FINO PhD Lectures 2018 – Genova, 9 February 2018

# Deductive arguments & Deductive fallacies

Cristina Amoretti

# Deductive arguments

- An **argument** aims at proving (or disproving) a certain conclusion (C) on the basis of premises (P1..Pn) and recognized rules of inference (deductive, inductive, abductive)

- —> Deductive rules of inference

  - A **deductive argument** aims at proving (or disproving) a certain conclusion (C) on the basis of premises (P1..Pn) and ***deductive rules of inference***

# Deductive arguments

- **Valid arguments**
  - If premises are true, then the conclusion is necessarily true
- **Sound arguments**
  - Valid arguments with true and justified premises
- **Good arguments**
  - Valid and sound arguments, whose premises are psychologically persuasive and pragmatically interesting

# Deductive arguments

- If a deductive argument is valid, no further premise can make it “more” valid;
- A **good** deductive argument aims at proving (or disproving) a certain conclusion (C) on the basis of premises (P1..Pn), which are true, justified, psychologically persuasive, and pragmatically interesting, as well as deductive rules of inference.

# Deductive arguments

- **Main characteristic of DA**

- Even if many deductive arguments go from general statements to particular ones, this is not always true (and it is not the right way to characterize deductive arguments);

- Deductive arguments are characterized by the fact that **the conclusion necessarily follows from the premises**.

# Deductive arguments

- **Disjunction (disjunctive syllogism)**
- A or B; not A. Therefore, B
    - The killer must be either the brother or the butler; the brother has an alibi; Therefore, the killer must be the butler
    - **N.B.** A and B must be the only two viable alternatives (either A or B).

# Deductive arguments

- **Modus ponens**
- If A then B; A. Therefore, B
    - If you have the license, then you are at least 18yo; You do have the license. Therefore, you are at least 18yo.

# Deductive arguments

- **Modus tollens**
- If A then B; nonB. Therefore, nonA
    - If you have the license, then you are at least 18yo; You are not 18yo yet. Therefore, you do not have the license.

# Remind!

- **Necessary vs sufficient conditions**
- “If you have the license, then you must be over 18”
- Necessary condition
- Sufficient condition

# Remind!

- **Necessary vs sufficient conditions**
- “If you have the license, then you must be over 18”
- Necessary condition
  - Being over 18 (it is necessary for having the license)
- Sufficient condition
  - Having the license (it is sufficient for being over 18)

# Deductive arguments

- **(Pure) hypothetical syllogism**
- If A then B; if B then C. Therefore, if A then C
  - If a creature has a mind, then it has a brain; if a creature has a brain, then it is a physical creature. Therefore, if a creature has a mind, then it is a physical creature.

# Deductive arguments

- **Categorical syllogisms**
- A deductive argument with two premises and a conclusion
- Premises and conclusions are categorical statements
  - (A) All X are Y; (I) Some X are Y; (E) No X are Y; (O) Some X are not T
- It contain three terms:
  the **major** term (P, it occurs in the first premise and is the predicate of the conclusion),
  the **minor** term (S, it occurs in the second premise and is the subject of the conclusion);
  the **middle** term (M, it occurs in both premises, not in the conclusion)

# Deductive arguments

- **Categorical syllogisms**
- Mood: it is determined by the types of propositions (A, E, I, O)
  - AAA, EAE, AII,…
- Figure: it is determined by the position of the middle term
  - 1st: M–P, S–M, therefore S–P.
  - 2nd: P–M, S–M, therefore S–P.
  - 3rd: M–P, M–S, therefore S–P.
  - 4th: P–M, M–S, therefore S–P.

# Deductive arguments

- **Syllogisms**
- (AAA-1) All M are P; All S are M; Therefore, all S are P
    - All mammals are mortals; All humans are mammals; Therefore, all humans are mortals.
- (AII-1) All M are P; Some S are M; Therefore, some S are P
    - All humans are mortals; Socrate is a human; Therefore, Socrate is mortal.
- (EAE-2) No P are M; All S are M; Therefore no S are P
    - No cocker spaniel is a cat; All persian longhair are cats; Therefore, no persian longhair is a cocker spaniel
- ….

