DEPARTMENT OF INFORMATION STUDIES

Exploring the Role of Formal Argumentation in Humanities Research

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MITE Research Seminar

Motivation

- Challenges of research in the humanities
  - Incomplete, ambiguous or contradictory information
  - Multiple conflicting interpretations
- Scholarly arguments
  - Evidence-based: based on verifiable and credible data, facts, and sources
  - Logically sound: the claim logically follows from the premises
  - Falsifiable: can be evaluated and logically contradicted (Popper, 1934)

Motivation

- Formal argumentation
  - Logic-based models of argument
  - Explicit representation of contradictory arguments
  - Arguments can be invalidated when sufficient contrary information becomes available
  - Methods for representing, analysing and evaluating arguments
  - A potentially valuable tool for documenting and analysing scholarly arguments

Talk Outline

- Examples of scholarly arguments and debates in the humanities
- Formal argumentation
- Connecting the dots…
- Related Work
- Looking ahead

Example 1: Hermes of Olympia

- Also known as *Hermes and the Infant Dionysus*
  - The statue represents the period following Dionysos' birth from Zeus' thigh when the king of the gods handed the infant to Hermes in order to protect Dionysos from the wrath of Hera
- Discovered in the temple of Hera in Olympia in 1877
- Controversy about the date and attribution of the work
  - According to Pausanias, it was created by Praxiteles in the 4th century BCE
  - More recent scholars claim it was a Roman copy of Praxiteles' (or some other artist's) original work

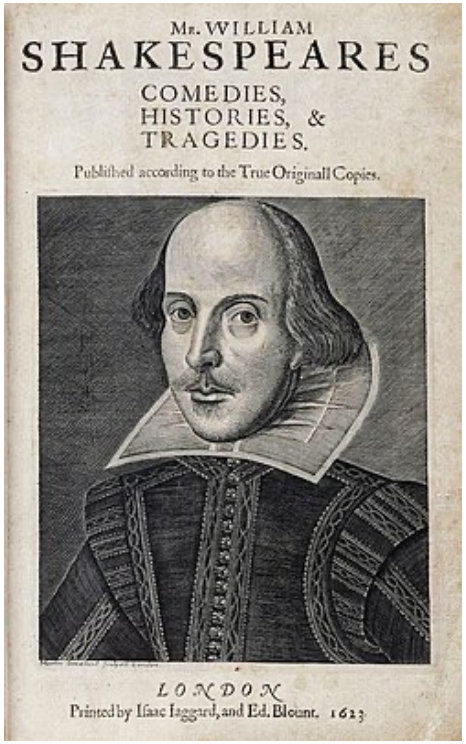
Example 1: Hermes of Praxiteles

- Arguments supporting Praxiteles as the creator
  - Ancient texts, such as Pausanias' "*Description of Greece*", mention a statue of Hermes by Praxiteles at Olympia.
  - The statue was discovered in the Temple of Hera at Olympia, a location historically associated with works by Praxiteles.
  - The style of the Hermes statue is consistent with other works attributed to Praxiteles. The soft, flowing lines, the delicate rendering of flesh, and the relaxed, naturalistic poses are hallmarks of his known works, such as the Aphrodite of Knidos.

