A Discussion Game for Grounded Semantics

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Cardiff University
School of Computer Science

Formal Preliminaries (1/2)

AF = (Ar, att)

Lab: Ar → {in, out, undec}

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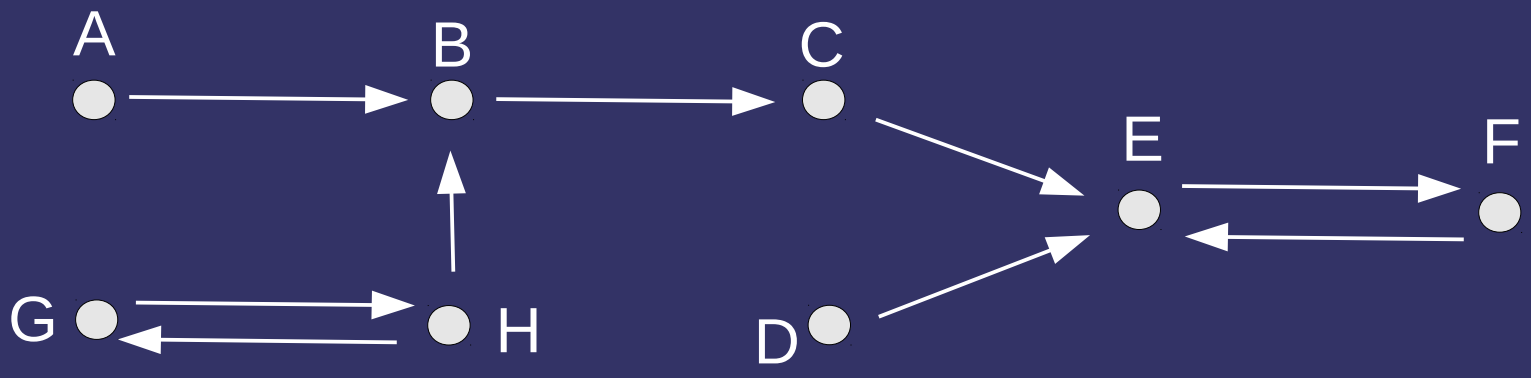
Complete labellings form a semi-lattice (w.r.t. $\sqsubseteq$)
with grounded at the bottom and preferreds at the top

Example



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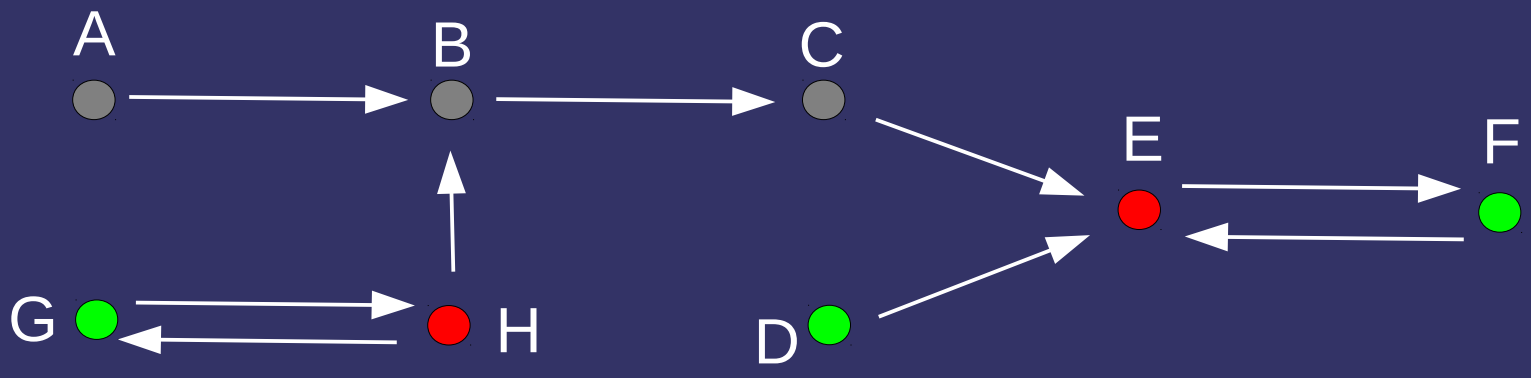

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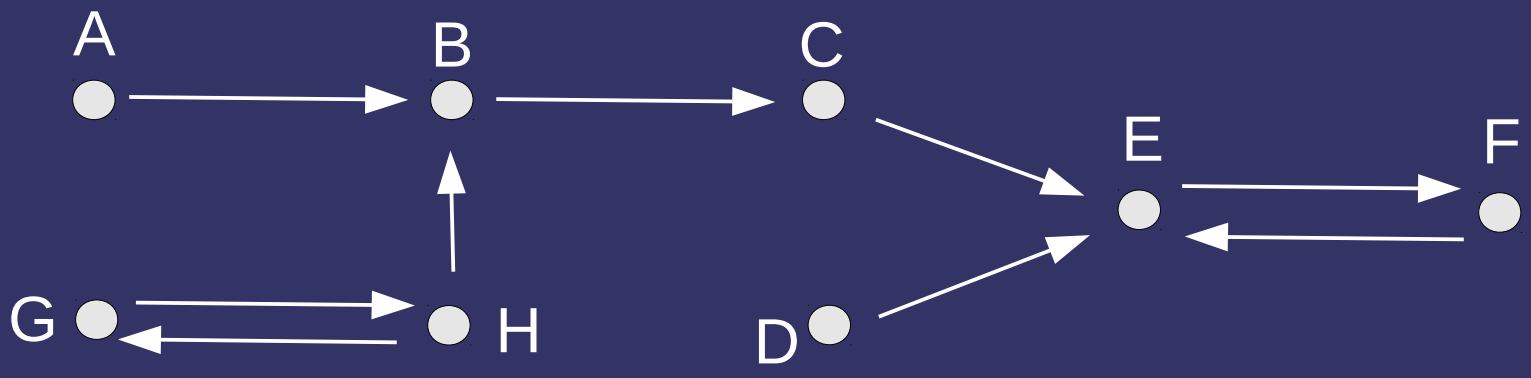