# Deductive fallacies

- Validity is a matter of form, not content; it has nothing to do with the truth of any of the statements in the argument.
    - An argument is valid if, when the evidence is true, the claim must be true. The necessity of this relationship allows us to say that the claim follows from the evidence.
- An argument will be invalid if it fails to follow the rules for a particular pattern of inference.
    - **Deductive fallacies** seem deductive arguments (they have a similar structure), but the conclusion DOES NOT necessarily follows from the premises.

# Deductive fallacies

- **Affirming the disjunct**
- A or B; A (B). Therefore, not B (A)
    - The killer must be either the brother or the butler; the brother has confessed; Therefore, the killer cannot be the butler
- **N.B.** This is when the “or” is not explicitly defined as being exclusive.

# Deductive fallacies

- **Affirming the consequent**
- If A then B; B. Therefore, A
    - If taxes were lowered, I will have more money to spend; I have more money to spend; Therefore, taxes have been lowered.
- **N.B.** This fallacy has the same structure of abductive reasoning or the inference to the best explanation (which are kinds of inductive arguments)

# Deductive fallacies

- **Denying the antecedent**
- If A then B; not A. Therefore, not B
    - If I were you, I would go to the party; I am not you. Therefore, I won’t go to the party.

# Deductive fallacies

- **Invalid syllogisms (syllogistic fallacies)**
- Some P is M; Some M is S; Therefore, some S is P
    - Some cats are tigers. Some tigers are yellow-striped. Therefore, some cats are yellow-striped.
- Analogy: Some women are Americans. Some Americans are men. Therefore, some women are men.

# Recap

- **Deductive arguments**
  - Disjunctive syllogism
  - Modus ponens
  - Modus tollens
  - (Pure) hypothetical syllogism
  - Categorical syllogism
- **Deductive fallacies**
  - Affirming the disjunct
  - Affirming the consequent
  - Denying the antecedent
  - Invalid syllogisms (syllogistic fallacies)

# Example

- If a man could not have done otherwise than he in fact did, then he is not responsible for his action. But if determinism is true, it is true of every action that the agent could not have done otherwise. Therefore, if determinism is true, no one is ever responsible for what he does.

- —Winston Nesbit and Stewart Candlish, “Determinism and the Ability to Do Otherwise,” Mind, July 1978

# Example

- **If** a man could not have done otherwise than he in fact did, **then** he is not responsible for his action.

- But **if** determinism is true, **(then)** it is true of every action that the agent could not have done otherwise.

- **Therefore**, **if** determinism is true, **(then)** no one is ever responsible for what he does.

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# Example

- But **if** determinism is true, **(then)** it is true of every action that the agent could not have done otherwise.

- **If** it is true of every action that the agent could not have done otherwise, **then** no one is ever responsible for what he does.

- **Therefore**, **if** determinism is true, **(then)** no one is ever responsible for what he does.

    - Hypothetical syllogism, valid.

- 1.

- If each man had a definite set of rules of conduct by which he regulated his life he would be no better than a machine. But there are no such rules, so men cannot be machines.
  —A. M. Turing, “Computing Machinery and Intelligence,” Mind, volume 59, 1950

- 2.

- If the second native told the truth, then the first native denied being a politician. If the third native told the truth, then the first native denied being a politician. Therefore if the second native told the truth, then the third native told the truth.

- 3.

- If the one-eyed prisoner does not know the color of the hat on his own head, then the blind prisoner cannot have on a red hat. The one-eyed prisoner does not know the color of the hat on his own head. Therefore the blind prisoner cannot have on a red hat.

- 4.

- I have already said that he must have gone to King’s Pyland or to Capleton. He is not at King’s Pyland, therefore he is at Capleton. —Arthur Conan Doyle, The Adventure of Silver Blaze

- 5.

- It is clear that we mean something, and something different in each case, by such words [as substance, cause, change, etc.]. If we did not we could not use them consistently, and it is obvious that on the whole we do consistently apply and withhold such names.

—C. D. Broad, Scientific Thought, 1923

- 6.

