

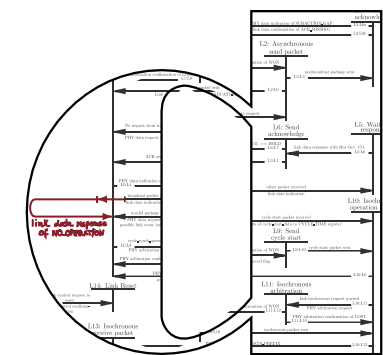


Ethics for Nerds

An Advanced Course in Computer Science
Summer Semester 2020

Precise Thinking 2.1
Deductive Arguments

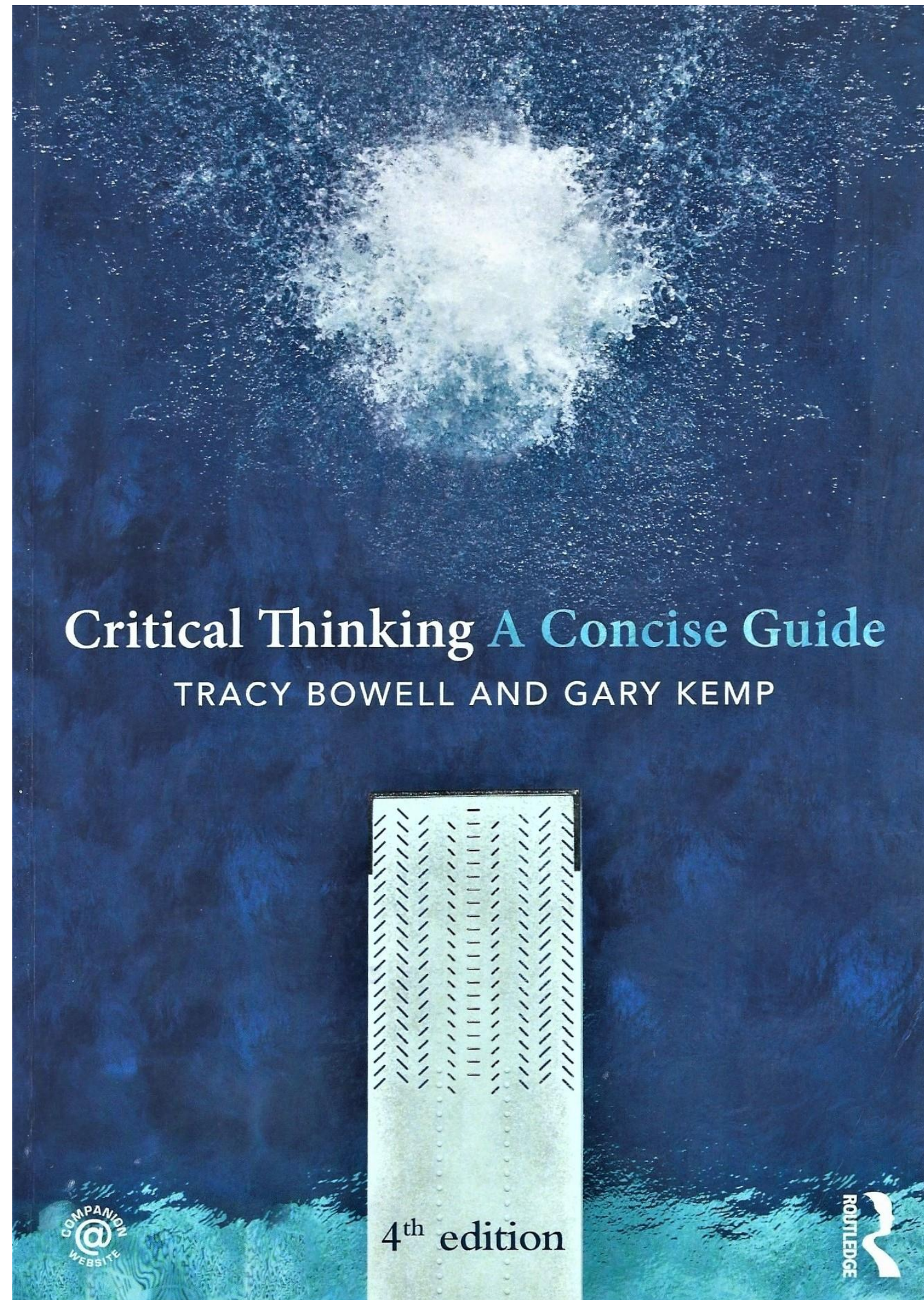
Validity and Soundness



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We *very* loosely follow this book:

Bowell, T., & Kemp, G. (2015). *Critical thinking: A concise guide (4th ed.)*. Routledge.

However, *lots* of things deviate from the book. What is said in the lecture has precedence over the book.

You do **not** have to buy the book. If you want to have an inexpensive look, you can find a digital copy of the 2nd edition online at:

[http://www.academia.edu/download/46383480/ Tracy Bowell Critical Thinking A Concise Guide BookFi.org.pdf](http://www.academia.edu/download/46383480/Tracy_Bowell_Critical_Thinking_A_Concise_Guide_BookFi.org.pdf)

