SIT105 – Thinking Technology and Design Class 05

Arguments & Truth Tables

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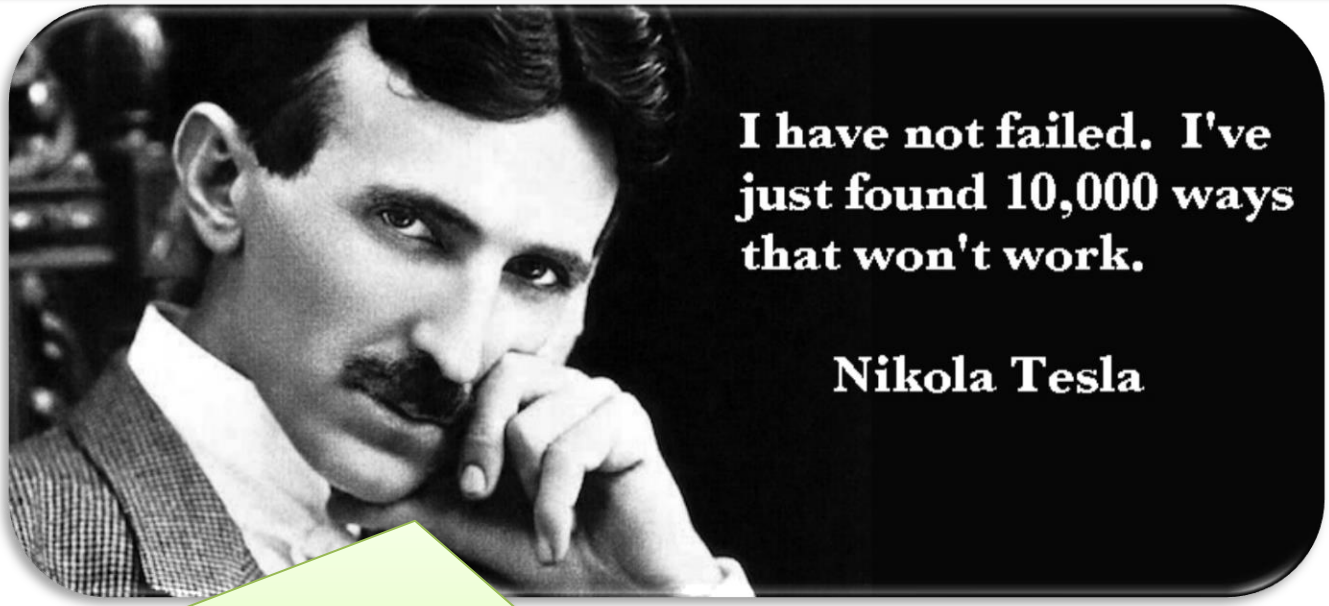
Critical Thinking Quote of the Class

Nikola Tesla was a Serbian American inventor, electrical engineer, mechanical engineer, and futurist. Most well known for harnessing light, inventing x-rays, radio, and alternating current.



Even when our efforts don't seem to provide results, that doesn't mean we've failed or should give up! Consider them part of the process of finding what *does* work.

So to begin, let's look at arguments

This week's ULO – [1] Apply critical thinking techniques and IT discourse to identify and analyse problems from technical and non-technical perspectives.

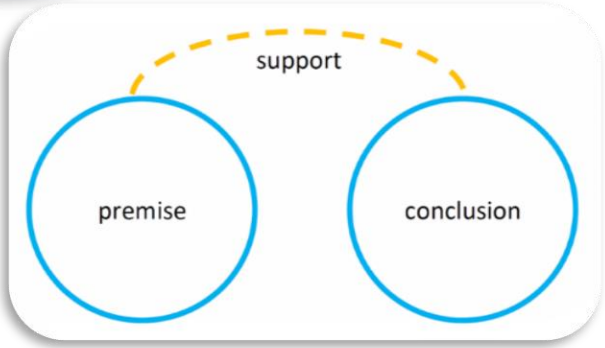
Arguments! What are they?

- *Arguments* are one of the ways used to settle issues.
- The process of an argument is actually where 2 or more people are debating (responding to each other) and making arguments on a particular topic.
  - Moving away from just stating claims but actually defending these claims by providing reasons.
- Arguments are actually claims backed by reasons that are supported by some form of evidence.
- Arguments attempt to support a claim by giving reasons for believing it (the *premises*).
- The *issue* is *"*Whether or not the *claim* is acceptable given the *reasons*."

