Logic

Aristotelian Syllogistic:
The Categorical Syllogism
(cont'd.)

Figure II

Xpm
Xsm
∴Xsp

Are second figure syllogisms possible?

- How can one relate two subjects by showing that they have a common predicate?
  - e.g., can one infer a relation between dogs & cats from the fact that both are mammals?—No.
- but if the predicate were related to one subject and separated from the other, one could conclude that there is some separation between the two subjects
  - e.g., one can infer from the fact that all human beings can think and no computers can that no human beings are computers.

Figure II: Principle

- The Exclusive Figure
  - Because the conclusion is always negative
- Starting point
  - If everything of a certain kind [p] has a certain property [m], then whatever lacks that property [m] is not a thing of that kind [p]
  - If nothing of a certain kind [p] has a certain property [m], then whatever has that property is not a thing of that [p] kind

Figure II: Four Valid Moods

No computers are capable of common sense. All human beings are capable of common sense. So, no human beings are computers.	Epm Asm ∴Esp	Cesare
All persons are capable of language use. No computers are capable of language use. So, no computers are persons.	Apm Esm ∴Esp	Camestres
No punishments that are not essential to the fight against crime are justified. Some contemporary executions are punishments not essential to the fight against crime. So, some contemporary executions are not justified.	Epm Ism ∴Osp	Festino
All animals have the power of sensation. Some living things do not have the power of sensation. So, some living things are not animals.	Apm Osm ∴Osp	Baroco

Figure II: Proofs of the Valid Moods

- All of these moods can be proven with the indirect proof technique shown above.
- Three of them—Cesare, Camestres, & Festino—can also be proven by direct proof (reduction to Figure I):

1. Epm
2. Asm [∴ Esp
3. Emp 1, Conversion
4. Esp 3, 2, Celarent; QED

Figure II: Summary of Valid Moods

- Four premise pairs yield conclusions in Figure II.

  E A E A

  A E I O
- The conclusions are as follows
  - The first two moods yield E
  - The last two yield O
- Two trivial special cases:
  - Since universal conclusions can be weakened (by the Square of Opposition)
    - EA & AE would also yield particular conclusions (EAO & AEO)
    - but that's trivial & will be ignored
- Aristotle shows that no other premise pairs yield conclusions in Figure II.

Figure II: Rule-Case-Result Analysis

The Major Premise	states a rule	(a criterion about when to apply the predicate, here the middle term)—Universal	All/No P are M.
The Minor Premise	denies a result (i.e., says that that something S is (or is not) related to the predicate of the major premise)	Since a result (see Fig. I above) can have any logical form, the denial (contradictory) of a result can have any form.	Relating S & M Any propositional form is possible
The Conclusion	denies the case (i.e., says that that thing S is not a case of the subject of the major premise)	(i.e., it says how the predicate of interest (major term) applies to the case (the minor)	No S are P, or Some are not

Figure II: Restrictions

1. The major premise must be universal
   since rules are universal.
2. The minor premise can have any form
   since results can have any form & therefore so can their denials.
3. The conclusion must be negative
   since cases are affirmative, so the denials of cases are negative.

Figure III

Xmp
Xms
∴ Xsp

Are third figure syllogisms possible?

- How can one relate two predicates by showing that they have a common subject?
- If a subject has two predicates, the two predicates must be compatible
  - e.g., one can infer from the fact that all computers can process representations and all computers are machines that being a machine & being able to process representations are compatible, i.e., that some machines can process representations.

Figure III: Principle

- The Inductive Figure
  - Because the subject of the premises can be considered a case on the basis of which a universal rule is refuted
- Starting point
  - If certain things have a certain property, and those things are of a certain kind, then some things of that kind have that certain property.
  - If certain things lack a certain property, and those things are of a certain kind, then some things of that kind lack that certain property.

Figure III: The Valid Moods

All lemons are sour. All lemons are fruits. Some fruits are sour.	Amp Ams ∴Isp	Darapti
Some human beings do stupid things. All human beings are rational. So, some rational beings do stupid things.	Imp Ams ∴Isp	Disamis
All human beings are rational. Some human beings do stupid things. So, some beings that do stupid things are rational beings.	Amp Ims ∴Isp	Datisi
No lemons are sweet. All lemons are fruits. So, some fruits are not sweet.	Emp Ams ∴Osp	Felapton
Some citrus fruits are not sweet. All citrus fruits are fruit. So, some fruits are not sweet.	Omp Ams ∴Osp	Bocardo
No living beings capable of local motion are plants. Some living beings capable of local motion are one-celled organisms. So, some one-celled organisms are not plants.	Emp Ims ∴Osp	Ferison

Figure III: Summary of Valid Moods

- Six premise pairs yield conclusions in Figure III.

  A A I E O E

  A I A A A I
- The conclusions are as follows:
  - The first three moods yield I.
    - The 2d & 3d have to for reasons already stated.
    - The first has to for other reasons.
  - The last three yield O.
    - The 2d & 3d have to for reasons already stated.
    - The first has to for other reasons.
- Aristotle shows that no other premise pairs yield conclusions in Figure III.

Figure III: Restrictions

1. Valid third figure syllogisms can have any form of major premise.
2. All valid third figure forms have an affirmative minor.
3. The conclusion of a third figure syllogism must be particular.

Figure III: Rule-Case-Result Analysis

The Major Premise	denies a result	Results can be in any form, so their denials can be also.	Relating M & P. Any propositional form is possible.
The Minor Premise	states a case	Cases are always—Affirmative	All/Some M are S.
The Conclusion	denies a rule	Since rules are universal, the denial of a rule is always—Particular.	Some S are (or are not) P.

Figure III as Refutation of a Rule by Counterexample

Syllogism	Refuted Rule	Counterexample (Middle Term)
All lemons are sour. All lemons are fruits. Some fruits are sour.	No fruits are sour.	Lemons
Some human beings do stupid things. All human beings are rational. So, some rational beings do stupid things.	No rational beings do stupid things.	Human beings
All human beings are rational. Some human beings do stupid things. So, some beings that do stupid things are rational beings.	No beings that do stupid things are rational beings.	Human beings
No lemons are sweet. All lemons are fruits. So, some fruits are not sweet.	All fruits are sweet.	Lemons
Some citrus fruits are not sweet. All citrus fruits are fruit. So, some fruits are not sweet.	All fruits are sweet.	Citrus fruits
No living beings capable of local motion are plants. Some living beings capable of local motion are one-celled organisms. So, some one-celled organisms are not plants.	All one-celled organisms are plants.	Living beings capable of local motion

The Famous Mnemonic

Barbara, Celarent, Darii, Ferioque prioris;
Cesare, Camestres, Festino, Baroco secundae:;
Tertia Darapti, Disamis, Datisi, Felapton, Bocardo, Ferison habet.