Critical Thinking: A Student's Introduction

Chapter 9

A Little Categorical Logic

Categorical Statements

Categorical statement: Makes a claim about the relationship between two or more categories or classes of things

Standard-form categorical statements

- All S are P (example, All Democrats are liberals)
- No S are P (example, No Democrats are liberals)
- Some S are P (example, Some Democrats are liberals)
- Some S are not P (example, Some Democrats are not liberals)

Venn Diagram, 1

Method to represent categorical statements (or test categorical arguments) with a series of overlapping circles that represent the suggested groups and their relations

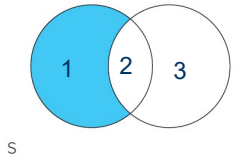
- Each circle represents a group
- Partially overlapping circles denote that the groups share similarities

Venn Diagram, 2

- An "X" in a portion of a circle entails that there is at least one thing within that portion
- Coloring in a portion of a circle entails that there is nothing within that portion

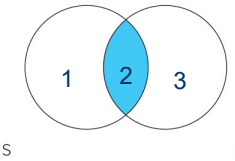
Standard-Form Examples, 1

All S are P



Jump to Standard-Form Examples, 1, Appendix 1

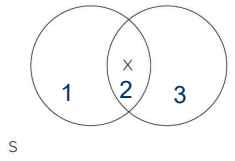
No S are P



Jump to Standard-Form Examples, 1, Appendix 2

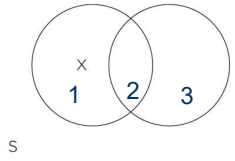
Standard-Form Examples, 2

Some S are P



Jump to Standard-Form Examples, 2, Appendix 1

Some S are not P



Jump to Standard-Form Examples, 2, Appendix 2

Parts of a Statement, 1

Quantifiers: Express a quantity or a number

- Examples: All, no, or some

Subject term: Word or phrase that names a class and that serves as the grammatical subject of a sentence

- Example: In "Some students are not voters," the subject term is "students"

Parts of a Statement, 2

Predicate term: Word or phrase that names a class and that serves as the subject complement of the sentence

- Example: In the statement "No prime ministers are prime numbers," the predicate term is "prime numbers"

Copula: Linking verb

- Example: In the statement "Some students are double majors," the copula is "are"

Tips for Translating Sentences into Standard Categorical Form, 1

Tip 1: Rephrase all nonstandard subject and predicate terms so that they refer to classes

- Example: "All actors are vain" becomes "All actors are vain *people*"

Tip 2: Rephrase all nonstandard verbs

- Example: "Some students walk to school" becomes "Some students *are persons who* walk to school"

Tips for Translating Sentences into Standard Categorical Form, 2

Tip 3: Fill in any unexpressed quantifiers

- Examples:
  - "Koalas are marsupials" becomes "*All* Koalas are marsupials"
  - "Californians are health nuts" becomes "*Some* Californians are health nuts" (in cases such as this, interpret the speaker's or writer's intent as charitably as possible)

Tips for Translating Sentences into Standard Categorical Form, 3

Tip 4: Translate singular statements as *all* or *no* statements

- Singular statement: Makes a claim about a particular person, place, or thing
- Example: "This flower is blooming" becomes "All things (that are) identical with this (particular) flower are things that are blooming"

Tips for Translating Sentences into Standard Categorical Form, 4

Tip 5: varian appro form

- Exa John Mar
- See 248

Tip 1: Rephrase all nonstandard subject and predicate terms so that they refer to classes.

Many everyday English sentences have adjectives as their grammatical predicates. Because adjectives name attributes rather than classes, they must be rewritten as nouns, pronouns, or noun phrases that refer to classes. Here are two examples:

All actors are vain.	All actors are vain *people*.
Some roses are white.	Some roses are white *flowers*.

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Tip 2: Rephrase all nonstandard verbs.

