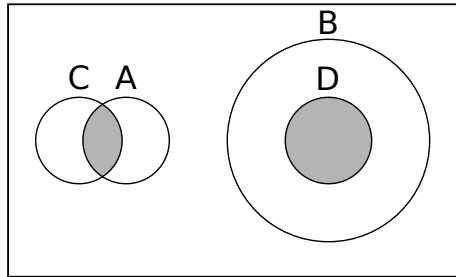


# Euler Diagram Readability Study

## Euler Diagram Training

### Euler Diagrams

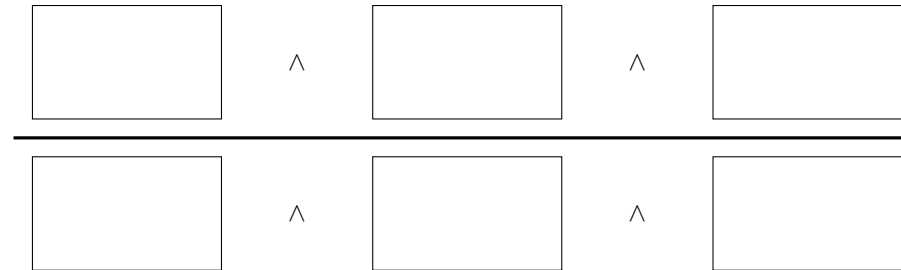


Euler diagrams are a visual language to reason about sets. An Euler diagram consists of a surrounding rectangle and a set of closed *contours* or *curves*. Each curve represents a set. The relations between the curves correspond to the relations between the sets they depict. For example, if two curves do not intersect, they denote disjoint sets. Similarly, if a curve  $A$  is shown in the interior of a curve  $B$ , the set  $A$  is required to be a subset of  $B$ .

The curves partition the area within the rectangle into disjoint blocks. These blocks are called *zones*. A zone may be *shaded* to indicate that it is empty. A non-shaded zone may be empty or not.

Euler diagrams can be composed using Boolean operators. Within this study, we will only use conjunction of diagrams, denoted by  $\wedge$ .

### Inference Rules



Rules of inference allow us to transfer information between diagrams or to remove unnecessary information from a single diagram. A rule is applied to the *premises* and yields a *conclusion*. Both are separated by a horizontal line. We will present you an application of a rule to a conjunction of three diagrams. The questions you are supposed to answer are always the same:

*Which proof rule has been applied?*

For this question, there are always five possibilities (the different proof rules) and one correct answer.

*Which diagrams are involved in the premise?*

For this question, there are always three possibilities (the three diagrams above the horizontal line) and the answer consists of one or two diagrams.

*Which diagram has been changed in the conclusion?*

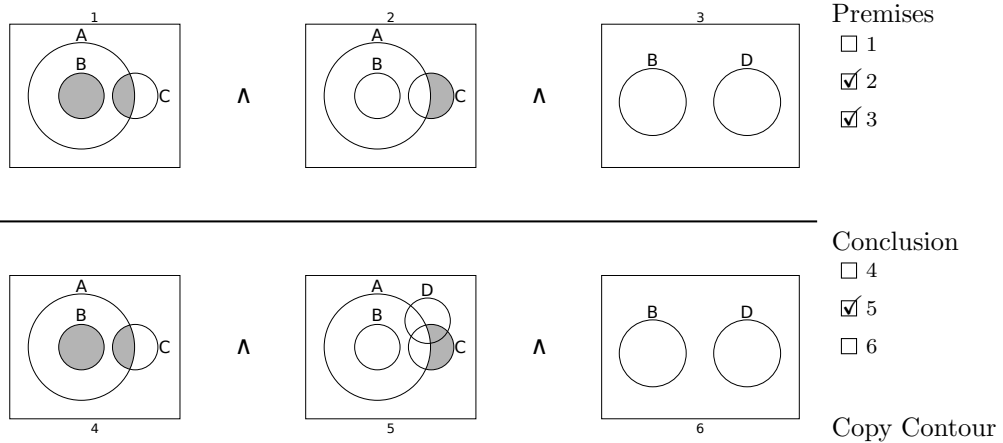
For this question, there are always three or two possibilities (the diagrams below the horizontal line) and one correct answer.

You can answer these question in any order you like.

There are five rules to consider.

## Copy Contour

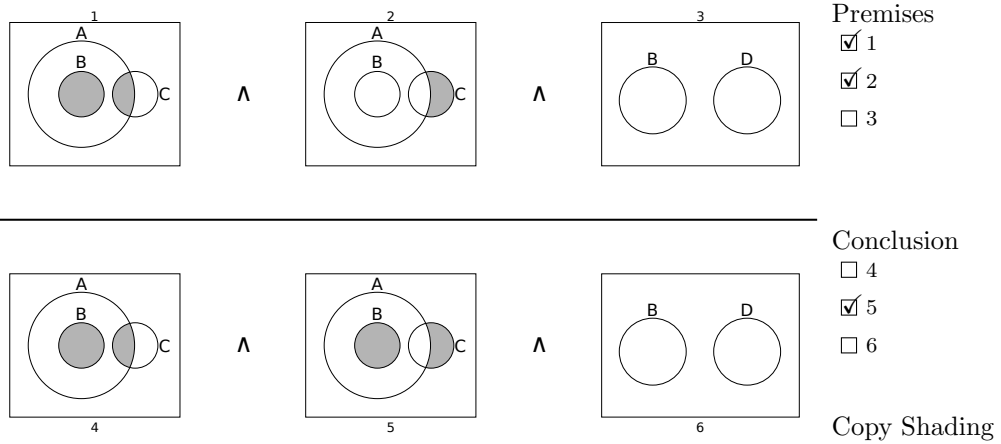
A contour from one diagram can be copied to a diagram. Doing that, the placement of the new copy of the contour must respect the topological relations within the diagram it comes from.