In order to get closer to the truth, we have to

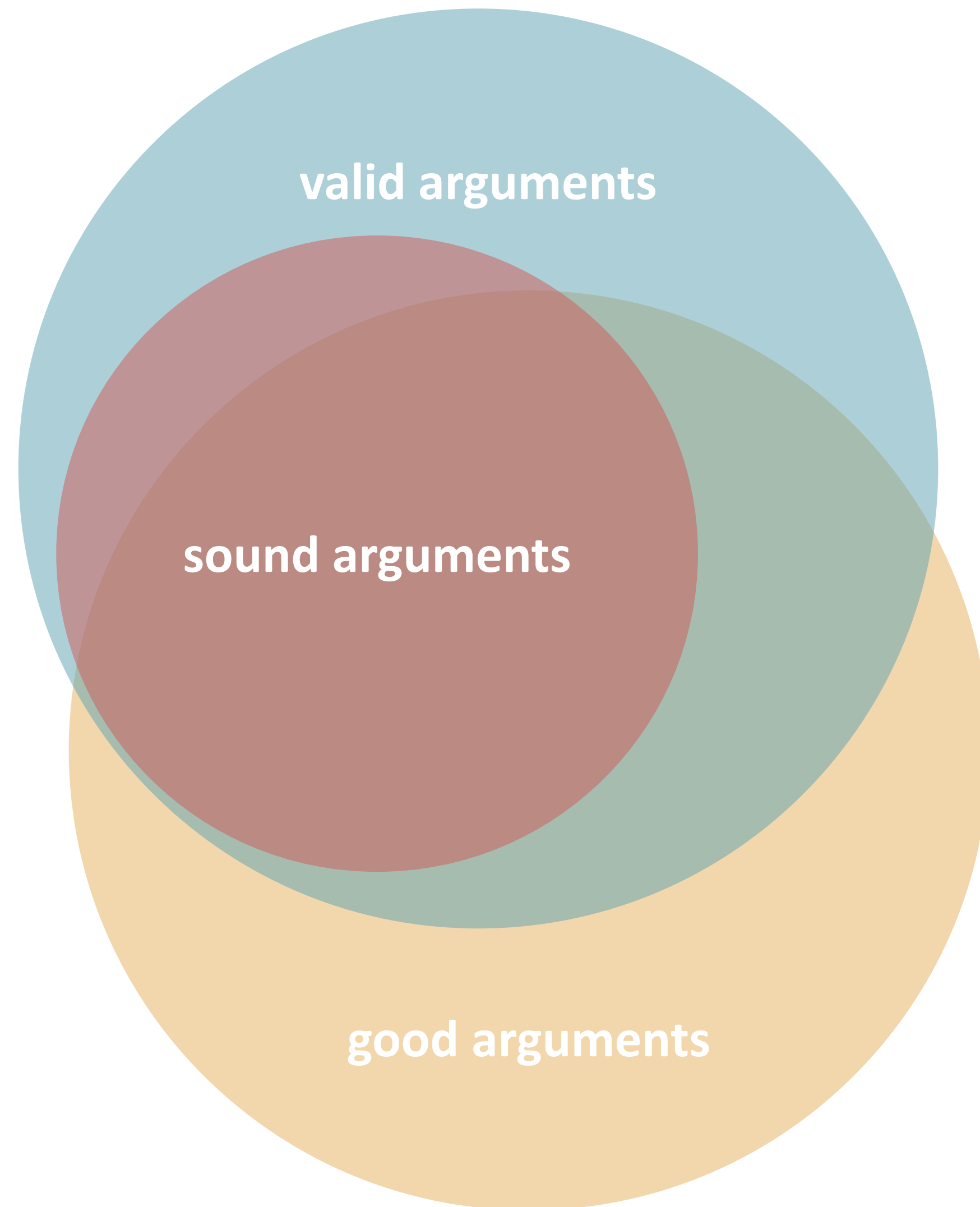
understand others'
arguments

assess others'
arguments

write good
arguments ourselves

we have formal tools and methods to help us with that

VALIDITY AND SOUNDNESS



We want arguments to be good,
and sound arguments often are good arguments.

Argument A

P1: Chappie is a dog.

P2: All dogs have fleas.

C1: Therefore, Chappie has fleas. ✓|—

What is wrong with argument A?

Argument A is deductively valid.

Argument B

P3: Kevin a human being.

P4: All women are human beings.

C2: Therefore, Kevin is a woman. ✗|✗

What is wrong with argument B?

Argument B is not deductively valid.

Intuition: when an argument is deductively valid, the conclusion really does follow from the premises.

(Deductive) Validity

An argument is (deductively) valid iff it is not possible for all premises to be true and the conclusion to be false. An argument is (deductively) invalid iff it is not (deductively) valid.

(We will usually just drop the “deductive” and “deductively”.)

How to show that something is not valid?

Give a (maybe counterfactual) case where all the premises are true, but the conclusion is false.

Example

Valid or not?

P1: I set my alarm to 5:50 am.

P2: My alarm clock works very reliably and will ring tomorrow at 5:50 am.

P3: I never snooze for more than five minutes before I get up.

P4: I have to get up at 6:00 am tomorrow.

C: I will get up in time tomorrow.

✗ | (✓)

Counterfactual scenarios where P1 – P4 are true but C is false:

- I become deaf overnight
- I fall into a coma
- I die in my sleep
- the alarm clock is taken away from me

VALIDITY

Example

Valid or not?

P1: I set my alarm at 5:50 am.

P2: My alarm clock works very reliably and will ring tomorrow at 5:50 am.

P3: I never snooze for more than five minutes before I get up.

P4: I have to get up at 6:00 am.

C: I will get up in time tomorrow.

✗ | (✓)

Question: Is this a counterexample that shows invalidity?

A guy in a unicorn costume and his guinea-pig sidekick break into my apartment at night. They steal the alarm clock and replace it with a cupcake that is shaped like Donald Trump's hair. They are trained ninjas such that they are incredibly stealthy and manage to do this without waking me up. At 5:50 am the guy and his guinea pig hysterically laugh at their evil plot when the alarm clock goes off in their unicorn-cave, and I oversleep.

Answer: Yes, it is. No matter how absurd the story needs to be, if you can tell a coherent story where the premises are true but the conclusion is false, then the argument is not valid.

(It's not a good counterexample, though.)

How to make sure that an argument is valid

Logical Validity

An argument is logically valid iff it is valid due to its logical structure.

The logical structure has to be as clear as possible from the argument!

Formally: Let P be the set of formalized premises and c the conclusion. Then $(\bigwedge_{p \in P} p) \rightarrow c$ has to be a tautology.

This also means that all arguments are valid where

- $\bigwedge_{p \in P} p$ is a contradiction or
- c is a tautology

Formalizing an argument

the *logical form* of an argument

Tabular form/standard form:

P1: Everything that is in the rain and not protected will get wet.

P2: John is in the rain and is not protected.

C: Therefore, John will get wet. ✓|-

Logical form:

P1: $\forall x: R(x) \wedge \neg P(x) \rightarrow W(x)$

P2: $R(\text{John}) \wedge \neg P(\text{John})$

C: $W(\text{John})$ ✓|-

Two common structures

Modus Ponens

P1: $a \rightarrow b$

P2: a

C: b

P1: a

P2: $a \rightarrow b$

C: b

Modus Tollens

P1: $a \rightarrow b$

P2: $\neg b$

C: $\neg a$

P1: $\neg b$

P2: $a \rightarrow b$

C: $\neg a$

Both are valid.

Another form of validity

Analytical Validity (working definition)

An argument is analytically valid iff it is valid due to the meaning of certain terms used in the argument.

This form of deductive validity is common and formally correct, but should be used with caution.

Examples:

P1: Paris is west of Saarbrücken.

C: Therefore, Saarbrücken is east of Paris. ✓ | –

P1: John is a bachelor.

C: Therefore, John is unmarried. ✓ | –

Another form of validity

You can translate analytically valid arguments to logically valid arguments:

| | | |
|-------|--|-------|
| P1: | Paris is west of Saarbrücken. | |
| <hr/> | | |
| C: | Therefore, Saarbrücken is east of Paris. | ✓ - |



| | | |
|-------|--|-------|
| P1: | Paris is west of Saarbrücken. | |
| P2: | If A is west of B, then B is east of A. | |
| <hr/> | | |
| C: | Therefore, Saarbrücken is east of Paris. | ✓ - |

| | | |
|-------|-------------------------------|-------|
| P1: | John is a bachelor. | |
| <hr/> | | |
| C: | Therefore, John is unmarried. | ✓ - |



| | | |
|-------|---|-------|
| P1: | John is a bachelor. | |
| P2: | If someone is a bachelor, then he is unmarried. | |
| <hr/> | | |
| C: | Therefore, John is unmarried. | ✓ - |

Recap

Standard Form of Arguments

An argument in standard form is an argument of the following form:

| | |
|----------|--|
| Pn_1 : | $[n_1\text{-th premise}]$ |
| Pn_2 : | $[n_2\text{-th premise}]$ |
| | \vdots |
| Pn_i : | $[n_i\text{-th premise}]$ |
| <hr/> | |
| Cm : | $[\text{optional: indicator word}], [\text{conclusion}]$ |

The premises have indexes from a suitable index set. The conclusion can, but does not have to have an index.

