudy.

It is not raining.

Therefore, it is not cloudy.

Quiz-2: Valid or not

Examples

- If $x > 2$, then $x^2 > 4$.

$$x > 2.$$

Therefore, $x^2 > 4$.

- If $x > 2$, then $x^2 > 4$.

$$x^2 > 4.$$

Therefore, $x > 2$.

- If $x > 2$, then $x^2 > 4$.

$$x^2 \leq 4.$$

Therefore, $x \leq 2$.

- If $x > 2$, then $x^2 > 4$.

$$x \leq 2.$$

Therefore, $x^2 \leq 4$.

**How to check if an
argument is valid?**

Method 1: Truth table

1. Identify the premises and conclusion
2. Construct a truth table for premises and conclusion
3. A row of the **truth table** in which all the premises are true is called a **critical row**.

If there is a critical row in which the conclusion is false, then the argument is **invalid**. If the conclusion in every critical row is true, then the argument is **valid**.

Example

Problem

- Determine the validity of the argument:

$$p \rightarrow q \vee \sim r$$

$$q \rightarrow p \wedge r$$

$$\therefore p \rightarrow r$$

p	q	r	$\sim r$	$q \vee \sim r$	$p \wedge r$	$p \rightarrow q \vee \sim r$	$q \rightarrow p \wedge r$	$p \rightarrow r$
T	T	T	F	T	T	T	T	T
T	T	F	T	T	F	T	F	
T	F	T	F	F	T	F	T	
T	F	F	T	T	F	T	T	F
F	T	T	F	T	F	T	F	
F	T	F	T	T	F	T	F	
F	F	T	F	F	F	T	T	T
F	F	F	T	T	F	T	T	T

**Let us solve two
problems from 2020 finals**

2020 Final-1

Problem 1. [5 points]

Determine if the following deduction rule is valid.

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

$$\sim(p \rightarrow q)$$

$$\therefore r$$

2020 Final-2

Problem 1. [5 points]

Determine if the following deduction rule is valid.

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

$$\sim p \vee \sim q$$

$$\therefore \sim r$$

Summary

- Check validity using truth tables
- Quiz and exam problems

Thank you for your attention!