



26-30 / JULIO / 2021



ESCUELA DE CIENCIAS
INFORMÁTICAS



DEPARTAMENTO
DE COMPUTACIÓN

Argumentation: Preliminaries

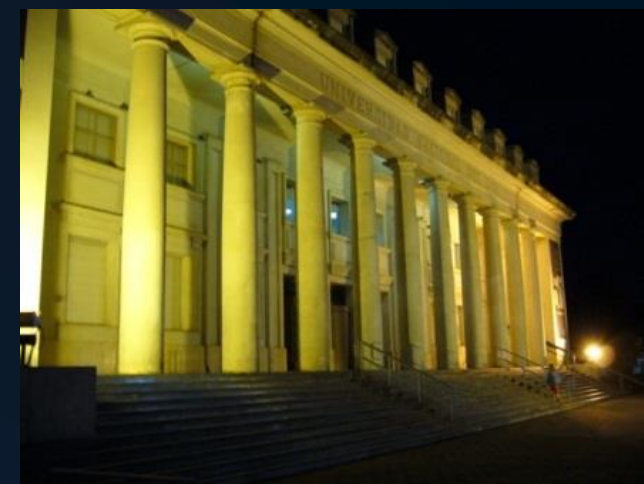
- Guillermo R. Simari



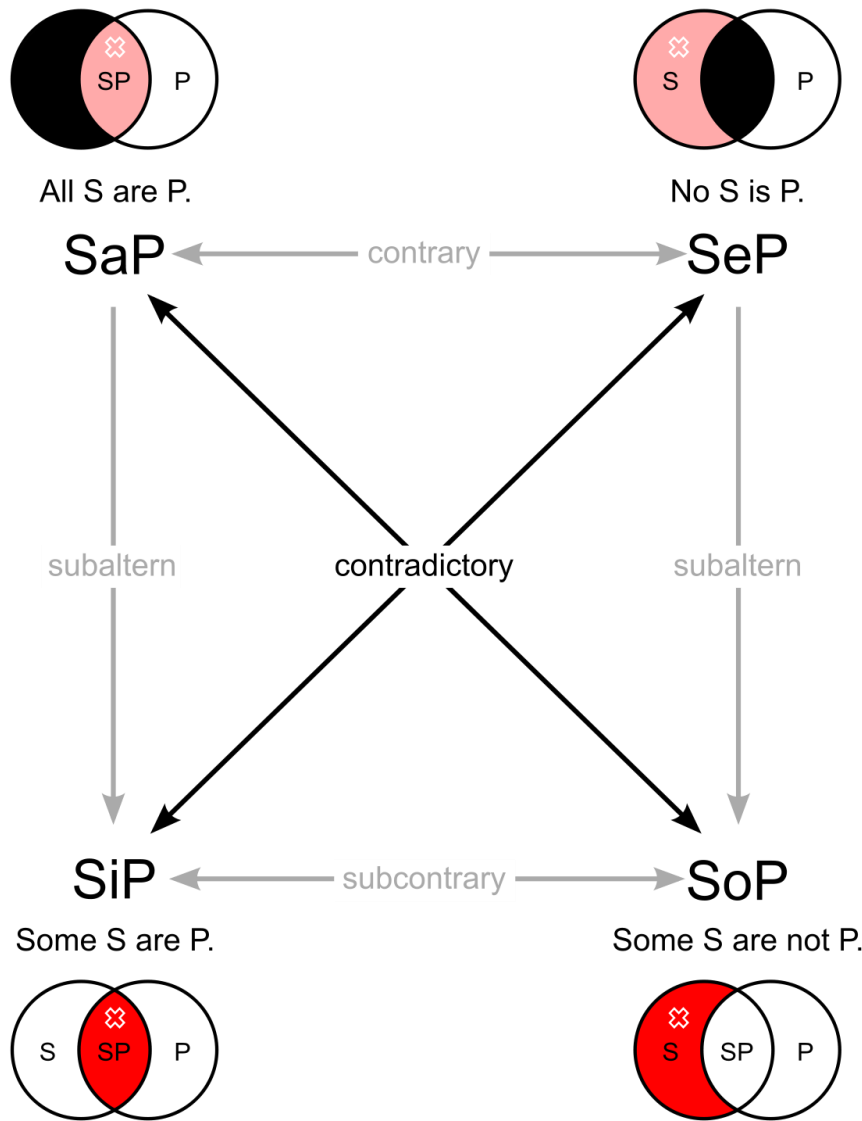
Laboratorio de Investigación y
Desarrollo en Inteligencia
Artificial (LIDIA)

Instituto de Ciencias e Ingeniería de la Computación
Departamento de Ciencias e Ingeniería de la Computación

UNIVERSIDAD NACIONAL DEL SUR
Bahia Blanca - ARGENTINA



Forms of Representing Arguments

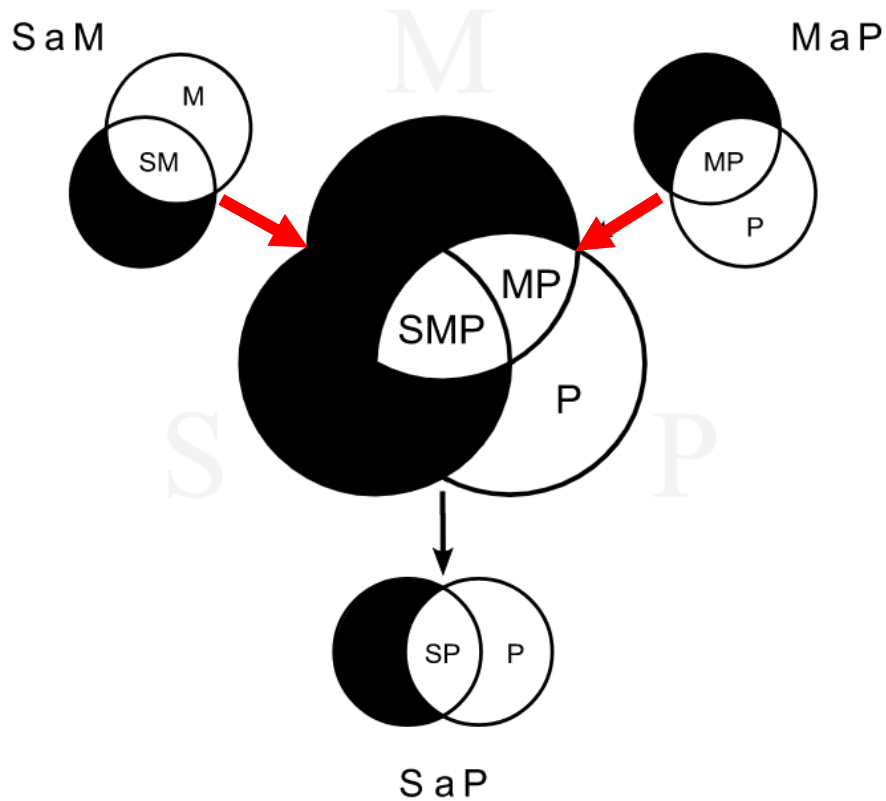


Relationships between the four types of propositions in the square of opposition

Aristotelian logic with its types of syllogism (methods of logical argument)

AAA-1 Modus Barbara

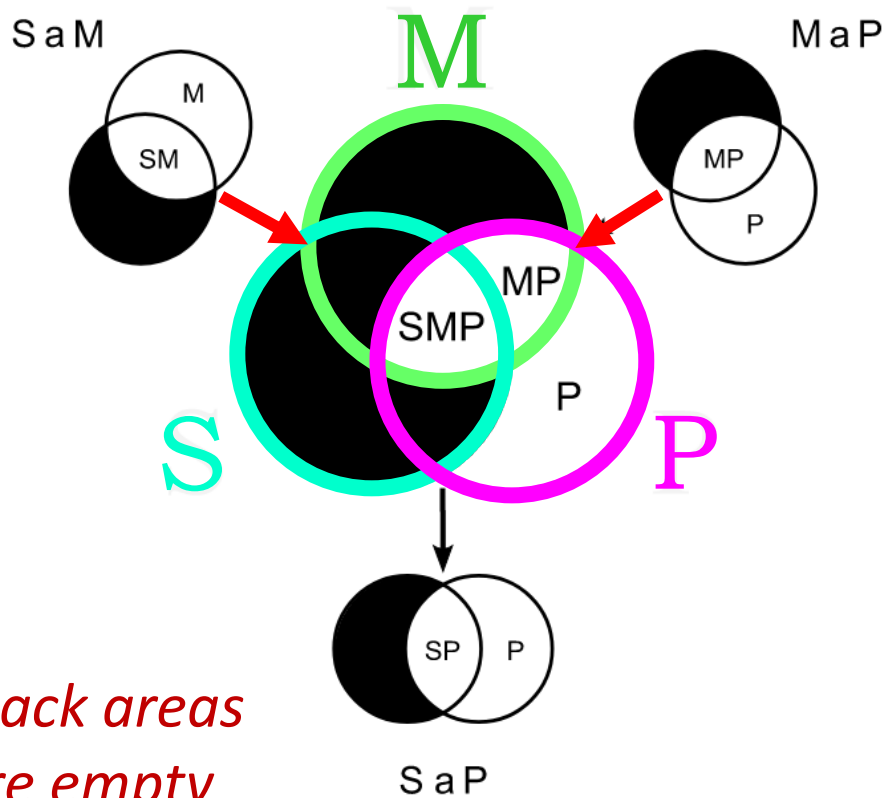
MaP All M are P,
SaM and all S are M;
SaP thus all S are P.



Aristotelian logic: syllogism Modus BARBARA

AAA-1 Modus Barbara

MaP All M are P,
SaM and all S are M;
SaP thus all S are P.



*Black areas
are empty*



Aristotelian logic: syllogism Modus BARBARA

AAA-1 Modus Barbara

$$\begin{array}{l} \overline{\exists x: Mx \wedge \overline{Px}} \\ \wedge \overline{\exists x: Sx \wedge \overline{Mx}} \\ \Rightarrow \overline{\exists x: Sx \wedge \overline{Px}} \end{array}$$

MaP

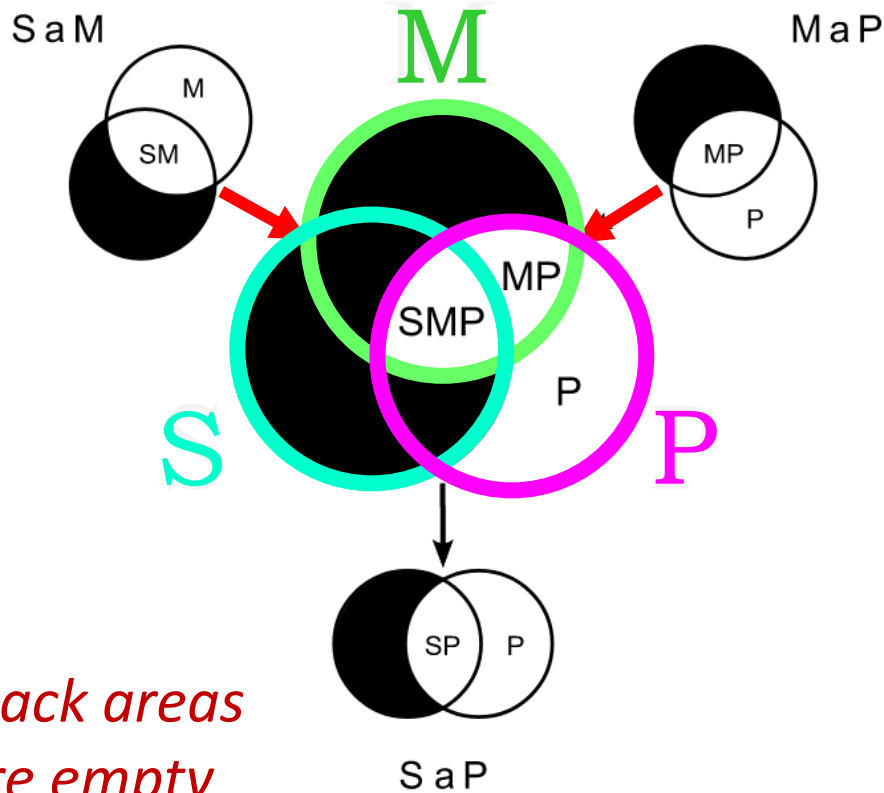
All M are P,

SaM

and all S are M;

SaP

thus all S are P.