Indicator words: “Thus” and “therefore” are the indicator words for deductively valid arguments.

RECAP

Logically valid

P1: If it rains, then the street is wet.

P2: It rains.

C1: Therefore, the street is wet. ✓|—

is valid because of its logical structure:

P1: $a \rightarrow b$

P2: a

C1: b

Analytically valid

P1: John is a bachelor.

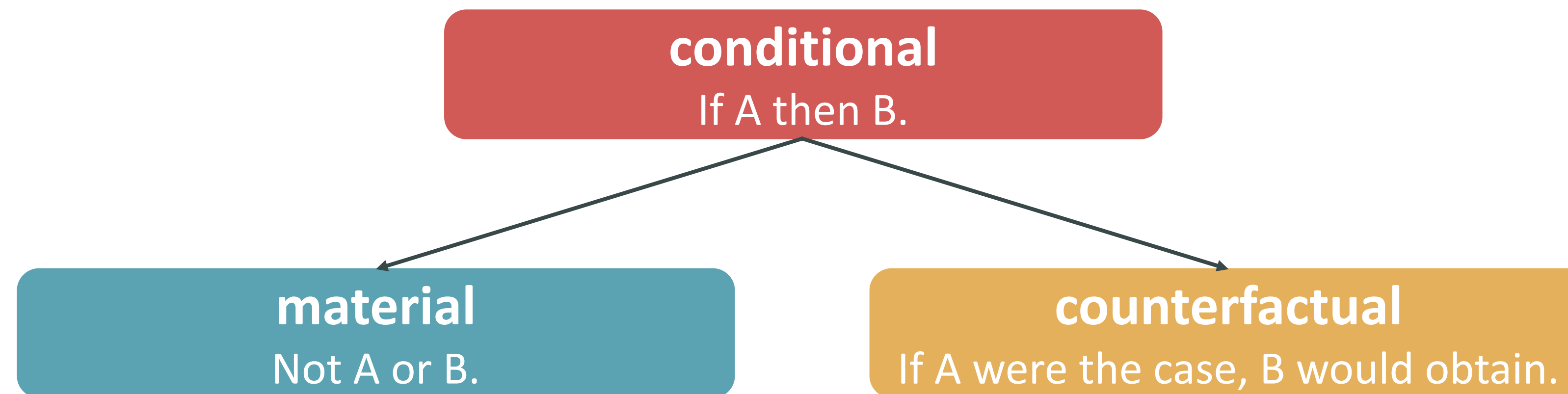
C: Therefore, John is unmarried. ✓|—

is valid because of its the terms used:

bachelors *are* single, unmarried young man, so if someone is a bachelor, then he also is unmarried.

SOME TRICKY THINGS ABOUT VALIDITY

Different kinds of conditionals



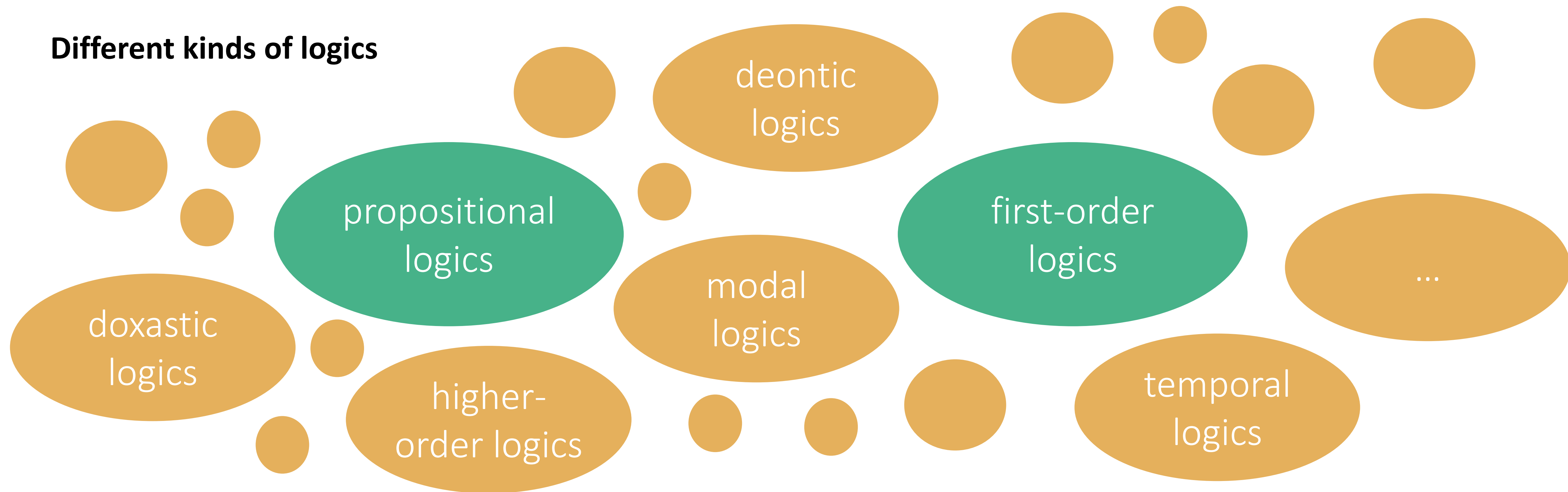
If Saarland is not part of Germany, it is part of France. **true**
If Saarland is not part of Germany, it is part of China. **true**
If Saarland is not part of Germany, it is part of Germany. **true**

true If Saarland were not part of Germany, it would be part of France.
false If Saarland were not part of Germany, it would be part of China.
false If Saarland were not part of Germany, it would be part of Germany.

Just be aware of this difference when dealing with conditionals.

SOME TRICKY THINGS ABOUT VALIDITY

Different kinds of logics



If you do not know the proper logic to formalize an argument, make a very fine-grained extended standard form to make the validity of your argument clear.