Example 1: Hermes of Praxiteles

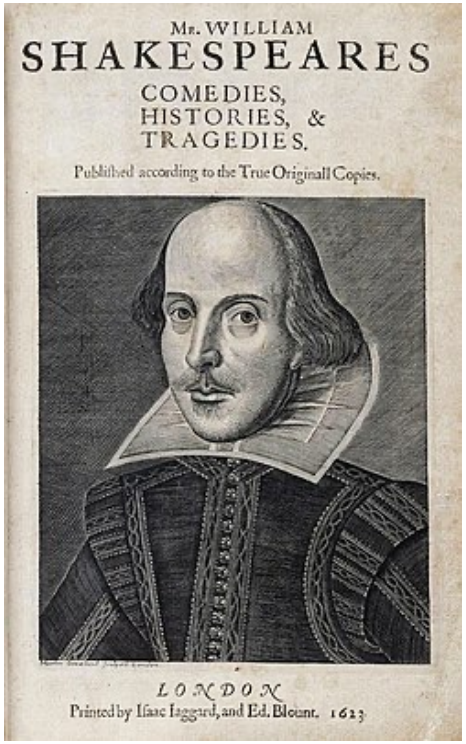
- Arguments questioning Praxiteles as the creator
  - Some scholars argue that the statue's stylistic elements align more closely with later Hellenistic works rather than those from the 4th century BCE when Praxiteles was active.
  - Other scholars have pointed out that certain aspects of the sculpture, such as the proportions and anatomical details, do not perfectly match Praxiteles' known works.
  - Analysis of the marble and sculpting techniques has led some experts to propose that the statue may have been created during the Roman period as a copy or adaptation of an earlier Greek work

Example 2: Shakespeare authorship



- The *Shakespeare authorship question*
  - Someone other than William Shakespeare wrote the works attributed to him.
- Arguments supporting Shakespeare as the author
  - Historical records support that Shakespeare was a recognised playwright and actor.
  - The publication of Shakespeare's plays in the *First Folio* in 1623 attributes the works to him.
  - Numerous contemporaries, such as Ben Johnson and Francis Meres, praise Shakespeare as a playwright and his work.

Example 2: Shakespeare authorship



- Arguments questioning Shakespeare as the author
  - Shakespeare's modest education does not align with the profound knowledge of law, history and classical literature displayed in the plays.
  - Shakespeare's social standing would not have had access to the elite circles and intimate knowledge of court life depicted in the plays.
  - Analyses of linguistic patterns, vocabulary, and themes have led some scholars to propose alternative authors or collaborative writing processes.
  - The use of pseudonyms was common in Elizabethan England, particularly for noblemen who wished to avoid the stigma associated with writing for the public stage.

Example 3: Origin of French fries

- Arguments for France
  - Fries were first sold by street vendors on the Pont Neuf bridge in Paris in the late 18th century.
  - French culinary literature includes early references to fried potatoes. For instance, the 1795 edition of the French cookbook "La Cuisinière Républicaine" includes a recipe for "pommes de terre frites"
  - The term "French fries" itself suggests a French origin.
  - French fries are often associated with French cuisine and are served as a side dish in many traditional French meals

Example 3: Origin of French fries

- Arguments for Belgium
  - The earliest written reference to fried potatoes in Belgium is attributed to a manuscript by Joseph Gérard in 1781, describing the practice of frying potatoes.
  - French fries originated in the Meuse Valley region of present-day Belgium. According to local folklore, villagers in this region were frying small fish as early as the late 17th century. When the river froze and fishing was impossible, they cut potatoes into fish-like shapes and fried them as a substitute.
  - The term “French fries” was popularised by American soldiers during World War I who encountered the dish in Belgium and referred to it as "French" due to the French-speaking Belgians.

Argument features

- Evidence-based: based on different types of evidence
  - Historical, Contextual, Cultural, Linguistic, Stylistic, etc.
- Falsifiable: can be disputed
  - For example by scientific analysis or by stronger contrary evidence
- Logically sound
  - Claims supported by evidence through logical reasoning
- Focused scope
  - Claims about a specific entity, event or phenomenon

Argument features

- Use of analogies
  - Claims supported by references to analogous cases
- Argument strength
  - Quality of evidence
  - Soundness of the collection method
  - Credibility of the source
  - Relevance of the evidence
  - Strength of contrary arguments

Argumentation Theory

> *" The study of argumentation in all its manifestations and varieties, irrespective of the intellectual backgrounds, primary research interests and angles of approach of the theorists"*

(van Eemeren et al., 2002)

Argumentation is studied in several disciplines:

- Philosophy
- Communication studies
- Cognitive Psychology
- Linguistics
- Artificial Intelligence

Argumentation

> *" a verbal, social, and rational activity aimed at convincing a reasonable critic of the acceptability of a standpoint by putting forward a constellation of propositions justifying or refuting the proposition expressed in the standpoint "*