For the sake of consistency, only two linking verbs (copulas) are allowed in standard-form categorical statements: *are* and *are not*. Sentences that contain linking verbs other than *are* or *are not* must be rewritten in standard form. Here are two examples:

Categorical Syllogisms

Syllogism: Three-line deductive argument

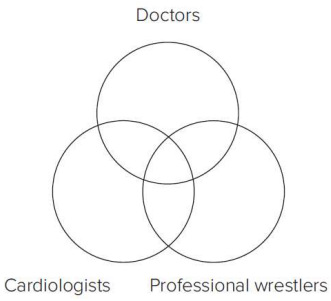
Categorical syllogism: Syllogism made up of all categorical statements

- Example
  - No doctors are professional wrestlers
  - All cardiologists are doctors
  - So, no cardiologists are professional wrestlers

Let's look at how to evaluate this argument with a Venn Diagram

Using Venn Diagrams to Test Validity, 1

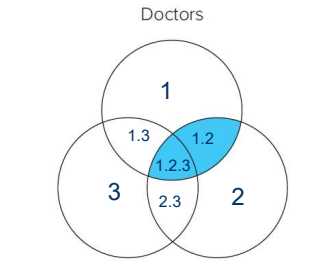
- Since there are three category terms (doctors, cardiologists, and professional wrestlers), we need three interlocking circles



Jump to Using Venn Diagrams to Test Validity, 1, Appendix

Using Venn Diagrams to Test Validity, 2

- No doctors are professional wrestlers



Jump to Using Venn Diagrams to Test Validity, 2, Appendix

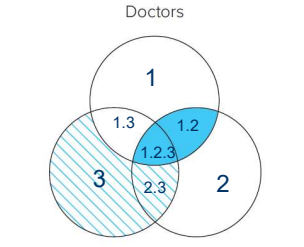
Using Venn Diagrams to Test Validity, 3

No doctors are professional wrestlers

All cardiologists are doctors

So, no cardiologists are professional wrestlers

- Since the conclusion suggests the shared area between Cardiologists and Pro Wrestlers is empty (shaded), and the first two premises already shaded that area, the argument is valid



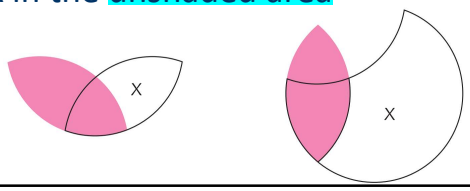
Jump to Using Venn Diagrams to Test Validity, 3, Appendix

Rules for Diagramming "Some" Statements, 1

If an argument contains one "all" or "no" statement, always do any necessary shading before placing an X

- If the argument contains two "all" or "no" statements, either statement can be done first

If part of the placement area has already been shaded, place the X in the unshaded area



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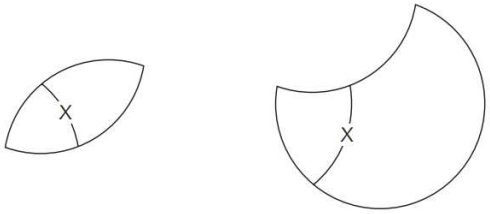
Rules for Diagramming "Some" Statements, 2

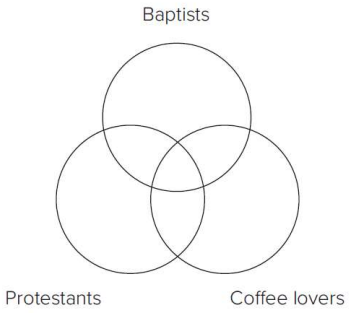
When placing an X in an area, if neither part of the area has been shaded, place the X on the line that separates the two parts (see examples on page 253 and 254)



9-18

"Some" Statements: Example, 1

- Some Baptists are coffee lovers
- All Baptists are Protestants
- So, some Protestants are coffee lovers

