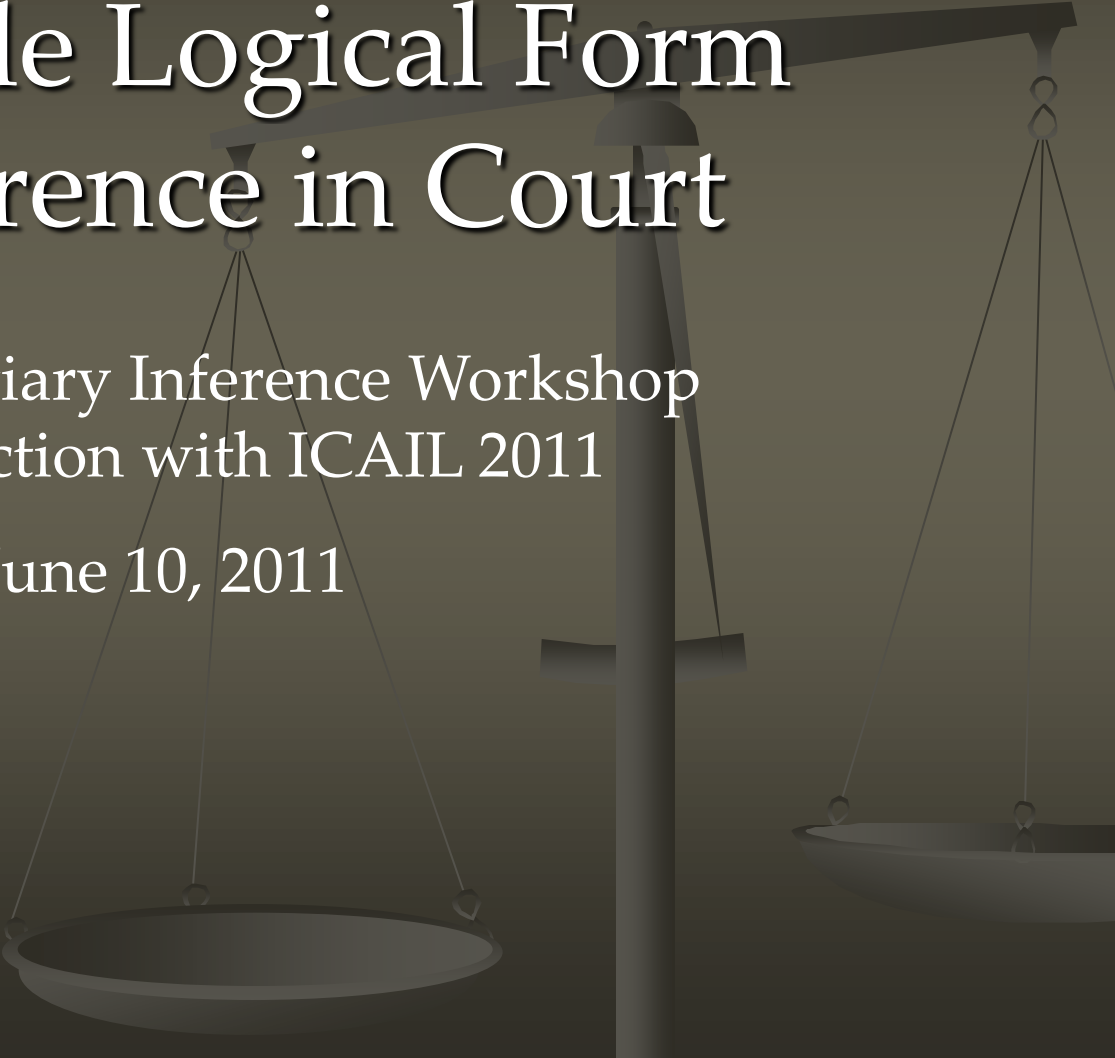


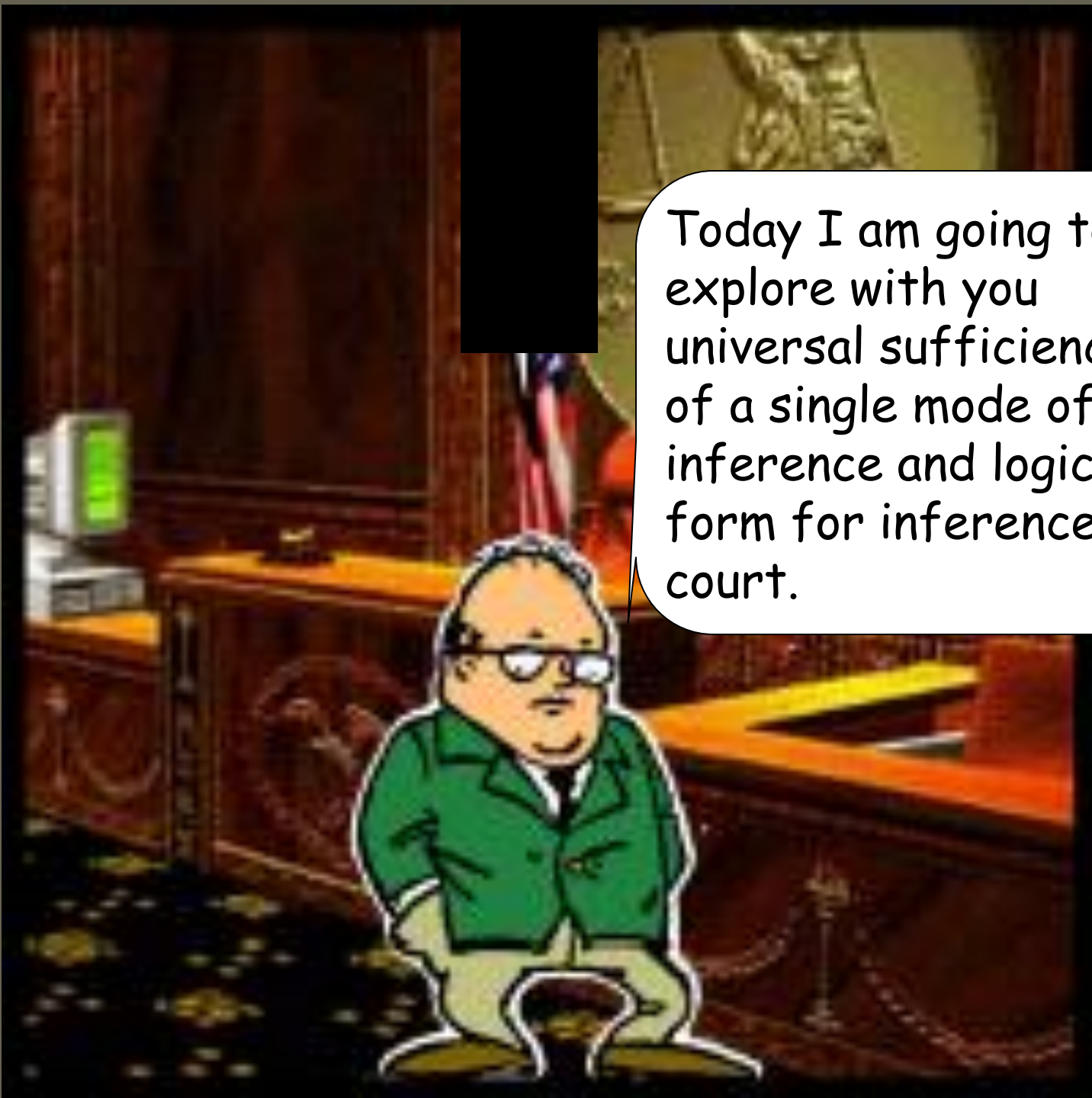
Evaluating Universal Sufficiency of a Single Logical Form for Inference in Court




AI & Evidentiary Inference Workshop
in conjunction with ICAIL 2011

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Today I am going to
explore with you
universal sufficiency
of a single mode of
inference and logical
form for inference in
court.

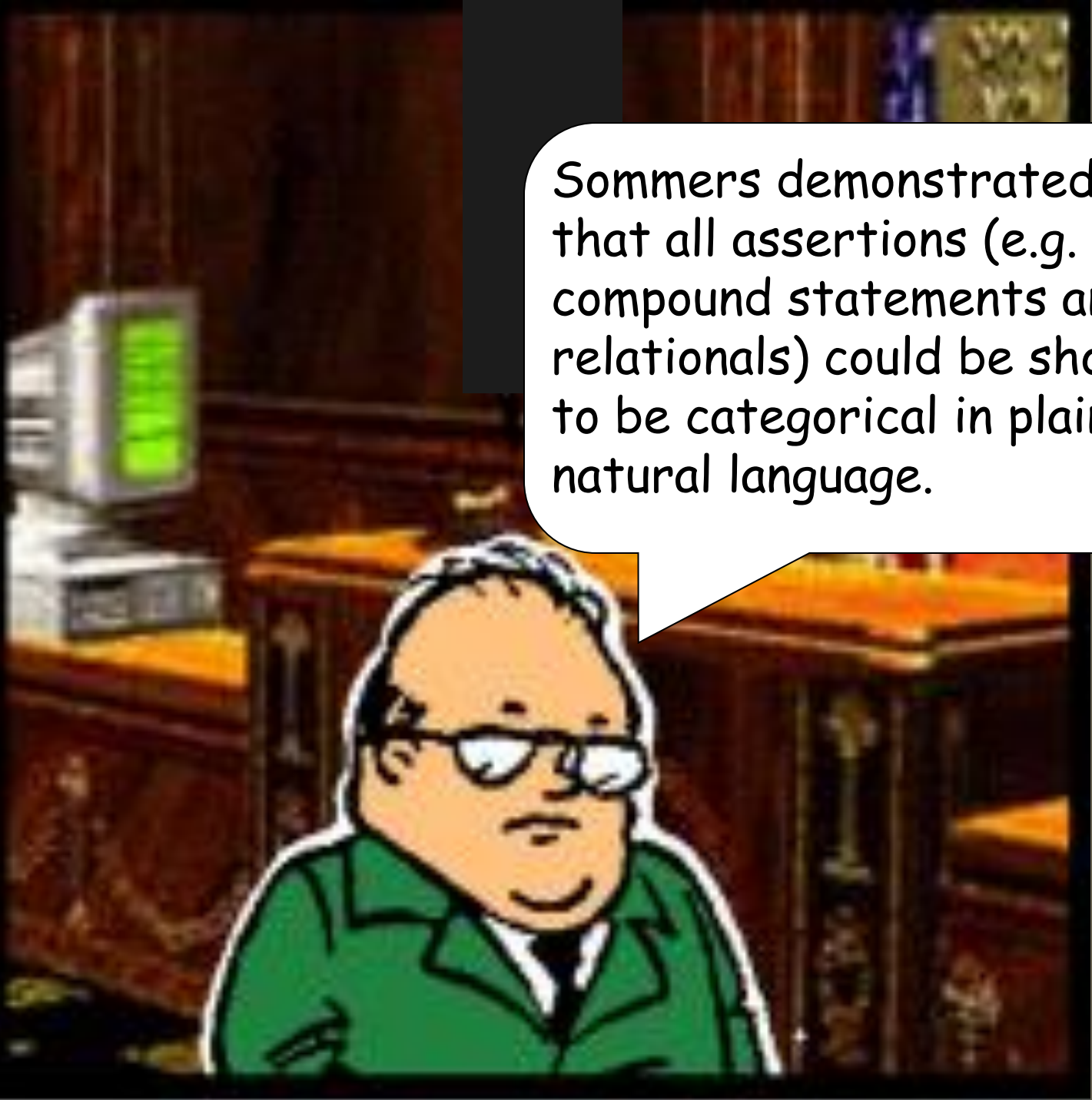


It is called...
Defeasible Class-Inclusion
Transitivity term logic or just
DCIT (pronounced dee•kit).

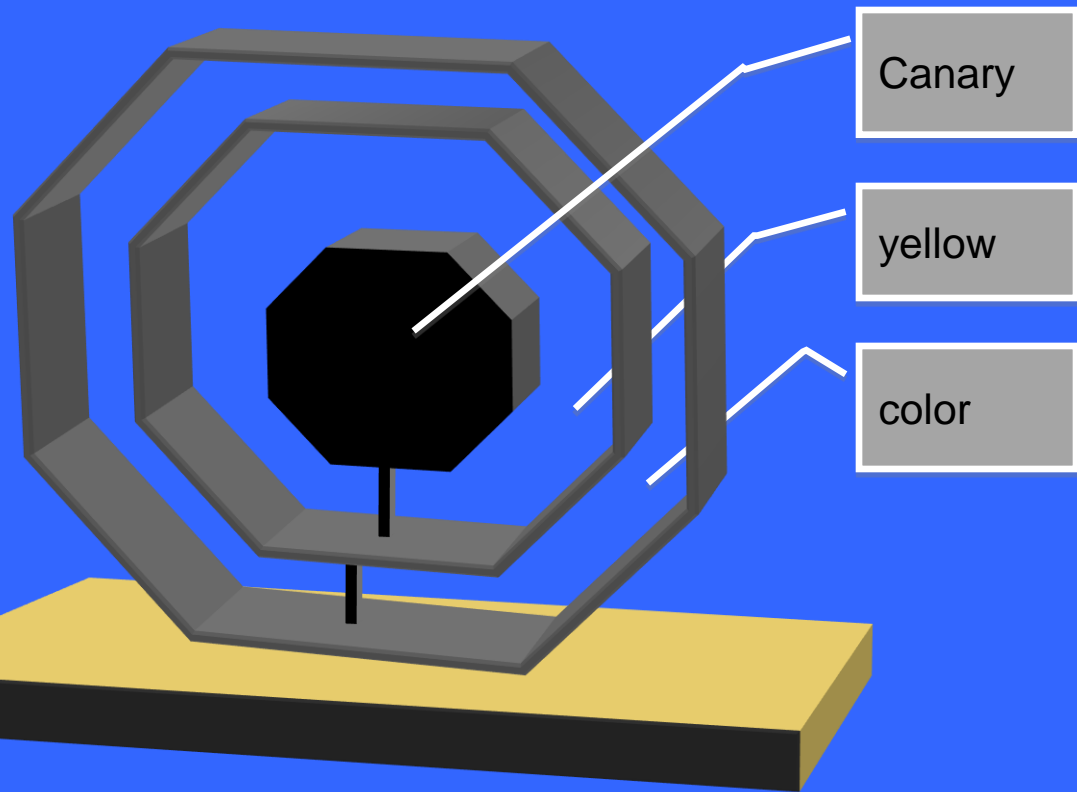
DCIT is a defeasible categorical logic that is a development from term-functor logic designed by Fred Sommers and further explored by George Englebretsen.