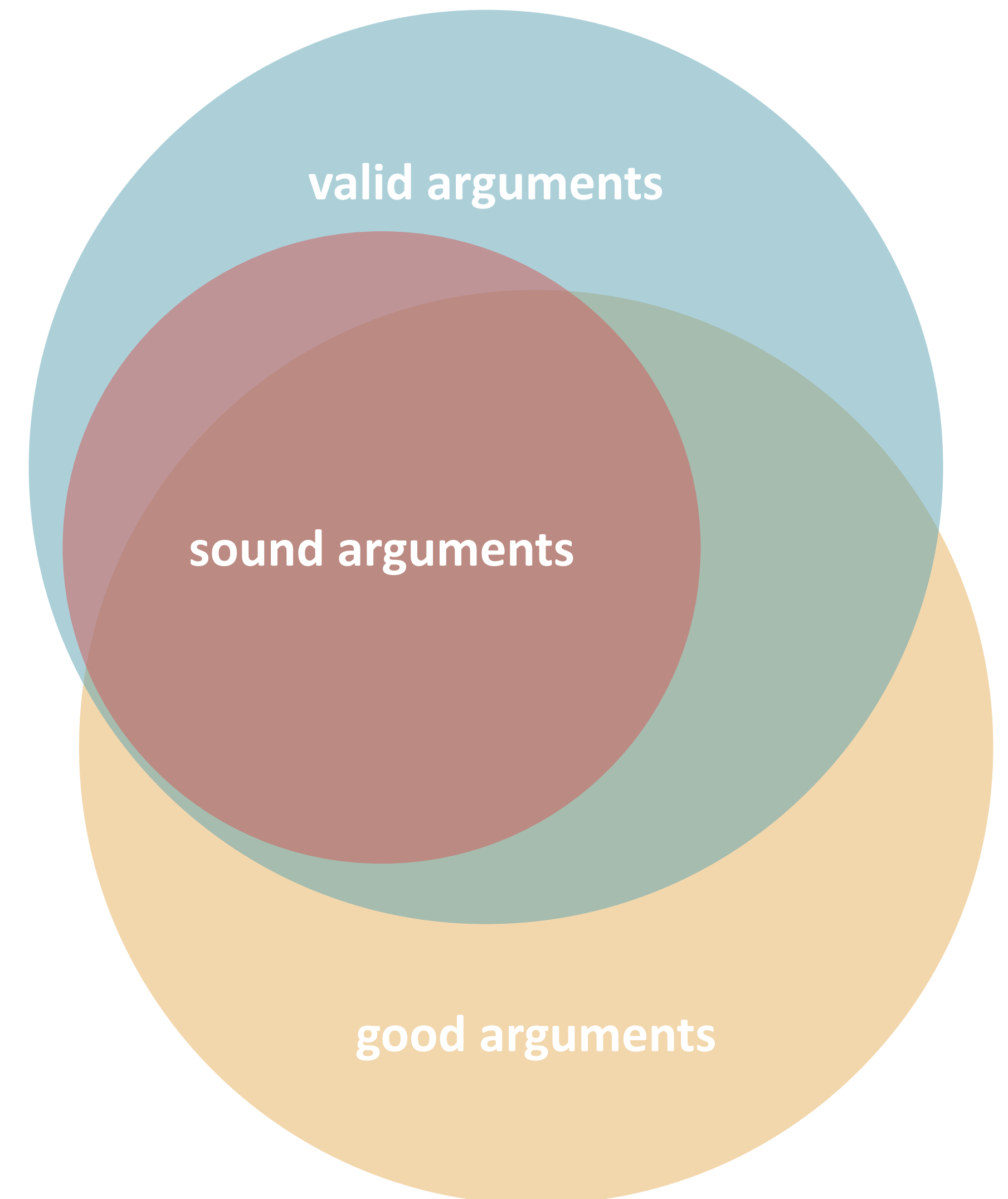
Is this a good argument?

P1: If we have a vaccine against SARS-CoV-2, then we can achieve herd immunity against SARS-CoV-2 at low costs in a comparatively short time.

P2: We have a vaccine against SARS-CoV-2.

C: Therefore, we can achieve herd immunity against SARS-CoV-2 at low costs in a comparatively short time. ✓ | –

No, because we do not have a vaccine (as of today)!



SOUNDNESS

Intuition: When an argument is sound, the conclusion does follow from the premises *and* you can actually deduce the conclusion since the premises are true. This may give you good reason to believe in an argument.

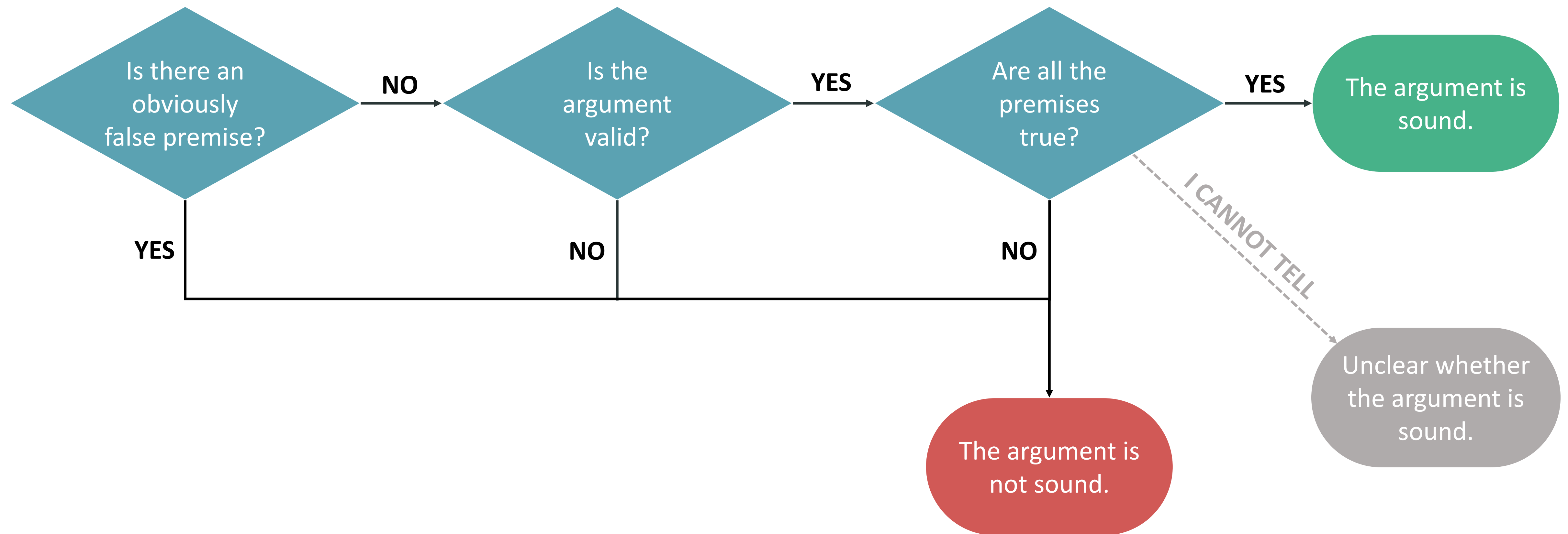
Soundness

An argument is sound iff if it is valid and all its premises are true.

