eColloq on Argumentation

Got Content, Won't Travel

Program 11th / 19 May 2014 (4-6 pm CET, Stockholm Berlin, Rome)

http://ecolloq.wordpress.com

A Clear Logical Argument Guaranteed:

Defeasible Class-Inclusion Transitivity (DCIT)

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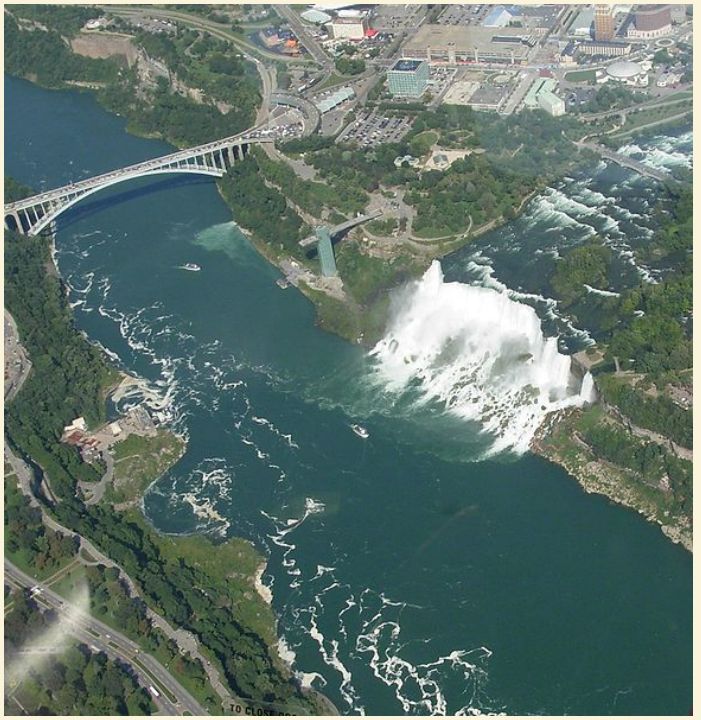
This eColloq presentation is a whirlwind 45 minute fly-over tour of some of the places of reasoning that I visited and the logic-bridges that I constructed in my search for a more effective approach to teaching practical argumentation.

We won't be stopping at any one location for you to stretch your legs and walk around to get comfortable by necessarily fully understanding everything you see. But, at least you don't have to take pictures, because these slides are posted at eColloq.

So please just strap in and enjoy the ride!



Rainbow Bridge joining the Canadian and American sides / Photographs by: SatuSuro...commons.wikimedia.org

Susan Stuart & Ruth Vance, *Bringing a Knife to the Gunfight: The Academically Underprepared Law Student & Legal Education Reform*, Valparaiso Law Faculty Publications (2013), http://scholar.valpo.edu/law_fac_pubs/116/.

> "Specific behaviors arising from these cognitive processes have been described as 'case analysis, synthesis, deduction, induction, and analogical reasoning' as well as "spotting and applying rules, recognizing corollaries, spotting holdings... and recognizing legal syllogisms."

"Lawyers must develop higher-order thinking skills for a particular professional subset of analysis...Specific behaviors arising from these cognitive processes have been described as 'case analysis, synthesis, deduction, induction, and analogical reasoning' as well as 'spotting and applying rules, recognizing corollaries, spotting holdings...and recognizing legal syllogisms.' In its most theoretical sense, thinking like a lawyer **forces students to 'domesticate doubt' and offers pragmatic strategies to do so: the recurring use of questions, a structured approach to reasoning,** a phase shift in the nature of knowledge, conventions of legal literacy, an abstracted legal world, and superficial exposure to lawyers' roles and professional norms."

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Herring, D. Lynch, C. (2012). Teaching Skills of Legal Analysis: Does the Emperor Have Any Clothes? In Gerdy, K. (ed). *Legal Writing: The Journal of the Legal Writing Institute*. Volume 18. (in press)

> "This finding is consistent with prior studies that have found a lack of significant learning gains in terms of law student reading and reasoning skills."

"In terms of performance for the [Herring/Lynch] study population as a whole, there were statistically significant raw learning gains. However, there were no statistically significant normalized learning gains. Overall, there was no significant positive movement in the development of reasoning skills once the students' post-test performance was examined relative to how much they could potentially improve based on their benchmark pre-test scores. Thus, while some students appeared to gain from their classroom experiences, these gains were not evenly or widely shared by the group as a whole. This finding is consistent with prior studies that have found a lack of significant learning gains in terms of law student reading and reasoning skills."

Susan Stuart & Ruth Vance, *Bringing a Knife to the Gunfight: The Academically Underprepared Law Student & Legal Education Reform*, Valparaiso Law Faculty Publications (2013), http://scholar.valpo.edu/law_fac_pubs/116/.

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"Today, more students enter the legal academy without even rudimentary problem-solving skills. Indeed, emerging empirical evidence reveals that fewer students possess the basic higher-order cognitive processes that the academy has assumed are the threshold educational achievement for success in law school. Without those threshold skills, an increasing number of students are unable to cope with the academic regimen in law school, which for years has presupposed their presence. Consequently, the critiques of both *Best Practices* and the Carnegie Report reflect the profession's disappointment with the legal academy's output, not because we don't understand our task but because we don't understand the enormity of our task."

Defeasible Class-Inclusion Transitivity (DCIT): An Empirical Theory of Logical Inference

"My search for a more effective approach to teaching and learning practical argumentation was fueled by my frustration from witnessing the struggles of many of my law students and expert-witness trainees in applying their argumentation skills with complex real-world examples."

My search for a more effective approach to teaching practical argumentation was fueled by my frustration from witnessing the struggles of many of my law students and expert-witness trainees in applying their argumentation skills with complex real-world examples.

My search began in earnest when one class asked me during the fifth week of a ten week training to provide a more functional explanation of the fundamental difference between a data and a warrant (e.g., premise and co-premise); how to separate premises between a linked and a convergent line of reasoning, and how to prove relevancy. I found my own explanations based on accepted theory and pedagogy vague and unsatisfactory to really help them meet the real-world demands of succeeding with inferences in court.

van Eemeren, 'Argumentation: an overview of theoretical approaches and research themes', *Argumentation, Interpretation, Rhetoric* (online journal) , issue 2 (2002).

"Toulmin's definitions, which combine functional and formal differences, are such that data and warrants are in practice difficult to distinguish."

"A variety of serious theoretical objections have been raised against Toulmin's views of argumentation and his model. In addition, in concrete cases the model very often appears hard to apply. Toulmin's definitions, which combine functional and formal differences, are such that data and warrants are in practice difficult to distinguish. The distinction between the two is only really clear in carefully selected examples. And without this distinction the model is in fact nothing more than a newly-clad reasoning scheme from classical antiquity, the 'epicheireme'. All the same the model and the connected idea of field-dependent norms of rationality are still extremely popular."

Twardy, Charles. "Argument maps improve critical thinking." *Teaching Philosophy* 27.2 (2004): 95-116.

> "[D]o two claims form part of a single reason, or are they parts of separate reasons? Even very bright students get it wrong surprisingly often."

"As we have already seen, argument maps force us to make a distinction we normally would not even consider: do two claims form part of a single reason, or are they parts of separate reasons? Even very bright students get it wrong surprisingly often.

Early in the semester the mistake is entirely expected: students have to learn the convention that separate branches should be full, independent reasons for believing the conclusion. However, although students do get much better at this, it continues to be a problem."

Defeasible Class-Inclusion Transitivity (DCIT): An Empirical Theory of Logical Inference

> "I started my search by analyzing hundreds of my argument maps used for court and eventually saw a predictable pattern.
>
> The identical underlying natural language logical pattern or form was always present or implied. Eureka."

I put the expert-witness argumentation training on hold and told the trainees that we would start the class over if and when I found a more straightforward and effective path to understanding argumentation.

I started my search by analyzing hundreds of my argument maps used for court and eventually saw a predictable pattern. The identical underlying natural language logical pattern or form was always present or implied. Eureka!

Defeasible Class-Inclusion Transitivity (DCIT)

LOGICAL SYNTAX

- Predication is conceptualized as solely the relationship of "belongs to the class of."
- The logical syntax of a regimented sentence is based on a binary analysis consisting of the grammarian Subject (phrase) and the Predicate (phrase) as terms. There is no analytic recognition of a copula as a third expression.
- The Predicate (phrase) begins with a verb but is homogenous with the Subject placement with the addition of the universal quantifier: "Any (All,One) such [like the Subject] who (that)."
- Only the quantifier "Any (All,One) such [like the Subject] who (that)" is given logical import. So, for example, "some" and "none" have no logical import.
- There is no analytic distinction made between the "is" of identity and the "is" of predication.
- The strength of a line of reasoning relies on the amount of subjectively assessed "acceptability" that can transit from its first to its last linked-premise.
- Issues like proto-typicality of categorical membership and scope of domain are reflected in the "**such** [like the Subject]" words in the universal quantifier.
- Inference proceeds through defeasible class-inclusion transitivity.

Phillips S, Wilson WH, Halford GS (2009) What do Transitive Inference and Class Inclusion have in common? Categorical (co)products and cognitive development. PLoS Comput Biol 5: e1000599.

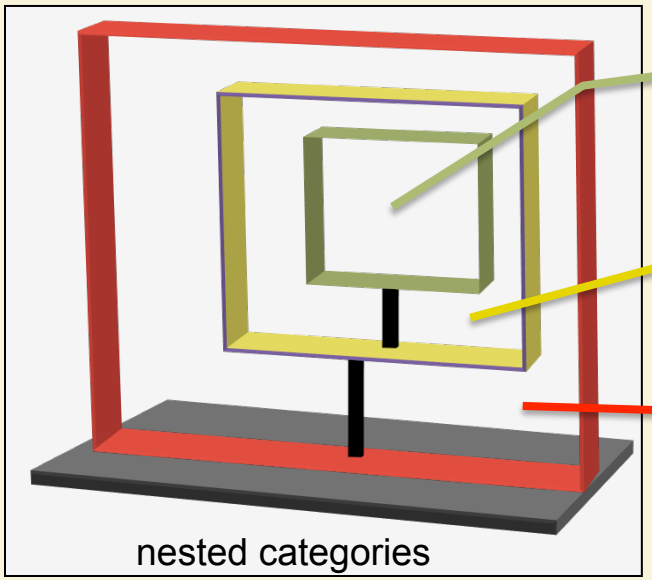
Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

"

Children acquire various reasoning skills over remarkably similar periods of development. Transitive Inference and Class Inclusion are two behaviours among a suite of inferential abilities that have strikingly similar developmental profiles—all are acquired around the age of five years.

INFERENTIALLY LINKED PREMISES			Supporting Assumptions (necessary and ancillary)
1	**The canary...**	...is yellow.	*N/A*
2	One [like the subject] that... [REPEAT PREVIOUS PREDICATE]	**...is a color.**	*N/A*
Therefore,	CONCLUSION		
	The canary...	**...is a color.**	



nested categories

The canary **A**

is yellow. **B**

is a color. **C**

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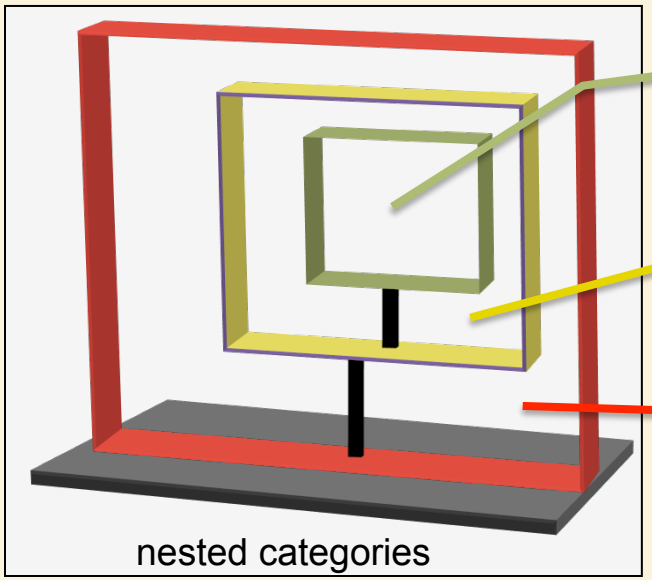
INFERENTIALLY LINKED PREMISES			Supporting Assumptions (necessary and ancillary)
1	The canary...	...is yellow.	N/A
2	Yellow...	...is a color.	N/A
Therefore,	CONCLUSION		
	The canary...	...is a color.	



nested categories

The canary **A**

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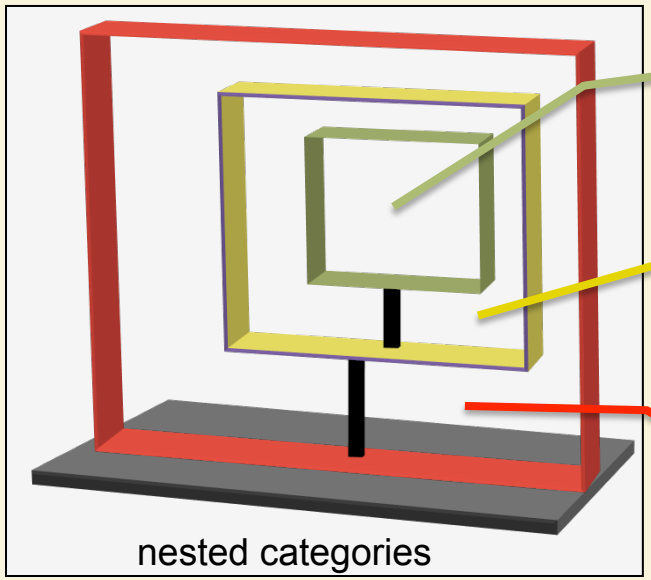


The President **A**

has a valid Hawaiian birth certificate **B**

was born in Hawaii **C**

SUBJECT COLUMN	PREDICATE COLUMN
1 The President...	... . has a valid Hawaiian birth certificate.
2 Any (all/one) who (that) [PREVIOUS PREDICATE]	...was born in Hawaii.
Therefore, **CONCLUSION**	
The President...	...was born in Hawaii.

The process by which the Logic-bridge line of reasoning justifies the conclusion (mode of inference) is called Defeasible Class-Inclusion Transitivity (DCIT dee•kit).

A belongs to (fits within) category **B**.

B belongs to (fits within) category **C**.

Therefore (through DCIT)...

A belongs to (fits within) category **C**.

Walton, Douglas. *Informal Logic*, 20.2 (2000) *reaching Supplement* #2: pp. TS 35 - TS 38.

> "What they seem to need are simple mechanical procedures that they can apply without being stressed by borderline cases, or any doubts at all about what the "right" answer is."

As for the pedagogical problem posed by the Intro. course, I wish I could say that I had a method or technique that has proved successful. But I do not and from what I can see, especially by looking at the abundance of textbooks on critical thinking, I don't think anyone else has solved this problem either. Most of these students do not do well with the case study method. What they seem to need are simple mechanical procedures that they can apply without being stressed by borderline cases, or any doubts at all about what the "right" answer is.

Bianchini, F. (2013). The Central Role of Analogy in Cognitive Science. Interview to E. Sander. Methode-Analytic Perspectives, 2(2), 21-26.

> "Educators...would try to expose pupils to situations in which some very concrete, obvious aspect embodied some abstract scientific idea."

"Among other subjects, your research deals with the depth and the superficiality of knowledge and representation. How could your ideas help us to understand the process of abstraction, and what do you see as possible future directions for this kind of research?

If educators took this idea seriously, they would try to expose pupils to situations in which some very concrete, obvious aspect embodied some abstract scientific idea; such situations would be extremely useful for introducing new concepts. After that, extra work could be done to help students understand how to distinguish between the surface and the deeper structure – that is, how to find the same abstract essence in situations that do not share the same surface."

Mahon BZ, Caramazza A. A critical look at the embodied cognition hypothesis and a new proposal for grounding conceptual content. J Physiol Paris. 2008;102(1–3):59–70.

> "The activation of specific sensory and motor representations complements the generality and flexibility of 'abstract' and 'symbolic' conceptual representations."

"In contrast, according to 'grounding by interaction', the instantiation of a concept includes the retrieval of specific sensory and motor information. Within the 'grounding by interaction' framework, 'removing' the sensory and motor systems (as in brain damage) would result in impoverished or 'isolated' concepts. Sensory and motor information on that view, contributes to the 'full' representation of a concept. The activation of sensory and motor processes during conceptual processing is not necessarily 'ancillary to' or 'inconsequential for' conceptual processing. The activation of specific sensory and motor representations complements the generality and flexibility of 'abstract' and 'symbolic' conceptual representations."

Walton, Douglas (2004). Classification of Fallacies of Relevance. *Informal Logic* 24 (1).

The degree to which a reasonable audience accepts your conclusion (e.g., contention, claim, or thesis) as true—such as beyond a reasonable doubt—largely depends on the audience's subjective opinion of the strength (e.g., goodness, quality, or probative weight) of the reasoning that leads to that conclusion.

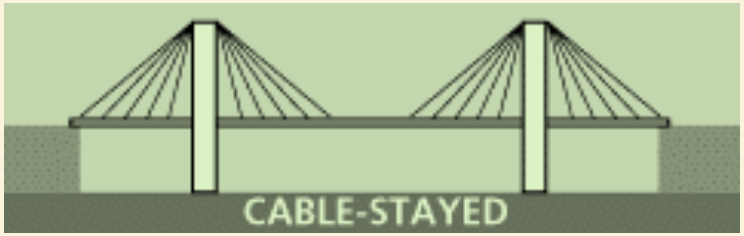
That individually judged reasoning strength, **like the strength of a bridge**, depends on two primary characteristics:

> "(1) the probative weight [bearing capacity] of the premises; and,
>
> (2) the probative weight [bearing capacity] (structural strength) of the argument from the premises to the conclusion."

The logic of reasoning depends on the underlying structural form of its sentences (premises and conclusion).

To guarantee that an argument is logical, the meaning of the sentences (**premises**) that together form the line of reasoning and that of the **conclusion** being asserted (contention, claim, or thesis) must be capable of being expressed in words that can combine together in **a defined logical structure**, form, or pattern that permits the transit of "acceptability."

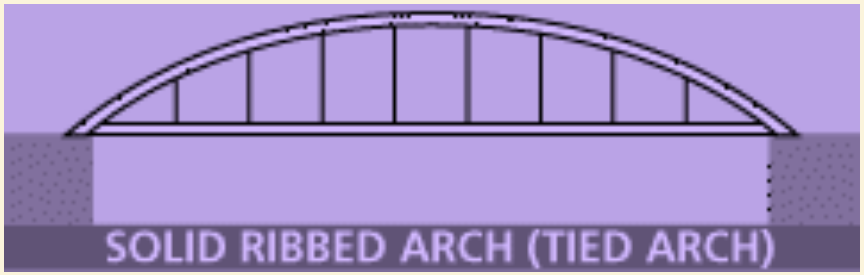
And just like for any bridge that holds together, there are different strictly defined structurally correct designs necessary for certain types of arguments to be logical. Fortunately, there is one form that accommodates any type of argument.

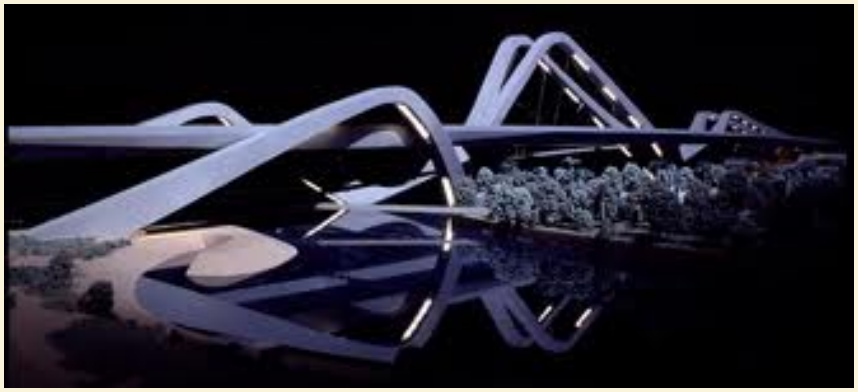


The underlying structure of a good line of reasoning may not always be readily apparent.

Just as the necessary structurally correct design of a sound bridge may not always be readily apparent on the surface, the underlying logical structure of a good line of reasoning may not always be readily apparent in the arrangement of its presented sentences and words.

So it is critical that the logic of the argument be self-evident to be accepted.





Infinity Loop Bridge, Zhuhai, China

Infinity Loop Bridge, Zhuhai, China

Forming a DCIT Logic-bridge

1. CATEGORICAL FORM: Individual inferential premises are regimented into a categorical form of grammarian Subject (phrase) and Predicate (phrase).

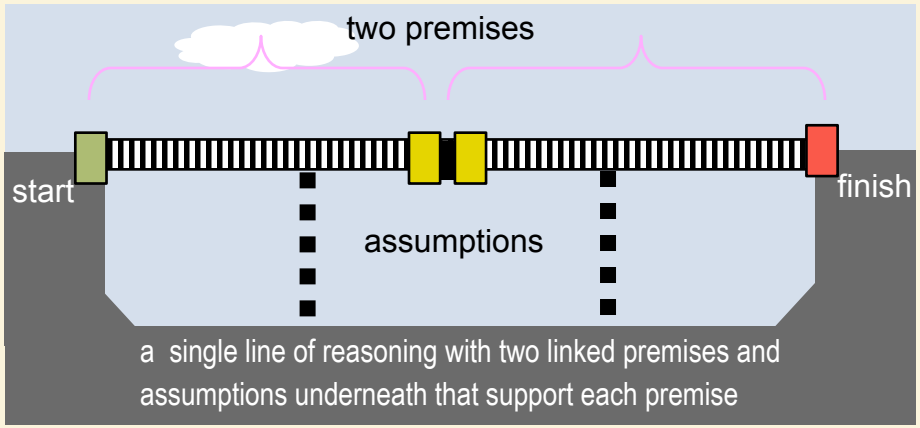
2. START: The Subject (phrase) of the first premise must be the Subject (phrase) of the main conclusion.

3. FINISH: The Predicate (phrase) of the last premise in the line of reasoning must be the Predicate (phrase) of the main conclusion.

4. LINKAGE: The remaining Predicate (phrases) of each inferential premise must be the Subject (phrase) of the following premise prefaced by the universal quantifier creating a transitively-linked chain of premises in this distinct order. (i.e., One such [*like the First Subject*] who/that…; Any such [*like the First Subject*] who/that…; All such [*like the First Subject*] who/that…)

5. ASSUMPTIONS: For each linked premise, any associated non-linking assumptions that provide some degree of support (necessary or ancillary) to that linked premise are appropriately added.

*The formal name of this universal logical form is Defeasible Class-Inclusion Transitivity (DCIT, dee•kit).



There is an all-purpose structure, form, or template to make any logical argument—the Logic-bridge.* The design is user-friendly, rigorous, robust, and foolproof.

Any type of logical argument (e.g., deductive, inductive, abductive, or argument schemes) can be built using the identical Logic-bridge structure or template.

Metaphorically, it resembles a cantilever style bridge. Each horizontal *span* represents each of the two or more sentences (premises) that link together to form the logical line of reasoning that leads to the conclusion (finish).

And the vertical *piers* beneath each *span* represent the supporting assumptions for each linked premise in the line of reasoning.

The Five Steps of DCIT

1. CATEGORICAL FORM: Individual inferential premises are regimented into a categorical form of grammarian Subject (phrase) and Predicate (phrase).

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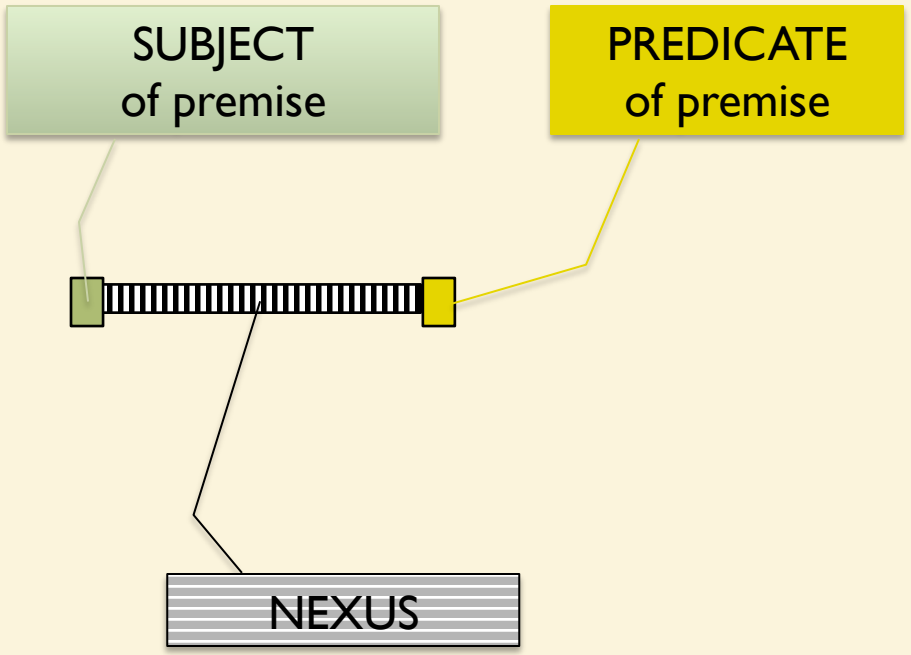
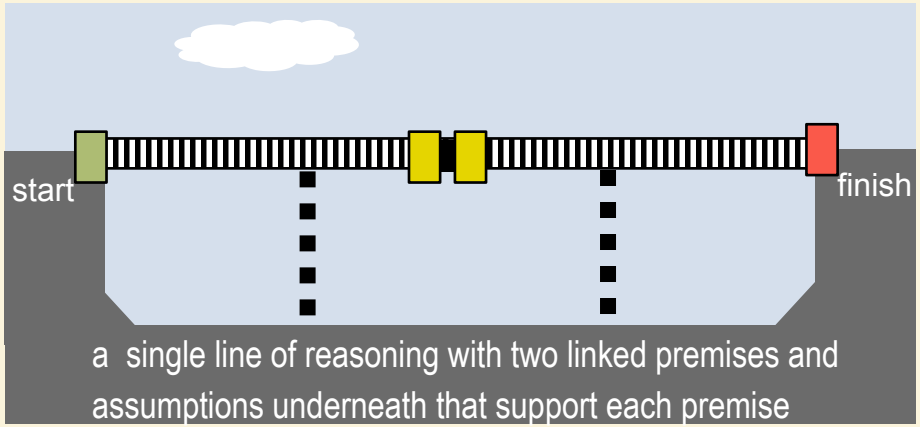
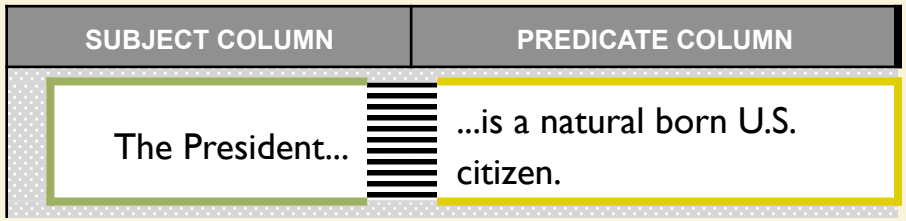
* Any sentence can be structured in this categorical form.

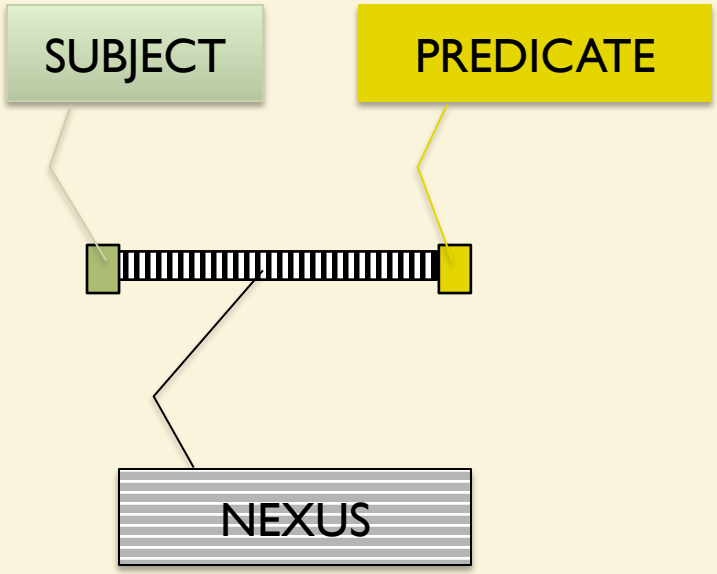


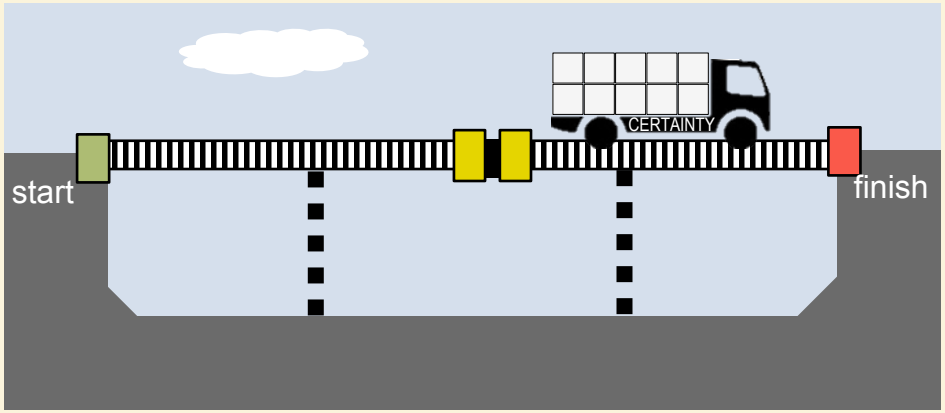
Each sentence (premise) of the Logic-bridge line of reasoning consists of three parts:*

1. SUBJECT [phrase] of the premise (starting colored end-cap of the span);
2. PREDICATE [phrase] of the same premise (ending colored cap of the span); and,
3. NEXUS of Predication that joins them









The NEXUS *span* between the SUBJECT and PREDICATE end-caps represents the relationship (i.e., single direction categorical) between the two parts of the premise.

The strength of that relationship represents an individual's subjective perception of the amount (load) of certainty (e.g., believability, acceptability, or likelihood) of the truth of that premise that it can support.

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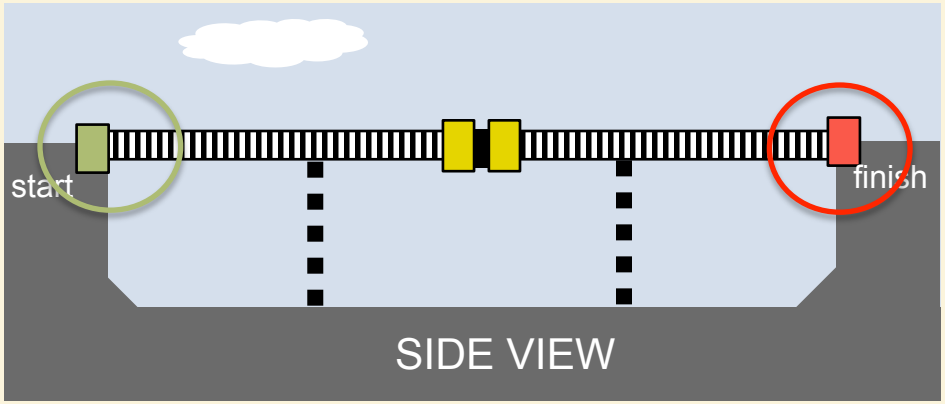
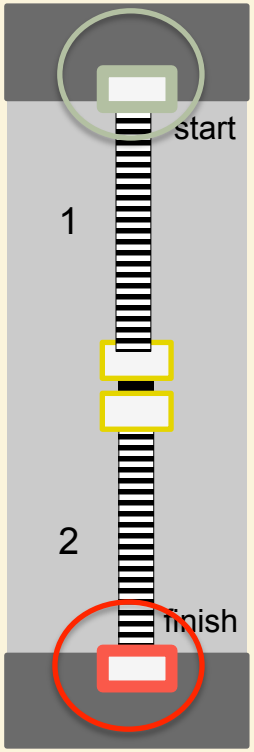
5. ASSUMPTIONS: For each linked premise, any associated non-linking assumptions that provide some degree of support (necessary or ancillary) to that linked premise are appropriately added.

The SUBJECT [phrase] and PREDICATE [phrase] of the CONCLUSION bound the ends of the line of reasoning.



The Logic-bridge requires that the SUBJECT (phrase) of the first premise and the PREDICATE (phrase) of the last premise in the line of reasoning form the CONCLUSION (claim or thesis).



SUBJECT COLUMN	PREDICATE COLUMN
1 The President...	...has a valid Hawaiian birth certificate.
2 One [such] who ...has a valid Hawaiian birth certificate...	...was born in Hawaii.
Therefore, CONCLUSION	
The President...	...was born in Hawaii.

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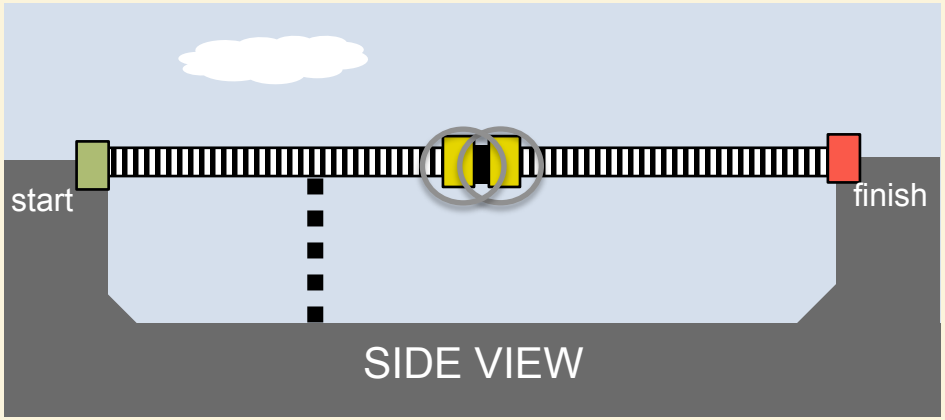
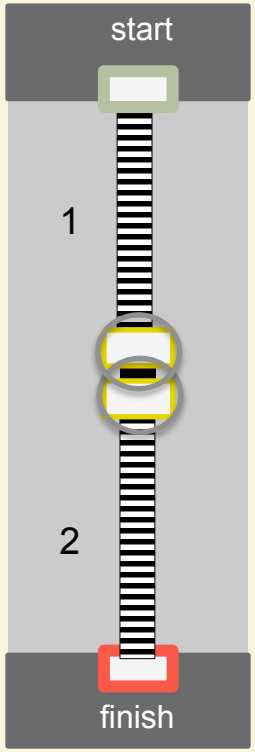
5. ASSUMPTIONS: For each linked premise, any associated non-linking assumptions that provide some degree of support (necessary or ancillary) to that linked premise are appropriately added.

* The word "such" means "like the original subject." While technically needed, in practice it can be dropped.



The premises of the Logic-bridge are arranged by linking each other back to front in order.

This linkage is created by the PREDICATE (phrase) of one premise matching the SUBJECT (phrase) of the next premise in the line of reasoning plus the added Universal [e.g., Any / All / One (such)...who / that*...].



SUBJECT COLUMN	PREDICATE COLUMN
1 The President...	... . has a valid Hawaiian birth certificate.
2 One [such] who has a Hawaiian birth certificate...	...was born in Hawaii.
Therefore, CONCLUSION	
The President...	...was born in Hawaii.

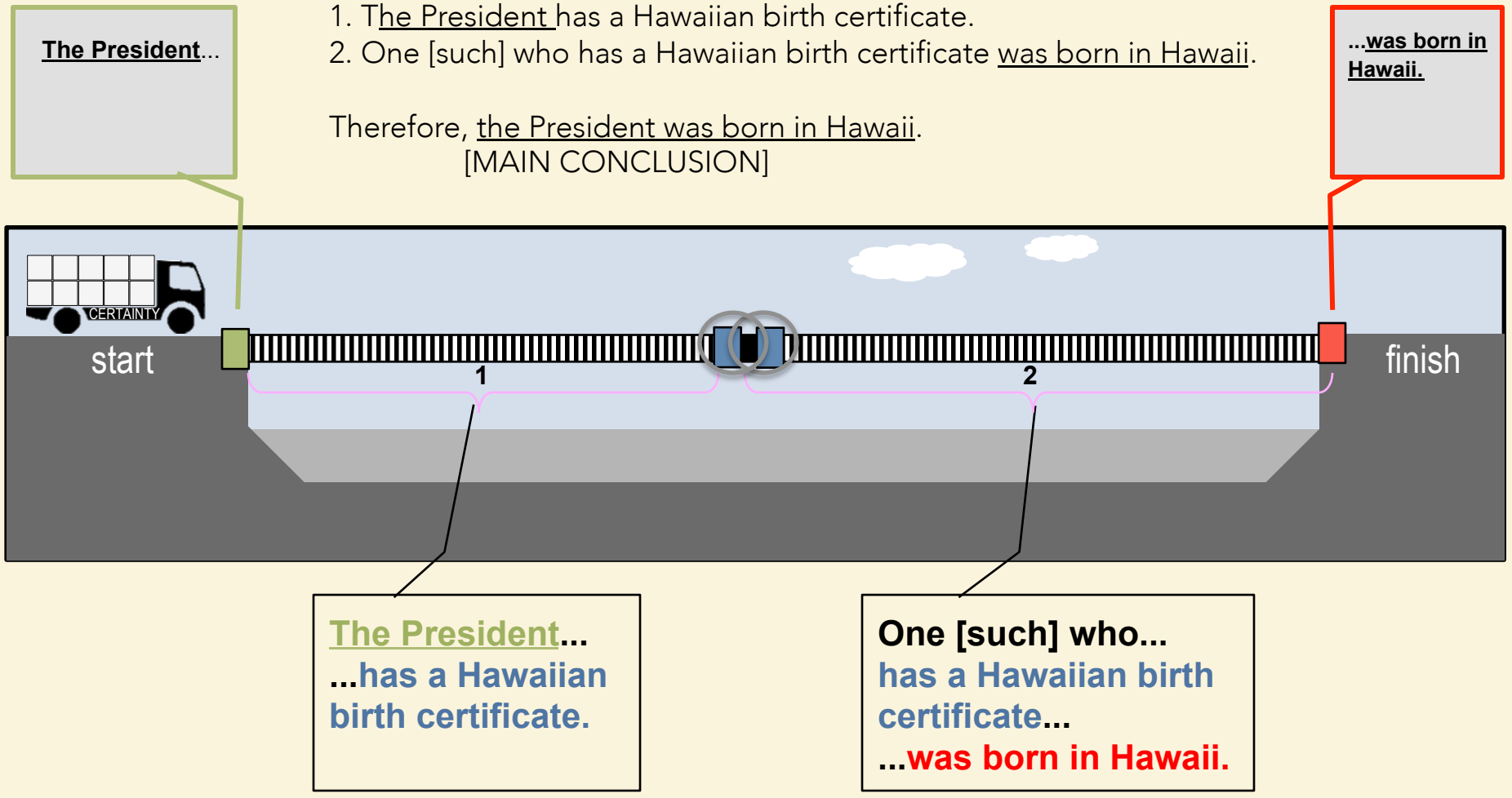
SUBJECT COLUMN	PREDICATE COLUMN
1 The President...	... . has a valid Hawaiian birth certificate.
2 Any (all/one) [such] who (that) [PREVIOUS PREDICATE]	...was born in Hawaii.
Therefore, CONCLUSION	
The President...	...was born in Hawaii.

MAIN CONCLUSION: The President was born in Hawaii.

STUDENT: My line of reasoning consists of two premises:

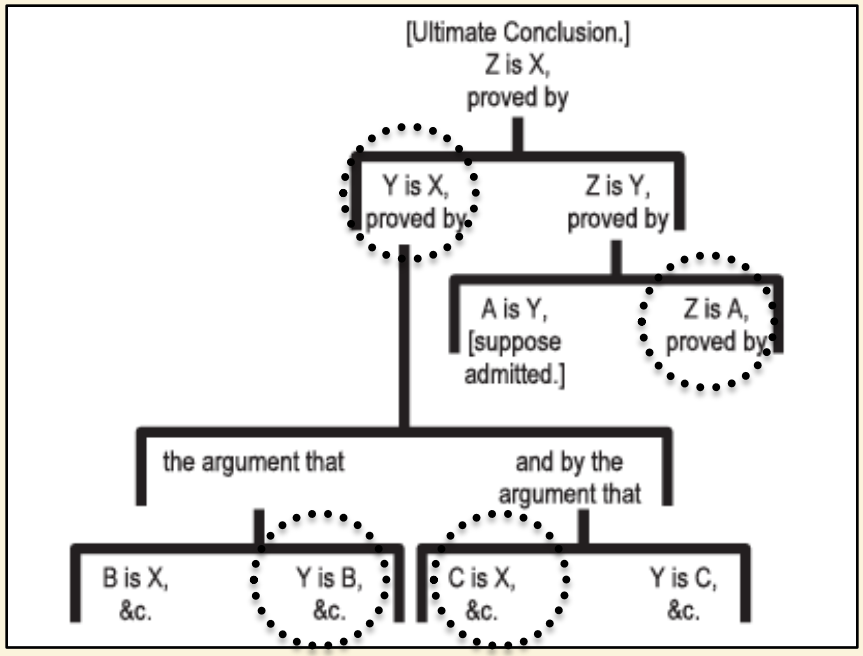
1. The President has a Hawaiian birth certificate.
2. One [such] who has a Hawaiian birth certificate was born in Hawaii.