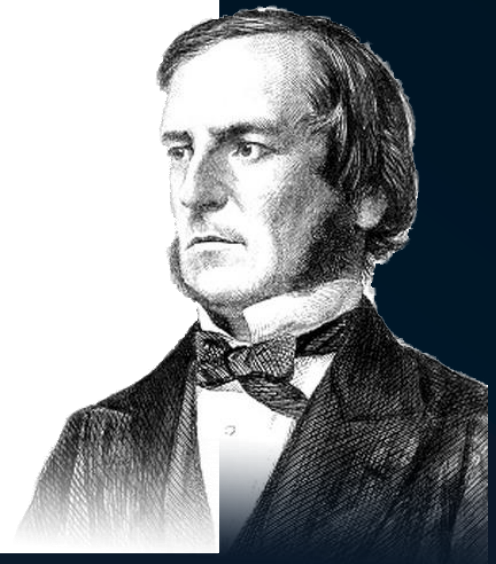
*Black areas
are empty*



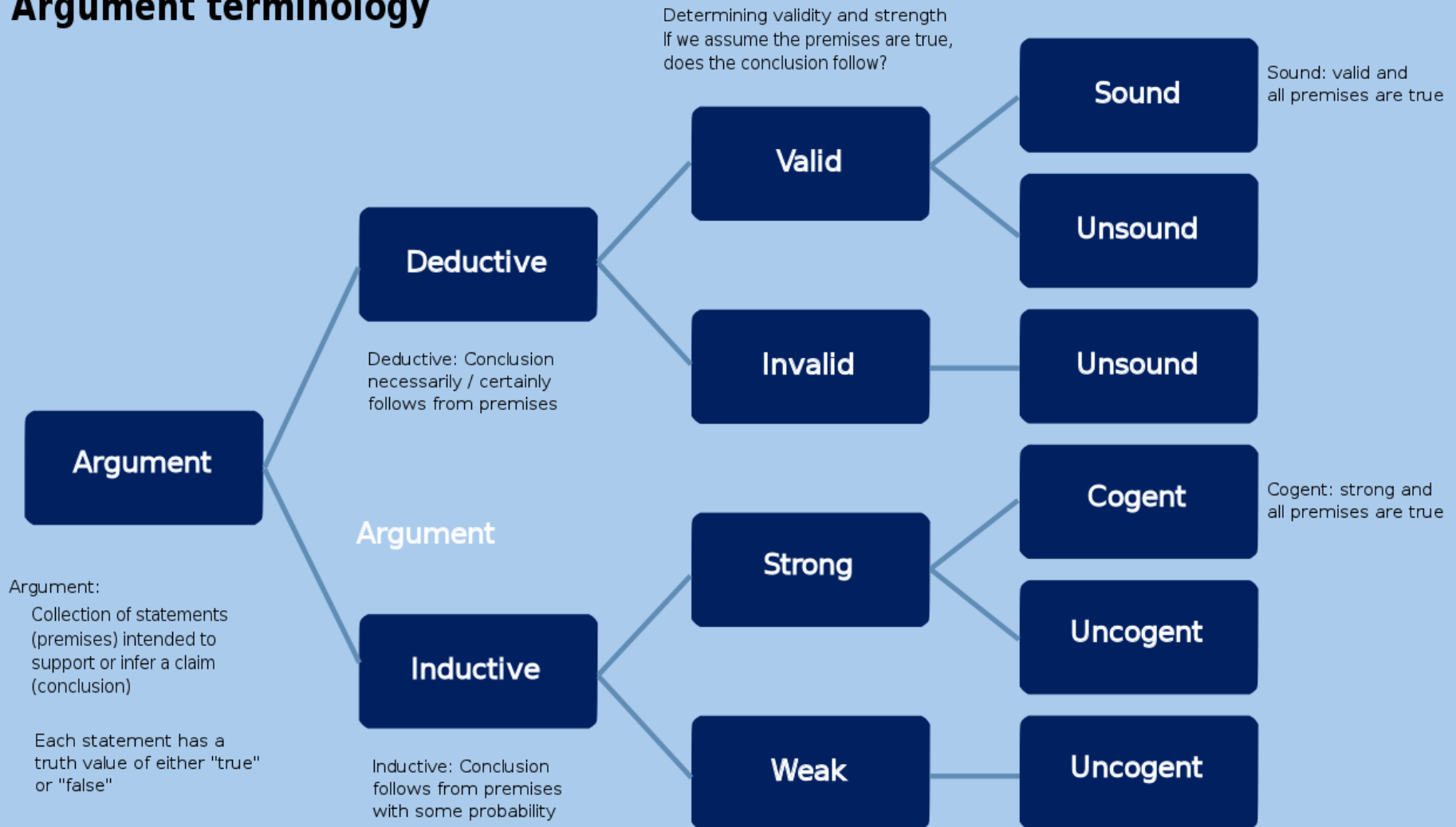
Aristotelian logic: syllogism Modus BARBARA

Formal Logic

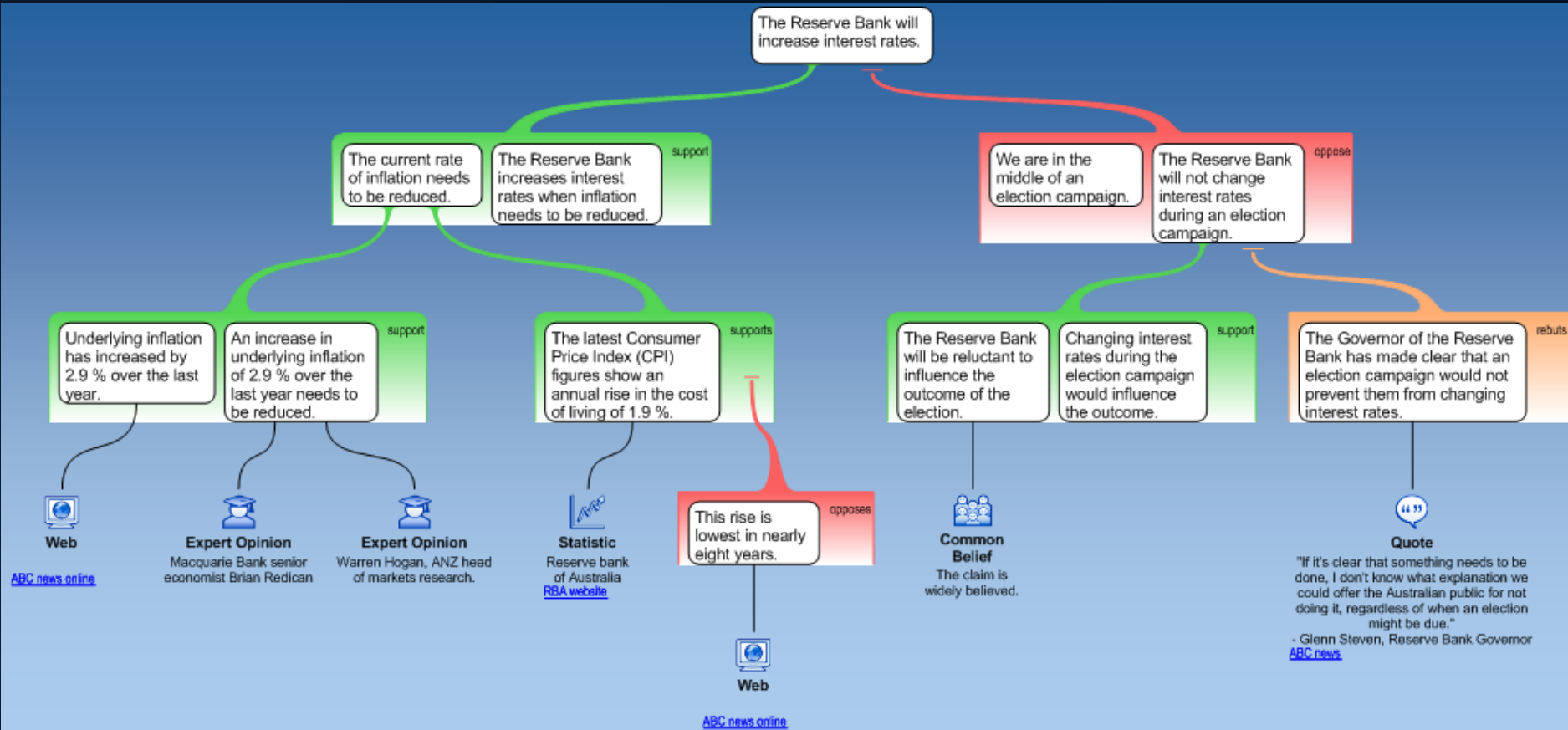
$$\frac{\alpha, \alpha \Rightarrow \beta}{\beta}$$



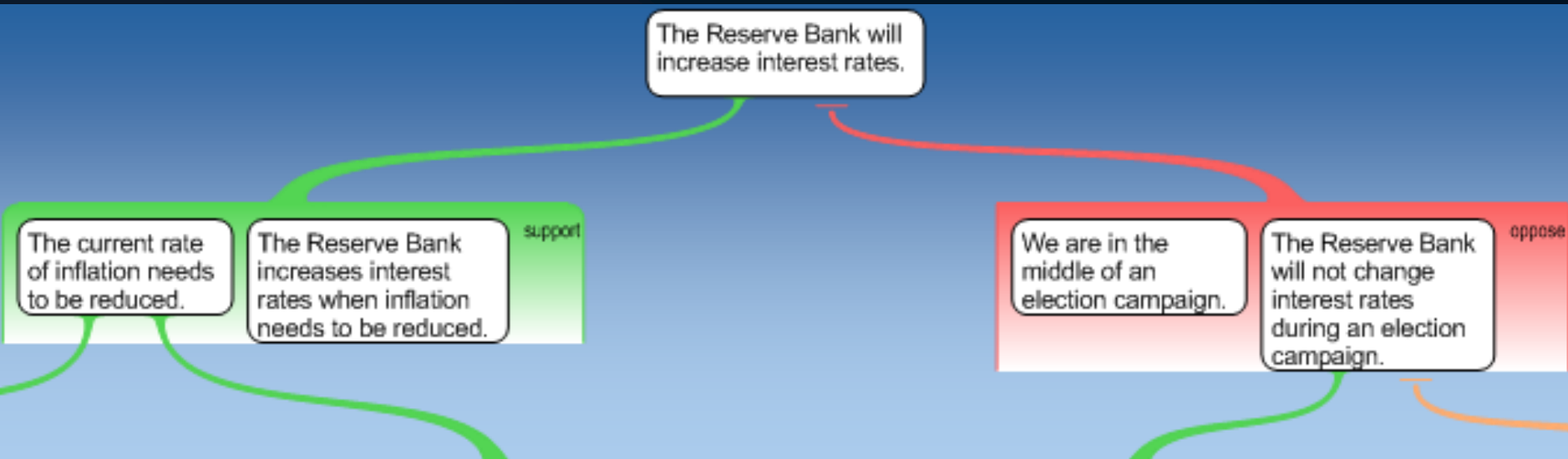
Argument terminology



Mapping Arguments



Mapping Arguments



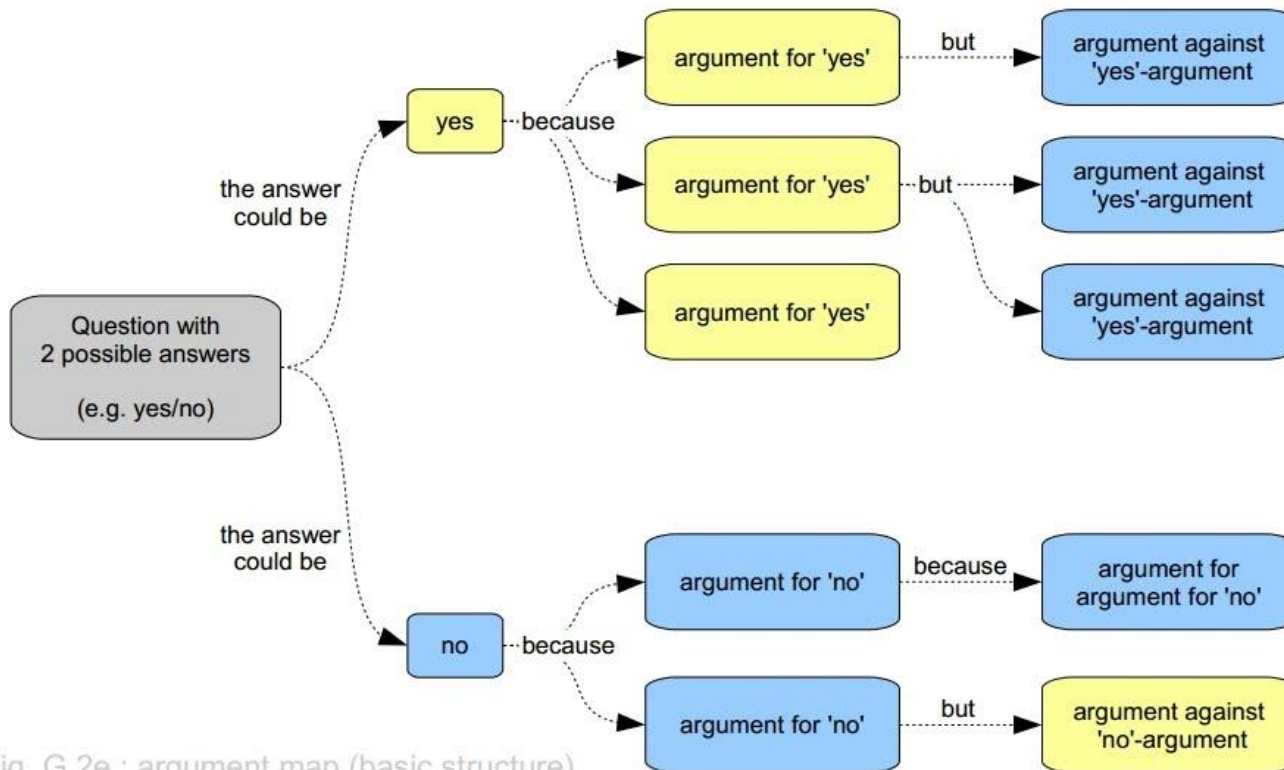
Mapping Arguments

Argument map (basic structure)

main arguments sub-arguments

1st order
arguments

2nd order
arguments



Main arguments are often rebutted (contradicted) or supported by **sub-arguments**

(arguments not directly referring to an answer).