(van Eemeren & Grootendorst, 2004)

- Stages of argumentation (argument-based inference)
  - Identifying arguments and counter-arguments relevant to an issue
  - Evaluating arguments
    - Is the argument valid?
    - Is the supporting evidence valid and strong?
    - Is the argument stronger/weaker than its counter-arguments?
  - Drawing a conclusion

Argument

> *“ any group of propositions of which one is claimed to follow from the others, which are regarded as providing support or grounds for the truth of that one ”*

(Copi & Cohen, 2002)

- Types of Information
  - Certain / Uncertain
    - Macbeth is a tragedy.
    - Macbeth was likely written in 1606 in the aftermath of the Gunpowder Plot.
  - Objective / Subjective / Hypothetical
    - At 2477 lines Macbeth is one of the shortest of Shakespeare's plays, and the shortest tragedy.
    - In my opinion, Macbeth is Shakespeare's greatest tragedy.
    - Assume, for the sake of argument, that Macbeth was not written by Shakespeare.

Argumentation in AI

- Formal argumentation
  - Argument-based inference
  - Argumentative dialogues
- Computer programs that model or support argumentative tasks
  - Identifying arguments, evaluating arguments, drawing conclusions, etc.

Abstract vs. Structured Argumentation

- Abstract Frameworks
  - Each argument is regarded as atomic (no internal structure)
  - Argument evaluation considers only the argument relations
- Structured Frameworks
  - Formal language for representing knowledge
  - Arguments constructed from the available knowledge
  - The premises and claim of the argument are made explicit
  - Relationship between premises and claim is formally defined

Abstract Argumentation Frameworks

(Dung, 1995)

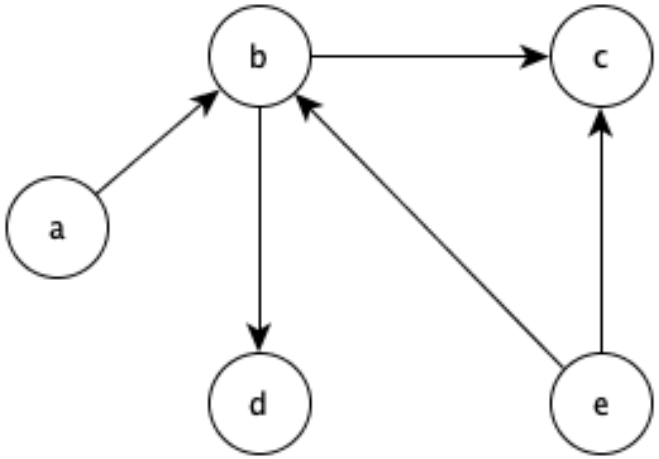
- A simple but poweful model for argument evaluation based on two notions: argument and attack

An argumentation framework is a pair $\mathbf{AF} = \langle \mathbf{A}, \mathbf{R} \rangle$ *where*

- $\mathbf{A}$ *is a set of argument*
- $\mathbf{R} \subseteq \mathbf{A} \times \mathbf{A}$ *is a binary relation on* $\mathbf{A}$

Abstract Argumentation Frameworks

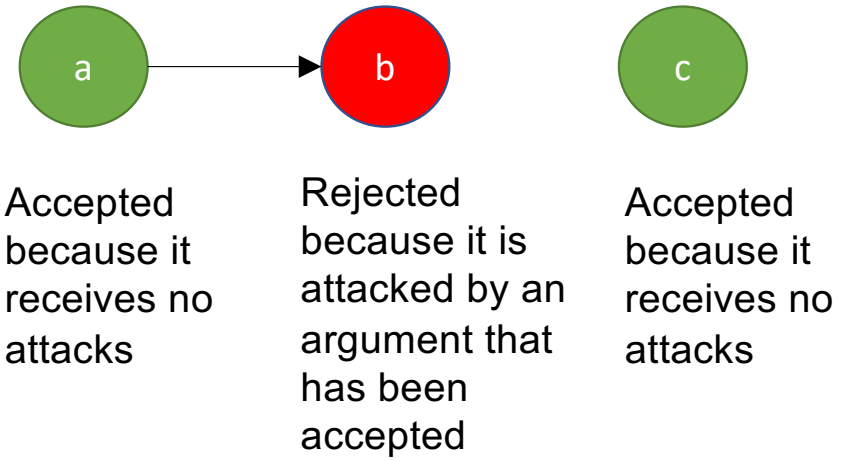
- An argumentation framework can be modelled as a directed graph where nodes denote arguments and directed edges denote attacks