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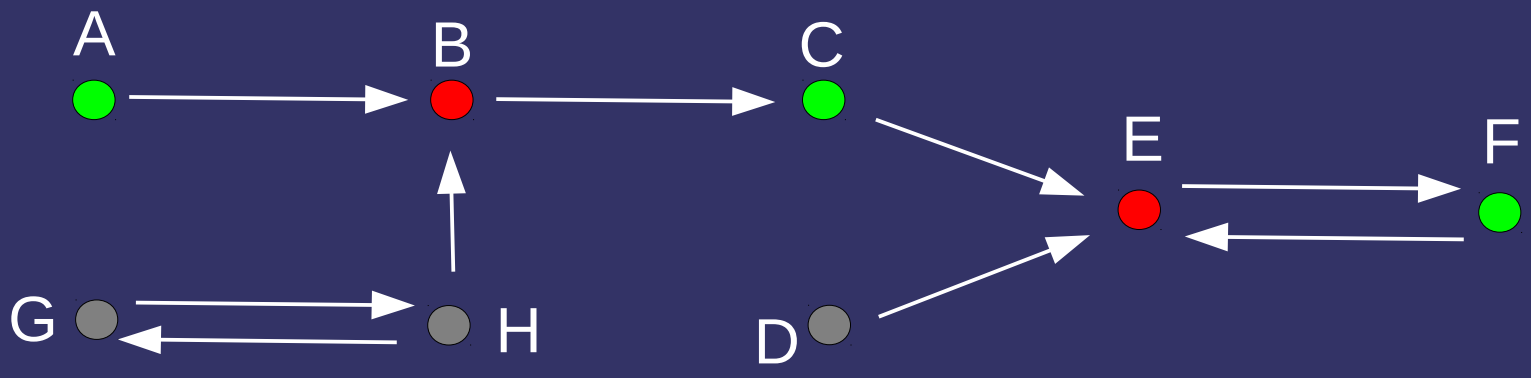

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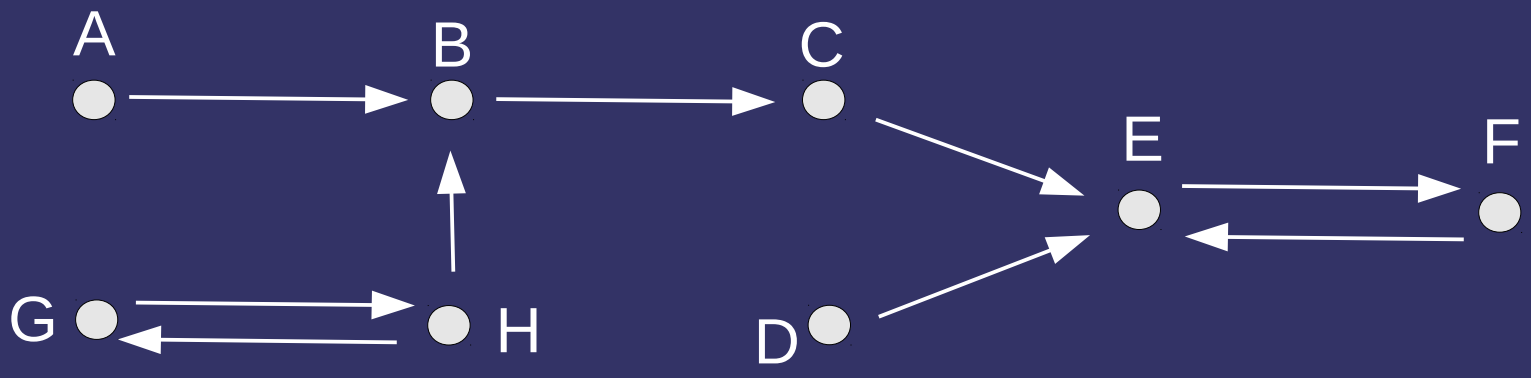

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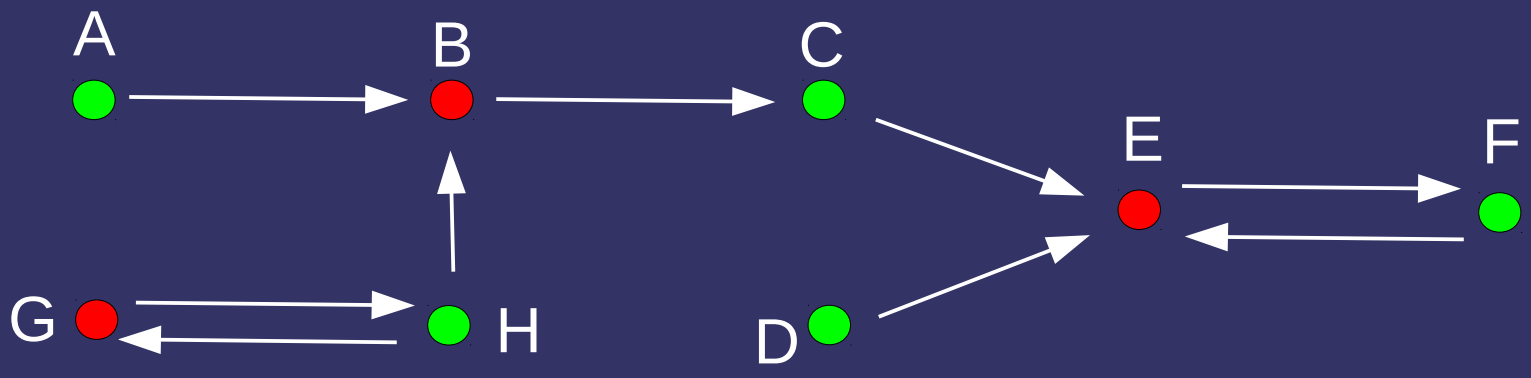

