



DEPARTAMENTO  
DE COMPUTACION

Facultad de Ciencias Exactas y Naturales - UBA



# *Argumentation: Preliminaries*

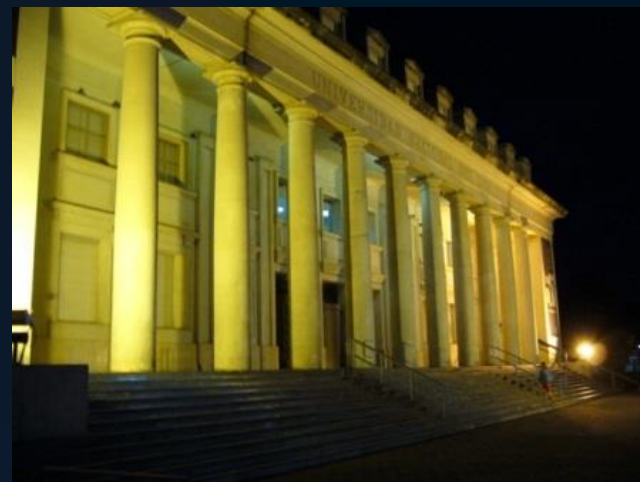
– *Guillermo R. Simari* ([grs@cs.uns.edu.ar](mailto:grs@cs.uns.edu.ar))



*Laboratorio de Investigación y  
Desarrollo en Inteligencia  
Artificial (LIDIA)*

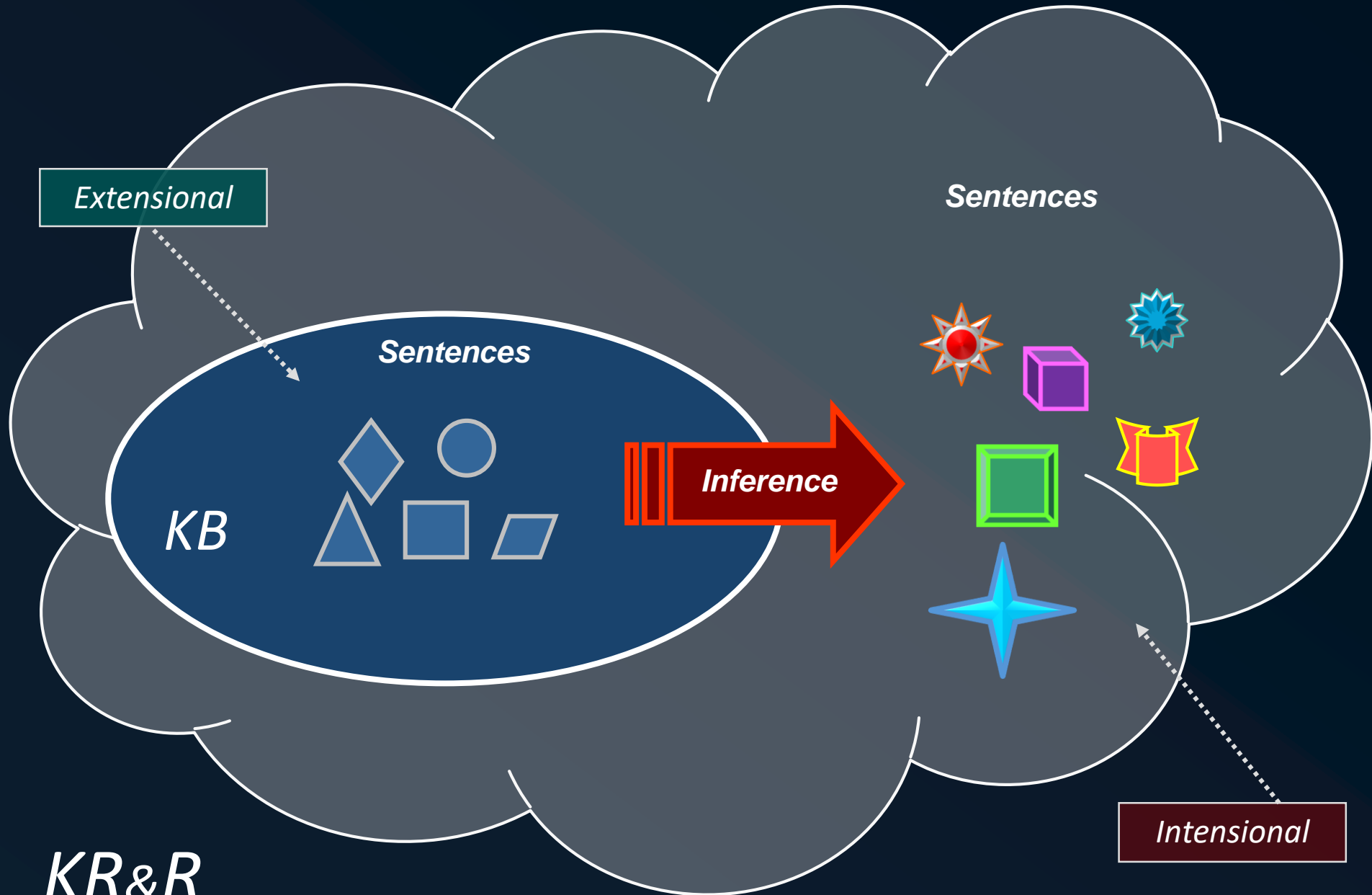
Instituto de Ciencias e Ingeniería de la Computación  
Departamento de Ciencias e Ingeniería de la Computación

UNIVERSIDAD NACIONAL DEL SUR  
Bahia Blanca - ARGENTINA

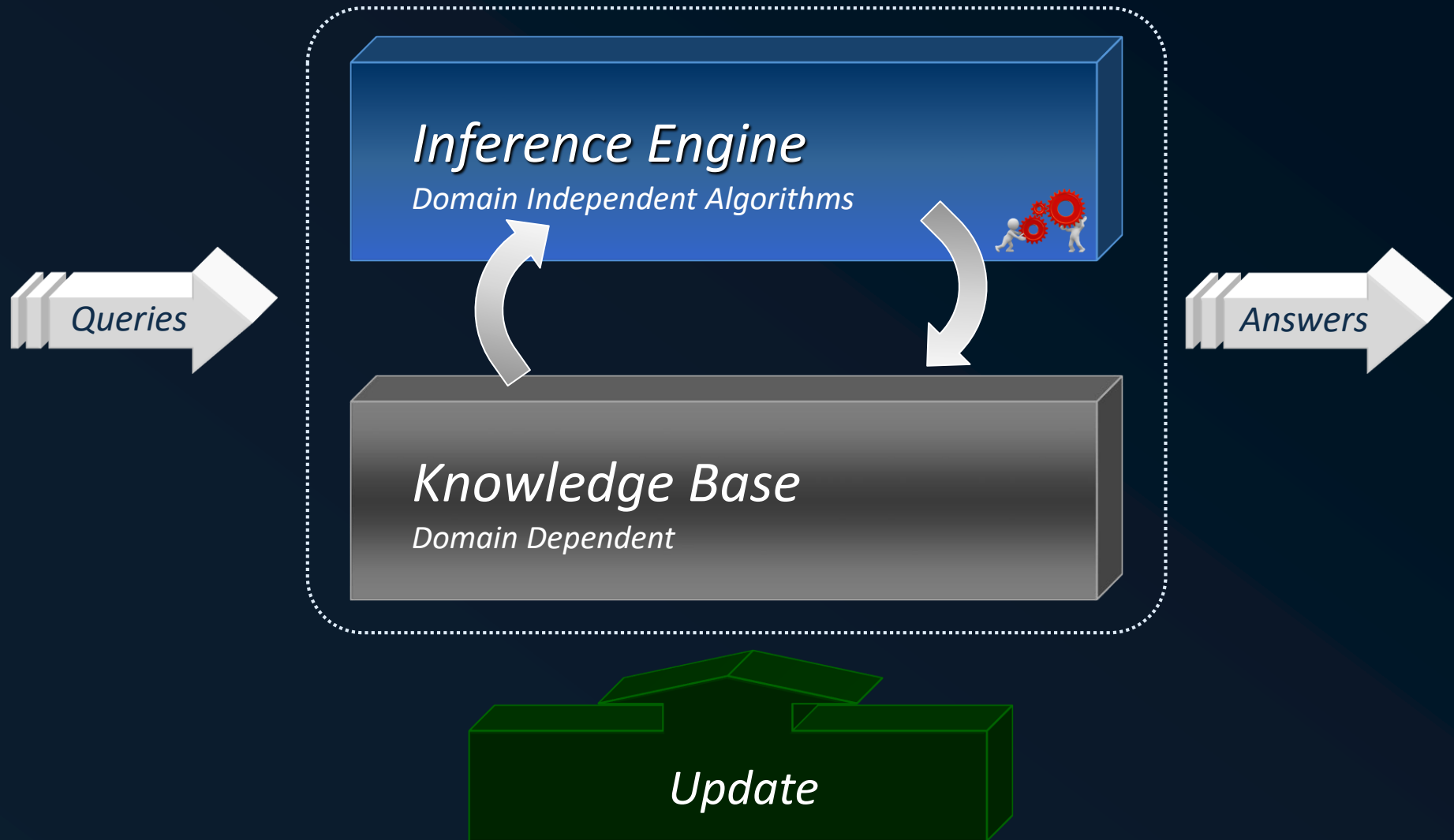


*Knowledge  
Representation &  
Reasoning*

# *KRR = Knowledge Base + Inference Engine*



# *KBS = Knowledge Base + Inference Engine*



# *KRR = Knowledge Base + Inference Engine*

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- ➡ *A well-recognized difficulty in constructing and exploiting Knowledge Bases is to avoid the consequences of inconsistency in Classical Systems of Logic (**Principle of explosion: ex falso quodlibet**).*
- ➡ *Many proposals have been advanced to handle this problem and maintain the usefulness of a **potentially inconsistent** knowledge base.*