Sommers demonstrated that all assertions (e.g. compound statements and relationals) could be shown to be categorical in plain natural language.

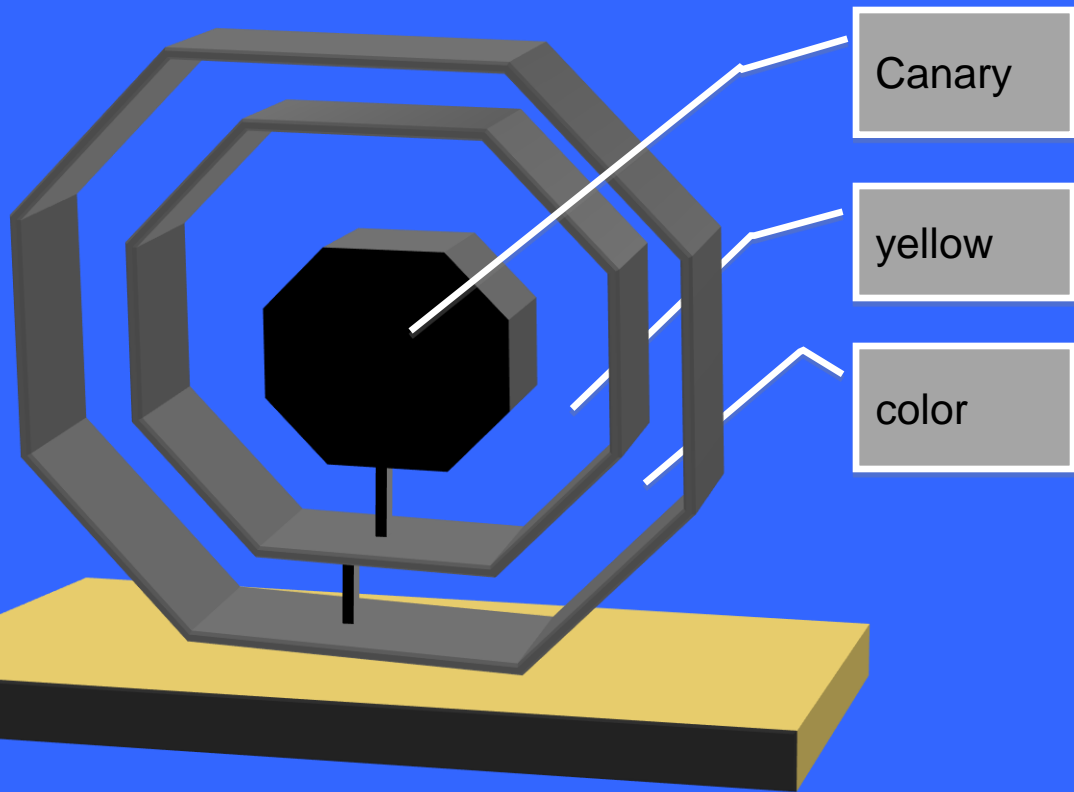


This is an example of classical categorical logic with monadic terms. [nested categorical containers]



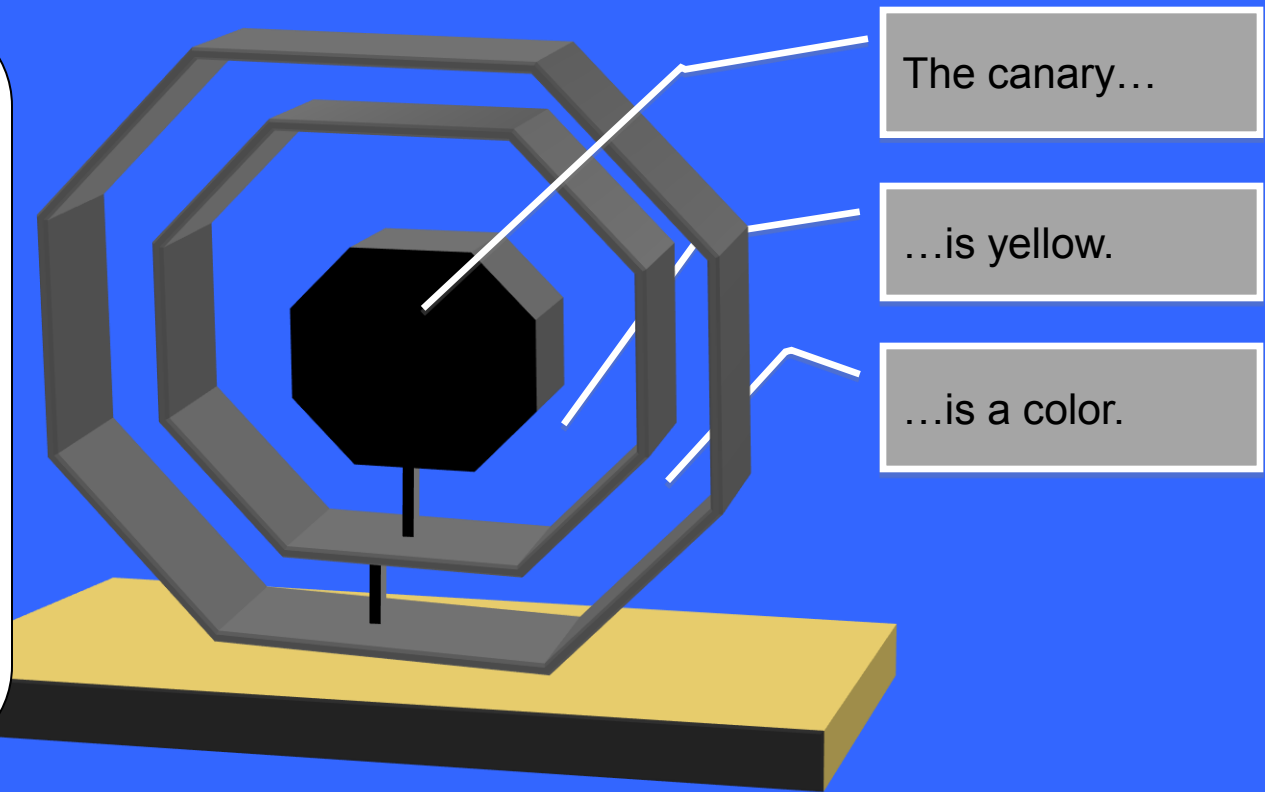
Premises: 1. The canary is yellow.
 2. Yellow is a color.
Conclusion: The canary is a color.

But, the conclusion is false since "yellow" is not essentially predicated of a canary, such as "bird."



Premises: 1. The canary is yellow.
2. Yellow is a color.
Conclusion: The canary is a color.

By comparison,
DCIT translates
all premises into
a categorical
form and parses
them into the
Subject and
Complex
Predicate.



Premises: 1. The canary...is yellow.
2. One that is yellow...is a color.
Conclusion: The canary...is a color.

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>The canary...</u>	...is yellow.
2	One that...	...is yellow...	... <u>is a color.</u>
CONCLUSION			
		<u>The canary...</u>	... <u>is a color.</u>
ASSUMPTIONS TO LINKED PREMISES			
#	NOT INDICATED		

Figure 3. DCIT template canary argument.

Premises:	1. The canary...is yellow.
	2. One that is yellow...is a color.
Conclusion:	The canary...is a color.

DCIT also has some similarity with the typical *modus ponens* logical form:

If A then B

A

Therefore B

The ubiquitous Tweety example follows this logical form [67]:

If Tweety is a bird, then Tweety flies.

Tweety is a bird.

Therefore, Tweety flies.

Like DCIT, *modus ponens* uses an internally consistent word order, sentence structure, and premise linkage which makes its structural correctness obvious. But while *modus ponens* relies upon non-distributive conditionals, DCIT relies upon distributive generalizations:

Tweety...is a bird.

One that is a bird...flies.

Therefore, Tweety...flies.

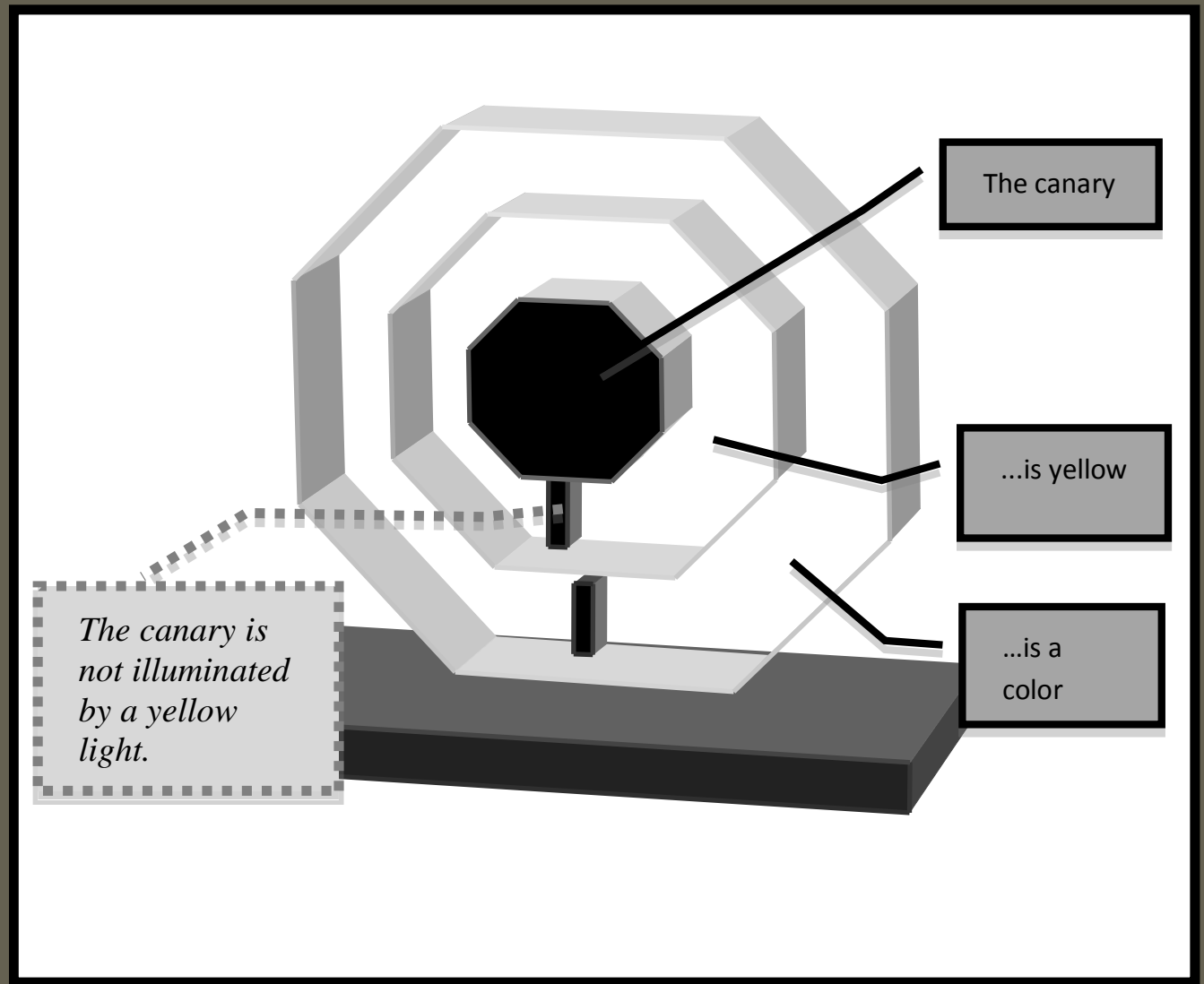
The distributive generalization of DCIT can, however, also be expressed as a distributive conditional:

Tweety is a bird.

If one is a bird, then one flies.

Therefore, Tweety flies.

And like defeasible *modus ponens* [67], DCIT can account for defeasibility as a nonmonotonic logic as later shown in this paper.



Premises: 1. The canary...is yellow.
2. One that is yellow...is a color.

Conclusion: The canary...is a color.