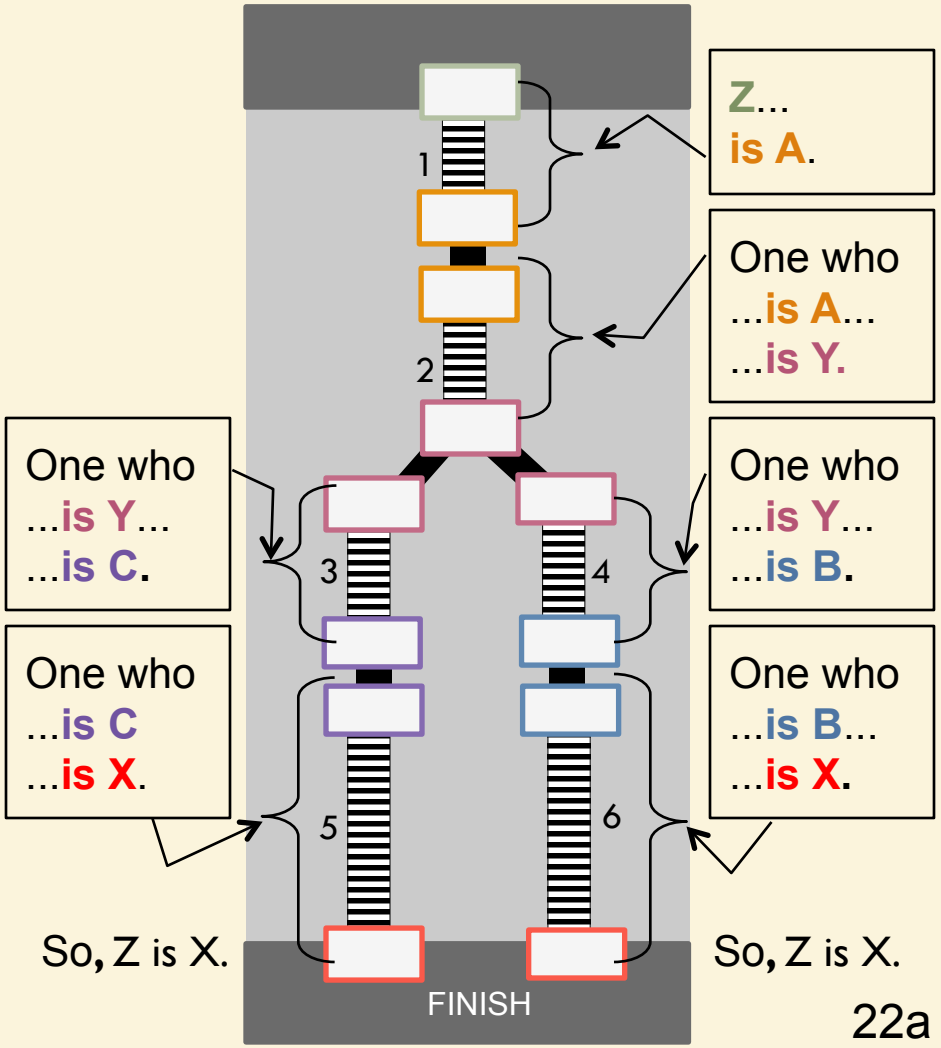
Therefore, the President was born in Hawaii.
[MAIN CONCLUSION]



Whately, Richard. (1836). Elements of Logic, New York, Jackson.

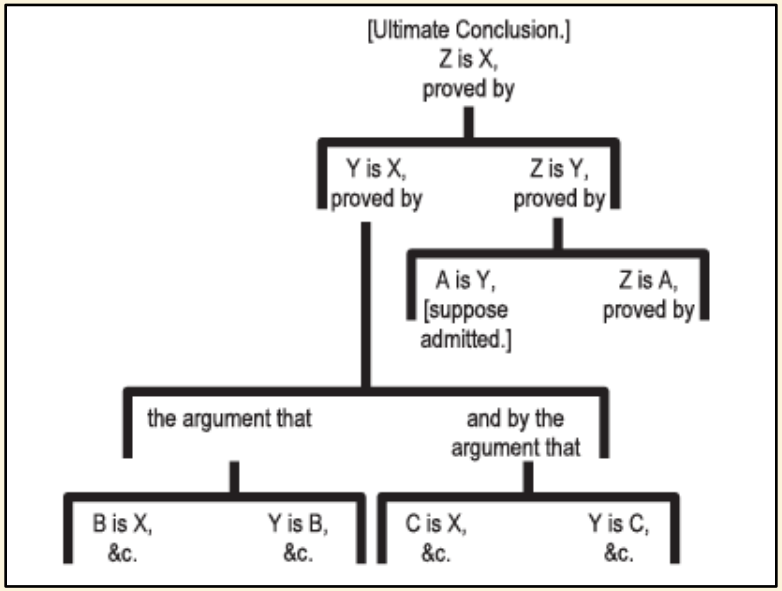
A Logic-bridge (LB) linear path makes clear the premise order in the line of inference as illustrated by the LB reconstruction of the Whately argument diagram.





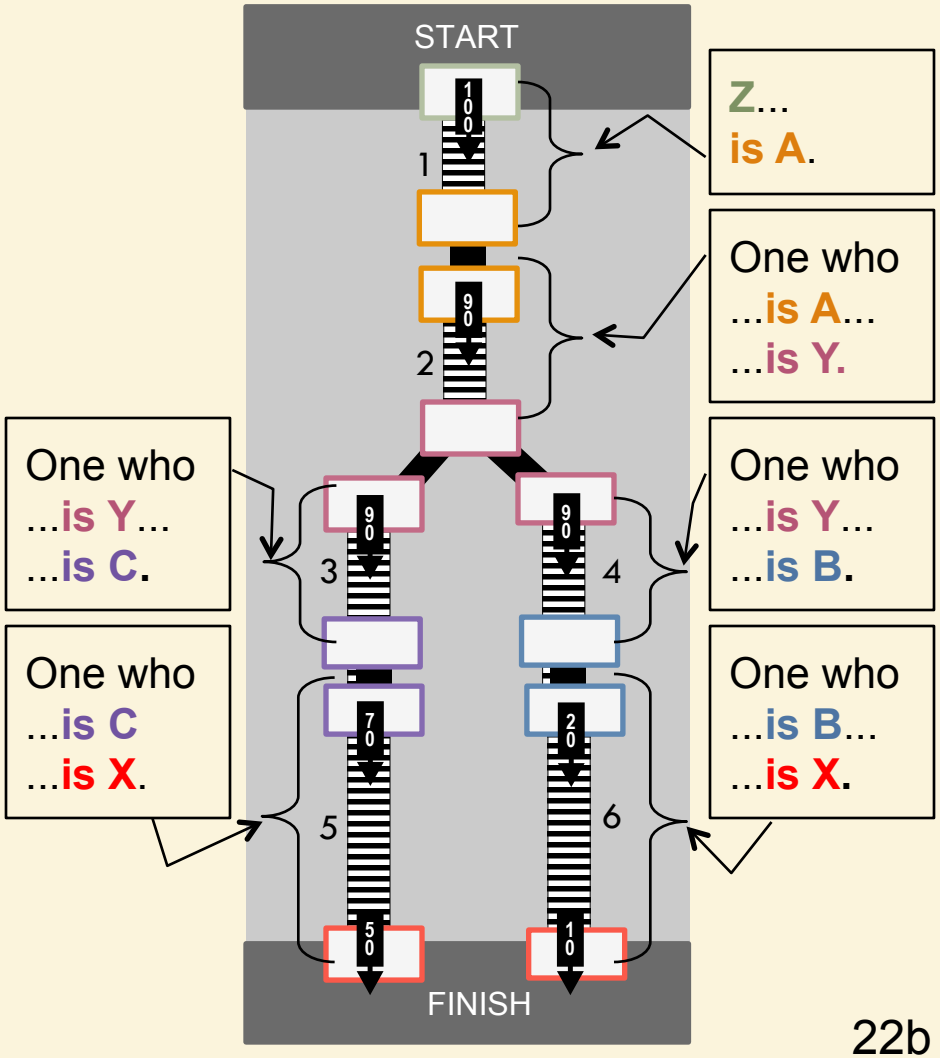
22a

Obscure Order of Premise Placement Problems

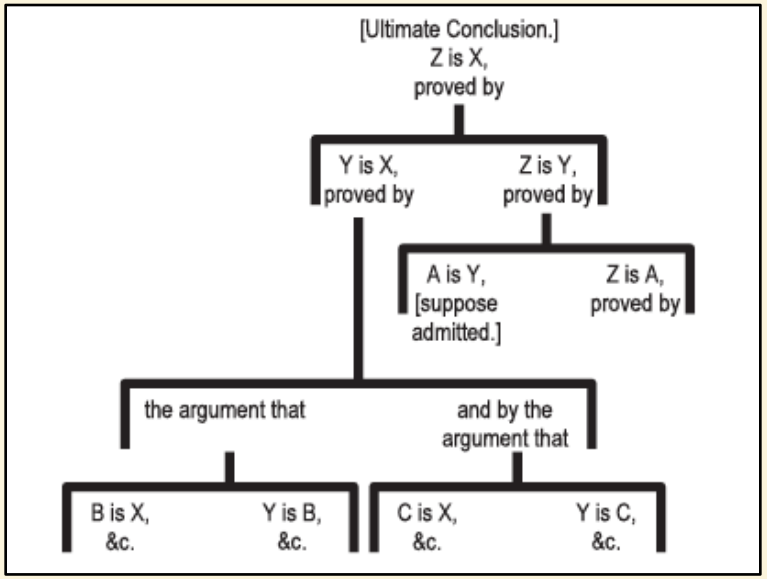


An assessment of probative force at the juncture of a premise within an inferential network is dependent on the level of probative force that reaches that premise through earlier links in the chain of evidence.

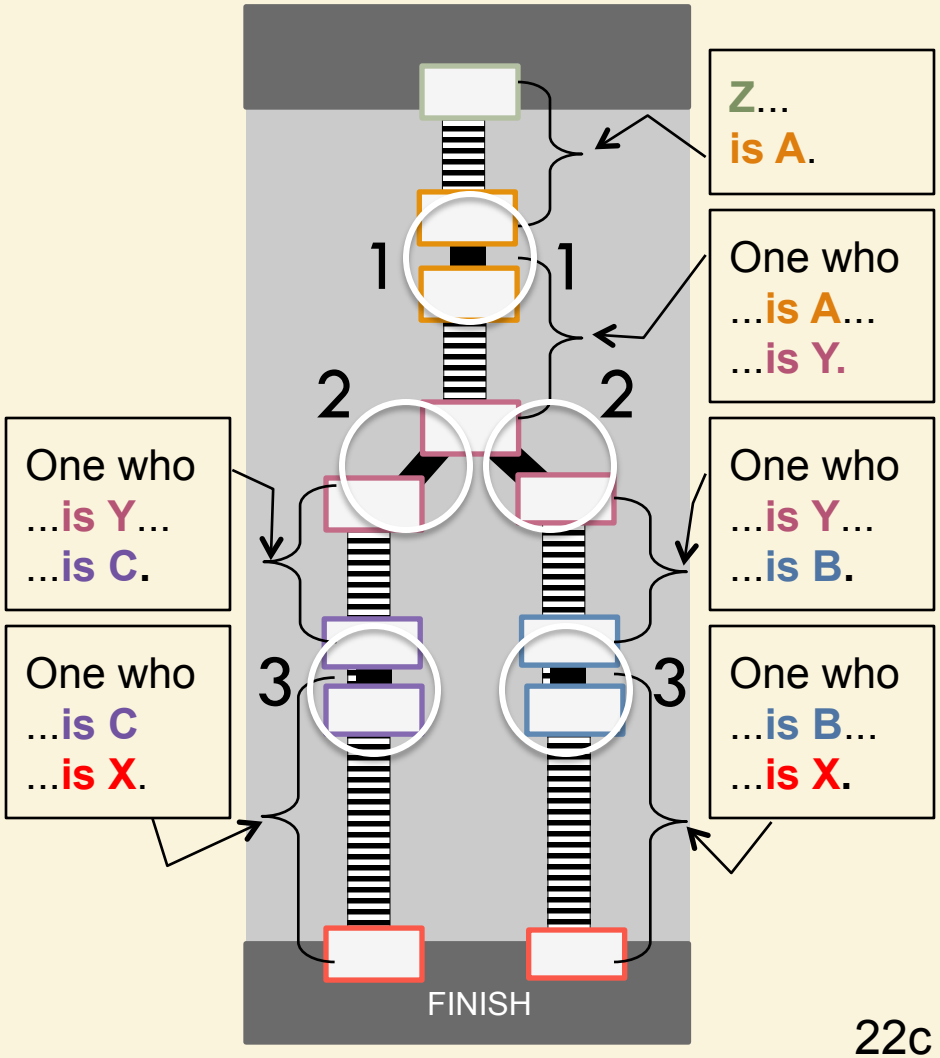
Without knowing the logical hierarchy of the linked premises, such evaluation of probative force is not possible.



Obscure Order of Premise Placement Problems



A tree-like argument structure does not always make it readily apparent the precise number of inference steps that are contained within the argument structure. In practice, this number can be an important factor in determining whether there is an insufficiency of evidence because of a stacking or piling inference upon inference.



22c

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	**The Gun-Free School Zone Act** …	…forbids knowingly possessing a firearm knowingly in a school zone.
2	Any such that…	...forbids knowingly possessing a firearm knowingly in a school zone...	…will reduce the number of firearms carried to school by students.
3	Any such that…	…will reduce the number of firearms carried to school by students...	…will reduce the amount of gun-related violence in schools.
4	Any such that…	…will reduce the amount of gun-related violence in schools...	…will reduce the number of dropouts and victims of gun-related violence who typically have suffered academically.
5	Any such that…	…will reduce the number of dropouts and victims of gun-related violence who typically have suffered academically...	…will improve the quality of education in schools.
6	Any such that…	…will improve the quality of education in schools...	…will improve the functional and technological literacy of students.
7	Any such that…	…will improve the functional and technological literacy of students...	…will improve the functional and technological literacy of workers.
8	Any such that…	…will improve the functional and technological literacy of workers...	…will improve the business competitiveness of employers in interstate and foreign commerce.
9	Any such that…	…will improve the business competitiveness of employers in interstate and foreign commerce...	…**falls within the scope of the Commerce Clause.**
CONCLUSION			
		The Gun-Free School Zone Act …	…**falls within the scope of the Commerce Clause.**
ASSUMPTIONS TO LINKED PREMISES			
#	NOT INDICATED		

TOO MANY PREMISE LINKAGES? *Lopez v. Gonzales*, 594 U.S. 47 (2006)

Phillips S, Wilson WH, Halford GS (2009) What do Transitive Inference and Class Inclusion have in common? Categorical (co)products and cognitive development. PLoS Comput Biol 5: e1000599.

Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

> Other evidence supported the conclusion that transitive inference was performed, not by logical reasoning, but by constructing a mental model comprising the ordered set of premise elements. **The inference could be made simply by inspecting this mental model, a process that Thayer and Collyer (1978) described as "almost perceptual" (p. 1338).**

Halford, G. S., & Andrews, G. (2004). The development of deductive reasoning: How important is complexity? Thinking and Reasoning, 10, 123–145.

Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

"[P]articipants performed the task by representing the elements as an ordered set, *a*, *b*, *c*, *d*, *e*, *(f)*.

Repeated presentation of the premises, often over hundreds of trials, also permits simplifying strategies. For example, ***a*** can be identified as an end element because it is always less, whereas ***e*** ***(f)*** can be identified as an end element because it is always more. **Once an end element is identified, the rest of the ordered set can be constructed by concatenation.** With *a* as an end element, and given $a < b$, we can form the string *a*, *b*, then with $b < c$ we can add *c*, yielding *a*, *b*, *c*, and so on.

The Five Steps of DCIT

1. CATEGORICAL FORM: Individual inferential premises are regimented into a categorical form of grammarian Subject (phrase) and Predicate (phrase).

2. START: The Subject (phrase) of the first premise must be the Subject (phrase) of the main conclusion.

3. FINISH: The Predicate (phrase) of the last premise in the line of reasoning must be the Predicate (phrase) of the main conclusion.

4. LINKAGE: The remaining Predicate (phrases) of each inferential premise must be the Subject (phrase) of the following premise prefaced by a universal quantifier creating a transitively-linked chain of premises in this distinct order. (e.g., One such [*like the First Subject*] who/that…; Any such [*like the First Subject*] who/that…; All such [*like the First Subject*] who/that…)

5. ASSUMPTIONS: For each linked premise, any associated non-linking assumptions that provide some degree of support (necessary or ancillary) to that linked premise are appropriately added.

* Bench-Capon, T., Prakken, H. and Sartor, G. (2009). Argumentation in legal reasoning. In Argumentation in artificial intelligence, ed. Iyad Rahwan and Guillermo R. Simari, 363-382. Dordrecht: Springer.

> "Every speech act thus implies a large set of associated beliefs that could be treated as standpoints."

"Every speech act thus implies a large set of associated beliefs that could be treated as standpoints. If that happens, they are termed virtual standpoints to emphasize that they are not put forward as standpoints, but only start functioning as such because they concern commitments of the speaker that have been problematized by the interlocutor and therefore require defense (van Eemeren, Grootendorst, Jacobs & Jackson, 1993, pp. 95–96)."

Schum, D.A. (1994). *The evidential foundations of probabilistic reasoning*. New York: Wiley.

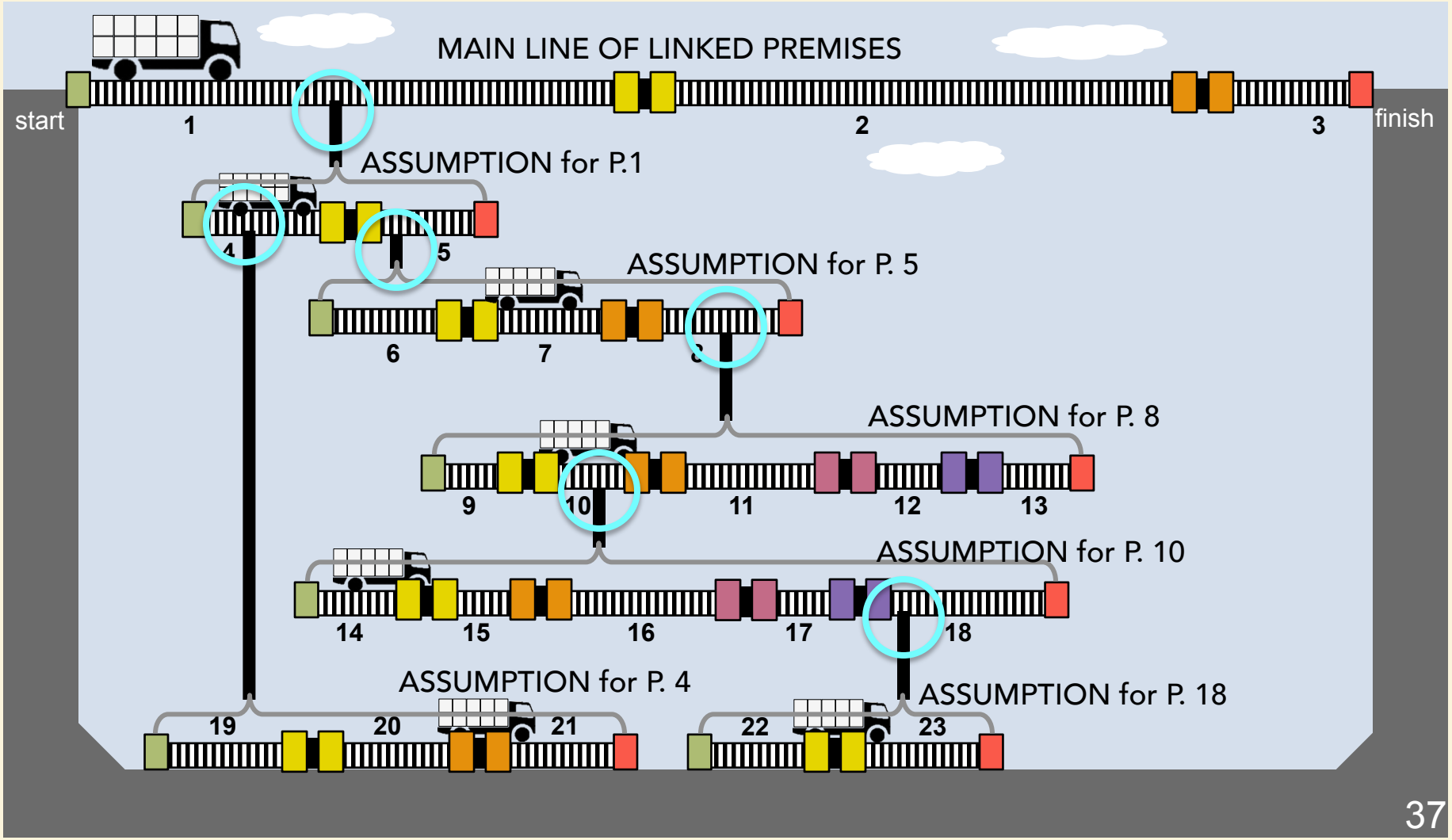
The concept of supporting assumptions aligns with Schum's 'ancillary evidence.' **They are hedges on the acceptability of generalizations. They address the question, Does this generalization hold in this particular instance?**

In charting inferential networks, Schum charts DCIT supporting assumptions **(his ancillary evidence) as arc-to-arc linkages rather than arcs connecting to nodes.**

"Recall that **the essential role of ancillary evidence [DCIT supporting assumptions] is to tell us how adequate are the generalizations we assert to license stages of reasoning** we identify based on evidence we believe is directly relevant on major hypotheses.

"I believe it is accurate to say that ancillary evidence and arguments from it are evocative in the sense that **they call us to assess probabilities associated with nodes on the 'main' portion [main line of linked premises] of an inference network or influence diagram.**"

Assumptions connect to inferentially linked premises at the nexus of predication influencing the probative weight bearing capacity of the inferentially linked premise.

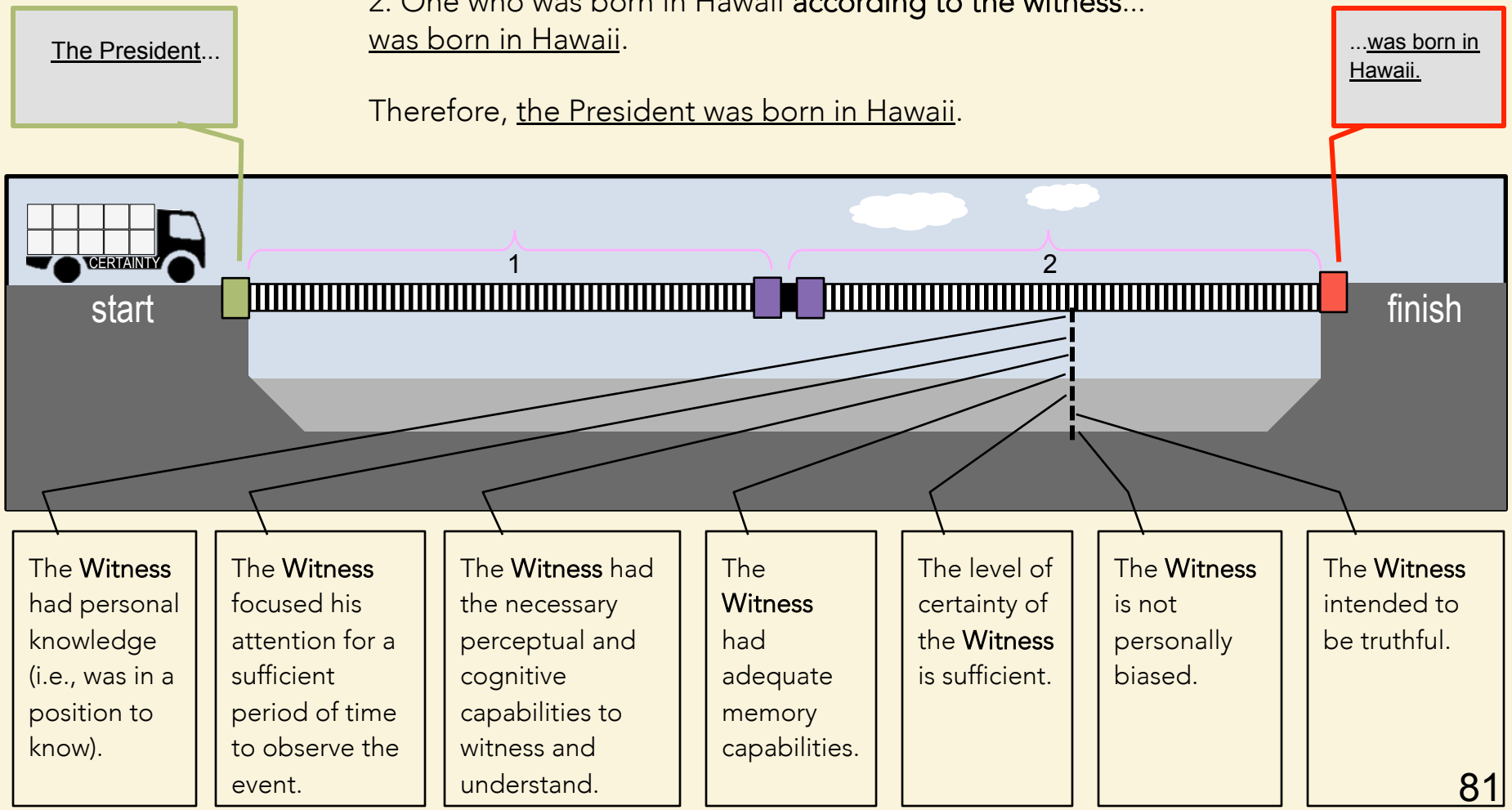


MAIN CONCLUSION: The President was born in Hawaii.

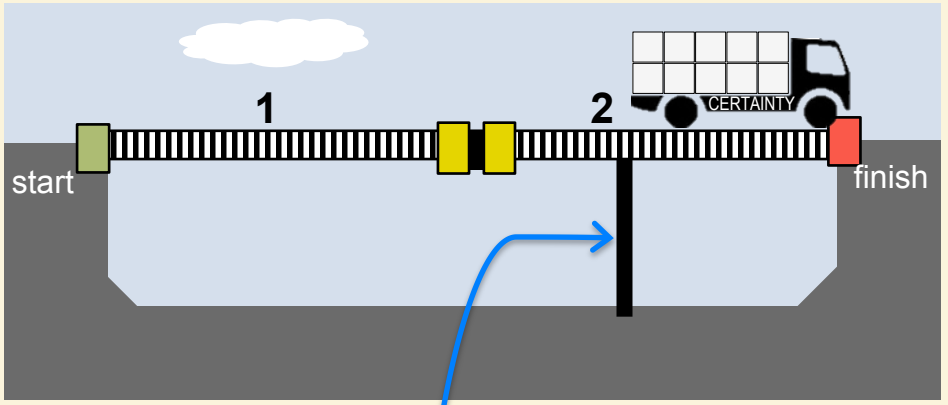
STUDENT: My line of reasoning consists of two premises:

1. The President...was born in Hawaii **according to the witness**.
2. One who was born in Hawaii **according to the witness**... was born in Hawaii.

Therefore, the President was born in Hawaii.



An ASSUMPTION provides **necessary** or **ancillary** support to the premise it supports. There can be many assumptions supporting a premise. And the subjective level of certainty of the truth of a premise can be impacted by the level of certainty of any of its assumptions.

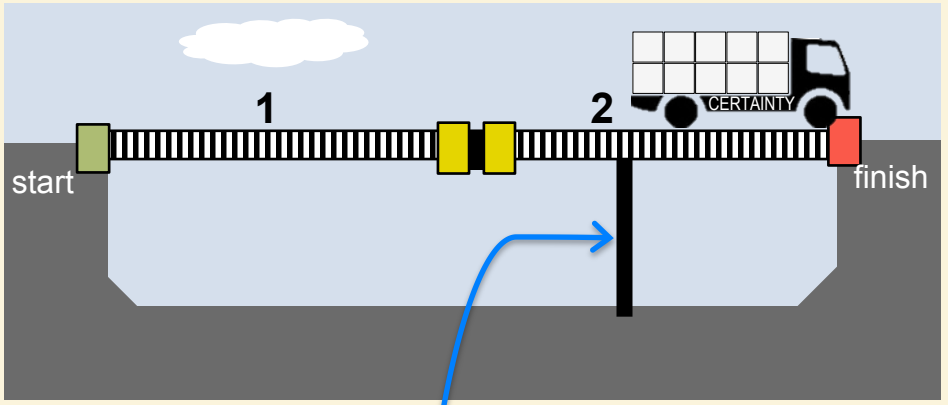


	SUBJECT COLUMN	PREDICATE COLUMN	Supporting Assumptions
1	The President...	... was born in Hawaii.	*[None stated.]*
2	Any (all/one) [such] who (that) [PREVIOUS PREDICATE]	...is a natural born U.S citizen.	*2a The person was born when Hawaii was a state or U.S. territory.* ***(necessary assumption)***
Therefore,	CONCLUSION		
	The President...	...is a natural born U.S citizen.	

Schum, D.A. (1994). *The evidential foundations of probabilistic reasoning*. New York: Wiley.

A necessary ASSUMPTION acts as an affirmative statement that the described particular exception to the linked premise does not exist.

The connection made to the linked premises is not matching predicates but rather Schum's arc-to-arc.



	SUBJECT COLUMN	PREDICATE COLUMN
1	The President...	... was born in Hawaii.
2	Any (all/one) [such] who (that) [PREVIOUS PREDICATE]	...is a natural born U.S citizen.
Therefore,	CONCLUSION	
	The President...	...is a natural born U.S citizen.

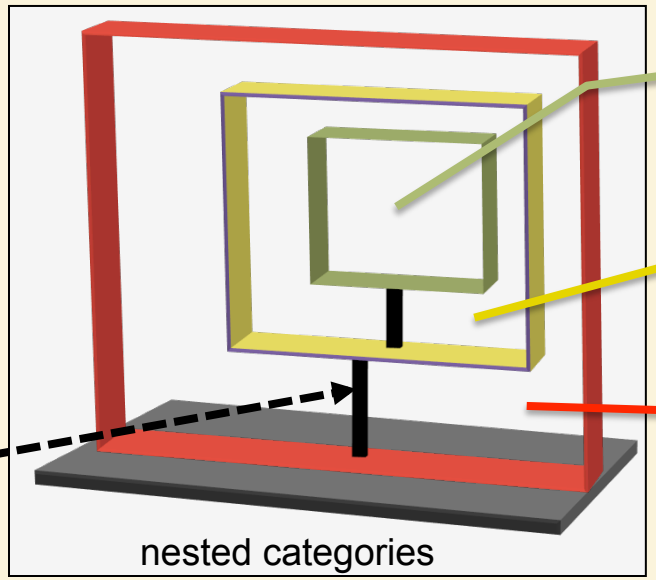
Supporting Assumptions

[None stated.]

2a The person was born when Hawaii was a state or U.S. territory. ***(necessary assumption)***

John L. Pollock, Cognitive Carpentry, Cambridge, Mass., The MIT Press, 1995.

INFERENTIALLY LINKED PREMISES			Supporting Assumptions (necessary and ancillary)
1	**This object...**	...looks red to me.	
2	One [like the subject] that... [REPEAT PREVIOUS PREDICATE]	**...is red.**	*This object is not illuminated by a red light that just makes it look red. [necessary]*
Therefore, CONCLUSION			
	The object...	**...is red.**	



This object is not illuminated by a red light that just makes it look red. [necessary assumption]

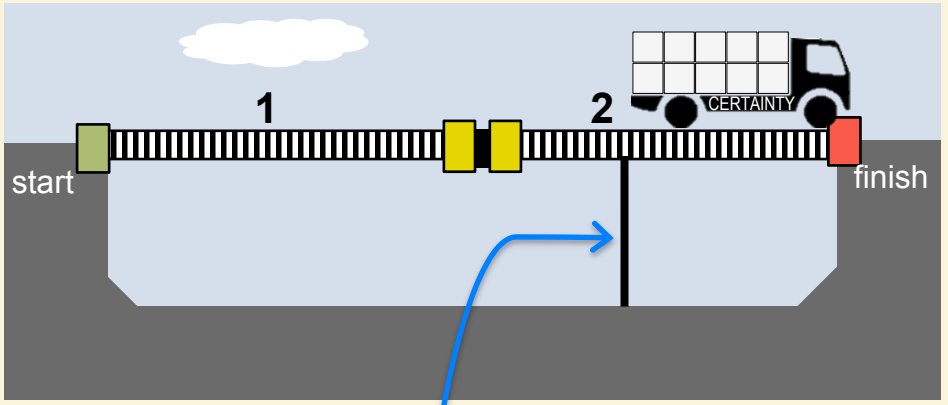
This object A

looks red to me B

is red C

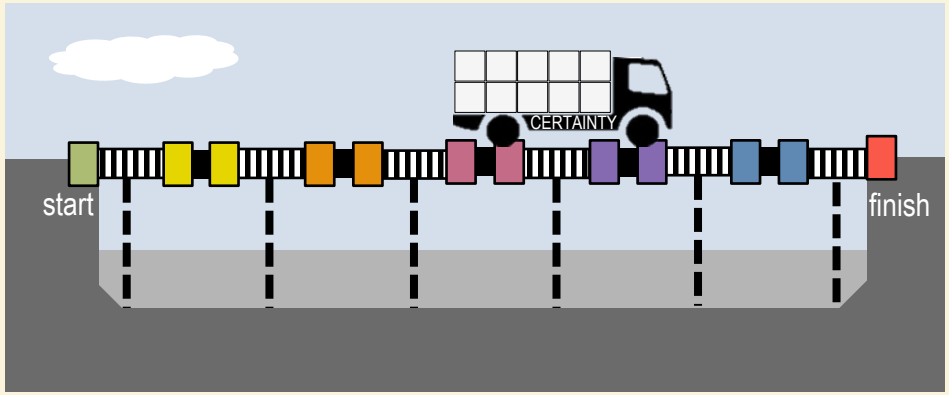
An ASSUMPTION provides **necessary** or **ancillary** support to the premise it supports.

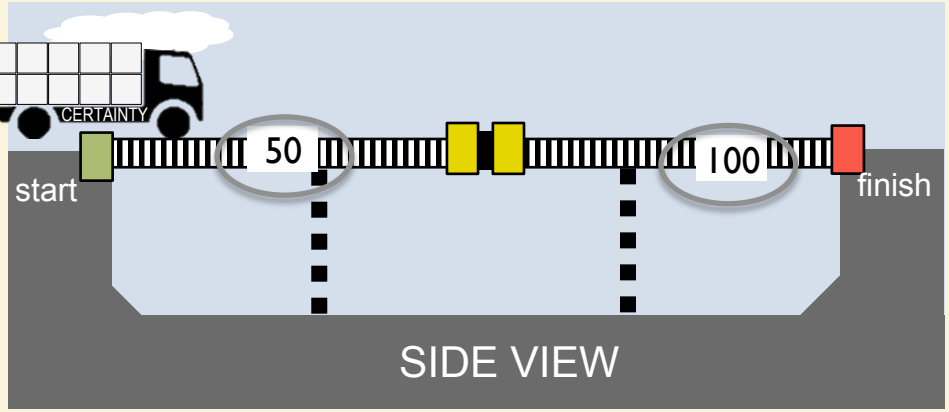
There can be many assumptions supporting a premise. And the subjective level of certainty of the truth of a premise can be impacted by the level of certainty of any of its assumptions.



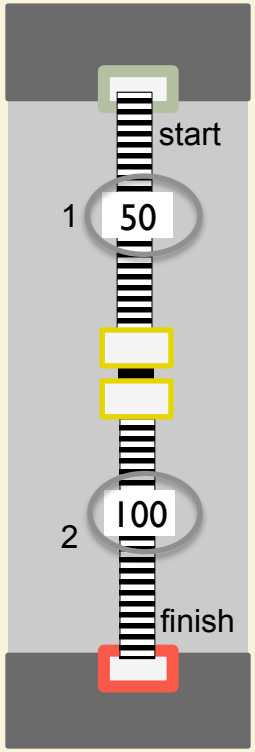
	SUBJECT COLUMN	PREDICATE COLUMN	Supporting Assumptions
1	The President...	... was born in Hawaii.	*[None stated.]*
2	Any (all/one) who (that) [PREVIOUS PREDICATE]	...is a natural born U.S citizen.	*2a The person was born in 1961.* ***(ancillary assumption)***
Therefore,	CONCLUSION		
	The President...	...is a natural born U.S citizen.	

Amount of Certainty



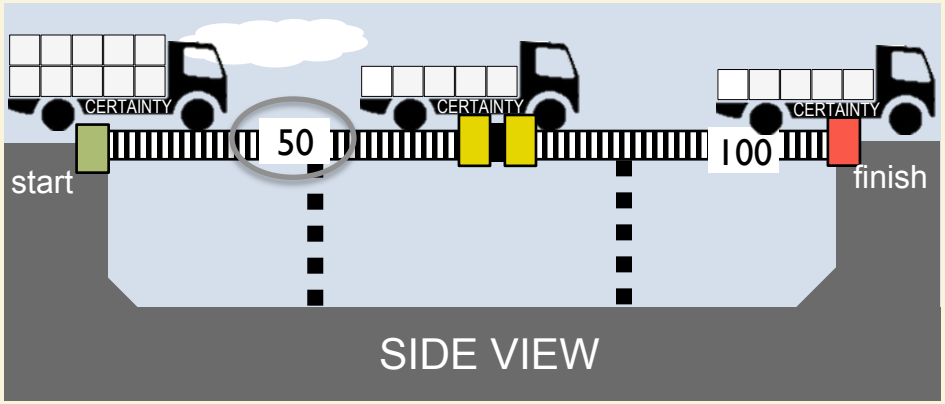


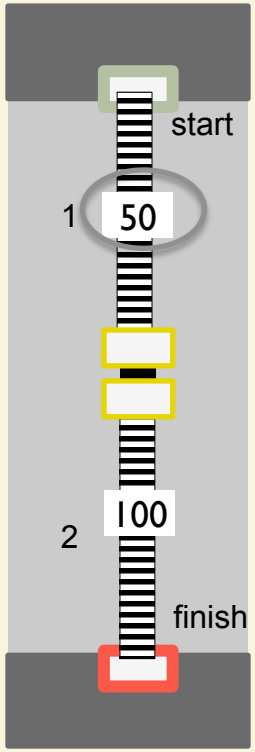
Assume you subjectively perceive the first premise having the **probative load bearing strength** to support a 50% level of certainty of being true. But the second premise is perceived to have the strength to support a 100% level of certainty of being true.



SUBJECT COLUMN		PREDICATE COLUMN
1 The President...	50	... has a valid Hawaiian birth certificate.
2 Any (all/one) who (that) [PREVIOUS PREDICATE]	100	...was born in Hawaii.
Therefore, **CONCLUSION**		
The President...		...was born in Hawaii.

The line of reasoning is only as strong as its weakest link.

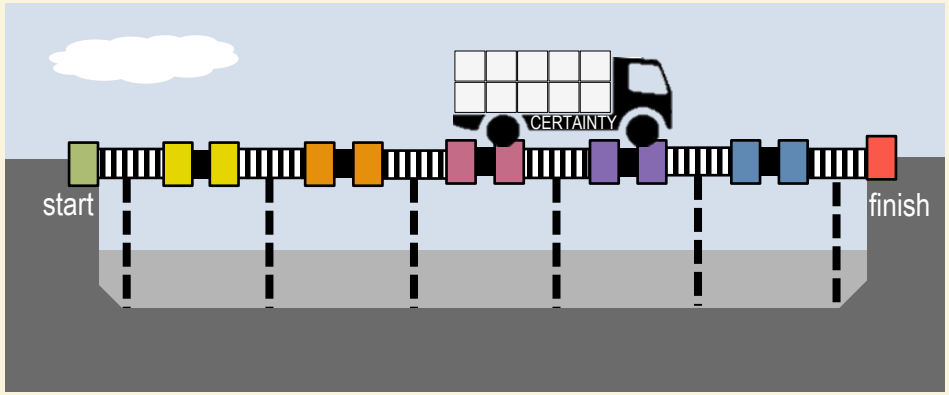




A CONCLUSION reached (justified) from one line of reasoning (without objections) possesses only the smallest subjective level of certainty of truth (e.g., 50%) that can be supported by any one of its premises. So the certainty of a CONCLUSION (e.g., guilty beyond a reasonable doubt) in this context can never be stronger than the weakest premise in the logical line of reasoning.

	SUBJECT COLUMN		PREDICATE COLUMN
1	The President...	50	... has a valid Hawaiian birth certificate.
2	Any (all/one) who (that) [PREVIOUS PREDICATE]	100	...was born in Hawaii.
Therefore,	**CONCLUSION**		
	The President...	50	...was born in Hawaii.

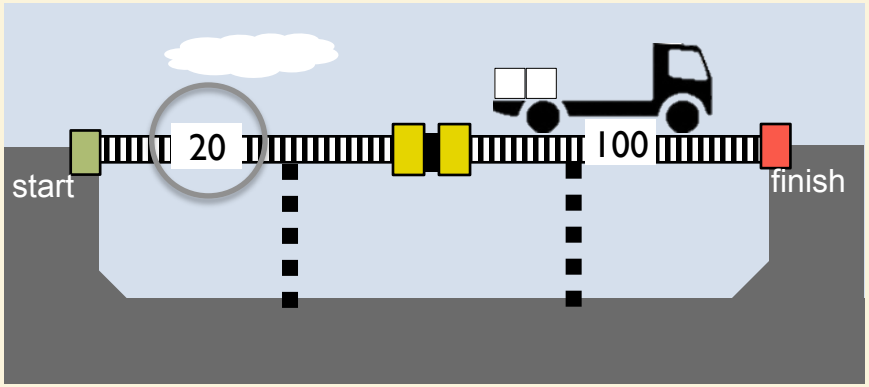
Qualifiers

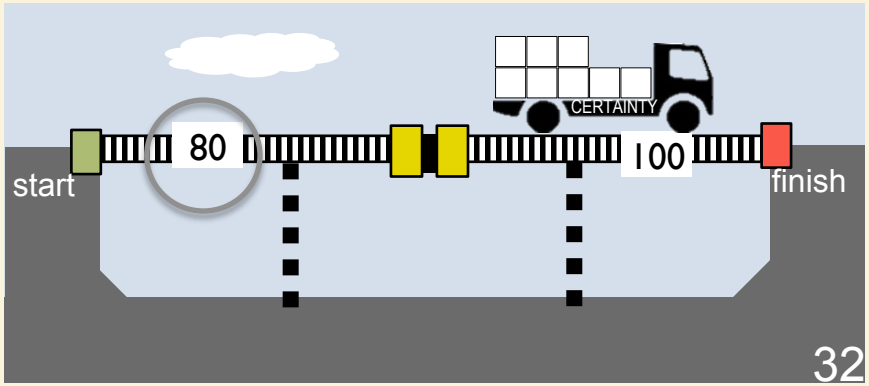


These examples illustrate using QUALIFIERS to possibly increase the perceived level of certainty by the audience for the conclusion. Examples of QUALIFIERS include the following: **some**, **many**, **most**, **probably**, **likely**, **possibly**, **generally** etc.

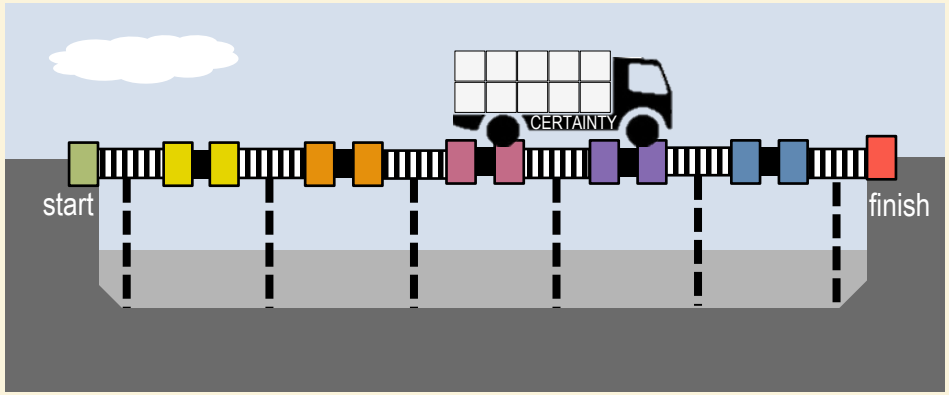
	SUBJECT COLUMN		PREDICATE COLUMN
1	The President...	20	... . has a valid Hawaiian birth certificate.
2	Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	100	...was born in Hawaii.
Therefore,	CONCLUSION		
	The President...	20	...was born in Hawaii.