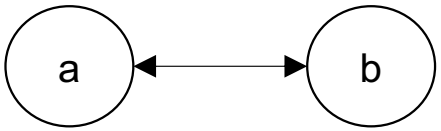
A = {a, b, c, d, e}
R = {(a,b),(b,c),(b,d),(e,b),(e,c)}

Evaluation of arguments

- An argument is
  - accepted if it does not receive any attacks
  - rejected if there is a counter-argument that has been accepted



A more interesting case



- Arguments that are in conflict cannot be both accepted
- Should we accept neither or either of them?

- Scenario 1:
  - a: The weather in Cuba is great, let's go there for our holidays.
  - b: The tickets to Cuba are expensive, let's go somewhere else.

Accept either

- Scenario 2:
  - a: Alice: Bob committed the murder. I saw him in the crime scene.
  - b: Bob: I didn't do it. Alice did it. She hated the victim!

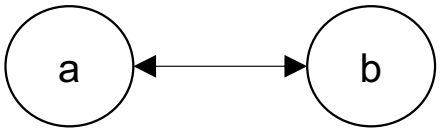
Accept neither

Acceptability semantics

- An extension of an argumentation framework $\mathbf{AF} = \langle \mathbf{A}, \mathbf{R} \rangle$ is a set of arguments $\mathrm{E} \subseteq \mathrm{A}$ that we can reasonably accept
  - Admissible: $\mathbf{E}$ is conflict-free and defends all its members
  - Complete: $\mathbf{E}$ is admissible and contains all arguments its defends
  - Grounded: $\mathbf{E}$ is the minimal complete extension
  - Preferred: $\mathbf{E}$ is the maximal complete extension
  - Stable: $\mathbf{E}$ is conflict-free and attacks all arguments it does not contain

- Each semantics corresponds to a different form of reasoning

Acceptability Semantics



	Admissible	Complete	Grounded	Preferred	Stable
{}	✓	✓	✓	✗	✗
{a}	✓	✓	✗	✓	✓
{b}	✓	✓	✗	✓	✓
{a,b}	✗	✗	✗	✗	✗

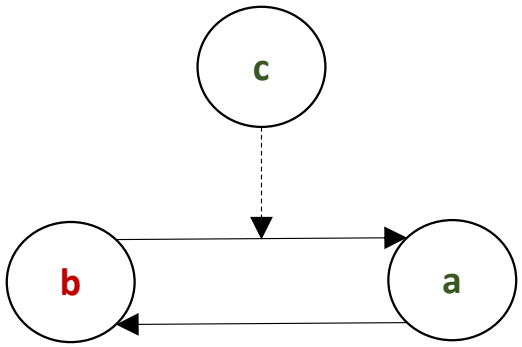
Extensions of Dung's model

- Extended: integrate second-order attacks
- Value-based: associate arguments with (social/ethical/..) values
- Bipolar: integrate the notion of support among arguments
- Evidence-based: integrate the notion of evidential support
- Weighted: assign weights to arguments and/or attacks
- Analogical: integrate the notion of analogy
- Domain assignments: integrate the notion of scope
- …

Second-order attacks

(Modgil, 2009)

- Extended Argumentation Frameworks
  - An extension of AAF supporting second-order attacks
  - A simple attack is an attack directed from an argument to another argument
  - A second-order attack is an attack directed from an argument to a simple attack
  - Second-order attacks provide a way to represent preferences over arguments