So What Do We Need to Know to Begin With? … ….Claims!

- A claim is a sentence that is used to make a claim capable of being true or false.
- Claims are the basic units of arguments.
- An argument is a set of claims (2 claims) where a premise, supports another (particular one) of them called the conclusion.

A Rundown on Arguments!
..What are they?



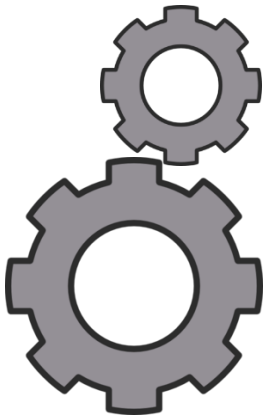
- A **conclusion** is:
  - A claim, and
  - Supported by one or more premises.

- A **premise** is:
  - A claim too, and
  - Used as a reason for believing the conclusion.

Arguments… A few examples

Each of the following premises are highlighted in blue and conclusion in red.

1. My 1:30pm train was cancelled because it was involved in an accident at 1:20pm.
2. Jane likes blue so her sister likes blue too.
3. I study hard because I want a good job.
4. The PlayStation network is down because hackers broke in and stole all the data.



A claim used as a reason for believing the conclusion.

Quick Thinking Task !
Premise/Conclusion

An argument has a premise and a conclusion.
The premise supports the conclusion!
(sometimes the conclusion can be 2nd!)

For example:

- Jack is taller than Paul, and Paul is taller than Jill.

  Therefore, Jack is taller than Jill.

Which is the premise?

Which is the conclusion?

Answer

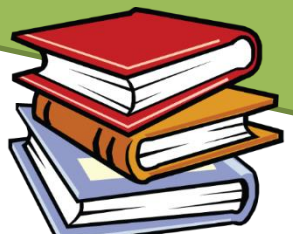
Now let's look at the theme of this week.

Societal and Scientific Arguments around Video Games!

Do Video Games Make People More Violent?

- A 2011 study by the Center for European Economic Research found that although violent video games might increase aggression they also have a paradoxical effect of reducing crime.
- This is possibly because the time spent playing games *reduces time spent engaged in more antisocial actives.*

The study states that: violent video games "paradoxically may reduce violence while increasing the aggressiveness of individuals by simply shifting these individuals out of alternative activities where crime is more likely to occur."



Cunningham, A. Scott; Engelstätter, Benjamin; Ward, Michael R. (2011). "Understanding the effects of violent video games on violent crime" (PDF). *ZEW Discussion Papers 11-042*. Center for European Economic Research. p. 25. Retrieved11 November 2014.

Remember: The **conclusion** is the claim you are making and the **premise** is used as a reason for believing the conclusion

Do Video Games Make People More Violent?

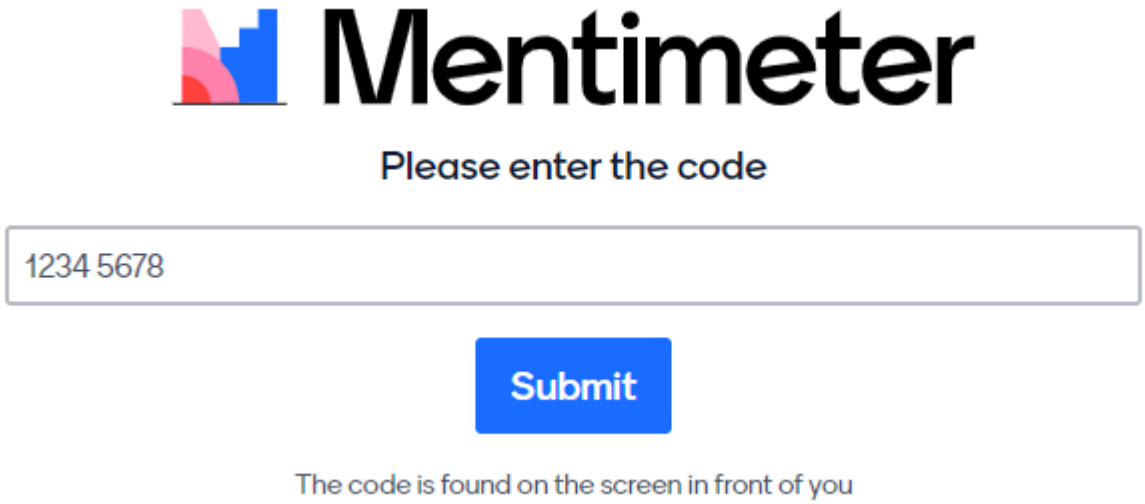
Let's spend 10 minutes to analyse the previous research.