Fig. G.2e : argument map (basic structure)

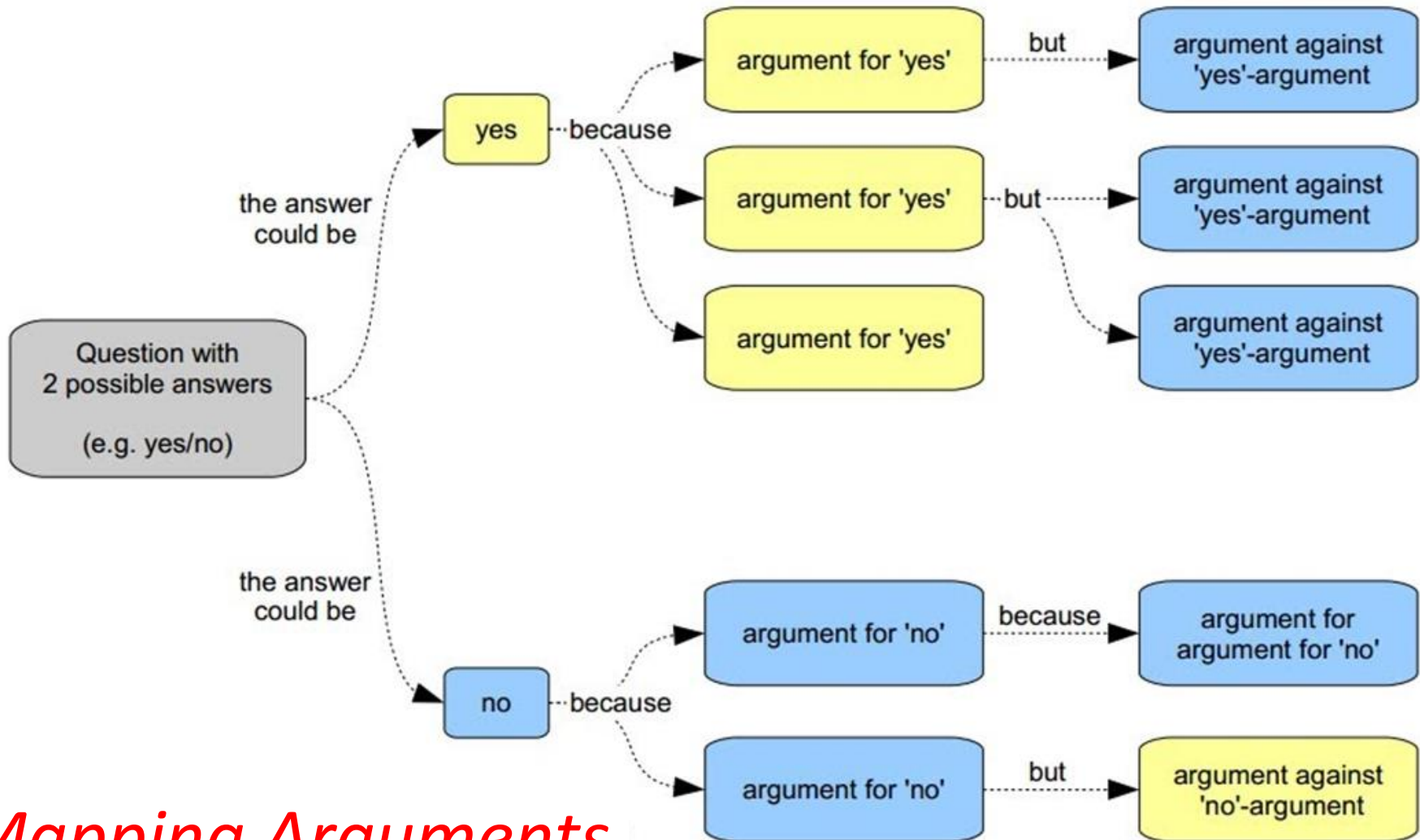
Argument map (basic structure)

main arguments

sub-arguments

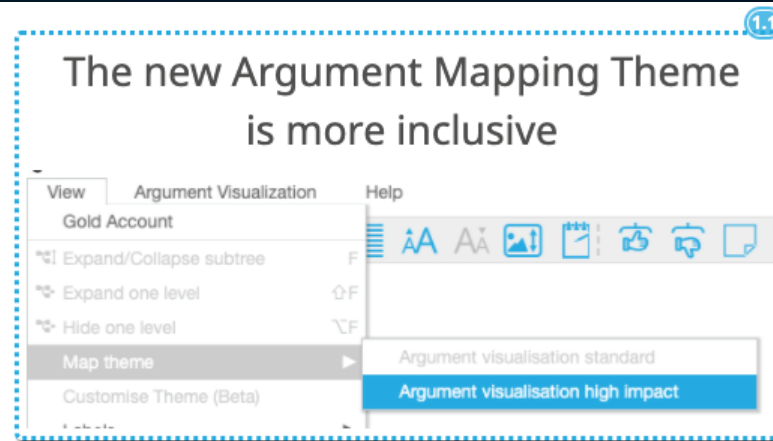
1st order
arguments

2nd order
arguments



Mapping Arguments

Mapping Arguments



Because

But

2.1
People new to Argument Visualisation can understand maps more intuitively

2.2
Shapes and labels help people who are colour-blind understand maps easily

2.3
they take up more screen space

2.4
default labels can change, but labels can't be completely deleted

Because

Because

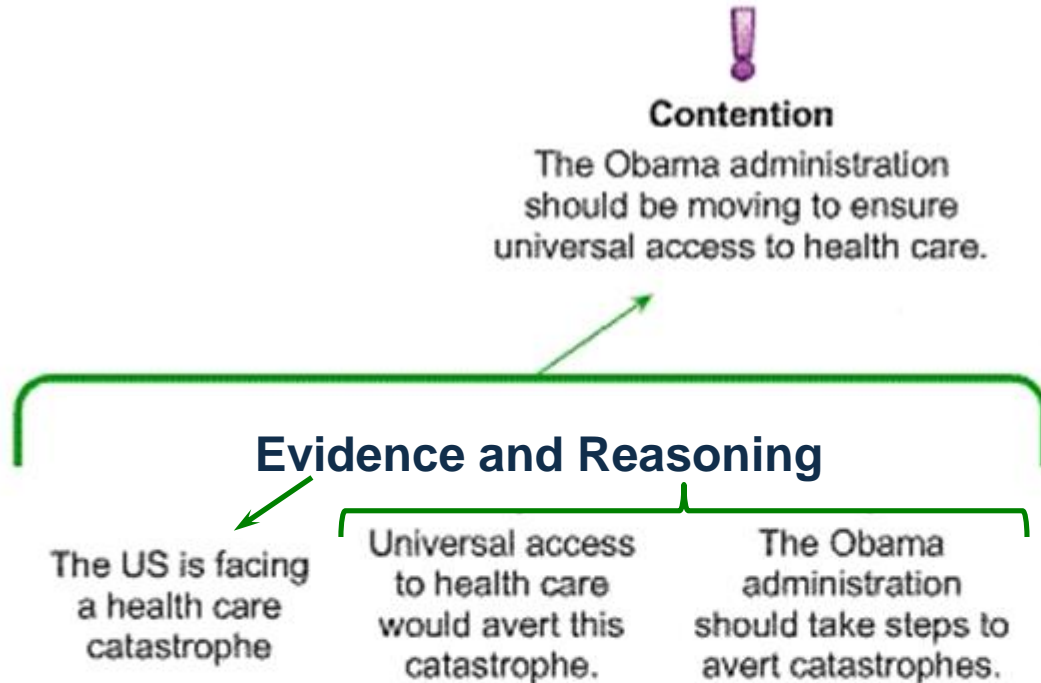
3.1
Connections have arrows on by default to show chain of reasoning

3.2
Labels on connections show if it's a claim or an objection

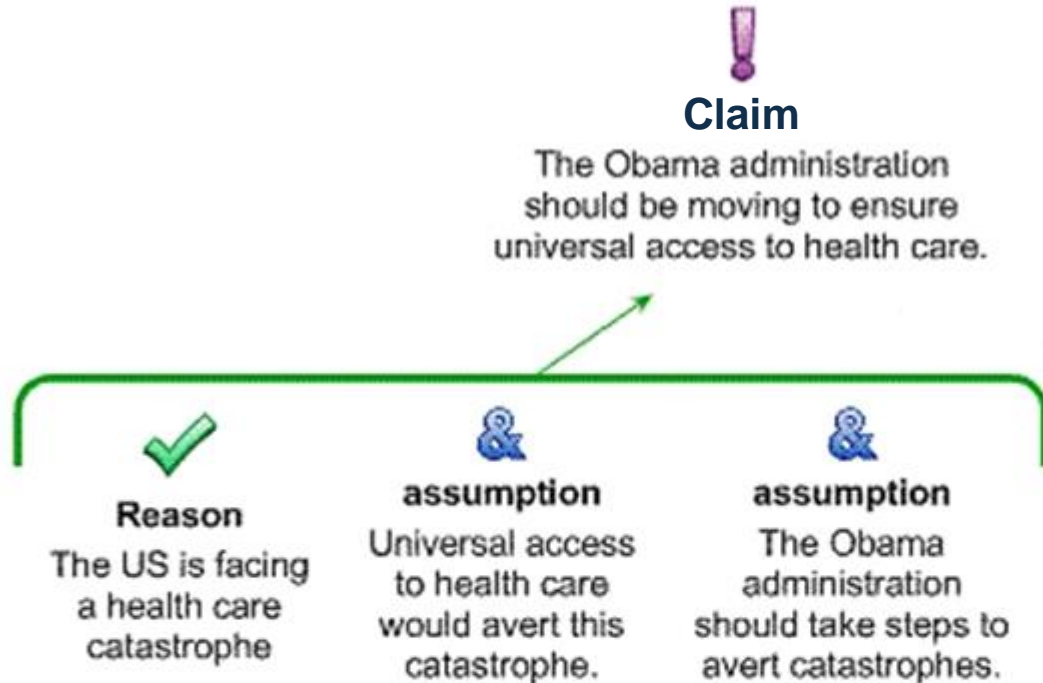
3.3
Instead of just red/green lines, objections have square overlines to make them easy to spot