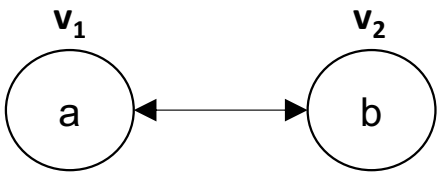
(a, b), (b, a): Simple attacks
(c, (a, b)): Second-order attack. It expresses a preference of **a** over **b**.

b does not successfully attack **a**, because of the attack from **c**, so **a** becomes justified

Value-based Argumentation

(Bench-Capon, 2003)

- A first attempt to model the audience
- Each argument is associated with a (social/ethical /…) value
- The acceptability of arguments takes into account the preferences of the audience over the values the arguments are associated with



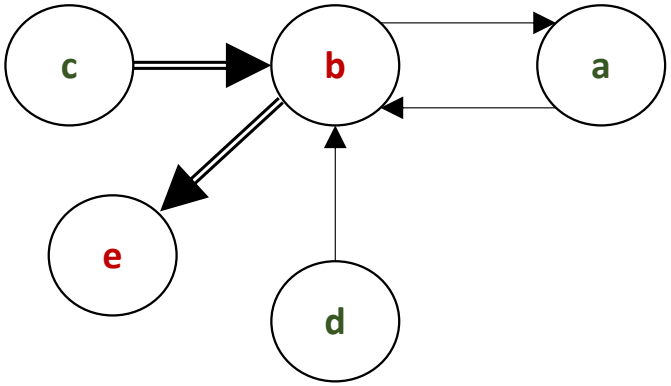
Suppose that:
a promotes value $\mathbf{v_1}$
b promotes value $\mathbf{v_2}$
For the audience, $\mathbf{v_1 > v_2}$

Then:
a will be accepted
b will be rejected

Bipolar argumentation

(Cayrol & Lagasquie-Schiex, 2005)

- Bipolar AF extend AAF with the notion of support among arguments
- Support is modelled as a binary relation on the set of arguments
- This relation enables two additional forms of attack: supported and secondary attacks



Direct attack: **(a, b), (b, a), (d, b)**
Support: **(c, b), (b, e)**
Supported attack: **(c, a)**
Secondary attack: **(a, 3)**

Evidence-based argumentation

(Oren & Norman, 2008)

- Specialised support relation that captures the notion of evidential support
- Binary argument relations: attack and support
- Two types of arguments: prima-facie and standard arguments
  - A prima-facie argument represents evidence and does not require support from other arguments
  - A standard argument must be linked to at least one prima-facie argument through a chain of supports

Weighted argumentation
(Amgoud et al., 2017)

- Use of weights to represent the strength of arguments
- More sophisticated modelling and analysis of conflicts
- Graded semantics
  - Acceptability has the form of a numerical (rather than binary) value
  - This value is derived from the aggregation of the basic strength of the argument and the strength of its attackers

Analogical argumentation

(Amgoud, 2020)

- Integrates the notion of analogy in argumentation
- Schema of analogical arguments:

  Entities **I_1** *and* **I_2** *are similar in having properties* **$P_1,\ldots,P_n$**

  I_1 *has property* **Q**

  Therefore, **I_2** *also has property* **Q**

- Elements of the model
  - Support and attack argument relations (endorsing / dismissing analogies)
  - Explicit representation of entity characteristics and their importance in making analogies

Domain assignments

(Vassiliades et al., 2021)

- Each argument is equipped with a domain of application describing the cases/entities to which the argument can be applied.
- Attacks are used to limit the scope of the argument
- Allows
  - Modelling policies (general rules and exceptions)
  - Case-by-case reasoning
  - Partial acceptance of arguments

Connecting the dots…

- Identify the relevant arguments and the supporting evidence
- Identify the relationships between the arguments
- Create a model of the arguments using elements from existing argumentation frameworks