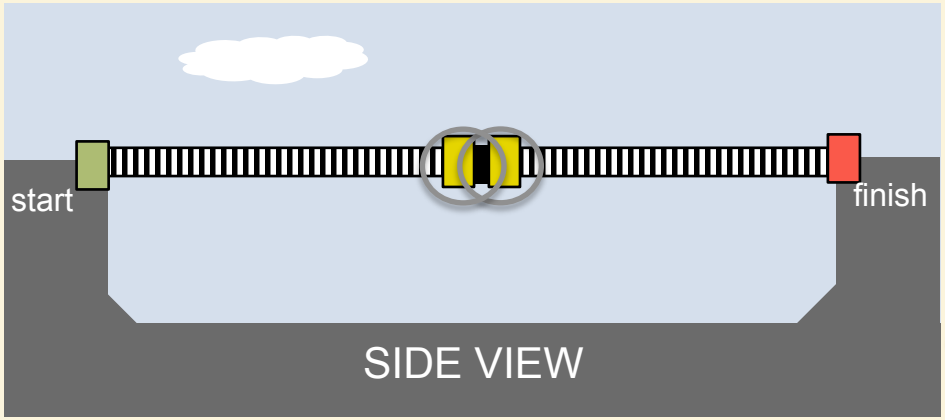
	SUBJECT COLUMN		PREDICATE COLUMN
1	The President...	80	... possibly has a valid Hawaiian birth certificate.
2	Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	100	...was possibly born in Hawaii.
Therefore,	CONCLUSION		
	The President...	80	...was possibly born in Hawaii.





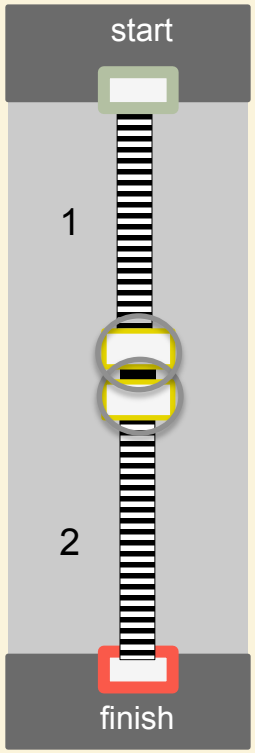
Multiple Linkages





The premises of the Logic-bridge are arranged by linking each other back to front in order.

This linkage is created by the PREDICATE (phrase) of one premise matching the SUBJECT (phrase) of the next premise in the line of reasoning plus an added Universal [e.g., Any / All / One (such)...who / that*...].



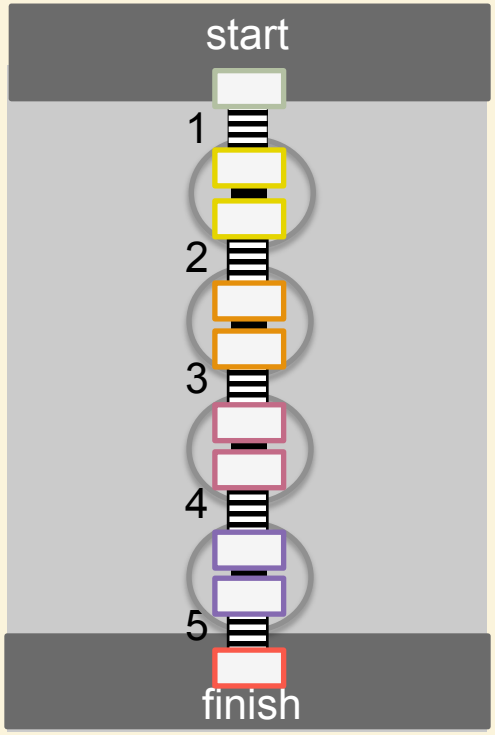
SUBJECT COLUMN	PREDICATE COLUMN
1 The President...	... . has a valid Hawaiian birth certificate.
2 One who has a Hawaiian birth certificate...	...was born in Hawaii.
Therefore, CONCLUSION	
The President...	...was born in Hawaii.

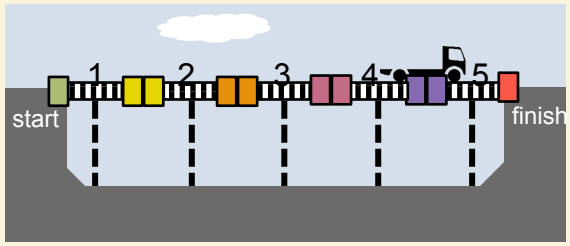
SUBJECT COLUMN	PREDICATE COLUMN
1 The President...	... . has a valid Hawaiian birth certificate.
2 Any (all/one) who (that) [PREVIOUS PREDICATE]	...was born in Hawaii.
Therefore, CONCLUSION	
The President...	...was born in Hawaii.

SINGLE LINKAGE

Multiple linkages is sometimes called "inference upon inference."

This example illustrates an actual line of reasoning with multiple linkages (formed from predicate/subject matching of adjoining premises).

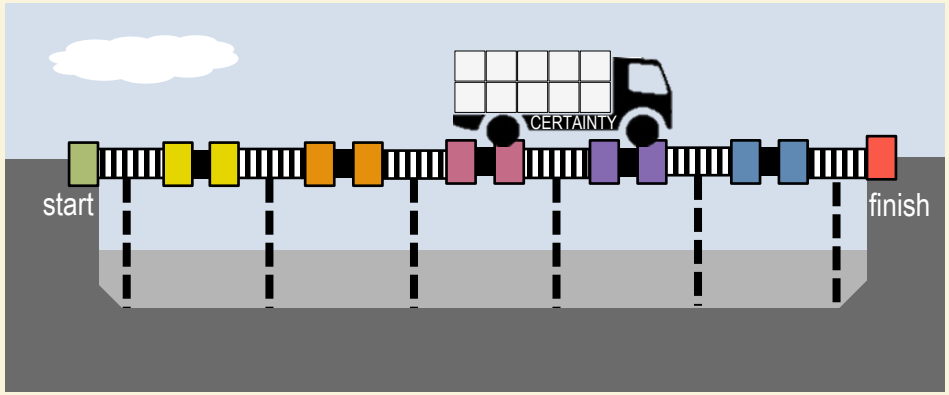




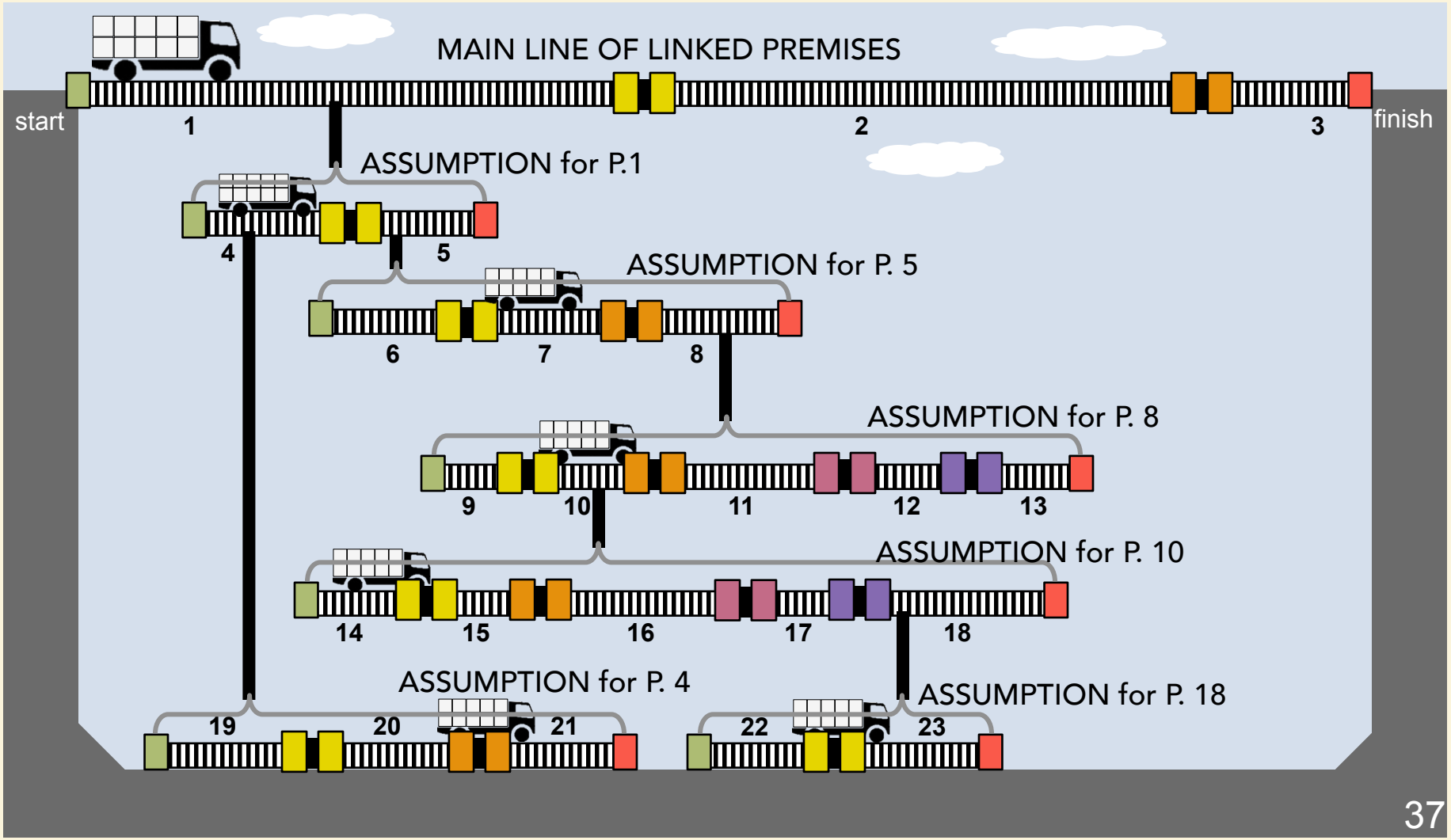
	SUBJECT COLUMN	PREDICATE COLUMN	Assumptions Column
1	The President...	...has a valid Hawaiian birth certificate, according to Director Fukino.	*[None stated.]*
2	Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	...has a valid Hawaiian birth certificate.	*[None stated.]*
3	Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	...was born in Hawaii.	*[None stated.]*
4	Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	...is a natural born U.S. citizen.	*[None stated.]*
5	Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	...satisfies Section 1 of Article II of the U.S. Constitution.	*[None stated.]*
Therefore,	The President...	...satisfies Section 1 of Article II of the U.S. Constitution.	

MULTIPLE LINKAGES EXAMPLE

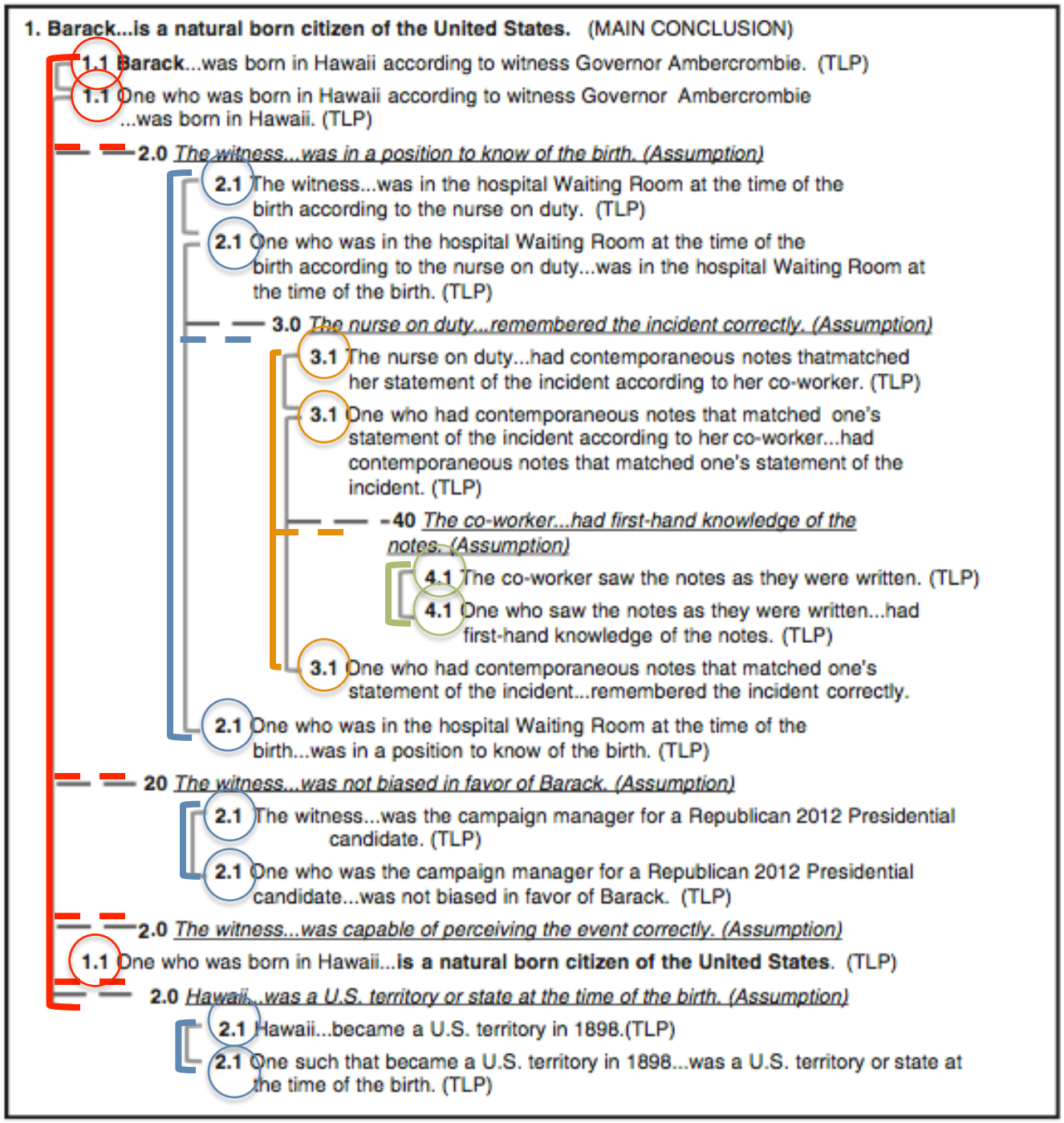
Multi-Level Support



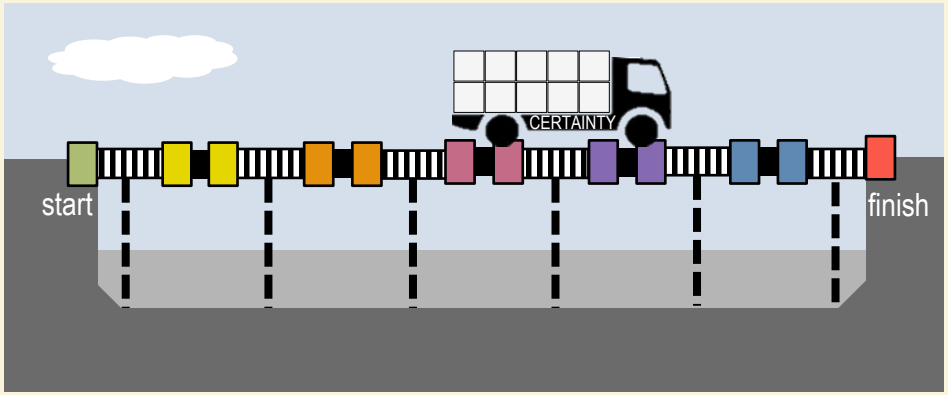
A line of reasoning can depend on multiple layers of ASSUMPTIONS with their own lines of reasoning support .



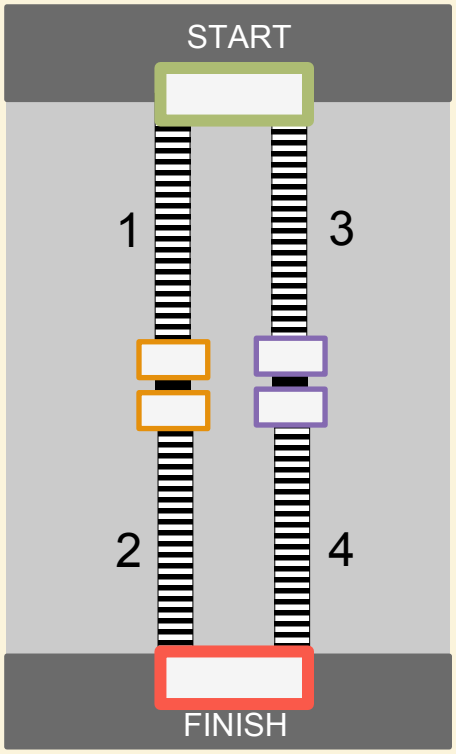
MULTI-LEVEL SUPPORT



Multiple Lines of Reasoning



This example illustrates multiple (i.e., two) lines of reasoning justifying the same CONCLUSION. Multiple lines of reasoning (e.g., corroboration) may increase the subjective perception of the level of certainty of the CONCLUSION.



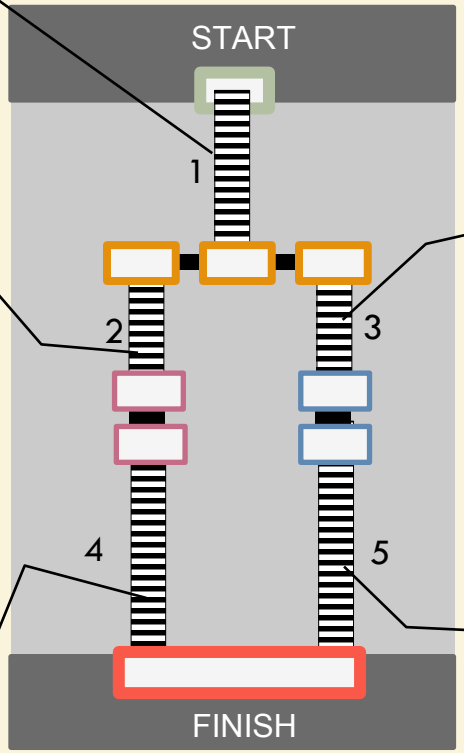
SUBJECT COLUMN		PREDICATE COLUMN
1 The President...	50	...has a Hawaiian birth certificate.
2 Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	100	...was born in Hawaii.
Therefore,	**CONCLUSION**	
The President...	50	...was born in Hawaii.

SUBJECT COLUMN		PREDICATE COLUMN
3 The President...	50	...was born in Kapi'olani Maternity & Gynecological Hospital.
4 Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	100	...was born in Hawaii.
Therefore,	**CONCLUSION**	
The President...	50	...was born in Hawaii.

PARALLEL LINES OF REASONING

This example illustrates (e.g., two) branching lines of reasoning that separate from within the main line of reasoning that then converge together to justify the same CONCLUSION.

The President...
...**produced a newly recertified Hawaiian birth certificate**.



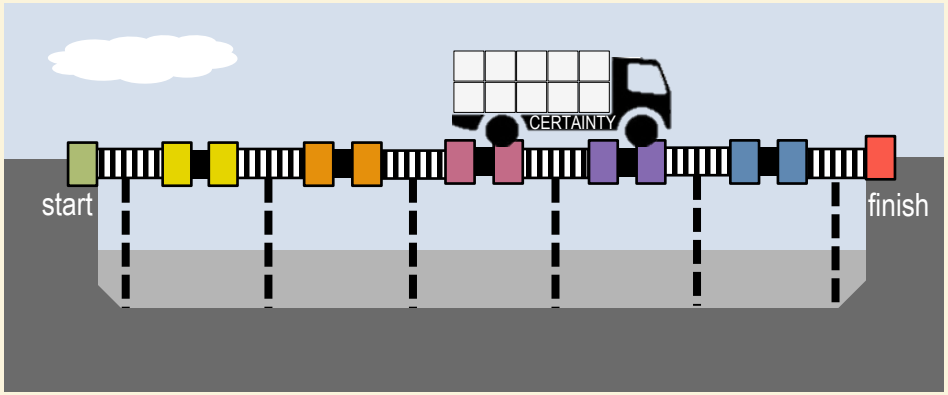
One who...
...**produced a newly recertified Hawaiian birth certificate**...
...**was born in Hawaii**.

One who...
... **produced a newly recertified Hawaiian birth certificate**...
has the Director's support of his Hawaiian birth claim.

One who...
...**was born in Hawaii**...
...**is a natural born U.S. citizen**.

One who...
... **has the Director's support of his Hawaiian birth claim**...
...**is a natural born U.S. citizen**.

Structuring "Argument Schemes" with DCIT (dee•kit)



* Walton, D. (2009). Argumentation Theory: A Very Short Introduction, Argumentation in Artificial Intelligence, ed. Iyad Rahwan and Guillermo Simari,Berlin, Springer, 2009, 1-24.

> "Argumentation schemes are abstract argument forms commonly used in everyday conversational argumentation."

"Argumentation schemes are abstract argument forms commonly used in everyday conversational argumentation, and other contexts, notably legal and scientific argumentation...

Some of the most common schemes are: argument from witness testimony, argument from expert opinion, argument from popular opinion, argument from example, argument from analogy...

Each scheme has a set of critical questions matching the scheme and such a set represents standard ways of critically probing into an argument to find aspects of it that are open criticism."*

* Bench-Capon, T., Prakken, H. and Sartor, G. (2009). Argumentation in legal reasoning. In Argumentation in artificial intelligence, ed. Iyad Rahwan and Guillermo R. Simari, 363-382. Dordrecht: Springer.

Minor premise 1:	Source E is an expert in subject domain S containing proposition A.
Minor premise 2:	E asserts that proposition A (in domain S) is true (false).
Conditional premise:	If source E is an expert in a subject domain S containing proposition A, and E asserts that proposition A is true (false), then A may plausibly be taken to be true (false).
Conclusion:	A may plausibly be taken to be true (false).

Table 1: Argumentation scheme: *Argument from expert opinion.*

* Walton, D. (2009). Argumentation Theory: A Very Short Introduction, Argumentation in Artificial Intelligence, ed. Iyad Rahwan and Guillermo Simari,Berlin, Springer, 2009, 1-24.

"Each scheme has a set of critical questions matching the scheme and such a set represents standard ways of critically probing into an argument to find aspects of it that are open criticism."*

"CQ1: *Expertise Question*. How credible is *E* as an expert source?

CQ2: *Field Question*. Is *E* an expert in the field that *A* is in?

CQ3: *Opinion Question*. What did *E* assert that implies *A*?

CQ4: *Trustworthiness Question*. Is *E* personally reliable as a source?

CQ5: *Consistency Question*. Is *A* consistent with what other experts assert?

CQ6: *Backup Evidence Question*. Is *E*'s assertion based on evidence?"*

* Bench-Capon, T., Prakken, H. and Sartor, G. (2009). Argumentation in legal reasoning. In Argumentation in artificial intelligence, ed. Iyad Rahwan and Guillermo R. Simari, 363-382. Dordrecht: Springer.

> "Most of the argumentation schemes listed in (Walton, Reed, and Macagno 2008) have a defeasible modus ponens structure [if/then conditional], grounded on a conditional defeasible generalization."

"Most of the argumentation schemes listed in (Walton, Reed, and Macagno 2008) have a defeasible modus ponens structure, grounded on a conditional defeasible generalization...It is readily visible that version of the scheme for argument from expert opinion has a modus ponens structure as an inference...Subsequent work on argumentation schemes has followed this general way of representing the logical structure of many defeasible argumentation schemes. Bench-Capon and Prakken (Bench-Capon and Prakken 2010) view the application of defeasible rules (such as legal or moral norms) as a particular instance of defeasible modus ponens."*

* Bench-Capon, T., Prakken, H. and Sartor, G. (2009). Argumentation in legal reasoning. In Argumentation in artificial intelligence, ed. Iyad Rahwan and Guillermo R. Simari, 363-382. Dordrecht: Springer.

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Table 1: Argumentation scheme: *Argument from expert opinion.*

*Henkemans, A. (2014). Speech Act Theory and the Study of Argumentation. Studies in Logic, Grammar and Rhetoric, 36(1), 41-58.

> "The logical minimum [**if/then** conditional] contributes nothing new, but only states explicitly that it is permitted to infer the conclusion... adding (2a) would be superfluous."

"The following example may be used to illustrate how this procedure [the pragma-dialectical procedure for reconstructing unexpressed premises] would work (van Eemeren & Grootendorst, 1992, pp. 63–67):

(1) Bart must be at home, because his landline is busy.

The logical minimum would be:

(2a) If Bart's landline is busy, then Bart must be at home.

This addition renders the reasoning valid, but pragmatically speaking this is not enough. The logical minimum contributes nothing new, but only states explicitly that it is permitted to infer the conclusion of example (1) from the premise. Since this was already clear from the fact that the speaker assumes that the conclusion follows from the premise that has been provided, adding (2a) would be superfluous. It seems justified to reconstruct a more generalized version of the logical minimum as underlying the argument. Hence, adding (2b) as the pragmatic optimum seems to be justified:

(2b) People whose landline is busy are at home."

* Bench-Capon, T., Prakken, H. and Sartor, G. (2009). Argumentation in legal reasoning. In Argumentation in artificial intelligence, ed. Iyad Rahwan and Guillermo R. Simari, 363-382. Dordrecht: Springer.

"'Argument schemes' are not classified according to their logical form but according to their content.*"

So DCIT is one argument structure that can be used for "argument schemes."

Different defined ASSUMPTION SETS can accompany certain types of inference steps such as ones that depend upon RELIABILITY OF A SOURCE, ANALOGY, SAMPLE GENERALIZING.

	SUBJECT COLUMN	PREDICATE COLUMN
1	The President...	... was born in Hawaii, ACCORDING TO THE WITNESS.
2	One who... was born in Hawaii... ACCORDING TO THE WITNESS...	...was born in Hawaii.
Therefore,	The President...	...was born in Hawaii.

CONCLUSION

Supporting Assumptions

[None stated.]

2a The **Witness** had personal knowledge (i.e., was in a position to know).

2b The **Witness** focused his attention for a sufficient period of time to observe the event.

2c The **Witness** had the necessary perceptual and cognitive capabilities to witness and understand.

2d The **Witness** had adequate memory capabilities.

2e The level of certainty of the **Witness** is sufficient.

2f The **Witness** is not personally biased.

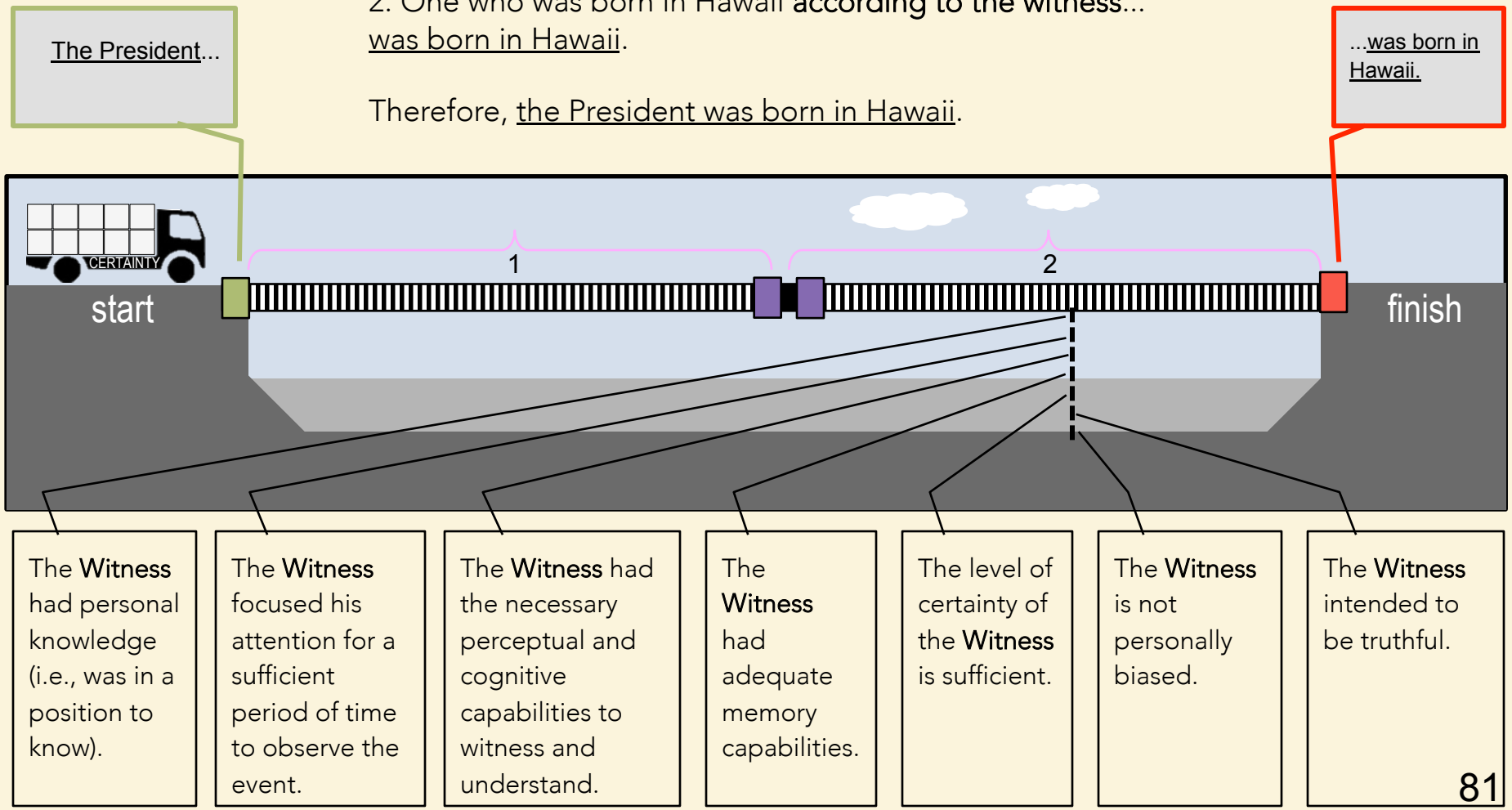
2g The **Witness** intended to be truthful.

MAIN CONCLUSION: The President was born in Hawaii.

STUDENT: My line of reasoning consists of two premises:

1. The President...was born in Hawaii **according to the witness**.
2. One who was born in Hawaii **according to the witness**... was born in Hawaii.

Therefore, the President was born in Hawaii.



Different defined ASSUMPTION SETS can accompany certain types of inference steps such as ones that depend upon RELIABILITY OF A SOURCE, ANALOGY, SAMPLE GENERALIZING.

	SUBJECT COLUMN	PREDICATE COLUMN	Supporting Assumptions
1	The President...	...had an authentic birth certificate ACCORDING TO THE EXPERT.	*[None stated.]*
2	One who... had an authentic birth certificate ACCORDING TO THE EXPERT...	... had an authentic birth certificate.	2a The **Expert** has sufficient qualifications and stature. 2b The **Expert** relied upon a theory or technique that has general acceptance in the scientific field of study. 2c The **Expert** made proper use of the theory or technique. 2d The error rate of the technique is acceptable. 2e The level of certainty of the **Expert** is sufficient. 2f The **Expert** is not personally biased. 2g The **Expert** intended to be truthful. 2h The **Expert** could make a rational inference of identification from the phenomena (sensory input) that the **Expert** actually perceived.
Therefore,	CONCLUSION		
	The President...	...had an authentic birth certificate.	

Different defined ASSUMPTION SETS can accompany certain types of inference steps such as ones that depend upon RELIABILITY OF A SOURCE, ANALOGY, SAMPLE GENERALIZING.

	SUBJECT COLUMN	PREDICATE COLUMN	*Supporting Assumptions*
1	The birth certificate ink...	...was authentic ACCORDING TO THE INSTRUMENT.	*[None stated.]*
2	One that... ...was authentic ACCORDING TO THE INSTRUMENT.	...was authentic.	2a The **Instrument** was properly calibrated. 2b The **Instrument** was administered and read correctly. 2c The **Instrument** readings were recorded accurately. 2d The **Instrument** readings were not altered. 2e The **Instrument** readings are sufficiently probative.
	Therefore,	**CONCLUSION**	
	The birth certificate ink...	...was authentic.	

Different defined ASSUMPTION SETS can accompany certain types of inference steps such as ones that depend upon RELIABILITY OF A SOURCE, ANALOGY, SAMPLE GENERALIZING.

	SUBJECT COLUMN	PREDICATE COLUMN	Supporting Assumptions
1	The President...	... is caught in a scandal that is similar to the Nixon scandal.	*[None stated.]*
2	Any one who... ...is caught in a scandal that is similar to the Nixon scandal...	...should, BY ANALOGY, resign.	2a There are no critical differences sufficient to destroy the **ANALOGY**. 2b The similarities are defining characteristics of the comparable (**SOURCE ANALOGUE**). 2c There are a sufficient amount of similarities to give assurance that other characteristics are shared. 2d The shared characteristics are relevant to the inferred characteristic. 2e The characteristic in the conclusion is not inconsistent with the subject (**TARGET ANALOGUE**).
Therefore,	The President...	...should, BY ANALOGY, resign.	CONCLUSION

Generalizing in many circumstances is also called induction.

Different defined ASSUMPTION SETS can accompany certain types of inference steps such as ones that depend upon RELIABILITY OF SOURCE, ANALOGY, GENERALIZING.

	SUBJECT COLUMN	PREDICATE COLUMN	Supporting Assumptions
1	The sample of citizens polled...	... indicates that the voting public generally believes the President's citizenship claim.	*[None stated.]*
2	Any such that... ...indicates that the voting public generally believes the President's citizenship claim...	...sufficiently proves, by **GENERALIZING (induction)**, that actually the voting public generally believes the President's citizenship claim.	2a Any deviant examples in the **SAMPLE** are sufficiently accounted for in the reasoning structure. 2b The **SAMPLE** examples all belong to the same class. 2c The terms in the conclusion are common and defining characteristics of the **SAMPLE** examples. 2d There are enough facts to support the inference that all unknown relevant facts will support the same conclusion. (Adequate **SAMPLE** size) 2e The interval estimate is sufficiently small.
Therefore,	CONCLUSION		
	The sample of citizens polled...	...sufficiently proves, by **GENERALIZING (induction)**, that actually the voting public generally believes the President's citizenship claim.	

"...the possibility that the fleeing person is entirely innocent.*"

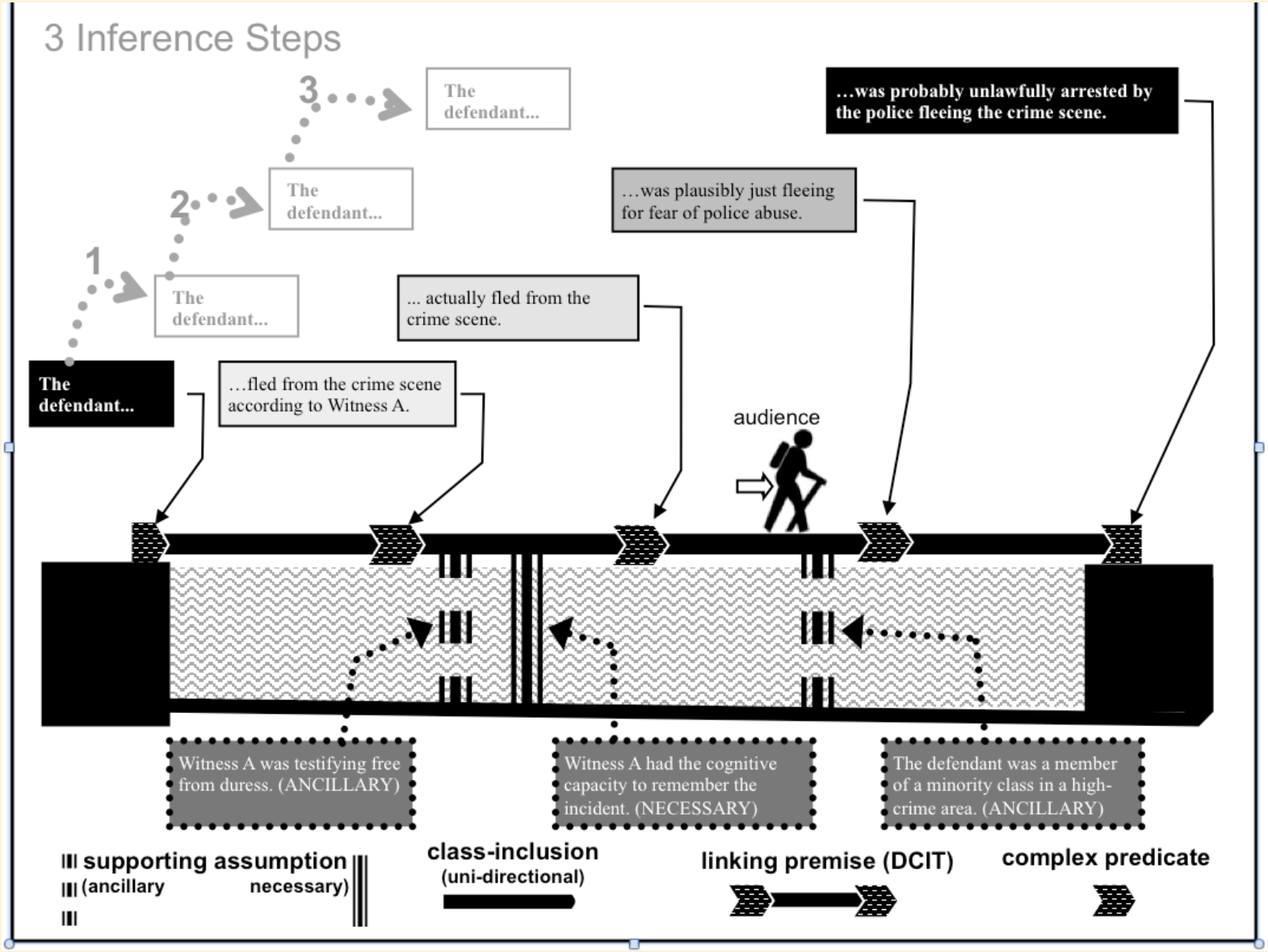
"Among some citizens, particularly minorities and those residing in high crime areas, there is also the possibility that the fleeing person is entirely innocent, but, with or without justification, believes that contact with the police can itself be dangerous, apart from any criminal activity associated with the officer's sudden presence."

Illinois v. Wardlow, 528 U.S. 119 (2000). *

"The defendant was a member of a minority class in a high-crime area."

Ancillary supporting assumption for Linked Premise 3

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	**The defendant...**	…fled from the crime scene according to Witness A.
2	One such who…	…fled from the crime scene according to Witness A...	... actually fled from the crime scene.
3	One such who…	... actually fled from the crime scene...	…was plausibly just fleeing for fear of police abuse.
4	One such who…	…was plausibly just fleeing for fear of police abuse...	**…was probably unlawfully arrested by the police fleeing the crime scene.**
CONCLUSION			
		The defendant...	**…was probably unlawfully arrested by the police fleeing the crime scene.**
ASSUMPTIONS TO LINKED PREMISES			
2	Witness A was testifying free from duress. (ANCILLARY) Witness A had the cognitive capacity to remember the incident. (NECESSARY)		
3	The defendant was a member of a minority class in a high-crime area. (ANCILLARY)		



> "This fact provides a cautionary note to uncritical reliance on a standardized list of Critical Questions or assumptions attached to any Argument Scheme."

Wardlow illustrates that the choice and degree of acceptability of generalizations, whether structured as transitively-linked premises, assumptions (ancillary or necessary), or implicit in Critical Questions attached to Argument Schemes can be dependent on the worldview of the audience. This fact provides a cautionary note to uncritical reliance on a standardized list of Critical Questions or assumptions attached to any Argument Scheme. Such constructions of stereotypical reasoning must always account for the fact that one group's sound stereotypical reasoning may be unsound from another group's worldview. And what is a Critical Question or assumption for one group may not be critical for another.

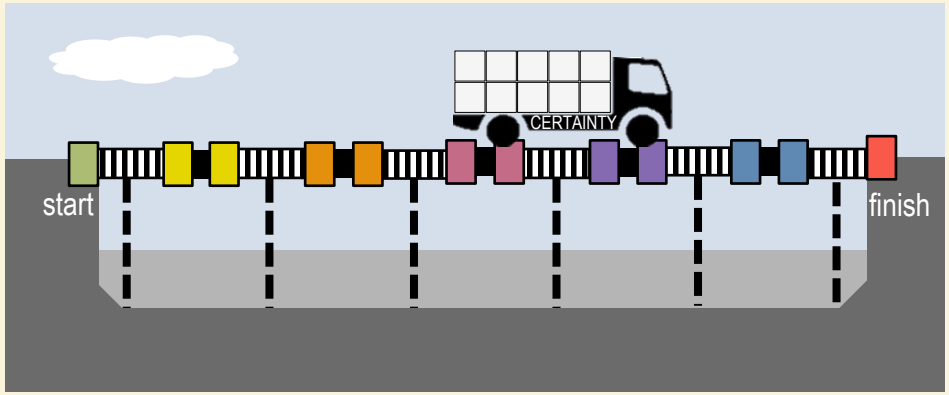
> "Argument Schemes can be found at different locations along the spectrum of generalized applicability."

Wardlow also illustrates that Argument Schemes can be found at different locations along the spectrum of generalized applicability.

A "Position to Know" Argument Scheme such as associated with premise 2 will likely have more opportunities for application than the "Fleeing" Argument Scheme associated with premise 3.

Even more generalizable might be an Argument Scheme such as "Argument from Analogy."

Structuring "Objections" with DCIT (dee•kit)

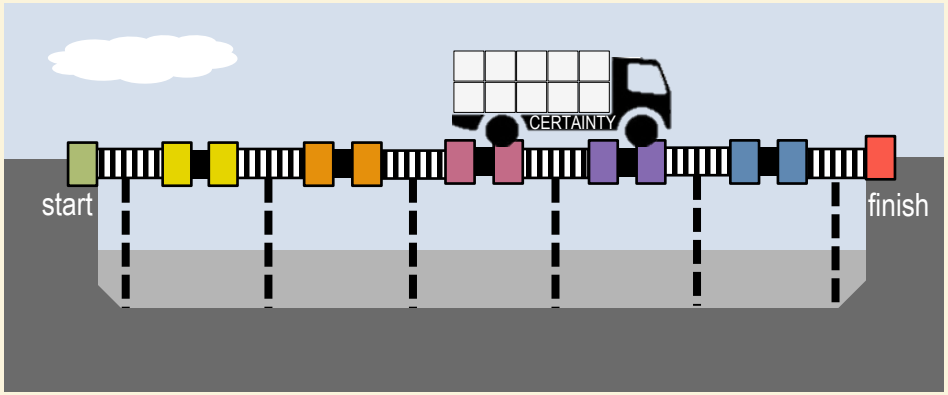


* Walton, D. (2011). How to refute an argument using artificial intelligence. Studies in Logic, Grammar and Rhetoric 23 (36), 123–154.