3.4
default labels also make the distinction between claims/objections clearer

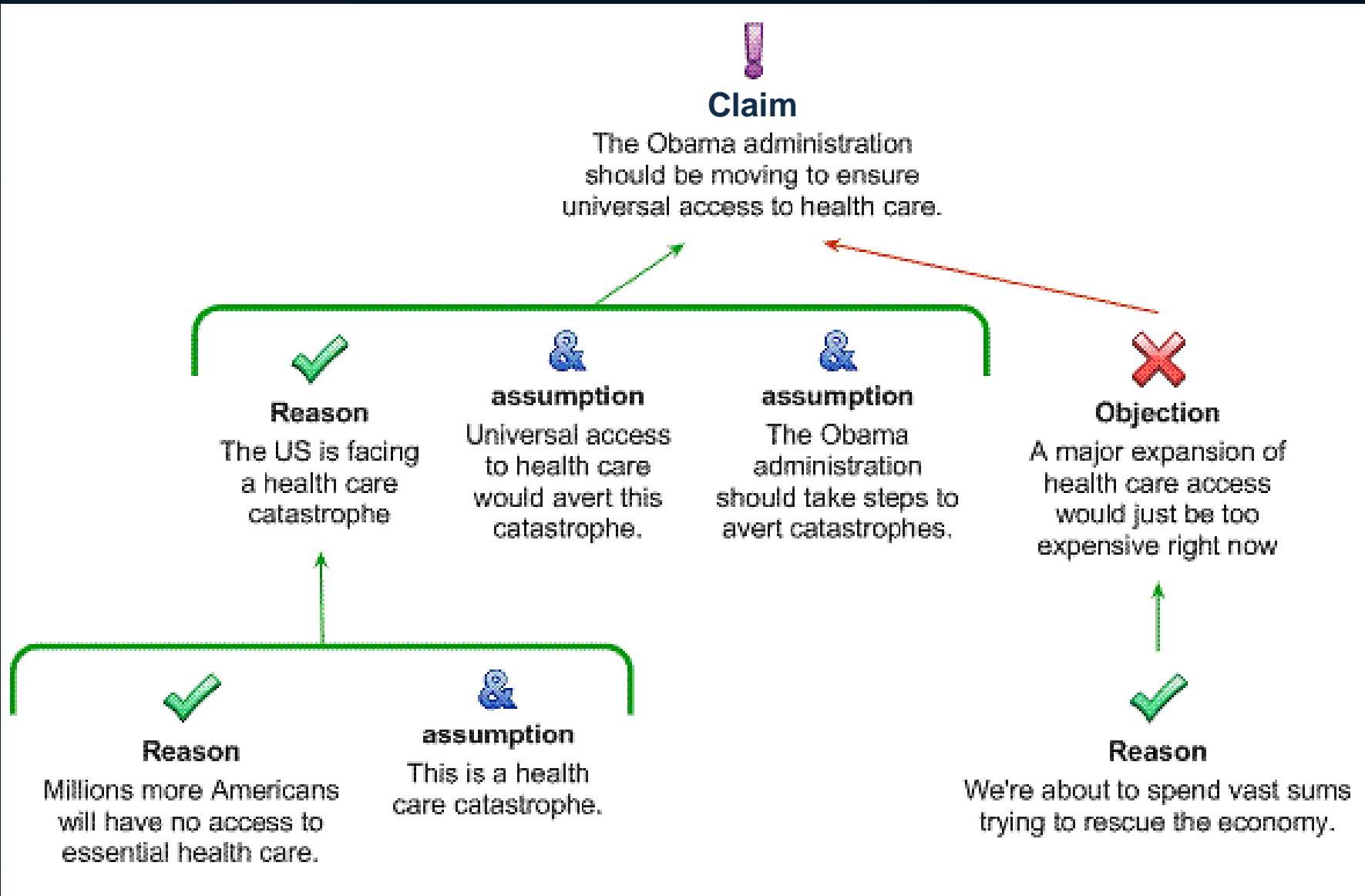
Argument Mapping



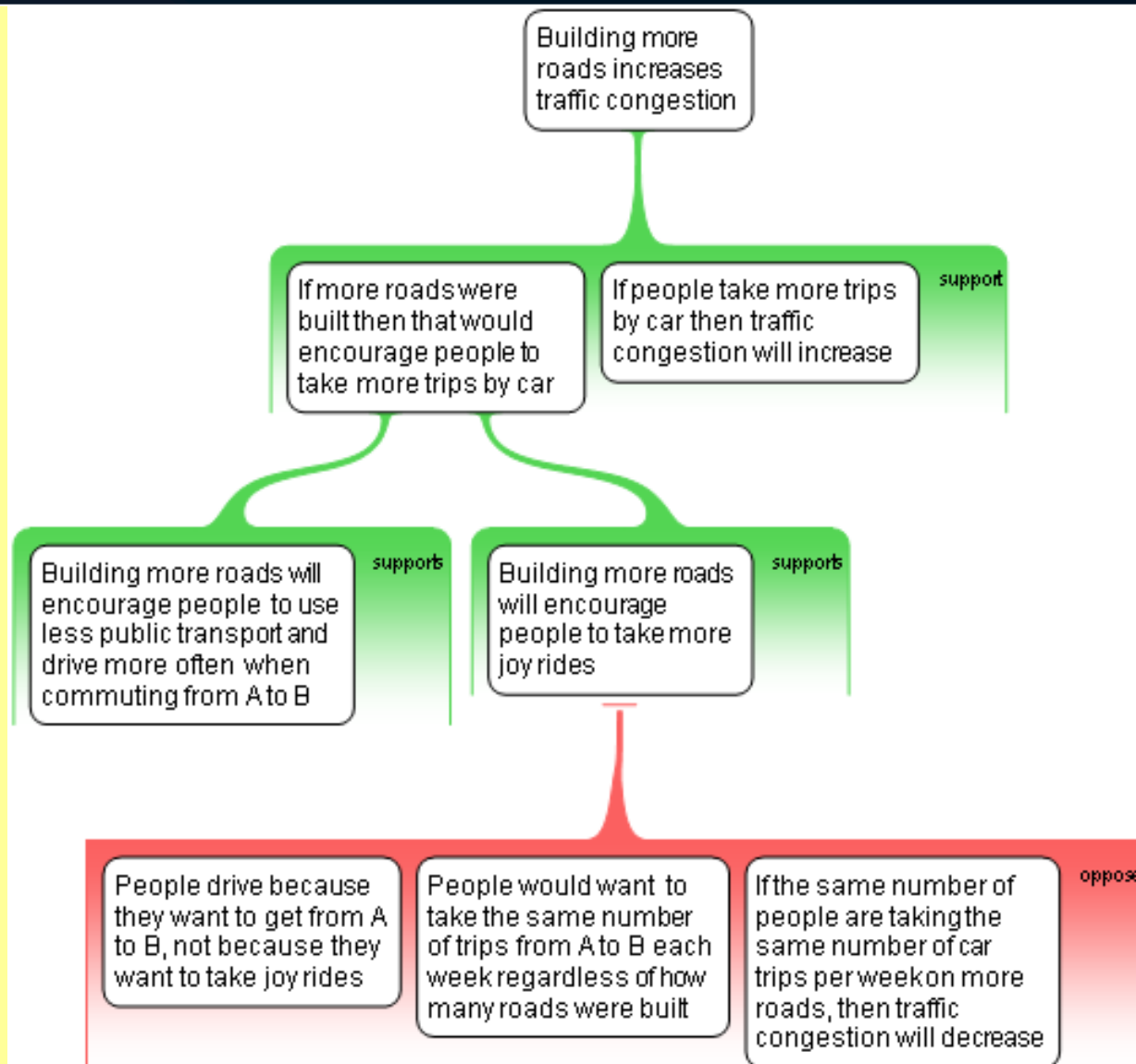
Argument Mapping

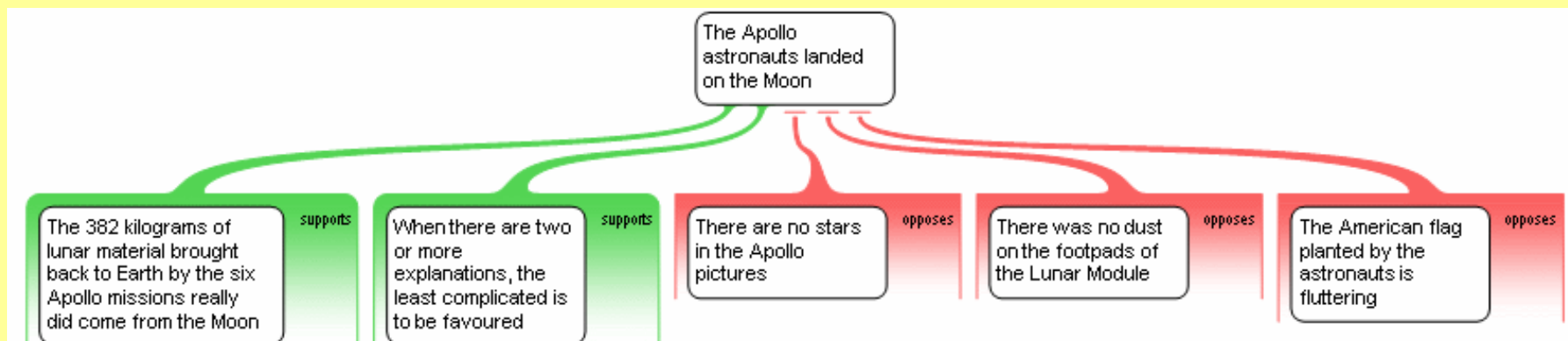
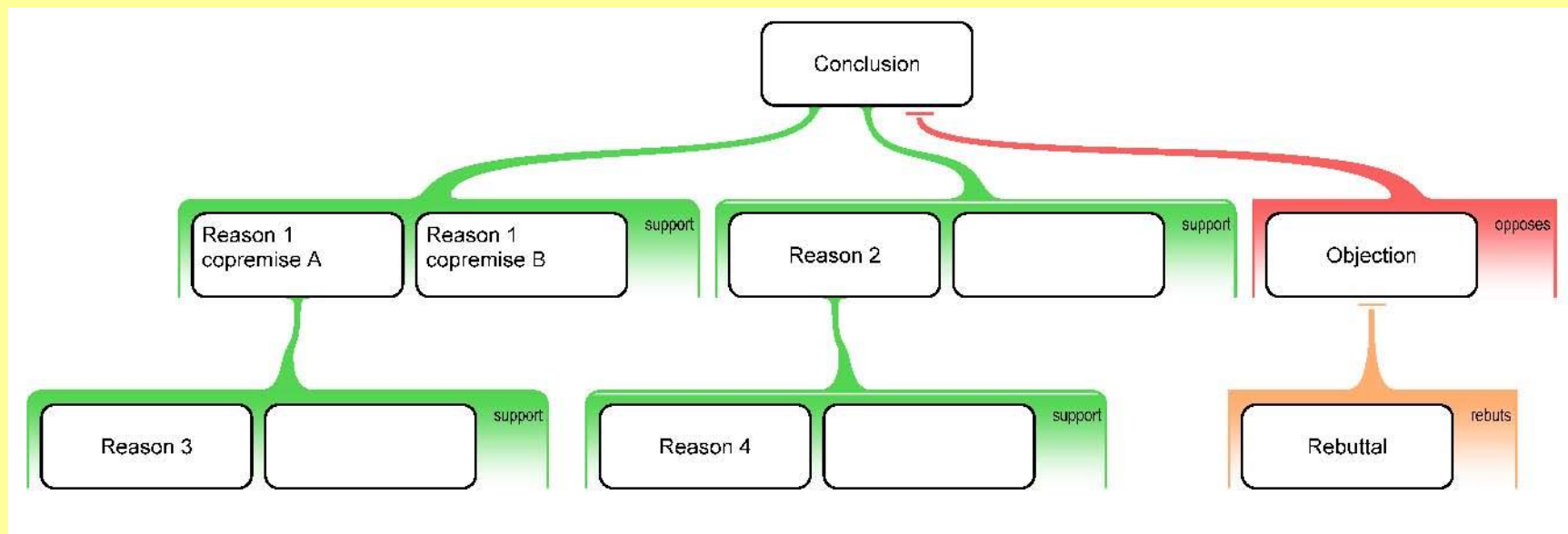