Arguments for Praxiteles as the creator

- Stylistic analysis
  - The style of the Hermes statue is consistent with other works attributed to Praxiteles. The soft, flowing lines, the delicate rendering of flesh, and the relaxed, naturalistic poses are hallmarks of his known works (A_1)
  - Comparative analysis with other sculptures such as the Aphrodite of Knidos, which is securely attributed to Praxiteles, shows similarities in technique and style (A_2)
  - Reference: Smith, A. H. (1891). "A Catalogue of Sculpture in the Department of Greek and Roman Antiquities, British Museum." British Museum Press (A_3)

Arguments for Praxiteles as the creator

- Historical records
  - Ancient texts, such as those by Pausanias, mention a statue of Hermes by Praxiteles at Olympia. (A_4)
  - Reference: Pausanias, "Description of Greece", 5.17.3 (A_5)

Arguments for Praxiteles as the creator

- Archaeological context
  - The statue was discovered in the Temple of Hera at Olympia, a location historically associated with works by Praxiteles. (A_6)
  - Reference: Stewart, Andrew. (1990). "Greek Sculpture: An Exploration." Yale University Press. (A_7)

Questioning Praxiteles as the creator

- Stylistic analysis
  - Some scholars argue that the statue's stylistic elements such as the treatment of the hair and the musculature, align more closely with later Hellenistic works rather than those from the 4th century BCE when Praxiteles was active. (**B_1**)
  - Reference: Ridgway, Brunilde Sismondo (1997). "Fourth-Century Styles in Greek Sculpture." University of Wisconsin Press (**B_2**)

Questioning Praxiteles as the creator

- Stylistic analysis
  - Some scholars have pointed out that certain aspects of the sculpture, such as the proportions and anatomical details, do not perfectly match Praxiteles' known works. (**B_3**)
  - Reference: Boardman, John. (1995). "Greek Sculpture: The Classical Period." Thames & Hudson (**B_4**)

Questioning Praxiteles as the creator

- Techniques and material
  - Analysis of the marble and sculpting techniques has led some experts to propose that the statue may have been created during the Roman period as a copy or adaptation of an earlier Greek work. (**B_5**)
  - Examination of the marble suggests it might be from a quarry commonly used during the Roman period, and certain sculpting techniques are indicative of Roman craftsmanship. (**B_6**)
  - Reference: Ridgway, Brunilde Sismondo (1997). "Fourth-Century Styles in Greek Sculpture." University of Wisconsin Press (**B_7**)

Counter-arguments

- Stylistic analysis

*In response to: Some scholars argue that the statue's stylistic elements align more closely with later Hellenistic works rather than those from the 4th century BCE, when Praxiteles was active (**B_1**)*

- The stylistic evolution within Praxiteles' own lifetime and the broader Classical period could account for elements that appear more advanced. Praxiteles was known for introducing softer, more naturalistic forms that influenced later Hellenistic styles. (**C_1**)
- Reference: Boardman, John. (1995). "Greek Sculpture: The Classical Period." Thames & Hudson. (**C_2**)

Counter-arguments

- Stylistic analysis

*In response to: Some scholars argue that the statue's stylistic elements align more closely with later Hellenistic works rather than those from the 4th century BCE, when Praxiteles was active (**B_1**)*

- The early Hellenistic period began shortly after Praxiteles' time, and his innovative style could have influenced contemporaries and slightly later artists, creating overlapping stylistic features. (**C_3**)
- Reference: Pollitt, J. J. (1986). "Art in the Hellenistic Age." Cambridge University Press. (**C_4**)

Counter-arguments

- Stylistic analysis

*In response to: Some scholars have pointed out that certain aspects of the sculpture, such as the proportions and anatomical details, do not perfectly match Praxiteles' known works. (**B_3**)*

  - Praxiteles was known for experimenting with different proportions and anatomical details to achieve naturalism and ideal beauty. (**C_5**)
  - Reference: Stewart, Andrew. (1977). "Praxiteles and the Hermes with the Infant Dionysos." In "Greek Sculpture: An Exploration." Yale University Press. (**C_6**)