> "One finds it to be a widely held commonplace in writings on logic and artificial intelligence that there are three ways to attack an argument." *

"One finds it to be a widely held commonplace in writings on logic and artificial intelligence that there are three ways to attack an argument (Prakken, 2010, 169). One is to argue that a premise is false or insufficiently supported. Let's call this premise attack. Another is to argue that the conclusion doesn't follow from the set of premises that were presented as supporting it. This could be called an undercutting attack, as we will see below. The third is to argue that the conclusion is shown to be false by bringing forward a counter-argument opposed to the original argument."*

Objections:
Opposing attacks



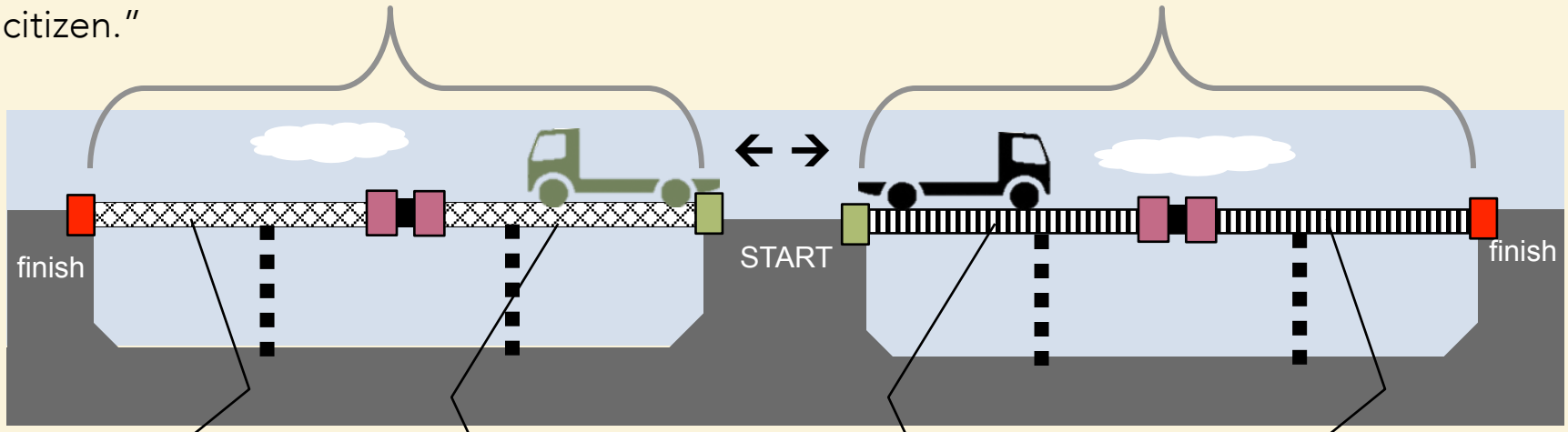
An OPPOSING attack provides support for an opposite CONCLUSION branching from the same starting point.

There are a number of possible types of attack against a logical line of reasoning. This type is named an OPPOSING attack since it leads in the opposite direction from the START to the opposite conclusion.

OPPOSITE CONCLUSIONS

"The President is NOT a natural born U.S. citizen."

"The President is a natural born U.S. citizen."



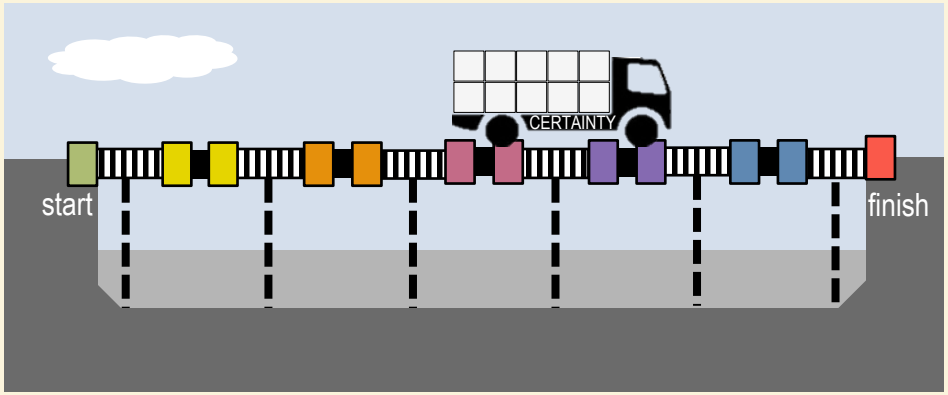
One who...
was born in Kenya...
...is NOT a natural born U.S. citizen.

The President...
... was born in Kenya.

The President...
... was born in Hawaii.

One who...
was born in Hawaii...
...is a natural born U.S. citizen.

Objections:
Diverting attacks



This is a DIVERTING type of attack since it attempts to divert the flow of certainty within the original line of reasoning.

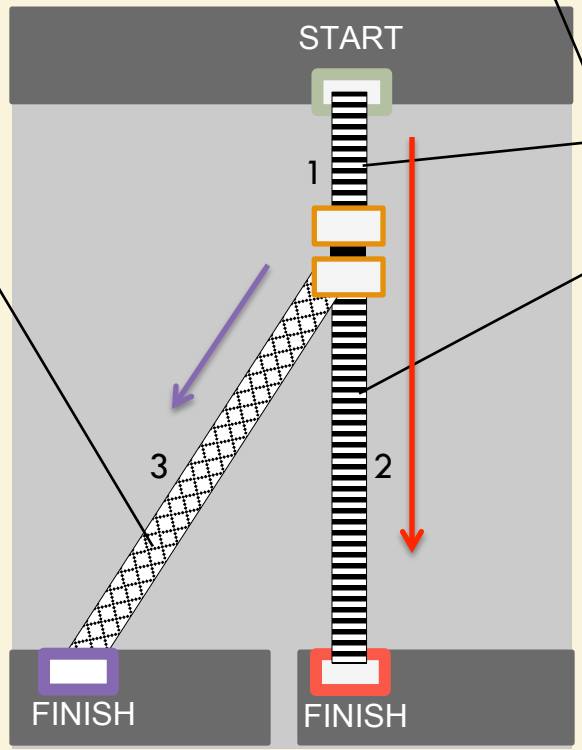
CONCLUSION

"The President does NOT have an Original Hawaiian birth certificate."

The President...
...only produced a recertified Hawaiian birth certificate.

CONCLUSION

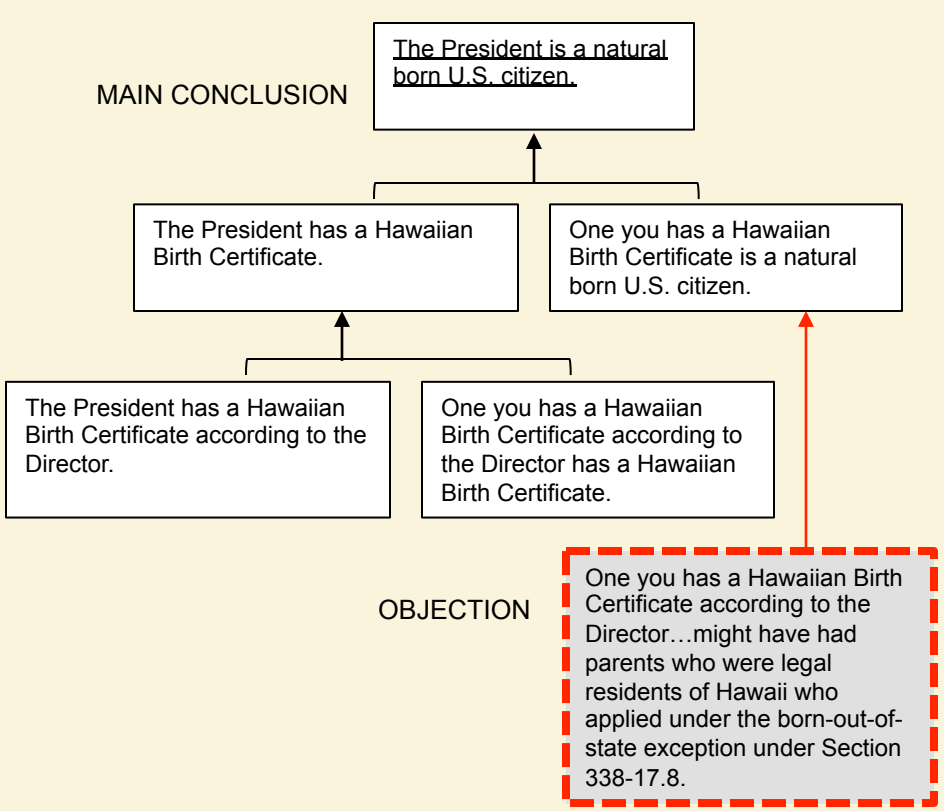
"The President has an Original Hawaiian birth certificate."

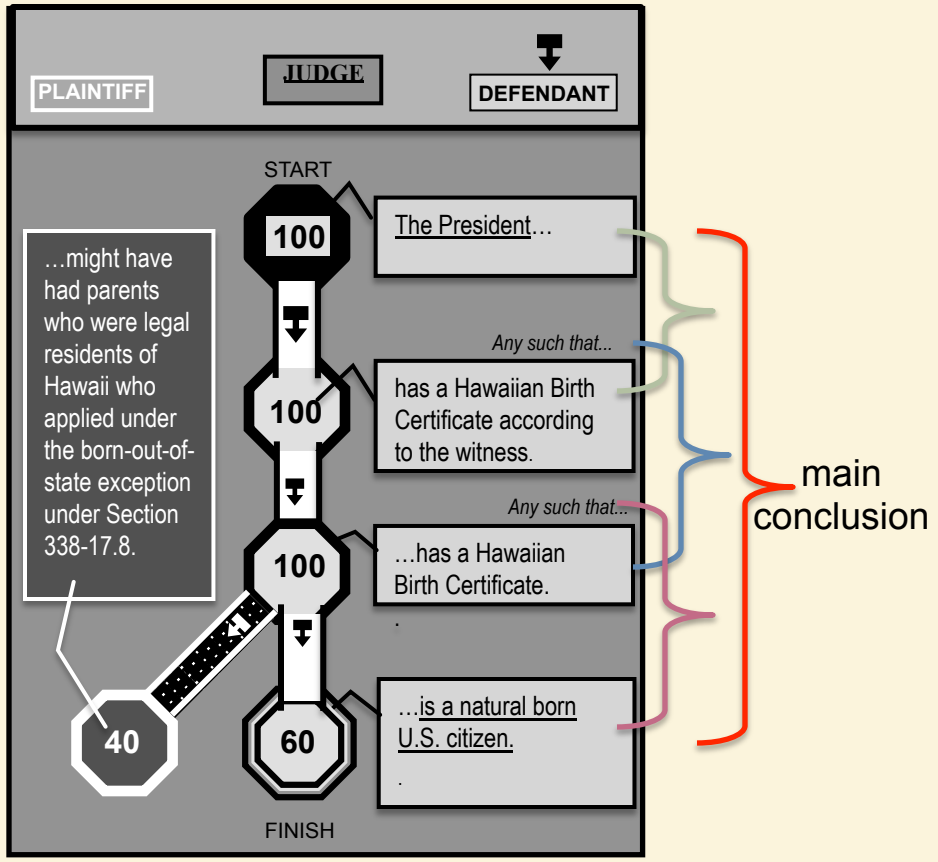


One who...
...only produced a recertified Hawaiian birth certificate...
...does NOT have an Original Hawaiian birth certificate.

One who...
...only produced a recertified Hawaiian birth certificate...
...has an Original Hawaiian birth certificate.

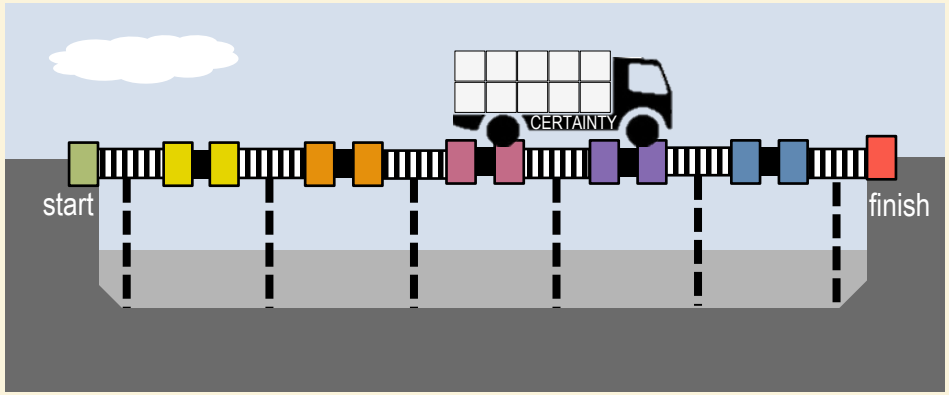
Precise impact on probative weight from objection is obscured.





Simply attaching a box with a red line as an objection in the tree-like structure fails to make apparent the degree of impact on the final determination of certainty (e.g., beyond a reasonable doubt).

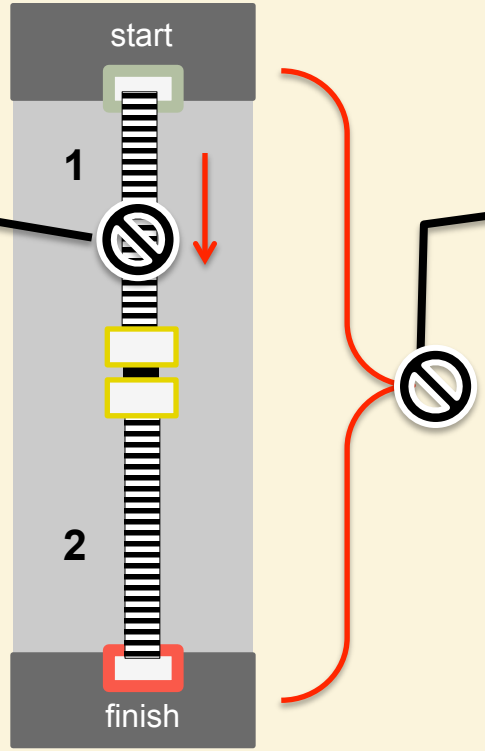
Objections:
Obstructing attacks



This is an OBSTRUCTING type of attack since it attempts to block the movement of certainty within the line of reasoning.

Examples:

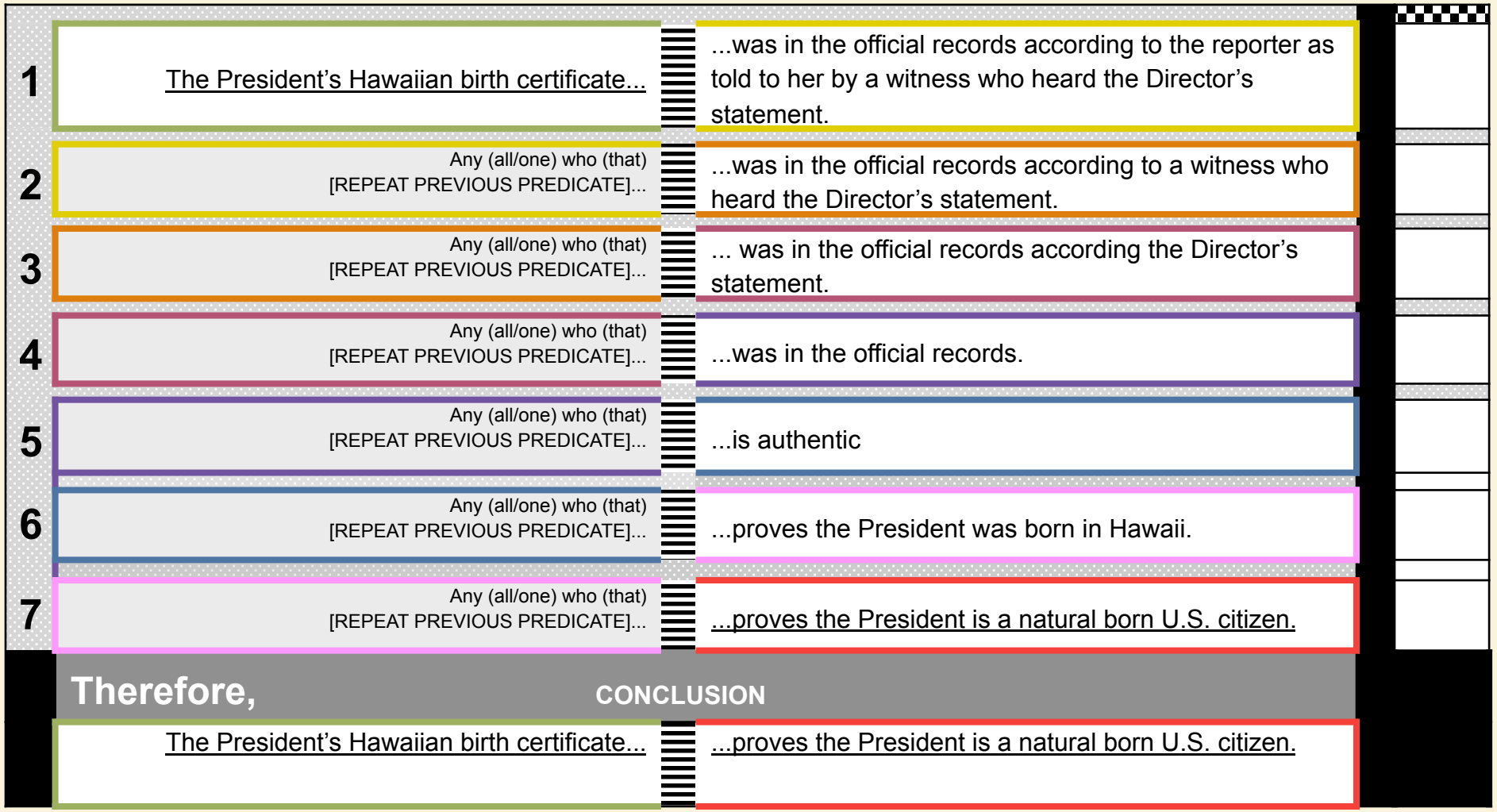
The premise/assumption is:
- Inconsistent
- Ambiguous
- Vague
- Conditional
- False
- Weak
- Irrelevant
- Unsubstantiated
- Over generalized
- Not authoritative



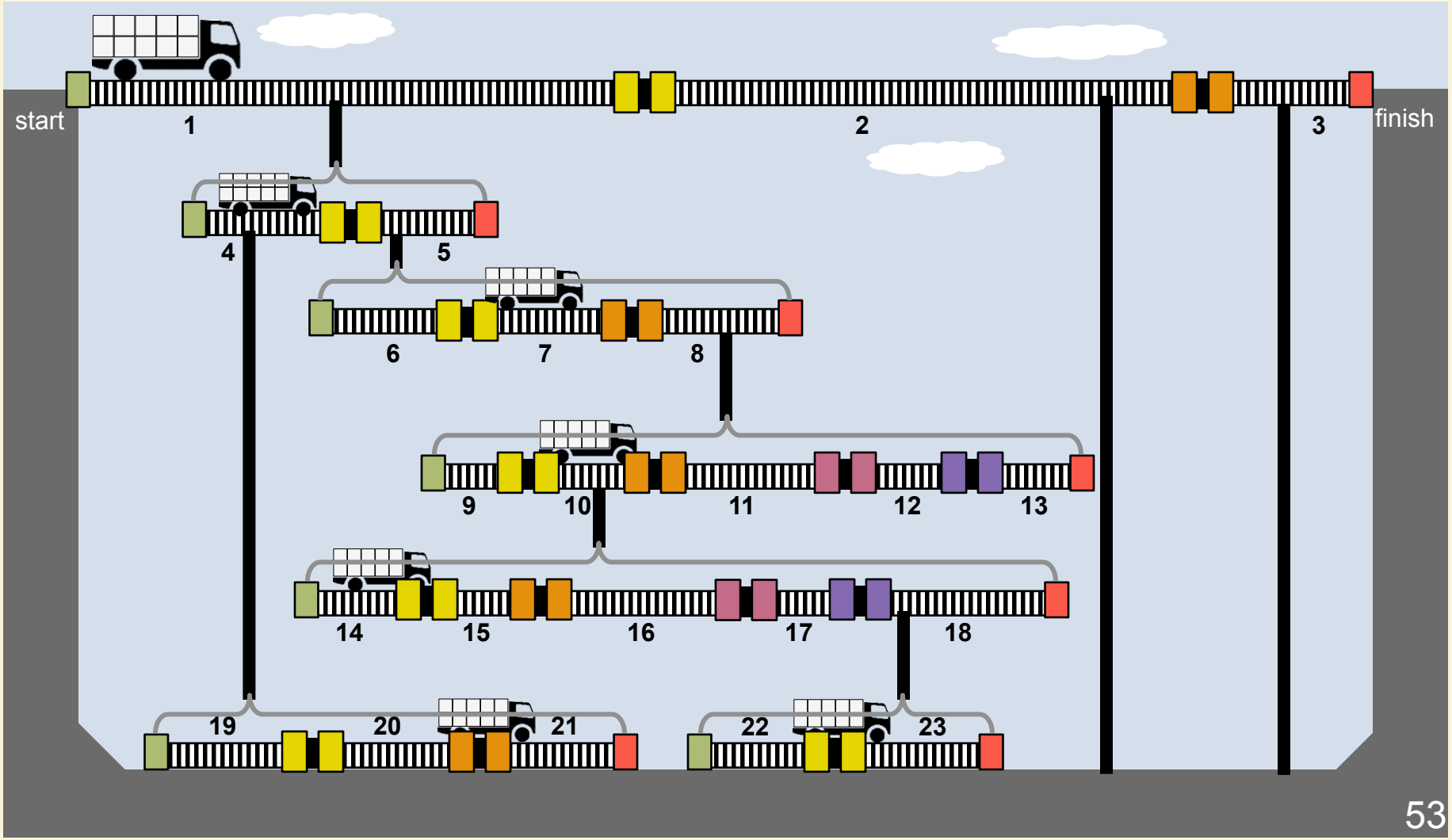
Examples:

The line of reasoning is:
- Illogical
- Irrelevant
- Inconsistent
- Conditional
- Incomplete
- Weak
- Fallacious
- Piling inference-upon-inference (speculative)

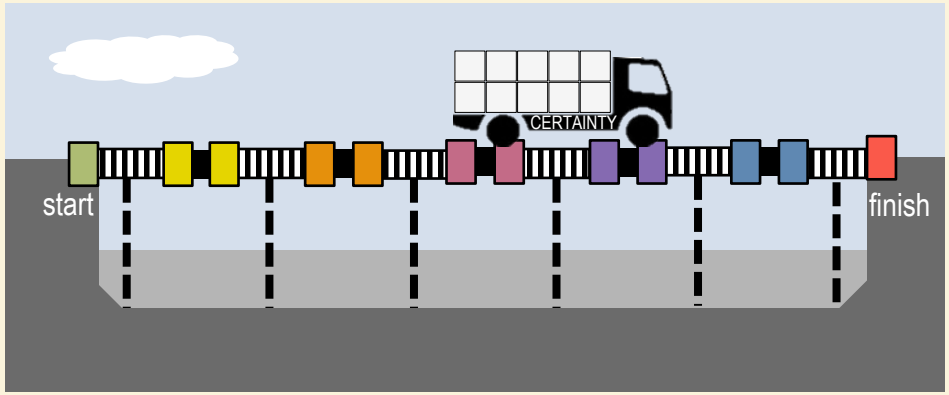
Too many inference steps (inference-upon-inference) can become perceived as merely speculation.



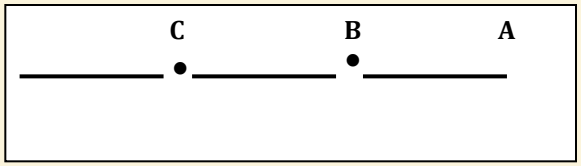
Each of these types of objections can be applied to each level of support.



Formal Logic and DCIT (dee•kit)



Englebretsen, G. (1998). *Line diagrams for logic: Drawing conclusions*. Lewiston, NY: The Edwin Mellen Press.



BARBARA

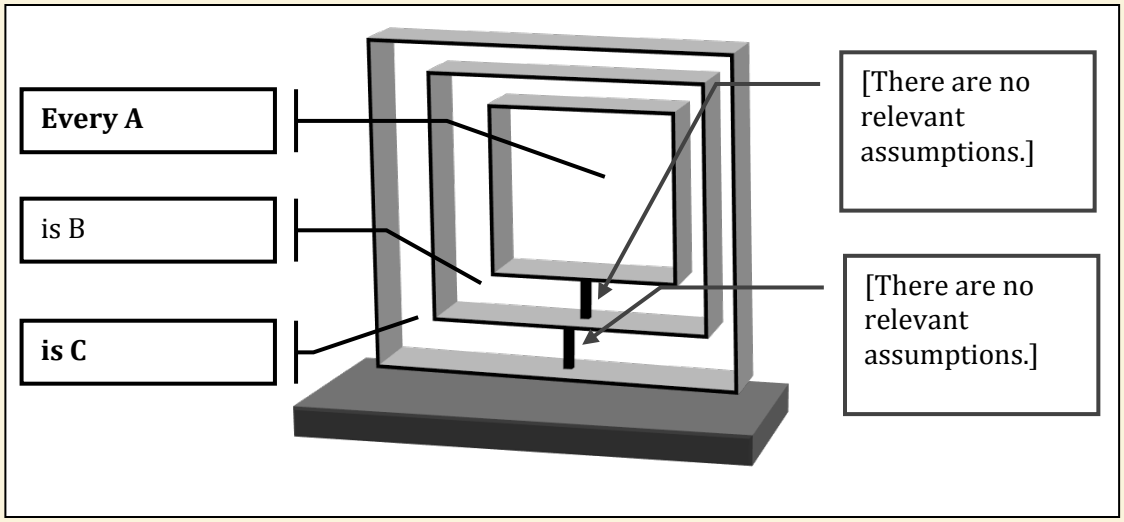
Every A is B.
Every B is C.
So every A is C.

In less natural terms, this argument would read as follows:

Every A is included in the class of "is B." Any that is included in the class of "is B" is included in the class of "is C." So, every A is included in the class of "is C."

Note that the phrase predicate, if it exists, is used as the category.

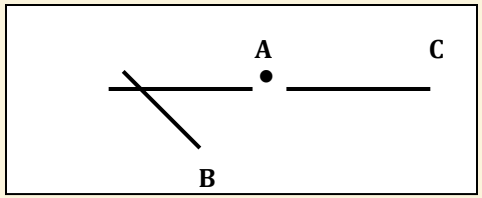
		DEFEASIBLE CLASS-INCLUSION TRANSITIVITY			Premise Assumptions
		Subject phrase		Predicate phrase	
1	➔	**Every A...**		...is B.	[no relevant assumptions]
2	Any who (that)	...is B...		**...is C.**	[no relevant assumptions]
		CONCLUSION			
3		**Every A is C.**			



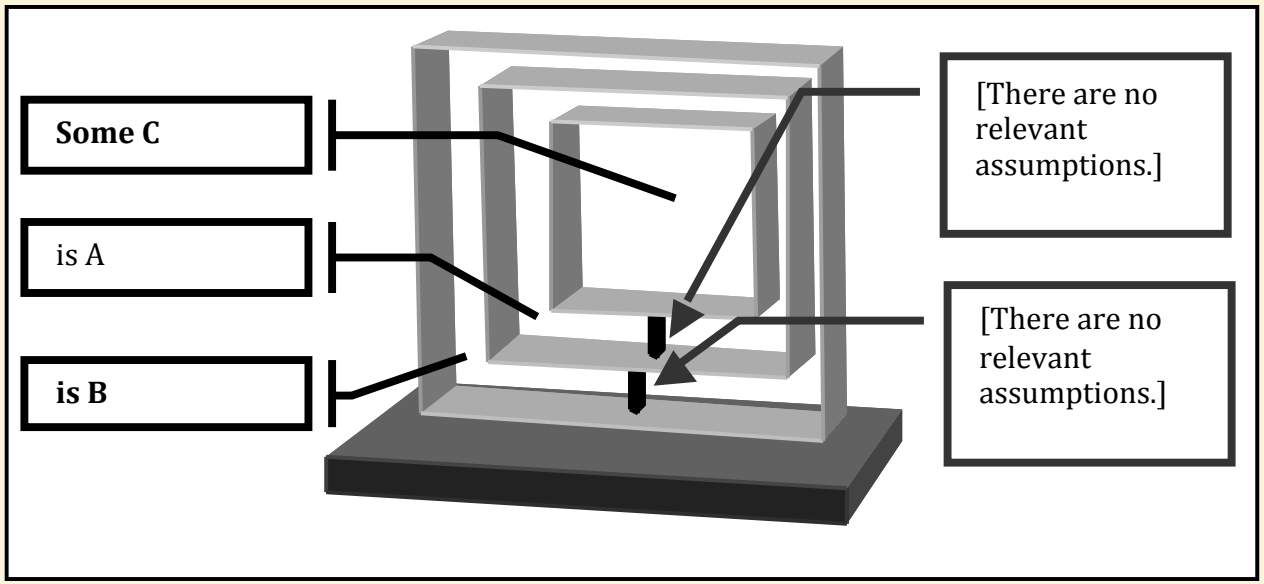
Englebretsen, G. (1998). *Line diagrams for logic: Drawing conclusions*. Lewiston, NY: The Edwin Mellen Press.

DARII

Every A is B.
Some C is A.
So some C is B.



	DEFEASIBLE CLASS-INCLUSION TRANSITIVITY				Premise Assumptions
		Subject phrase		Predicate phrase	
1	➔	**Some C...**		...is A.	[no relevant assumptions]
2	Any who (that)	...is A...		**...is B.**	[no relevant assumptions]
	CONCLUSION				
3	**Some C is B.**				



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Some detective gave some money to every Justice.

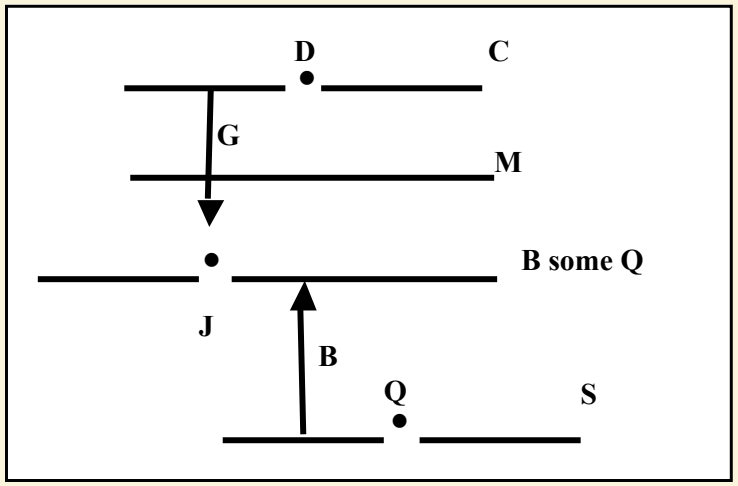
Every Justice is bound by an oath.

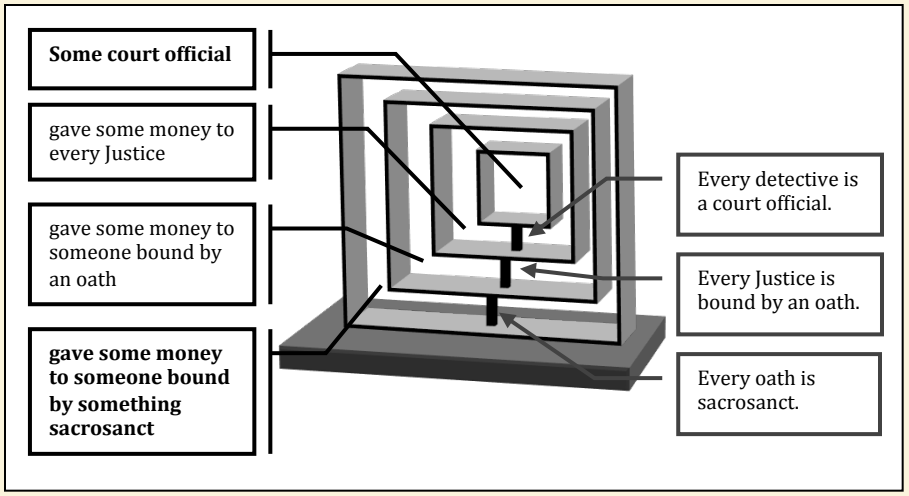
Every detective is a court official.

Every oath is sacrosanct.

So some court official gave some money to someone bound by something sacrosanct.

	Defeasible Class-Inclusion Transitivity				Premise Assumptions
		Subject phrase		Predicate phrase	
1	→	**Some court official...**		...gave some money to every Justice.	Every detective is a court official.
2	Any who (that)	...gave some money to every Justice...		...gave some money to someone bound by an oath.	Every Justice is bound by an oath.
3	Any who (that)	...gave some money to someone bound by an oath...		**...gave some money to someone bound by something sacrosanct.**	Every oath is sacrosanct.
		CONCLUSION			
4		**Some court official gave some money to someone bound by something sacrosanct.**			





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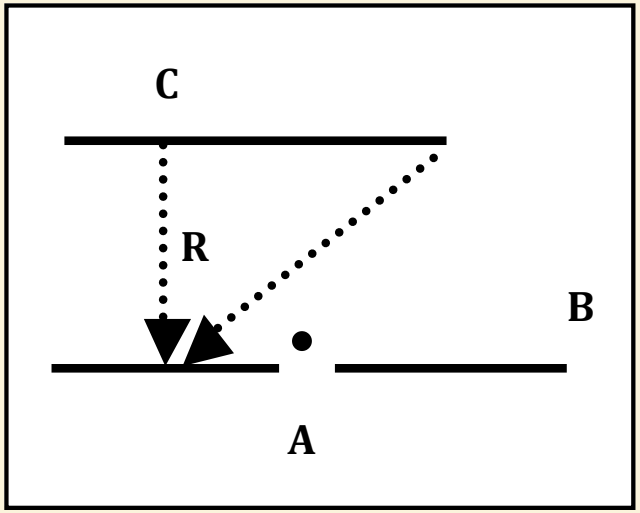
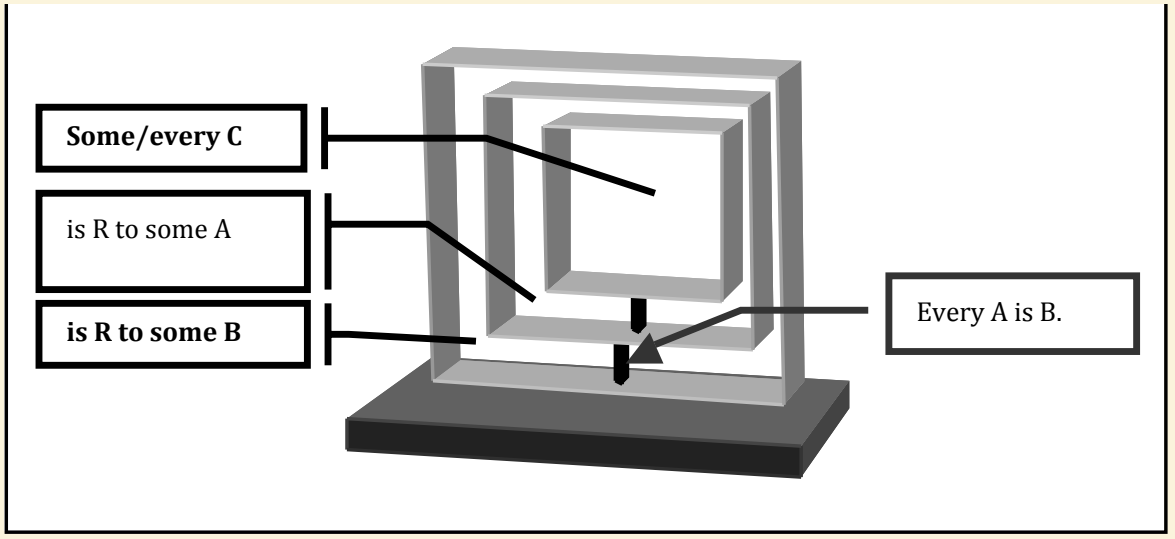
Every A is B.

Some/every C is R to some A.

So some/every is C is R to some B.



	DEFEASIBLE CLASS-INCLUSION TRANSITIVITY				Premise Assumptions
		Subject phrase		Predicate phrase	
1	→	**Some/every C**		...is R to some A.	
2	Any who (that).. .	...is R to some A ...		**...is R to some B.**	Every A is B.
		CONCLUSION			
		Some/every C is R to some B.			



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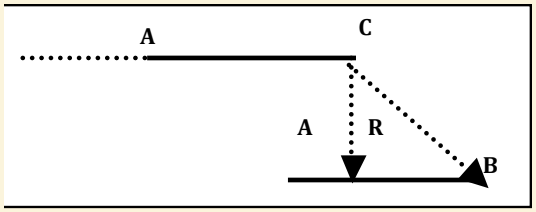
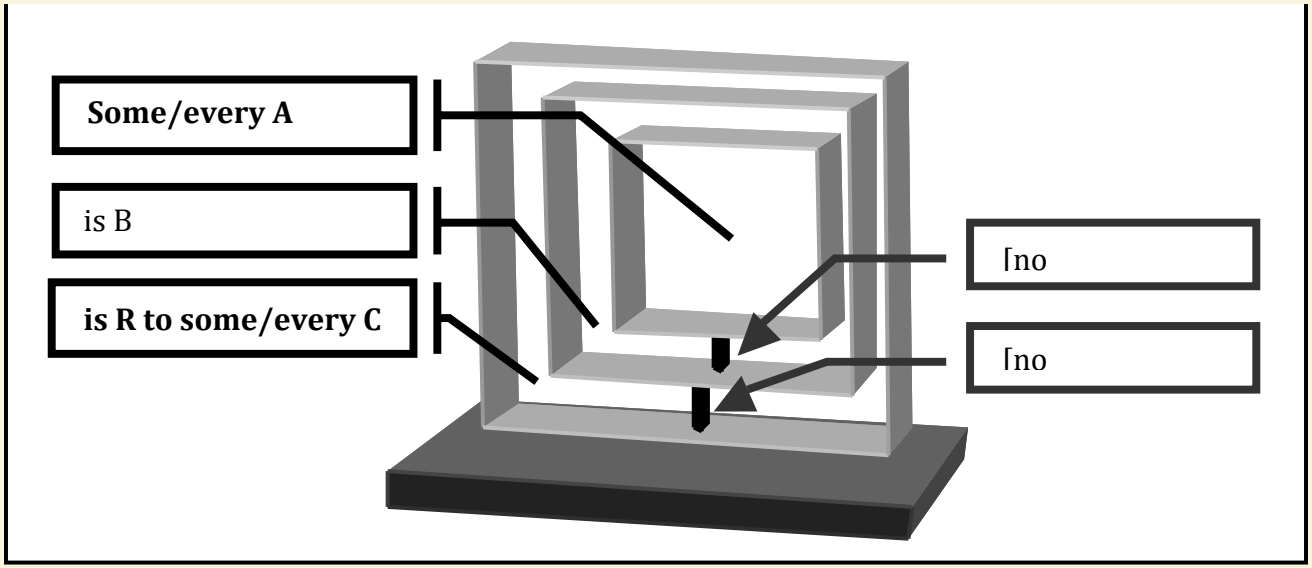
Some/every A is B.

Every B is R to some/every C.

So some/every A is R to some/every C.



		DEFEASIBLE CLASS-INCLUSION TRANSITIVITY			Premise Assumptions
		Subject phrase		Predicate phrase	
1	→	**Some/every A**		...is B	[no relevant assumptions]
2	Any who (that).. .	...is B		**...is R to some/every C**	[no relevant assumptions]
		CONCLUSION			
		Some/every A is R to some/every C.			



Englebretsen, G. (1998). *Line diagrams for logic: Drawing conclusions*. Lewiston, NY: The Edwin Mellen Press.

The following is a similar example (Figure 25) with a modus tollens form after regimenting the premises into a DCIT form.

If Bob stays, Jane will leave.
Jane is not leaving.
So Bob is not staying.

	DEFEASIBLE CLASS-INCLUSION TRANSITIVITY					Premise Assumptions
		Subject phrase		Predicate phrase		
1	→	**The state of affairs**		...is Jane is not leaving.		
2	Any who (that)...	...is Jane is not leaving..		**... is Bob is not staying.**		
		CONCLUSION				
3		**The state of affairs is Bob is not staying.**				

FIGURE 25. DCIT inference template for modus tollens.

Englebretsen, G. (1998). *Line diagrams for logic: Drawing conclusions*. Lewiston, NY: The Edwin Mellen Press.

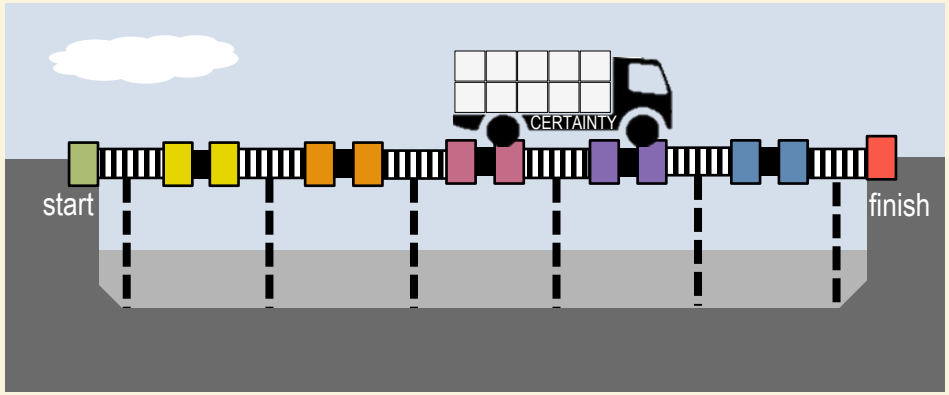
The following example (modus ponens) (Figure 26) is adapted directly from Englebretsen [6, p. 58].

If Bob stays, Jane will leave.
Bob will stay.
So Jane will leave.