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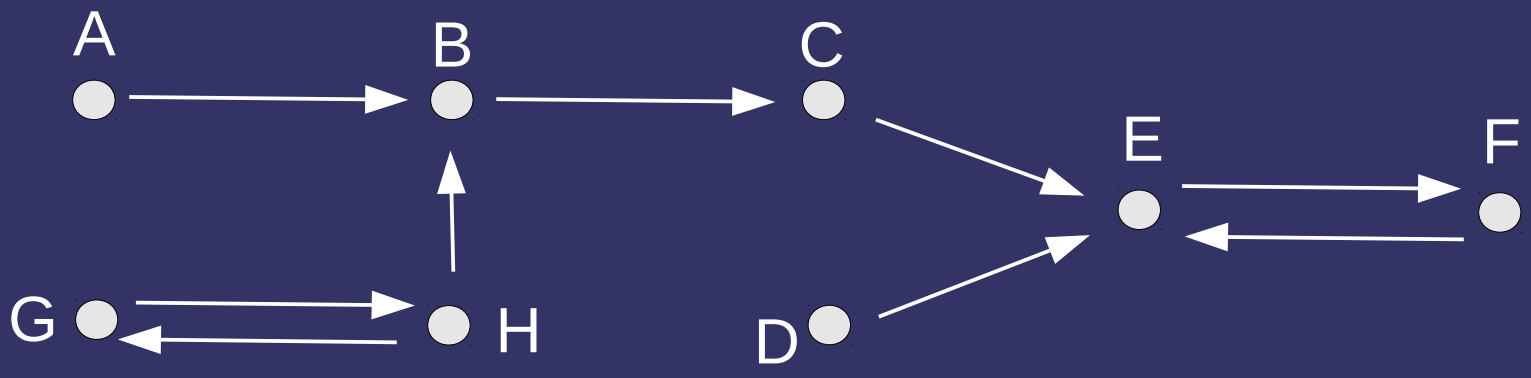

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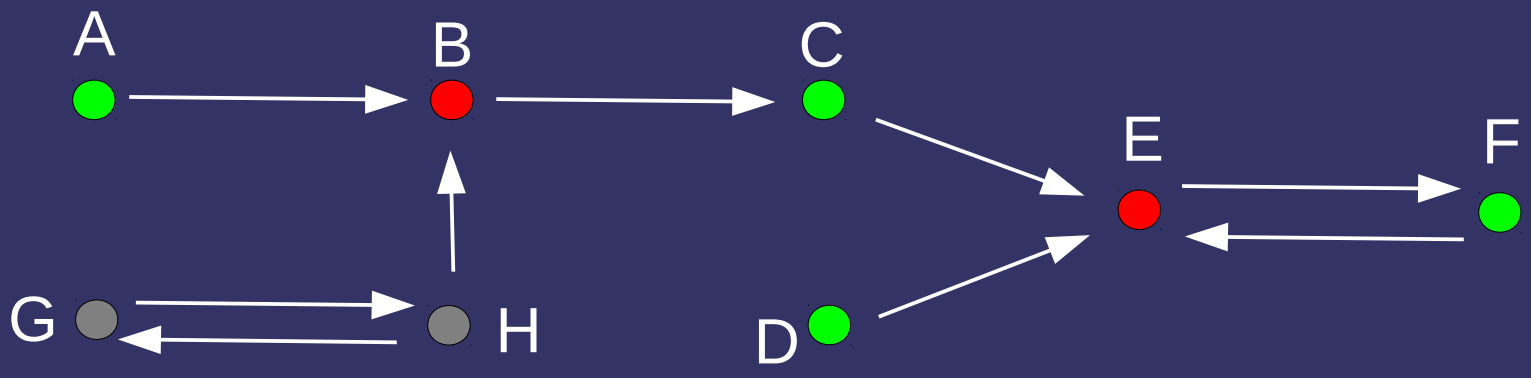

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MinMax numbering *MM*: in(Lab) ∪ out(Lab) → $\mathbb{N} \cup \{\infty\}$

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A in in str. adm. ≡ A in in grounded (details:COMMA14)

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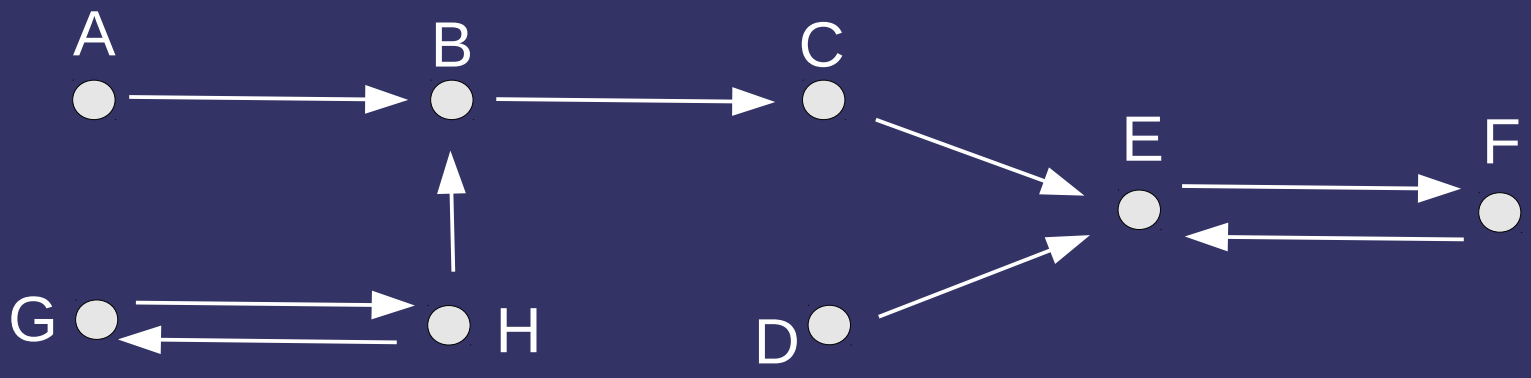