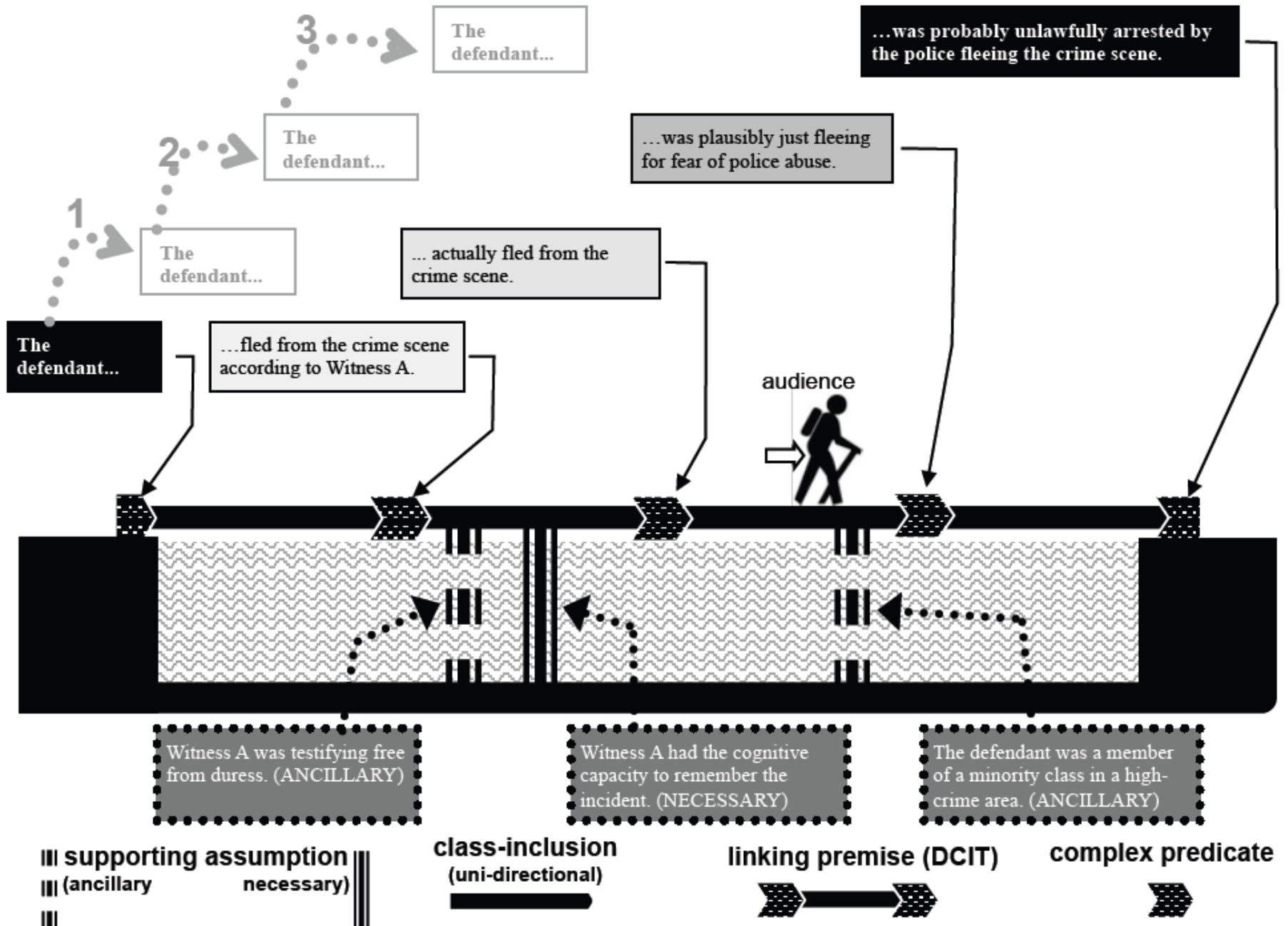
DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>The canary...</u>	...is yellow.
2	One that...	...is yellow...	... <u>is a color.</u>
CONCLUSION			
		<u>The canary...</u>	... <u>is a color.</u>
ASSUMPTIONS TO LINKED PREMISES			
1	The canary is not illuminated by a yellow light.		

Premises: 1. The canary...is yellow.
 2. One that is yellow...is a color.
 Conclusion: The canary...is a color.

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>The defendant...</u>	...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 <u>unlawfully arrested by the police fleeing the crime scene.</u>
CONCLUSION			
		<u>The defendant...</u>	...was probably <u>unlawfully arrested by the police fleeing the crime scene.</u>
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)		

Figure 5. DCIT template fleeing argument.

3 Inference Steps



The court describes the prosecutor's line of reasoning as follows:

"To be sure, the record provides an ample basis for the first two steps in that line of logic. Payne's testimony provided the jury with a basis to conclude that the children were in their bedroom [away from the hallway where the fight took place] during most of the argument, and in particular were there toward the end of the argument when defendant slapped Payne in the face. Both Payne's testimony and that of the investigating officer's provide sufficient grounds to conclude that the argument and the fight could be easily heard in other areas of the house, and easily seen if doors were open." *Bivins* at 468. (see Figure 7)

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>The children...</u>	...were in the house.
2	Any such who...	...were in the house...	...would have heard the arguing of the defendant and Payne.
3	Any such who...	...would have heard the arguing of the defendant and Payne...	... <u>heard the open-hand slap to Payne's face.</u>
CONCLUSION			
		<u>The children...</u>	... <u>heard the open-hand slap to Payne's face.</u>
ASSUMPTIONS TO LINKED PREMISES			
#	NOT INDICATED		

Figure 7. DCIT template *Bivins* argument with no supporting assumptions.

The court found the state's reasoning incomplete, however, noting that "the state's line of logic requires several additional intermediate inferences." *Bivens* at 470. These are as follows:

- (a) "The open hand slap made a distinctive sound."
- (b) "[T]he sound of the slap rose above the noise of the argument."
- (c) "C, at age five, was sufficiently mature to distinguish the assaultive conduct from other aspects of the fight."
- (d) "[T]he children and the five-year old in particular paid attention to the fight."

While the court characterizes these propositions as “additional intermediate inferences,” from a more rigorous logical perspective, these statements are not “intermediate inferences.” There are no additional inference leaps that need to be made in the prosecution’s line of reasoning since it follows a standard logical form. More accurately described, these four propositions are assumptions that provide support for premise number 3. This more complete argument structure is depicted in Figure 8.

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>The children...</u>	...were in the house.
2	Any such who...	...were in the house...	...would have heard the arguing of the defendant and Payne.
3	Any such who...	would have heard the arguing of the defendant and Payne...	<u>... heard the open-hand slap to Payne’s face.</u>
CONCLUSION			
		<u>The children...</u>	<u>... heard the open-hand slap to Payne’s face.</u>
ASSUMPTIONS TO LINKED PREMISES			
3	(a) “The open hand slap made a distinctive sound.” (b) “[T]he sound of the slap rose above the noise of the argument.” (c) Any such “was sufficiently mature to distinguish the assaultive conduct from other aspects of the fight.” (d) Any such paid particular “attention to the fight.”		

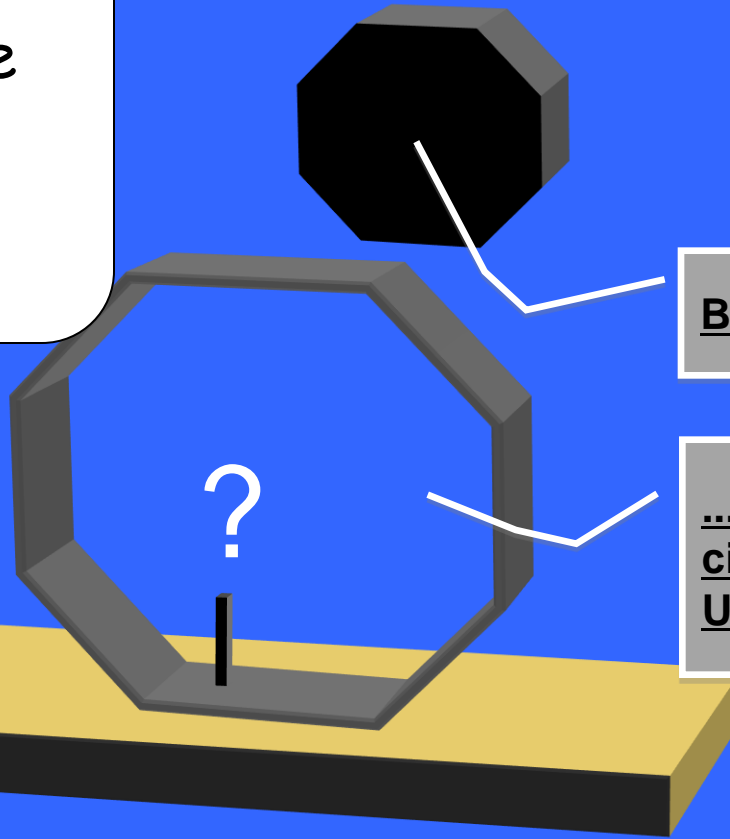
Figure 8. DCIT template *Bivins* argument with supporting assumptions.

DCIT's scaffolding also accommodates lines of reasoning when most of the generalizations contain statutory language (see Figure 9). Thus, there is no law-fact distinction [2] for DCIT analytical purposes.

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>The property tax complaint...</u>	...was filed more than 90 days after the Notice of Assessment.
2	Any such that...	...was filed more than 90 days after the Notice of Assessment...	...was not filed within the time allowed under ORS 305.280.
3	Any such that...	...was not filed within the time allowed under ORS 305.280...	...did not meet the ORS 305.560 requirements for a tax court appeal under ORS 305.275.
4	Any such that...	...did not meet the ORS 305.560 requirements for a tax court appeal under ORS 305.275...	<u>...should be dismissed.</u>
CONCLUSION			
		<u>The property tax complaint...</u>	<u>...should be dismissed.</u>
ASSUMPTIONS TO LINKED PREMISES			
4	Premise 4 necessarily assumes that the tax court does not have jurisdiction under another statute such as ORS 305.288.		

Figure 9. DCIT template property tax complaint dismissal

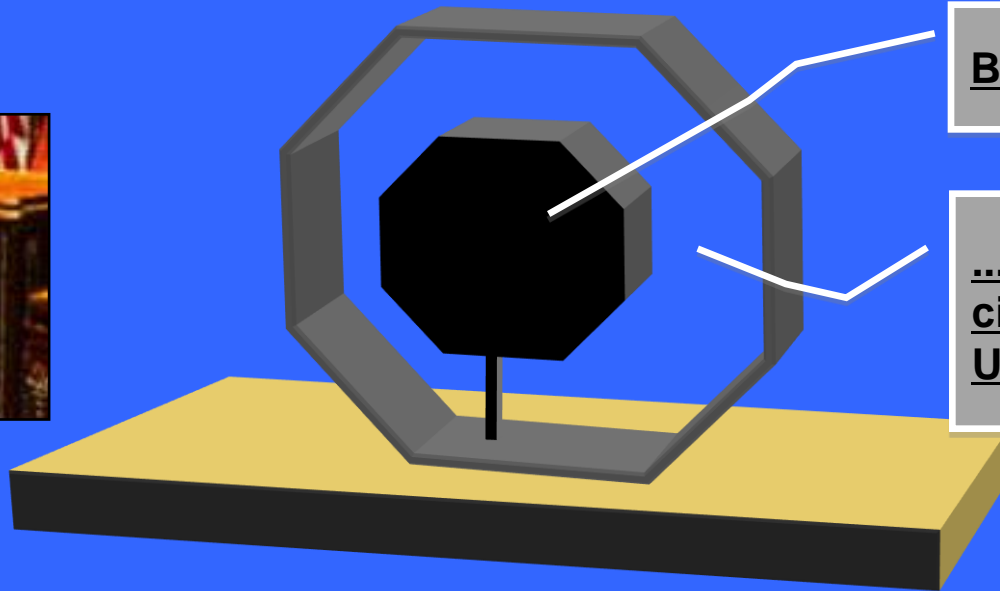
The issue is whether
"Barack" belongs to the
category "is a natural
born citizen of the
United States."



Barack...

...is a natural born
citizen of the
United States.

Defendant contends that
"Barack" does belong to the
category "is a natural born
citizen of the United States."



Barack...

...is a natural born
citizen of the
United States.

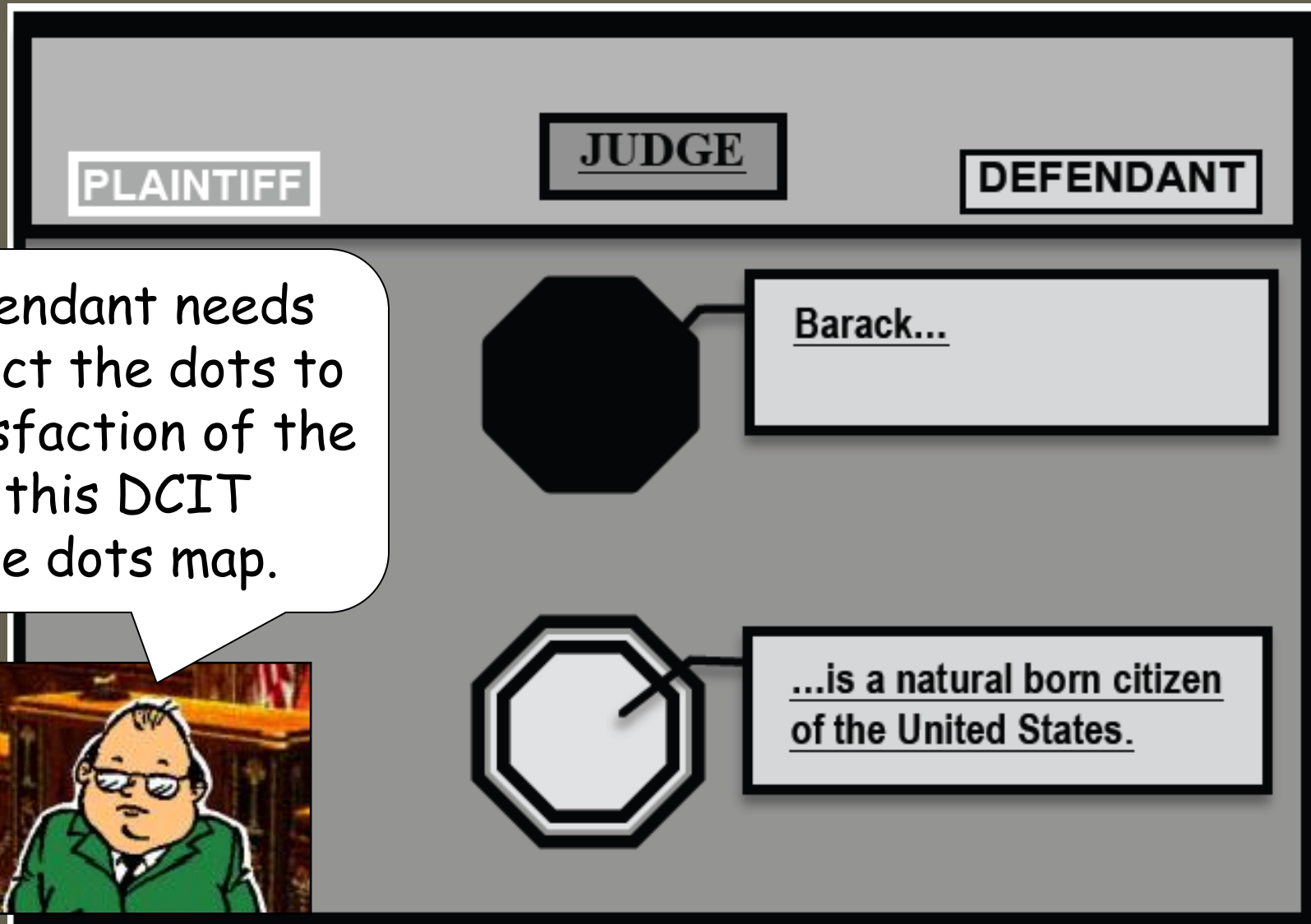


Figure 9. DCIT predicate dots argument map Barack 1.