# *KRR = Knowledge Base + Inference Engine*

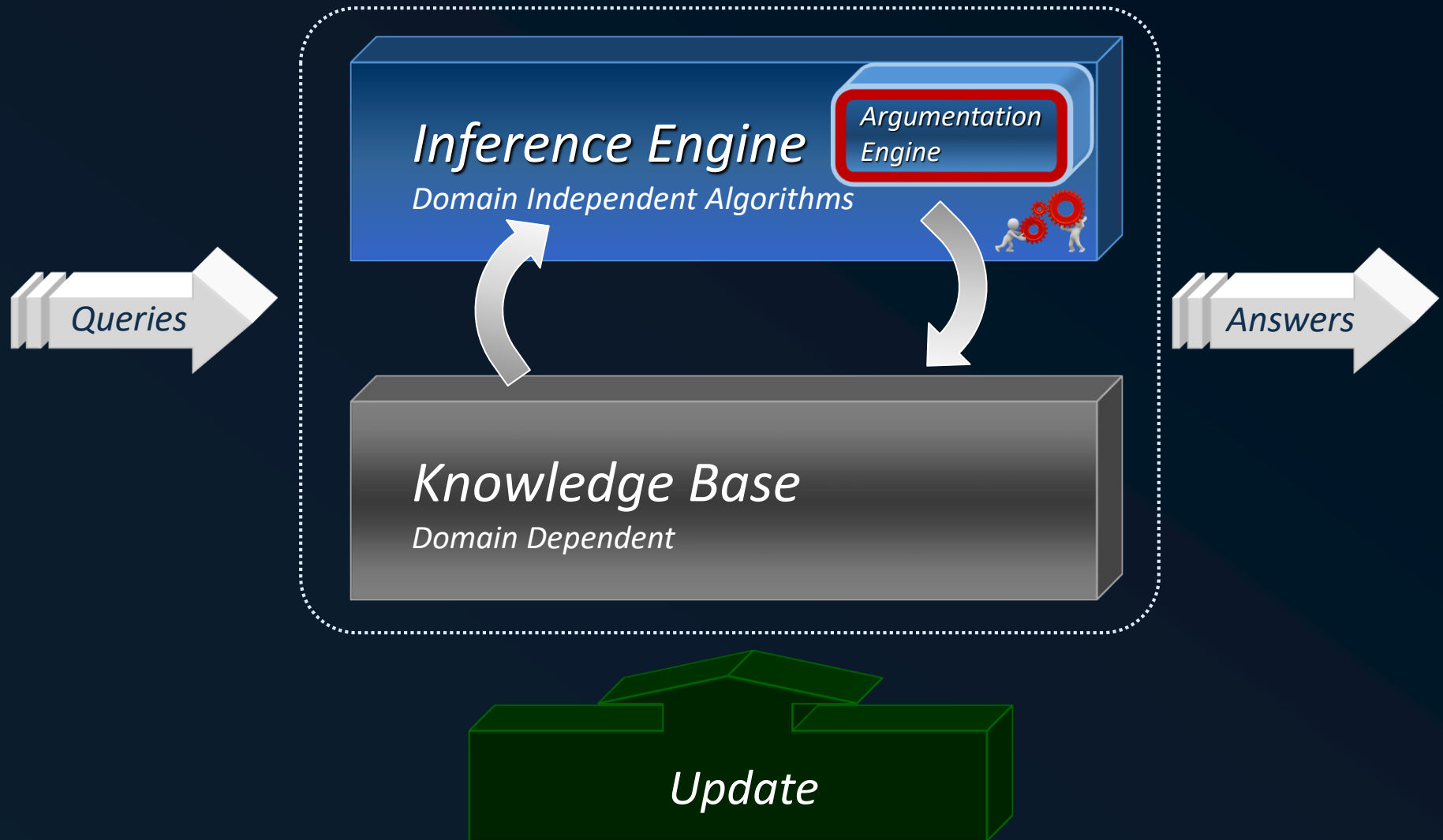
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- ➔ *One method that keeps classical logic inference is to restore consistency in some way before making any inference.*
- ➔ *A different approach is to avoid obtaining inconsistent conclusions by changing the way the inference engine works, keeping the state of KB.*

# Argumentation

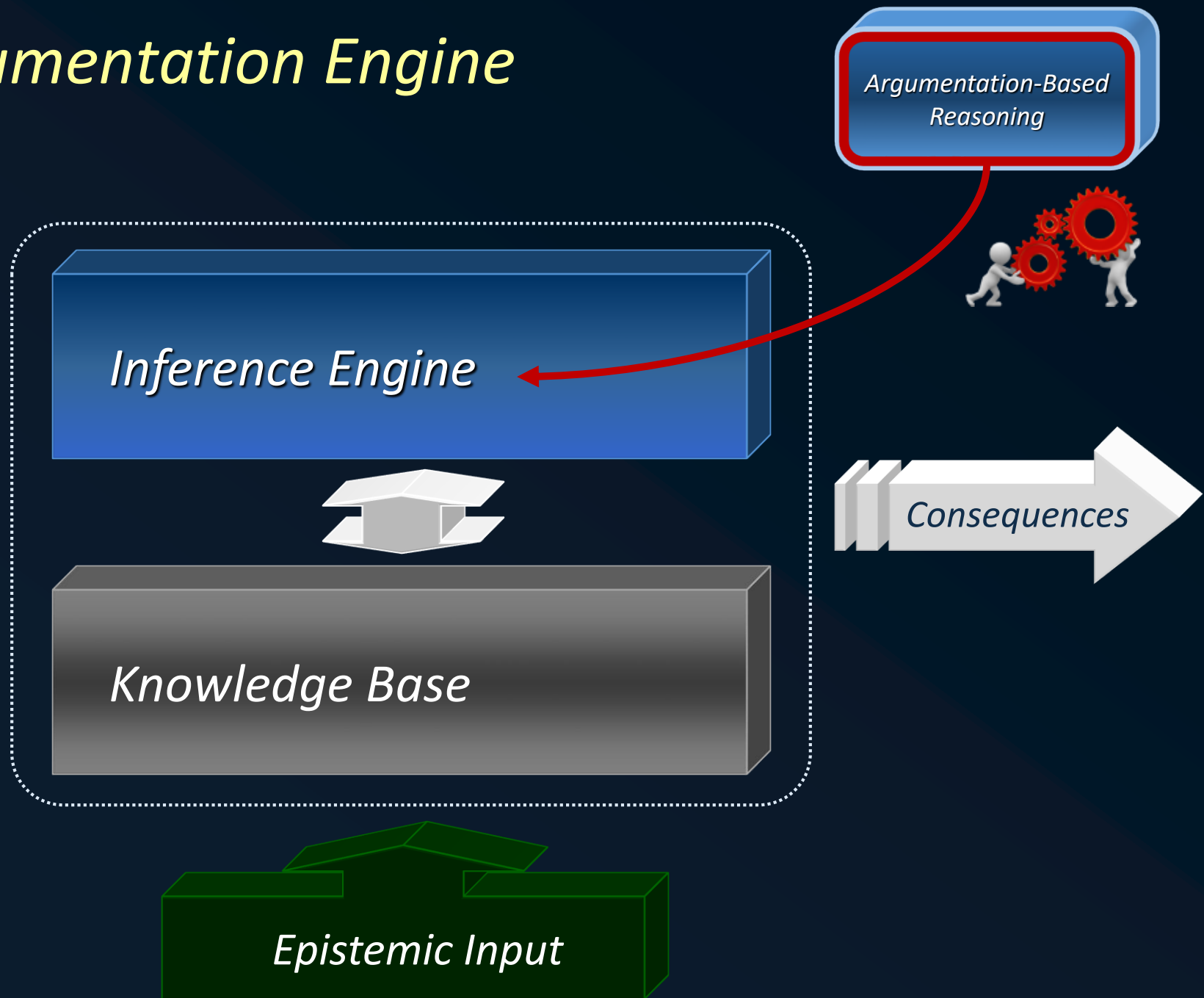
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- K. Atkinson, P. Baroni, M. Giacomin, A. Hunter, H. Prakken, C. Reed, G. R. Simari, M. Thimm, S. Villata: Towards Artificial Argumentation. AI Magazine 38(3): 25-36 (2017).
- P. Baroni. D. Gabbay, L. van der Torre: Handbook of Formal Argumentation (HOFA), Volume 1 (of 5). College Publications, 2018. (Volume 2, coming up soon)