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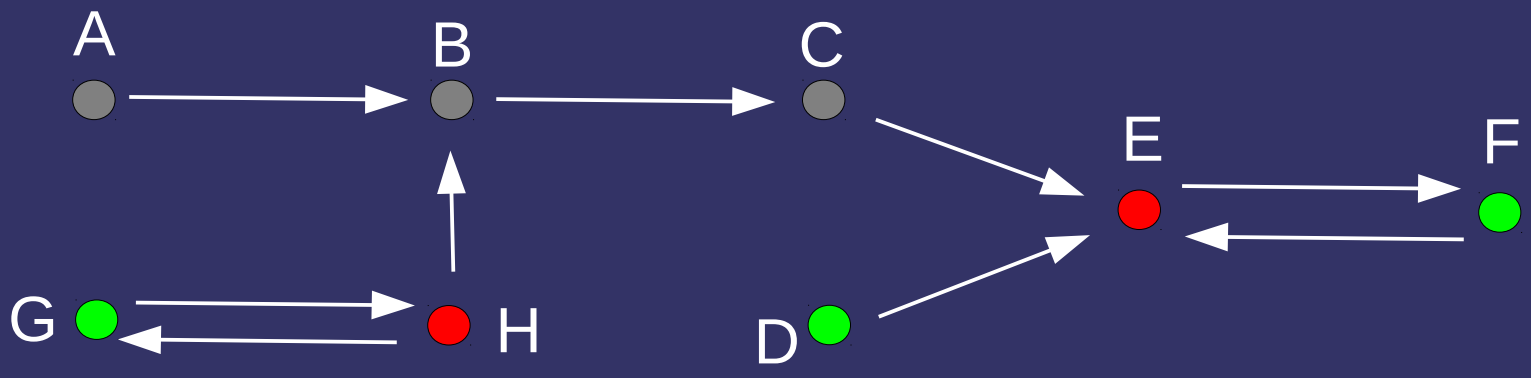

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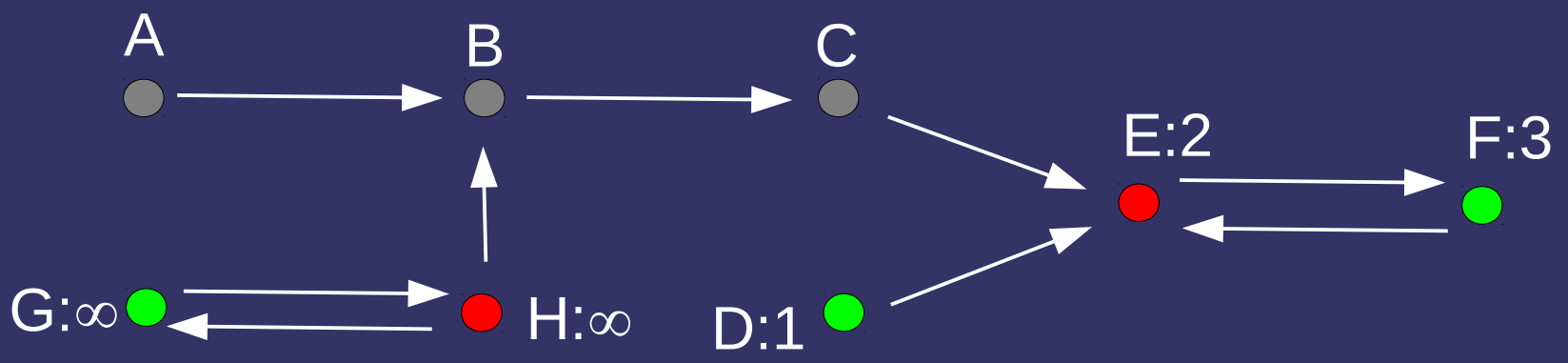

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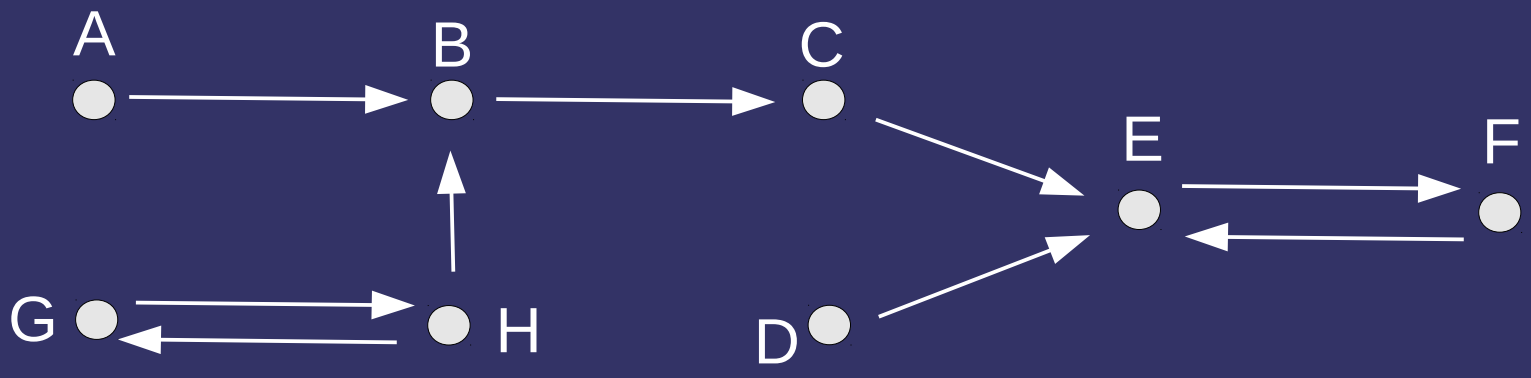