The only difference is between the diagrams in the middle. In the lower diagram (5),  $D$  is present, while in upper one (2) it is not. The only diagram in the upper row containing  $D$  is diagram 3. Within it,  $D$  is not intersecting with  $B$ , as in diagram 5.

## Copy Shading

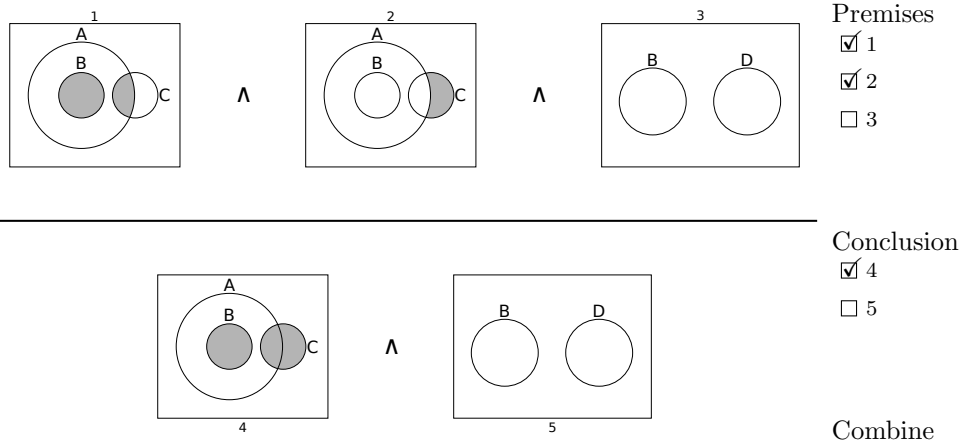
The shading of a zone can be copied from one diagram into another diagram.



The only difference is between the diagrams in the middle. In the lower diagram (5), *B* is shaded, while in upper one (2) it is not. The only diagram in which *B* is originally shaded is diagram 1.

## Combine

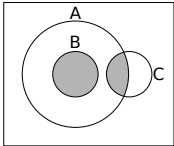
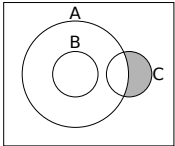
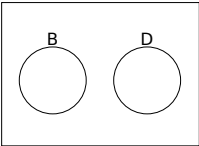
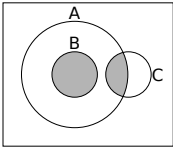
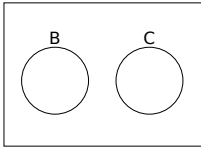
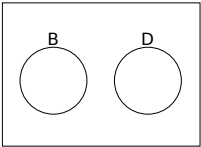
Two diagrams with the same set of visible zones can be combined to a single diagram. If a zone is shaded in one of the original diagrams, it has to be shaded in the new diagram.



The set of zones in 1, 2 and 4 is similar and in 4, all zones that are shaded in 1 or 2 are shaded.

## Erase Contour

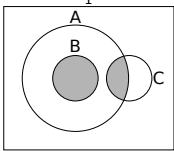
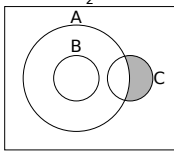
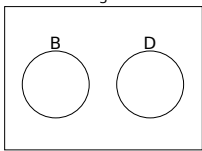
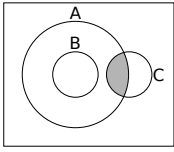
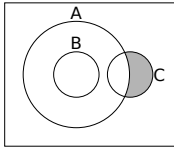
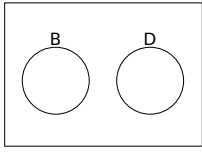
Remove a contour from a diagram. If this erasure removes a boundary between a shaded and a non-shaded zone, the resulting zone is not shaded.

 1	$\wedge$	 2	$\wedge$	 3	Premises <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3
 4	$\wedge$	 5	$\wedge$	 6	Conclusion <input type="checkbox"/> 4 <input checked="" type="checkbox"/> 5 <input type="checkbox"/> 6  Erase Contour

The only difference is between the diagrams in the middle. Diagram 5 consists only of the curves *B* and *C*. If curve *A* in diagram 2 is removed, the interior of curve *C* would consist of a shaded and a non-shaded part. Hence, it will not be shaded, which is consistent with 5.

## Erase Shading

Remove shading from a zone.

 <p>1</p>	$\wedge$	 <p>2</p>	$\wedge$	 <p>3</p>	<p>Premises</p> <p><input checked="" type="checkbox"/> 1</p> <p><input type="checkbox"/> 2</p> <p><input type="checkbox"/> 3</p>
 <p>4</p>	$\wedge$	 <p>5</p>	$\wedge$	 <p>6</p>	<p>Conclusion</p> <p><input checked="" type="checkbox"/> 4</p> <p><input type="checkbox"/> 5</p> <p><input type="checkbox"/> 6</p> <p>Erase Shading</p>

The only difference is between the diagrams on the left. In the lower diagram (4), *B* is not shaded, while in the upper one (1) it is .