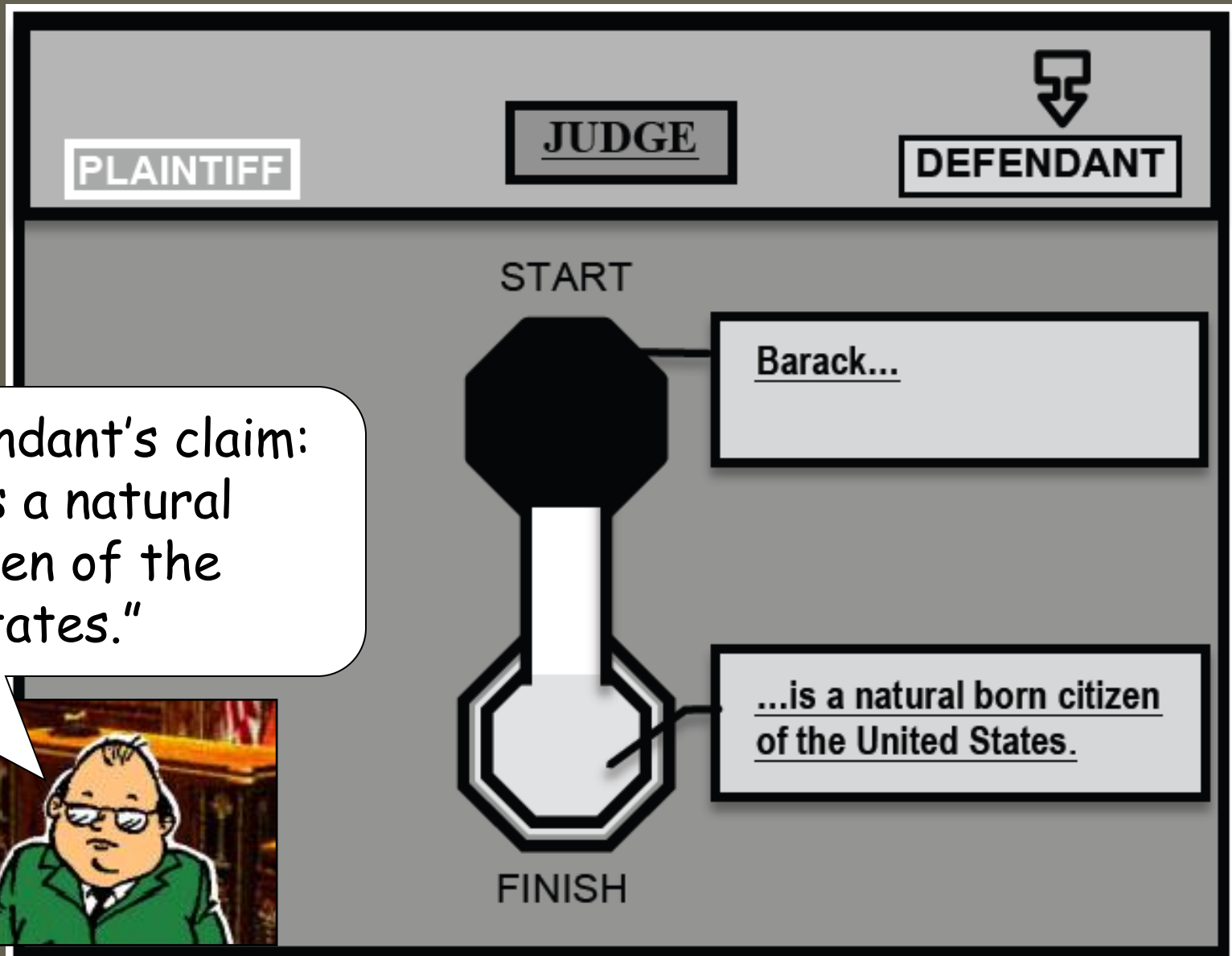


Figure 10. DCIT predicate dots argument map Barack 2.



Figure 11. DCIT predicate dots argument map Barack 3.

DCIT LINKED PREMISES

#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>Barack...</u>	<u>... is a natural born citizen of the United States.</u>
2			

CONCLUSION

Barack... ... is a natural born citizen of the United States.

ASSUMPTIONS TO LINKED PREMISES

Not Indicated

This same contention or claim is depicted in a DCIT template.



PLAINTIFF

JUDGE

DEFENDANT

Barack...

?

...is a natural born citizen
of the United States.

The judge does not,
however, perceive
any connection
(e.g., acceptability)
to the claim.

DCIT predicate dots argument map Barack 4.



DCIT LINKED PREMISES

#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>Barack...</u>	???
2	One such who...	???	... <u>is a natural born citizen of the United States.</u>
CONCLUSION			
		<u>Barack...</u>	... <u>is a natural born citizen of the United States.</u>
ASSUMPTIONS TO LINKED PREMISES			
#	Not Indicated		

PLAINTIFF

JUDGE

DEFENDANT



100

Barack...

100

...was born in Hawaii.

100

...is a natural born citizen
of the United States.

So the defendant suggests an intervening predicate to bridge the gap, thereby, creating two premises.



DCIT LINKED PREMISES

#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>Barack...</u>	...was born in Hawaii.
2	One such who...	...was born in Hawaii...	... <u>is a natural born citizen of the United States.</u>
CONCLUSION			
	So...	<u>Barack...</u>	... <u>is a natural born citizen of the United States.</u>
ASSUMPTIONS TO LINKED PREMISES			
#	Not Indicated		

PLAINTIFF

JUDGE

DEFENDANT

Barack...

?

...was born in Hawaii.

...is a natural born citizen
of the United States.

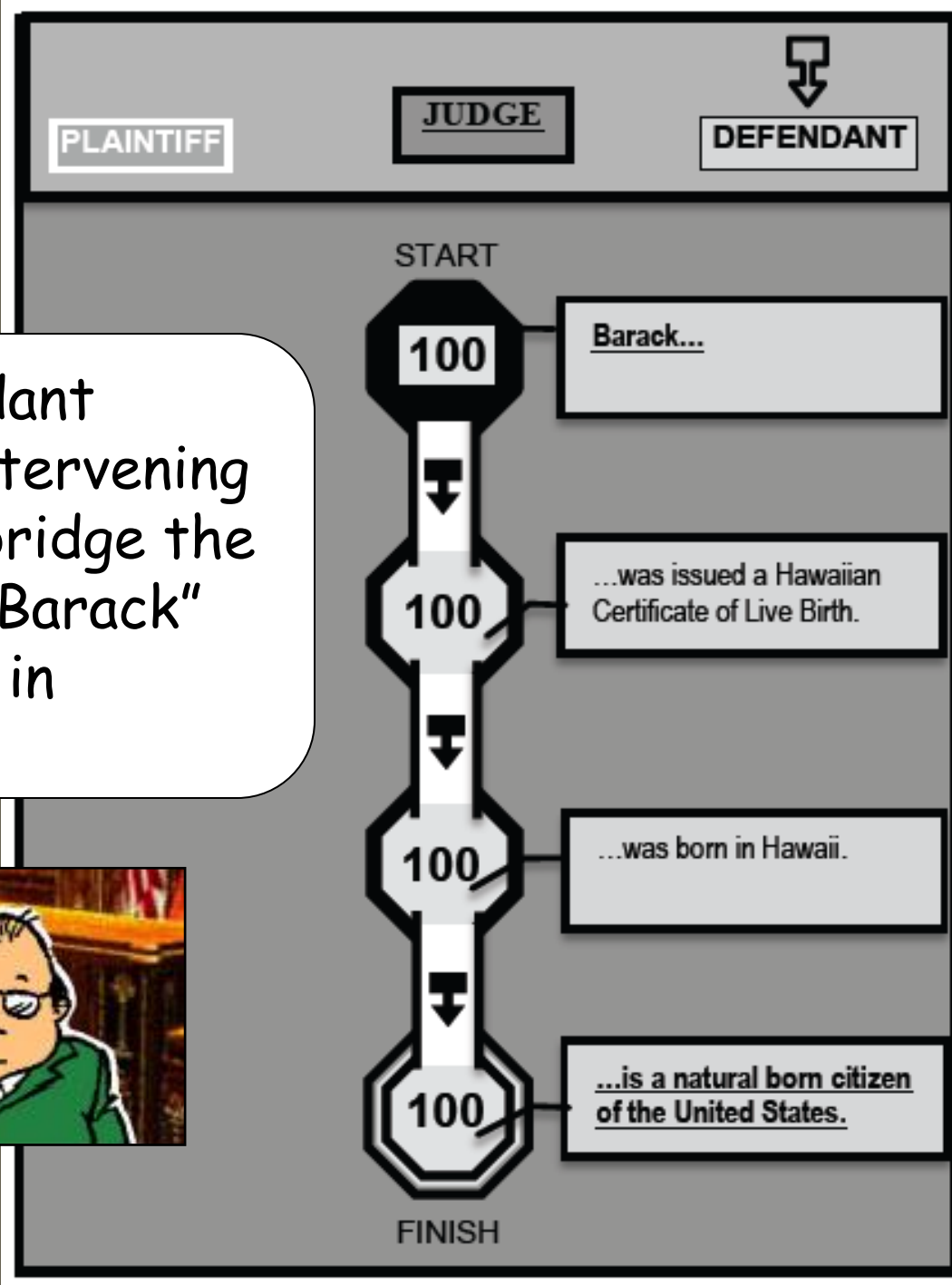
The judge perceives a connection (some acceptability) for the second nexus, but not for the first one.

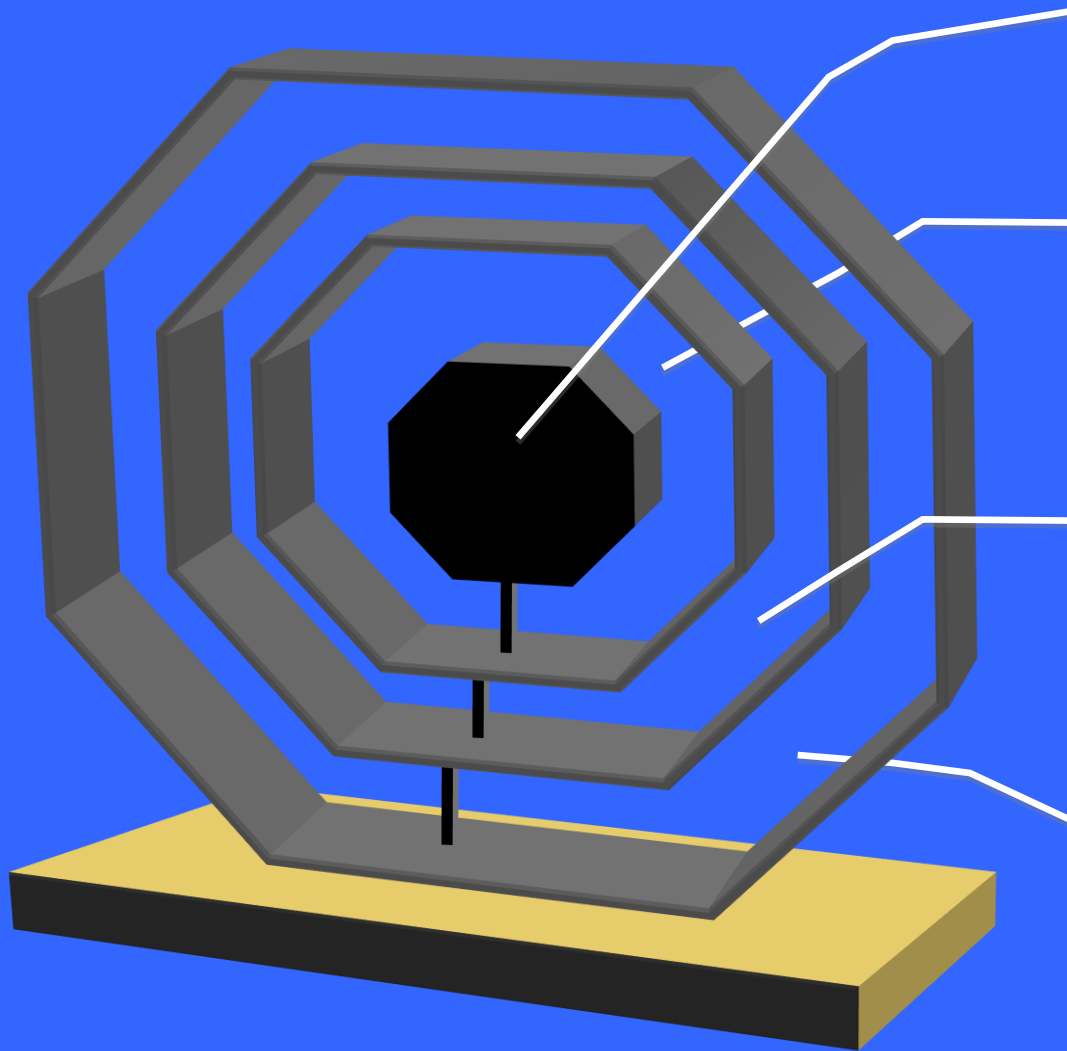


DCIT LINKED PREMISES

#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>Barack...</u>	???
	One such who...	???	...was born in Hawaii.
2	One such who...	...was born in Hawaii...	<u>...is a natural born citizen of the United States.</u>
CONCLUSION			
		<u>Barack...</u>	<u>... is a natural born citizen of the United States.</u>
ASSUMPTIONS TO LINKED PREMISES			
#	Not Indicated		

So the defendant suggests an intervening predicate to bridge the gap between "Barack" and "was born in Hawaii."