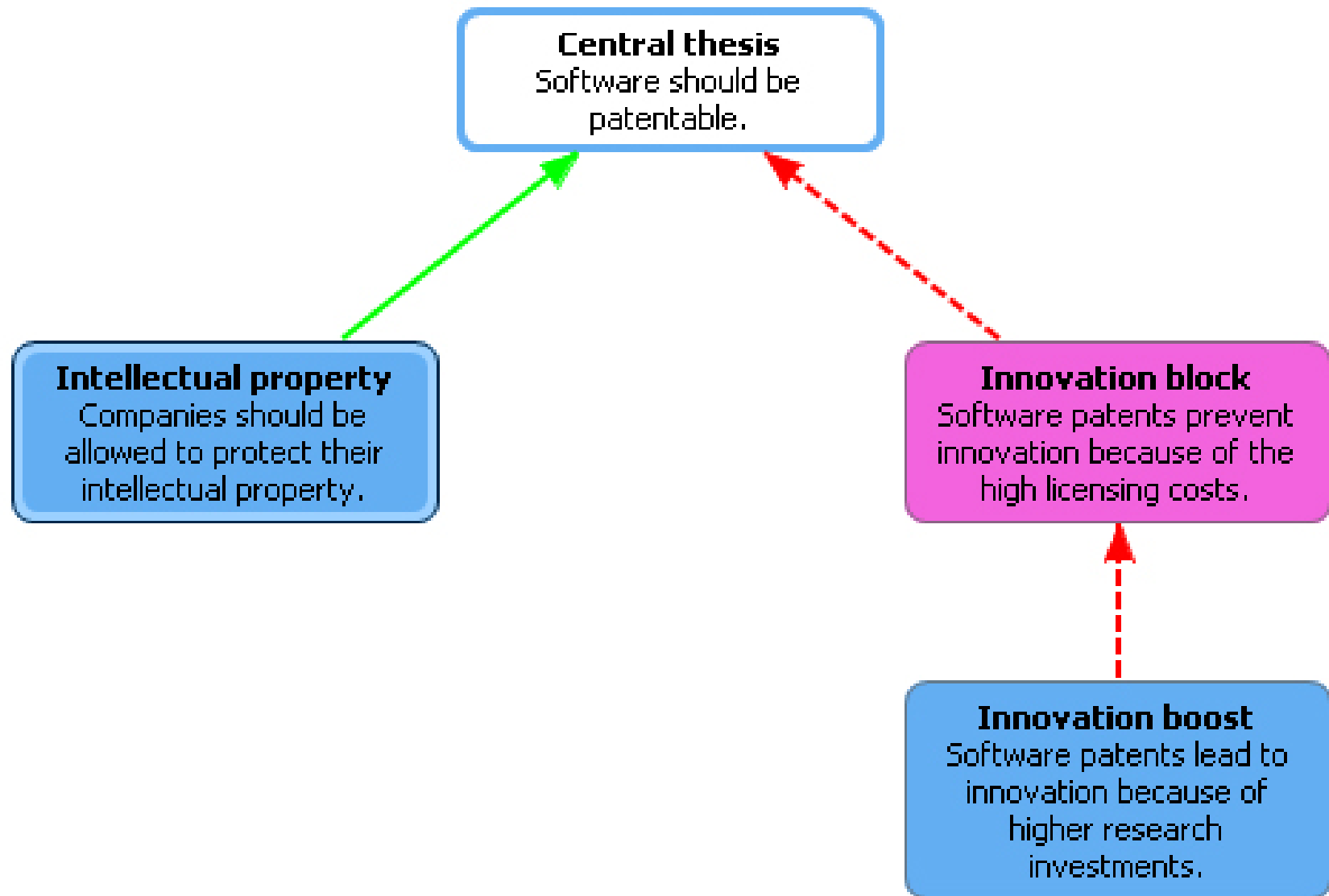
Argument Mapping



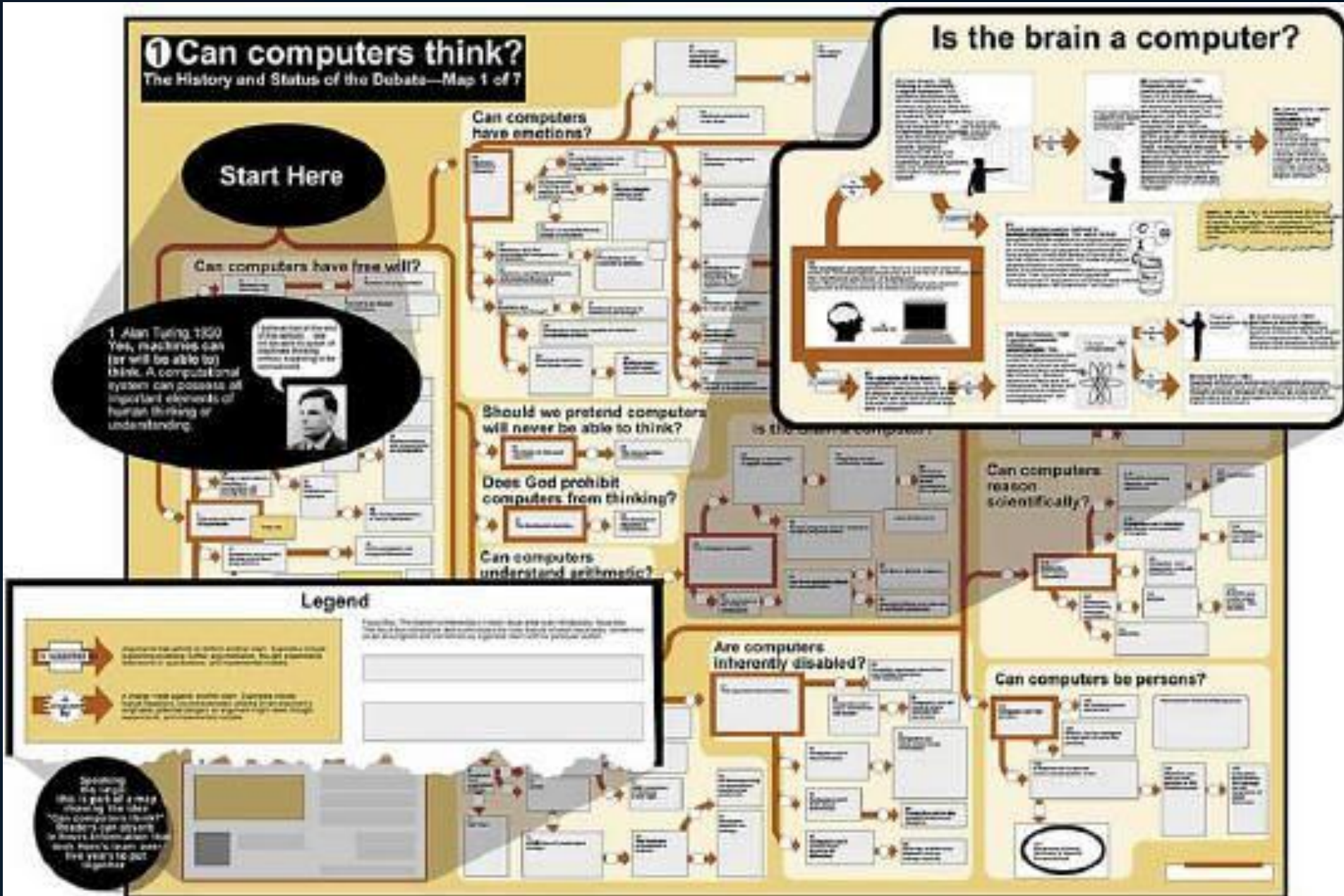
Argument Mapping



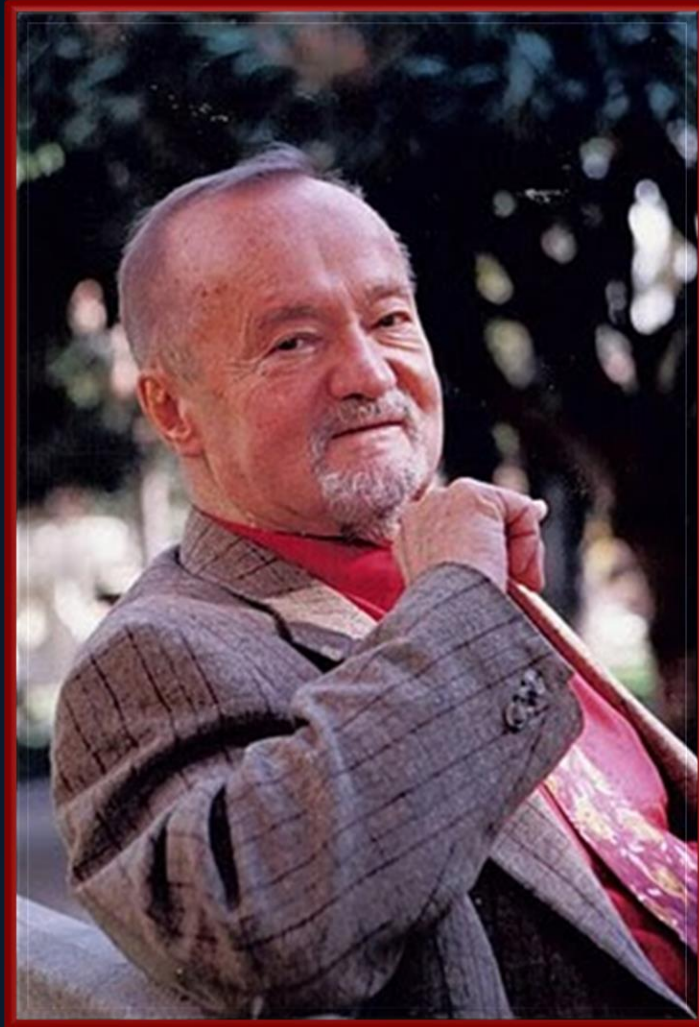




Argument Mapping



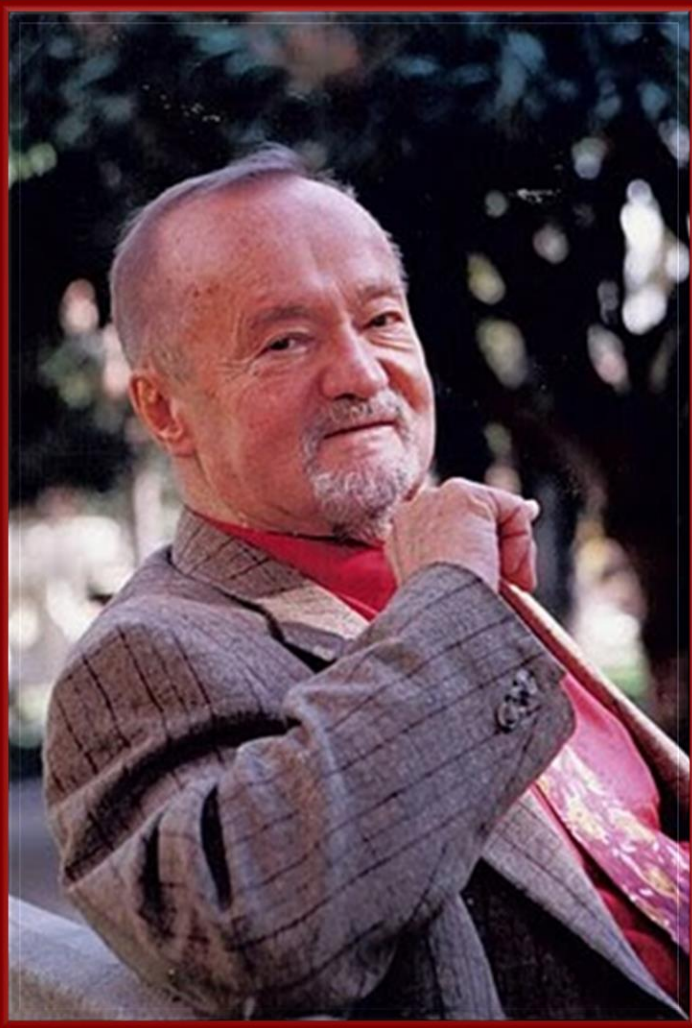
The Toulmin Model



Stephen E. Toulmin
(1922-2009)

Originally published: 1958

Updated: 2003

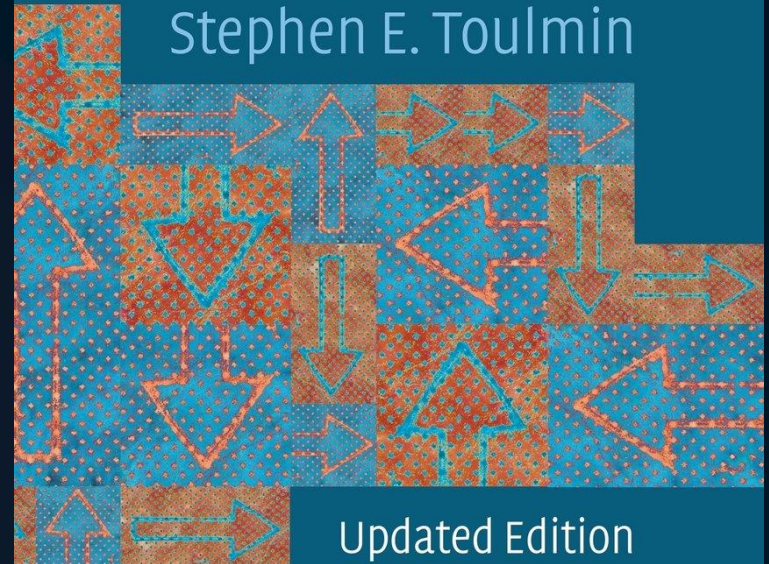


Stephen E. Toulmin

(1922-2009)

