

## THE CARNEADES SYSTEM (Tom Gordon)

**Carneades is both**

**a mathematical model of argumentation and**

**a software toolbox providing support for**

**argument evaluation, construction and visualization.**

**Carneades is a research vehicle for**

**studying argumentation from a more formal, computational perspective**

**than is typical in the field of informal logic, and**

**for developing prototypes of tools designed to be useful**

**for supporting real-world argumentation in practice**

## THE ROLE OF RULES IN CARNEADES

- 1. Rules have properties, such as their date of enactment, jurisdiction and authority.**
- 2. When the antecedent of a rule is satisfied by the facts of a case,  
the conclusion of the rule is only presumably true, not necessarily true.**
- 3. Rules are subject to exceptions.**
- 4. Rules can conflict.**
- 5. Some rule conflicts can be resolved using rules about rule priorities,  
e.g. lex superior, which gives priority to the rule from the higher authority.**
- 6. Exclusionary rules provide one way to undercut other rules.**
- 7. Rules can be invalid or become invalid.  
Deleting invalid rules is not an option when it is necessary to reason  
retroactively with rules which were valid at various times over a course of events.**
- 8. Rules do not counterpose. If some conclusion of a rule is not true,  
the rule does not sanction any inferences about the truth of its premises.**

## THE ROLE OF INFERENCES IN CARNEADES (1)

**The Carneades inference engine uses rules to construct and search a space of argument states, where each state consists of:**

*topic*

**The statement, i.e. proposition, which is the main issue of the dialogue, as claimed by its proponent.**

*viewpoint*

**Either ‘pro’ or ‘con’. When the viewpoint is pro, the state is a goal state if and only if the topic of the state satisfies its proof standard.**

**If the viewpoint is con, the state is a goal state only if the topic does not satisfy its proof standard.**

**Notice the asymmetry between pro and con.**

**The con viewpoint need not prove the complement of the topic, but need only prevent the pro viewpoint from achieving its goal of proving the topic.**

## THE ROLE OF INFERENCES IN CARNEADES (2)

### *pro-goals*

**A list of clauses, in disjunctive normal form,  
where each clause represents a set of statements  
which might be useful for helping the proponent to prove the topic.**

### *con-goals*

**A list of clauses, in disjunctive normal form,  
where each clause represents a set of statements  
which might be useful for helping the opponent to prevent  
the proponent from proving the topic.**

### *arguments*

**A graph of the arguments, representing all the arguments which  
have been put forward, hypothetically, by both the pro and con roles  
during the search for arguments.**

## THE ROLE OF INFERENCES IN CARNEADES (3)

### *substitution*

**A substitution environment mapping schema variables to terms.**

**The scope of variables is the whole argument graph.**

**Variables in rules are renamed to prevent name conflicts  
when they are applied to construct arguments.**

### *candidates*

**A list of candidate arguments, which have been previously constructed.**

**A candidate argument is added to the argument graph, and  
removed from this list,**

**only after all of its schema variables are instantiated in the substitution environment.  
This assures that all statements in the argument graph are ground atomic formulas.**

# RESULTS OF INFERENCES IN CARNEADES

## *SE (Scintilla of Evidence)*

**A statement meets this standard**

**iff it is supported by at least one defensible pro argument.**

## *BE (Best Argument)*

**A statement meets this standard**

**iff it is supported by some defensible pro argument**

**with priority over all defensible con arguments**

## *DV (Dialectical Validity)*

**A statement meets this standard iff it is supported by at**

**least one defensible pro argument and none of its con arguments are defensible.**

## A CARNEADES EXAMPLE FEATURING BURDEN OF PROOF

**Prakken and Sartor's example about a murder trial**

**Section §187 of the California Penal Code, murder is killing  
with 'malice aforethought'.**

**Section §197 states an exception for self-defense.**

**The prosecution filing a complaint in which it makes its first arguments,  
by applying a scheme for arguments from legal rules to Section §187 and  
providing enough evidence of killing and malice aforethought  
to meet the burden of production**

**The defense has accepted the killing and malice elements of the crime**

## THE CARNEADES EXAMPLE - FIRST STATE

**The appropriate type of premise is a policy issue in developing argumentation schemes**

**In the scheme for arguments from legal rules used here,**

**the validity of a legal rule is assumed,**

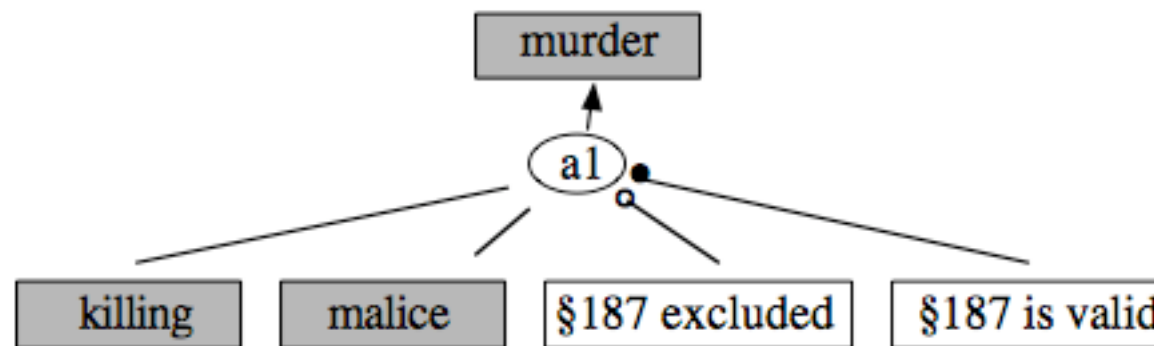
**and thus must be supported with evidence only if questioned;**