Barack...

...was issued a Hawaiian
Certificate of Live Birth.

...was born in Hawaii.

...is a natural born
citizen of the United
States.

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>Barack...</u>	...was issued a Hawaiian Certificate of Live Birth.
3	One who...	...was issued a Hawaiian Certificate of Live Birth...	...was born in Hawaii.
	One who...	...was born in Hawaii...	... <u>is a natural born citizen of the United States.</u>
CONCLUSION			
		<u>Barack...</u>	... <u>is a natural born citizen of the United States.</u>
ASSUMPTIONS TO LINKED PREMISES			
	Not Indicated		

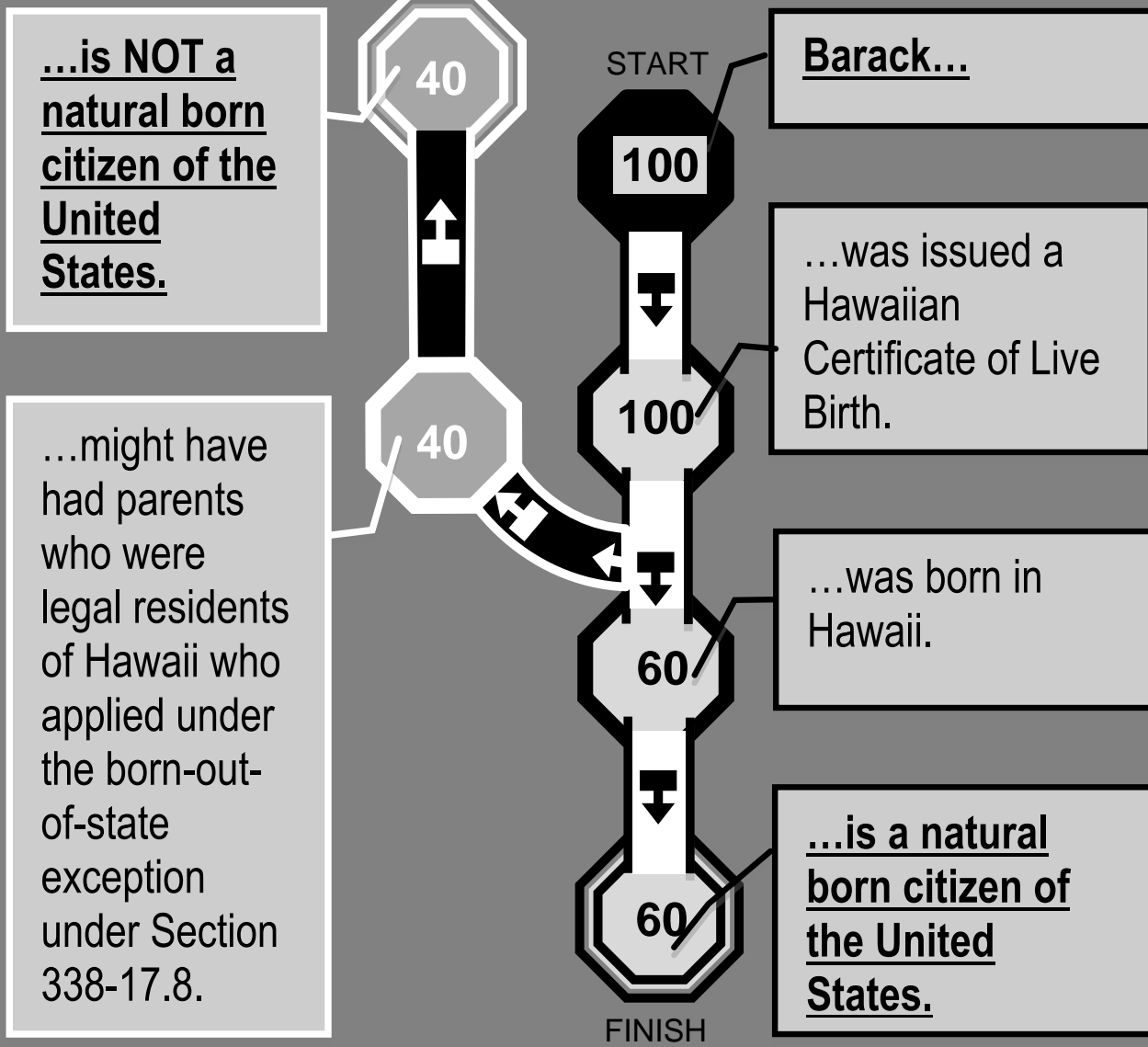
Figure 18. DCIT argument template Barack argument 3



PLAINTIFF

JUDGE

DEFENDANT



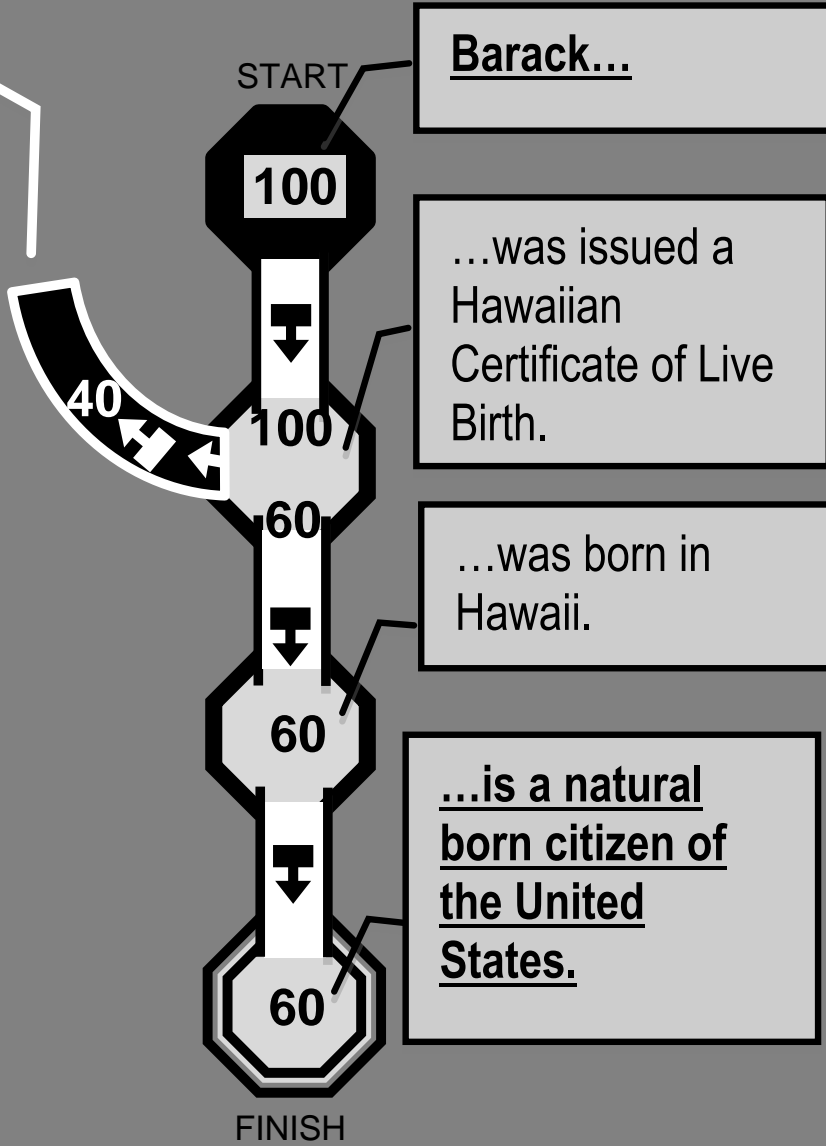


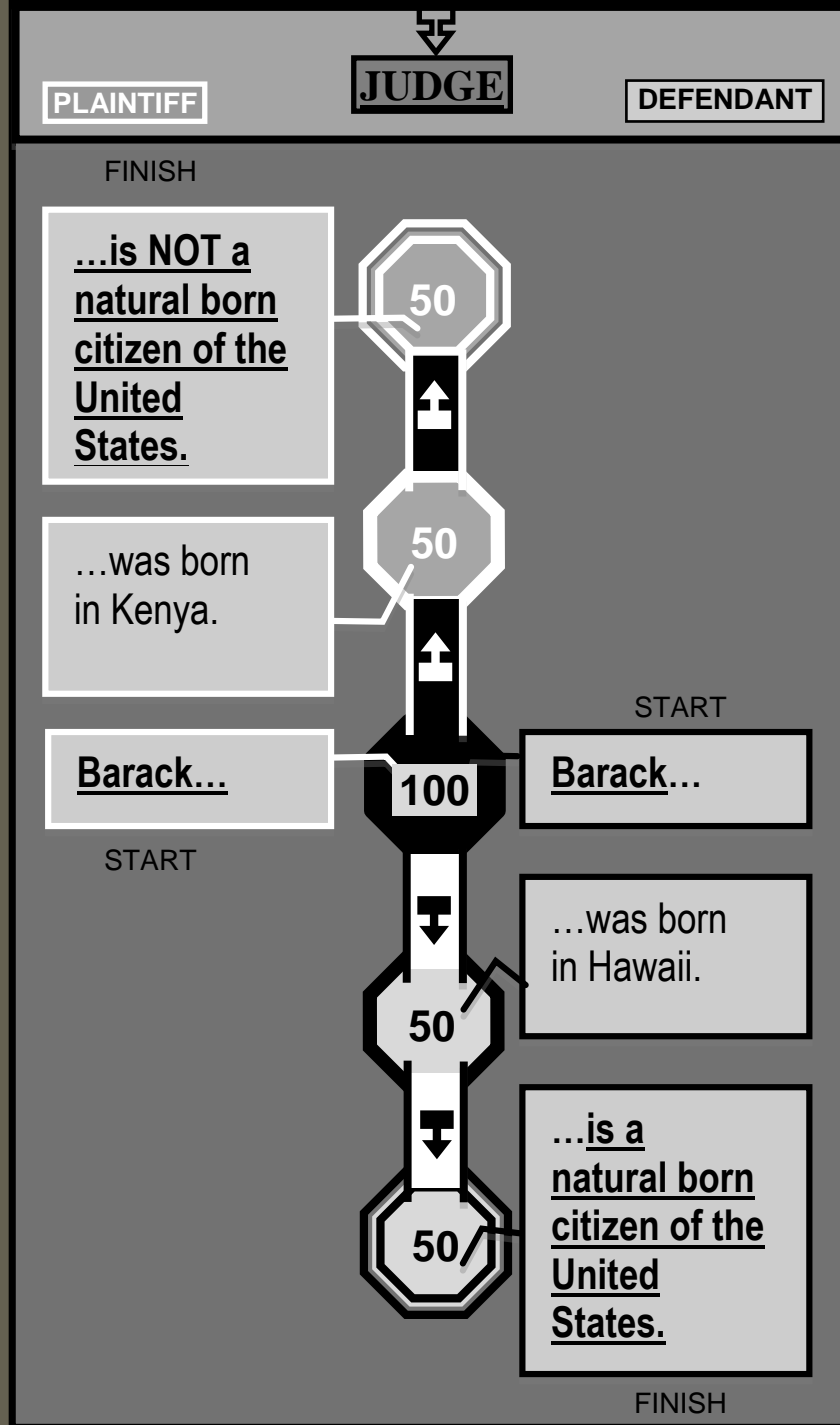
PLAINTIFF

JUDGE

DEFENDANT

THE PREMISE
THAT
*"Barack was
issued a
Hawaiian
Certificate of Live
Birth"*
IS
INCONSISTENT
WITH
DEFENDANT'S
OTHER CLAIM.