- Total pacifism might be a good principle if everyone were to follow it. But not everyone does, so it isn’t. — Gilbert Harman, The Nature Of Morality, 1977

# Fallacies vs heuristics

- Fallacies are somehow similar to **cognitive biases and heuristics**, that is, mental shortcuts (Daniel Kahneman and Amos Tversky ), as they both deal with errors in reasoning.

- However, **fallacies require an argument** whereas cognitive biases and heuristics refer to our default pattern of thinking.

- Cognitive biases are largely unconscious processes that bypass reason; however, the exercise of consciously evaluating an argument can counteract the bias.

# Deductive fallacies vs heuristics

- **Example 1:**

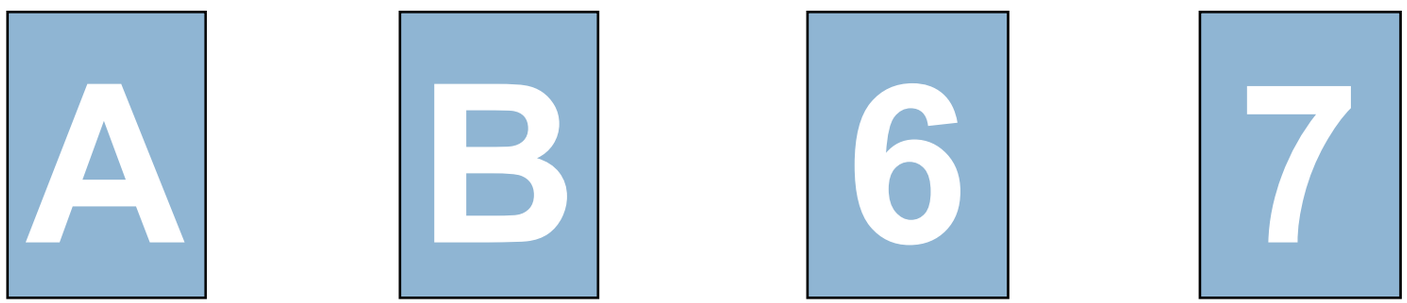
- **Bandwagon effect**: the tendency to believe things because many other people believe them (cognitive bias, heuristic)

- **Appeal to popularity/majority**: using the popularity of a premise or proposition as evidence for its truthfulness.

    - The appeal to popularity is a fallacy because it applies to an argument.

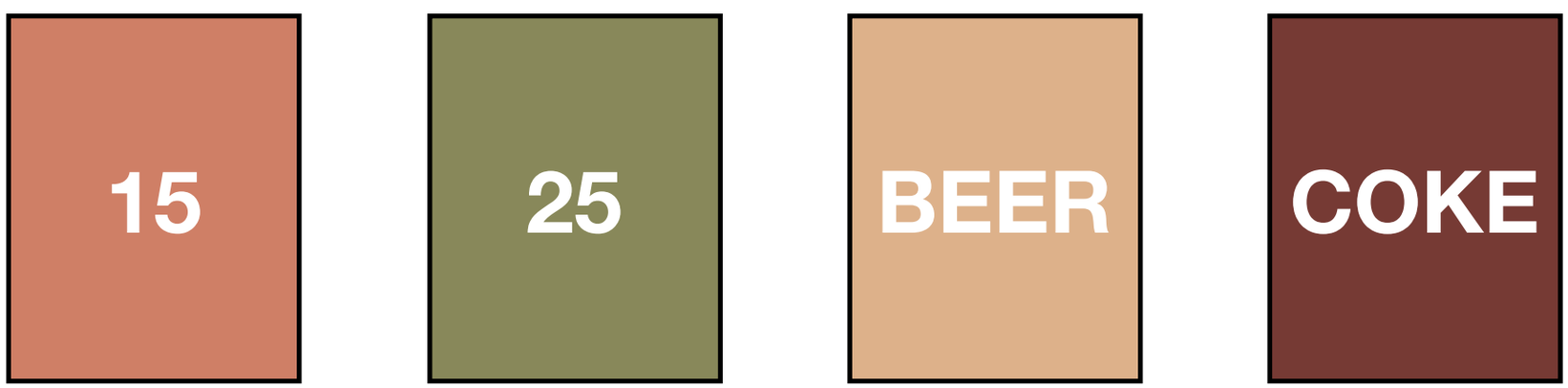
# Deductive fallacies vs heuristics

- **Example 2 (selection task):**
- Each card has a letter on one side, and a number on the other.
- Which card(s) must be turned over to test the idea that
  - if a card shows a vowel on one face, then its opposite face shows an even number?