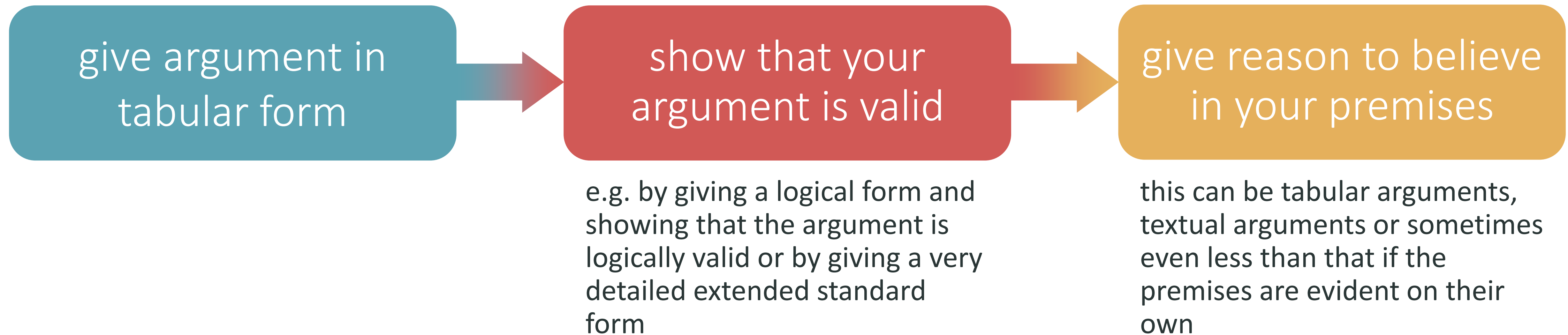
There cannot be a sound argument with a false conclusion.

| | |
|-------------|--------------------------------|
| arguments | valid, sound, invalid, unsound |
| premises | true, false |
| conclusions | true, false |

How to (smartly) tell that an argument is sound?



How to convince others that an argument is sound?



Example on which premises need more reasoning

P1: Kids are either taught inside the regular school system or not taught inside the regular school system.

P2: Empirical data shows that kids benefit from being taught inside the regular school system.

P3 If P1 and P2, then C.

C: Therefore, it is wrong to allow homeschooling.

✓ | -

P1 needs just a short remark that it is a logical truth (given that there is no vagueness involved)

P2 it likely suffices to point at the empirical data that is referenced in the premise

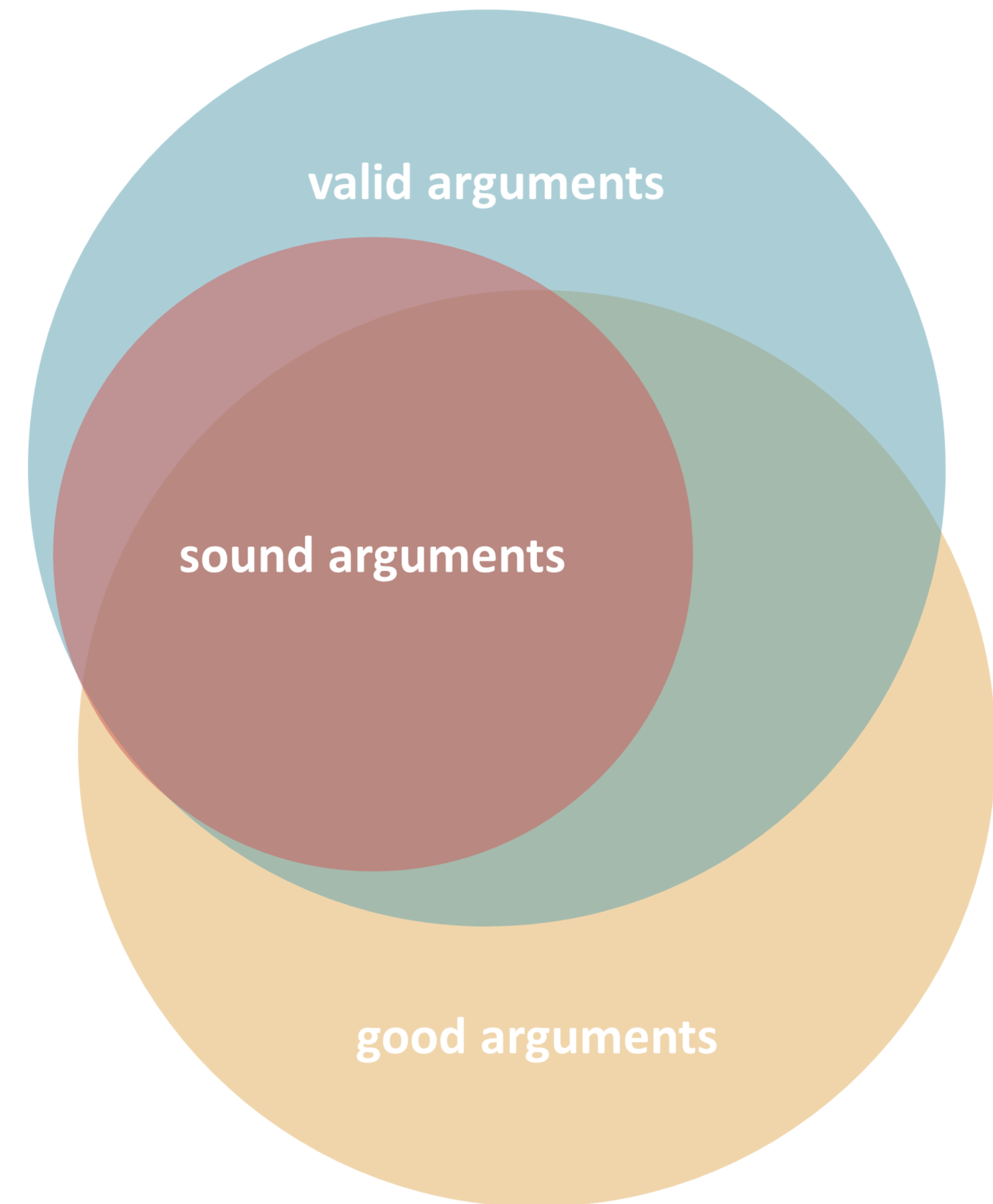
P3 much more work needs to be done, another argument needs to be given

SUMMARY

validity: it is not possible that all premises are true, but the conclusion is false, usually you go for logical validity

soundness is **validity** and **truth of all premises**


the argument's inference is formally ok and you can pull the argument's inference off, because what you infer from is true



DIFFERENT FORMS OF ARGUMENTS

text(ual) form

If it's raining, then the street gets wet and it, indeed, rains. Thus, the street is wet.


 good for communicating the argument, natural to start with


 but bad for assessing

standard form

P1: If it rains, then the street is wet.
P2: It rains.