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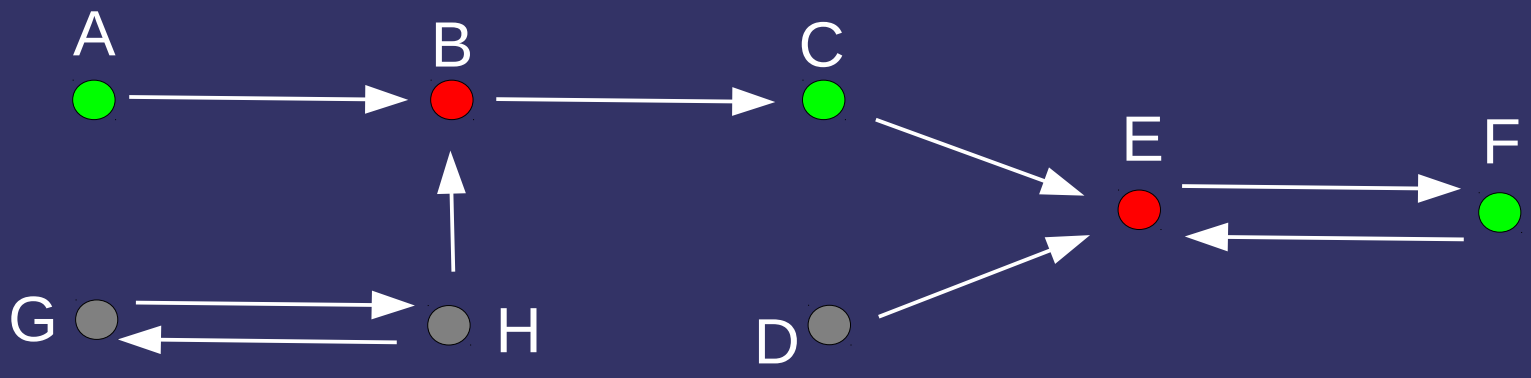

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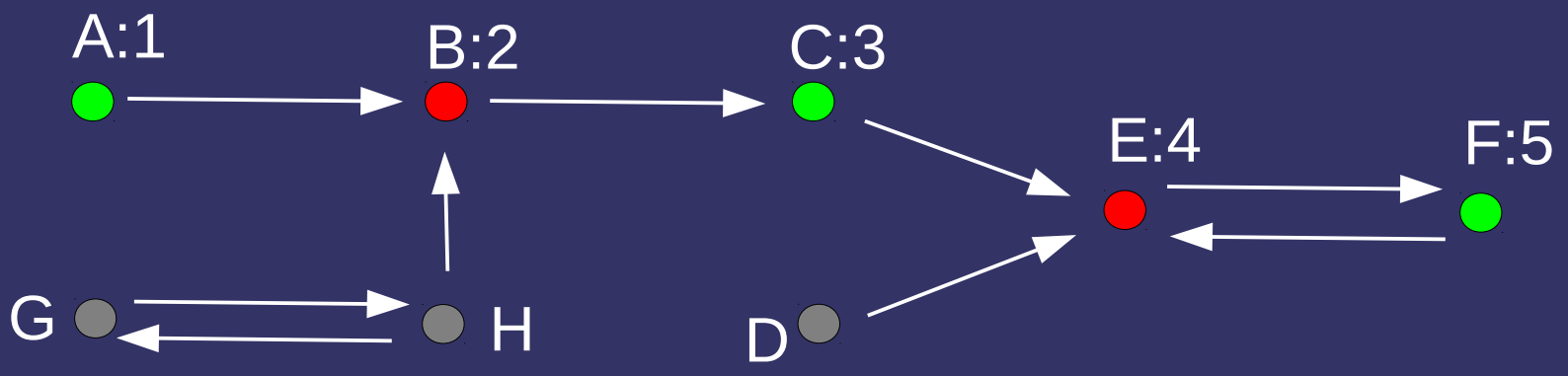

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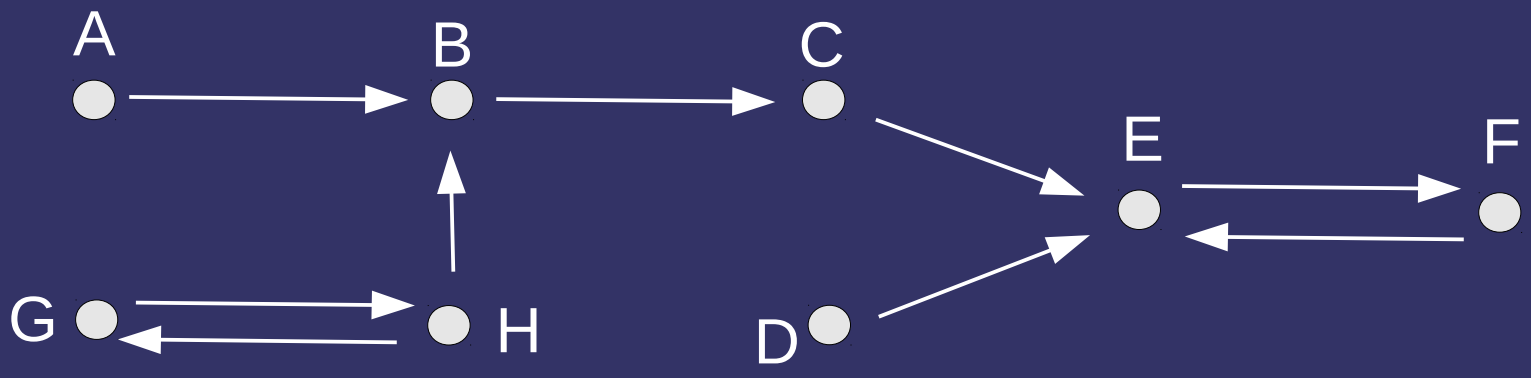

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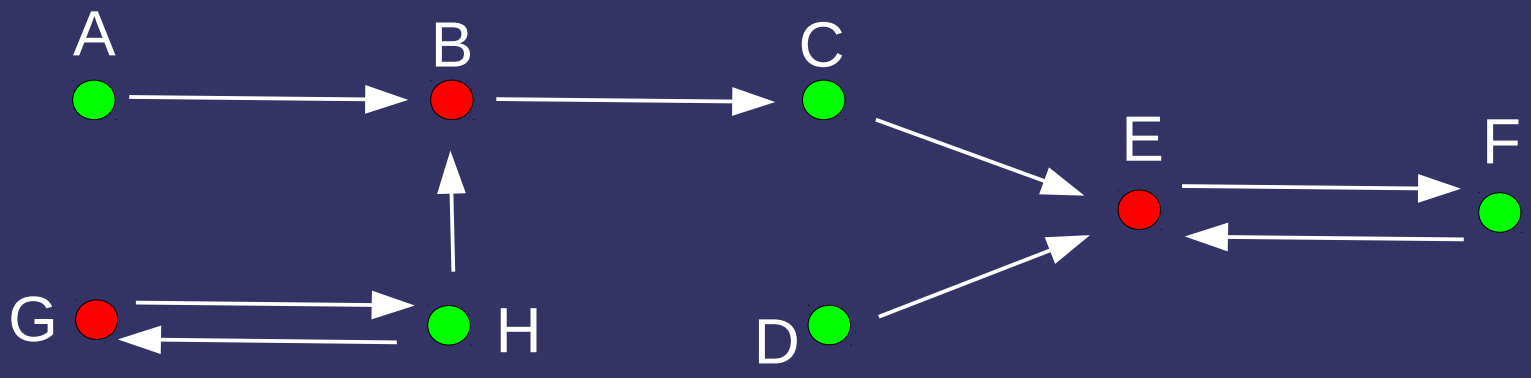