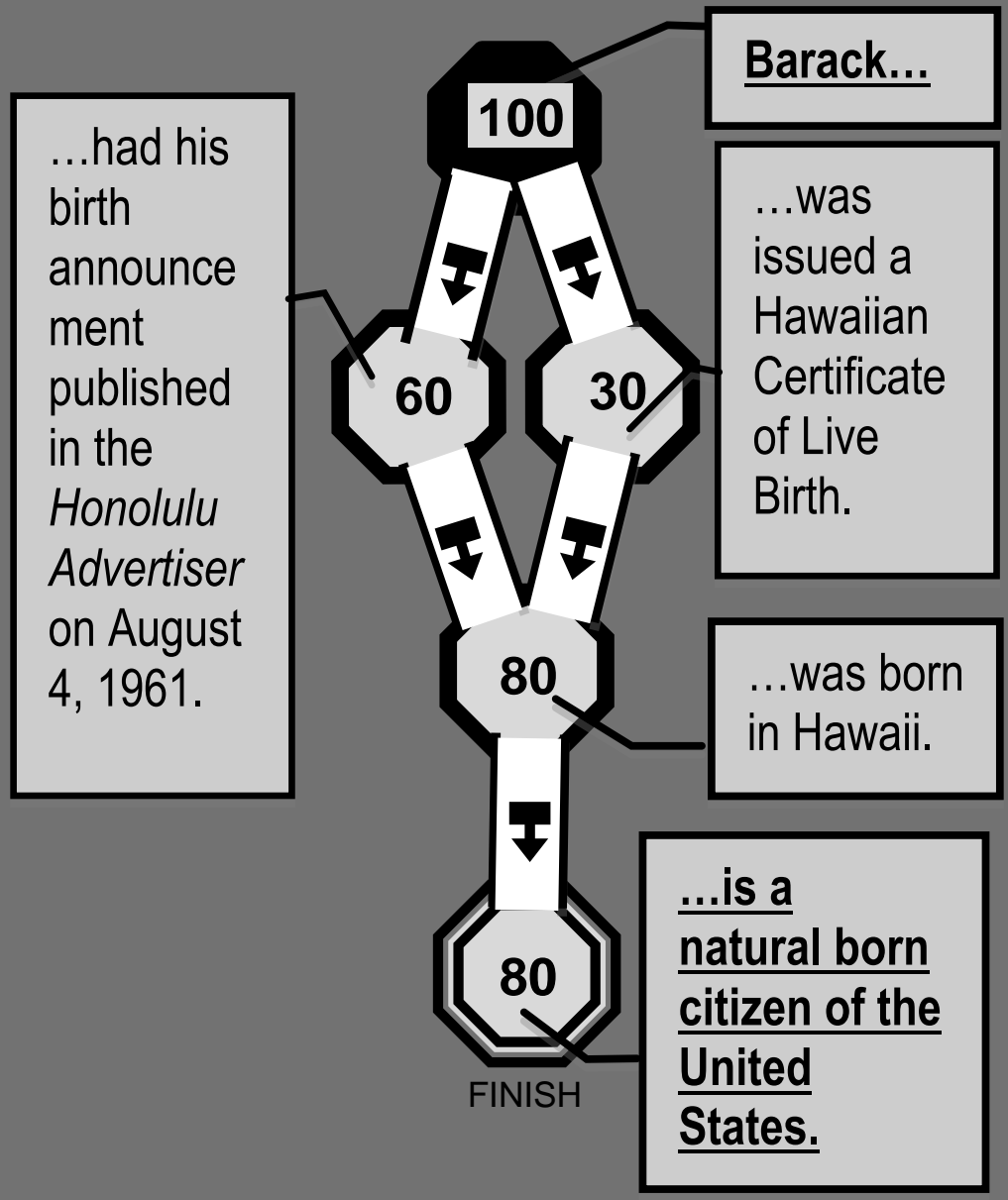




PLAINTIFF

JUDGE

DEFENDANT



Barack...

...was issued a Hawaiian Certificate of Live Birth.

...was born in Hawaii.

...is a natural born citizen of the United States.

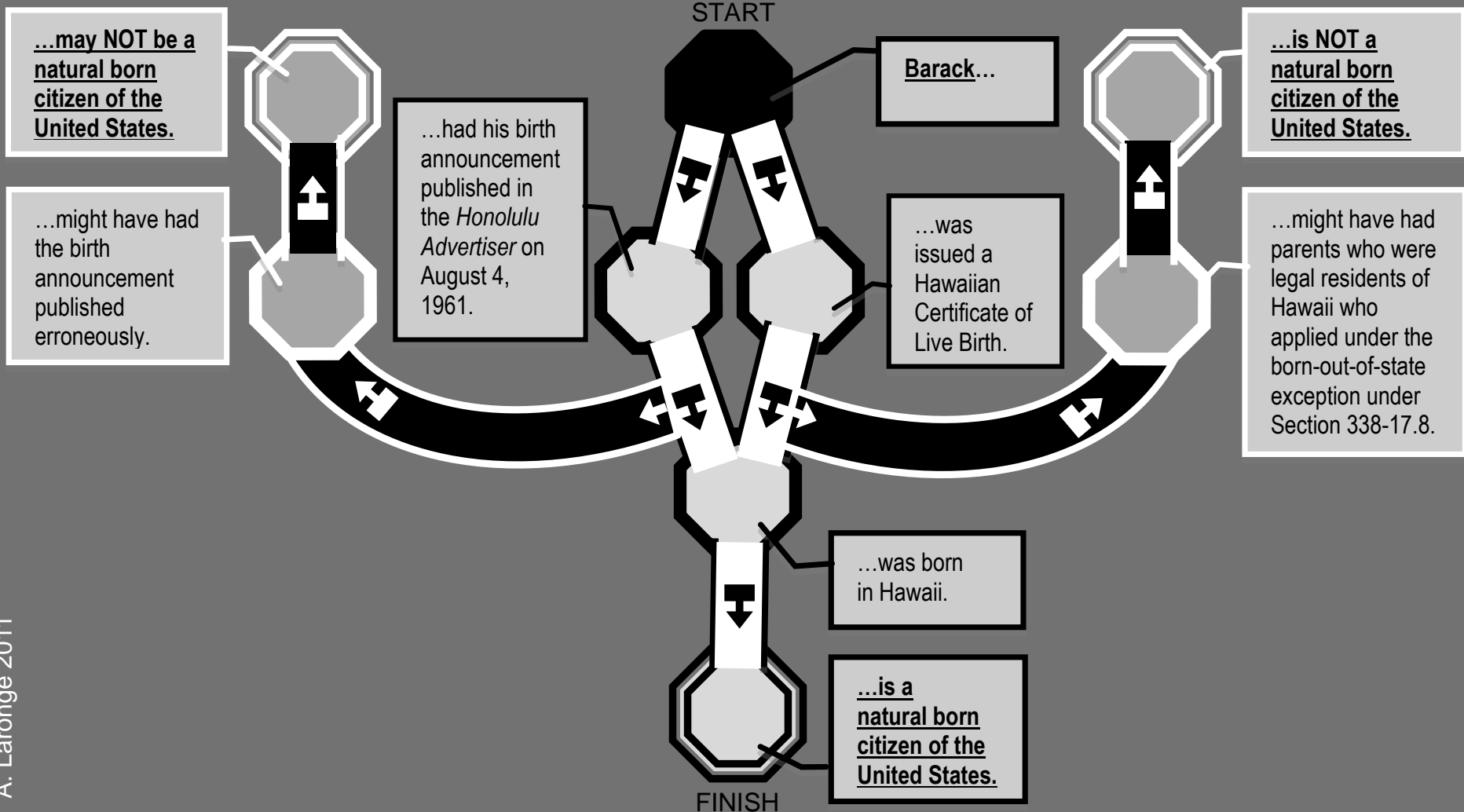
...had his birth announce ment published in the *Honolulu Advertiser* on August 4, 1961.

FINISH

PLAINTIFF

JUDGE

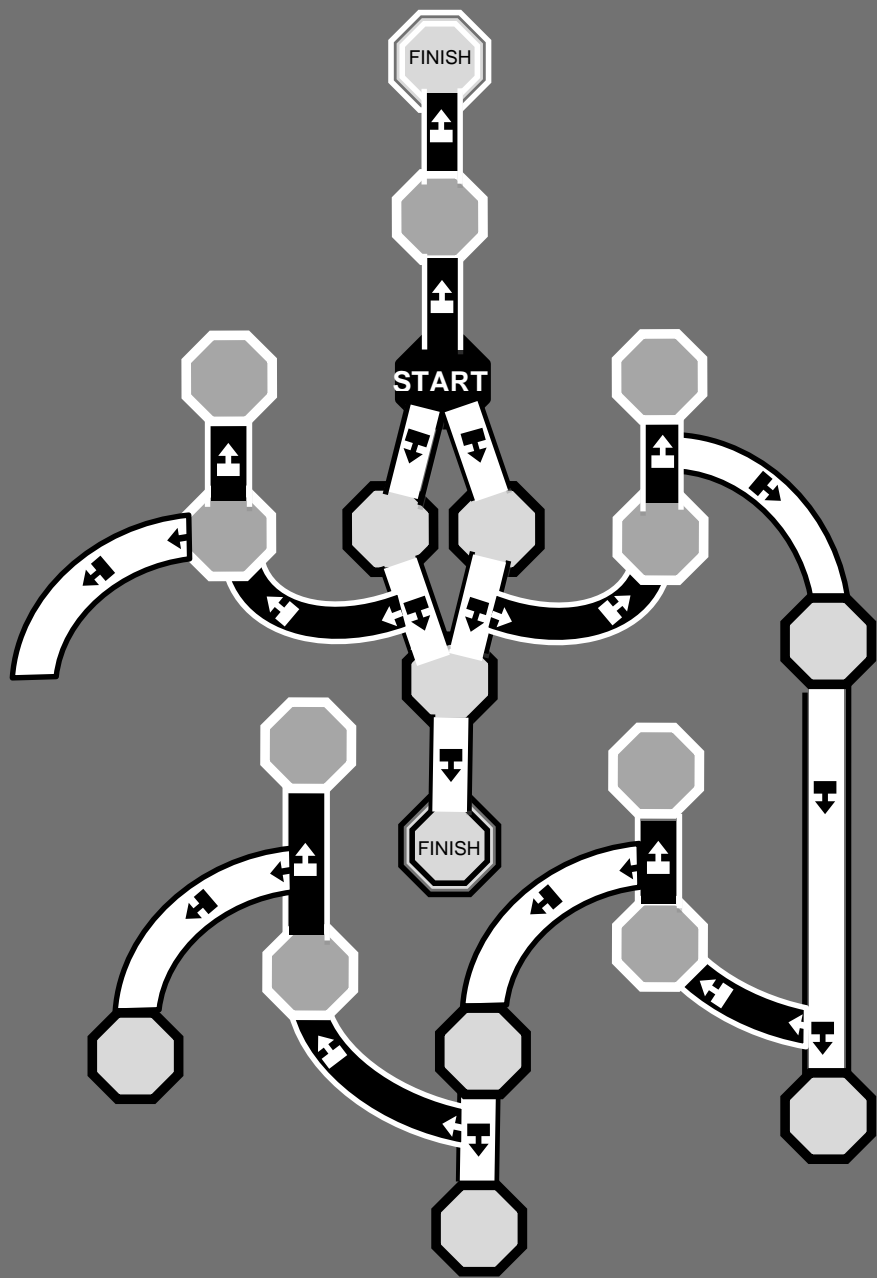
DEFENDANT



PLAINTIFF

JUDGE

DEFENDANT



PLAINTIFF

JUDGE

DEFENDANT

START

Level 1

Barack...

*The Witness ...
was not biased in
favor of citizenship..*

ANCILLARY
ASSUMPTION
Level 2

100

... was born in Hawaii,
according to witness
Governor Ambercrombie.

*The Witness ...
was in a position to
know.*

NECESSARY
ASSUMPTION
Level 2

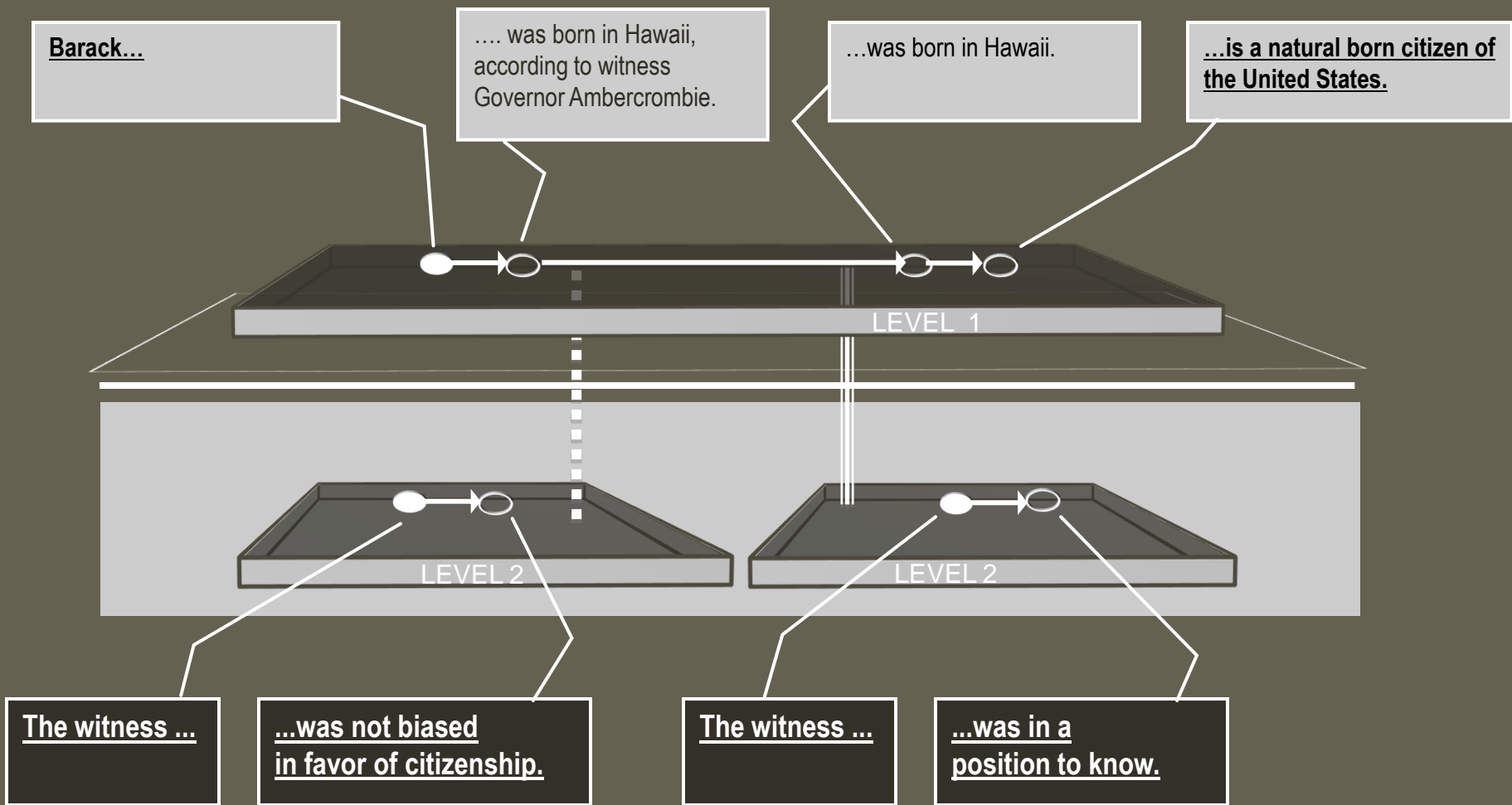
100

...was born in Hawaii.

100

...is a natural born citizen of
the United States.