	DEFEASIBLE CLASS-INCLUSION TRANSITIVITY					Premise Assumptions
		Subject phrase		Predicate phrase		
1	→	**The state of affairs**		...is Bob will stay.		
2	Any who (that)	...is Bob will stay...		**... is Jane will leave.**		
		CONCLUSION				
3		**The state of affairs is Jane will leave.**				

FIGURE 26. DCIT inference template for modus ponens.

AI and DCIT (dee•kit)



Debowska, K., Lozinski, P. & Reed, C. (2009). "Building Bridges between Everyday Argument and Formal Representations of Reasoning", 16 (29) Studies in Logic, Grammar and Rhetoric, 95-135.

"The gap between natural argumentation text and formal, machine processible argument structures is in large part due to lack of a single, easily extractable formal structure that every argument would reveal."*

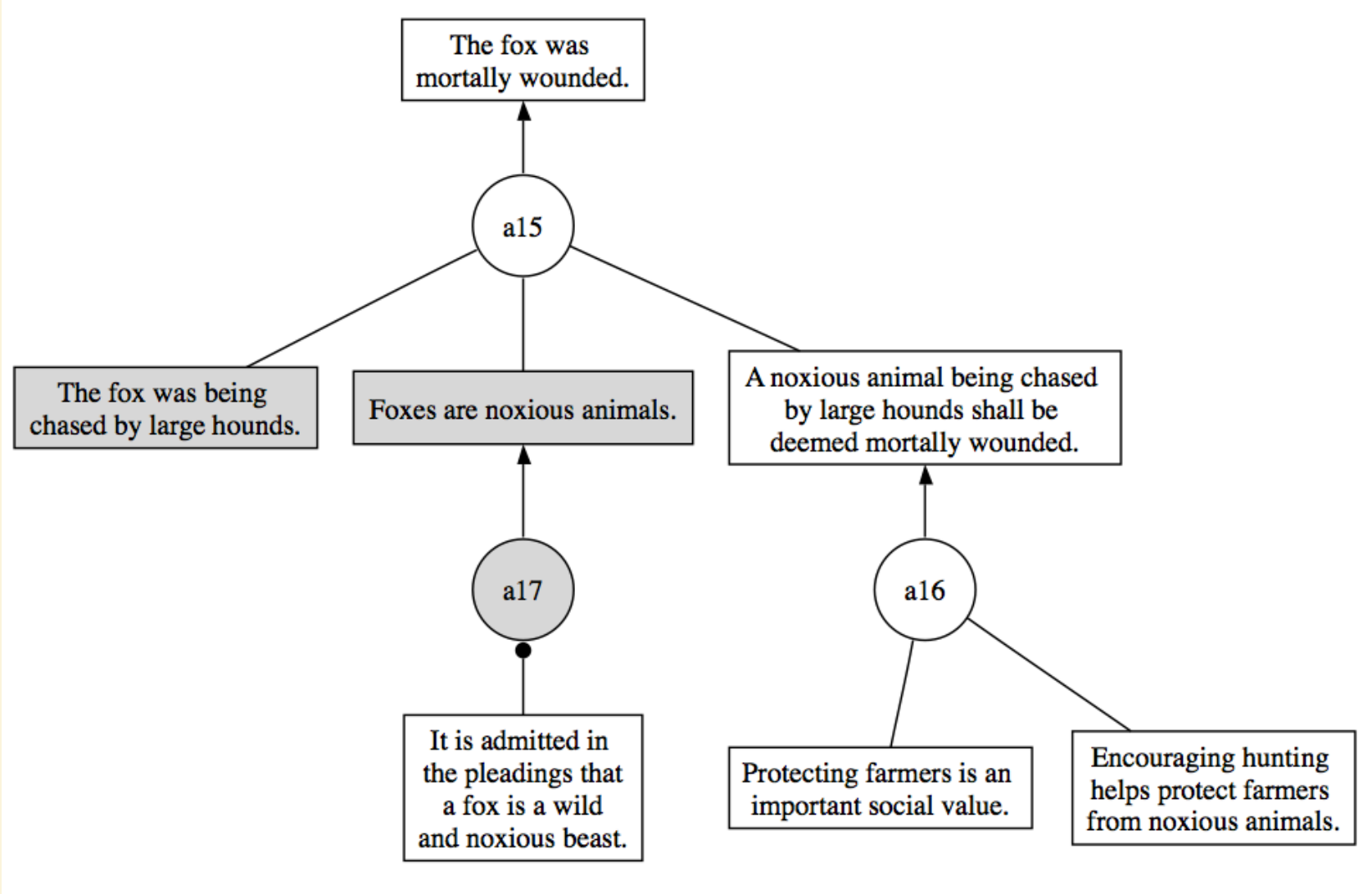
❖ ❖ ❖ ❖ ❖

DCIT is an expression of one such formalism that attempts to achieve such universality and ease of extractability through its logical syntax.

"In AI (& Law), one means of demonstrating different argumentation frameworks and computational models is to illustrate them with legal cases. For example, *Pierson v. Post*, 3 Cai. R. 175 (N.Y. 1805)..."

In AI (& Law), one means of demonstrating different argumentation frameworks and computational models is to illustrate them with legal cases. For example, *Pierson v. Post*, 3 Cai. R. 175 (N.Y. 1805) has been commonly used as a standard example. The issue in this case is "[w]hether a person who, with his own hounds, starts and hunts a fox on waste and uninhabited ground, and is on the point of seizing his prey, acquires such an interest in the animal as to have a right of action against another, who in view of the huntsman and his dogs in full pursuit, and with knowledge of the chase, shall kill and carry him away."

Gordon, T. F., & Walton, D. (2006). Pierson vs. Post Revisited. *Frontiers in Artificial Intelligence and Applications*, 144, 208.



DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	**The fox**…	…is a noxious animal according to the admissions in the pleading
2	Any such that…	…is a noxious animal according to the admissions in the pleadings…	…is a noxious animal.
3	Any such that…	…is a noxious animal…	..should have the act of their being hunted encouraged to promote the important social value of protecting farmers.
4	Any such that…	..should have the act of their being hunted encouraged to promote the important social value of protecting farmers…	...should have the act of their being chased by large hounds encouraged to promote the important social value of protecting farmers.
5	Any such that…	...should have the act of their being chased by large hounds encouraged to promote the important social value of protecting farmers…	..**shall be deemed mortally wounded**.
CONCLUSION			
		The fox…	..**shall be deemed mortally wounded.**
ASSUMPTIONS TO LINKED PREMISES			
5	The noxious animal was actually being chased by hounds.		

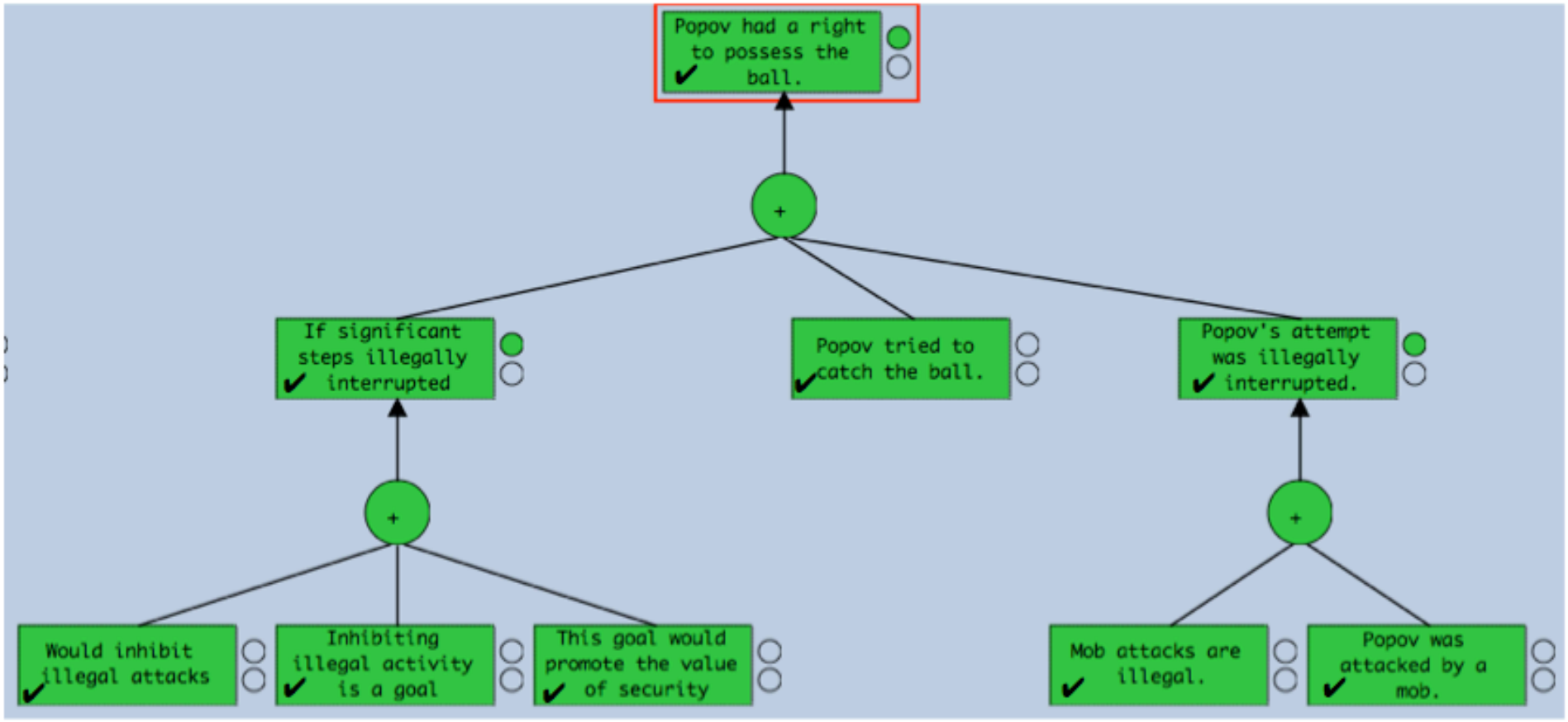
DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	**The fox**…	…is a "wild and noxious beast," hostile to humans, that harms the work of farmers.
2	Any such that…	…is a "wild and noxious beast," hostile to humans, that harms the work of farmers...	…is a "wild and noxious beast," whose killing wherever found is meritorious and of public benefit.
3	Any such that…	…is a "wild and noxious beast," whose killing wherever found is meritorious and of public benefit...	… is a "wild and noxious beast:" that should have the act of destroying them encouraged.
4	Any such that…	… is a "wild and noxious beast:" that should have the act of destroying them encouraged...	…is a "wild and noxious beast" that pursuit like the present confers such a right to the object of it, as to make any one a wrong-doer who shall interfere and shoulder the spoil.
5	Any such that…	…is a "wild and noxious beast" that pursuit like the present confers such a right to the object of it, as to make any one a wrong-doer who shall interfere and shoulder the spoil...	…**shall be deemed to have been in the possession of Post who had a good claim of trespass.**
CONCLUSION			
		The fox…	…**shall be deemed to have been in the possession of Post who had a good claim of trespass.**
ASSUMPTIONS TO LINKED PREMISES			
	NOT INDICATED		

> "*Popov v. Hayashi*, 2002 WL 31833731 (Ca. Sup. Ct. 2002) is another case whose reasoning has been modeled to illustrate an argumentation framework."

"*Popov v. Hayashi*, 2002 WL 31833731 (Ca. Sup. Ct. 2002) is another case whose reasoning has been modeled to illustrate an argumentation framework. A portion of that reasoning is modeled here with a DCIT framework.

The main issue was whether Popov or Hayashi had an ownership interest in a baseball hit into the stands at the ballpark. While Popov momentarily touched the ball, it ended up in Hayashi's pocket (see Figures 39-41)."

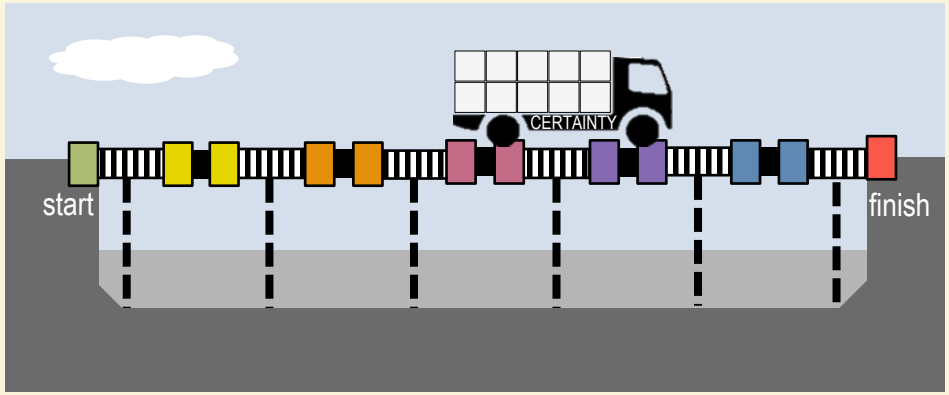
Gordon, Thomas F., and Douglas Walton. "A Carneades reconstruction of Popov v Hayashi." *Artificial Intelligence and Law* 20.1 (2012): 37-56.



DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	**Hayashi**...	…discovered the loose baseball and put it in his pocket.
2	Any one that…	…discovered the loose baseball and put it in his pocket...	…acquired unequivocal dominion and control of the baseball.
3	Any one that…	…acquired unequivocal dominion and control of the baseball...	…assumed full possession of the baseball subject to the cloud of Papov's claim.
4	Any one that…	…assumed full possession of he baseball subject to the cloud of Papov's claim...	…had an equal undivided interest in the baseball with Papov.
5	Any one that…	…had an equal undivided interest in the baseball with Papov...	**…is entitled to share the proceeds of the sale equally with Papov.**
CONCLUSION			
		Hayashi...	**…is entitled to share the proceeds of the sale equally with Papov.**
ASSUMPTIONS TO LINKED PREMISES			
4	A1. That one was not a wrongdoer in acquiring possession of the ball. A2. Papov had a prior legitimate claim.		
5	A1. That one and Papov had a claim of equal dignity as to each other.		

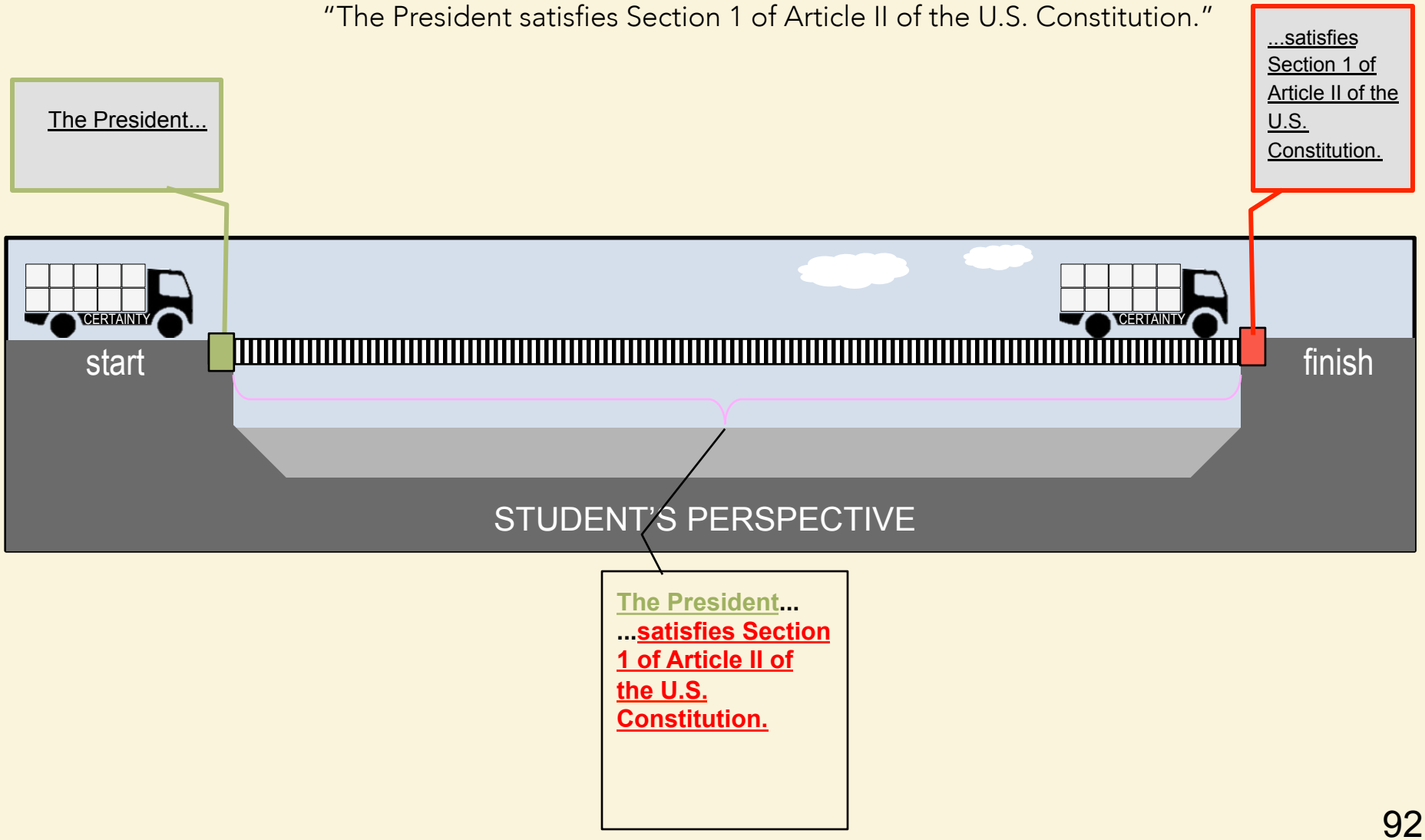
DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	**Popov**...	…had the hit ball momentarily touch his glove as he was falling before striking the ground as his attempted catch was interrupted by the unlawful acts of the crowd attacking him.
2	Any one that…	…had the hit ball momentarily touch his glove as he was falling before striking the ground as his attempted catch was interrupted by the unlawful acts of the crowd attacking him...	…undertook significant but incomplete steps to achieve possession of abandoned personal property that was interrupted by the unlawful acts of others.
3	Any one that…	…undertook significant but incomplete steps to achieve possession of abandoned personal property that was interrupted by the unlawful acts of others...	…has a legally cognizable pre-possessory interest in the property.
4	Any one that…	…has a legally cognizable pre-possessory interest in the property...	…**had a qualified right to possession which can support a cause of action for conversion.**
CONCLUSION			
		Popov...	…**had a qualified right to possession which can support a cause of action for conversion.**
ASSUMPTIONS TO LINKED PREMISES			
3	A1. That one is seeking an action in equity. (NECESSARY) A2. A court sitting in equity has the authority to fashion rules and remedies to achieve fundamental fairness. (NECESSARY)		

Argument Dialogue



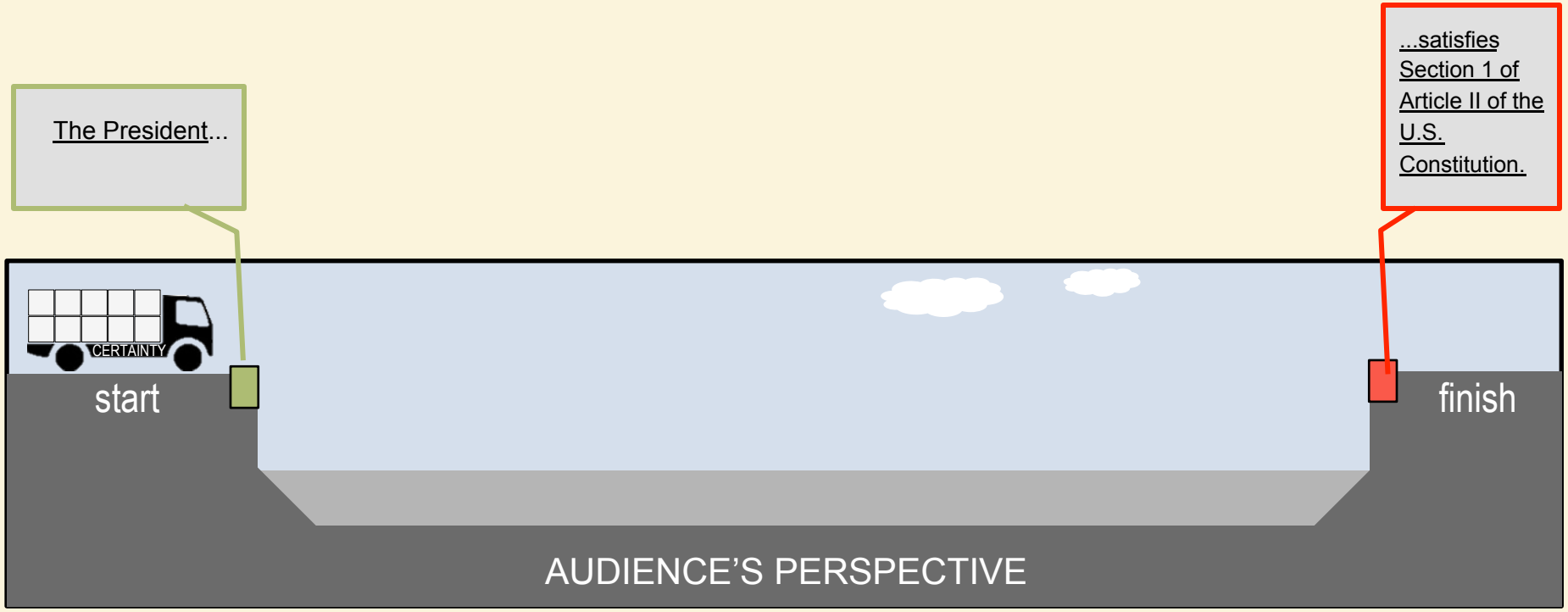
MAIN CONCLUSION: The President satisfies Section 1 of Article II of the U.S. Constitution.

STUDENT: My claim (contention) is that
"The President satisfies Section 1 of Article II of the U.S. Constitution."



MAIN CONCLUSION: The President satisfies Section 1 of Article II of the U.S. Constitution.

AUDIENCE'S: How did you reach that conclusion?

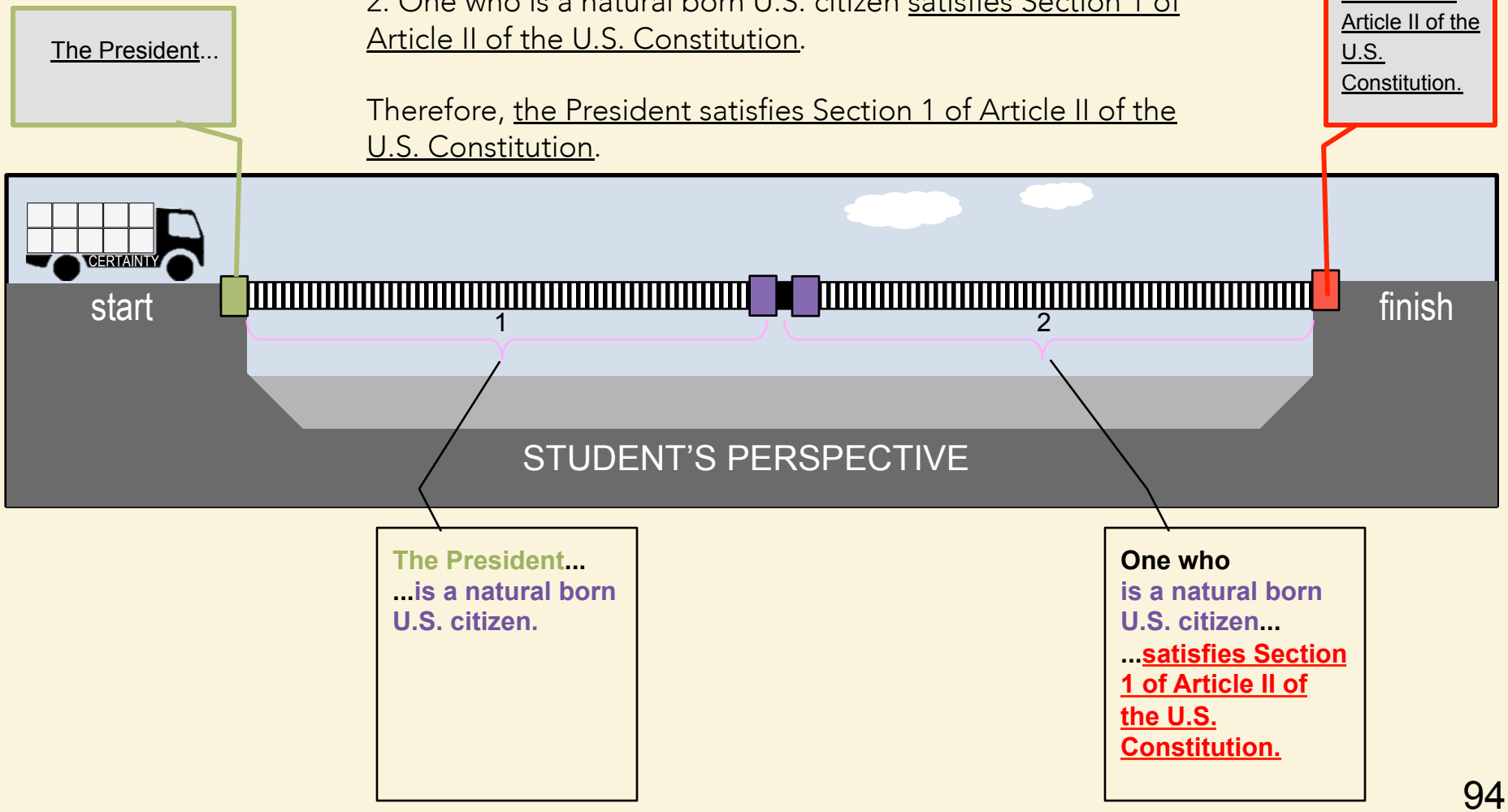


MAIN CONCLUSION: The President satisfies Section 1 of Article II of the U.S. Constitution.

STUDENT: My line of reasoning consists of two premises:

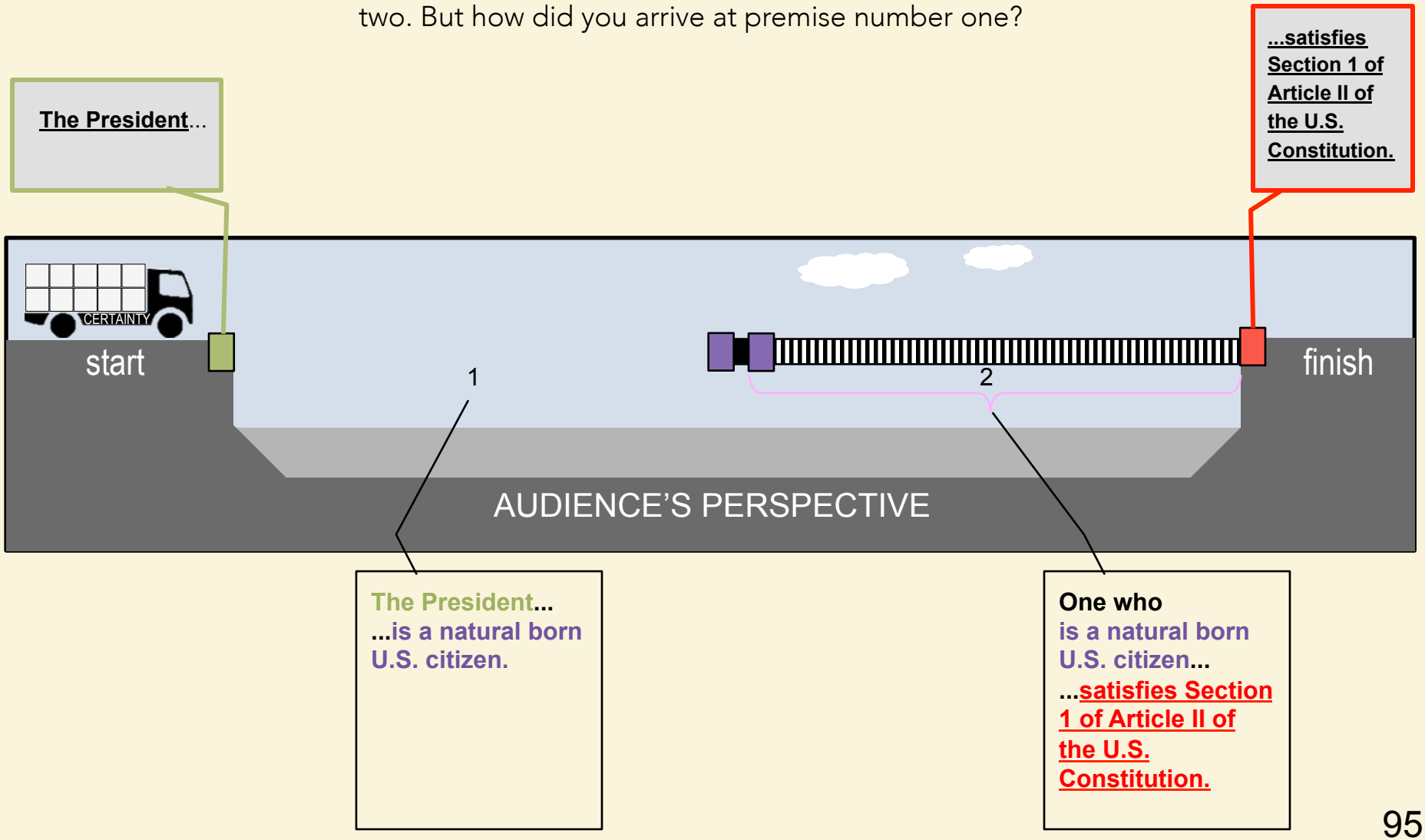
1. The President is a natural born U.S. citizen.
2. One who is a natural born U.S. citizen satisfies Section 1 of Article II of the U.S. Constitution.

Therefore, the President satisfies Section 1 of Article II of the U.S. Constitution.



MAIN CONCLUSION: The President satisfies Section 1 of Article II of the U.S. Constitution.

AUDIENCE: I agree to some extent with your premise number two. But how did you arrive at premise number one?

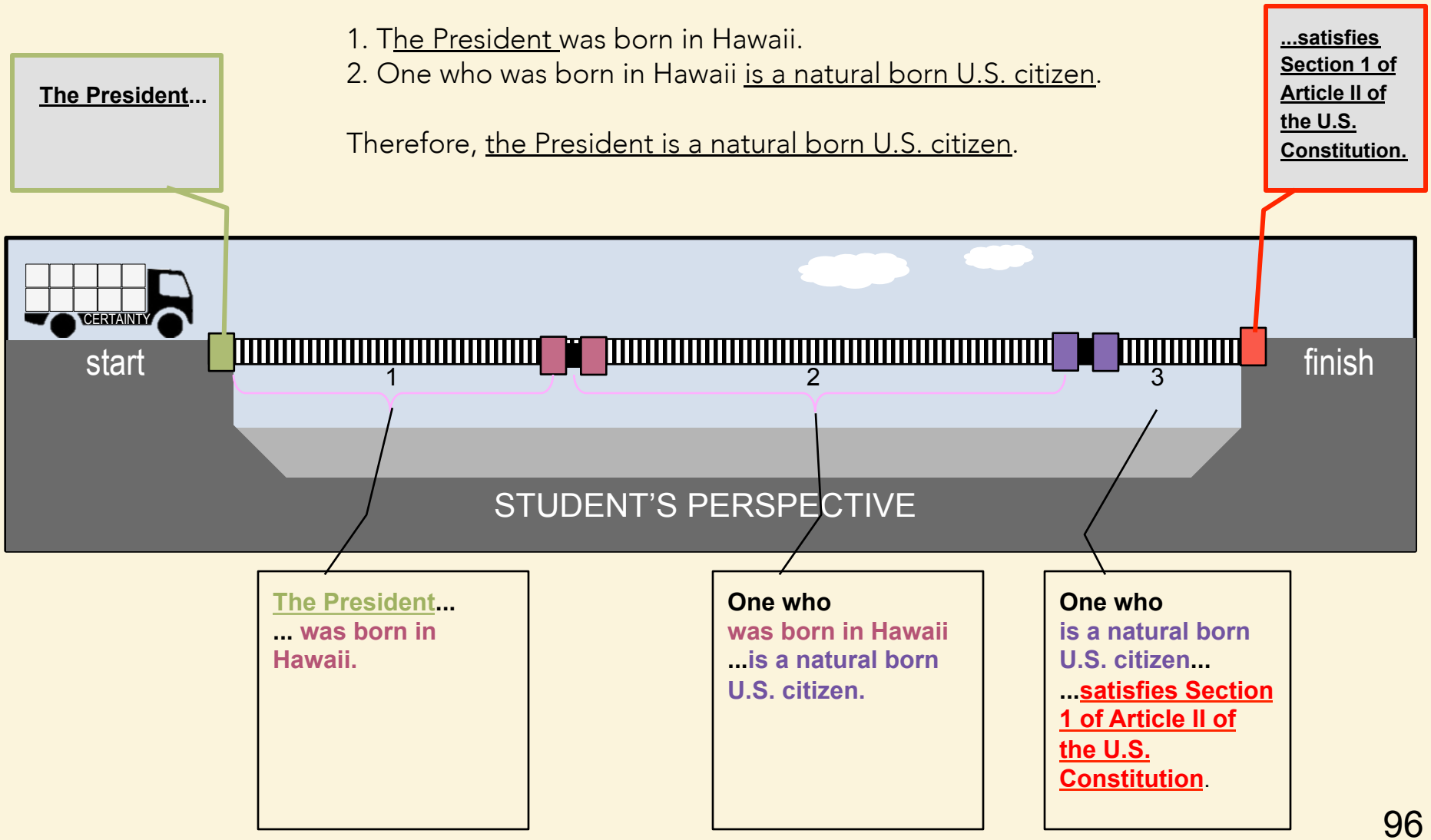


MAIN CONCLUSION: The President satisfies Section 1 of Article II of the U.S. Constitution.

STUDENT: My line of reasoning consists of two premises:

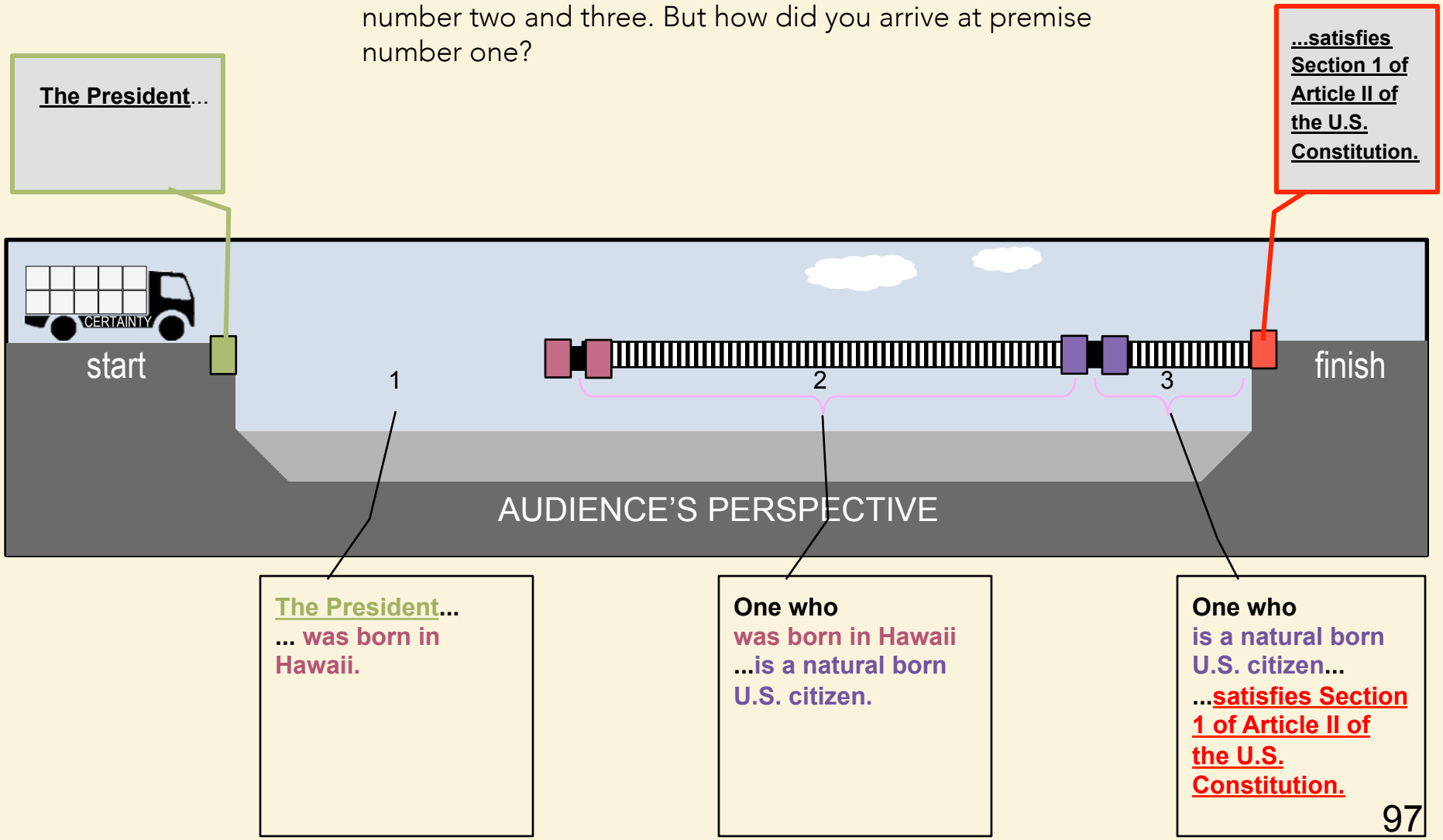
1. The President was born in Hawaii.
2. One who was born in Hawaii is a natural born U.S. citizen.

Therefore, the President is a natural born U.S. citizen.



MAIN CONCLUSION: The President satisfies Section 1 of Article II of the U.S. Constitution.

AUDIENCE: OK. I agree to some extent with your premise number two and three. But how did you arrive at premise number one?



MAIN CONCLUSION: The President satisfies Section 1 of Article II of the U.S. Constitution.

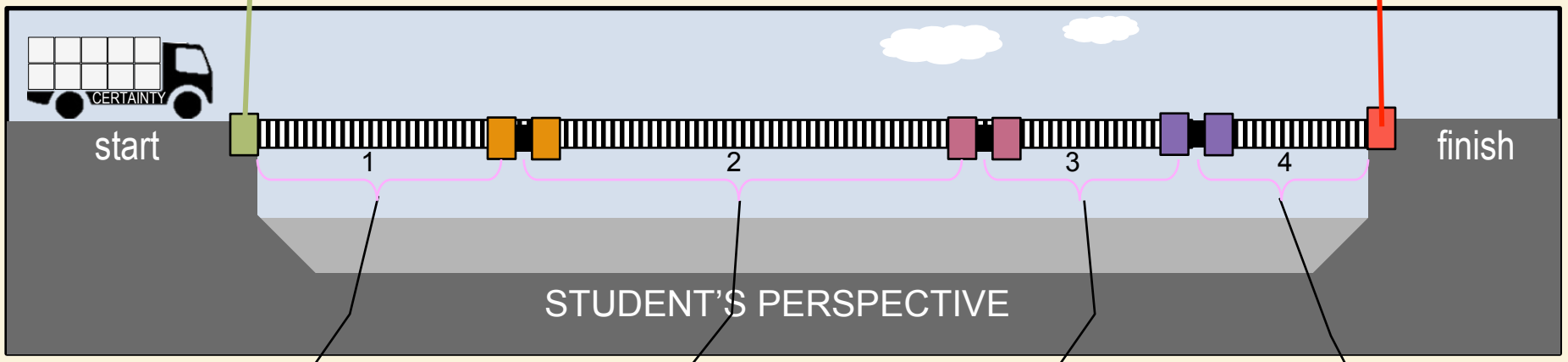
The President...

STUDENT: My line of reasoning consists of two premises:

1. The President has a Hawaiian birth certificate.
2. One who has a Hawaiian birth certificate was born in Hawaii.

Therefore, the President was born in Hawaii.

...satisfies Section 1 of Article II of the U.S. Constitution.



The President...
...has a Hawaiian birth certificate.

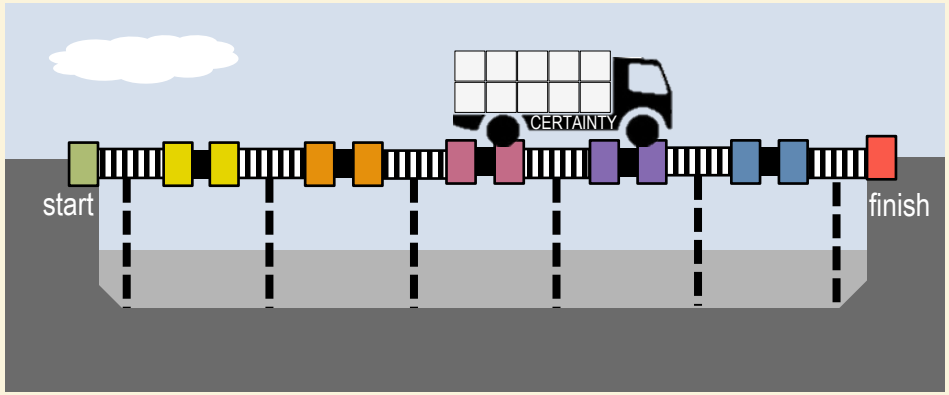
One who
has a Hawaiian birth certificate...
...was born in Hawaii.

One who
was born in Hawaii
...is a natural born U.S. citizen.

One who
is a natural born U.S. citizen...
...satisfies Section 1 of Article II of the U.S. Constitution.

*Toulmin, S. *The Uses of Argument*. (1958). Updated ed. Cambridge: Cambridge UP, 2003.