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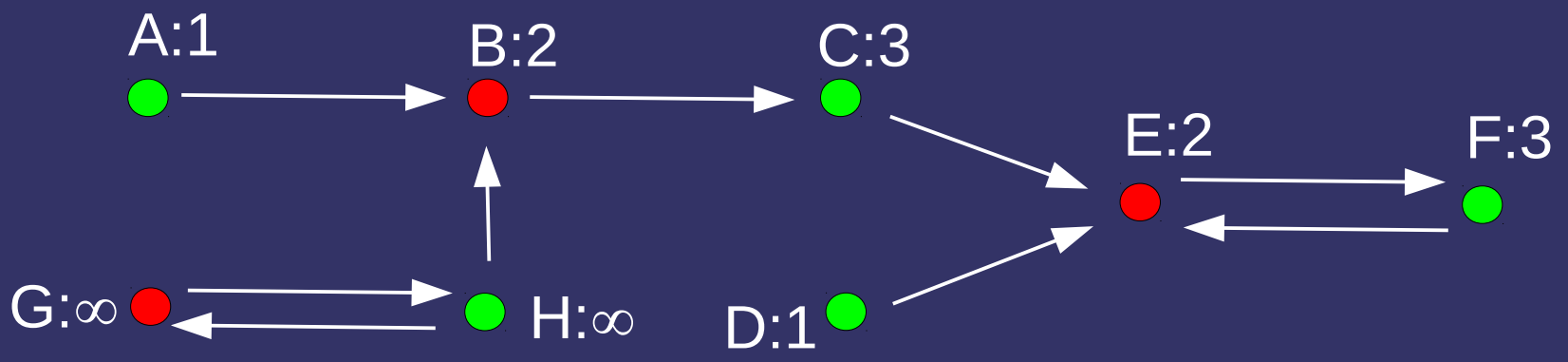

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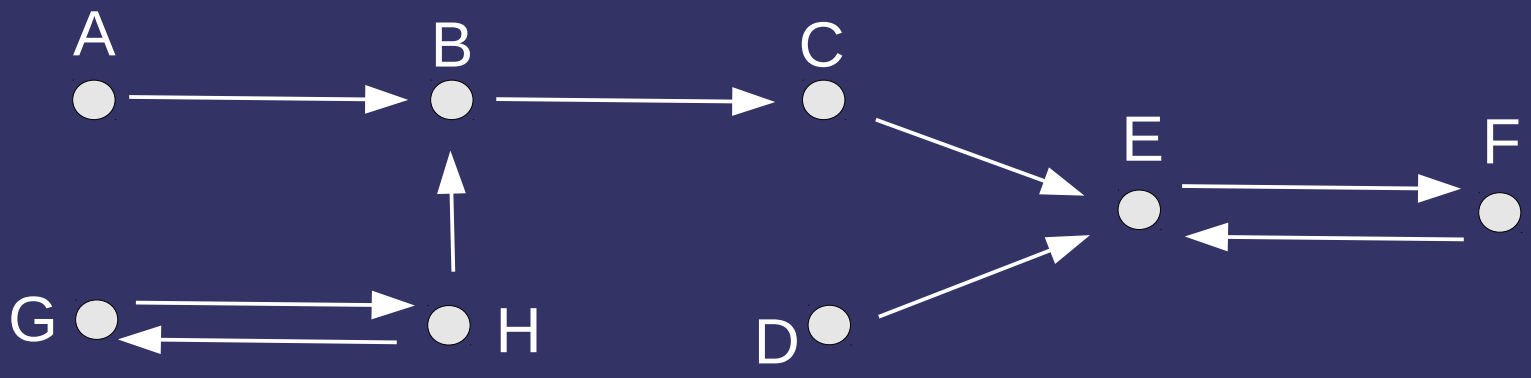

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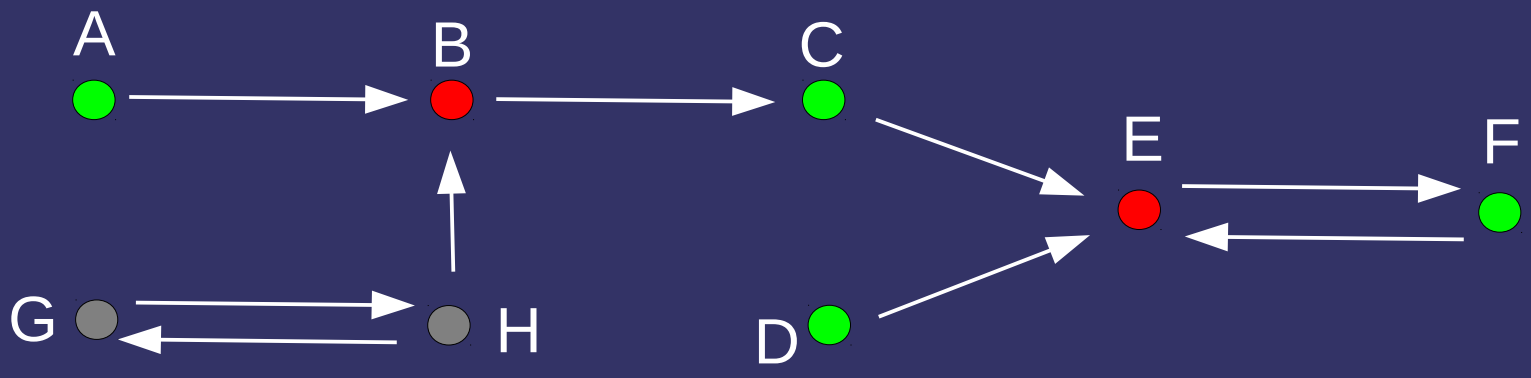

