# CL Tutorial 3

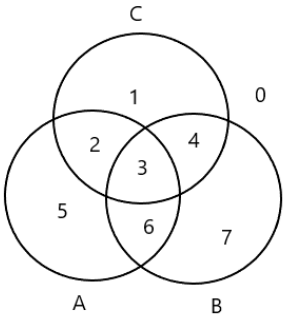
## Exercise 1

- **Diligent and ignorant students**

$$\frac{a \models b \quad c \models \neg a}{a \not\models \neg c}$$

a is diligent students, b is successful, c is ignorant students

The syllogism is not sound, a counterexample is shown below:




All a is b means 2 & 5 are empty.

No c is a means 2 & 3 are empty.

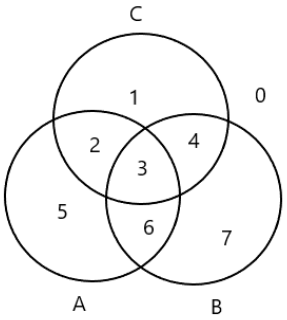
If some a is c, at least one of 2 and 3 is inhabited, but both 2 and 3 and empty from the predicate. Thus, the syllogism is not sound.

- **Eagle and pig**

$$\frac{a \models c \quad b \not\models c}{b \not\models a}$$

a is eagle, b is pig, c is fly

The syllogism is sound, as shown below:




All a is c, some b is not c, some c is not a.

All a is c means 5 & 6 are empty.

Some b is not c means at least one of 6 and 7 is inhabited – since 6 is empty, 7 is inhabited.

This shows that the conclusion is valid since,

Some b is not a means at least one of 1 and 4 is inhabited.

The syllogism is derived from Barbara:

$$\frac{a \vDash b \quad b \vDash c}{a \vDash c}$$

$$\frac{b \vDash a \quad a \vDash c}{b \vDash c}$$

$$\frac{b \nvDash c \quad a \vDash c}{b \nvDash a}$$

**Exercise 2**

There can only be exactly 2 occurrences of $\nvDash$ and/or $\neg$ in any syllogisms.

$$\frac{a \vDash \neg u \quad u \vDash h}{h \nvDash a}$$

Since this syllogism has only 1 $\nvDash$ and 1 $\neg$, it is not sound.

**Exercise 3**

$$a \nvDash \neg a$$

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null [x | x <- filter a xs, a x == True] == False
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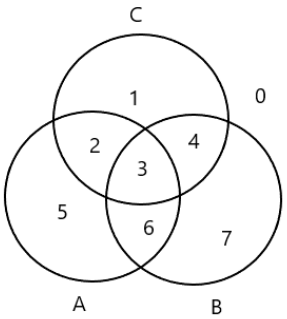


$$\frac{a \vDash b \quad c \vDash a}{c \nvDash \neg b}$$

All a is b means 2 & 5 are empty.

All c is a means 2 & 1 & 4 are empty. (c only inhabits 3)

Thus, the syllogism is sound since some c is b means at least one of 3 and 4 is inhabited, which is true.

$$\frac{a \models b \qquad c \not\models \neg a}{c \not\models \neg b} \ (Darii)$$

Since:

$$a \not\models \neg a \text{ and } c \not\models \neg a$$

Thus, the syllogism is sound given $a \not\models \neg a$ is true:

$$\frac{a \models b \qquad c \models a}{c \not\models \neg b}$$

**Exercise 4**

1. and [hasThickBorder x | x <- things, isBig x && isAmber x] == False
2. or [isDisc x | x <- things, isSmall x]
3. or [ isAmber x | x <- things, isSmall x && isSquare x ]

**Exercise 6**

2, 3, 5, 6 are True.

**Exercise 7**

Yes, the property still holds for three predicates.