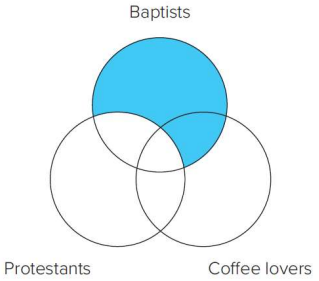


Jump to "Some" Statements: Example, 1, Appendix

"Some" Statements: Example, 2

All Baptists are Protestants

- Notice we do the "all" statement first because it requires shading



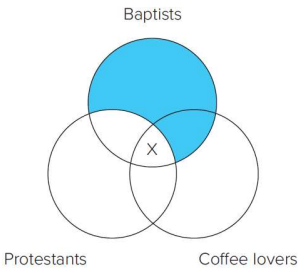
Jump to "Some" Statements: Example, 2, Appendix

"Some" Statements: Example, 3

Some Baptists are coffee lovers

- Since part of the area that represents the overlap of Baptists and coffee lovers is already shaded, we place the "X" in the unshaded part of that overlap

All Baptists are Protestants



Jump to "Some" Statements: Example, 3, Appendix

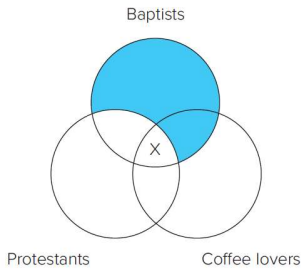
"Some" Statements: Example, 4

Some Baptists are coffee lovers

All Baptists are Protestants

So, some Protestants are coffee lovers

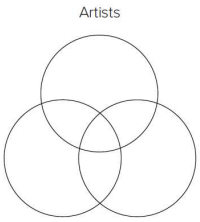
- Since the conclusion suggests that there is at least one individual within the overlap of Protestants and coffee lovers, and the first two premises place an "X" in that area, the argument is valid



Jump to "Some" Statements: Example, 4, Appendix

Diagramming When an Argument is Invalid: Example, 1

- All painters are artists
- Some magicians are artists
- So, some magicians are painters

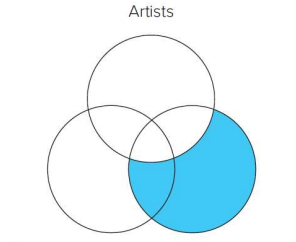


Jump to Diagramming When an Argument is Invalid: Example, 1, Appendix

Diagramming When an Argument is Invalid: Example, 2

All painters are artists

- Notice we start with the first premise because it is an "all" statement and thus requires shading



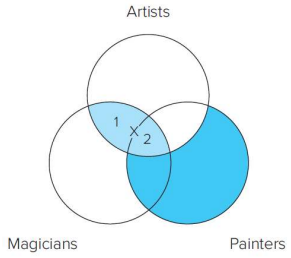
Jump to Diagramming When an Argument is Invalid: Example, 2, Appendix

Diagramming When an Argument is Invalid: Example, 3

All painters are artists

Some magicians are artists

- We place an X in that portion of the Magicians circle that overlaps with the Artists circle to represent the claim
  - The area is divided into two parts ("1" and "2")
  - We have no information that warrants placing the X in one of these areas rather than the other. In such cases, we place the X precisely on the line between the two sections.



Jump to Diagramming When an Argument is Invalid: Example, 3, Appendix

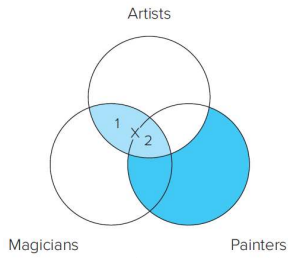
Diagramming When an Argument is Invalid: Example, 4

All painters are artists

Some magicians are artists

So, some magicians are painters

- There is an X in the Magicians circle, but it dangles on the line between the Artists circle and the Painters circle. We don't know whether it is inside or outside the Painters circle. Consequently, the argument is invalid.