Toulmin Model*

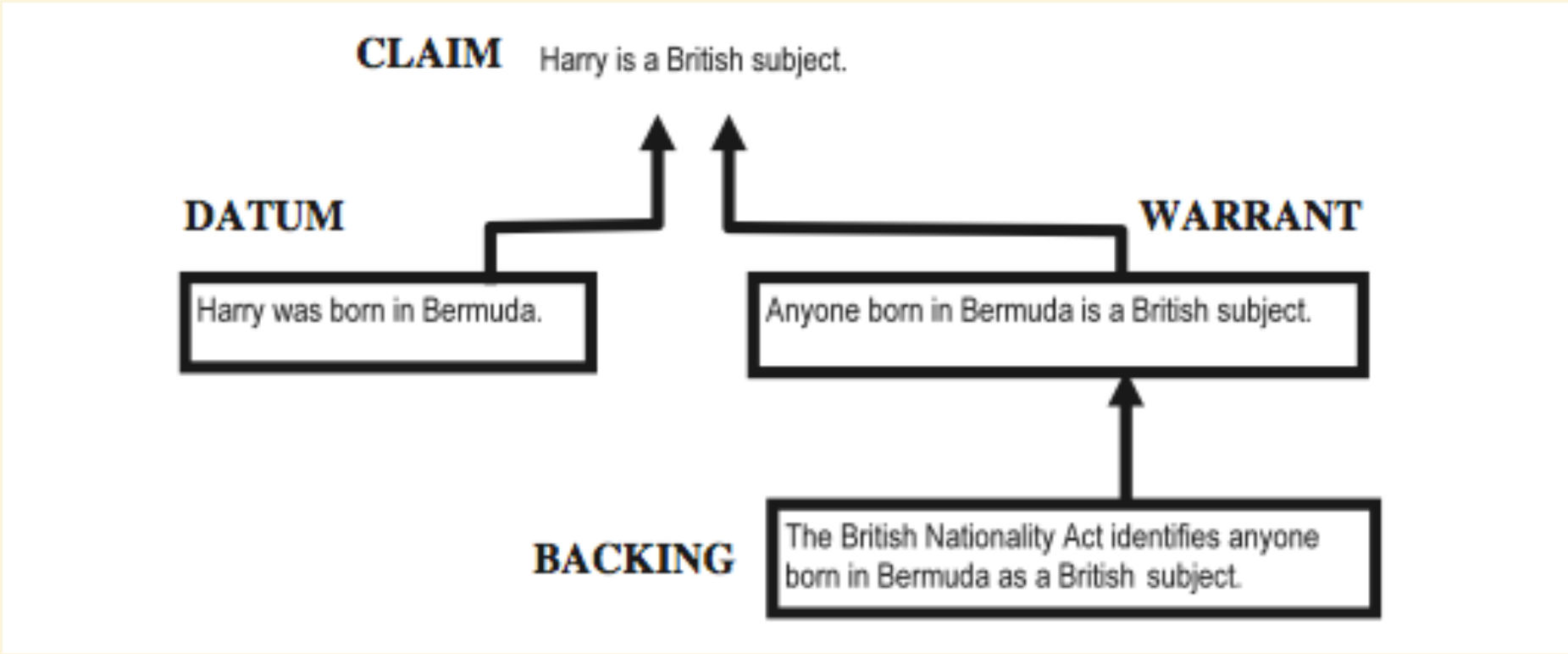


van Eemeren, 'Argumentation: an overview of theoretical approaches and research themes', Argumentation, Interpretation, Rhetoric (online journal) , issue 2 (2002).

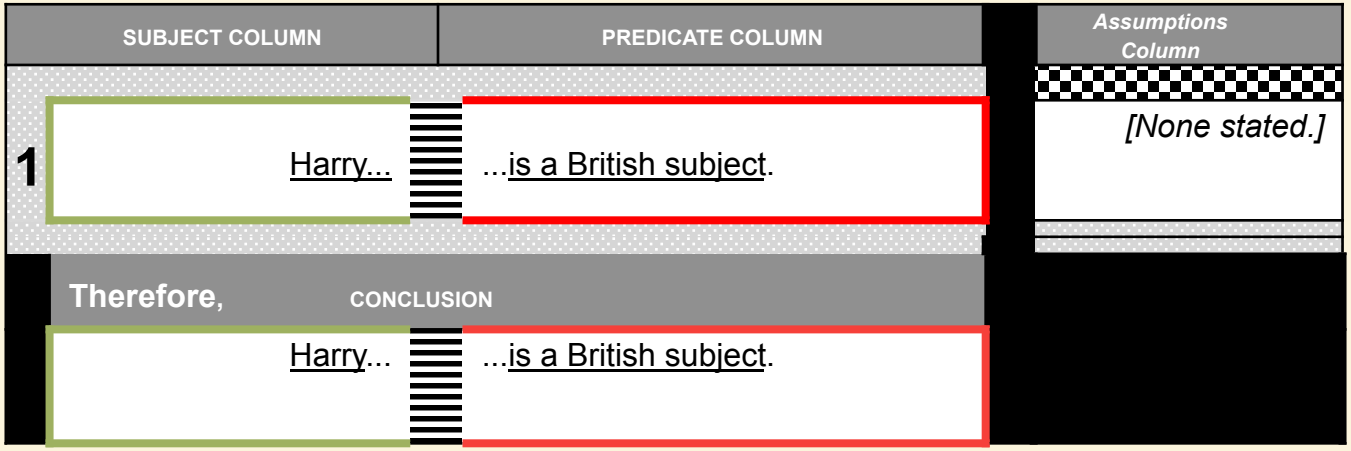
> "Toulmin's definitions, which combine functional and formal differences, are such that data and warrants are in practice difficult to distinguish."

A variety of serious theoretical objections have been raised against Toulmin's views of argumentation and his model. In addition, in concrete cases the model very often appears hard to apply. Toulmin's definitions, which combine functional and formal differences, are such that data and warrants are in practice difficult to distinguish. The distinction between the two is only really clear in carefully selected examples. And without this distinction the model is in fact nothing more than a newly-clad reasoning scheme from classical antiquity, the 'epicheireme'. All the same the model and the connected idea of field-dependent norms of rationality are still extremely popular.

MAIN CONCLUSION: Harry is a British subject.

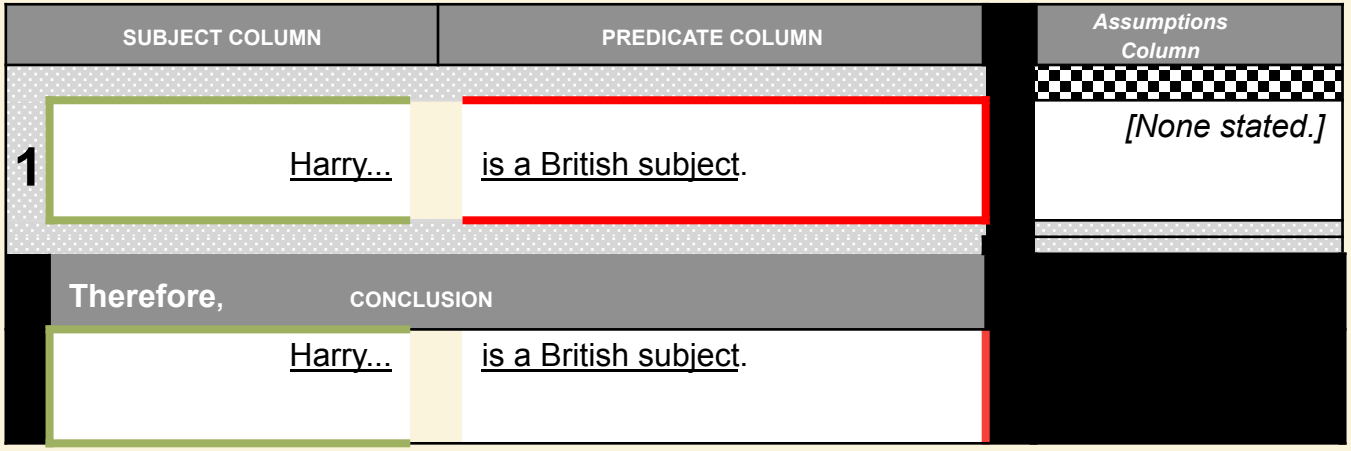


MAIN CONCLUSION: Harry is a British subject.



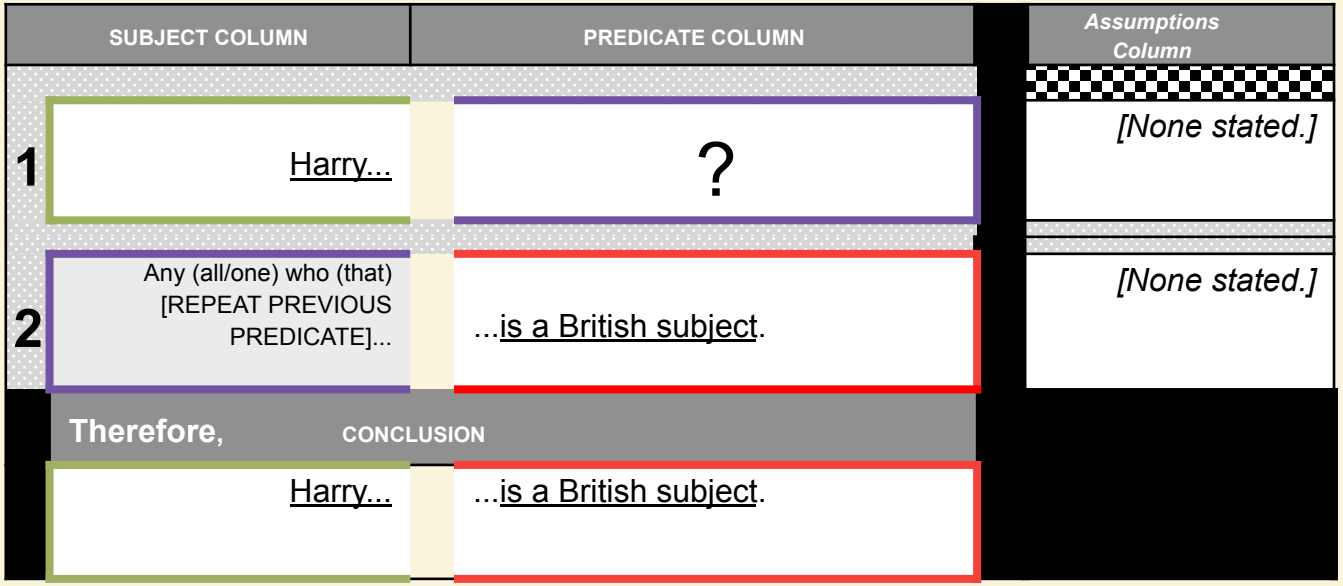
STUDENT: My conclusion (contention) is that "Harry is a British subject."

MAIN CONCLUSION: Harry is a British subject.



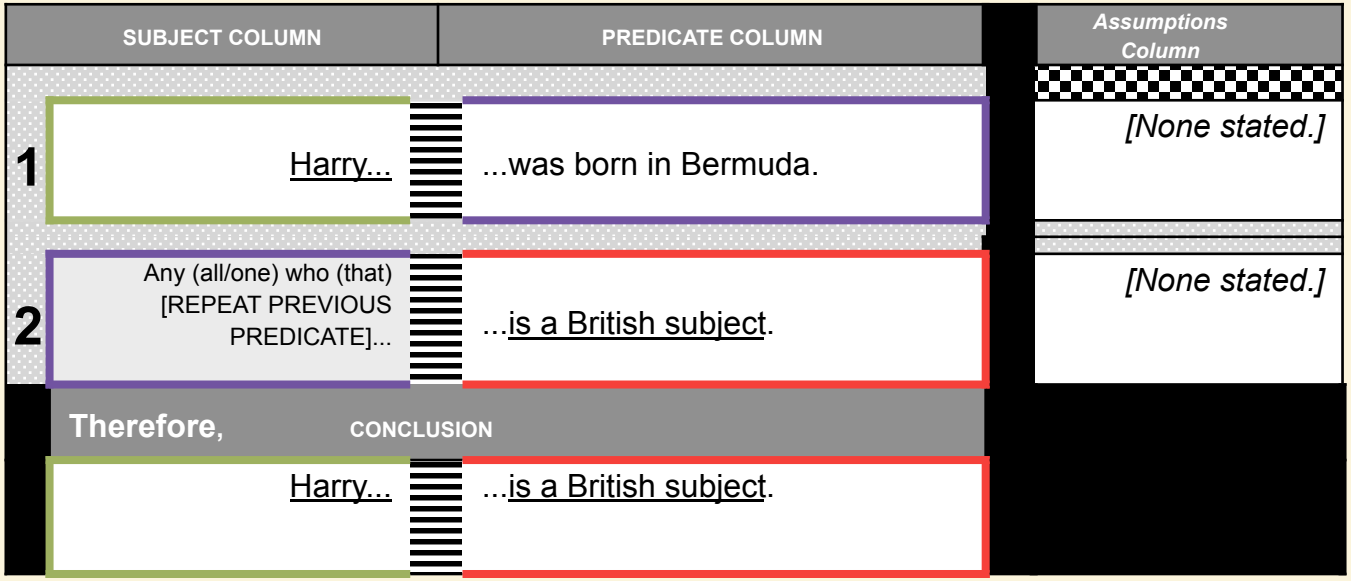
AUDIENCE: How did you reach that conclusion?

MAIN CONCLUSION: Harry is a British subject.



AUDIENCE'S PERSPECTIVE

MAIN CONCLUSION: Harry is a British subject.

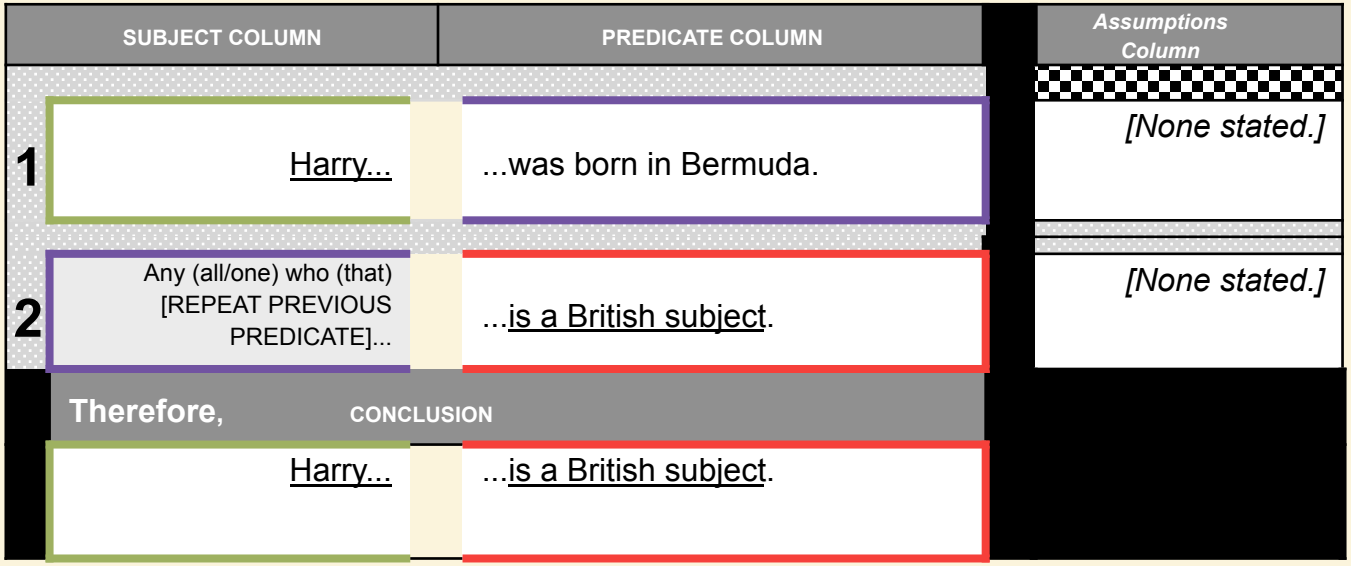


STUDENT: My line of reasoning consists of two premises:

1. Harry was born in Bermuda.
2. One who was born in Bermuda is a British subject.

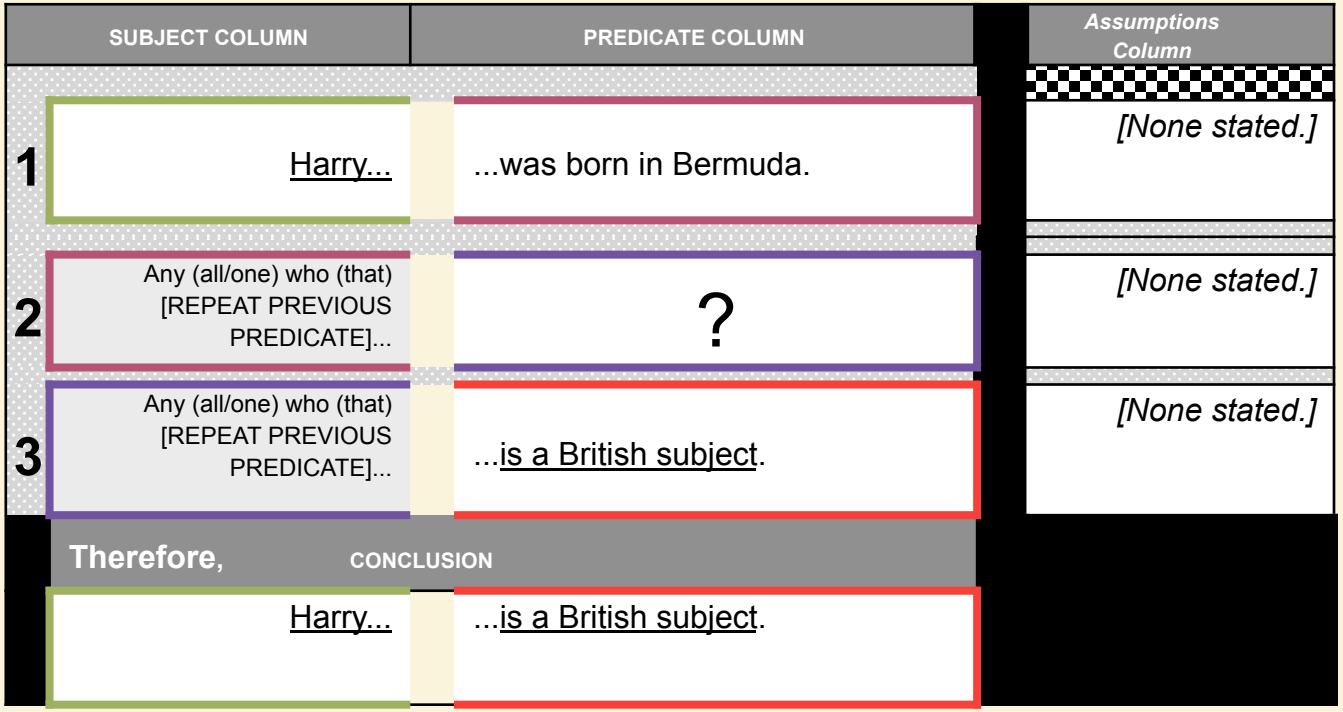
Therefore, Harry is a British subject.

MAIN CONCLUSION: Harry is a British subject.



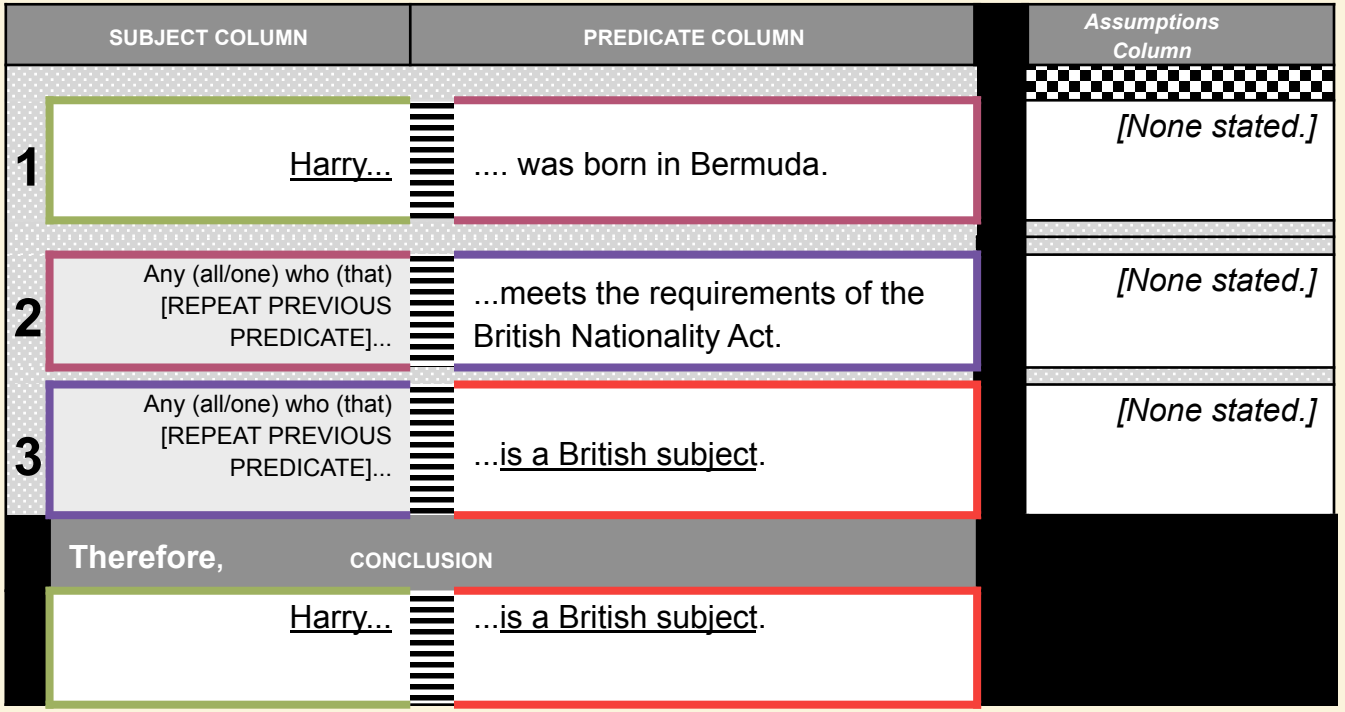
AUDIENCE: How did you arrive at premise number two?

MAIN CONCLUSION: Harry is a British subject.



AUDIENCE'S PERSPECTIVE

MAIN CONCLUSION: Harry is a British subject.

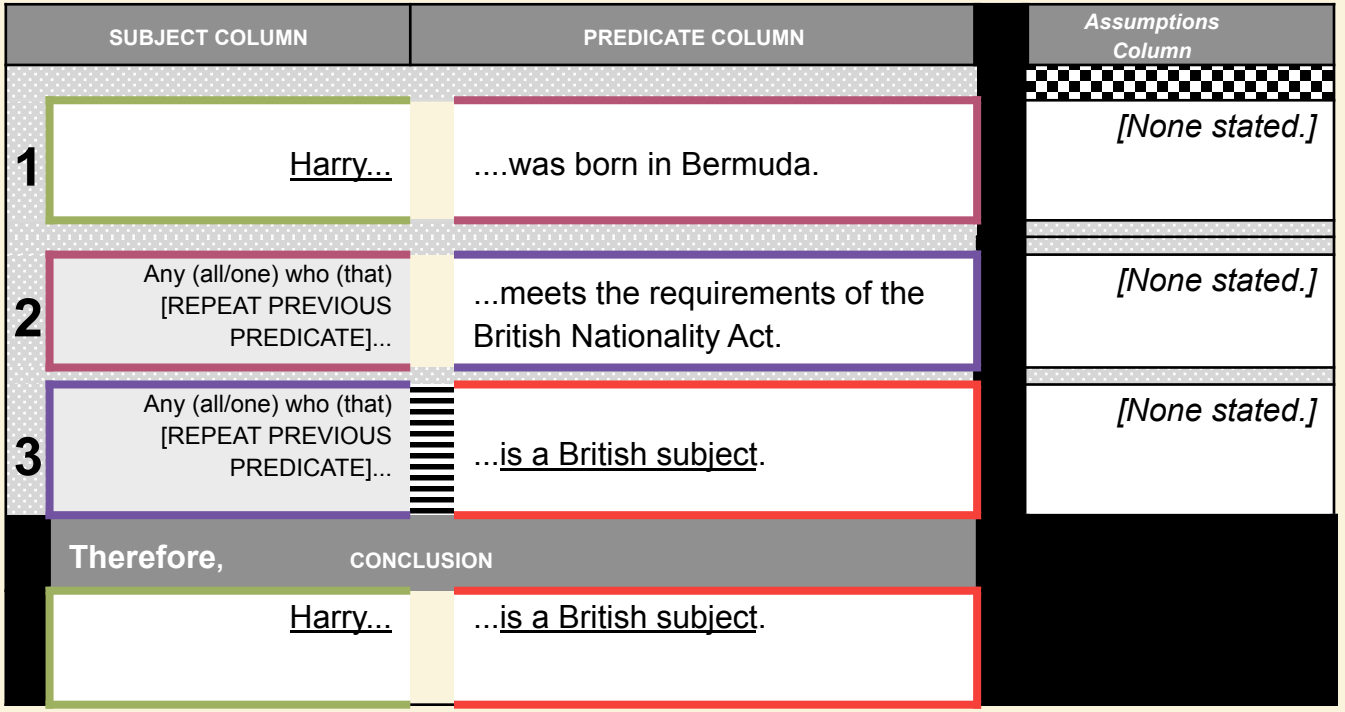


STUDENT: My line of reasoning consists of two premises:

1. Harry meets the requirements of the British Nationality Act.
2. One who meets the requirements of the British Nationality Act is a British subject.

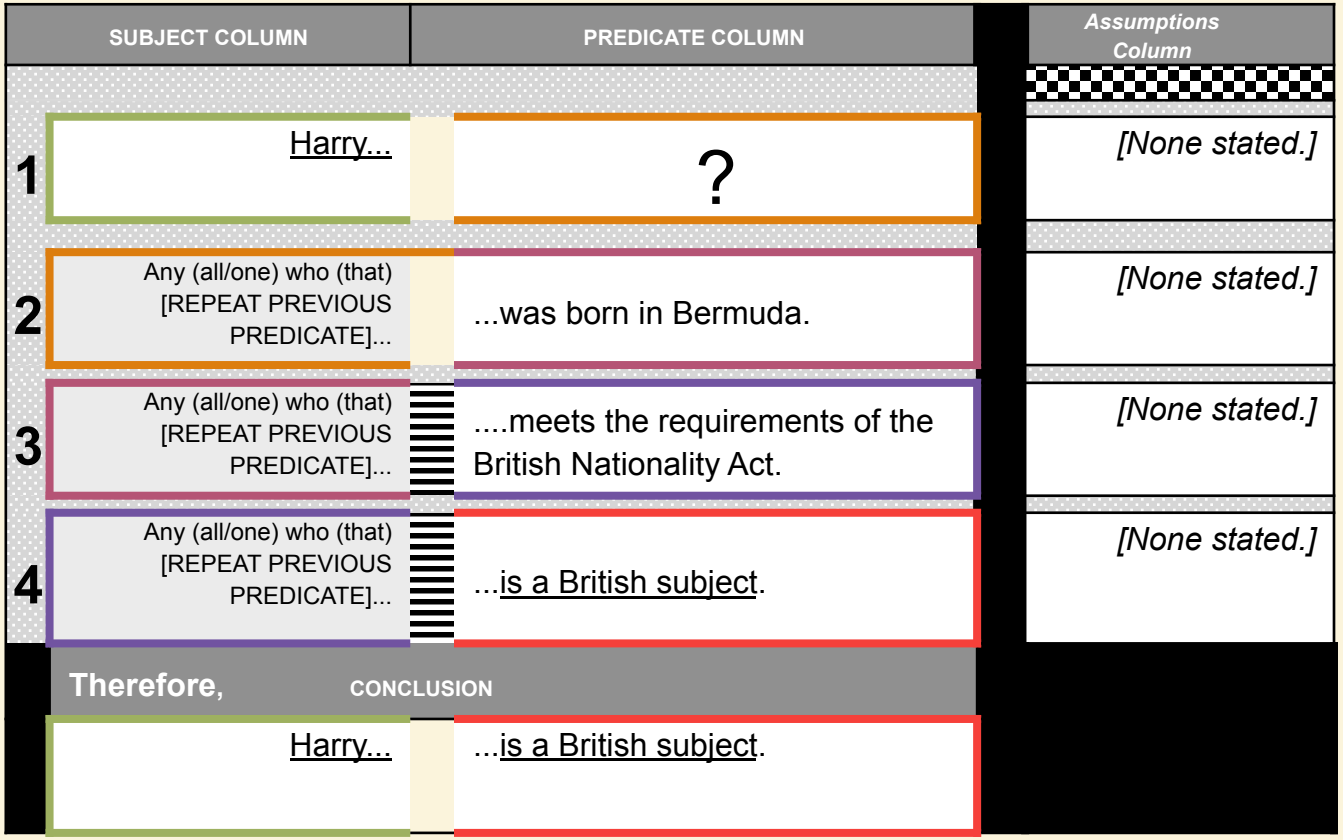
Therefore, Harry is a British subject.

MAIN CONCLUSION: Harry is a British subject.



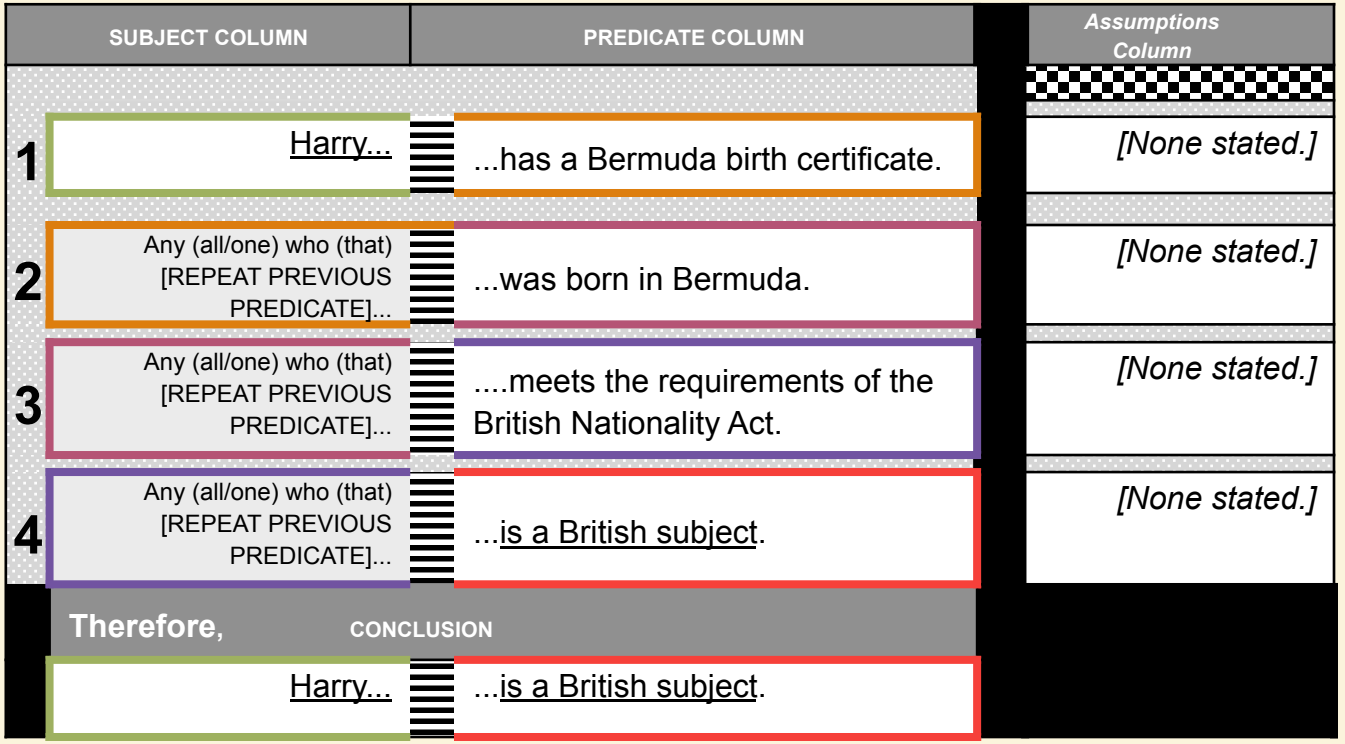
AUDIENCE: OK. I agree to some extent with your premise number two and three. But how did you arrive at premise number one?

MAIN CONCLUSION: Harry is a British subject.



AUDIENCE'S PERSPECTIVE

MAIN CONCLUSION: Harry is a British subject.



STUDENT: My line of reasoning consists of two premises:

1. Harry has a Bermuda birth certificate.
2. One who has a Bermuda birth certificate was born in Bermuda.

Therefore, Harry was born in Bermuda.

MAIN CONCLUSION: Harry is a British subject.

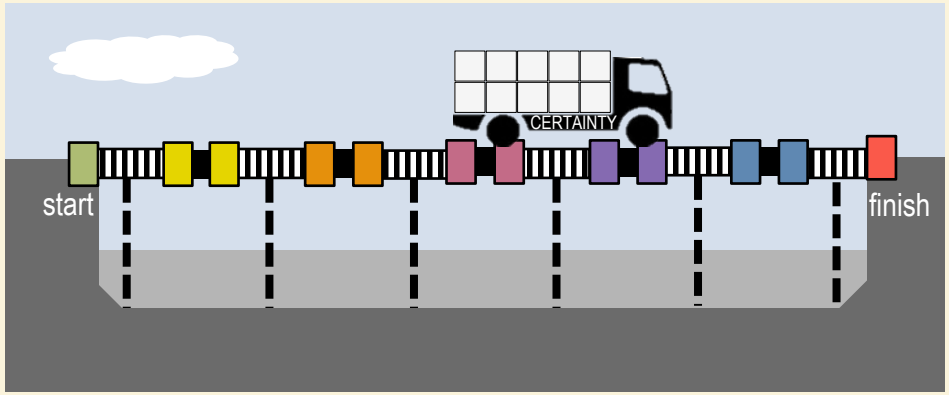
SUBJECT COLUMN	PREDICATE COLUMN	Assumptions Column
START OF INFERENCE PATH — Harry...	...has a Bermuda birth certificate.	[None stated.]
2 — Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	...was born in Bermuda.	[None stated.]
3 — Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	...meets the requirements of the British Nationality Act.	[None stated.]
4 — Any (all/one) who (that) [REPEAT PREVIOUS PREDICATE]...	FINISH OF INFERENCE PATH — ...is a British subject.	[None stated.]
Therefore,	CONCLUSION	
Harry...	...is a British subject.	

STUDENT: My line of reasoning consists of two premises:

1. Harry has a Bermuda birth certificate.
2. One who has a Bermuda birth certificate was born in Bermuda.

Therefore, Harry was born in Bermuda.

Reconstruction



http://www.afp.gov.au/media-centre/publications/platypus/previous-editions/1999/october-1999/murder.aspx

The Queen v. David Harold Eastman / http://courts.act.gov.au/resources/attachments/Eastman10Nov95.pdf

"A defining stage in the AFP's history was the Winchester tragedy. The highest ranking police officer in Australia to be murdered, Assistant Commissioner Colin Winchester was shot twice in the head at point blank range as he was stepping from his car outside his Deakin home in the ACT at about 9.15pm on January 10, 1989.

* * *

The investigation which followed ran for more than five years and led to David Harold Eastman, a Commonwealth public servant on long-term sick leave, being charged with the murder, his trial beginning in the ACT Supreme Court on May 2, 1995.

David Eastman was found guilty by unanimous jury verdict on November 3 the same year and was sentenced to life imprisonment by Justice Kenneth Carruthers, a retired judge of the NSW Court of Criminal Appeal who had been appointed by the ACT executive on a temporary basis as an Acting Judge of the ACT Supreme Court.

* * *

After the trial, AFP Commissioner Mick Palmer said the investigation had been one of the most complex criminal prosecutions ever launched in this country.

It is always a difficult task to build a case based largely on circumstantial evidence. To successfully prosecute a circumstantial case against the width of public allegations and innuendo which related to the Winchester killing was, I believe, quite exceptional."

http://www.afp.gov.au/media-centre/publications/platypus/previous-editions/1999/october-1999/murder.aspx

http://www.afp.gov.au/media-centre/publications/platypus/previous-editions/1999/october-1999/murder.aspx

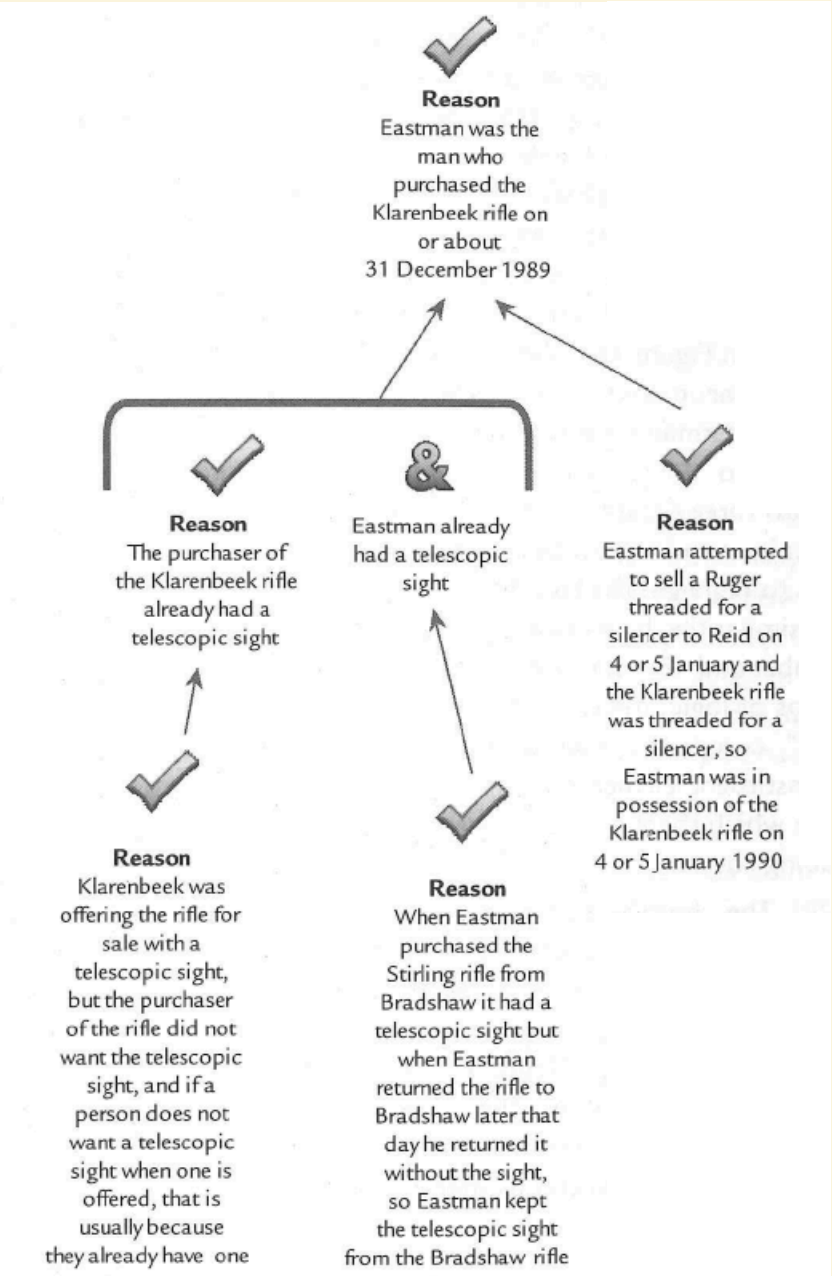
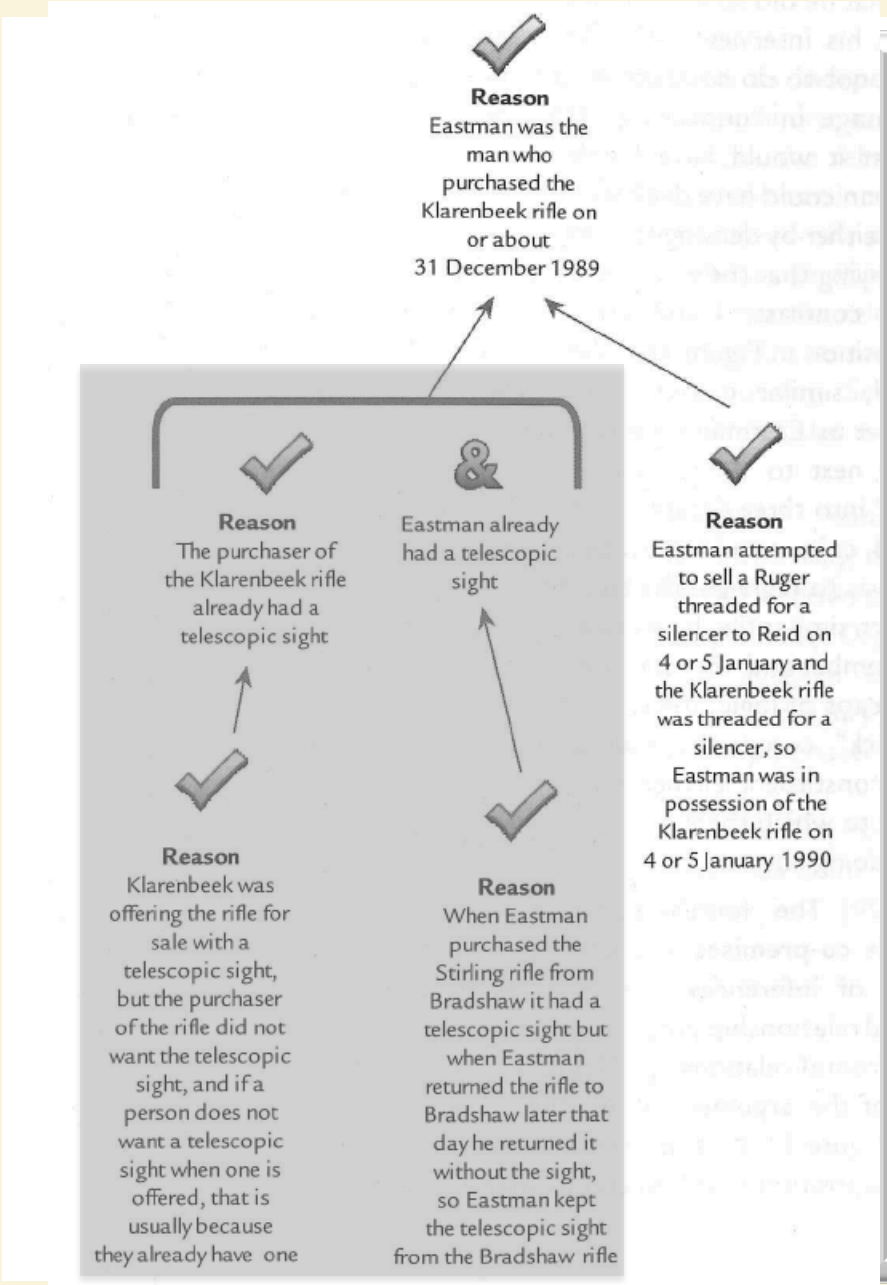


Figure 11.15: Reasoning in the box

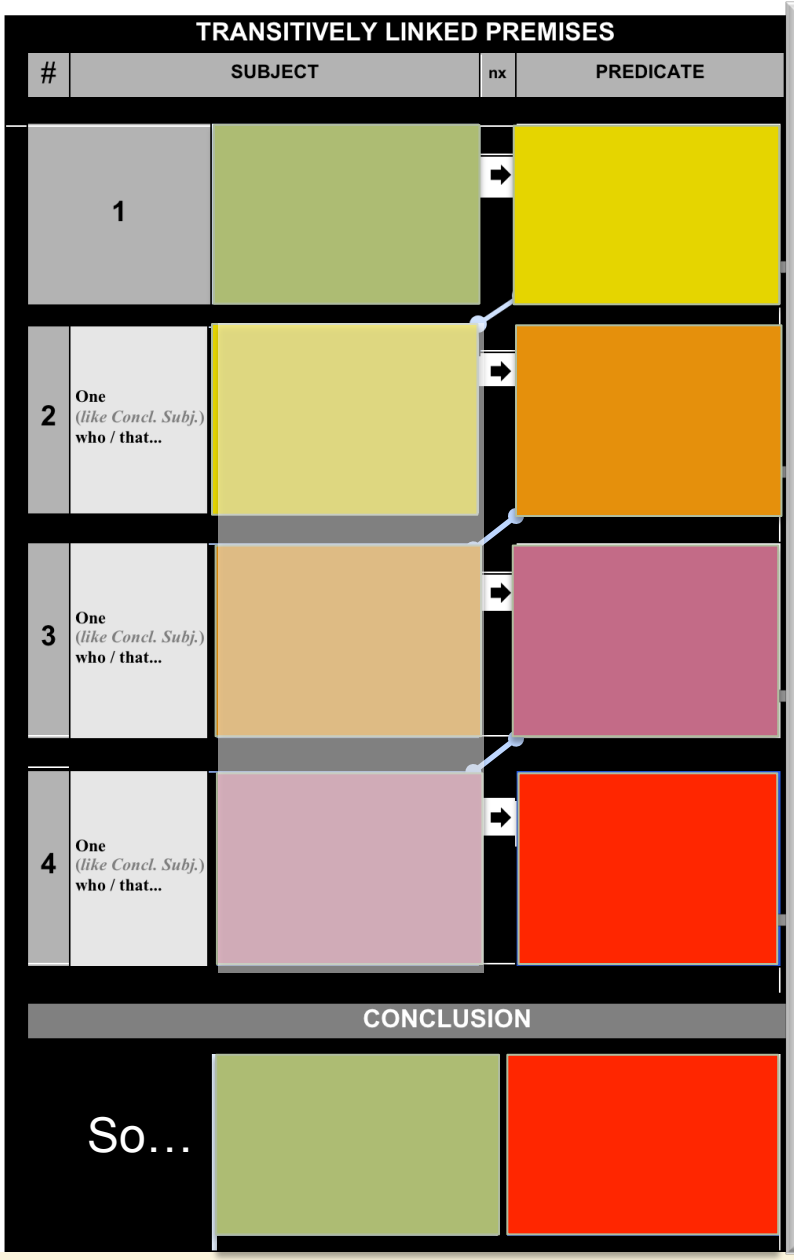
http://www.afp.gov.au/media-centre/publications/platypus/previous-editions/1999/october-1999/murder.aspx

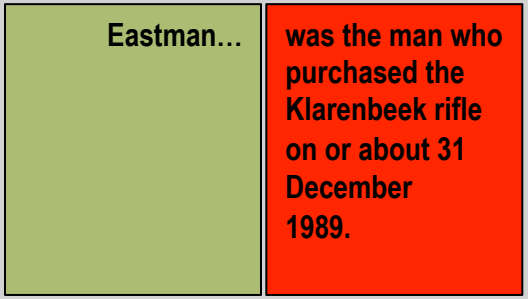


Eastman was the man who purchased the Klarenbeek rifle on or about 31 December 1989.