Can you suggest 2 arguments either for, or against?

Premise	Conclusion

Let’s go to www.menti.com

- Do Video Games Make People More Violent?
- The catharsis explanation on the impact of violent video game is based on the economic theory of time use
- What arguments did you find in this research paper? List any least two of them.



Next let's look at
Truth Tables!

Truth Tables

… Why do we need them?

It is often difficult to determine the **validity** of long and/or complex arguments by just reading them!

Truth tables provide:

- A visual way to see relationships between **claim variables**
- Ways to **determine validity**

Important!

Truth Tables – 2 Ways!

- There are two kinds of truth tables
  - Long Truth Table
  - Short Truth Table

- Development of a long truth table normally takes more time…
- A short truth table can be done faster than a long truth table **but you need to think critically!**

What do we mean by TRUE(T) and FALSE(F)?

Example:

Tina is tall	John is tall
T	T
T	F
F	T
F	F

Meaning	Meaning
Tina is tall	John is tall
Tina is tall	John is not tall (short)
Tina is not tall (short)	John is tall
Tina is not tall (short)	John is not tall (short)

Logic and Types of Claims

- There are 4 logic operations that are being used in truth functional arguments:

- **Negation NOT**
- **Conjunction AND**
- **Disjunction OR**
- **The Conditional IF,THEN**

Negation (Not) ~

Whatever truth value a claim may have, the negation will result in the other value.

- Example, let p = Tina is tall
  - Then **not** (Tina is tall) = Tina is short
- '~p' represents 'not p'

p	~p (i.e., not p)
T	F
F	T

p = Tina is tall

Conjunction (and) ●

- A conjunction is a compound claim made up of two simpler claims
- Example, Tina is tall **and** John is short
- '●' represents '**and**' (sometimes ∧ is used)

p	q	p ● q
T	T	T
T	F	F
F	T	F
F	F	F

p = Tina is tall

q = John is short

True value is when both claims are True, all other times False

Disjunction (or) V

A disjunction is a compound claim made up of two simpler claims

- Example, Tina is tall **or** John is short
- 'V' represents '**or**'

p	q	p V q
T	T	T
T	F	T
F	T	T
F	F	F

p = Tina is tall

q = John is short

False value is when both claims are False, all other times True

Conditional →

- A conditional is a compound claim made up of two simpler claims
- E.g. **<u>If</u> Jack is my son, Jack is younger than me**
- '→' represents the conditional operator

p	q	p → q
T	T	T
T	F	F
F	T	T
F	F	T

p = Jack is my son

q = Jack is younger

False value is when the first claims is True and the second claims is False, all others True

Summary of Steps in Truth Tables

1. **Summarise** the argument
2. **Calculate** the number of rows
3. **Draw** the table
4. **Fill** the table
5. **Identify** whether the argument is **valid** or **invalid**

Let’s Begin with
Long Truth Tables!

Steps Involved in a **Long** Truth Table

1. **Summarise the argument (cont.)**

– Firstly create a single variable code for each, something that relates to the claim/s used… apple = a.

– Use the logical operators we looked at earlier: ~/V /● /➡

- Michael does **NOT** like **a**pple = **~a**
- Michael likes apple **OR b**anana = a **V b**
- Michael likes apple **AND** banana = a ● b
- **IF** Michael likes apple, THEN he likes banana = a ➡ b

Steps Involved in a **Long** Truth Table

2. Calculate the number of rows that table needs:

The number of rows = 2^n

n is the number of **variables** that you have when you summarise the argument.

If there is positive and negative of a variable you should only count it once: **a and ~a** are both count as one variable

$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

Steps Involved in a **Long** Truth Table

3. Draw the table. List all variables as a single form then list premises and the conclusion.

Michael does not like apple = ~a (p1)

Michael likes apple OR banana = a V b (p2)

Therefore, Michael likes banana = b (c)

Number of rows: $2^2 = 4$

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$

Steps Involved in a **Long** Truth Table

4. Fill the first column:

First column always gets TRUE for half of the number of rows and FALSE for the other half

Number of rows = 4 (first column gets 2 trues and 2 false)
Number of rows = 8 (first column gets 4 trues and 4 false)
Number of rows = 16 (first column gets 8 trues and 8 false)

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$
T				
T				
F				
F				

Steps Involved in a **Long** Truth Table

4. Fill the next column:

- If column 1 has 2 T and 2 F the next column needs to have 1 T and 1 F.
- If column 1 has 4 T and 4 F the next column needs to have 2 T and 2 F.
- If column 1 has 8 T and 8 F the next column needs to have 4 T and 4 F.