# *KBS = Knowledge Base + Inference Engine*

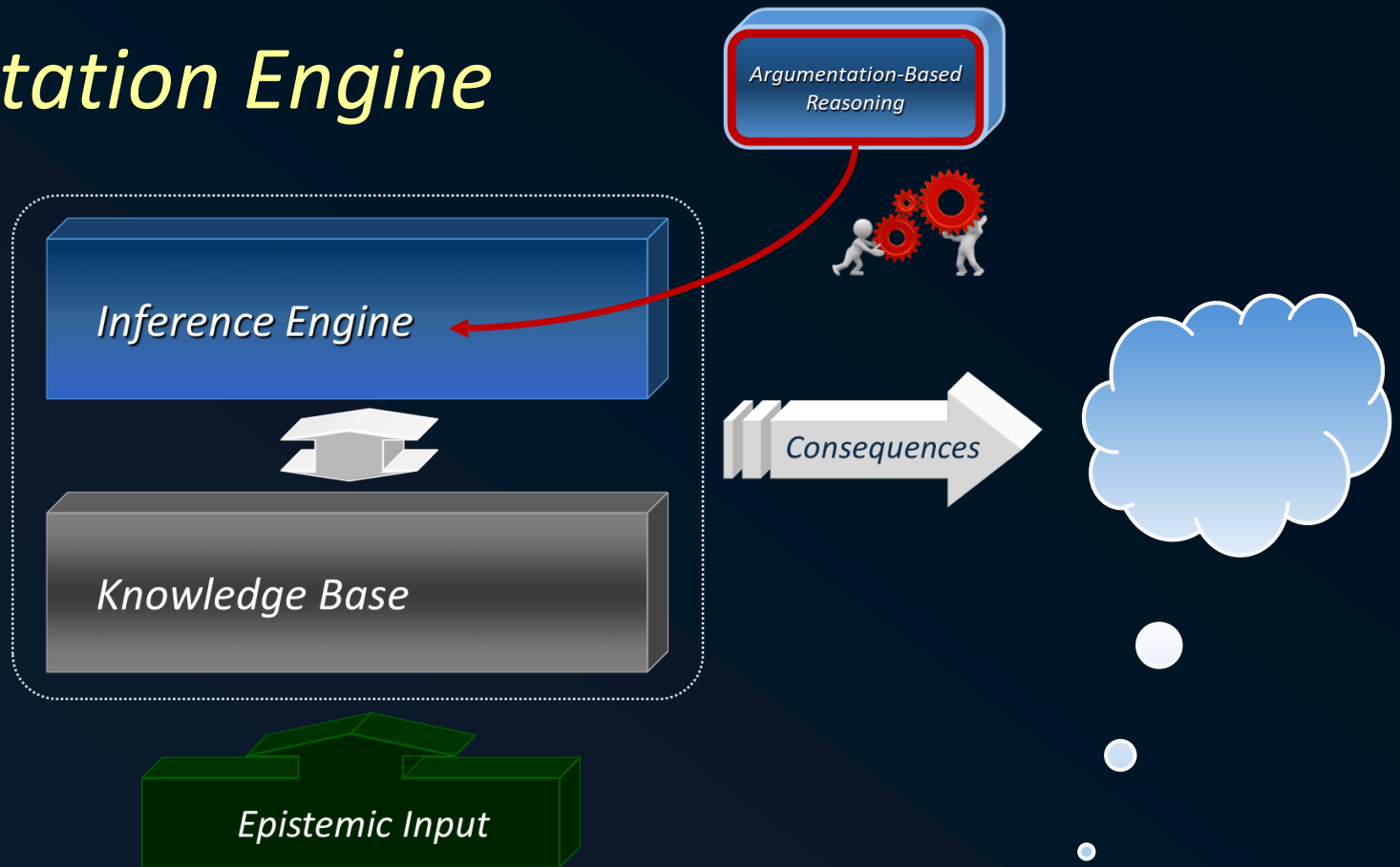




# *Argumentation Engine*



# Argumentation Engine



## Common assumptions:

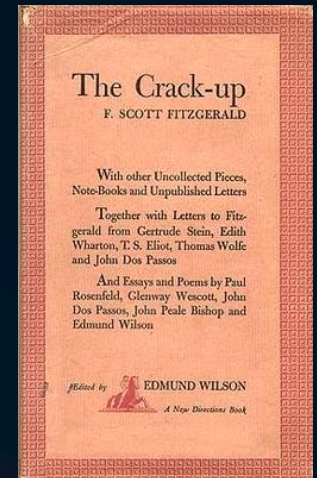
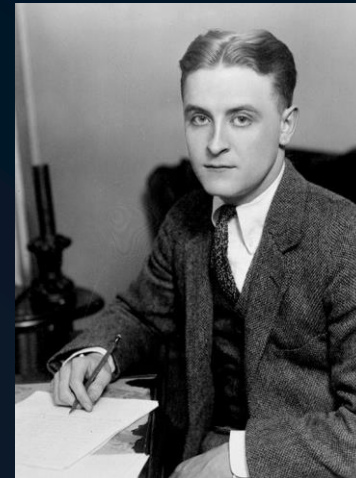
*If the Knowledge Base contains a subset based on classical logic, that part should be consistent and thus inference engine should be superclassical.*

*The set of conclusions must be classically consistent, i.e. soundness is required, and any sentence considered as a fact must be inferred. Also, completeness is desirable.*

# *What Argumentation brings to the table?*

*The test of a first-rate intelligence is the ability to hold two opposed ideas in the mind at the same time, and still retain the ability to function.*

- F. Scott Fitzgerald,  
"The Crack-Up" (1936)



*Paraphrasing ...*

*The test of a useful knowledge base is the ability to store two opposed sentences, and still retain the ability to provide useful inferences.*

# Argumentation as a decision process

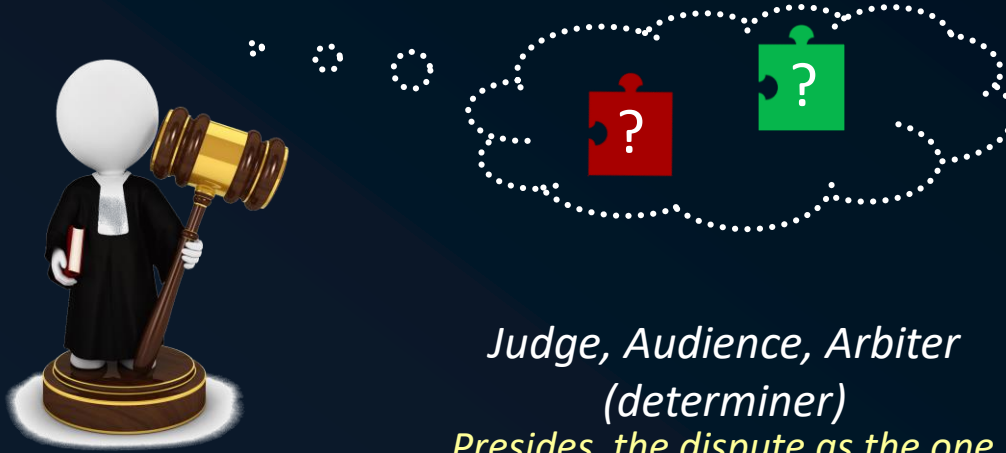
Argumentation is the “*human*” way of rationally handling conflicting information to establish beliefs:

- ➡ When arguing, we seek arguments *in favor* (or *pro*) and arguments *against* (or *con*) the point of conflict.
- ➡ *Pro* arguments aim at promoting the issue, while *Con* arguments suggest points against it.
- ➡ After finding the pros and cons, is necessary to compare them to answer the question: *which is better?*
- ➡ The decision might depend on who is considering the arguments and counterarguments: sometimes the analysis is *internal* to the reasoner, sometimes it involves an *external* audience.

*Dispute(s)*



*Dialogical  
Dispute*



*Judge, Audience, Arbiter  
(determiner)  
Presides the dispute as the one  
capable of deciding and controls  
the evolution of the dispute*



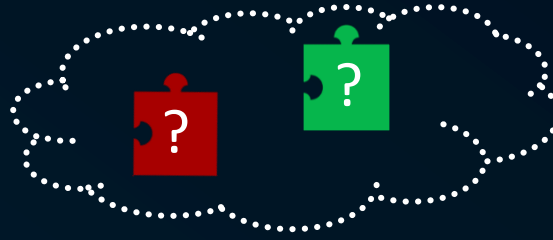
*Opponent*



*Introduces  
the initial  
thesis*



*Proponent*



*Judge, Audience, Arbiter  
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Presides the dispute as the one  
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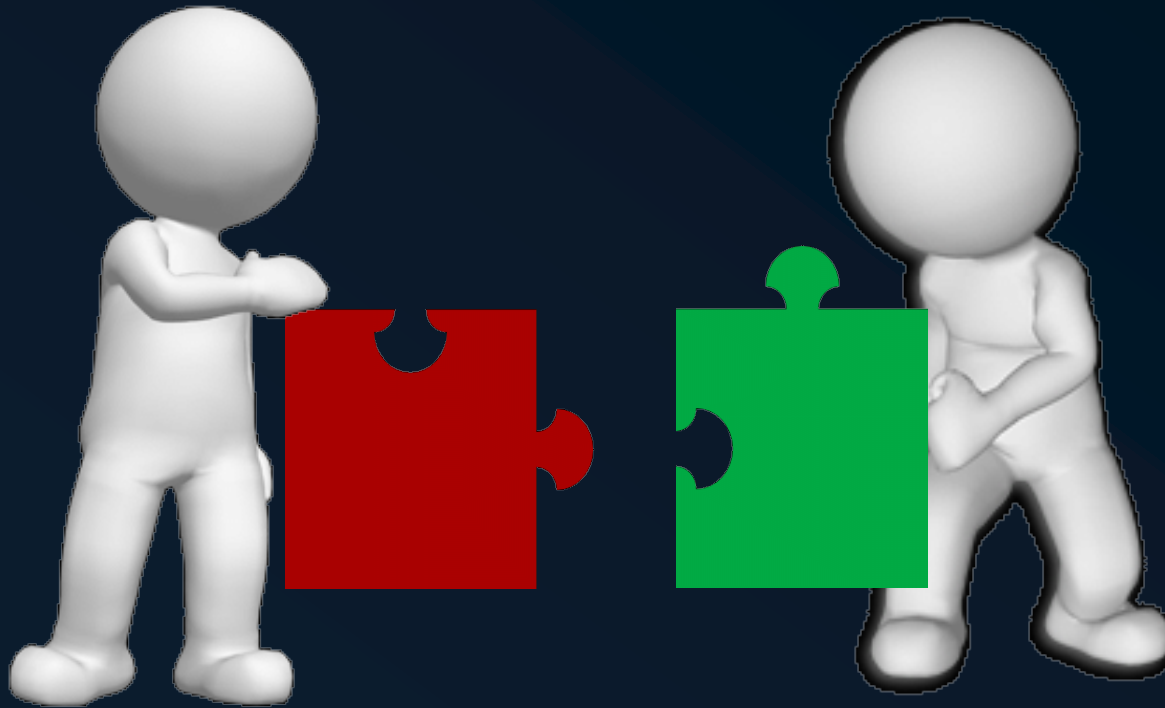
*Proponent*