Counter-arguments

- Techniques and material

*In response to: Analysis of the marble and sculpting techniques has led some experts to propose that the statue may have been created during the Roman period as a copy or adaptation of an earlier Greek work. (**B_5**)*

- The sculpting techniques used in the Hermes exhibit high Classical characteristics, such as the subtle modeling of the body and the fine attention to detail, which were hallmarks of Praxiteles' craftsmanship. (**C_7**)
- Reference: Smith, A. H. (1891). "A Catalogue of Sculpture in the Department of Greek and Roman Antiquities, British Museum." British Museum Press. (**C_8**)

Counter-arguments

- Techniques and material

*In response to: Examination of the marble suggests it might be from a quarry commonly used during the Roman period, and certain sculpting techniques are indicative of Roman craftsmanship. (**B_6**)*

- The marble used for the statue could be from a quarry utilized in both the Classical and Roman periods. Identifying the precise date of quarrying based on marble alone can be challenging. (**C_9**)
- Reference: Stewart, Andrew. (1990). "Greek Sculpture: An Exploration." Yale University Press. (**C_{10}**)

Argument relations

- Let's assume a top-level argument for the main issue of the debate: "Hermes of Olympia was created by Praxiteles" (A_0)
- A_1, A_4 and A_6 support A_0 based on different types of evidence (stylistic, historical, archaeological)
- B_1 and B_5 oppose A_0 based on different types of evidence (stylistic, technical); B_3 opposes A_4 based on stylistic evidence
- C_1 and C_3 oppose B_1
- C_5 opposes B_3
- C_7 opposes B_5
- C_9 opposes B_6 (which supports B_5)
- All arguments are supported by references to the relevant literature