C1: Therefore, the street is wet.

 good for checking the truth of the premises, missing/implicit premises and general structure

 but bad for communication (to non-philosophers)


extended
standard
form

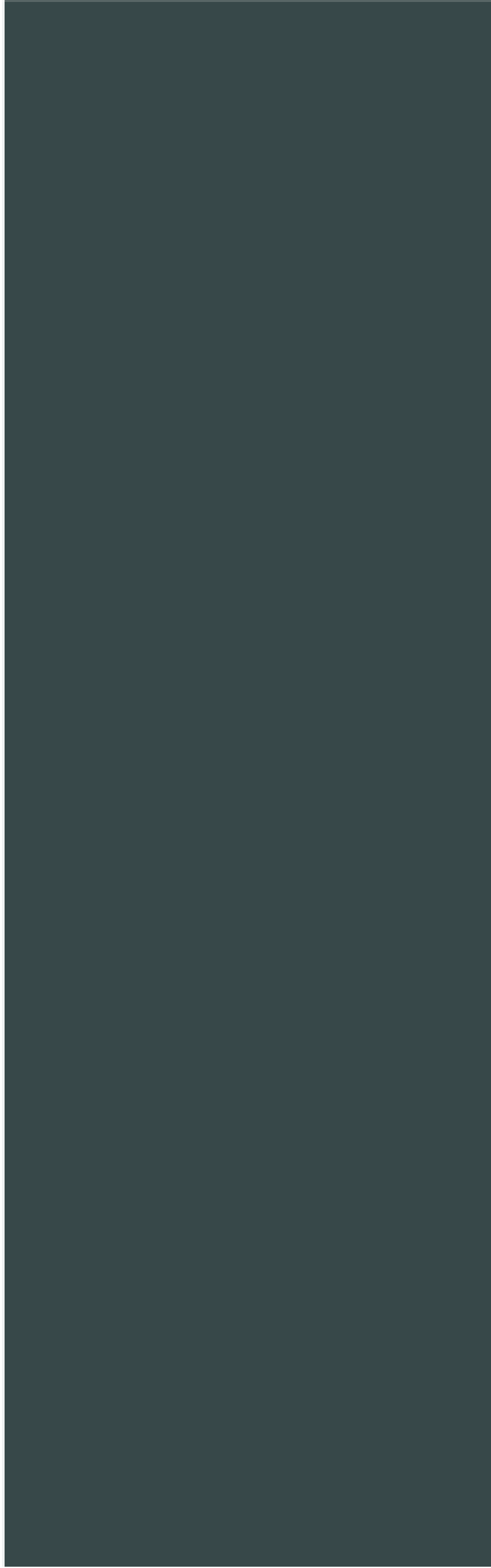
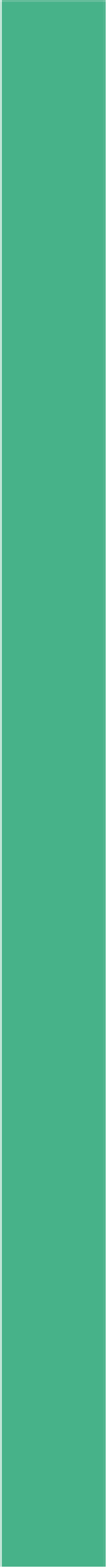
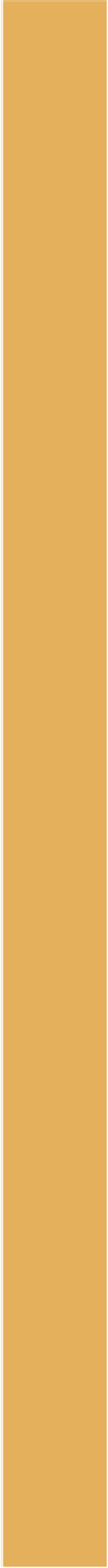
logical form

P1: $a \rightarrow b$
P2: a

C1: b

 good for checking for validity

 but impossible to check truth/plausibility of premises, i.e. impossible to check soundness



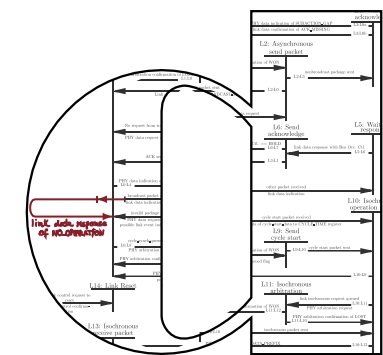


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Deductive Arguments

Example



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EXAMPLE

Coming up with an own valid argument

We want to argue for the following claim:

If you drink and drive, then you are doing something wrong.

Arguments in general

- coming up with own arguments
- reconstructing and assessing the arguments of others

How do we want an argument to be?

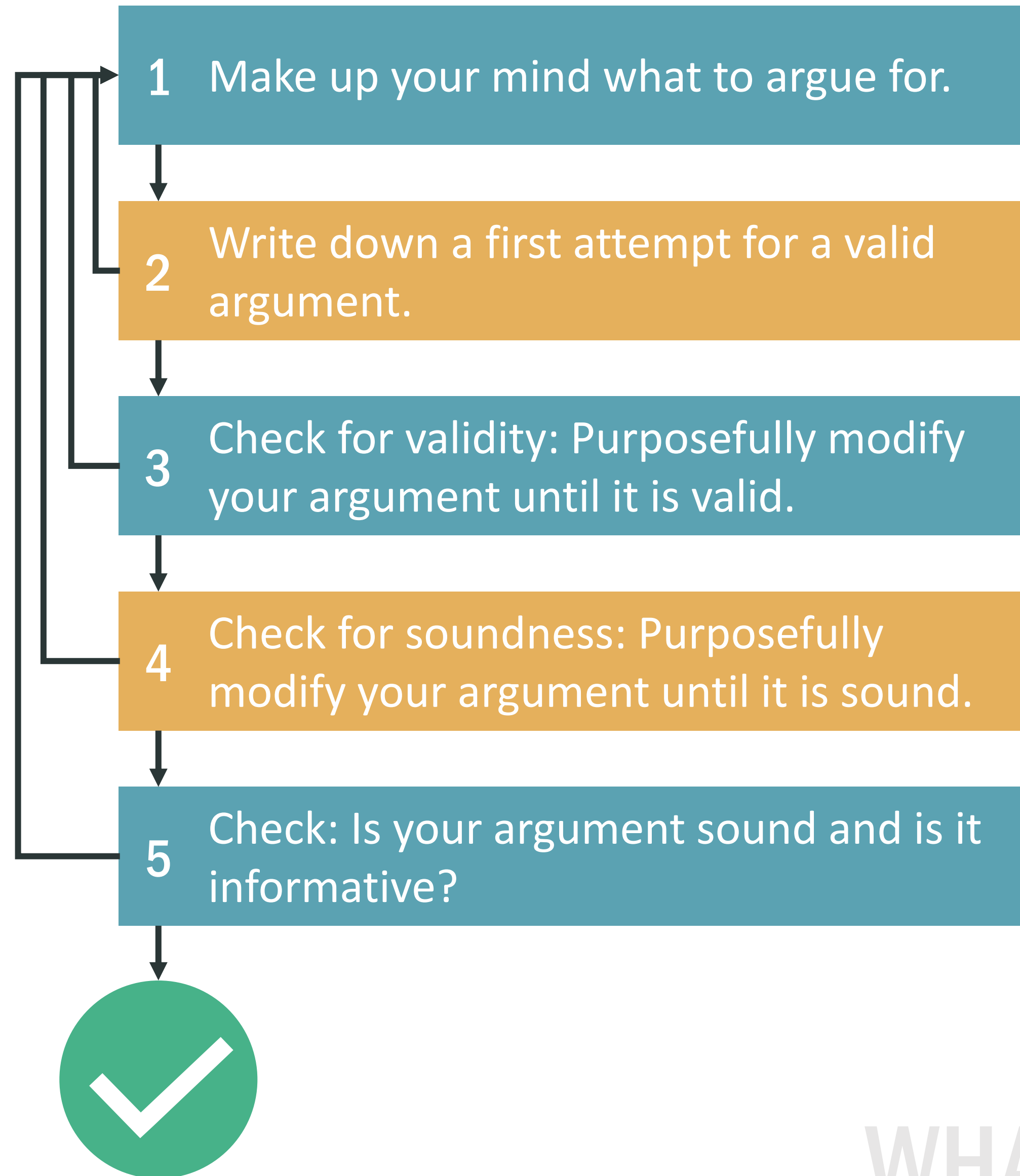
- sound
 - valid
 - all premises are true
- informative and non-trivial