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$
T	T			
T	F			
F	T			
F	F			

Steps Involved in a **Long** Truth Table

4. Fill the table cells:

Apply operations:

Negation (~) when T then ~T = F

Conjunction (●) The only T answer is when both variables are T

Disjunction (V) The only F answer is when both variables are F

Conditional (→) The only F answer is when the first variable is T and the second variable is F

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$
T	T	F	T	T
T	F	F	T	F
F	T	T	T	T
F	F	T	F	F

Steps Involved in a **Long** Truth Table

Exercise: Let's tackle a long truth table for this new argument!

Angela is hungry

If Angela is hungry, she eats pizza

Therefore, Angela is hungry and eats pizza

Answer:
Angela is hungry H
If Angela is hungry, she eats pizza H → P
Therefore, Angela is hungry and eats pizza H ● P

H	P	H_{p1}	$H \rightarrow P_{p2}$	$H \bullet P_{c}$

Steps Involved in a **Long** Truth Table

Answer: Fill the table for Angela's Argument

H	P	H_{p1}	$H \rightarrow P_{p2}$	$H \bullet P_{c}$
T	T	T	T	T
T	F	T	F	F
F	T	F	T	F
F	F	F	T	F

Valid or invalid argument? Find out next slide!

Valid! – no conclusion which is false with all true premises!

Steps Involved in a **Long** Truth Table

5. Find whether an argument is valid or invalid

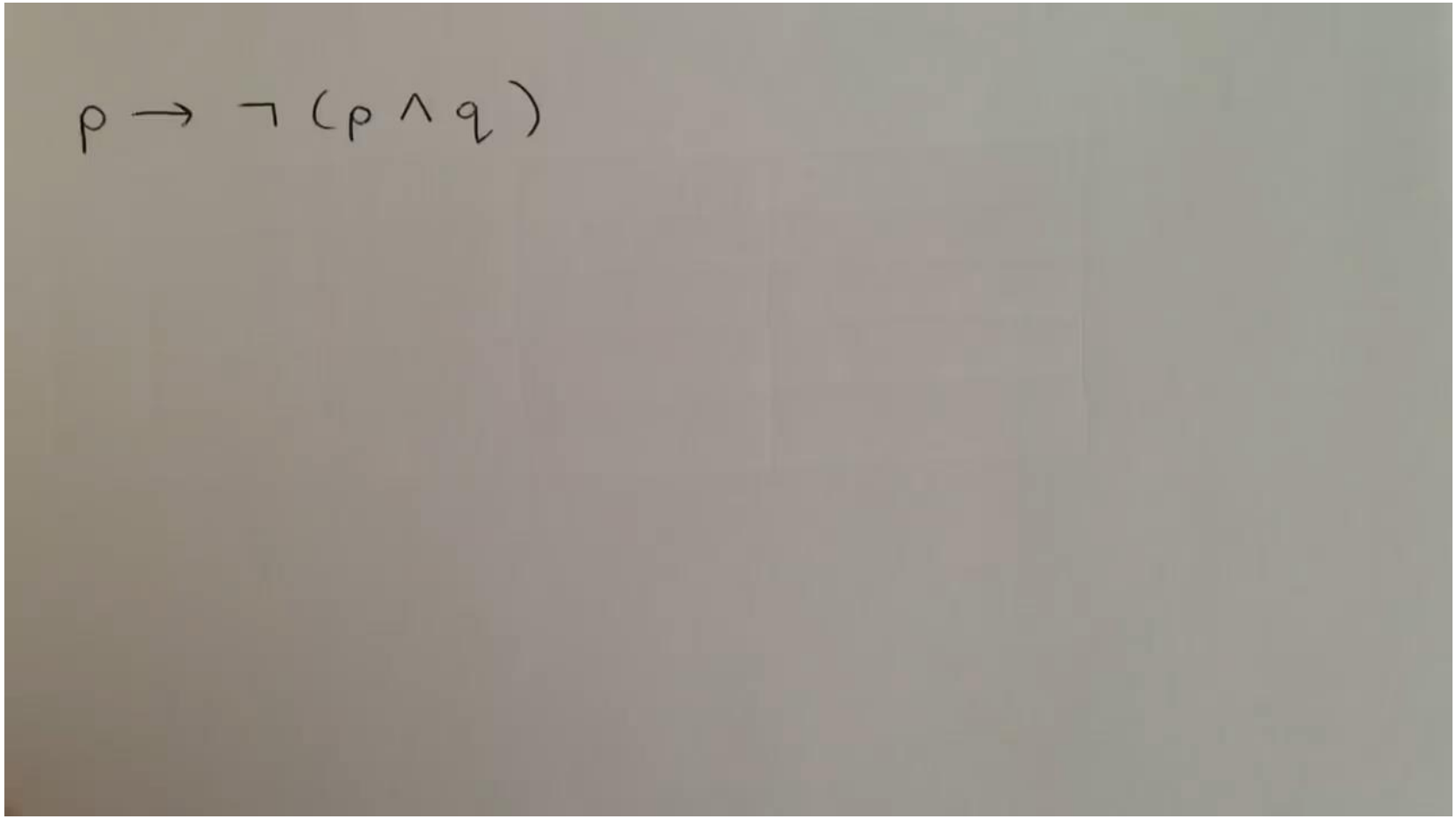
REMEMBER : an argument is invalid when it has a false conclusion and all premises true.