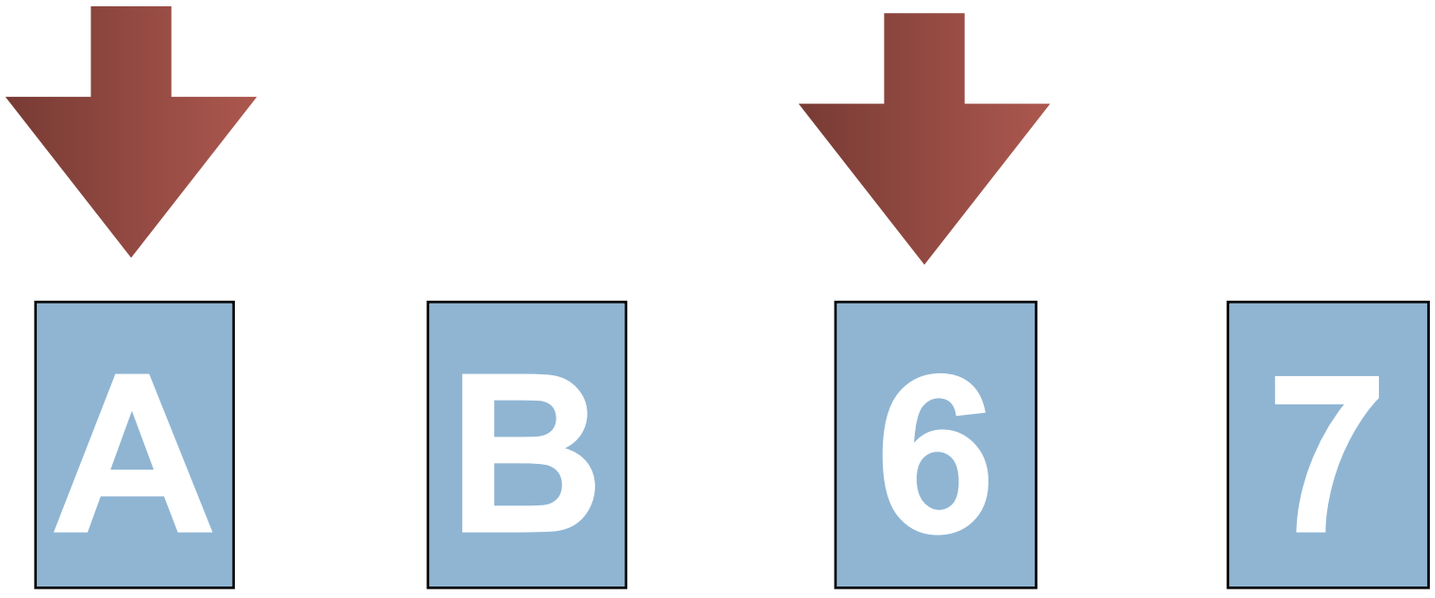
# Deductive fallacies vs heuristics

- **Example 2***
- In Italy, the legal drinking age is 18
- Which card(s) must be turned over to test the rule that
- “If you are drinking alcohol, then you must be over 18”