*Dialogical  
Dispute*



# *Dispute Resolution*



# *Dispute Resolution*

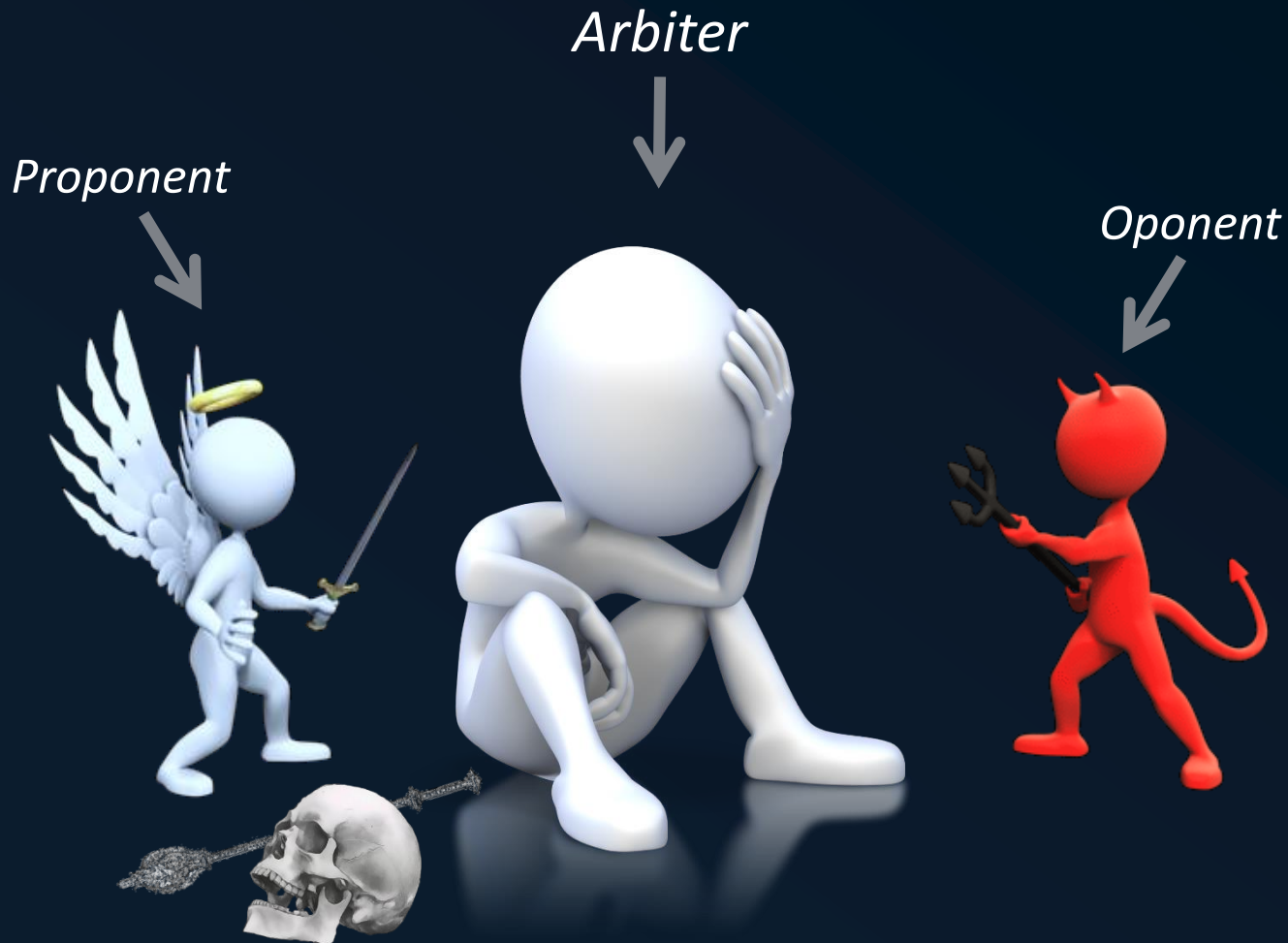


# *Dispute Resolution*



# Monological Dispute

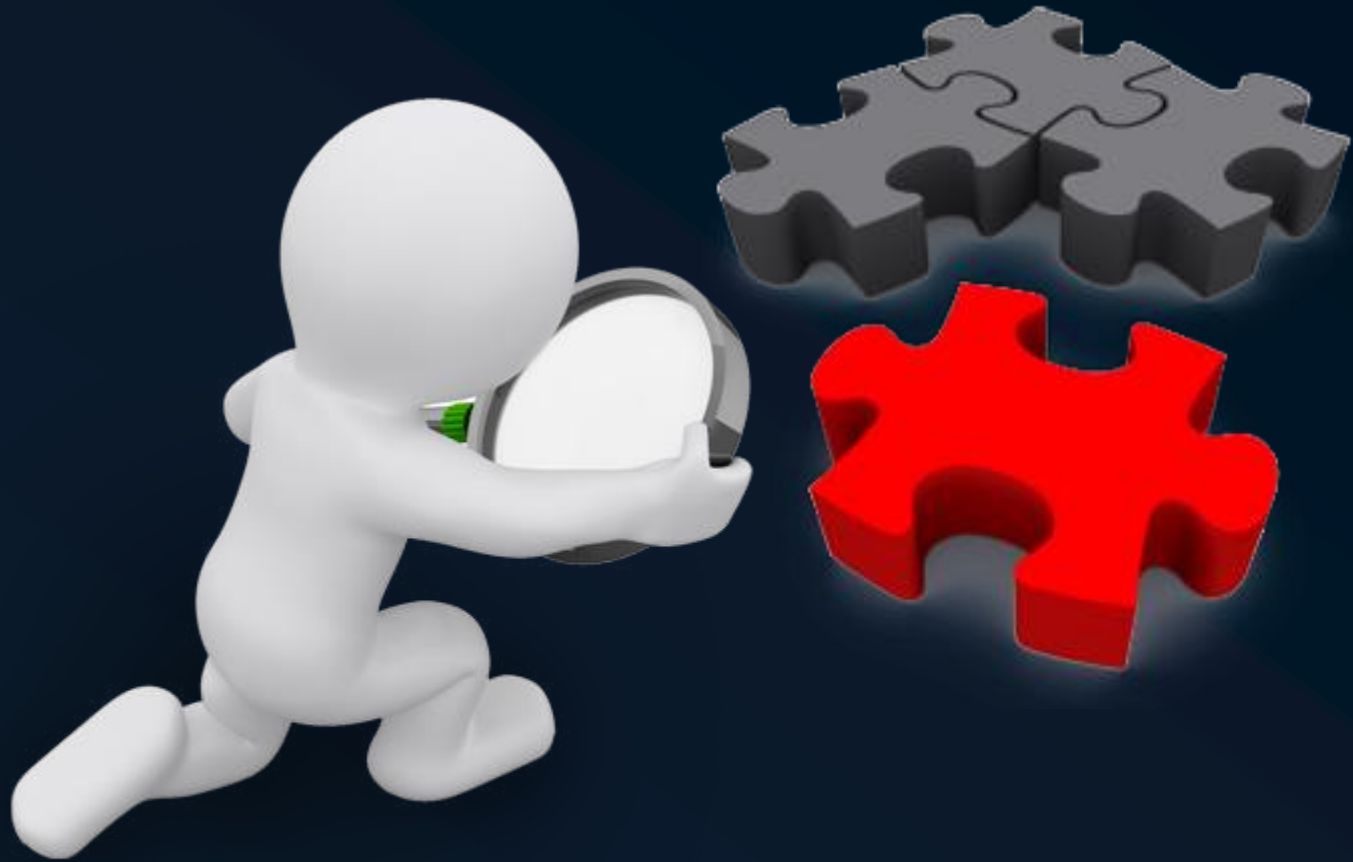
*The agent itself  
introduces the initial  
thesis, plays the role of  
opponent and it is also  
the arbiter.*



# *Dispute Resolution*



# *Dispute Resolution*



# *Dispute Resolution*



# *Dispute Resolution*





# *Argumentation*

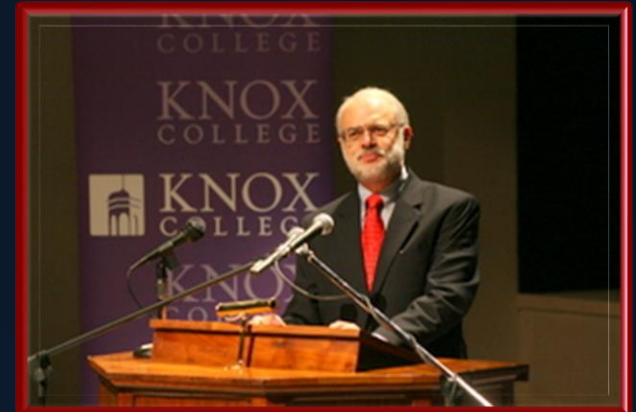
# Introduction

*“Reasoning, tested by doubt, is argumentation.”*

*“We do it in our own minds,  
and we do it with others.”*



*Prof. David Zarefsky  
Department of Communication Studies  
Northwestern University*



# Introduction

- ➔ Argumentation is *reason-giving*, that is, when people speak to one another, or with an audience in mind, claims are made in the form of statements they believe, and they would like for their listeners to accept as well.
- ➔ Therefore, *a claim is a statement that we assert as our belief, and we want our interlocutor to share.*
- ➔ *These claims are about matters that are uncertain, that cannot be established absolutely or definitely.*

# Introduction

- ➔ *In the context of a particular claim, reasons are the **justifications** for this claim, and they are not absolute proofs because they are inherently uncertain.*
- ➔ *Thus, claims depend on external judgment; from that point of view, **argumentation could be considered as the practice of justifying claims.***
- ➔ *A **substantial part of human rationality** is based on this ability to engage in reason-giving that connect the claims we make to the justifications for them.*

# Introduction

- ➔ *An essential aspect of argumentation is that it is a form of **effective reasoning**.*
- ➔ *This effectiveness is measured in relation to an **audience** because the success of an argument depends upon the **assent** the audience gives.*
- ➔ *Therefore, adherence to the claim is obtained based on the **reasons** given for it and the **connection** made between those reasons and the claim.*

# *Introduction*

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*In brief:*

*Argumentation is the practice of giving reasons to justify claims seeking the adherence of an audience.*

# *Introduction*

---

*In brief:*

*Argumentation is the practice of giving  
reasons to justify claims seeking the  
adherence of an audience.*

# Introduction

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*In brief:*

*Argumentation is the practice of giving reasons to justify claims seeking the adherence of an audience.*

*These action words point to the fact that argumentation is a process.*



# Introduction

- ➔ *Another aspect that is worthwhile to remark is that the persuasion sought after when introducing a claim and the reasons that support it, is reached through a **controversial process**.*
- ➔ ***Argumentation is Debate**, therefore it is a form of reasoning that closely follows the model of a **formal disputation** that seeks to find the best reason to support a possible conclusion.*

# Arguments

- ➔ *Informally, an argument is a coherent set of statements leading from a premise to a conclusion.*
- ➔ *More precisely, an **argument** is a set of statements in which a **claim** is made, and **support** is offered for that claim attempting to influence someone in a context of **disagreement**.*
- ➔ *Usually, the parts of an argument are called **Claim**, **Evidence**, and **Reasoning**.*

# Example


From “A practical Study of Argument”,  
Trudy Govier, 6<sup>th</sup> Edition, Wadsworth, 2005.