→ Give explicit, good reason to believe in a statement

- give others explicit, good reason to believe in a statement you think is correct
- checking if someone else gave you good reason to believe in a statement he thinks is correct
- because then our inference works
- because then we actually give the other person reason to believe in our statement (instead of e.g. just saying “well, my statement is true”)

WHAT? : WHY?

What to do when writing your own argument



→ In the end we want an informative and sound argument. This is the way to go there.

WHAT? : WHY?

Think of what we could say in general

- When you drive under the influence of alcohol, you are more likely to cause an accident, e.g. because alcohol messes with some body functions you need for driving, e.g. reaction time.
- It's wrong to do something that makes it more likely to cause an accident.
- Drinking and driving is forbidden by law, e.g. for the case of Germany by §316 StGB. You even can go to jail for that.

→ roughly making up your mind what you could say is a good first step. You will notice if you need to do more research and get a good starting point for writing your argument

WHAT? : WHY?

Come up with your first argument

- P1 If you drink and drive, you are driving under the influence of alcohol.
 - P2 Because alcohol decreases your motor functions, it holds that if you are driving under the influence of alcohol, your reaction time will be longer than normal.
 - P3 If your reaction time is longer than normal, you won't be able to react fast enough in dangerous situations.
 - P4 Under the influence of alcohol you are not able to react fast enough in dangerous situations, thus it will significantly raise the chance of an accident.
 - P5 Raising the chance of an accident causes significant raise of the chance of harm without any additional pleasure.
 - P6 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
 - P7 In Germany you can get to jail for driving under the influence of alcohol (§316 StGB).
-
- C1 If you drink and drive, then you are doing something wrong.

This is our starting point. (Most of what follows is going to make sure that our argument will be valid.)

WHAT? : WHY?

Is there something that does not belong here?

- P1 If you drink and drive, you are driving under the influence of alcohol.
 - P2 Because alcohol decreases your motor functions, it holds that if you are driving under the influence of alcohol, your reaction time will be longer than normal.
 - P3 If your reaction time is longer than normal, you won't be able to react fast enough in dangerous situations.
 - P4 Under the influence of alcohol you are not able to react fast enough in dangerous situations, thus it will significantly raise the chance of an accident.
 - P5 Raising the chance of an accident causes significant raise of the chance of harm without any additional pleasure.
 - P6 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
 - P7 In Germany you can get to jail for driving under the influence of alcohol (§316 StGB).
-
- C1 If you drink and drive, then you are doing something wrong.



That's soundness reasoning.
Reasons to believe in a premise should not be part of the premise itself as this makes it only more complicated (especially the logical structure).

WHAT? : WHY?

Is there something that does not belong here?

- P1 If you drink and drive, you are driving under the influence of alcohol.
 - P2 If you are driving under the influence of alcohol, your reaction time will be longer than normal.
 - P3 If your reaction time is longer than normal, you won't be able to react fast enough in dangerous situations.
 - P4 Under the influence of alcohol you are not able to react fast enough in dangerous situations, thus it will significantly raise the chance of an accident.
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 - P6 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
 - P7 In Germany you can get to jail for driving under the influence of alcohol (§316 StGB).
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- C1 If you drink and drive, then you are doing something wrong.

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 - P2 If you are driving under the influence of alcohol, your reaction time will be longer than normal.
 - P3 If your reaction time is longer than normal, you won't be able to react fast enough in dangerous situations.
 - P4 Under the influence of alcohol you are not able to react fast enough in dangerous situations, **thus** it will significantly raise the chance of an accident.
 - P5 Raising the chance of an accident causes significant raise of the chance of harm without any additional pleasure.
 - P6 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
 - P7 In Germany you can get to jail for driving under the influence of alcohol (§316 StGB).
-
- C1 If you drink and drive, then you are doing something wrong.

- “Thus” and “therefore” are words to indicate the conclusion. So, they should not be part of a premise.
 - If it indicates soundness reasoning: throw it out along with the soundness reasoning
 - If it does not indicate soundness reasoning: you can instead use an “if”-construction most of the time

WHAT? WHY?

Is there something that does not belong here?

- P1 If you drink and drive, you are driving under the influence of alcohol.
 - P2 If you are driving under the influence of alcohol, your reaction time will be longer than normal.
 - P3 If your reaction time is longer than normal, you won't be able to react fast enough in dangerous situations.
 - P4 If you are not able to react fast enough in dangerous situations, you will significantly raise the chance of an accident.
 - P5 Raising the chance of an accident causes significant raise of the chance of harm without any additional pleasure.
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 - P7 In Germany you can get to jail for driving under the influence of alcohol (§316 StGB).
-
- C1 If you drink and drive, then you are doing something wrong.

- Remove this. A tabular form should not contain unnecessary premises. (And it is quite obvious that this premise turns out to be unnecessary.)
 - One reason for this is soundness: If this premise is false, the argument is not sound, even though the premise is not needed.

WHAT? WHY?

Is there something that does not belong here?

- P1 If you drink and drive, you are driving under the influence of alcohol.
 - P2 If you are driving under the influence of alcohol, your reaction time will be longer than normal.
 - P3 If your reaction time is longer than normal, you won't be able to react fast enough in dangerous situations.
 - P4 If you are not able to react fast enough in dangerous situations, you will significantly raise the chance of an accident.
 - P5 Raising the chance of an accident causes significant raise of the chance of harm without any additional pleasure.
 - P6 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
-
- C1 If you drink and drive, then you are doing something wrong.