The Uses of Argument

Stephen E. Toulmin



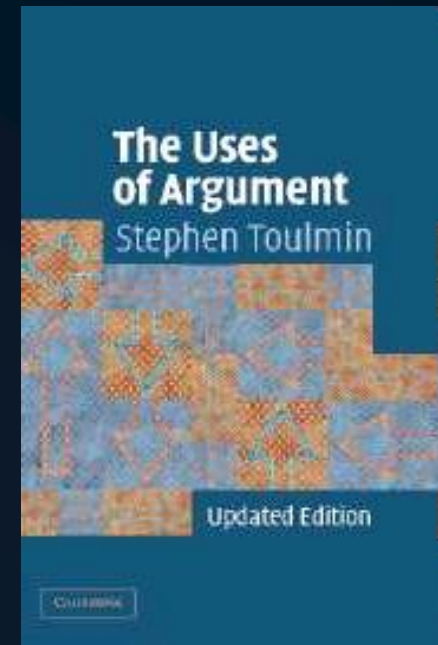
Updated Edition

CAMBRIDGE

The Uses of Argument

From the Preface of the Updated Edition:

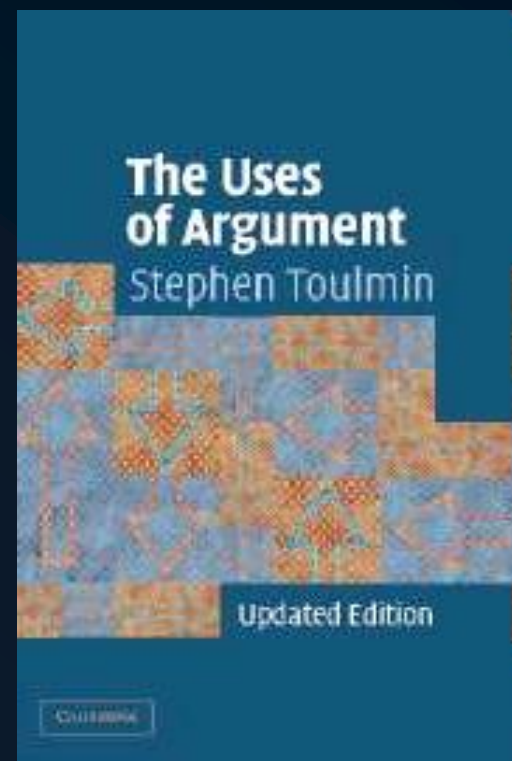
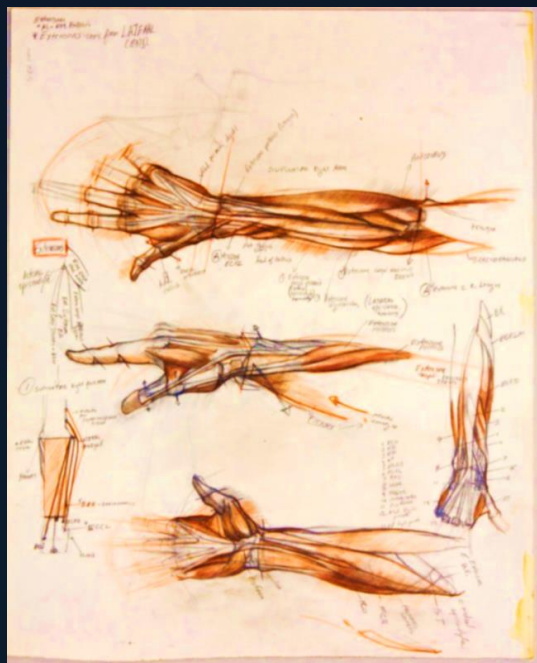
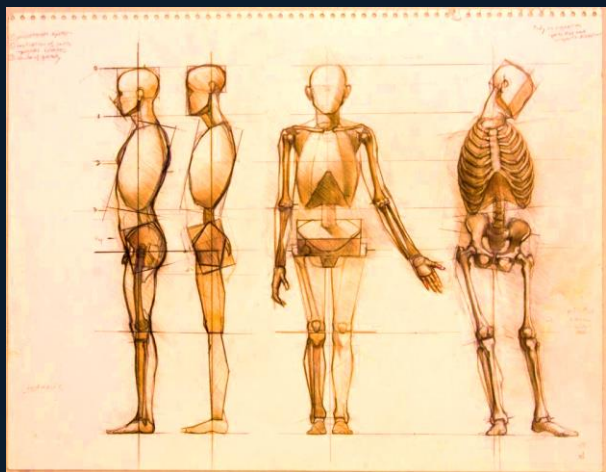
“... my aim was strictly philosophical: to criticize the assumption, made by most Anglo-American academic philosophers, that any significant argument can be put in formal terms: not just as a syllogism, since for Aristotle himself any inference can be called a ‘syllogism’ or ‘linking of statements’, but a rigidly demonstrative deduction of the kind to be found in Euclidean geometry.”

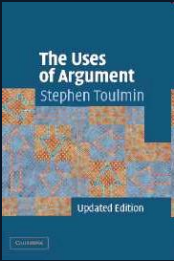


The Uses of Argument

From Chapter III: The Layout of Arguments

“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”





From Chapter III, The Layout of Arguments:

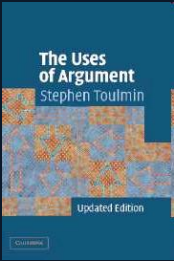
“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”



Datum



So, Claim



From Chapter III, The Layout of Arguments:

“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”



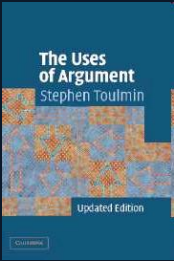
Datum



So, Claim

*Harry was
born in
Bermuda*

*Harry is
a British
subject*



From Chapter III, The Layout of Arguments:

“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”



Datum

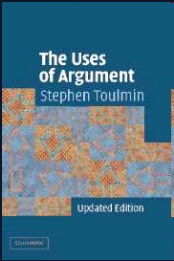
*Harry was
born in
Bermuda*



So, Claim

*Harry is
a British
subject*

*Since
Warrant*



From Chapter III, The Layout of Arguments:

“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”



Datum

*Harry was
born in
Bermuda*

*A man born in
Bermuda will generally
be a British subject*

*Since
Warrant*

So, Claim

*Harry is
a British
subject*

From Chapter III, The Layout of Arguments:

“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”



Datum

*Harry was
born in
Bermuda*

*A man born in
Bermuda will generally
be a British subject*

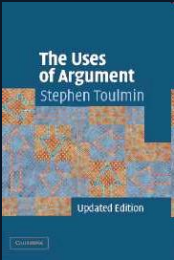
*The following
statutes and other
legal provisions*

*Since
Warrant*

*On account of
Backing*

So, Claim

*Harry is
a British
subject*



From Chapter III, The Layout of Arguments:

“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”



Datum

*Harry was
born in
Bermuda*

*A man born in
Bermuda will generally
be a British subject*

*The following
statuses and other
legal provisions*

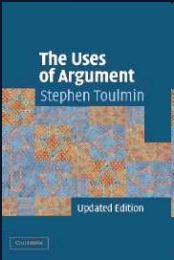
*Since
Warrant*

*On account of
Backing*

presumably

So, Qualifier, Claim

*Harry is
a British
subject*



From Chapter III, The Layout of Arguments:

“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”



Datum

*Harry was
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Bermuda*

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Bermuda will generally
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legal provisions*

*Since
Warrant*

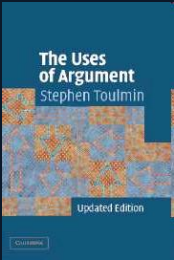
*On account of
Backing*

presumably

So, Qualifier, Claim

*Harry is
a British
subject*

*Unless
Rebuttal*



From Chapter III, The Layout of Arguments:

“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”