Eastman attempted to sell a Ruger threaded for a silencer to Reid on 4 or 5 January and the Klarenbeek rifle was threaded for a silencer, so Eastman was in possession of the Klarenbeek rifle on 4 or 5 January 1990.

http://www.afp.gov.au/media-centre/publications/platypus/previous-editions/1999/october-1999/murder.aspx





Eastman attempted to sell a Ruger threaded for a silencer to Reid on 4 or 5 January and the Klarenbeek rifle was threaded for a silencer, so Eastman was in possession of the Klarenbeek rifle on 4 or 5 January 1990.

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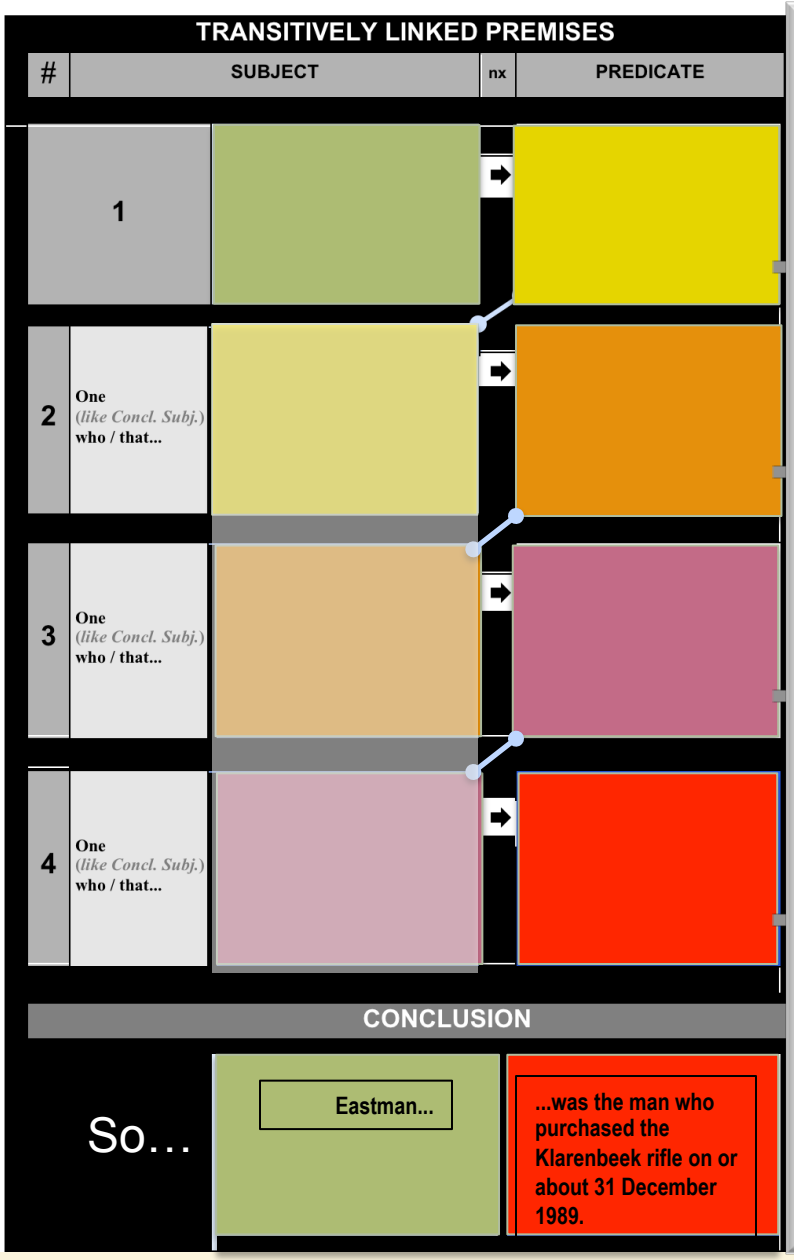

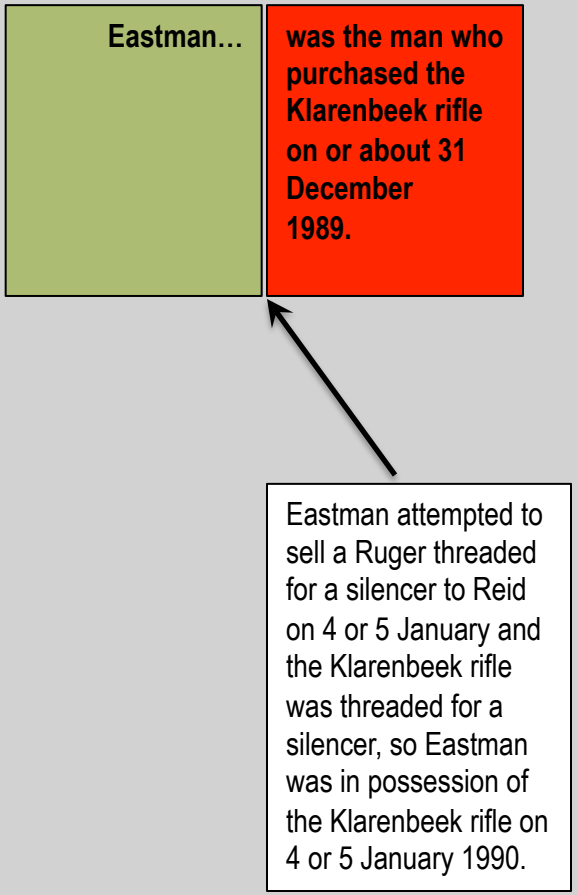

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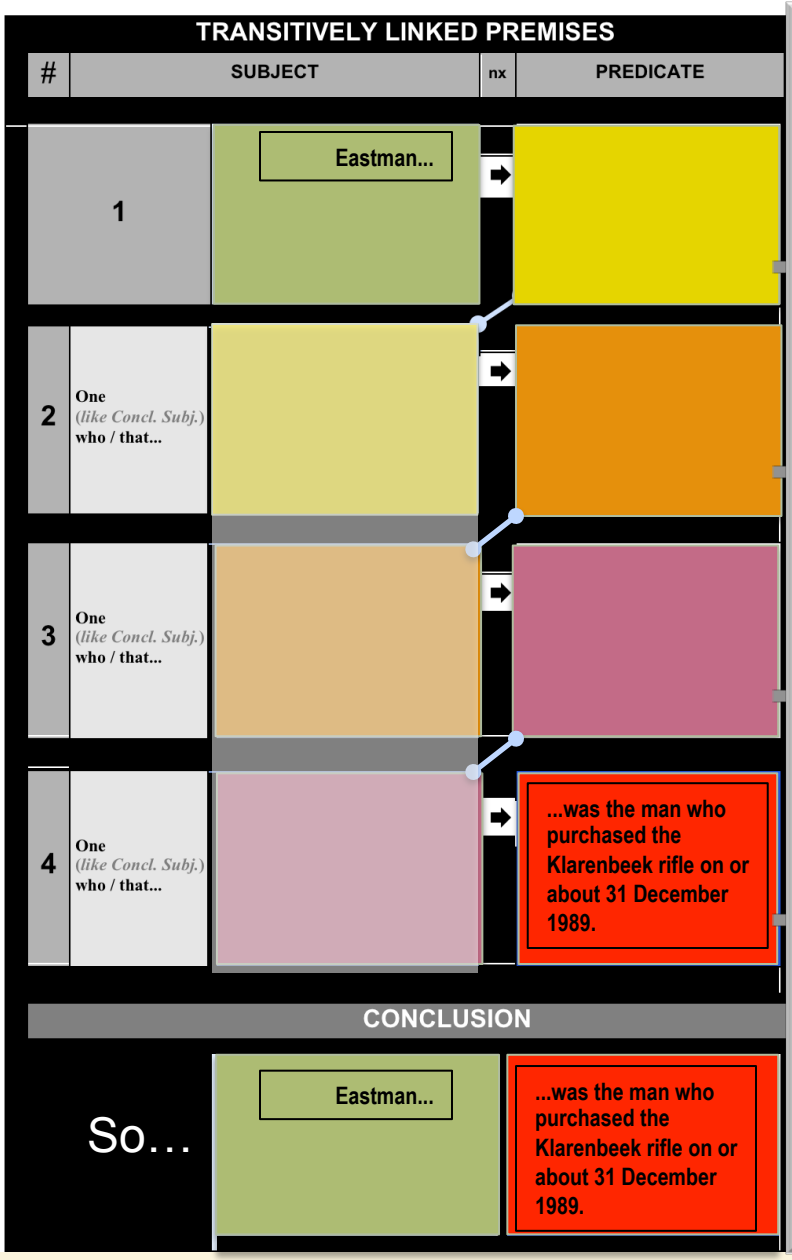

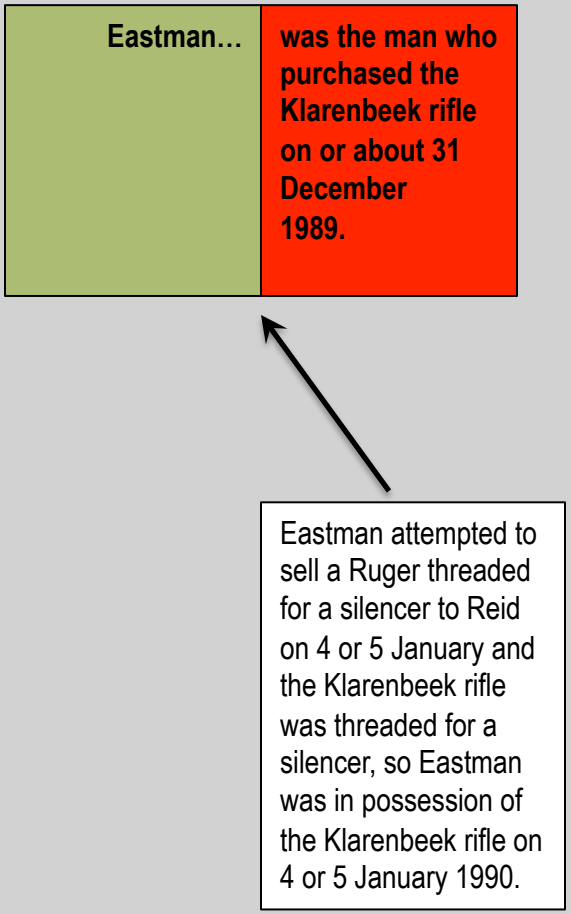

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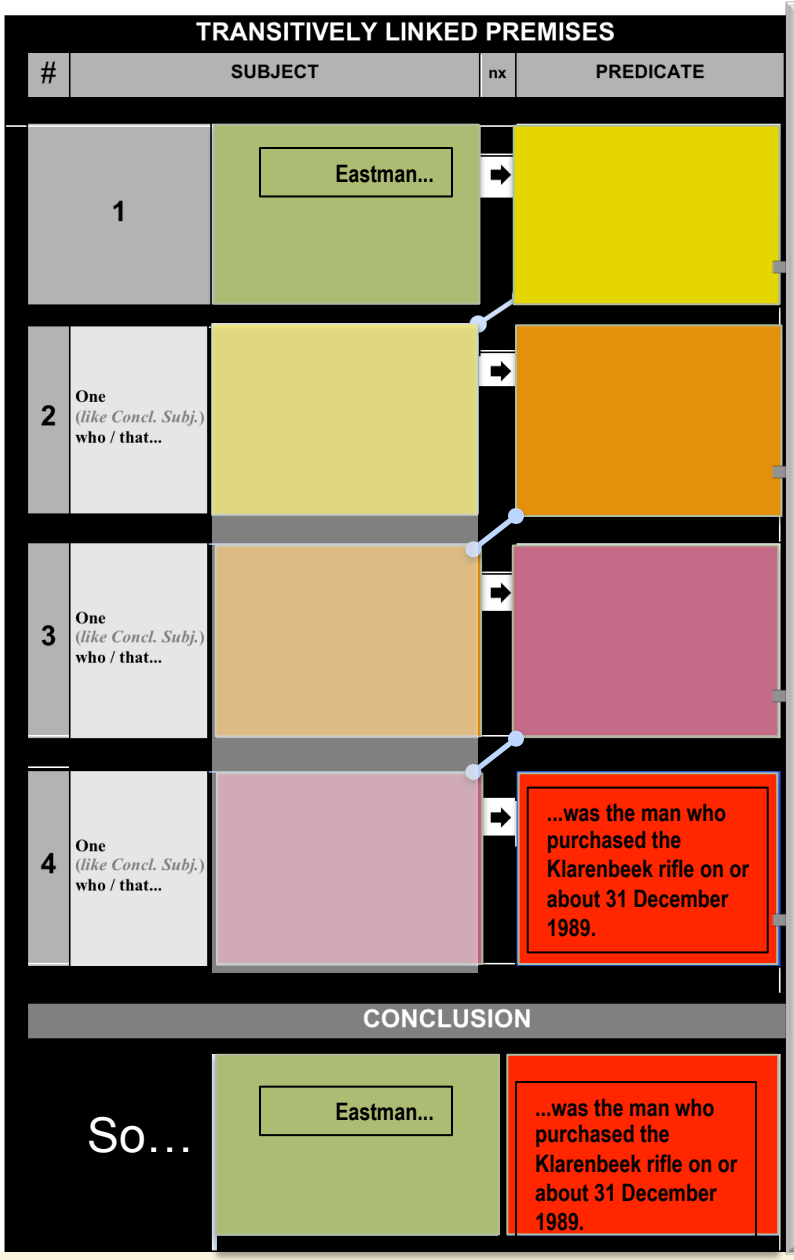

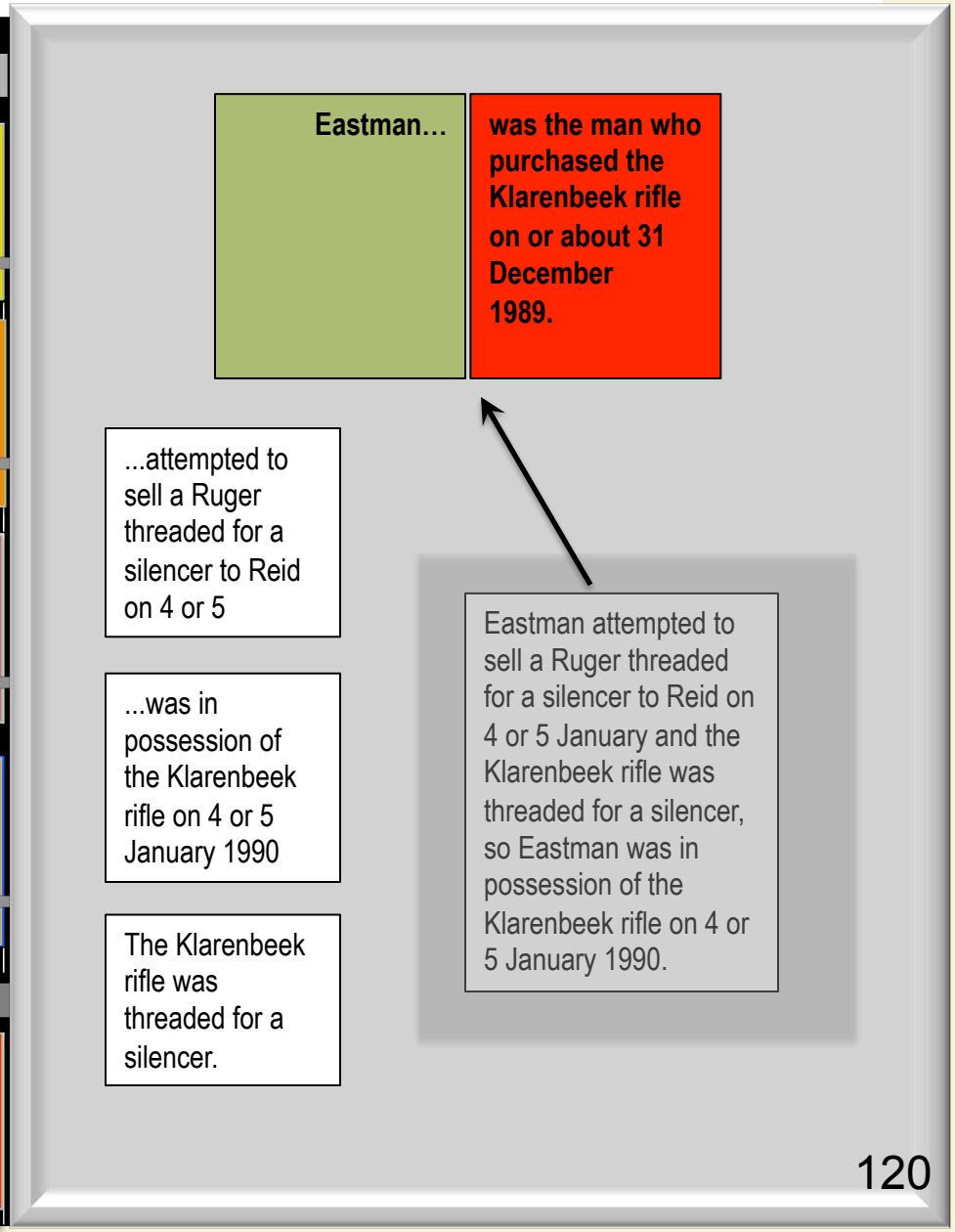

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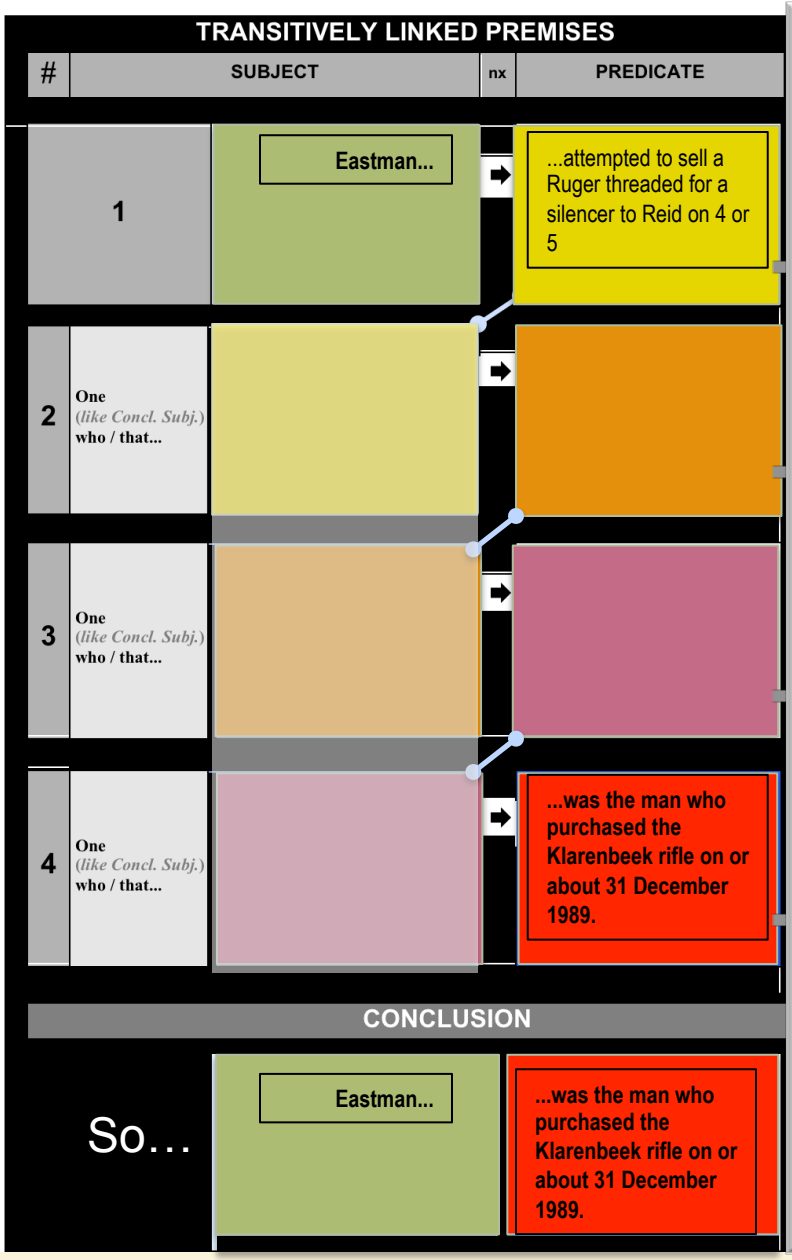

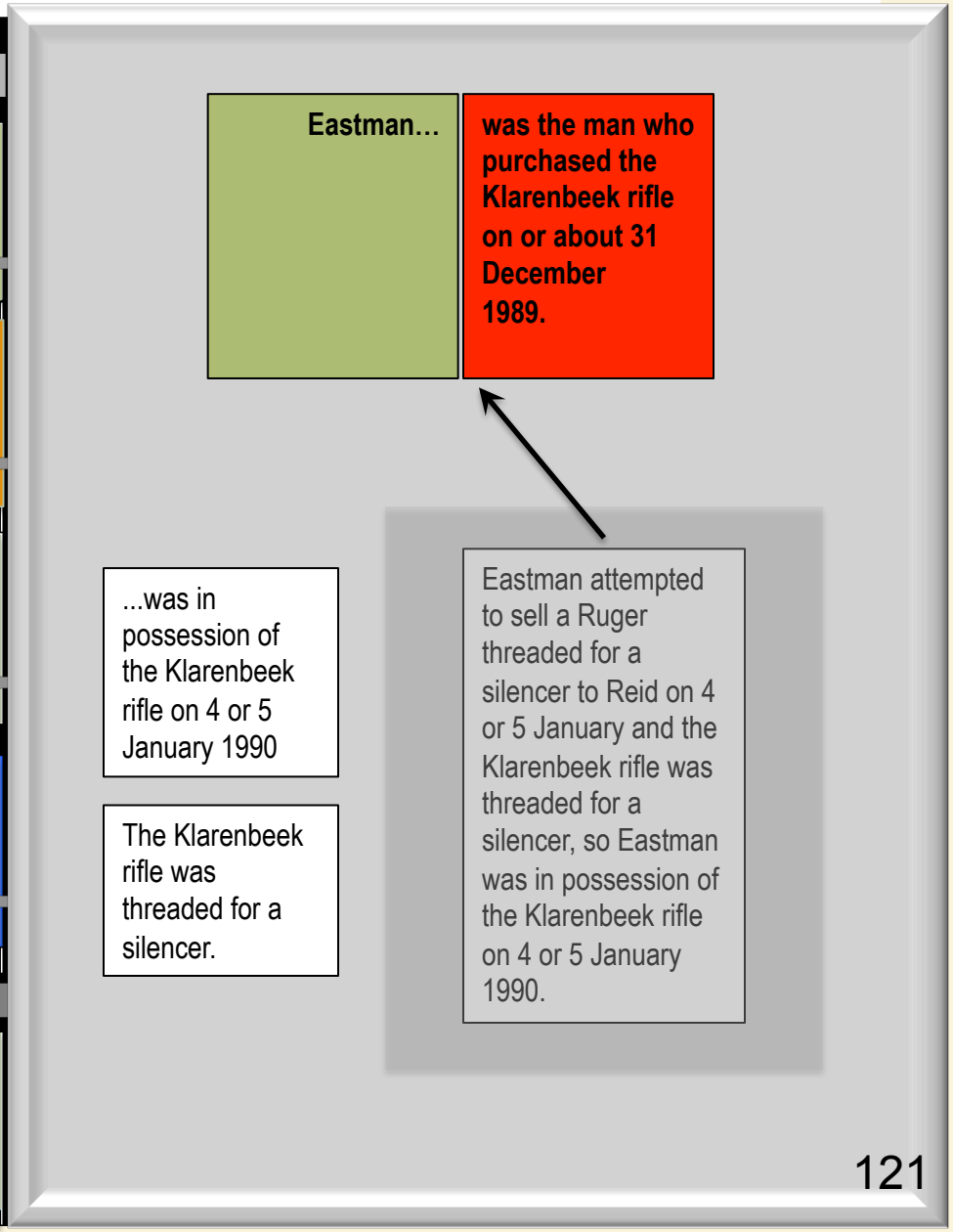

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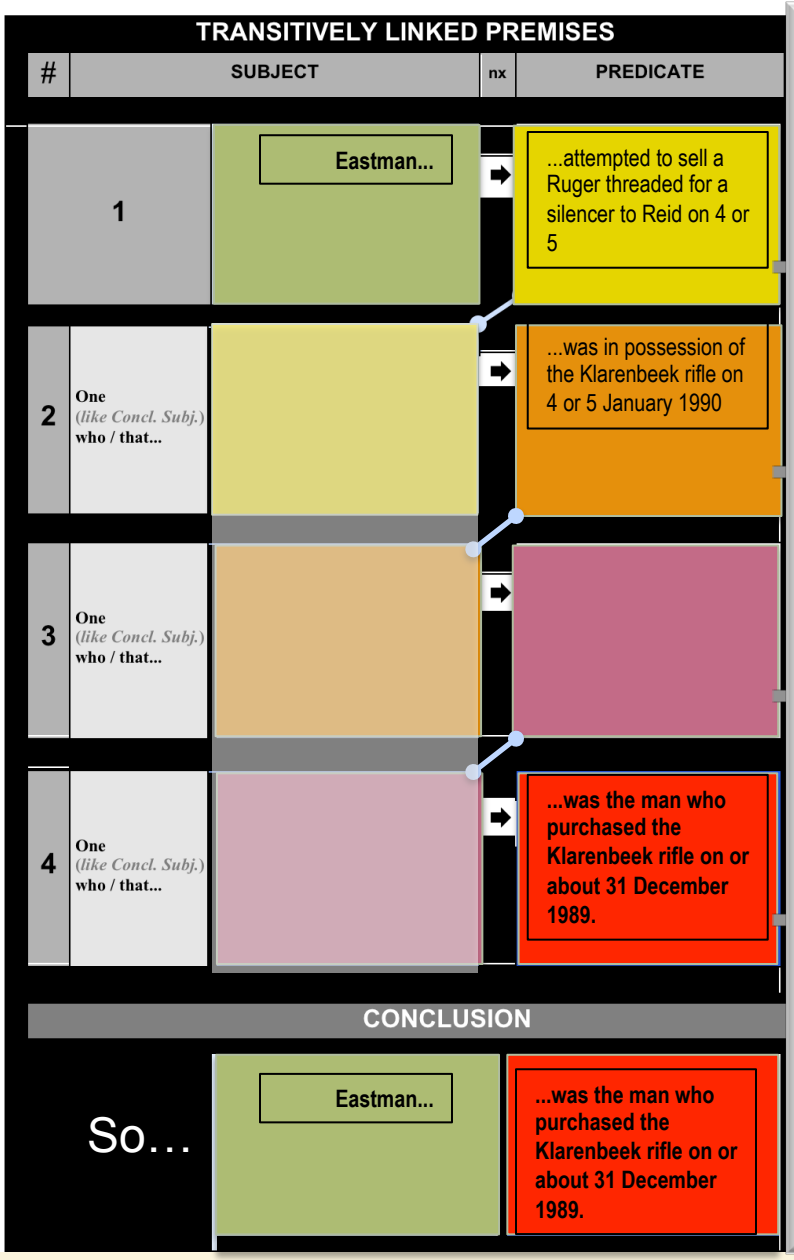

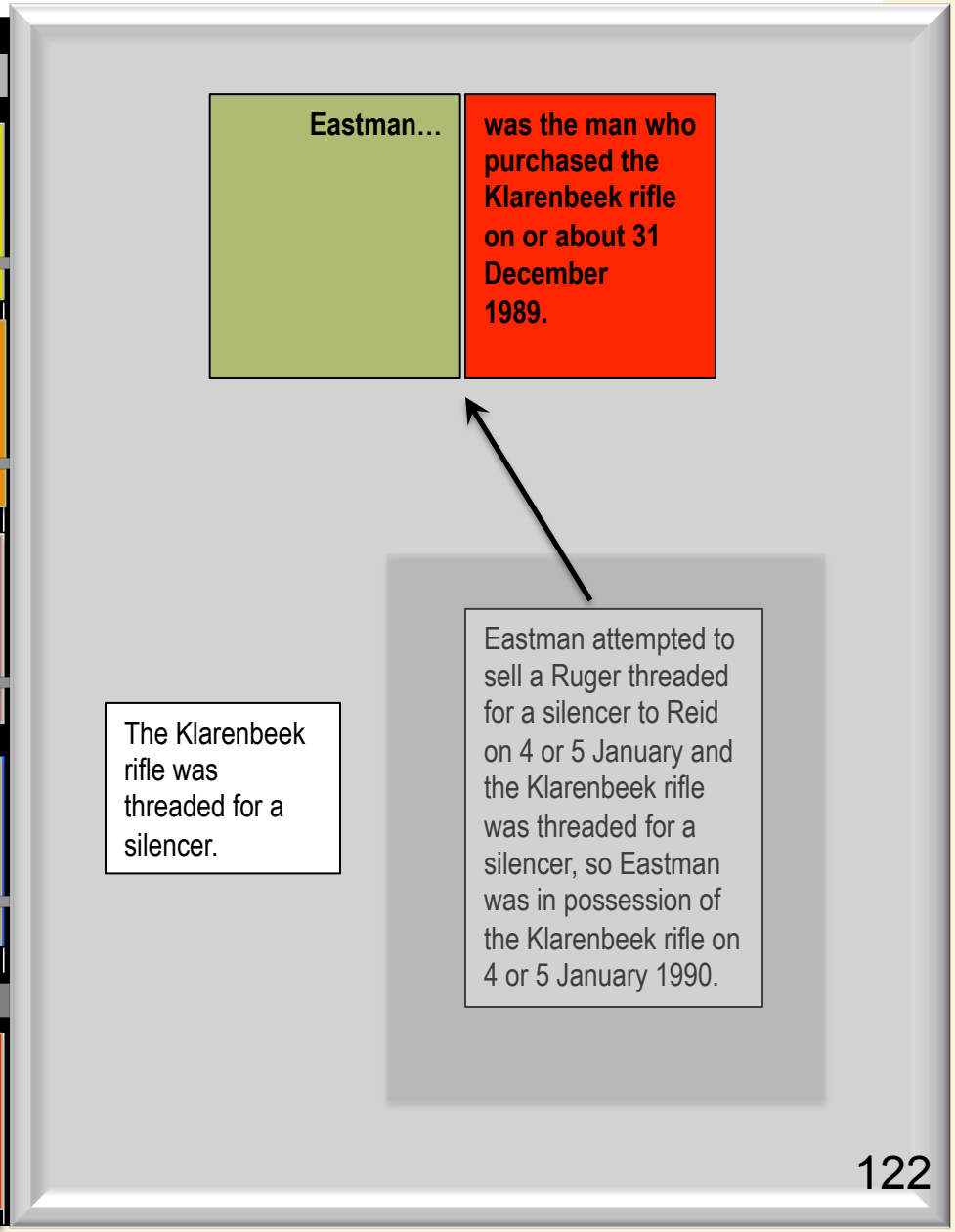

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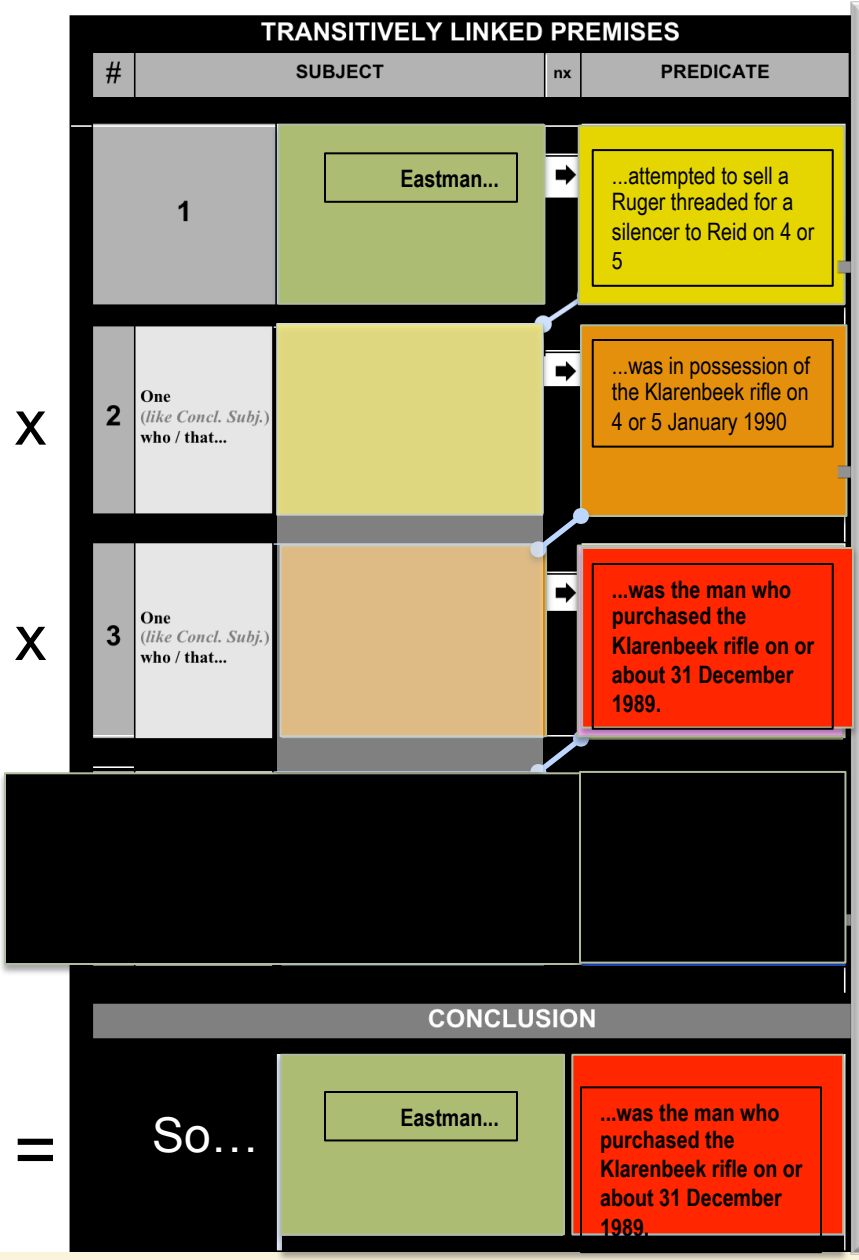

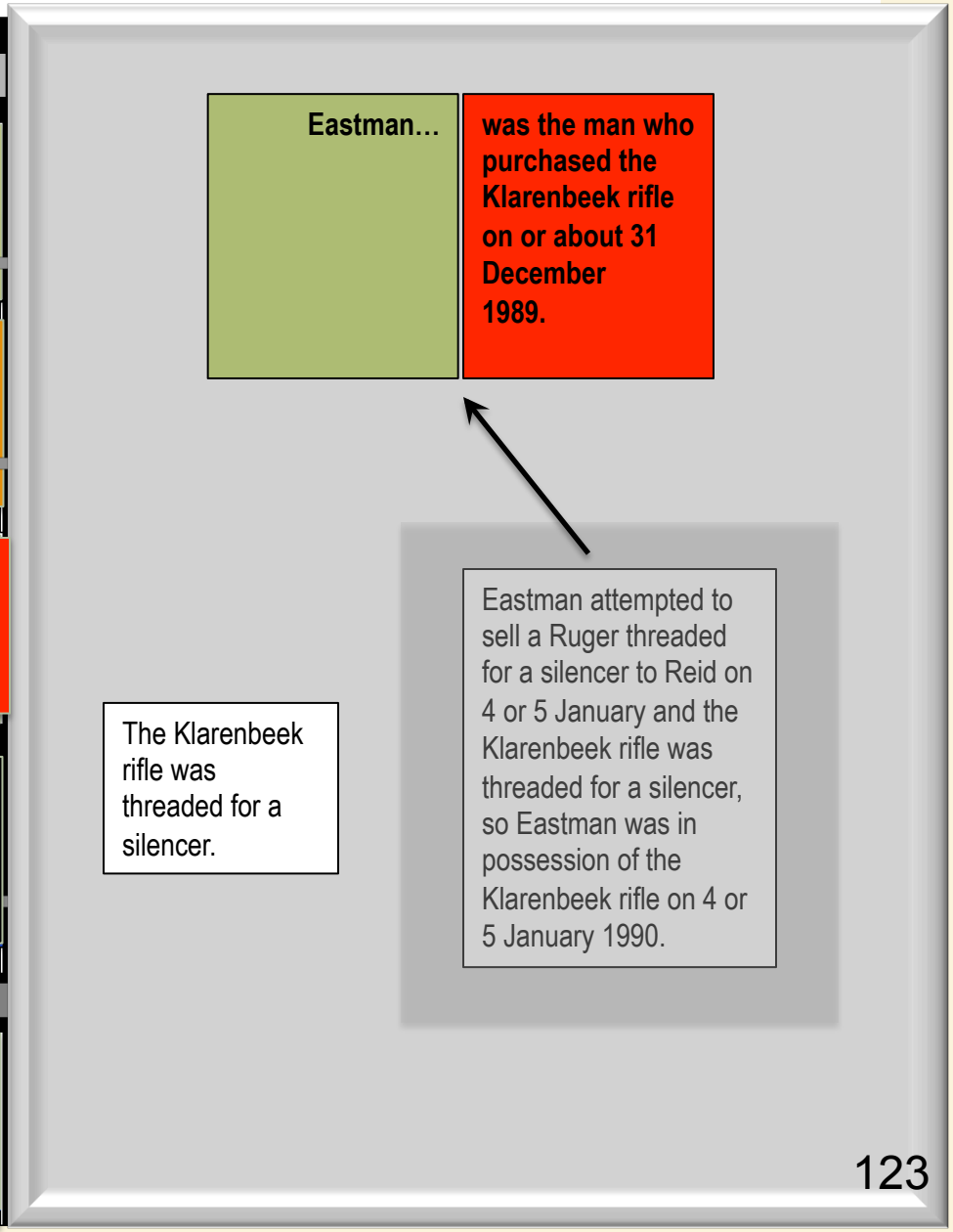

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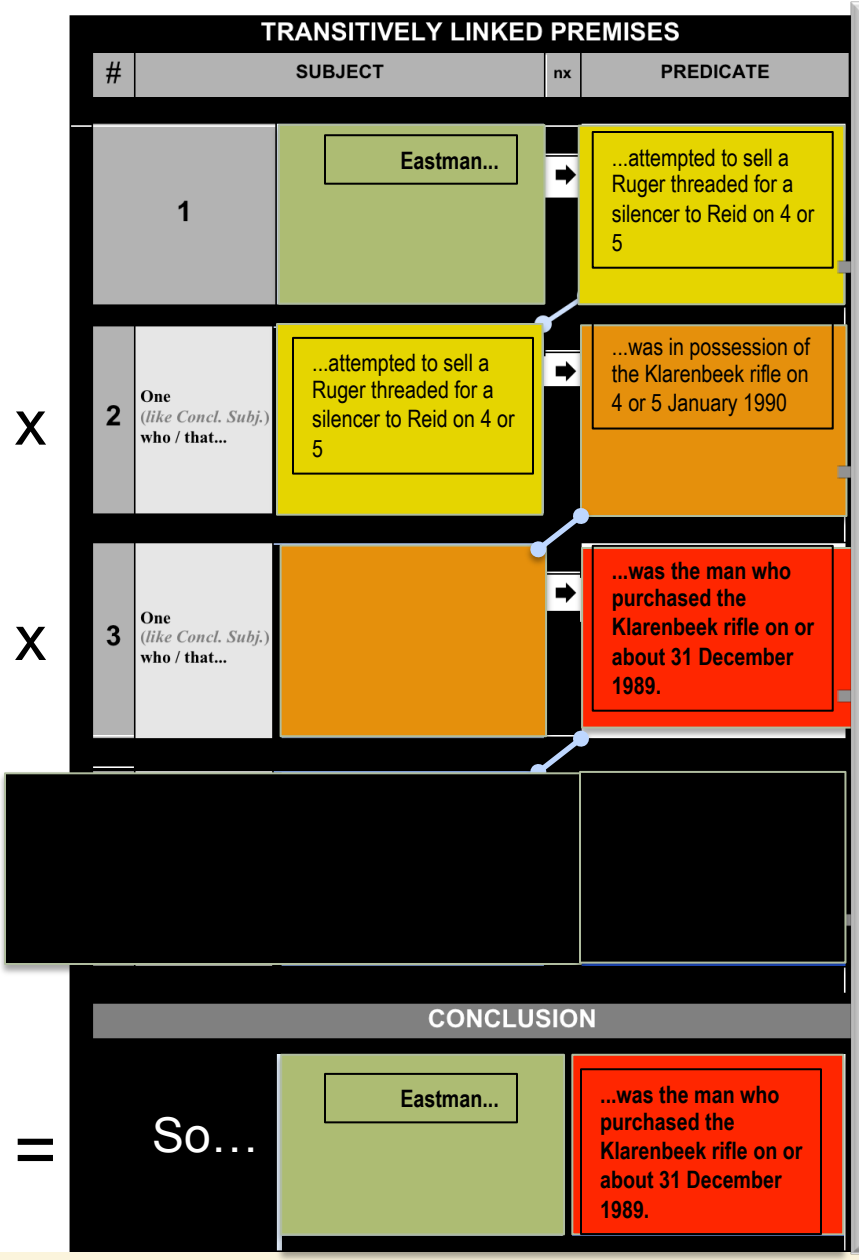