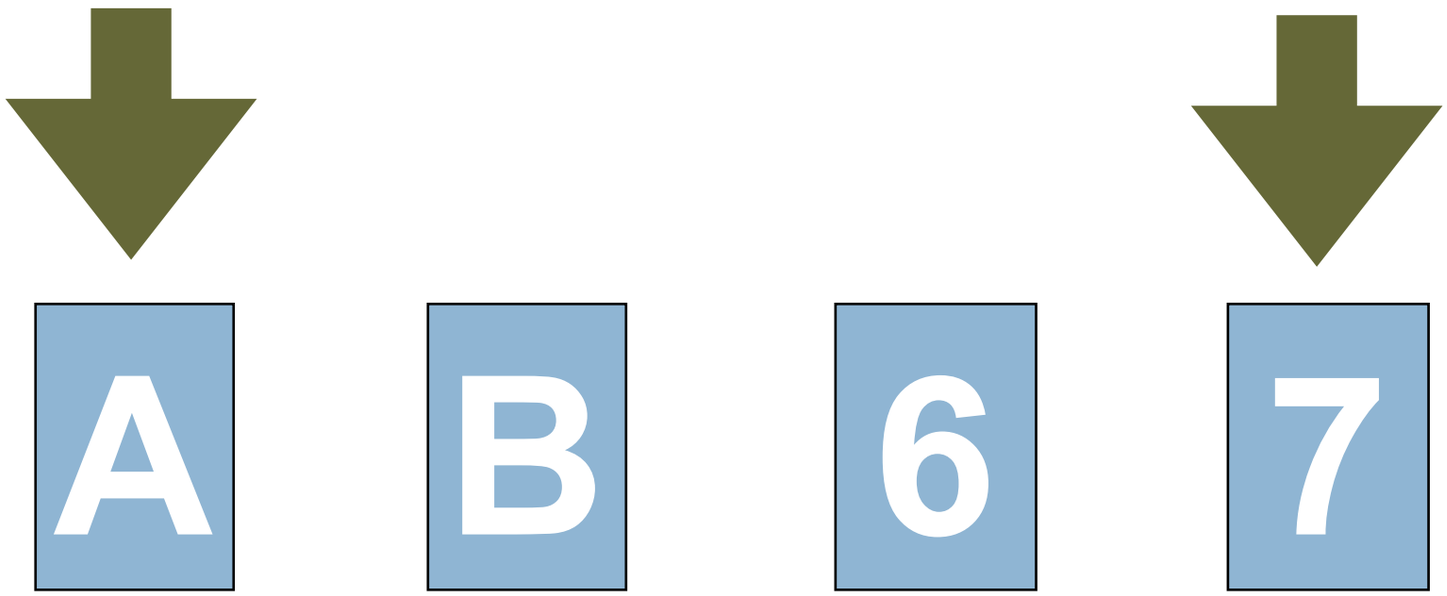
# Deductive fallacies vs heuristics

- **Example 2:**
- Which card(s) must be turned over to test the idea that
  - if a card shows a vowel on one face, then its opposite face shows an even number?
- **Confirmation bias:** the tendency to search for information that confirms one's preexisting hypothesis.
- **Affirming the consequent:** If A then B; B. Then, A