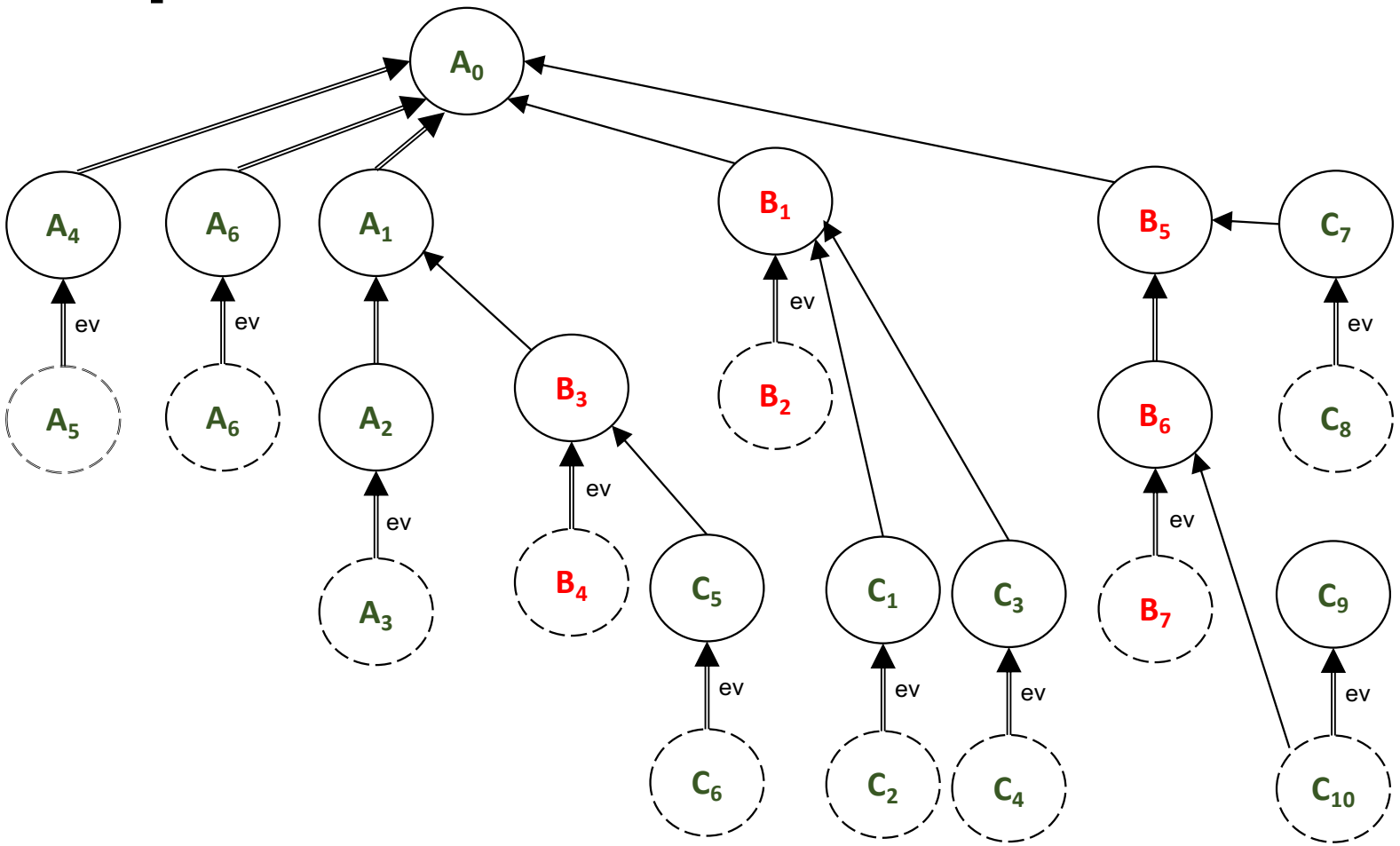
Creating a model of the arguments

- Abstract argumentation model where:
  - Statements and bibliographic references are modelled as arguments
    - Bibliographic references are modelled as prima-facie arguments
    - Statements about the issue of debate are modelled as standard arguments
    - Arguments using analogies are modelled as analogical arguments
  - Each argument has a domain of application
    - For example, some arguments refer specifically to specific statue, others to all Praxiteles' works, and others to all Greek sculptures of a certain period
  - Each argument has a value representing the type of evidence it is based on

Creating a model of the arguments

- A binary attack relation models the cases where an argument opposes another argument
- A binary support relation models the cases where an argument supports another argument
- A binary evidential support relation models the cases where an argument is supported by a bibliographic reference
- Weights can be added on:
  - Prima-facie arguments to represent the quality of a study or the evidence
  - Analogical arguments to represent the validity of the analogy
  - Standard arguments to represent the strength of the claim or the connection between the evidence and the claim

A graphical representation of the model



Related Work

- Ontology and rule-based models for the representation of claims about cultural artifacts (Vasilipoulou-Spitha & Bikakis, 2013)
- Formal model of scholarly statements on literary texts based on bipolar argumentation frameworks (Sanfilippo et al., 2023)
- A model of archaeological arguments based on Toulmin's scheme (Smith, 2023)
- CRMinf: a formal ontology for integrating metadata about argumentation and inference making in descriptive and empirical sciences (Stead, 2023)

Other useful methods and tools

- Manual argument annotation and visualisation
  - Araucaria (Reed and Rowe, 2004), Rationale (van Gelder, 2007), OVA (Bex et al., 2013), Carneades (Gordon et al., 2007) etc.
  - https://argunotes.wordpress.com/argunest/
- Argument mining
  - Automatic identification of arguments and their relations in natural language text
  - See (Stede and Schneider, 2018) and (Lawrence and Reed, 2019) for relevant surveys
- Argument Search Engines
  - Systems that finds pro and con arguments for controversial issues
  - https://www.args.me/, https://www.argumentsearch.com/, https://perspectroscope.seas.upenn.edu/

Looking ahead

- Model development, refinement and evaluation
- Mapping to existing models
  - Argumentation Frameworks
  - Metadata models such as CRMinf, Argument Interchange Format, etc.
- Develop methods and tools for
  - Argument annotation
  - Argument evaluation
  - Argument visualisation
- Develop research methodologies with argumentation as a core element

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