*“Marijuana should not be legalized.  
That’s because sustained use of  
marijuana worsens a person’s memory,  
and nothing that adversely affects one’s  
mental abilities should be legalized.”*

# Example

From “A practical Study of Argument”,  
Trudy Govier, 6<sup>th</sup> Edition, Wadsworth, 2005.

**Claim**



*“Marijuana should not be legalized.  
That’s because sustained use of  
marijuana worsens a person’s memory,  
and nothing that adversely affects one’s  
mental abilities should be legalized.”*

# Example

From "A practical Study of Argument",  
Trudy Govier, 6<sup>th</sup> Edition, Wadsworth, 2005.

**Claim**

*"Marijuana should not be legalized.*

*That's because sustained use of  
marijuana worsens a person's memory,  
and nothing that adversely affects one's  
mental abilities should be legalized."*

**Evidence**

# Example

From "A practical Study of Argument",  
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**Claim**

*"Marijuana should not be legalized.*

*That's because sustained use of marijuana  
worsens a person's memory, AND*

*IF something adversely affects one's  
mental abilities THEN it shouldn't be  
legalized."*

**Evidence**

# Example

From "A practical Study of Argument",  
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**Claim**

*"Marijuana should not be legalized.*

*That's because sustained use of marijuana  
worsens a person's memory, AND*

*IF something adversely affects one's  
mental abilities THEN it shouldn't be  
legalized."*

**Evidence**

*Reasoning:*

**Defeasible Detachment**

# *The Process of Argumentation*

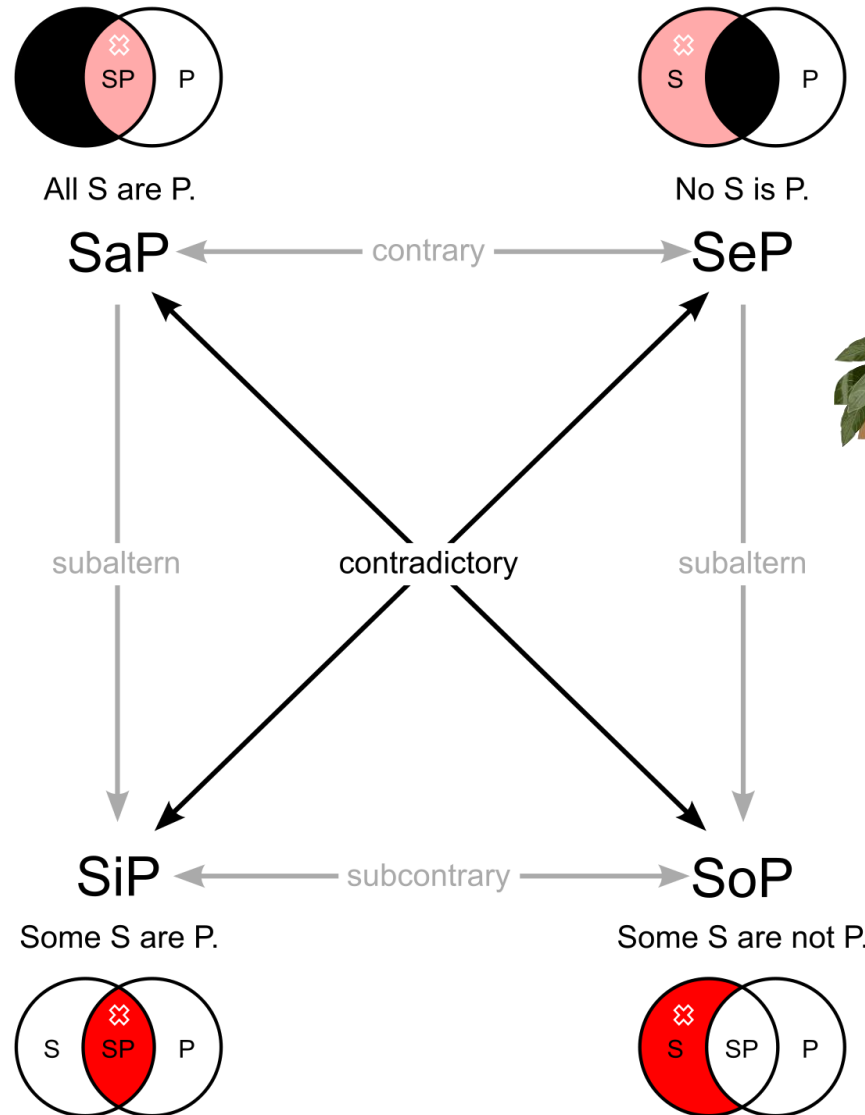
*As examples of the study of argumentation we will look at two types of systems.*

- ➔ *First, we will describe **abstract argumentation** where arguments are handled without analyzing how they are built.*
- ➔ *Second, we will consider two systems that actually **build arguments** and decide if there exists a prevailing argument for a given claim.*
- ➔ *Before starting with the formal development we will look at a simple, but rich, model.*



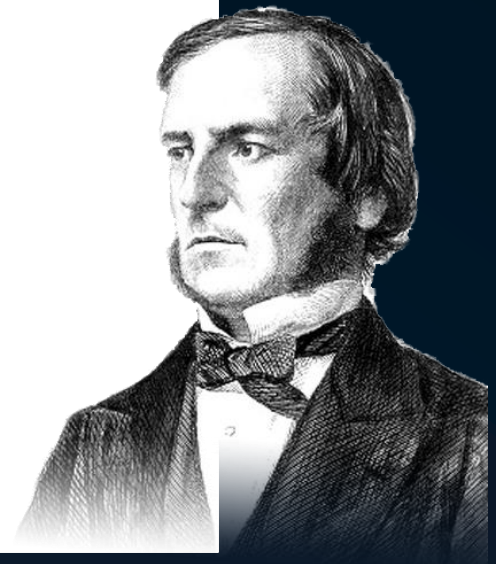
# *Representing Arguments*

# Categorical Logic

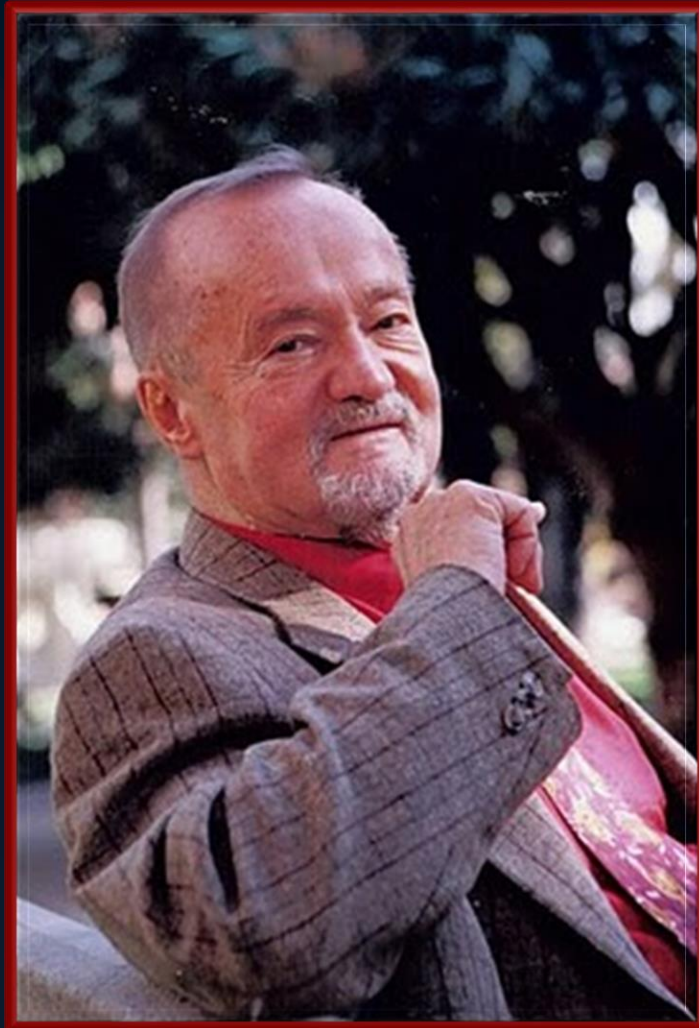


# *Formal Logic*

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



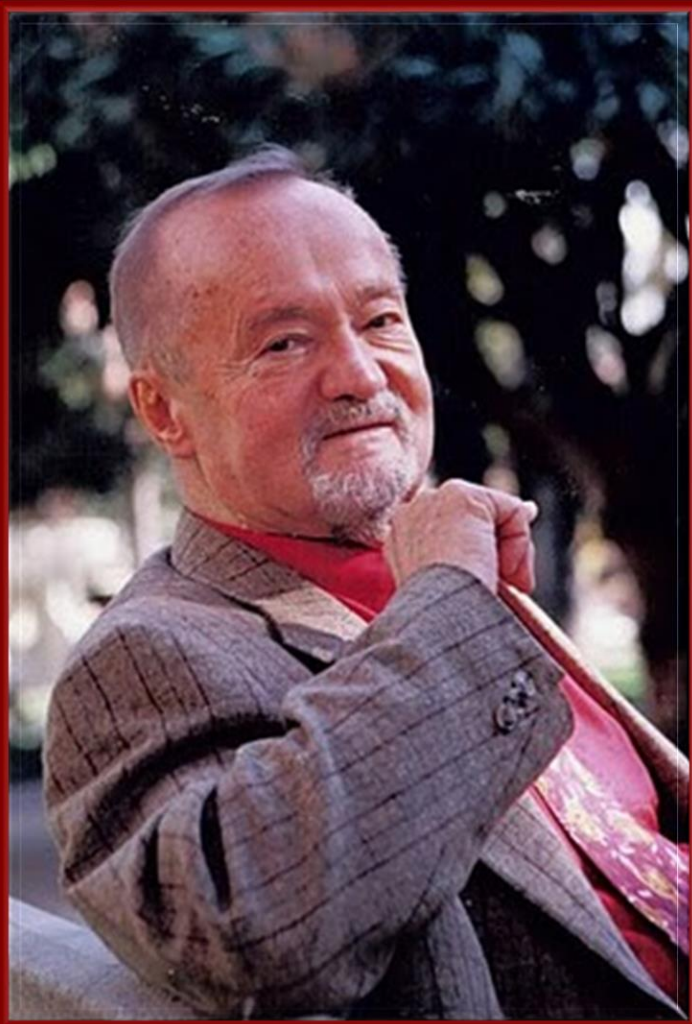
# *The Toulmin Model*



*Stephen E. Toulmin*  
(1922-2009)

