Critical Reasoning

‘A Typology of Inferences: Part I’

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Deduction

Deduction: Validity and soundness

- When we speak about logic, what is typically meant is *deductive* logic.

- **Central notion**:
  An argument is ***valid*** if and only if the truth of the premises guarantees the truth of the conclusion.

  NB: The definition should be read 'If the premises *were* true, the conclusion *would also* be true'.

- An argument is ***sound*** if and only if it is valid and its premises are true.

Deduction and risk

- If the truth of the premises *guarantees* the truth of the conclusion, what does this mean in terms of risk?

- **Advantage**: Deduction is the safest form of inference as it eliminates all risk.

- For that reason, deduction is known as ‘truth-preserving’ or ‘content-preserving’.

Truth/content preservation

Deduction and novelty

- **Disadvantage:** We cannot learn any *new* content.

- After all, the content of the conclusion is already included in the content of the premises.

- One can of course learn (or better yet realise) that some content is part of the premises.

  NB: That content is buried in the premises but, lacking logical omnipotence, we have difficulty to see it.

Deductive reasoning: Examples

Joe is tall.
<u>Kim is ferocious.</u>
∴ Joe is tall and Kim is ferocious.

If everyone gets a raise, Sam gets a raise.
<u>Everyone gets a raise</u>.
∴ Sam gets a raise.

If everyone gets a raise, Sam gets a raise.
<u>Sam doesn't get a raise.</u>
∴ It's not the case everyone gets a raise.

<u>It's not the case that the car is not red</u>.
∴ The car is red.

Deductive reasoning: Examples (continued)

- Note that validity is *not* the same thing as truth.

- All sorts of arguments with one or more false premises and even a false conclusion are valid.

  All criminals are altruists.
  <u>All altruists have wings.</u>
  ∴ All criminals have wings.

- Also, arguments with true premises and a true conclusion may be invalid.

  <u>Anthony is English.</u>
  ∴ Anthony is a philosopher.

Monotonicity

- Deductive logic is monotonic.

  Monotonicity: If an argument is valid, it remains valid no matter how many or what premises we add.

- What if we add a false statement?

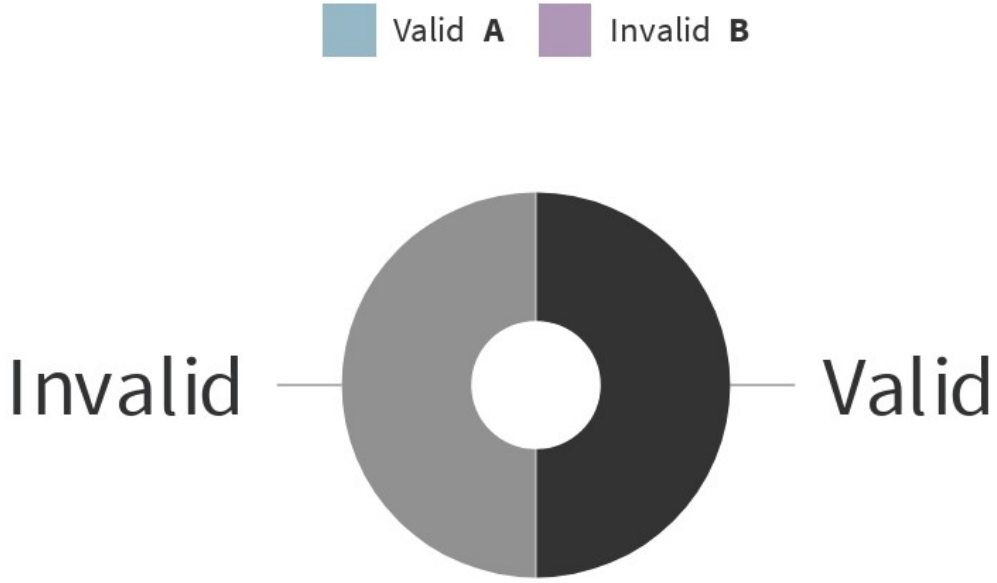
  Reply: That doesn't matter as validity does not require that the premises are true!

- What if we add a contradiction?

  Reply: Again, it doesn't matter because in classical deductive logic, anything follows from a contradiction!

An argument is valid if and only if

'All economists are funny people. All funny people are rich. Therefore, all funny people are economists.' Is this valid or invalid?



Interlude: The Principle of Explosion

Syntactic rules: Conjunctions

- There are two rules involving conjunctions:

Conjunction intro

A

B

$\therefore$ A $\wedge$ B

Example:

Joe is rich.

Kim is ferocious.

$\therefore$ Joe is rich and Kim is ferocious.

Conjunction elim

A $\wedge$ B

$\therefore$ A

Example:

Chris sings and Amy works hard.

$\therefore$ Amy works hard.

Syntactic rules: Disjunctions

- There are two rules involving (inclusive) disjunctions:

Disjunction elim

$A \vee B$

$\underline{\neg A}$

$\therefore B$

Example:

Either Ann or Joe runs the race.

<u>It's not the case that Ann runs.</u>

$\therefore$ Joe runs the race.

Disjunction intro

$\underline{A \qquad}$

$\therefore A \vee B$

Example:

<u>Tom is in Bern.</u>

$\therefore$ Either Tom is in Bern or in Basel.

Proof

Aim: Show that anything follows from a contradiction.

Plan: Suppose a contradiction and derive an arbitrary claim.

1. $\neg A \wedge A$	Premise
2. A	Conjunction Elimination 1
3. $A \vee Z$	Disjunction Introduction 2
4. $\neg A$	Conjunction Elimination 1
5. Z	Disjunction Elimination 3-4

Proof (in natural language)

Desideratum: Prove that anything follows from a contradiction.

Plan: Suppose a contradiction and derive an arbitrary claim.

1. <u>The cat is brown and the cat is not brown</u>
2. The cat is brown
3. The cat is brown or Aliens abducted me
4. The cat is not brown
5. Aliens abducted me

The principle of explosion holds that

[redacted]

Which of the following rules did we NOT use in the proof?

disjunction introduction

conjunction introduction

disjunction elimination

conjunction elimination

The End