FINISH



1. **Barack...is a natural born citizen of the United States.** (MAIN CONCLUSION)

1.1 **Barack...was born in Hawaii according to witness Governor Ambercrombie.** (TLP)

1.1 One who was born in Hawaii according to witness Governor Ambercrombie
...was born in Hawaii. (TLP)

2.0 The witness...was in a position to know of the birth. (Assumption)

2.1 The witness...was in the hospital Waiting Room at the time of the birth according to the nurse on duty. (TLP)

2.1 One who was in the hospital Waiting Room at the time of the birth according to the nurse on duty...
was in the hospital Waiting Room at the time of the birth. (TLP)

3.0 The nurse on duty...remembered the incident correctly. (Assumption)

3.1 The nurse on duty...had contemporaneous notes that matched
her statement of the incident according to her co-worker. (TLP)

3.1 One who had contemporaneous notes that matched one's statement of the incident according to
her co-worker...had contemporaneous notes that matched one's statement of the incident. (TLP)

4.0 The co-worker...had first-hand knowledge of the notes. (Assumption)

4.1 The co-worker saw the notes as they were written. (TLP)

4.1 One who saw the notes as they were written...had first-
hand knowledge of the notes. (TLP)

3.1 One who had contemporaneous notes that matched one's statement of the incident...remembered
the incident correctly.

2.1 One who was in the hospital Waiting Room at the time of the birth...was in a position to know of the birth. TLP)

2.0 The witness...was not biased in favor of Barack. (Assumption)

2.1 The witness...was the campaign manager for a Republican 2012 Presidential candidate. (TLP)

2.1 One who was the campaign manager for a Republican 2012 Presidential candidate...was not biased
in favor of Barack. (TLP)

2.0 The witness...was capable of perceiving the event correctly. (Assumption)

1.1 One who was born in Hawaii...**is a natural born citizen of the United States.** (TLP)

2.0 Hawaii...was a U.S. territory or state at the time of the birth. (Assumption)

2.1 Hawaii...became a U.S. territory in 1898. (TLP)

2.1 One such that became a U.S. territory in 1898...was a U.S. territory or state at the time of the birth.
(TLP)

Barack...

...was born in Hawaii according to witness Governor Ambercrombie.

...was born in Hawaii.

...is a natural born citizen of the United States.

Main Conclusion LEVEL 1

LEVEL 2

Assumption

LEVEL 2

Assumption

LEVEL 2

Assumption

LEVEL 2

Assumption

LEVEL 3

Assumption

LEVEL 4

Assumption

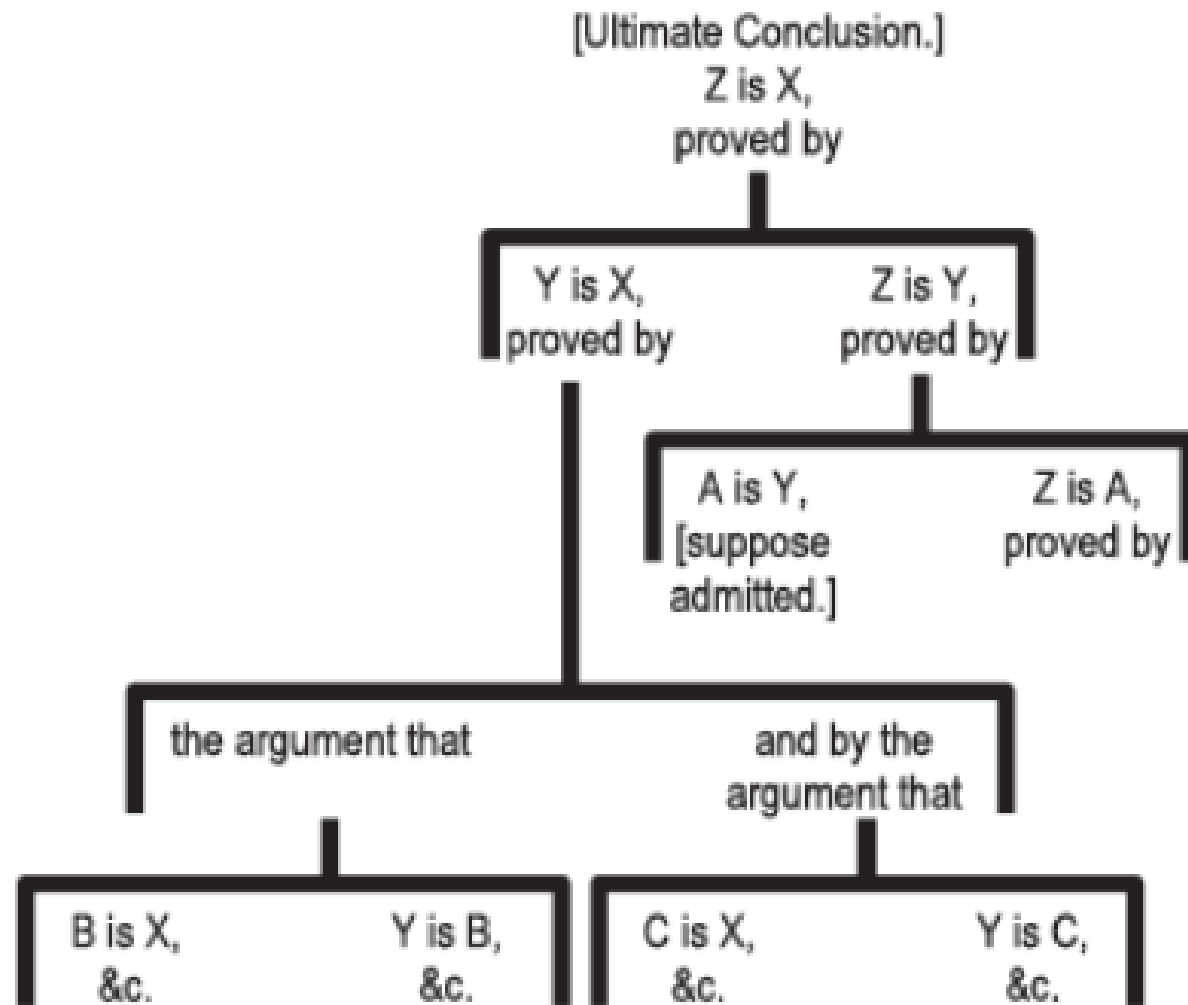
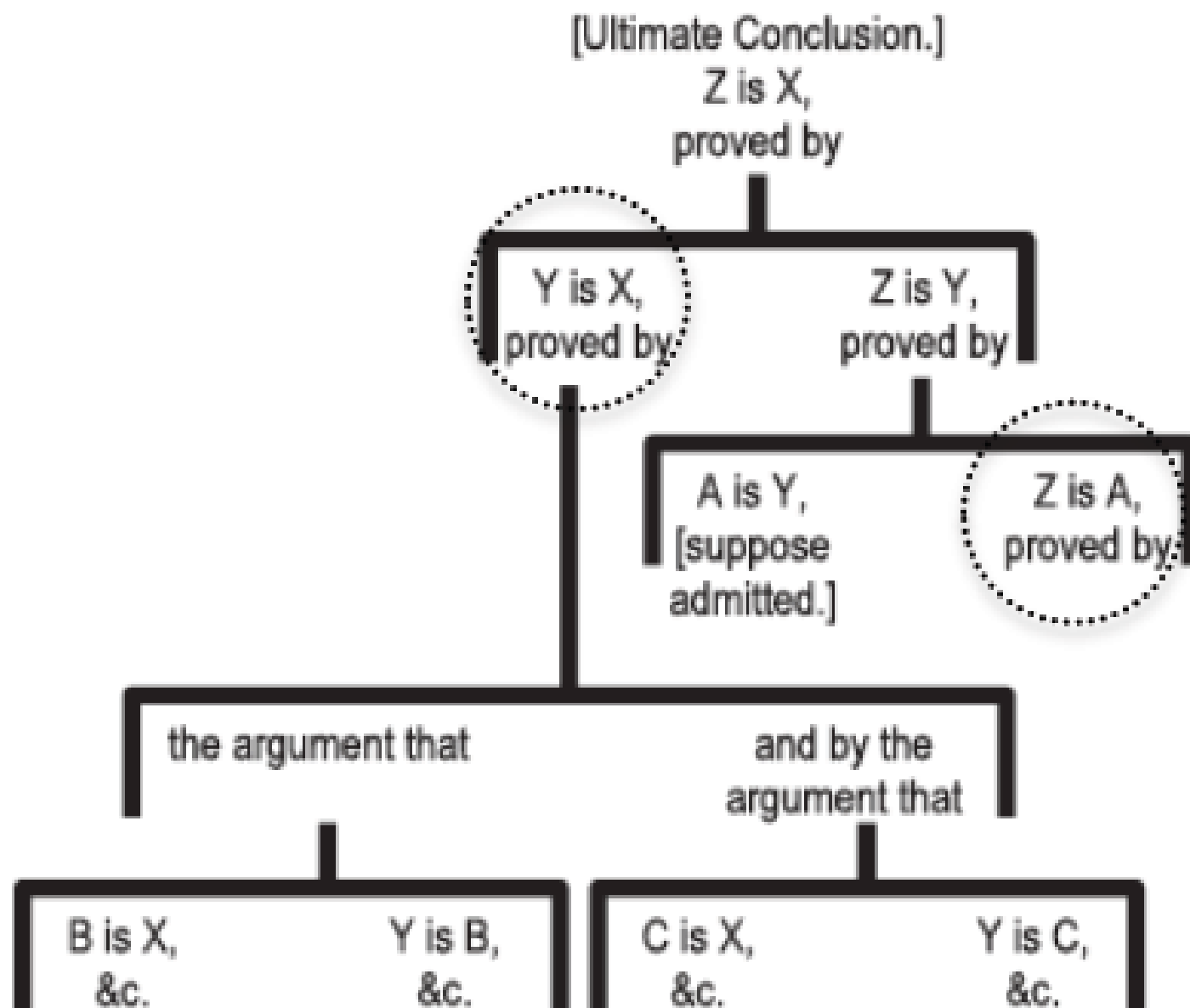
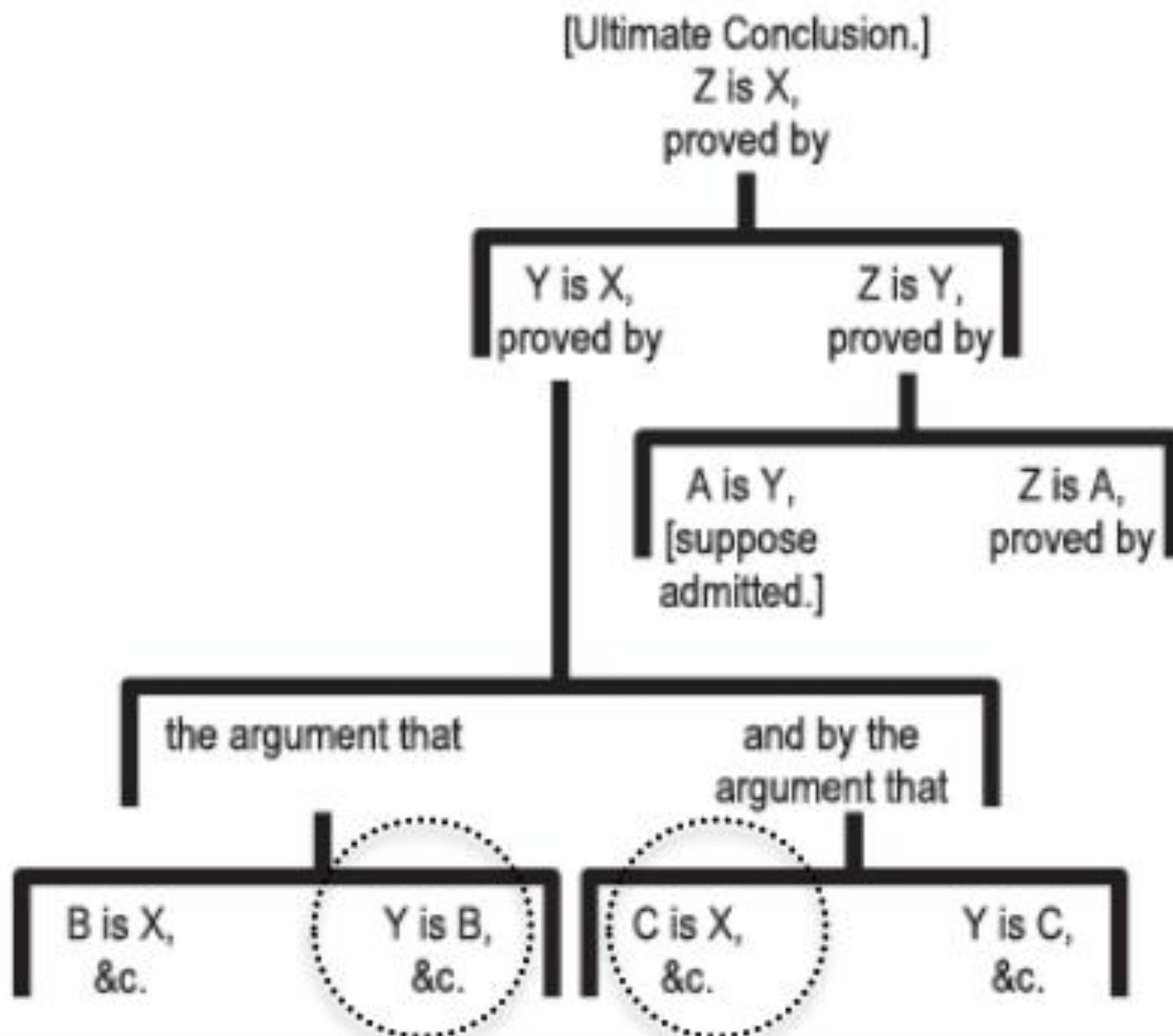


Figure 30. Whately tree-like argument map (current replication).