*Originally published: 1958*

*Updated: 2003*

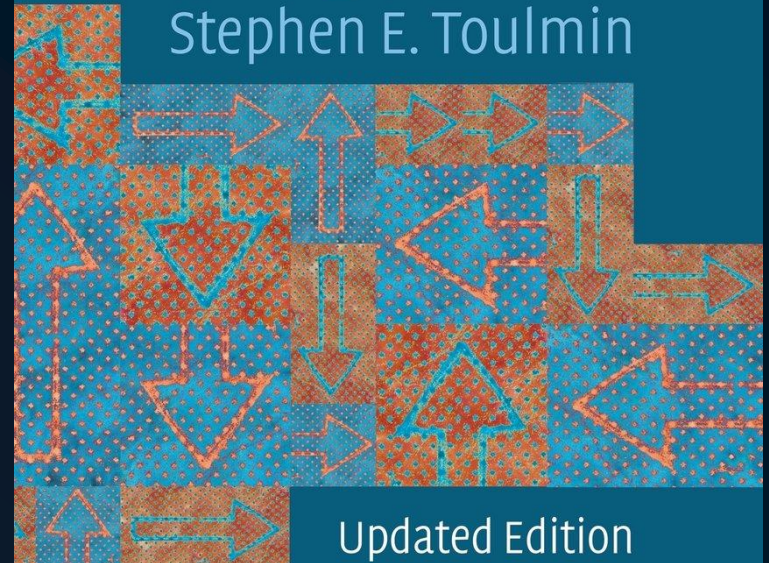


*Stephen E. Toulmin*

(1922-2009)

# The Uses of Argument

Stephen E. Toulmin



Updated Edition

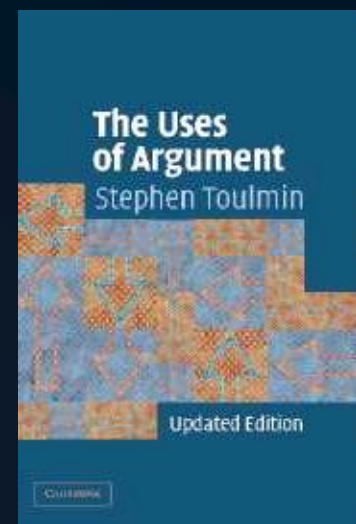
CAMBRIDGE



# 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.”*

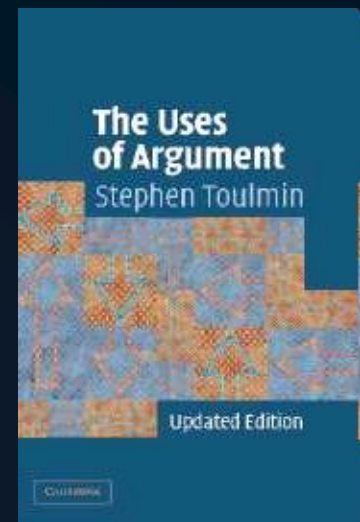
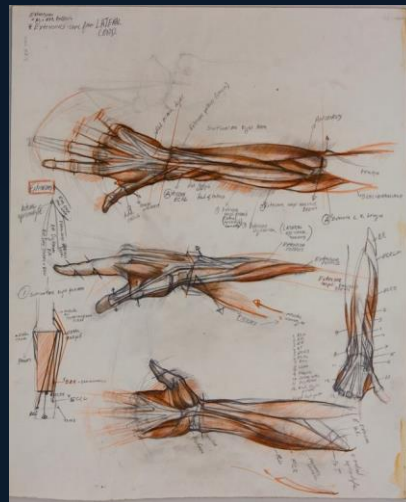
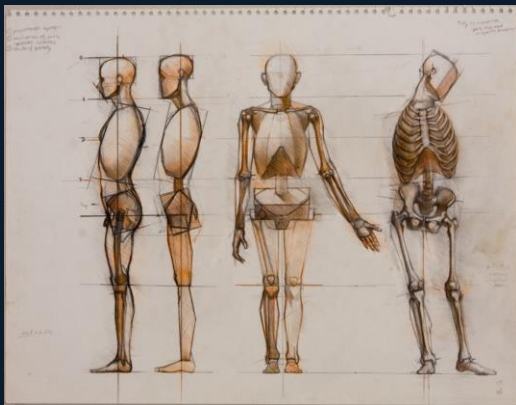


# *The Uses of Argument*

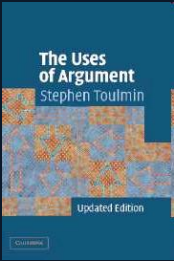
*From Chapter III:*

## *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:*

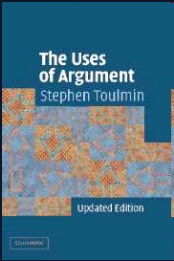
*“Argument is like an organism. It has both a gross anatomical structure and a finer, as-it-were physiological one.”*



*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.”*



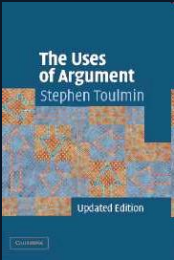
*Datum*

*Harry was  
born in  
Bermuda*



*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*

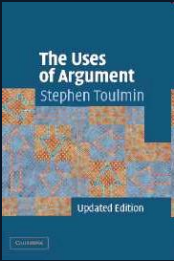
*Harry was  
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Bermuda*



*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  
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From Chapter III, *The Layout of Arguments*:

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*Datum*

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Bermuda will generally  
be a British subject*

*The following  
statuses and other  
legal provisions*

*Since  
Warrant*

*On account of  
Backing*

*So, Claim*

*Harry is  
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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.”*



The Uses  
of Argument  
Stephen Toulmin

Updated Edition

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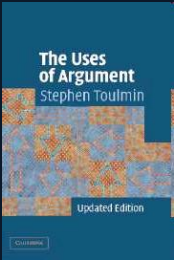
*Since  
Warrant*

*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.”*



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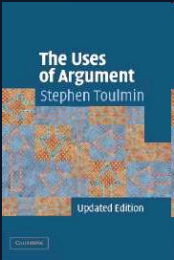
*On account of  
Backing*

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*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.”*



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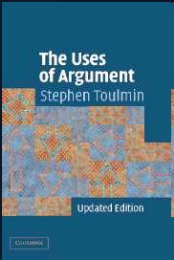
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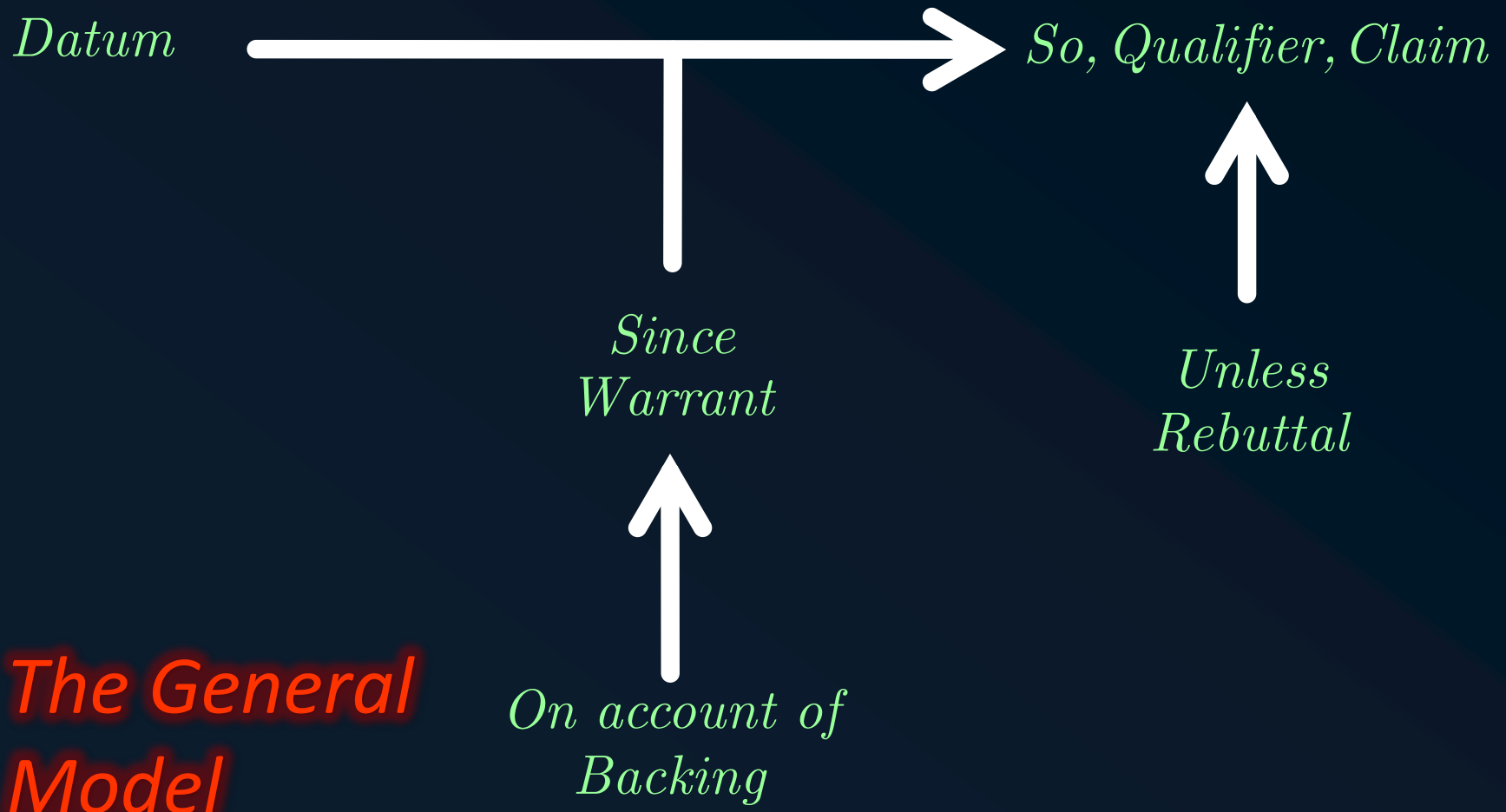
*Unless  
Rebuttal*