Jump to Diagramming When an Argument is Invalid: Example, 4, Appendix

Using Venn Diagrams to Test the Validity of Categorical Syllogisms, 1

Step 1: Translate all statements in the argument (if necessary) into standard-form categorical statements

Step 2: Draw and label three overlapping circles

- One for each term (class name) in the argument, with the two circles for the conclusion at the bottom

Step 3: Use shading to represent the information in all or no statements and use X's to represent the information in "some" statements

Using Venn Diagrams to Test the Validity of Categorical Syllogisms, 2

Step 4: Diagram the two premises

- No marks should be entered for the conclusion

Step 5: When placing an X in a two-part area, if one part of the area has been shaded, place the X in the unshaded part

- If neither part of the area has been shaded, place the X precisely on the line separating the two parts

Using Venn Diagrams to Test the Validity of Categorical Syllogisms, 3

Step 6: Look to see if the diagram contains all the information presented in the conclusion

- If it does, the argument is valid
- If it doesn't, the argument is invalid

Practice:

1. No sharks are pets, since no barracuda are pets, and no sharks are barracuda

2. Some bankers are vegetarians.
No anarchists are bankers.
So, some anarchists are not vegetarians.

3. No poker players are early-risers.
Some firefighters are early-risers.
So, some firefighters are not poker players

Midterm exam preparation

40 multiple choices questions (90 min)

- 10 for chapter 1,2 (20 points)
- 10 for chapter 3 (20 points)
- 10 for chapter 9 (30 points)
- 10 for chapter 10 (30 points)

Practice the examples in reference book for these chapters

Appendices

Standard-Form Examples, 1, Appendix 1

The Venn diagram contains two partially overlapping circles. The circle on the left is labeled S and is shaded. The circle on the right is labeled P.

Jump back to Standard-Form Examples, 1

Standard-Form Examples, 1, Appendix 2

The Venn diagram contains two partially overlapping circles. The circle on the left is labeled S, and the circle on the right is labeled P. The area where the circles overlap is shaded.

Jump back to Standard-Form Examples, 1

Standard-Form Examples, 2, Appendix 1

The Venn diagram contains two partially overlapping circles. The circle on the left is labeled S, and the circle on the right is labeled P. The area where the circles overlap contains an X.

Jump back to Standard-Form Examples, 2

Standard-Form Examples, 2, Appendix 2

The Venn diagram contains two partially overlapping circles. The circle on the left is labeled S, and the circle on the right is labeled P. The circle on the left contains an X.

Jump back to Standard-Form Examples, 2

Using Venn Diagrams to Test Validity, 1, Appendix

The Venn diagram represents the statements “No doctors are professional wrestlers. All cardiologists are doctors. So, no cardiologists are professional wrestlers.” The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled doctors, the second circle is labeled professional wrestlers, and the third circle is labeled cardiologists.

Jump back to Using Venn Diagrams to Test Validity, 1

Using Venn Diagrams to Test Validity, 2, Appendix

The Venn diagram represents the statements “No doctors are professional wrestlers. All cardiologists are doctors. So, no cardiologists are professional wrestlers.” The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled doctors, the second circle is labeled professional wrestlers, and the third circle is labeled cardiologists. The circles labeled doctors and professional wrestlers and the area where the three circles overlap are shaded.

Jump back to Using Venn Diagrams to Test Validity, 2

Using Venn Diagrams to Test Validity, 3, Appendix

The Venn diagram represents the statements “No doctors are professional wrestlers. All cardiologists are doctors. So, no cardiologists are professional wrestlers.” The diagram contains three partially overlapping circles. In clockwise direction, the first circle is labeled doctors, the second circle is labeled professional wrestlers, and the third circle is labeled cardiologists. The circles labeled doctors and professional wrestlers and the area where the three circles overlap are shaded to represent the premise “No doctors are professional wrestlers.” To represent the premise “All cardiologists are doctors,” the part of the Cardiologists circle that does not overlap with the Doctors circle is shaded using lines.