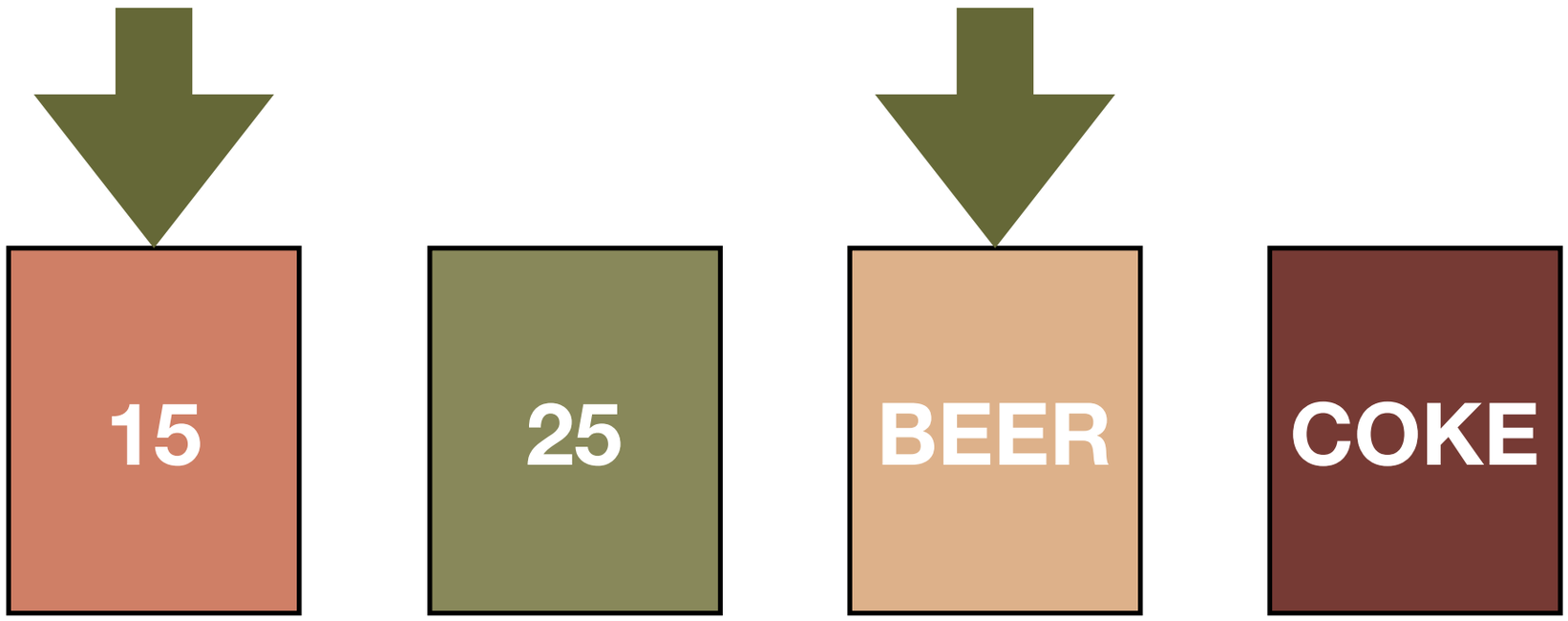
# Deductive fallacies vs heuristics

- **Example 2:**
- Which card(s) must be turned over to test the idea that
  - if a card shows a vowel on one face, then its opposite face shows an even number?
- **Modus tollens:** If A then B; not B. Then, not A
- We have to search for information that could disconfirm one's preexisting hypothesis.



# Deductive fallacies vs heuristics

- **Example 2***
- Which card(s) must be turned over to test the rule that
- “If you are drinking alcohol, then you must be over 18”
- **No confirmation bias**: when we are presented with a rule, we have the tendency to search for information that could disconfirm the rule, and thus the confirmation bias is weaker.



# Exercises

¥ Mankind, he said, judging by their neglect of him, have never, as I think, at all understood the power of Love. For if they had understood him they would surely have built noble temples and altars, and offered solemn sacrifices in his honor; but this is not done. —Plato, Symposium

¥ If then, it is agreed that things are either the result of coincidence or for an end, and that these cannot be the result of coincidence or spontaneity, it follows that they must be for an end. —Aristotle, Physics

¥ There is no case known (neither is it, indeed, possible) in which a thing is found to be the efficient cause of itself; for in such a case it would be prior to itself, which is impossible. —Thomas Aquinas, Summa Theologiae, I, question 2, article 3

¥ Either wealth is an evil or wealth is a good; but wealth is not an evil; therefore wealth is a good.
—Sextus Empiricus, Against the Logicians, second century CE

¥ I do know that this pencil exists; but I could not know this, if Hume's principles were true; therefore, Hume's principles, one or both of them, are false.
—G. E. Moore, Some Main Problems of Philosophy (New York: Allen & Unwin, 1953)

¥ If number were an idea, then arithmetic would be psychology. But arith-
metic is no more psychology than, say, astronomy is. Astronomy is con- cerned, not with ideas of the planets, but with the planets themselves, and by the same token the objects of arithmetic are not ideas either.
—Gottlob Frege, The Foundations of Arithmetic, 1893

¥ . . . If a mental state is to be identical with a physical state, the two must
share all properties in common. But there is one property, spatial localiz- ability, that is not so shared; that is, physical states and events are locat- ed in space, whereas mental events and states are not. Hence, mental events and states are different from physical ones.
—Jaegwon Kim, "On the Psycho-Physical Identity Theory," American Philosophical Quarterly, 1966

¥ When we regard a man as morally responsible for an act, we regard him as a legitimate object of moral praise or blame in respect of it. But it seems plain that a man cannot be a legitimate object of moral praise or blame for an act unless in willing the act he is in some important sense a "free" agent. Evidently free will in some sense, therefore, is a precondi- tion of moral responsibility.
—C. Arthur Campbell, In Defence of Free Will, 1938

(1) Quel bambino non contrarrà mai la malattia X, perché da attente analisi **si è visto che non presenta alcuna anomalia al gene y**. È scientificamente dimostrato, infatti, che *se un bambino contrae la malattia X, allora manifesta un'anomalia del gene y*.