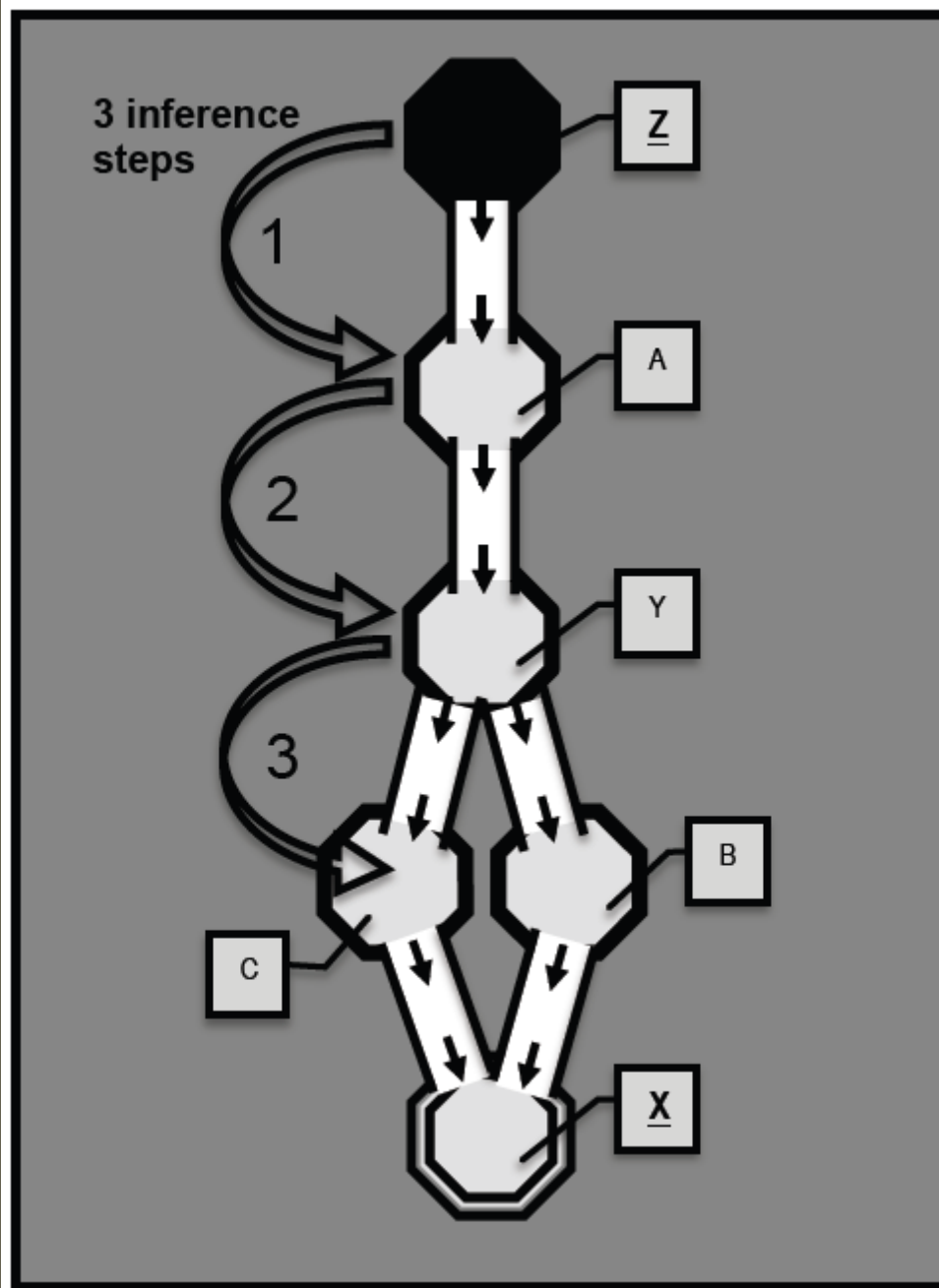


Figure 35. DCIT predicate dots argument map Whately.

DCIT LINKED PREMISES			
#	COMPLEX SUBJECT		COMPLEX PREDICATE
1	→	<u>The Gun-Free School Zone Act</u>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...	<u>...falls within the scope of the Commerce Clause.</u>
CONCLUSION			
		<u>The Gun-Free School Zone Act</u> ...	<u>...falls within the scope of the Commerce Clause.</u>
ASSUMPTIONS TO LINKED PREMISES			
#	NOT INDICATED		

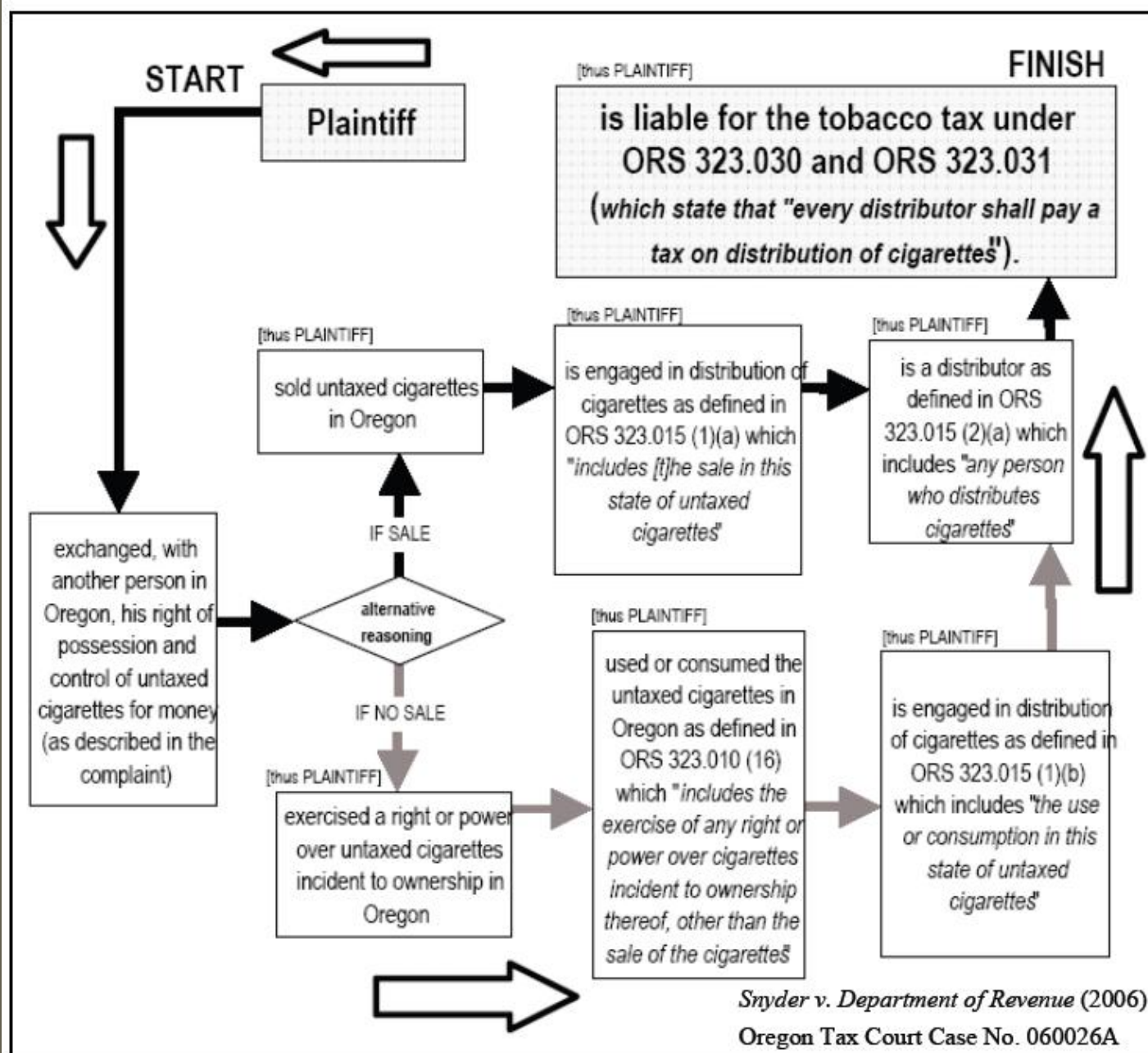


Figure 44. DCIT first-generation argument map *Snyder v. Department of Revenue*.

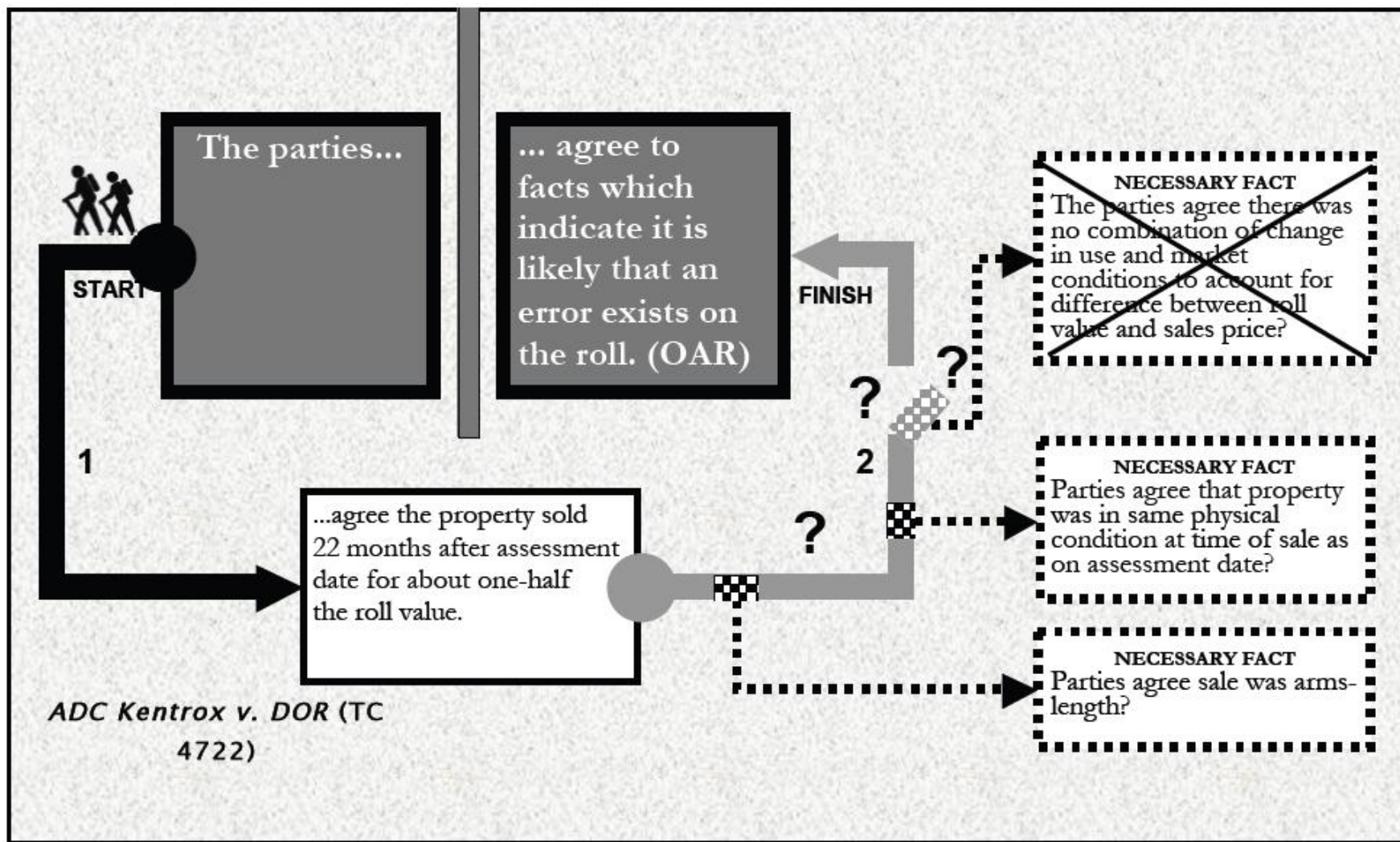


Figure 45. DCIT first-generation argument-bridge diagram *ADC Kentrox v. Department of Revenue*.

Linked Premises of Line of Reasoning

1	→	The personal property	... is used for personal purposes by the fractional interest owners and the timeshare participants.
2	Any such that...	is used for personal purposes by the fractional interest owners and the timeshare participants...	... is used for personal purposes by the owner as "owner" is intended under ORS 307.190.
3	Any such that...	is used for personal purposes by the owner as "owner" is intended under ORS 307.190	...is exempt from taxation under ORS 307.190.

CONCLUSION

So...	The personal property	...is exempt from taxation under ORS 307.190.
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Worldmark v. Dept. of Revenue, Oregon Tax Court

ACKNOWLEDGMENTS

I gratefully acknowledge the years of collegial support in conventional tree-like argument mapping by Tim van Gelder during my association with Austhink. His passion and commitment to consider and pursue new argumentation pedagogy in a successful effort to produce substantial measurable gains in critical thinking skills has been inspirational to me for my own work in court with DCIT. I am also grateful for the years of encouragement of Peter Tillers. And while the merit of Peter Tillers' substantial academic publications is readily acknowledged, I have also greatly benefited from his years of blogging on evidentiary inference. I also want to express my appreciation for this workshop opportunity to my fellow AI & Evidential Inference panelists: Ronald J. Allen, Rainhard Benghez, Floris Bex, Scott Brewer, James Franklin, David Hamer, Bruce Hay, D. Michael Risinger, Michael Pardo, Federico Picinali, Henry Prakken, Boaz Sangero, Giovanni Sartor, Peter Tillers, Bart Verheij, and Douglas Walton. Finally, I wish to gratefully acknowledge Sharone Lee for our years of ongoing discussions on the placement and utility of fact-based inquiry within the dimensional structures of knowledge.

DISCLAIMER

Any views and opinions expressed herein reflect only the author's and do not necessarily reflect those of the Oregon Department of Justice or any other of the author's affiliations.

Thank you for this
wonderful opportunity
to share these ideas with you.