If you find the conclusion that is F when all premises are T the argument is invalid; otherwise it is valid.

H	P	H_{p1}	$H \rightarrow P_{p2}$	$H \bullet P_{c}$
T	T	T	T	T
T	F	T	F	F
F	T	F	T	F
F	F	F	T	F

Based on above truth table, is this argument valid or invalid?

Let us watch another demo



Now with Short Truth Tables!

Short Truth Table

- **We will use our example from earlier to conduct the short truth table.**

Michael does not like apple = ~a (p1)
Michael likes apple OR banana = a V b (p2)
Therefore, Michael likes banana = b (c)

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$

Steps to Develop a **Short** Truth Table

1. **Draw a table with only one row (Excluding Header)**

In header list single variables first then premises and at the end conclusion(same as long truth table)

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$

Steps to Develop a **Short** Truth Table

2. First assume that this is an invalid argument

REMEMBER : an argument is invalid when it has a **false conclusion** and all **premises true**

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$
		T	T	F

3. Fill the empty cells by considering second step

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$
F	F	T	T	F

Steps to Develop a **Short** Truth Table

4. Check whether your assumption (invalid) is correct or not by finding a conflict in the table.

If you have found the **conflict** it means your assumption is not correct therefore the argument is **Valid.**

a	b	~a $_{p1}$	a V b $_{p2}$	b $_{c}$
F	F	T	T	F

In this case a V b (p2) should be False.
Why? Because (F V F = F) all other times its True!

Valid!

Let us watch another demo

$$p \rightarrow q \quad q \rightarrow r \therefore p \rightarrow r$$

Valid argument: **true** premises lead to **true** conclusion

Invalid argument: **true** premises lead to **false** conclusion

Summary Steps to Develop a **Short** Truth Table

1. Draw a table with only 1 row (Consider heading)
2. Assume that the argument is invalid (F conclusion and T premises)
3. Fill empty cells by considering second step
4. Check whether your assumption (invalid) is correct or not by finding a conflict in your table.

In Conclusion…

- Arguments attempt to support a claim by giving reasons for believing it (the premises).

- An argument normally contains 2 parts.
  - Each part is a claim.
  - One part is called the premise, and;
  - The second part is called the conclusion.

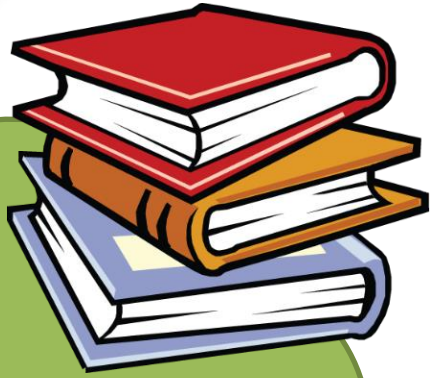
- A conclusion is:
  - A claim, and supported by one or more premises.

- A premise is:
  - A claim too, and used as a reason for believing the conclusion.

- Truth tables are a tool to help us to check whether an argument is valid or not.

Any Questions?

End of Class!



Readings:

[Understanding The Effects Of Violent Video Games On Violent Crime]