

CSE215

Foundations of Computer Science

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Plan

- Valid arguments

<https://youglish.com/pronounce/%22Valid%20Argument%22/english/us?>

Valid arguments

Final, 2020-1

Problem 1. [5 points]

Determine if the following deduction rule is valid.

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

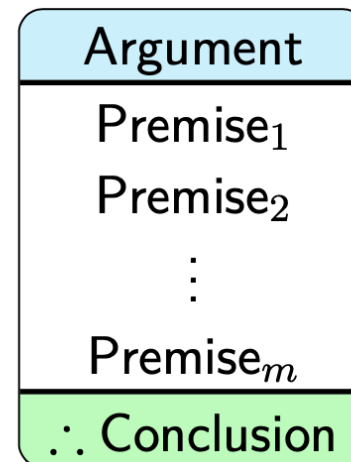
$$\sim (p \rightarrow q)$$

$$\therefore r$$

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



If Premise₁ and Premise₂ and \dots 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
- Congressmen/women own classified info
- Investors can take profit from classified info
- So, congressmen/women should not be allowed to actively do investment

Exercise: Valid or Not?

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

Valid or not?

Examples

Valid	<ul style="list-style-type: none">• If Socrates is a man, then Socrates is mortal. Socrates is a man. Therefore, Socrates is mortal.	$\text{If } p, \text{ then } q.$ $p.$ Therefore, $q.$
Invalid	<ul style="list-style-type: none">• If Socrates is a man, then Socrates is mortal. Socrates is mortal. Therefore, Socrates is a man.	$\text{If } p, \text{ then } q.$ $q.$ Therefore, $p.$
Valid	<ul style="list-style-type: none">• If Socrates is a man, then Socrates is mortal. Socrates is not mortal. Therefore, Socrates is not a man.	$\text{If } p, \text{ then } q.$ $\sim q.$ Therefore, $\sim p.$
Invalid	<ul style="list-style-type: none">• If Socrates is a man, then Socrates is mortal. Socrates is not a man. Therefore, Socrates is not mortal.	$\text{If } p, \text{ then } q.$ $\sim p.$ Therefore, $\sim q.$

How to mathematically check if an argument is valid?

- Truth table
- Inference rules

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**.

Importantly, if there are no critical rows, then the arguments is considered 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

Exercise

Problem 1. [5 points]

Determine if the following deduction rule is valid.

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

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

$$\therefore r$$

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