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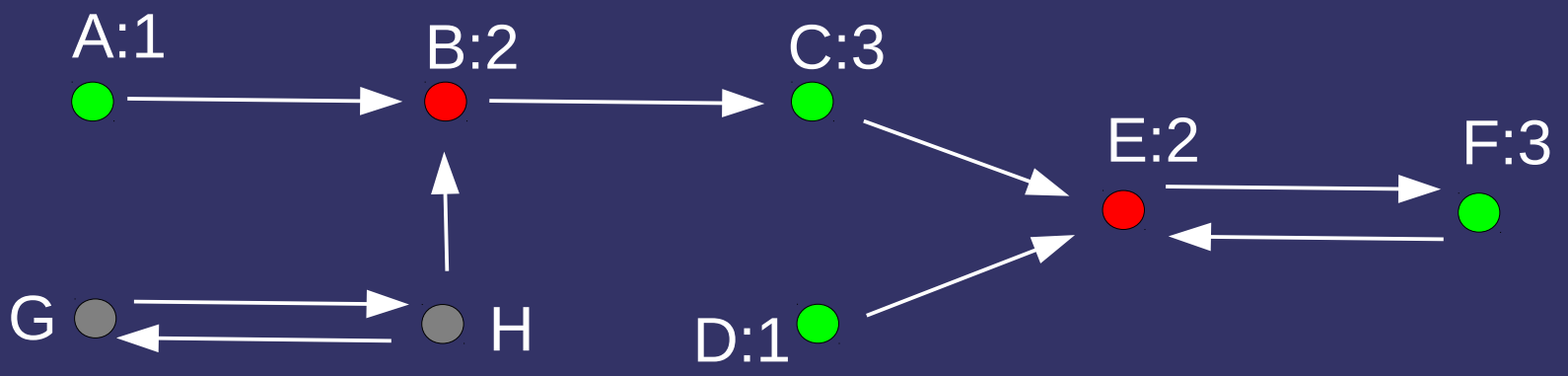

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two players:

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four moves (A,B $\in$ Ar)

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(2) O: CB(B)
"B can be the case"

(3) O: CONCEDE(A)
"I now agree that A"

(4) O: RETRACT(B)
"I no longer hold that B can be the case"

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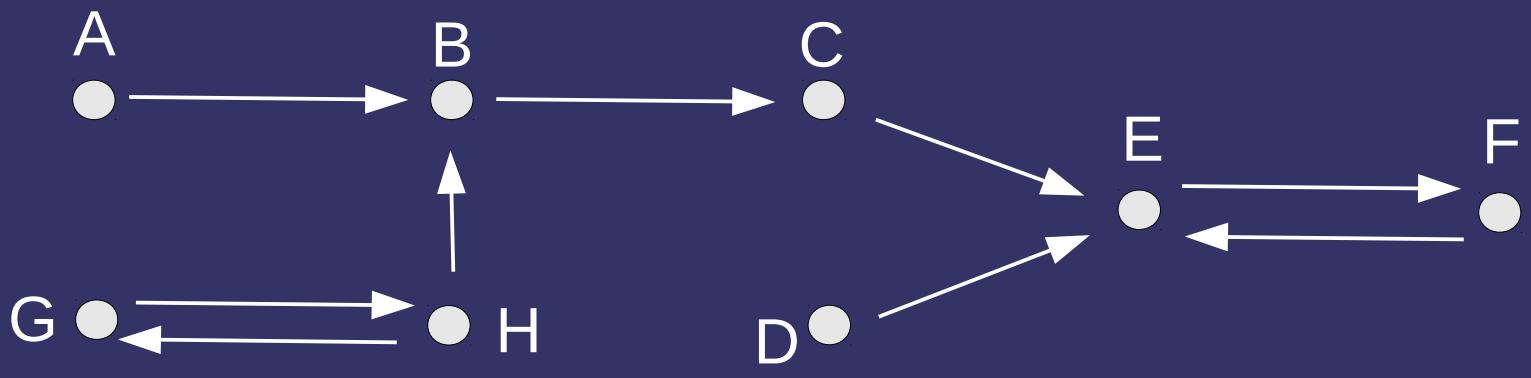

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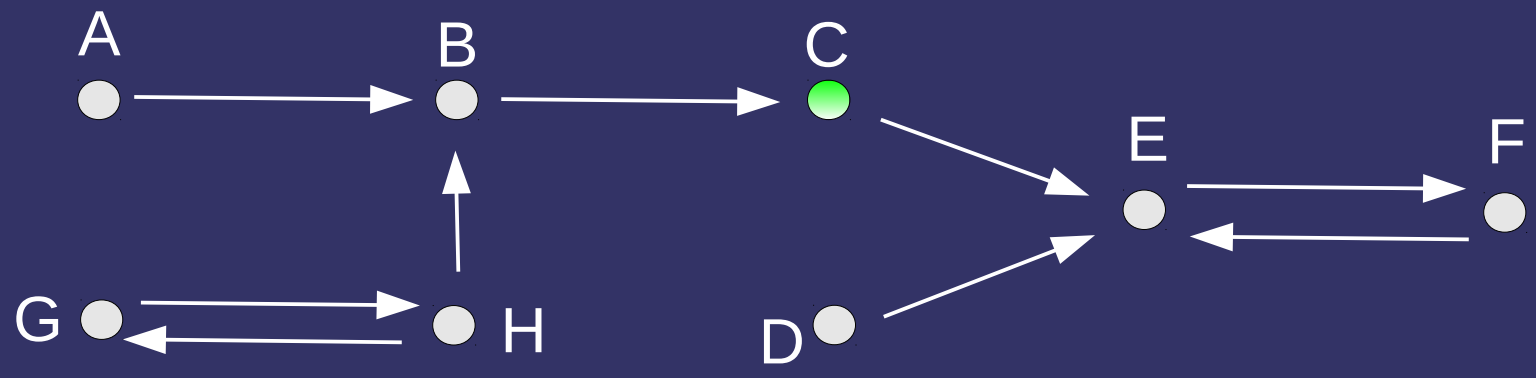