Datum

*Harry was
born in
Bermuda*

*A man born in
Bermuda will generally
be a British subject*

*The following
statuses and other
legal provisions*

*Since
Warrant*

*On account of
Backing*

presumably

So, Qualifier, Claim

*Harry is
a British
subject*

*Unless
Rebuttal*

*Both his parents
were aliens/ he
has become a
naturalised
American/ ...*

The Layout of Arguments



Datum



So, Qualifier, Claim

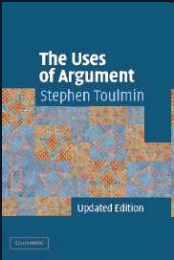
*Since
Warrant*



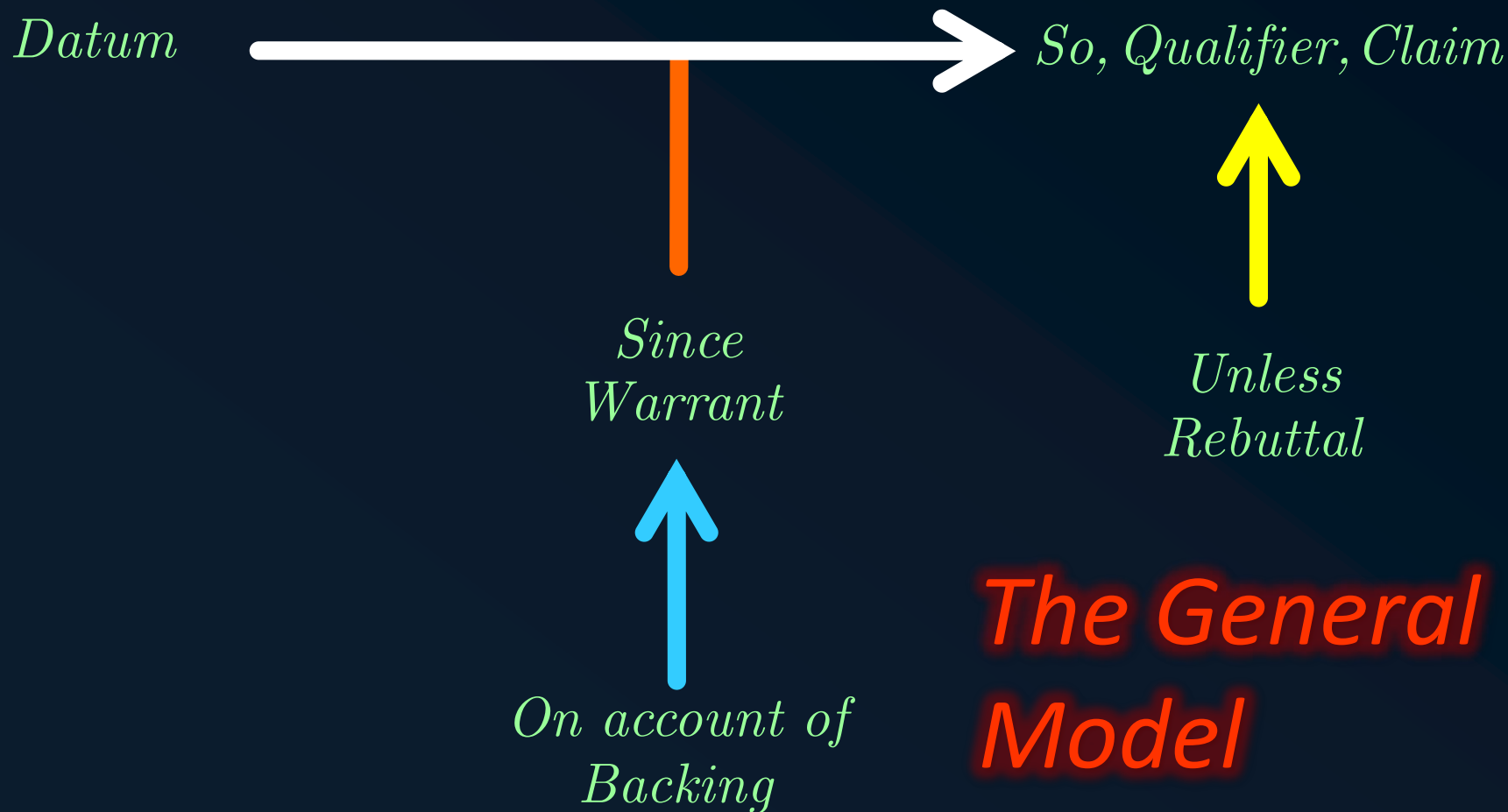
*On account of
Backing*

*Unless
Rebuttal*

*The General
Model*



The Layout of Arguments

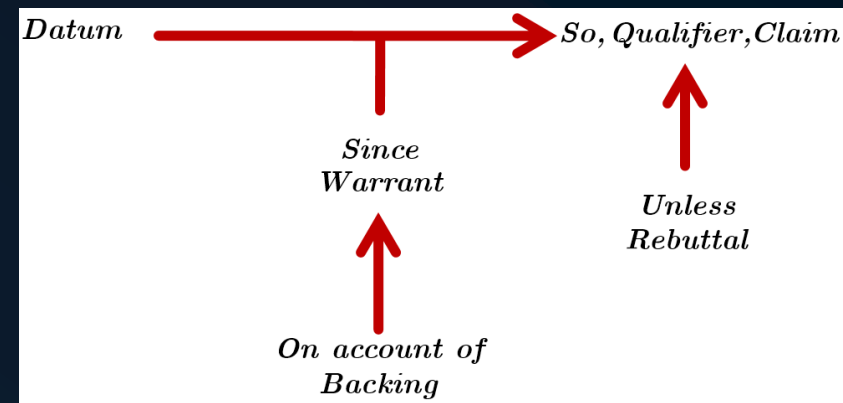


An argument in text form

Old cars pollute and are less safe, therefore most cars older than 20 years should not be allowed to circulate. Removing old cars from the road will result in a cleaner environment and less accidents, because cars exhaust fumes are a major cause of greenhouse gases and safety features are not installed (airbags, antilock brakes, etc.). Perhaps, some old cars can be updated to new standards and some classic cars can be therefore driven safely.

Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztu0Y>

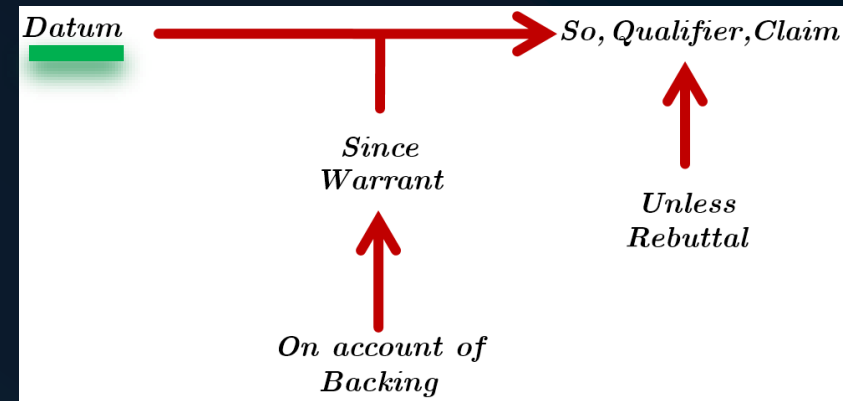


An argument in text form (Datum)

Old cars pollute and are less safe, therefore most cars older than 20 years should not be allowed to circulate. Removing old cars from the road will result in a cleaner environment and less accidents, because cars exhaust fumes are a major cause of greenhouse gases and safety features are not installed (airbags, antilock brakes, etc.). Perhaps, some old cars can be updated to new standards and some classic cars can be therefore driven safely.

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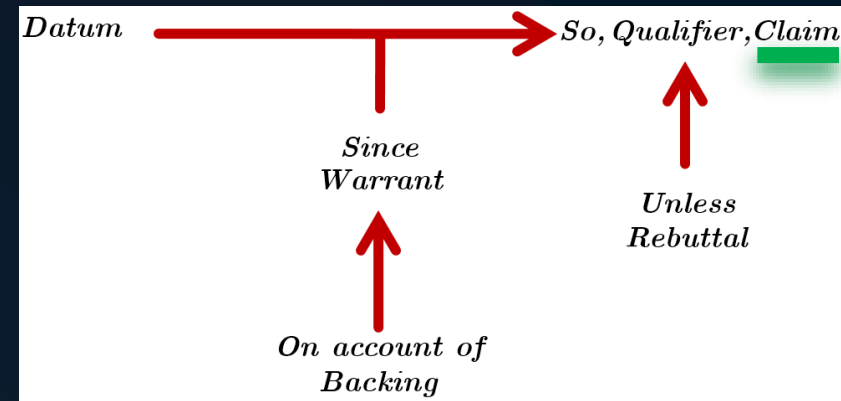


An argument in text form (Claim)

Old cars pollute and are less safe, therefore most cars older than 20 years should not be allowed to circulate. Removing old cars from the road will result in a cleaner environment and less accidents, because cars exhaust fumes are a major cause of greenhouse gases and safety features are not installed (airbags, antilock brakes, etc.). Perhaps, some old cars can be updated to new standards and some classic cars can be therefore driven safely.

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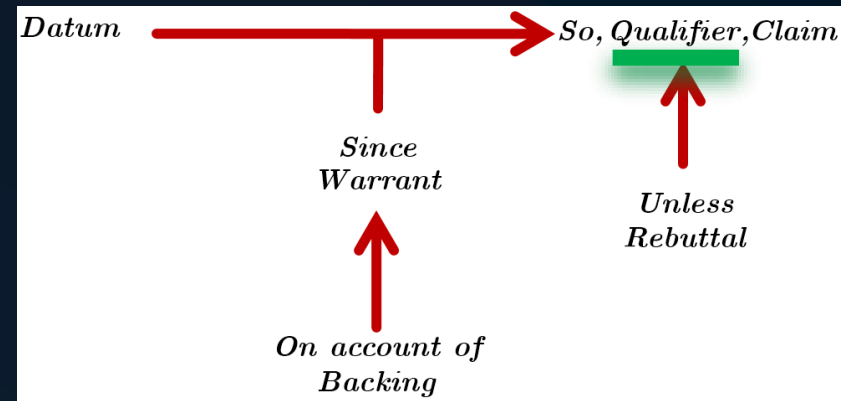


An argument in text form (Qualifier)

*Old cars pollute and are less safe, therefore **most** cars older than 20 years should not be allowed to circulate. Removing old cars from the road will result in a cleaner environment and less accidents, because cars exhaust fumes are a major cause of greenhouse gases and safety features are not installed (airbags, antilock brakes, etc.). Perhaps, some old cars can be updated to new standards and some classic cars can be therefore driven safely.*

Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztu0Y>



An argument in text form (Warrant)

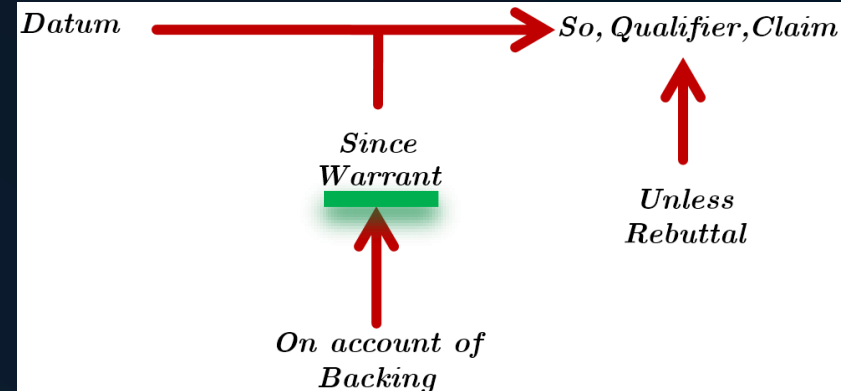
Old cars pollute and are less safe, therefore most cars older than 20 years should not be allowed to circulate.

Removing old cars from the road will result in a cleaner environment and less accidents,

because cars exhaust fumes are a major cause of greenhouse gases and safety features are not installed (airbags, antilock brakes, etc.). Perhaps, some old cars can be updated to new standards and some classic cars can be therefore driven safely.

Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

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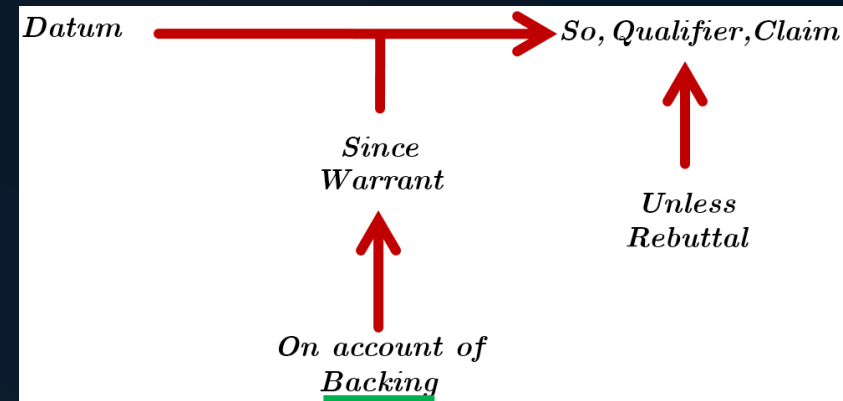


An argument in text form (Backing)

Old cars pollute and are less safe, therefore most cars older than 20 years should not be allowed to circulate. Removing old cars from the road will result in a cleaner environment and less accidents, because cars exhaust fumes are a major cause of greenhouse gases and safety features are not installed (airbags, antilock brakes, etc.). Perhaps, some old cars can be updated to new standards and some classic cars can be therefore driven safely.

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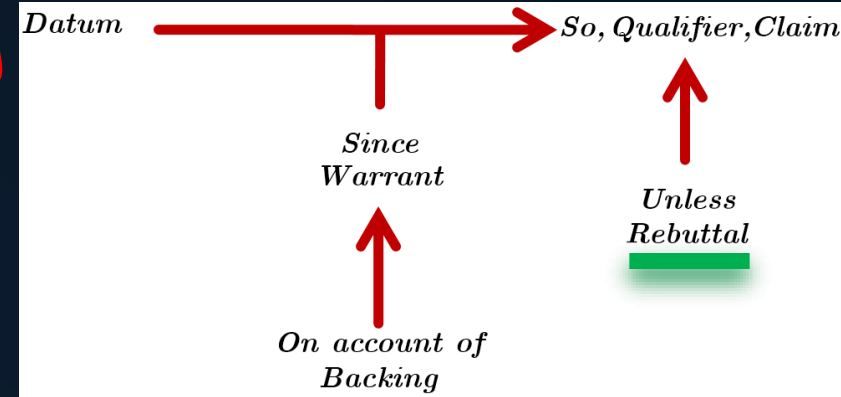


An argument in text form (Rebuttal)

Old cars pollute and are less safe, therefore most cars older than 20 years should not be allowed to circulate. Removing old cars from the road will result in a cleaner environment and less accidents, because cars exhaust fumes are a major cause of greenhouse gases and safety features are not installed (airbags, antilock brakes, etc.). Perhaps, some old cars can be updated to new standards and some classic cars can be therefore driven safely.

Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztu0Y>



Mapping it to the Toulmin Model

Datum: Old cars pollute and are less safe.

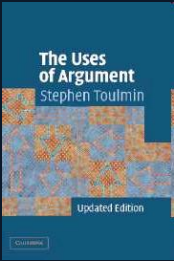
Claim: Cars older than 20 years should not be allowed to circulate.

Qualifier: Most.

Warrant: Removing old cars from the road will result in a cleaner environment and less accidents.

Backing: Cars exhaust fumes are a major cause of greenhouse gases and safety features are not installed (airbags, antilock brakes, etc.).

Rebuttal: Some old cars can be updated to new standards and some classic cars can be therefore driven safely.



Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztuOY>



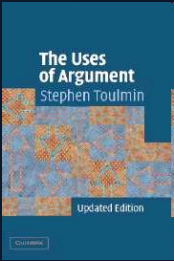
Datum

*Old cars
pollute and
are less safe*



So, Claim

*Cars older than
20 years should
not be allowed to
circulate*



Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztuOY>



Datum

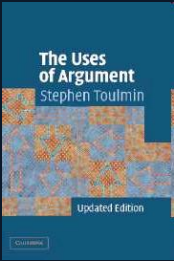
*Old cars
pollute and
are less safe*



So, Claim

*Cars older than
20 years should
not be allowed to
circulate*

*Since
Warrant*



Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztuOY>



Datum

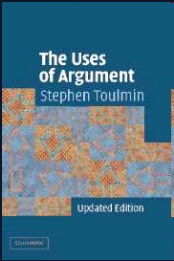
*Old cars
pollute and
are less safe*

*Removing old cars from the
road will result in a cleaner
environment and less
accidents.*

*Since
Warrant*

So, Claim

*Cars older than
20 years should
not be allowed to
circulate*



Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztuOY>



Datum

*Old cars
pollute and
are less safe*

*Removing old cars from the
road will result in a cleaner
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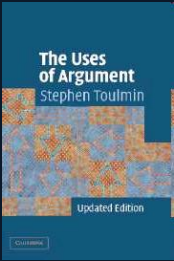
*Cars exhaust fumes are a
major cause of greenhouse
gases and safety features are
not installed (airbags,
antilock brakes, etc.)*

*Since
Warrant*

*On account of
Backing*

So, Claim

*Cars older than
20 years should
not be allowed to
circulate*



Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztuOY>



most

Datum

*Old cars
pollute and
are less safe*

*Removing old cars from the
road will result in a cleaner
environment and less
accidents.*

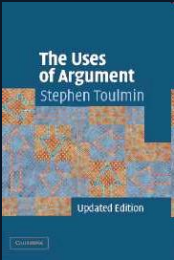
*Cars exhaust fumes are a
major cause of greenhouse
gases and safety features are
not installed (airbags,
antilock brakes, etc.)*

*Since
Warrant*

*On account of
Backing*

So, Qualifier, Claim

*Cars older than
20 years should
not be allowed to
circulate*



Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztuOY>



Datum

*Old cars
pollute and
are less safe*

*Removing old cars from the
road will result in a cleaner
environment and less
accidents.*

*Cars exhaust fumes are a
major cause of greenhouse
gases and safety features are
not installed (airbags,
antilock brakes, etc.)*

*Since
Warrant*

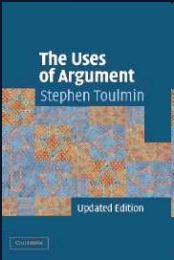
*On account of
Backing*

most

So, Qualifier, Claim

*Cars older than
20 years should
not be allowed to
circulate*

*Unless
Rebuttal*



Example from: David Wright
Furman University, English Department,
University of Richmond, VA, USA

<https://www.youtube.com/watch?v=D-YPPQztuOY>



Datum

*Old cars
pollute and
are less safe*

*Removing old cars from the
road will result in a cleaner
environment and less
accidents.*

*Cars exhaust fumes are a
major cause of greenhouse
gases and safety features are
not installed (airbags,
antilock brakes, etc.)*

*On account of
Backing*

*Since
Warrant*

most

So, Qualifier, Claim

*Cars older than
20 years should
not be allowed to
circulate*

*Unless
Rebuttal*

*Some old cars
can be updated to
new standards and
some classic cars
can be therefore
driven safely*

Some Remarks

- ➡ *The Toulmin Model of Argument, as a tool to formulate and plan arguments, forces the consideration of all the parts involved in it: the **Datum**, the **Claim**, and the **Warrant**.*
- ➡ *Also is important to think about the **Backing** to the warrant, the **Qualifier** to the claim, and possible **Rebuttals** that block obtaining the claim.*
- ➡ *Although it is not Mathematical Logic, it forces to establish a natural form of an argument.*

Some Remarks

- ➔ *From the receiving end, when facing an argument, it helps the analysis of the structure of it considering the **Claim**, the **Datum** in which the claim is supported, the **Warrant** that allows the move from the datum to the conclusion.*
- ➔ *Then, the consideration of the reasons for the warrant exhibits the **Backing**, and the **Qualifier** and **Rebuttals** show how strongly the claim can be supported.*

Systems of Defeasible Argumentation

Formalizing argumentation

- ➔ Abstract argumentation: Graph-based approaches (each node is an argument and each arc is an attack relationship), e.g., Dung, Bench-Capon, Dunne, Cayrol, Amgoud, Doutre, Devred, Lagasquie-Schiex, Coste-Marquis et al., Baroni+Giacomin, Atkinson, Modgil, etc.
- ➔ Defeasible argumentation: Defeasible logic-based approaches (propositional KB & literal queries) that use a non-classical notion of implication, e.g., Nute, Lin+Shoham, Simari+Loui, Prakken, Fox+Krause+Parsons, García+Simari, Cayrol et al, Caminada+Amgoud, Toni et al, Vreeswijk, Verheij, etc.
- ➔ Coherence argumentation: Classical logic-based approaches (propositional/first-order KB & queries) that base each argument on a consistent subset of the information available, e.g., Pollock, Benferhat et al, Amgoud+Cayrol, Besnard+Hunter, etc.

A Conceptual View of Argumentation

Summarizing

- ➔ *To implement an argumentation system, it is required to have a Knowledge base created by Knowledge Representation tools.*
- ➔ *To exploit the represented knowledge, it is standard to make use of reasoning mechanisms.*
- ➔ *Finally, the result of reasoning over the represented knowledge is the conclusions that can be obtained.*

Conceptual View

It's accepted that there are five common elements to systems for defeasible argumentation:



Definition of Status of Arguments

Definition of Defeat among Arguments

Definition of Conflict among Arguments

Definition of Argument

Definition of the Underlying (Logical) Language

Conceptual View



Language

It is concerned with the language in which information can be expressed, and with the rules for constructing arguments in this language.

Defines what arguments are, i.e., how pieces of information can be combined to provide support for a claim.

Definition of Status of Arguments

Definition of Defeat among Arguments

Definition of Conflict among Arguments

Definition of Argument

Definition of the Underlying (Logical) Language

Conceptual View



Argument Definition

Defines what is an argument, i.e., how pieces of information can be combined to provide support for a claim. It is concerned with the language in which information can be expressed, and with the rules for constructing arguments in this language.

Definition of Status of Arguments

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Conceptual View



Argument Interaction (i)

Three issues are addressed here:

- (i) when arguments are in conflict,
- (ii) how conflicting arguments can be compared, and
- (iii) which arguments survive the competition between all conflicting arguments.

Here the notions of *counterarguments*, *attack*, *rebuttal* are defined

Definition of Status of Arguments

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Definition of Argument

Definition of the Underlying (Logical) Language

Conceptual View



Argument Interaction (ii)

Three issues are addressed here:

- (i) when arguments are in conflict,
- (ii) how conflicting arguments can be compared, and
- (iii) which arguments survive the competition between all conflicting arguments.

Here the problem of deciding which argument is «better» must be defined.

Definition of Status of Arguments

Definition of Defeat among Arguments

Definition of Conflict among Arguments

Definition of Argument

Definition of the Underlying (Logical) Language

Conceptual View



Argument Interaction (iii)

Three issues are addressed here:

- (i) when arguments are in conflict,
- (ii) how conflicting arguments can be compared, and
- (iii) which arguments survive the competition between all conflicting arguments.

Here the problem of deciding which argument is «better» must be defined.

→ *Definition of Status of Arguments*

Definition of Defeat among Arguments

Definition of Conflict among Arguments

Definition of Argument

Definition of the Underlying (Logical) Language

Additional Elements



Procedural Layer

Regulates how an actual dispute can be conducted, i.e. how parties can introduce or challenge new information and state new arguments. In this level it is defined the speech acts that are allowed and the discourse rules governing them.

Procedural Layer

Definition of Status of Arguments

Definition of Defeat among Arguments

Definition of Conflict among Arguments

Definition of Argument

Definition of the Underlying (Logical) Language

Additional Elements



Strategy Level

Provides rational ways of conducting a dispute within the procedural bounds of the procedural layer.

<i>Strategy Level</i>
<i>Procedural Layer</i>
<i>Definition of Status of Arguments</i>
<i>Definition of Defeat among Arguments</i>
<i>Definition of Conflict among Arguments</i>
<i>Definition of Argument</i>
<i>Definition of the Underlying (Logical) Language</i>

Conceptual View

Definition of Status of Arguments

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Structural Layer

Conceptual View

Definition of Status of Arguments

Definition of Defeat among Arguments

Definition of Conflict among Arguments

Definition of Argument

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Relational Layer



Conceptual View

Definition of Status of Arguments

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Definition of the Underlying (Logical) Language

Assessment Layer

Structural layer: How are arguments constructed?

Relational layer: What are the relationships between arguments?

Dialogical layer: How can argumentation be undertaken in dialogues?

Assessment layer: How can a constellation of interacting arguments be evaluated and conclusions drawn?

Rhetorical layer: How can argumentation be tailored for an audience so that it is persuasive?

Figure 1. Key Aspects of Argumentation.

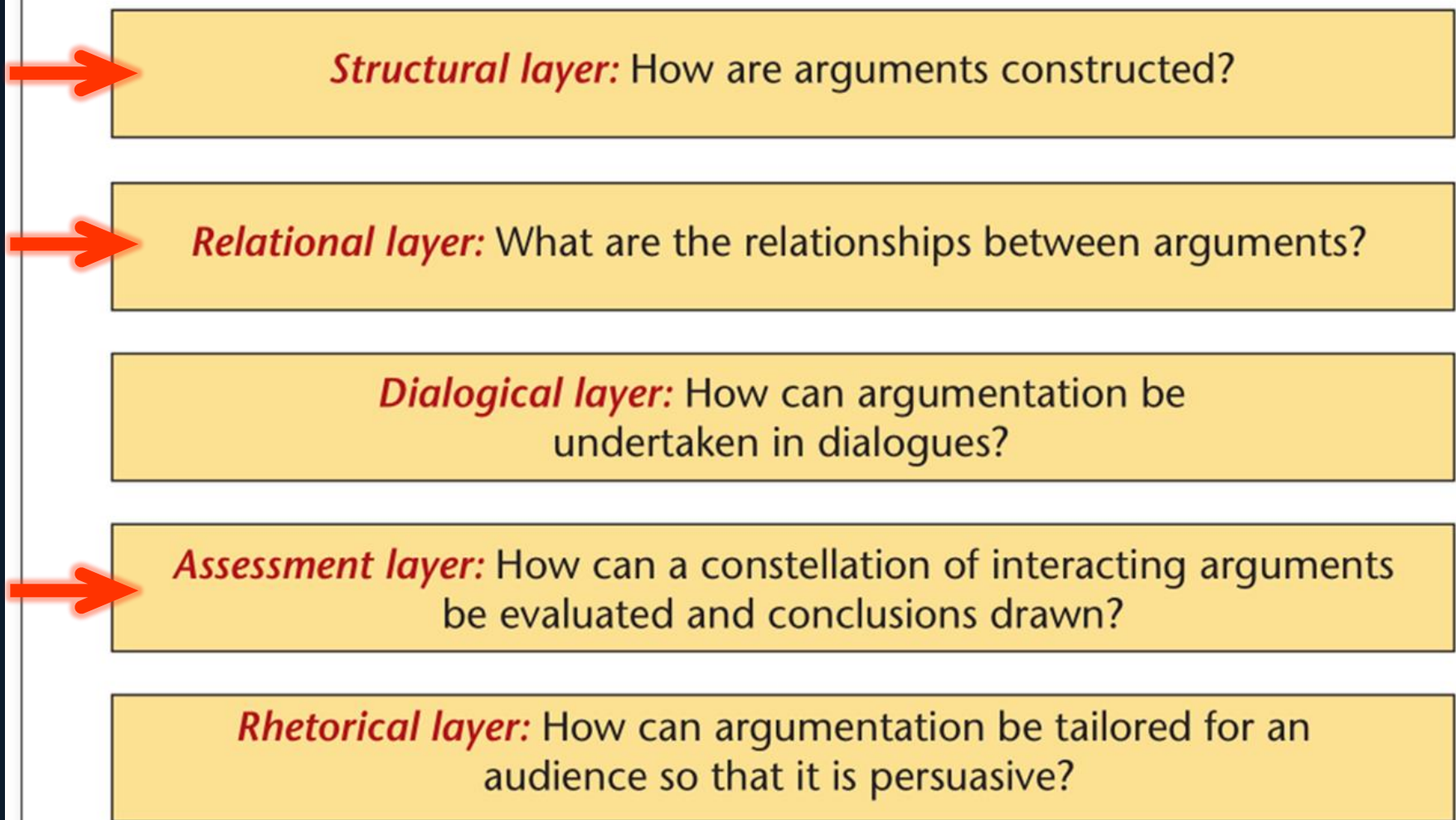


Figure 1. Key Aspects of Argumentation.

Thank you!
Questions?