Jump back to Using Venn Diagrams to Test Validity, 3

“Some” Statements: Example, 1, Appendix

The Venn diagram represents the statements “Some Baptists are coffee lovers. All Baptists are Protestants. So, some Protestants are coffee lovers.” The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled Baptists, the second circle is labeled coffee lovers, and the third circle is labeled Protestants.

Jump back to “Some” Statements: Example, 1

"Some" Statements: Example, 2, Appendix

The Venn diagram represents the statements "Some Baptists are coffee lovers. All Baptists are Protestants. So, some Protestants are coffee lovers." The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled Baptists, the second circle is labeled coffee lovers, and the third circle is labeled Protestants. To represent the premise "All Baptists are Protestants," the area of the Baptists circle that does not overlap with the Protestants circle is shaded.

Jump back to "Some" Statements: Example, 2

"Some" Statements: Example, 3, Appendix

The Venn diagram represents the statements "Some Baptists are coffee lovers. All Baptists are Protestants. So, some Protestants are coffee lovers." The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled Baptists, the second circle is labeled coffee lovers, and the third circle is labeled Protestants. To represent the premise "All Baptists are Protestants," the area of the Baptists circle that does not overlap with the Protestants circle is shaded. To represent the premise "Some Baptists are coffee lovers," an X is placed in the unshaded portion of the Baptists circle that overlaps with the Coffee lovers circle.

Jump back to "Some" Statements: Example, 3

"Some" Statements: Example, 4, Appendix

The Venn diagram represents the statements "Some Baptists are coffee lovers. All Baptists are Protestants. So, some Protestants are coffee lovers." The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled Baptists, the second circle is labeled coffee lovers, and the third circle is labeled Protestants. To represent the premise "All Baptists are Protestants," the area of the Baptists circle that does not overlap with the Protestants circle is shaded. To represent the premise "Some Baptists are coffee lovers," an X is placed in the unshaded portion of the Baptists circle that overlaps with the Coffee lovers circle.

Jump back to "Some" Statements: Example, 4

Diagramming When an Argument is Invalid: Example, 1, Appendix

The Venn diagram represents the statements "All painters are artists. Some magicians are artists. So, some magicians are painters." The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled artists, the second circle is labeled painters, and the third circle is labeled magicians.

Jump back to Diagramming When an Argument is Invalid: Example, 1

Diagramming When an Argument is Invalid: Example, 2, Appendix

The Venn diagram represents the statements “All painters are artists. Some magicians are artists. So, some magicians are painters.” The diagram contains three partially overlapping circles In a clockwise direction, the first circle is labeled artists, the second circle is labeled painters, and the third circle is labeled magicians. To represent the premise “All painters are artists,” the part of the Painters circle that does not overlap with the Artists circle is shaded.

Jump back to Diagramming When an Argument is Invalid: Example, 2

Diagramming When an Argument is Invalid: Example, 3, Appendix

The Venn diagram represents the statements “All painters are artists. Some magicians are artists. So, some magicians are painters.” The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled artists, the second circle is labeled painters, and the third circle is labeled magicians. The area where the circles labeled artists and magicians overlap is labeled 1, and the area where all three circles overlap is labeled 2. To represent the premise “Some magicians are artists,” an X is placed on the line between the areas labeled 1 and 2.

Jump back to Diagramming When an Argument is Invalid: Example,3

Diagramming When an Argument is Invalid: Example, 4, Appendix

The Venn diagram represents the statements “All painters are artists. Some magicians are artists. So, some magicians are painters.” The diagram contains three partially overlapping circles. In a clockwise direction, the first circle is labeled artists, the second circle is labeled painters, and the third circle is labeled magicians. The area where the circles labeled artists and magicians overlap is labeled 1, and the area where all three circles overlap is labeled 2. To represent the premise “Some magicians are artists,” an X is placed on the line between the areas labeled 1 and 2.

Jump back to Diagramming When an Argument is Invalid: Example,4