La frase sottolineata rappresenta:
(a) una premessa.
(b) una conclusione intermedia.
(c) la conclusione.

La frase in **grassetto** rappresenta:
(a) una premessa.
(b) una conclusione intermedia.
(c) la conclusione.

La frase in *corsivo* rappresenta:
(a) una premessa.
(b) una conclusione intermedia.
(c) la conclusione.

Quale schema di inferenza rappresenta
(a) Transitività
(b) Modus Ponens
(c) Modus Tollens

(2) Una giovane ereditiera è stata assassinata e l'assassino non può che essere uno tra il maggiordomo, la cameriera, il cuoco e l'autista. Non sono stati né il maggiordomo, né la cameriera perché quel giorno erano in ferie fuori città. **Rimangono il cuoco e l'autista**. Ma l'autista era all'aeroporto quando il delitto è avvenuto. Quindi è logico concludere che *il cuoco è l'unico senza un alibi*. Inoltre L'EREDITIERA È STATA AVVELENATA. Non può che essere stato il cuoco.

La frase sottolineata rappresenta:
(a) una premessa.
(b) una conclusione intermedia.
(c) la conclusione.

La frase in **grassetto** rappresenta:
(a) una premessa.
(b) una conclusione intermedia.
(c) la conclusione.

La frase in *corsivo* rappresenta:
(a) una premessa.
(b) una conclusione intermedia.
(c) la conclusione.

La frase in MAIUSCOLETTO rappresenta:
(a) una premessa.
(b) una conclusione intermedia.
(c) la conclusione.

(3) Supponiamo che la pena di morte costituisca un buon deterrente per i criminali più violenti. Allora, nei paesi in cui la pena di morte è prevista dal codice penale, la percentuale di crimini violenti punibili con la pena di morte dovrebbe essere inferiore rispetto a quella dei paesi dove la pena di morte non è prevista dal codice penale. In realtà, dati alla mano, **la percentuale di condanne per tali crimini è addirittura più alta proprio in quei paesi dove la pena di morte è prevista dal codice penale**.

La frase sottolineata rappresenta:
(a) una premessa.
(b) la conclusione dell'argomento che viene criticato.
(c) la conclusione dell'argomento presentato.

La frase in **grassetto** rappresenta:
(d) una premessa.
(e) una conclusione intermedia.
(f) la conclusione.

(4) Se ami davvero una persona, non la tradisci, quindi:

(a) visto che Maura non ti ama ti tradisce.
(b) visto che Maura non ti tradisce, ti ama.
(c) visto che Maura ti ama, non ti tradisce.
(d) visto che Maura ti tradisce, non ti ama.

(5) Questa sera non andremo a mangiare in pizzeria, ma al ristorante. Infatti, se al ristorante si spendessero più di 50 euro, allora andremmo di sicuro in pizzeria, ma so con certezza che si spendono al massimo 30 euro.

Qual è la formalizzazione corretta dell'argomento?

| Se A allora B | Se A allora B | Se A allora B | Se A allora B |
|---|---|---|---|
| A | Non A | Non B | B |
| B | Non B | Non A | A |

È valido? Si [ ] No[ ]

(6) I cani, in genere, riescono a udire frequenze che gli esseri umani non riescono ad udire. I gatti, invece, riescono a vedere in condizioni di illuminazione in cui, in genere, gli esseri umani non riescono a vedere nulla.

Quale delle seguenti conclusioni possiamo inferire per ottenere un argomento valido?
(a) L'udito dei cani è migliore di quello degli umani.
(b) Alcuni animali hanno capacità sensoriali diverse dalle nostre.
(c) L'udito di alcuni cani è migliore di quello di qualsiasi essere umano.
(d) Gli animali hanno capacità sensoriali più acute delle nostre.
(e) Alcuni animali hanno capacità sensoriali più acute delle nostre.
(f) L'udito di alcuni cani è migliore di quello di alcuni esseri umani.