**Being excluded by some other rule is an exception,**

**and the elements of the crime, killing and malice here,**

**are ordinary premises which must always be supported with evidence.**

**Accepted/acceptable statements appear with background grey color**





## THE CARNEADES EXAMPLE - NEXT STATES

**The defense cites Section §197 of the Penal Code, and calls a witness who testifies that the defendant was attacked with a knife by the victim.**

**The argument concluding that Section §187 is excluded, a2, is another instance of the scheme for arguments from legal rules.**

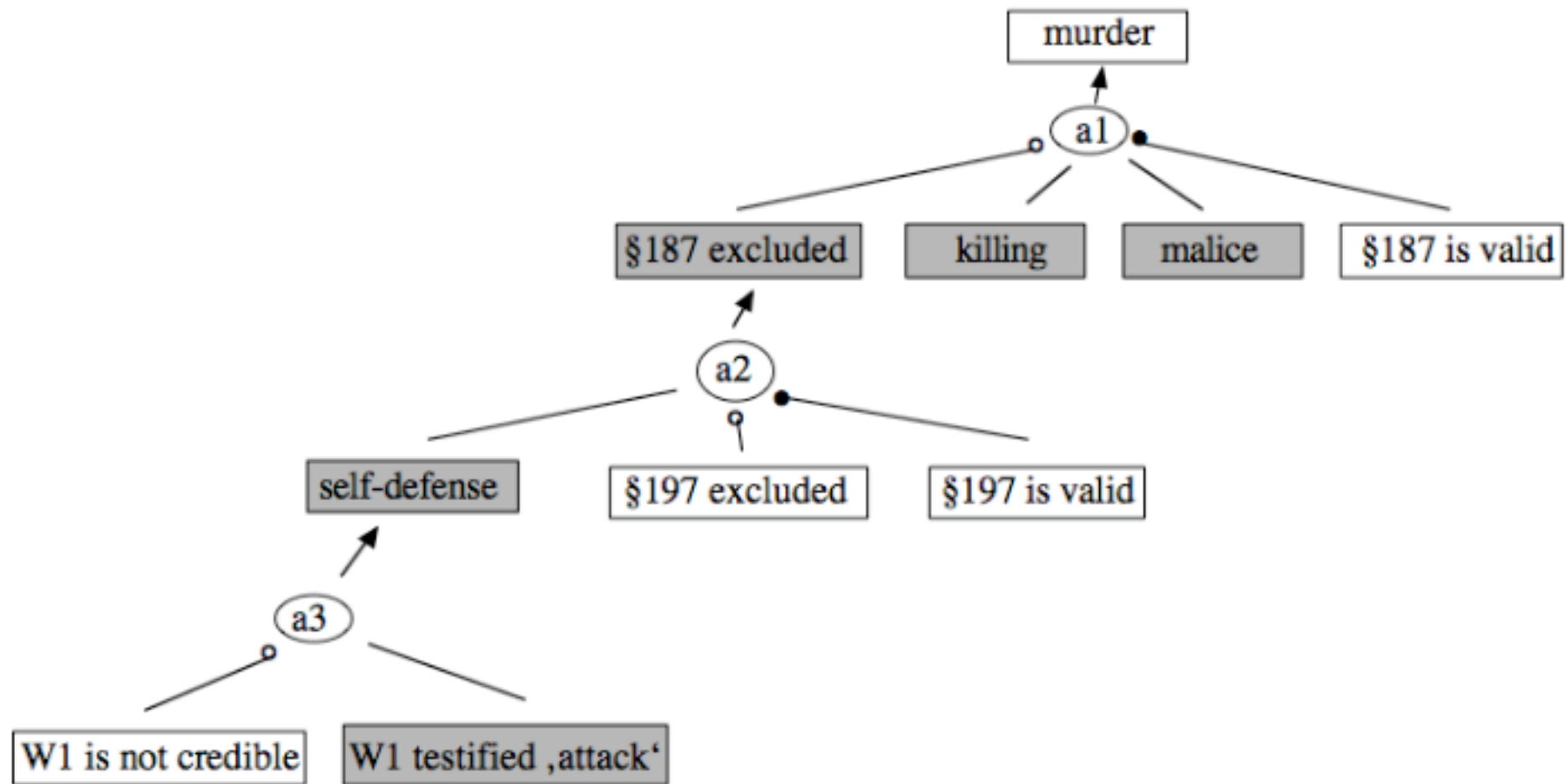
**The third argument applies as implied scheme for arguments from testimony.  
Since the witness testified before the court, this testimony is accepted (assumption)  
This does not imply accepting that the defendant was attacked  
This is enough to meet the defense's burden of production for the self-defense claim**

**The prosecution calls another witness to the stand to testify that the defendant had enough time to run away.**

**Notice, however, that this rebuttal does not (yet) succeed.**

**The self-defense claim is still acceptable, because the prosecution has the burden of persuasion in criminal cases, also for exceptions such as the self-defense claim here**

# THE CARNEADES EXAMPLE - SELF DEFENSE ARGUMENT



# THE CARNEADES EXAMPLE - WITNESS PUTTING DOUBT ON THIS ARGUMENT

