WHAT ARE TRUTH TABLES?

WEEK 1 . TOPIC INTRODUCTION

RECALL:

$$(\neg C \wedge D)$$

Translation manual:

C is "He's a white supremacist" and

D is "He's a racist."

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To answer, we'd need to know whether C is true or false and whether D is true or false. Then, we could determine whether $(\neg C \wedge D)$ is true or false.

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But what if we don't know?

Is there a way we can represent all the possibilities?

IS $(\neg C \wedge D)$ TRUE OR FALSE?

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C is true and D is true

C is true and D is false

C is false and D is true

C is false and D is false

all the possibilities

A truth table allows us to consider the truth value of a wff under all possible assignments of truth values to its atomic constituents.

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YOU CAN THINK OF EACH ROW OF THE TRUTH TABLE AS A POSSIBLE WORLD.

IS $(\neg C \wedge D)$ TRUE OR FALSE?

C is true and D is true
C is true and D is false
C is false and D is true
C is false and D is false

all the possibilities

IS $(\neg C \wedge D)$ TRUE OR FALSE?

$$\left.\begin{array}{l}\text{C is true and D is true}\\ \text{C is true and D is false}\\ \text{C is false and D is true}\\ \text{C is false and D is false}\end{array}\right\}\ \text{all the possibilities}$$

C	D
T	T
T	F
F	T
F	F

IS $(\neg C \wedge D)$ TRUE OR FALSE?

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C	D	$\neg C$
T	T	F
T	F	F
F	T	T
F	F	T

IS $(\neg C \wedge D)$ TRUE OR FALSE?

C is true and D is true
C is true and D is false
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C is false and D is false

all the possibilities

C	D	$\neg C$	$(\neg C \wedge D)$
T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	F

IS $(\neg C \wedge D)$ TRUE OR FALSE?

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T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	F

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$\Bigg\}$ all the possibilities

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T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	F

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all the possibilities

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T	T	F	F
T	F	F	F
F	T	T	T
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T	F	F	F
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C	D	$\neg C$	$(\neg C \wedge D)$
T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	F

TRUTH TABLES FOR ALL THE CONNECTIVES

∧ (and)

A	B	$A \land B$
T	T	T
T	F	F
F	T	F
F	F	F

$\wedge$ (and)

A	B	A $\wedge$ B
T	T	T
T	F	F
F	T	F
F	F	F

$\vee$ (or)

A	B	A $\vee$ B
T	T	T
T	F	T
F	T	T
F	F	F

$\wedge$ (and)

A	B	$A \wedge B$
T	T	T
T	F	F
F	T	F
F	F	F

$\vee$ (or)

A	B	$A \vee B$
T	T	T
T	F	T
F	T	T
F	F	F

you can see we're
not using the "exclusive or"
here!

$\wedge$ (and)

A	B	A $\wedge$ B
T	T	T
T	F	F
F	T	F
F	F	F

$\vee$ (or)

A	B	A $\vee$ B
T	T	T
T	F	T
F	T	T
F	F	F

$\wedge$ (and)

A	B	$A \wedge B$
T	T	T
T	F	F
F	T	F
F	F	F

$\neg$ (negation)

A	$\neg A$
T	F
F	T

$\vee$ (or)

A	B	$A \vee B$
T	T	T
T	F	T
F	T	T
F	F	F

→ (conditional)

A	B	A→B
T	T	T
T	F	F
F	T	T
F	F	T

→ (conditional)

A	B	A→B
T	T	T
T	F	F
F	T	T
F	F	T

Conditional can be tricky! Note that it is only false if the antecedent (A) is true but the conclusion (B) is not.

→ (conditional)

A	B	A→B
T	T	T
T	F	F
F	T	T
F	F	T

Conditional can be tricky! Note that it is only false if the antecedent (A) is true but the conclusion (B) is not.

Example: Suppose I tell my sister
``If you do your homework, I'll give you a cookie."

To understand implication, think: ``When does she have the right to be mad?" When she does her homework but I don't give her a cookie!

But I haven't said anything about the case where she doesn't do her homework. Maybe she goes and makes cookies herself!

$\rightarrow$ (conditional)

A	B	$A \rightarrow B$
T	T	T
T	F	F
F	T	T
F	F	T

$\to$ (conditional)

A	B	$A \to B$
T	T	T
T	F	F
F	T	T
F	F	T

Example: Suppose I have the following script:

```
if x :
    a = 2
print(a)
```

Think of implication like you've triggered the "if" condition. If x is True, the script will print "2." If x is False, the script might still print "2" because a was already 2 but it might print something else.

$\rightarrow$ (conditional)

A	B	$A \rightarrow B$
T	T	T
T	F	F
F	T	T
F	F	T

$\rightarrow$ (conditional)

A	B	$A \rightarrow B$
T	T	T
T	F	F
F	T	T
F	F	T

$\leftrightarrow$ (biconditional)

A	B	$A \rightarrow B$	$B \rightarrow A$	$((A \rightarrow B) \wedge (B \rightarrow A))$
T	T	T	T	T
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

$\rightarrow$ (conditional)

A	B	$A \rightarrow B$
T	T	T
T	F	F
F	T	T
F	F	T

This is like
$((A \rightarrow B) \wedge (B \rightarrow A))$

$\leftrightarrow$ (biconditional)

A	B	$A \rightarrow B$	$B \rightarrow A$	$((A \rightarrow B) \wedge (B \rightarrow A))$
T	T	T	T	T
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

$\rightarrow$ (conditional)

A	B	$A \rightarrow B$
T	T	T
T	F	F
F	T	T
F	F	T

$\wedge$

$\leftrightarrow$ (biconditional)

A	B	$A \rightarrow B$	$B \rightarrow A$	$((A \rightarrow B) \wedge (B \rightarrow A))$
T	T	T	T	T
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

→ (conditional)

A	B	A→B
T	T	T
T	F	F
F	T	T
F	F	T

↔

→ (conditional)

A	B	A→B
T	T	T
T	F	F
F	T	T
F	F	T

↔ (biconditional)

A	B	A↔B
T	T	T
T	F	F
F	T	F
F	F	T

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