(7) Secondo quattro indipendenti ricerche, negli ultimi 15 anni, in Italia, il numero dei bambini obesi (sarebbe a dire: il numero di quei bambini che hanno una percentuale di grasso corporeo superiore a quella dell'85 % dei loro coetanei) sta aumentando costantemente.

Quale delle seguenti conclusioni possiamo inferire per ottenere un argomento valido?
(a) Quando quattro ricerche indipendenti danno lo stesso risultato, quel risultato è sicuramente vero.
(b) Quando quattro ricerche indipendenti danno lo stesso risultato, quel risultato è sicuramente falso.
(c) Quando quattro ricerche indipendenti danno lo stesso risultato, quel risultato è probabilmente vero.
(d) Negli ultimi 15 anni, in Italia i bambini sono diventati sempre più pigri.
(e) Negli ultimi 15 anni, in Italia, la percentuale di bambini pigri è aumentata.
(f) Secondo quattro indipendenti ricerche, negli ultimi 15 anni, in Italia il numero dei bambini non obesi è aumentato.
(g) Secondo quattro indipendenti ricerche, negli ultimi 15 anni, in Italia il numero dei bambini non obesi è diminuito.

(8) Lo sciamano del villaggio sostiene che la madre di Ananke è una strega. Ma una strega non può che generare una strega. Infatti, mentre il figlio di una strega può nascere senza poteri demoniaci, non accade mai che la figlia di una strega nasca senza poteri demoniaci. E una femmina con poteri demoniaci è una strega. Quindi……

Per ottenere un argomento valido, dovremmo sostituire ai puntini quale dei seguenti enunciati?
(a) Ananke è una strega.
(b) Ananke possiede poteri demoniaci (che poi sia una strega, questo è tutto da dimostrare).
(c) Lo sciamano del villaggio ce l'ha con la madre di Ananke, e probabilmente nemmeno Ananke gli sta troppo simpatica.
(d) Lo sciamano del villaggio sostiene che Ananke sia una strega.
(e) A dar retta a quello che lo sciamano dice della madre di Ananke, Ananke è una strega.
(f) Se Ananke fosse nata maschio non avrebbe avuto poteri demoniaci.

(9) Secondo la definizione datane da Aristotele, un essere umano è un bipede implume. È quindi chiaro che, se diamo per buona questa definizione, non esistono uomini con una sola gamba.

L'argomento proposto:
(a) è valido.
(b) è corretto, ma non valido.
(c) assume indebitamente che il non aver ancora incontrato uomini con una sola gamba assicuri che non ne esistano.
(d) assume indebitamente che l'avere due gambe ci metta al riparo dall'eventualità di avere le piume.
(e) assume indebitamente che Aristotele abbia ragione.
(f) riposa indebitamente sull'assunzione che Aristotele avesse due gambe. Infatti, se ne avesse avuta solo una non sarebbe stato un uomo. Quindi non avrebbe potuto pensare. Quindi il fatto che sostenesse che gli esseri umani non sono altro che bipedi implumi sarebbe stato irrilevante. E questo inficia l'argomento.
(g) Sarebbe valido se solo si potesse dimostrare che o gli esseri umani hanno due gambe o ne hanno una sola.
(h) Sarebbe valido se solo si potesse dimostrare che o gli esseri umani hanno due gambe o gli esseri umani non hanno due gambe.
(g) Sarebbe corretto se solo si potesse dimostrare che o gli esseri umani hanno due gambe o gli esseri umani non hanno due gambe.

(10) Essere alti più di 1.50 assicura l'immortalità. Io sono alto più di 1.50. Quindi io non morirò mai.

L'argomento proposto è:
(a) valido, ma non corretto.
(b) corretto.
(c) corretto, ma la sua conclusione è falsa.
(d) valido, ma la conclusione non scende dalle premesse.
(e) dotato di una conclusione vera, eppure tutt'altro che valido.
(f) valido.
(g) valido. Ma anche tanto breve da non occupare più di una o due righe.