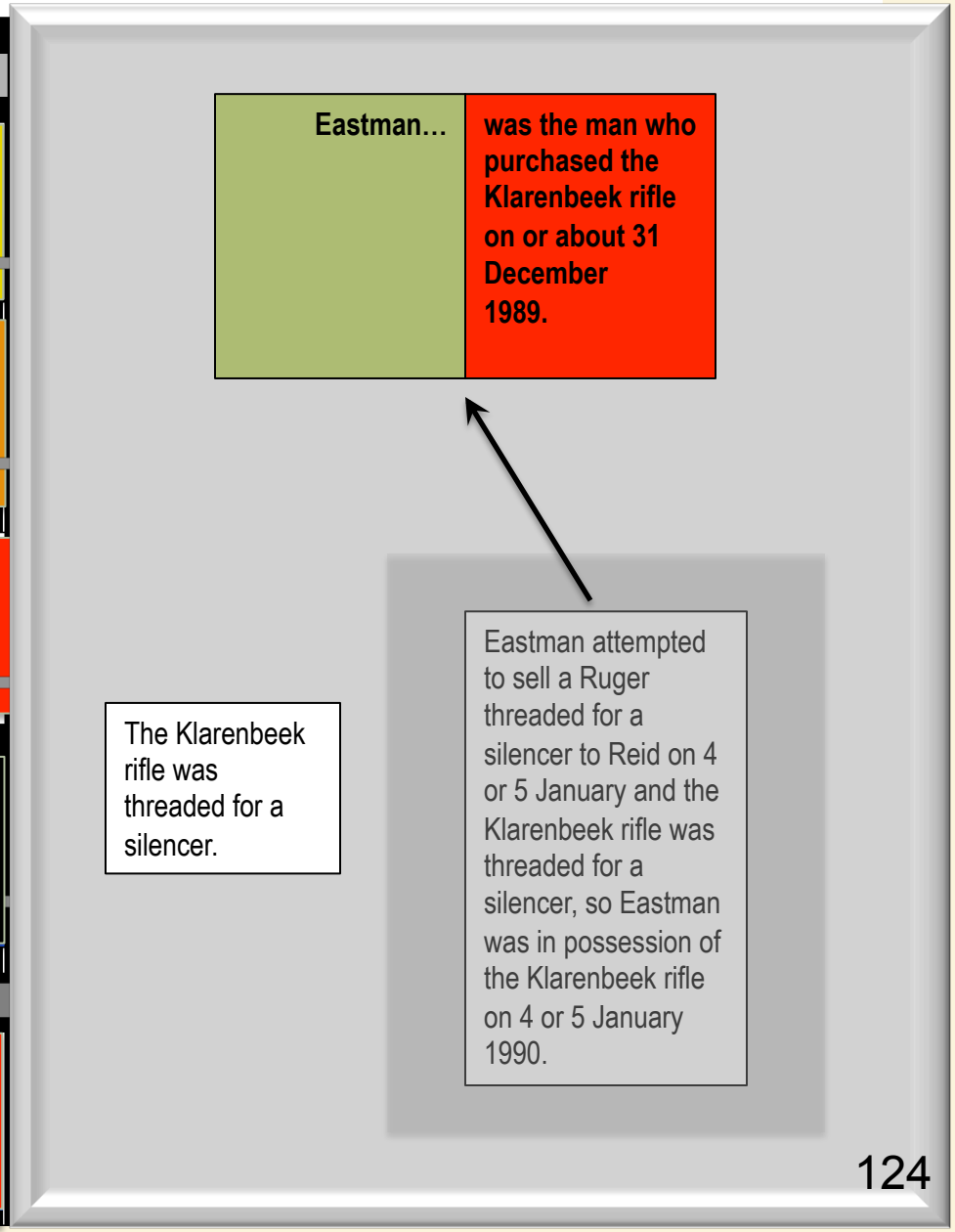

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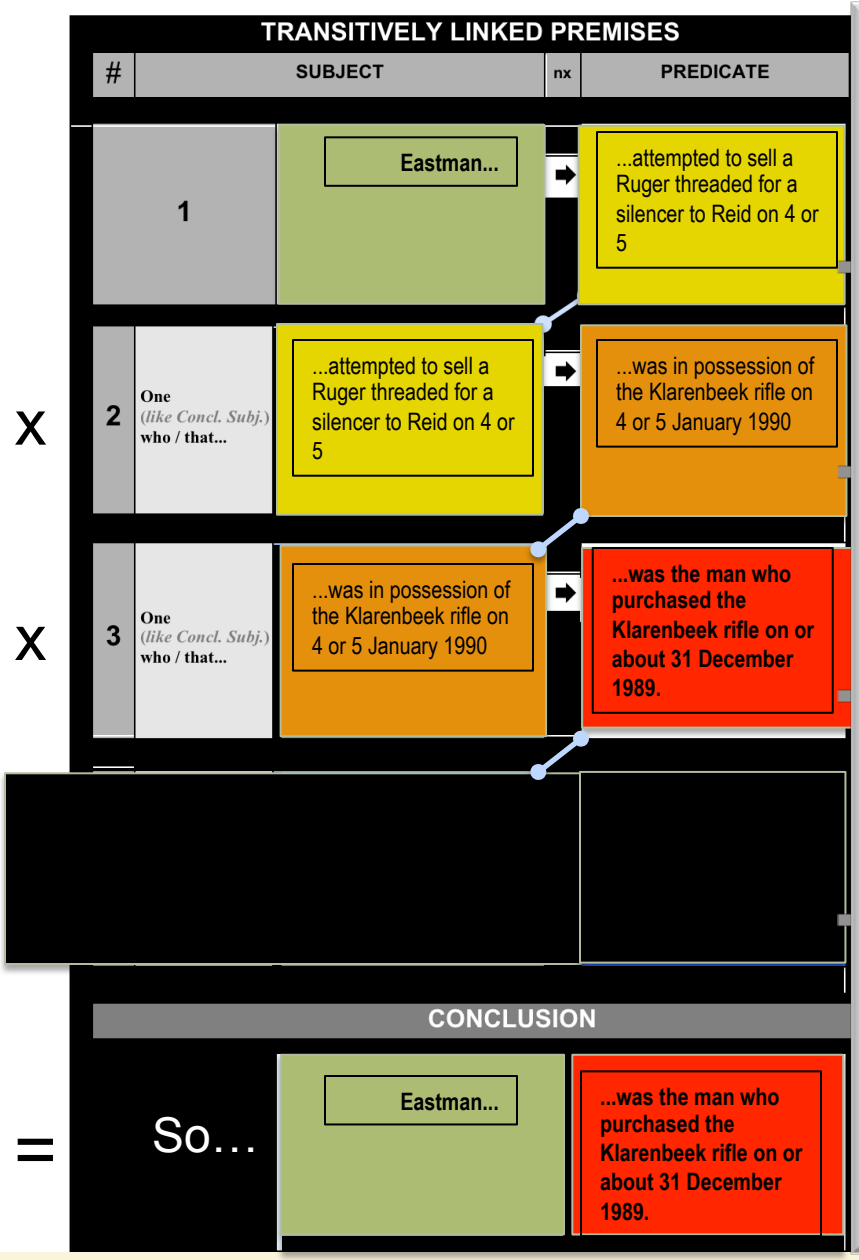

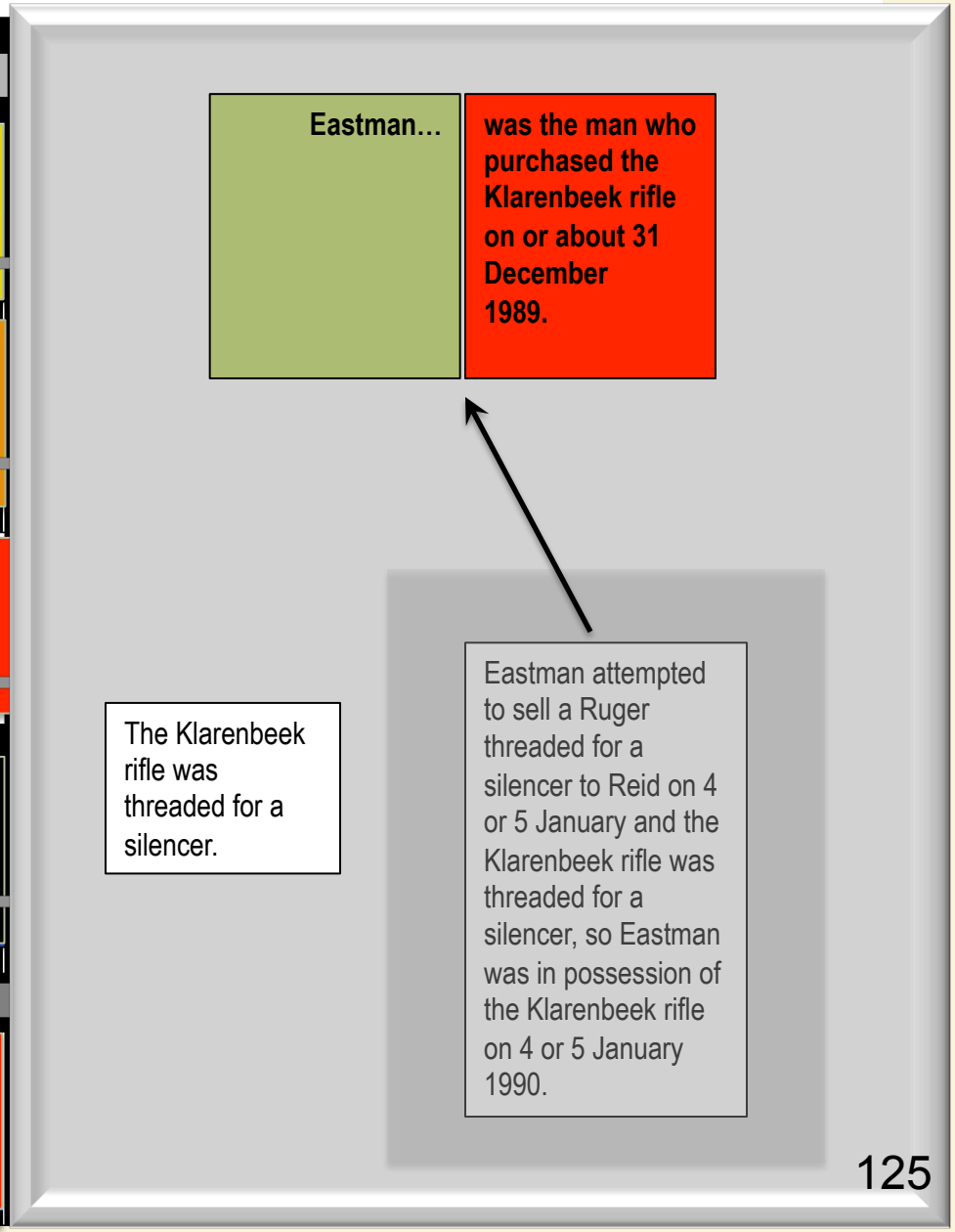

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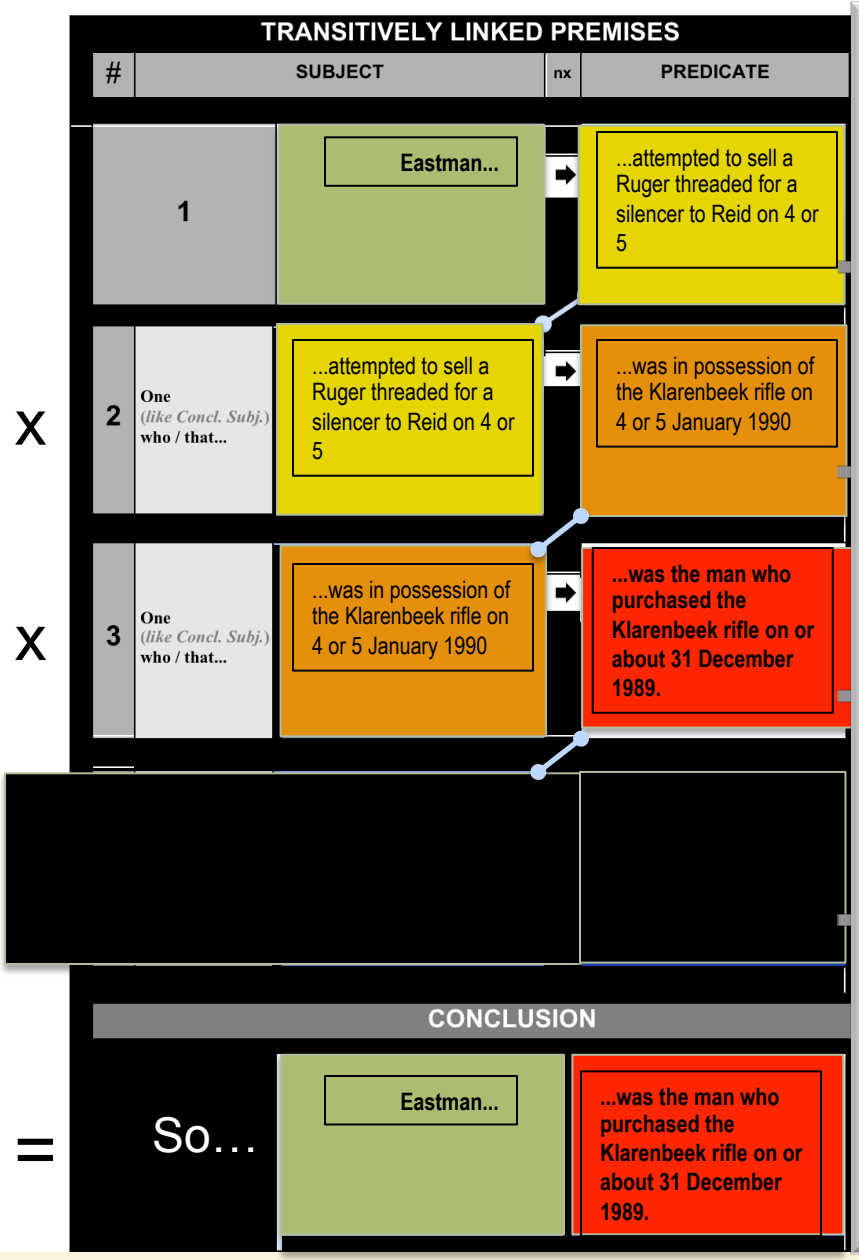

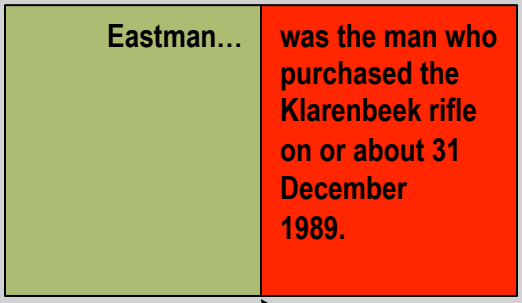

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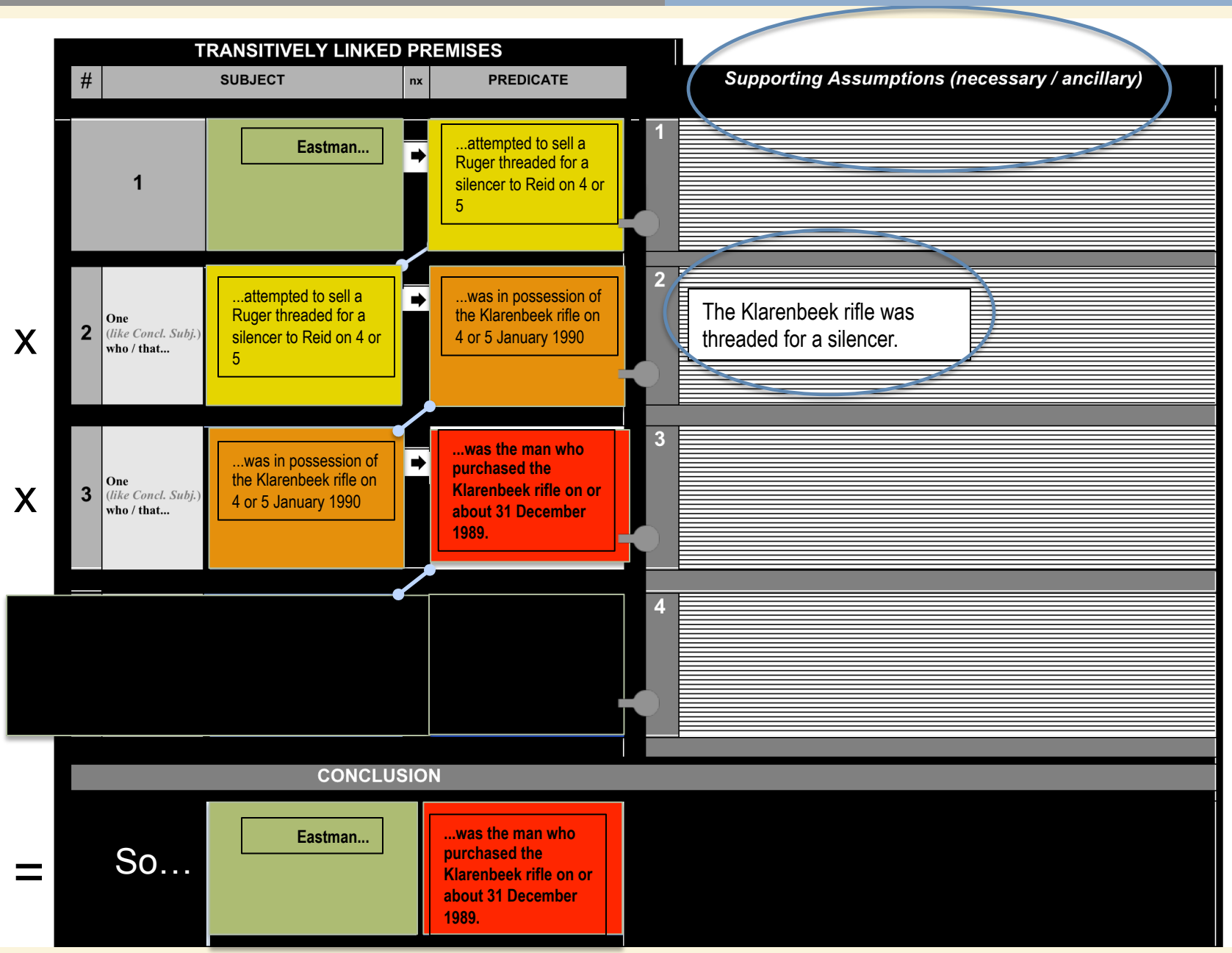


An Abstract of Ernie Regehr's

"Culpable Nonviolence: The Moral Ambiguity of Pacifism"

Part One

Regehr's goal in this essay is establishing that (MC)
<the international community of nations has a duty to intervene to prevent further violence against those being victimized–killed or forced to flee their homes–even if this involves use of restrained protective force, when it is too late to employ non-violent means.>
Consider that **(1)** <regional violence around the world, such as seen in Sudan, is producing many victims, including those killed and displaced.> **(2)** <Refusal to add to the violence by intervention with force increases the number of victims, including those killed.> **(3)** <Refusal to use force to prevent killing is not just morally ambiguous but actually culpable nonviolence.> **(4)** <Culpable nonviolence must be justified–it is a matter of moral accountability.> But **(5)** <refusal to intervene using protective force, where prevention has failed or would be too late, is dereliction of duty and cannot be justified.>

(Main Conclusion) The international community of nations has a duty to intervene to prevent further violence against those being victimized–killed or forced to flee their homes–even if this involves use of restrained protective force, when it is too late to employ non-violent means.>

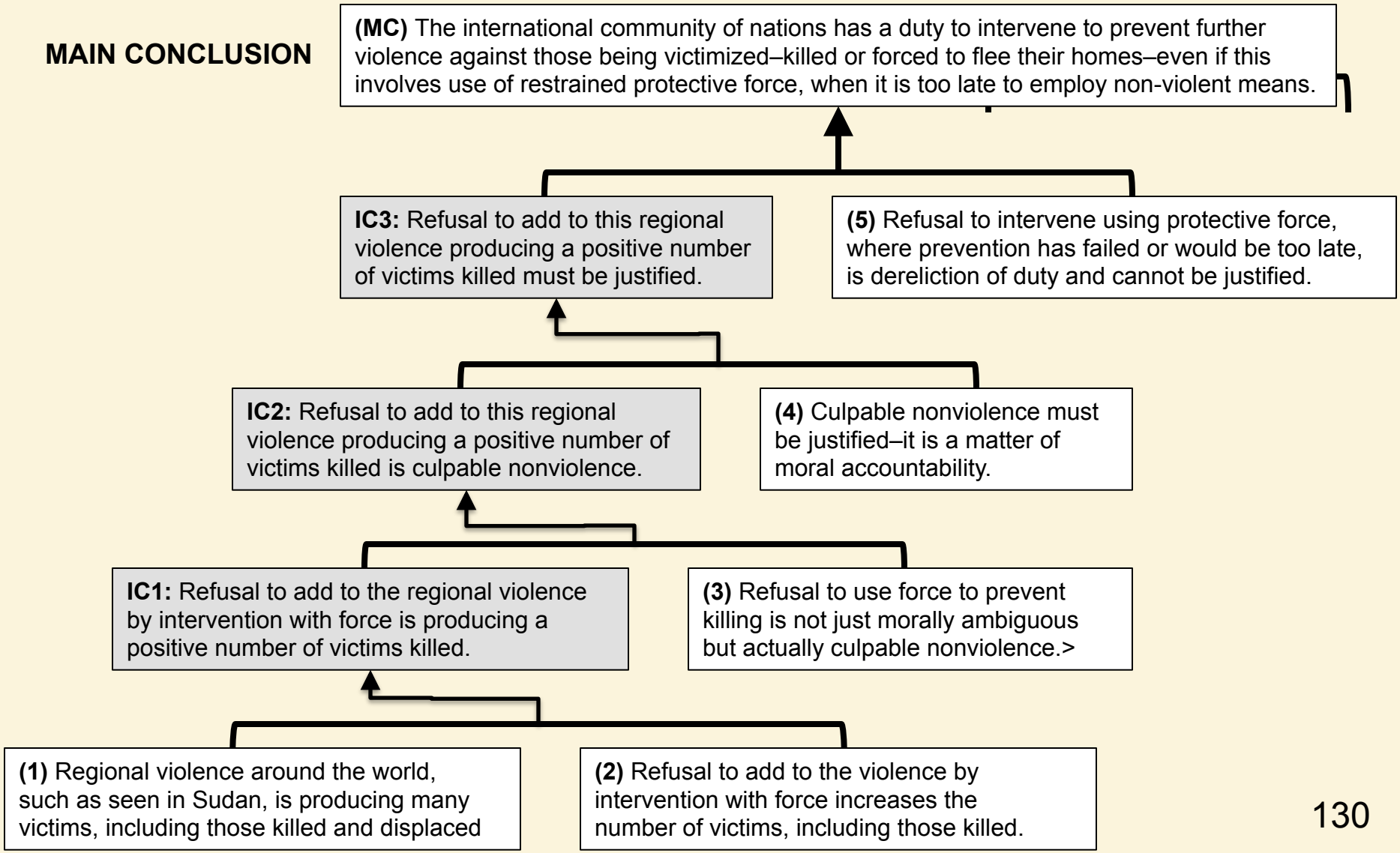
(1) Regional violence around the world, such as seen in Sudan, is producing many victims, including those killed and displaced.

(2) Refusal to add to the violence by intervention with force increases the number of victims, including those killed.

(3) Refusal to use force to prevent killing is not just morally ambiguous but actually culpable nonviolence.

(4) Culpable nonviolence must be justified–it is a matter of moral accountability.

(5) Refusal to intervene using protective force, where prevention has failed or would be too late, is dereliction of duty and cannot be justified.



	INFERENTIALLY LINKED PREMISES		SUPPORTING ASSUMPTIONS
1	Refusal [by the international community] to add to the [regional] violence [around the world] by intervention with force...	... increases the number of victims, including those killed.	**(1)** *Regional violence around the world, such as seen in Sudan, is producing many victims [already], including those killed and displaced.*
2	Any [like the Subject] that [REPEAT PREVIOUS PREDICATE]...	is not just morally ambiguous but actually culpable nonviolence.	
3	Any [like the Subject] that [REPEAT PREVIOUS PREDICATE]..	...must be justified– it is a matter of moral accountability.	
4	Any [like the Subject] that [REPEAT PREVIOUS PREDICATE]..	... is dereliction of duty and where prevention has failed or would be too late.	**(4)** *Refusal to intervene cannot be justified.*
5	Any [like the Subject] that [REPEAT PREVIOUS PREDICATE]..	...must not be done–even if this involves use of restrained protective force, when it is too late to employ non-violent means.	

Therefore,	CONCLUSION
Refusal [by the international community] to add to the [regional] violence [around the world] by intervention with force...	...must not be done–even if this involves use of restrained protective force, when it is too late to employ non-violent means.

Acknowledgements

I gratefully acknowledge the years of collegial support in conventional argument mapping and mapping software by Professor Tim van Gelder (www.austhinkconsulting.com) during my association with Austhink.

I am also grateful for the years of encouragement and support of Professor Peter Tillers (http://en.wikipedia.org/wiki/Peter_Tillers) and Professor David Hitchcock http://www.humanities.mcmaster.ca/~philos/people/profile_hitchcock.php).

I also want to acknowledge the encouragement and the body of work of Professor Douglas Walton (http://www.dougwalton.ca/) that provided me with a course of study for my essential understanding of argumentation.

I also want to thank Professor John Woods (http://www.johnwoods.ca/) for inviting me to participate in the Special Edition on "Relevancy" in the Oxford Journal, *The Journal of Logic and Computation*.

I also acknowledge the seminal work of Professor Fred Sommers (http://www.ontology.co/sommersf.htm) and Professor George Englebretsen (http://www.ontology.co/biblio/englebretseng.htm) in the "New Syllogistic." The Logic-bridge is one approach that builds on their work in that "New Syllogistic."

Finally, I wish to gratefully acknowledge Dr. Sharone Lee for our years of ongoing discussions on the placement and utility of fact-based inquiry within the dimensional structures of knowledge.

References

ENGLEBRETSEN, G. (1981). *Three Logicians: Aristotle, Leibniz, and Sommers and The Syllogistic*. Van Gorcum & Company, The Netherlands.

ENGLEBRETSEN, G. (1996). *Something to Reckon with: The Logic of Terms.* University of Ottawa Press, Ottawa, ON.

ENGLEBRETSEN, G. (1998). *Line Diagrams for Logic: Drawing Conclusions.* The Edwin Mellen Press, Lewiston.

http://www.udemy.com/a-clear-logical-argument-guaranteed

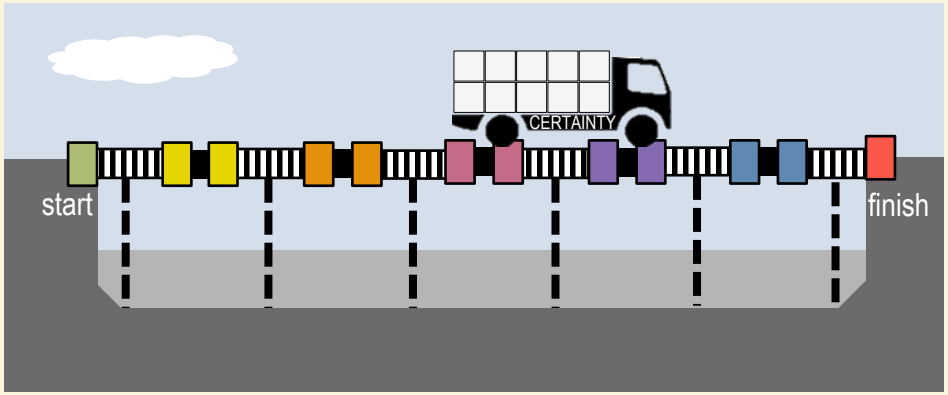
http://logicguaranteed.com

LARONGE, J. A. (2012). A generalizable argument structure using defeasible class-inclusion transitivity for evaluating evidentiary probative relevancy in litigation. *Journal of Logic and Computation*, 22(1):129-162.

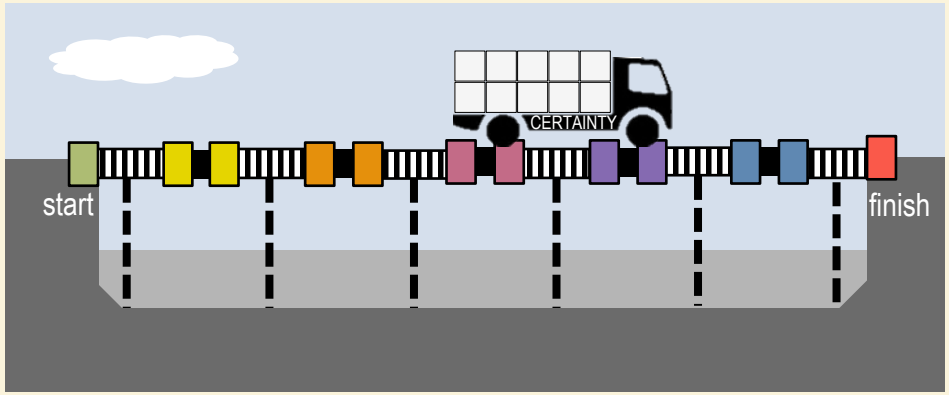
LARONGE, J. A. (2012). Evaluating universal sufficiency of a single logical form for inference in court. *Law, Probability and Risk*, 11(2-3):159-196.

SOMMERS, F. & ENGLEBRETSEN, G. (2000). *An Invitation to Formal Reasoning.* Ashgate Publishing Company, Aldershot.

Appendix



Logic-bridge Inference



Defeasible Class-Inclusion Transitivity (DCIT)

LOGICAL SYNTAX

- Predication is conceptualized as solely the relationship of "belongs to the class of."
- The logical syntax of a regimented sentence is based on a binary analysis consisting of the grammarian Subject (phrase) and the Predicate (phrase) as terms. There is no analytic recognition of a copula as a third expression.
- The Predicate (phrase) begins with a verb but is homogenous with the Subject placement with the addition of the universal quantifier: "Any (All,One) such [like the Subject] who (that)."
- Only the quantifier "Any (All,One) such [like the Subject] who (that)" is given logical import. So, for example, "some" and "none" have no logical import.
- There is no analytic distinction made between the "is" of identity and the "is" of predication.
- Likelihood of membership relies on degrees of probability based on a subjective assessment.
- Issues like proto-typicality of categorical membership are reflected in the "such [like the Subject]" words in the universal quantifier.
- Inference proceeds through defeasible class-inclusion transitivity.

Defeasible Class-Inclusion Transitivity

(DCIT pronounced dee•kit)

an empirically derived theory of inference, predication, categorization, argument structure and embodied visual language

Phillips S, Wilson WH, Halford GS (2009) What do Transitive Inference and Class Inclusion have in common? Categorical (co)products and cognitive development. PLoS Comput Biol 5: e1000599.

Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

"

Children acquire various reasoning skills over remarkably similar periods of development. Transitive Inference and Class Inclusion are two behaviours among a suite of inferential abilities that have strikingly similar developmental profiles—all are acquired around the age of five years.

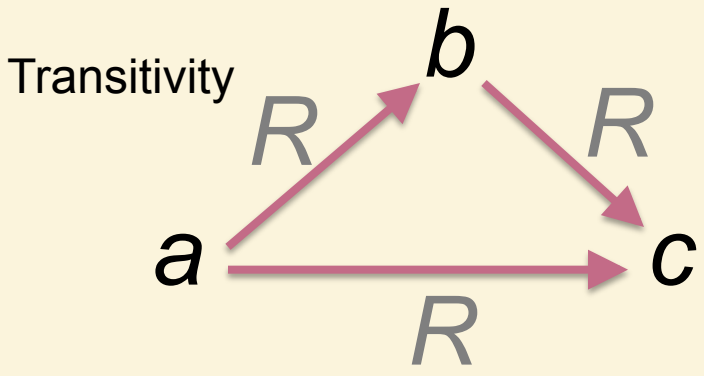
Phillips S, Wilson WH, Halford GS (2009) What do Transitive Inference and Class Inclusion have in common? Categorical (co)products and cognitive development. PLoS Comput Biol 5: e1000599.

Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

"A transitive inference has the general form that given *aRb* and *bRc*, then one can infer *aRc*, where R is some binary relation that has the transitivity property.

For example, older children can infer that if *John is taller than Mary*, and *Mary is taller than Sue*, then *John is taller than Sue*. This form of reasoning is called Transitive Inference.



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Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

> "Other evidence supported the conclusion that transitive inference was performed, not by logical reasoning, but by constructing a mental model comprising the ordered set of premise elements. The inference could be made simply by inspecting this mental model, a process that Thayer and Collyer (1978) described as "almost perceptual" (p. 1338).

Halford, G. S., & Andrews, G. (2004). The development of deductive reasoning: How important is complexity? Thinking and Reasoning, 10, 123–145.

Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

"[P]articipants performed the task by representing the elements as an ordered set, *a*, *b*, *c*, *d*, *e*, *(f)*.

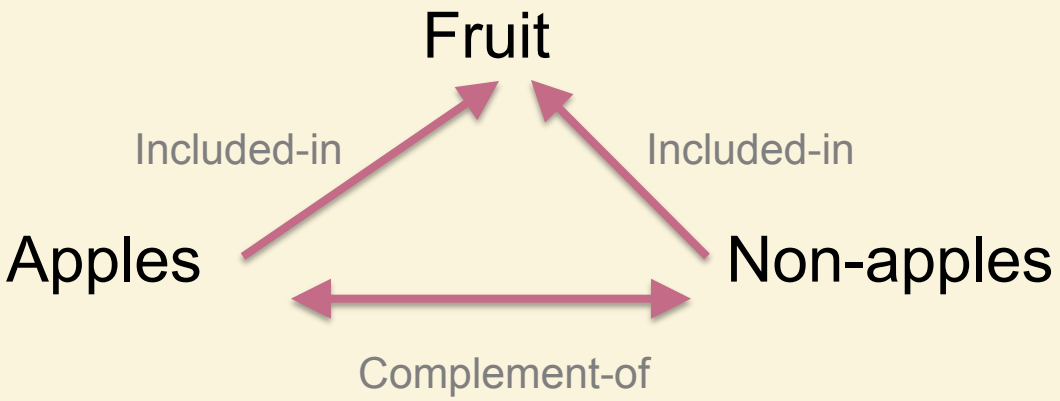
Repeated presentation of the premises, often over hundreds of trials, also permits simplifying strategies. For example, ***a*** can be identified as an end element because it is always less, whereas ***e*** ***(f)*** can be identified as an end element because it is always more. Once an end element is identified, the rest of the ordered set can be constructed by concatenation. With *a* as an end element, and given $a < b$, we can form the string *a*, *b*, then with $b < c$ we can add *c*, yielding *a*, *b*, *c*, and so on.

Phillips S, Wilson WH, Halford GS (2009) What do Transitive Inference and Class Inclusion have in common? Categorical (co)products and cognitive development. PLoS Comput Biol 5: e1000599.

Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

"Older children also understand that a grocery store will contain more fruit than apples. That is, the number of items belonging to the superclass is greater than the number of items in any one of its subclasses. This form of reasoning is called Class Inclusion.



Walton, Douglas, Defeasible Reasoning and Informal Fallacies (March 3, 2011). Available at SSRN: http://ssrn.com/abstract=1775825 or http://dx.doi.org/10.2139/ssrn.1775825

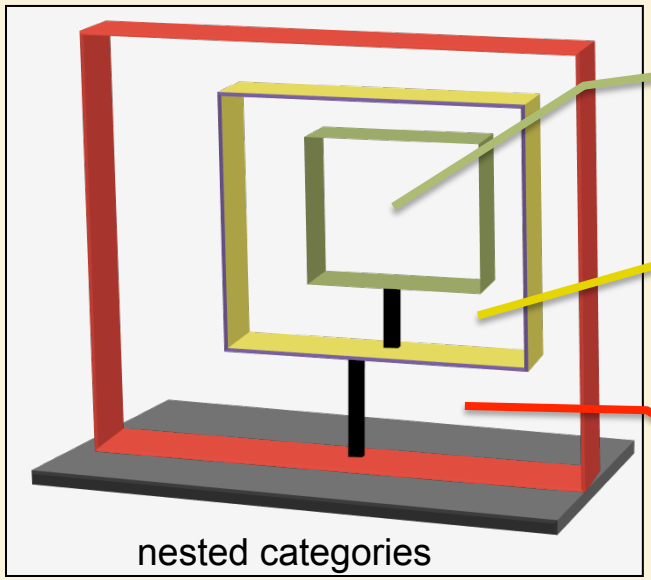
Defeasible Class-Inclusion Transitivity

THEORY OF INFERENCE

> "a claim being at first acceptable because it is supported by reasoning, but that is later defeated because circumstances are present that bring the case under an exception.

'Claims can usually be challenged or opposed in two ways. First, by a denial of the facts upon which they are based and secondly by something quite different, namely a plea that although all the circumstances on which a claim could succeed are present, yet in the particular case, the claim .. . should not succeed because other circumstances are present which brings the case under some recognized head of exception, the effect of which is either to defeat the claim . .. altogether, or to "reduce" it .. . .' (1951, 147-148).

Judging from this quotation, it would appear that Hart had the idea of a claim being at first acceptable because it is supported by reasoning, but that is later defeated because circumstances are present that bring the case under an exception. Thus we recognize the idea of a defeasible argument, of a kind so common in law.



The President **A**

has a valid Hawaiian birth certificate **B**

was born in Hawaii **C**

SUBJECT COLUMN	PREDICATE COLUMN
1 The President...	... . has a valid Hawaiian birth certificate.
2 Any (all/one) who (that) [PREVIOUS PREDICATE]	...was born in Hawaii.
Therefore, CONCLUSION	
The President...	...was born in Hawaii.

The process by which the Logic-bridge line of reasoning justifies the conclusion (mode of inference) is called Defeasible Class-Inclusion Transitivity (DCIT dee•kit).

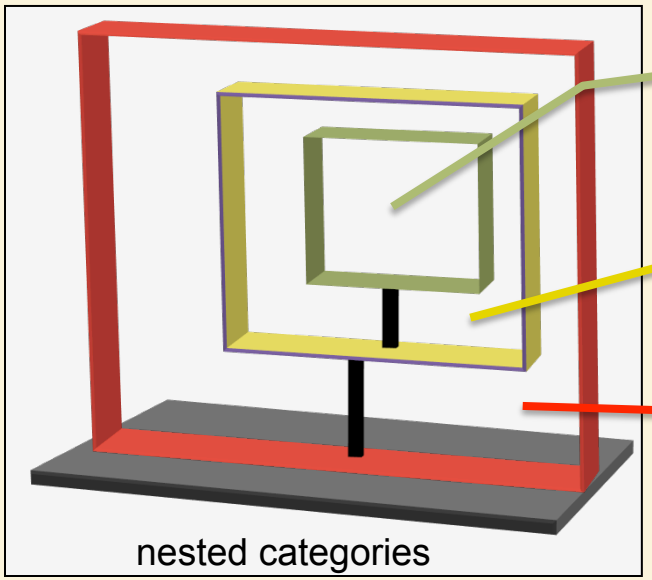
A belongs to (fits within) category B.

B belongs to (fits within) category C.

Therefore (through DCIT)...

A belongs to (fits within) category C.

INFERENTIALLY LINKED PREMISES			Supporting Assumptions (necessary and ancillary)
1	**The canary...**	...is yellow.	*N/A*
2	One [like the subject] that... [REPEAT PREVIOUS PREDICATE]	**...is a color.**	*N/A*
Therefore,	CONCLUSION		
	The canary...	**...is a color.**	



nested categories

The canary **A**

is yellow. **B**

is a color. **C**

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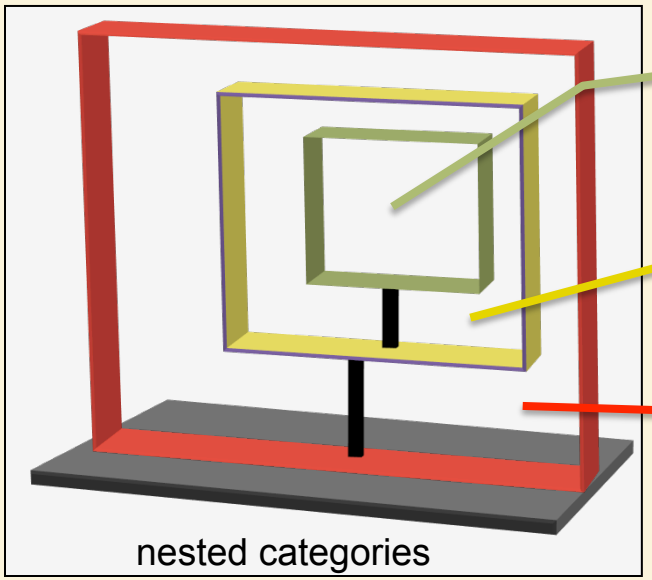
INFERENTIALLY LINKED PREMISES			Supporting Assumptions (necessary and ancillary)
1	The canary...	...is yellow.	N/A
2	Yellow...	...is a color.	N/A
Therefore,	CONCLUSION		
	The canary...	...is a color.	



nested categories

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color. **C**

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