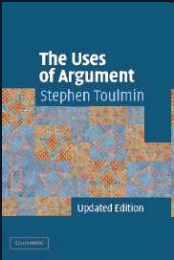
*Both his parents  
were aliens/ he  
has become a  
naturalised  
American/ ...*



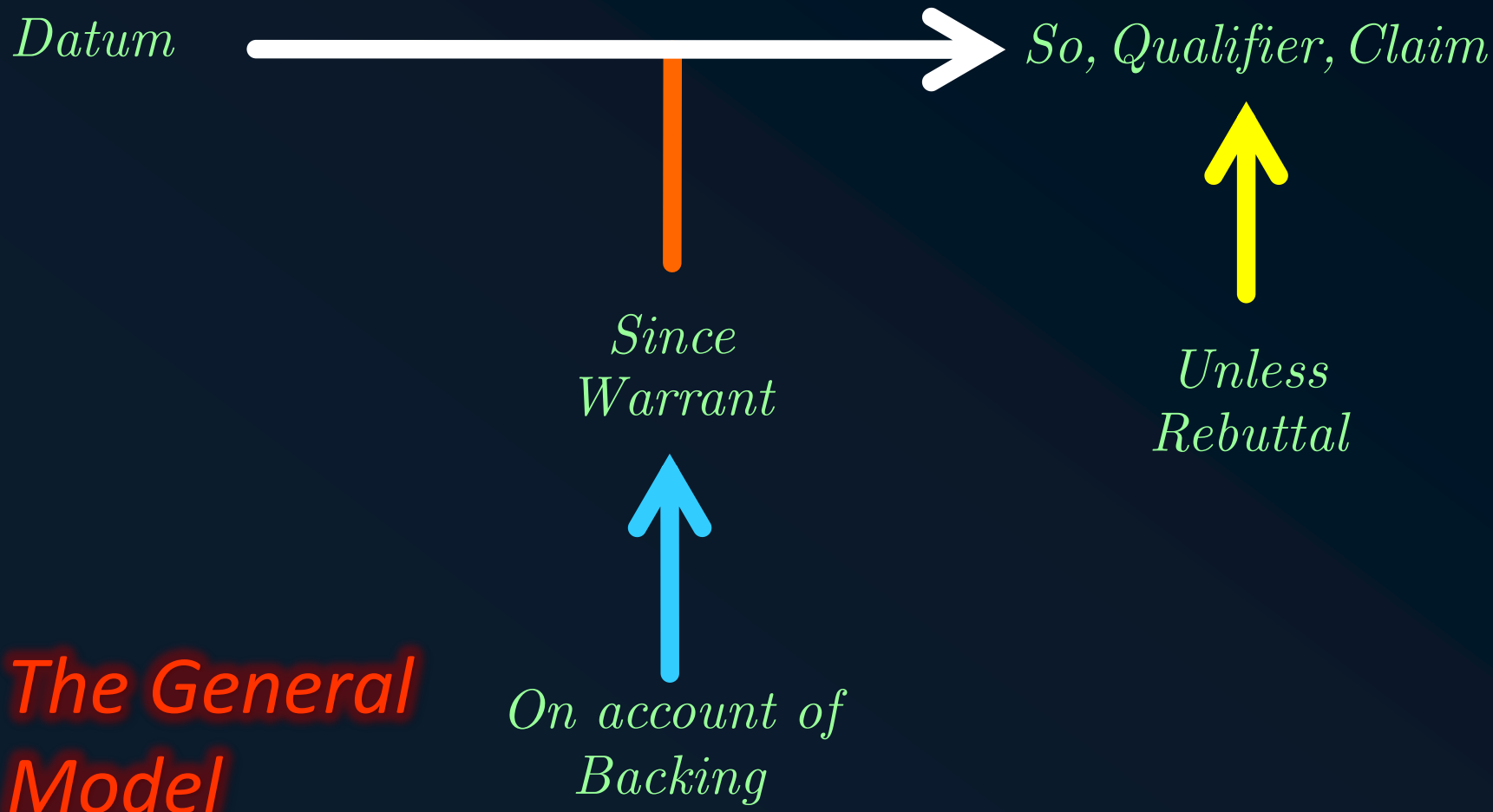


# *The Layout of Arguments*





# *The Layout of Arguments*

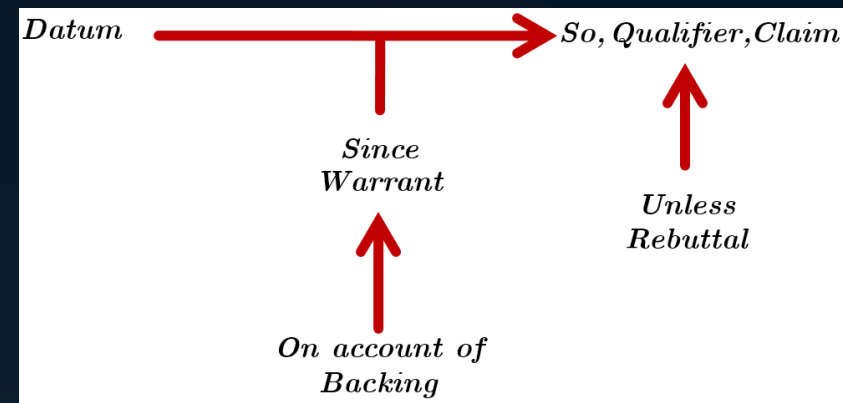


# An argument in text form

*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>

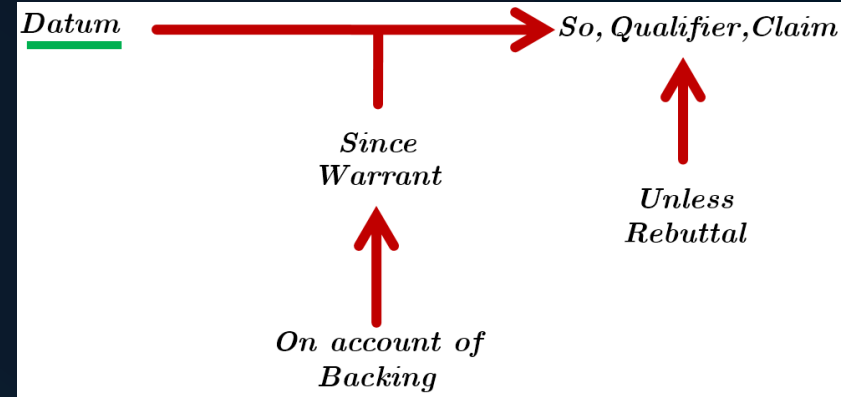


# An argument in text form (Datum)

*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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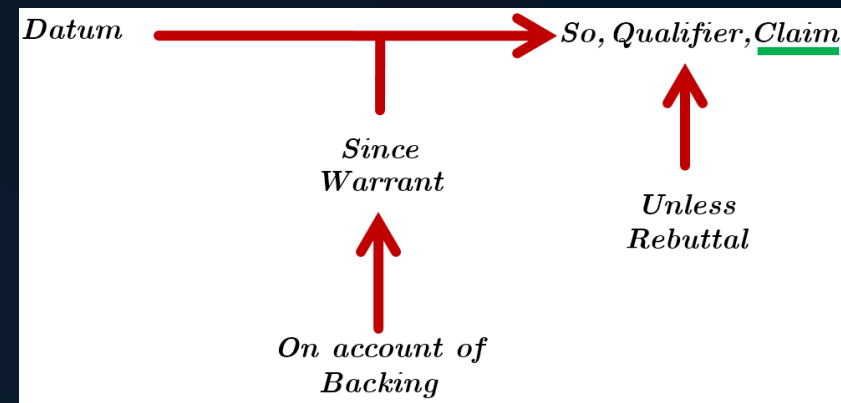


# An argument in text form (Claim)

*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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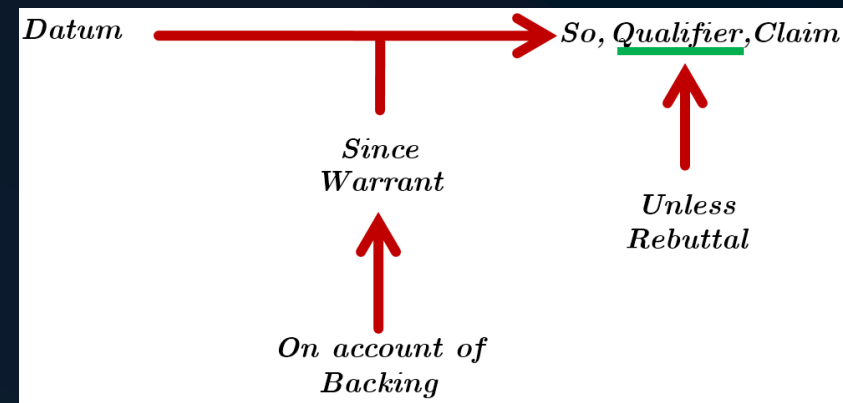