WHAT? : WHY?

Is the number of premises reasonable and do they have an appropriate level of detail?

- P1 If you drink and drive, you are driving under the influence of alcohol.
- P2 If you are driving under the influence of alcohol, your reaction time will be longer than normal.
- P3 If your reaction time is longer than normal, you won't be able to react fast enough in dangerous situations.
- P4 If you are not able to react fast enough in dangerous situations, you will significantly raise the chance of an accident.
- P5 Raising the chance of an accident causes significant raise of the chance of harm without any additional pleasure.
- P6 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
-
- C1 If you drink and drive, then you are doing something wrong.



You do not want to have too many and too detailed premises:

- they make the argument harder to read and to understand
- the argument becomes more vulnerable to attacks (because you have more premises to deny)
- you are more likely to make a mistake along the way
- **Tip:** often you just can 'shrink them down' into one premise, making the old premises part of the soundness reasoning



But be careful! Sometimes, arguments are very complicated and actually need many premises. In this case go for an extended standard form.

WHAT? : WHY?

Is the number of premises reasonable?

- P1 If you drive under the influence of alcohol, then you significantly raise the chance of an accident.
 - P2 Raising the chance of an accident causes significant raise of the chance of harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
-
- C1 If you drink and drive, then you are doing something wrong.

WHAT? : WHY?

Can you make the logical structure clearer?

- P1 If you drive under the influence of alcohol, then you significantly raise the chance of an accident.
- P2 Raising the chance of an accident causes significant raise of the chance of harm without any additional pleasure.
- P3 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
-
- C1 If you drink and drive, then you are doing something wrong.

- Looking at the rest of our argument it makes sense to go for a conditional here (and actually this is what we mean with the sentence). So we should make that clear by using “if...then”.*
- In the tabular form you should always go for the clearest phrasing possible to make your argument easy to understand and less attackable

*Hint: If you are unsure about this, write down your argument in logical form and then reverse that process by first writing down the operators in natural language and afterwards replacing the variables, constants etc. with what they stand for

WHAT? : WHY?

Can you make the logical structure clearer?

- P1 If you drive under the influence of alcohol, then you significantly raise the chance of an accident.
 - P2 If you raise the chance of an accident, then you significantly raise the chance of harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
-
- C1 If you drink and drive, then you are doing something wrong.

WHAT? : WHY?

Are there terms appearing out of thin air?

- P1 If you **drive under the influence of alcohol**, then you significantly raise the chance of an accident.
- P2 If you raise the chance of an accident, then you significantly raise the chance of harm without any additional pleasure.
- P3 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
-
- C1 If you **drink and drive**, then you are doing something wrong.

→ Both expressions mean the same, nevertheless we should use the same in both places as we want to achieve maximal clarity. (Plus someone who denies that both mean the same has no possibility to attack anymore.)

- Note: Sometimes you cannot do that without making your argument sound very trivial. In this case your argument is either actually trivial or you are not only going for logical validity, but also for analytical validity.

WHAT? : WHY?

Are there terms appearing out of thin air?

- P1 If you **drink and drive**, then you significantly raise the chance of an accident.
 - P2 If you raise the chance of an accident, then you significantly raise the chance of harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm, then you ought not to perform the action that leads to this significant rise.
-
- C1 If you **drink and drive**, then you are doing something wrong.

WHAT? : WHY?

Are there terms appearing out of thin air?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you raise the chance of an accident, then you significantly raise the chance of harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm, then **you ought not to perform the action that leads to this significant rise.**
-
- C1 If you drink and drive, then **you are doing something wrong.**

→ We mean both phrases to be equivalent as in the last step. But this is a more problematic case, as you could argue that one does – in fact – not even mean the same as the other. Also, both phrases have a very different logical structure. (And that's always a problem, as it messes with the argument's validity.) So we should decide for one of the two and stick to it.

WHAT? : WHY?

Are there terms appearing out of thin air?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you raise the chance of an accident, then you significantly raise the chance of harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm, then **you are doing something wrong**.
-
- C1 If you drink and drive, then **you are doing something wrong**.

WHAT? : WHY?

Are you losing terms on the way?

- P1 If you drink and drive, then you **significantly** raise the chance of an accident.
 - P2 If you raise the chance of an accident, then you significantly raise the chance of harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

→ It sometimes can be ok to leave away terms on the way, but this should then be *very well* thought through. Losing terms on the way usually messes with validity.

WHAT? : WHY?

Are you losing terms on the way?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

WHAT? : WHY?

Are you losing terms on the way?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of harm **without any additional pleasure.**
 - P3 If you significantly raise the chance of causing harm, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

→ Same reason as before: this messes with validity, and even if we somehow reconstruct the argument in a way that we maintain validity, it won't be sound in this case, because P3 as it is right now is false.

WHAT? : WHY?

Are you losing terms on the way?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of harm **without any additional pleasure**.
 - P3 If you significantly raise the chance of causing harm **without any additional pleasure**, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

WHAT? : WHY?

We left something for you: What's still not good about this argument?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm without any additional pleasure, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

WHAT? : WHY?

We left something for you: What's still not good about this argument?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of **causing** harm without any additional pleasure.
 - P3 If you significantly raise the chance of **causing** harm without any additional pleasure, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

→ nothing should appear out of thin air

WHAT? : WHY?

Our final argument:

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of causing harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm without any additional pleasure, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

Let's check its soundness!

WHAT? : WHY?

Are there obviously false premises?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of causing harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm without any additional pleasure, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

Nope, there are no obviously false premises.

→ if there is an obviously false premise, you can spot it very easily, but checking for validity and checking the truth of premises in details costs a lot of time.

WHAT? : WHY?

Is the argument valid?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of causing harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm without any additional pleasure, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

→ The next easiest thing to check is the validity of your argument.

WHAT? : WHY?

Is the argument valid?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
- P2 If you significantly raise the chance of an accident, then you significantly raise the chance of causing harm without any additional pleasure.
- P3 If you significantly raise the chance of causing harm without any additional pleasure, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

P1 $a \rightarrow b$

P2 $b \rightarrow c$

P3 $c \rightarrow d$

C1 $a \rightarrow d$

Yes, it's valid!

WHAT? : WHY?

Are all premises true?

- P1 If you drink and drive, then you significantly raise the chance of an accident.
 - P2 If you significantly raise the chance of an accident, then you significantly raise the chance of causing harm without any additional pleasure.
 - P3 If you significantly raise the chance of causing harm without any additional pleasure, then you are doing something wrong.
-
- C1 If you drink and drive, then you are doing something wrong.

Prima facie yes, but we will not analyse this in more detail here. If you are convinced that they are true, then start with your soundness reasoning.

→ The hardest and most complicated part of the soundness check is to evaluate the truth of the premises. For this we usually have little formal tools that can help us out.

WHAT? : WHY?