# An argument in text form (Qualifier)

*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.*

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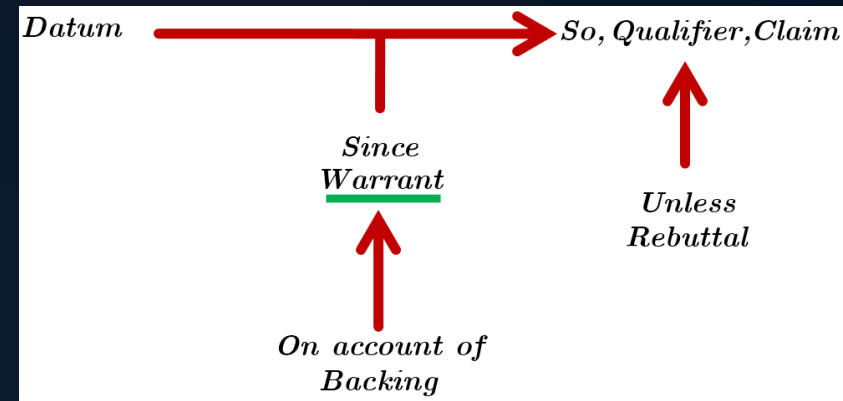


# An argument in text form (**Warrant**)

*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.*

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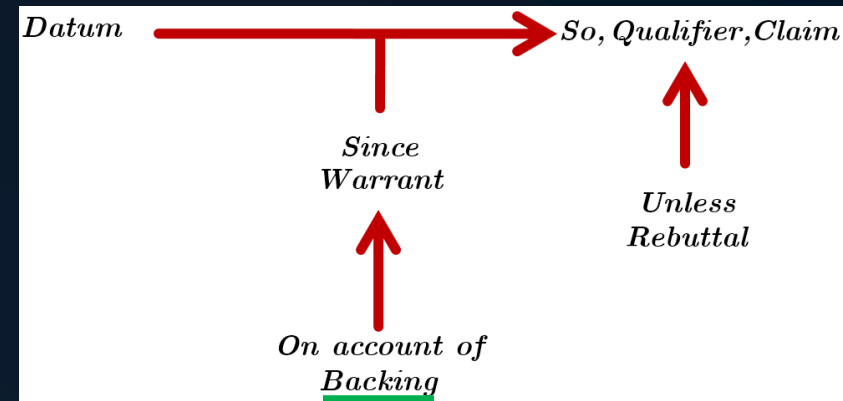


# An argument in text form (**Backing**)

*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.*

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

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



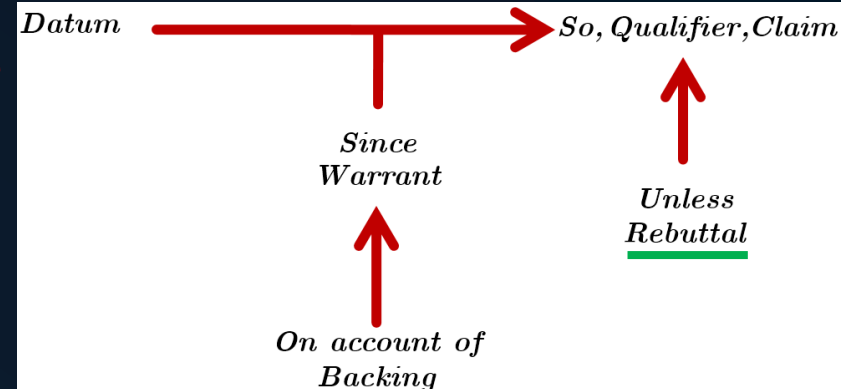


# An argument in text form (Rebuttal)

*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

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*Datum:* Old cars pollute and are less safe.

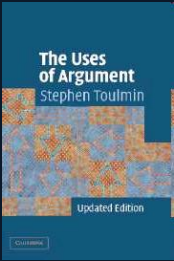
*Claim:* Cars older than 20 years should not be allowed to circulate.

*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-YPPQztu0Y>



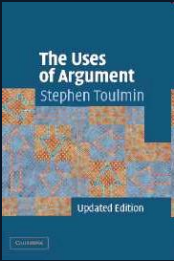
*Datum*

*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-YPPQztu0Y>



*Datum*

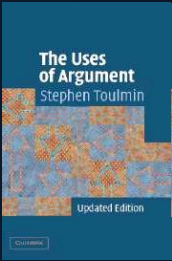
*Old cars  
pollute and  
are less safe*



*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-YPPQztu0Y>



*Datum*

*Old cars  
pollute and  
are less safe*

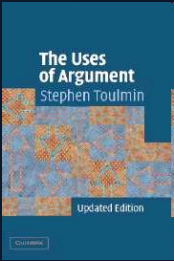


*So, Claim*

*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.*

*Since  
Warrant*



Example from: David Wright  
Furman University, English Department,  
University of Richmond, VA, USA  
<https://www.youtube.com/watch?v=D-YPPQztu0Y>



*Datum*

*Old cars  
pollute and  
are less safe*



*So, Claim*

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

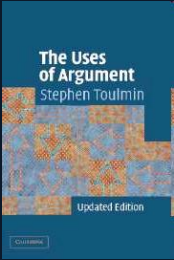
*Removing old cars from the  
road will result in a cleaner  
environment and less  
accidents.*

*Since  
Warrant*



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

*On account of  
Backing*



Example from: David Wright  
Furman University, English Department,  
University of Richmond, VA, USA  
<https://www.youtube.com/watch?v=D-YPPQztu0Y>



*Datum*

*Old cars  
pollute and  
are less safe*

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road will result in a cleaner  
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major cause of greenhouse  
gases and safety features are  
not installed (airbags,  
antilock brakes, etc.)*

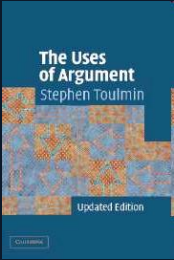
*Since  
Warrant*

*On account of  
Backing*

*most*

*So, Qualifier, Claim*

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



Example from: David Wright  
Furman University, English Department,  
University of Richmond, VA, USA  
<https://www.youtube.com/watch?v=D-YPPQztu0Y>



*Datum*

*Old cars  
pollute and  
are less safe*

*Removing old cars from the  
road will result in a cleaner  
environment and less  
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major cause of greenhouse  
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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-YPPQztu0Y>



*Datum*

*Old cars  
pollute and  
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*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.*

*In summary*

# *Conceptual View*

*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*

*Definition of Status of Arguments*

*Definition of Defeat among 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*

*Definition of the Underlying (Logical) Language*

*→ Relational Layer*

# *Conceptual View*

*Definition of Status of Arguments*

*Definition of Defeat among Arguments*

*Definition of Conflict among arguments*

*Definition of Argument*

*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.

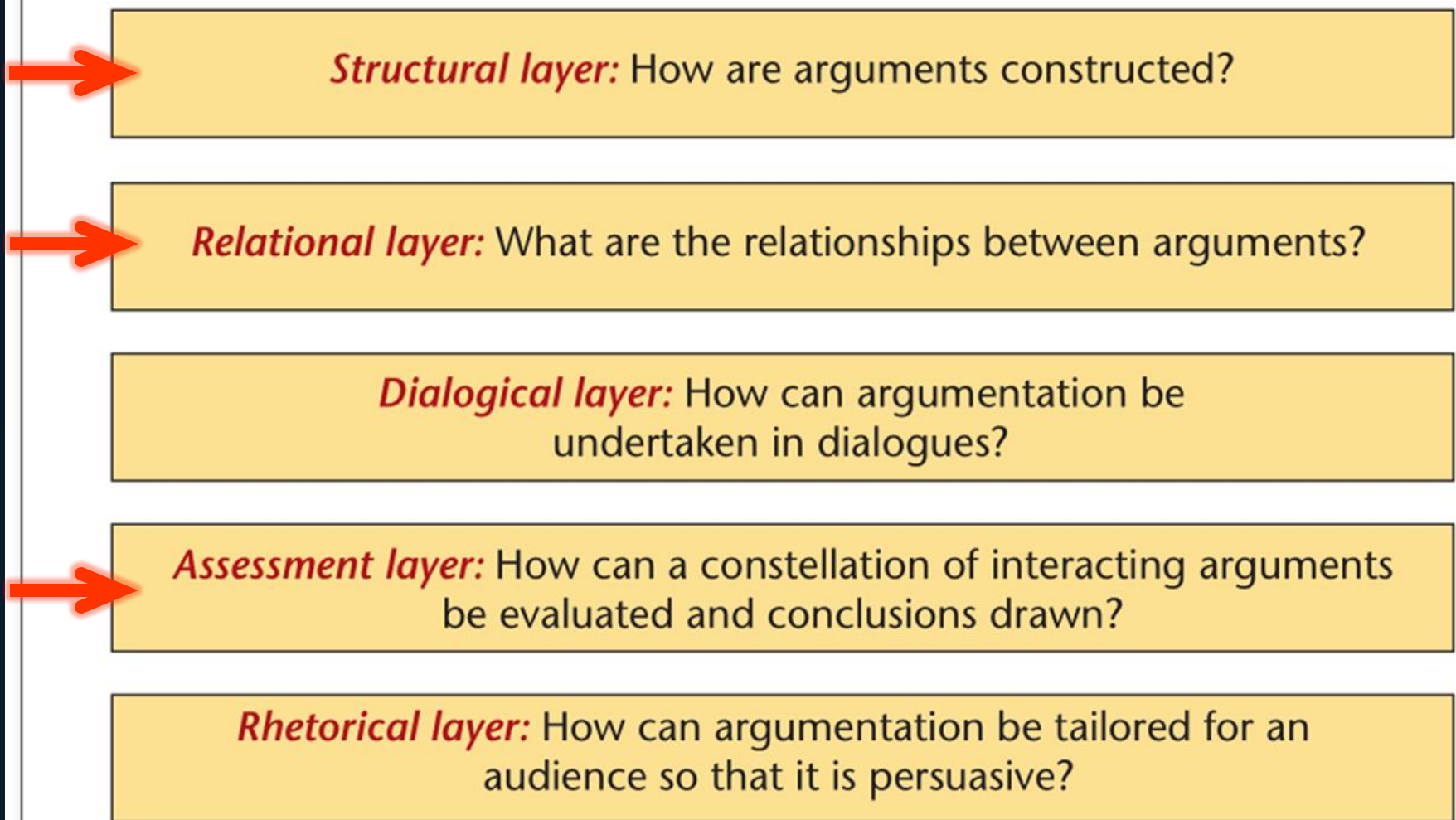


Figure 1. Key Aspects of Argumentation.

*Thank you!*  
*Questions?*