P: HTB(C)

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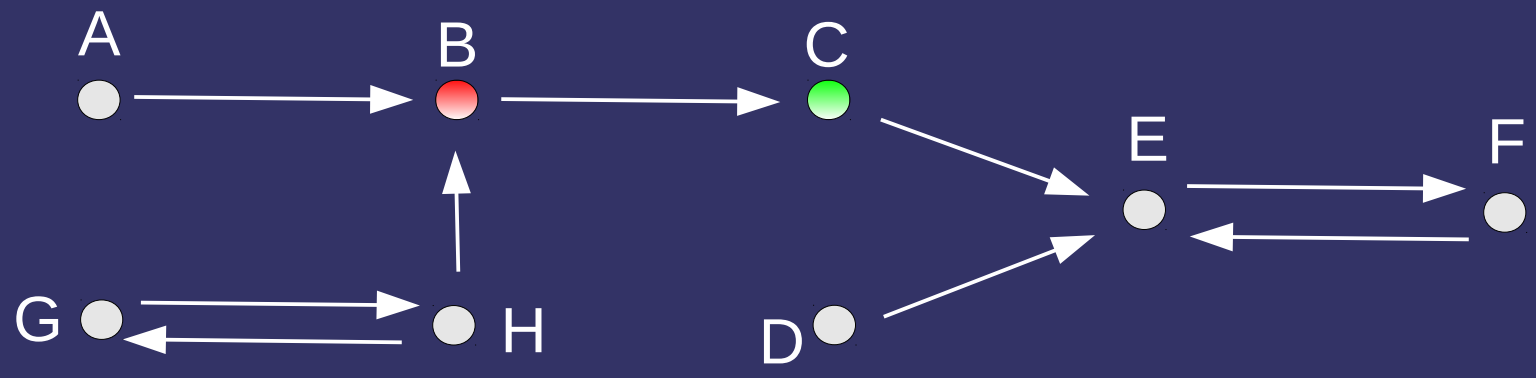

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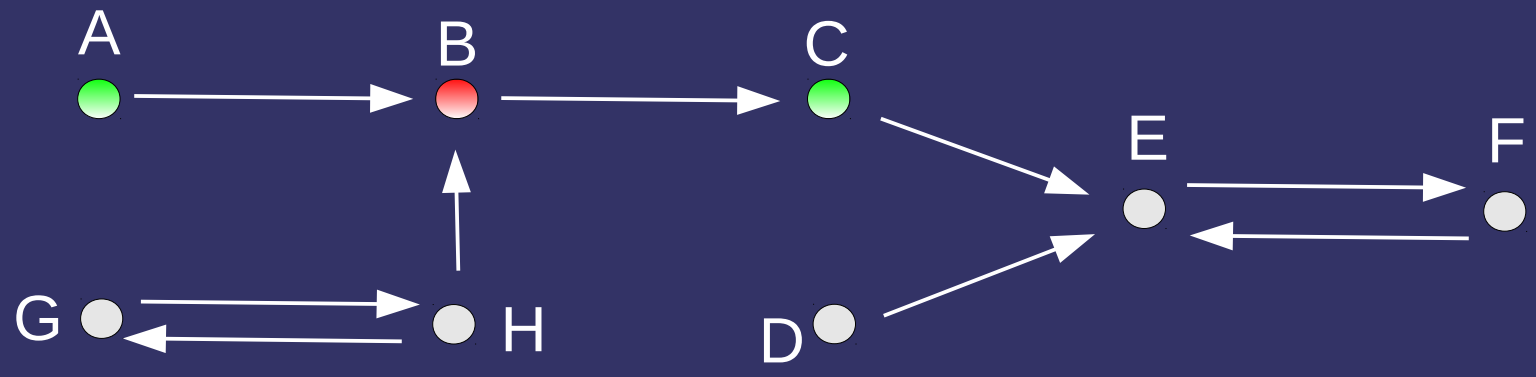

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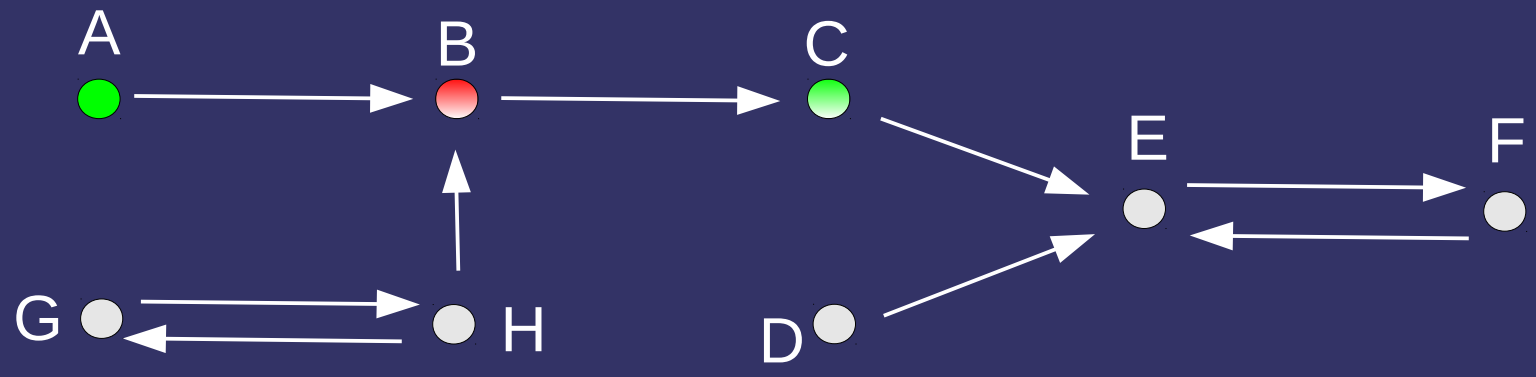

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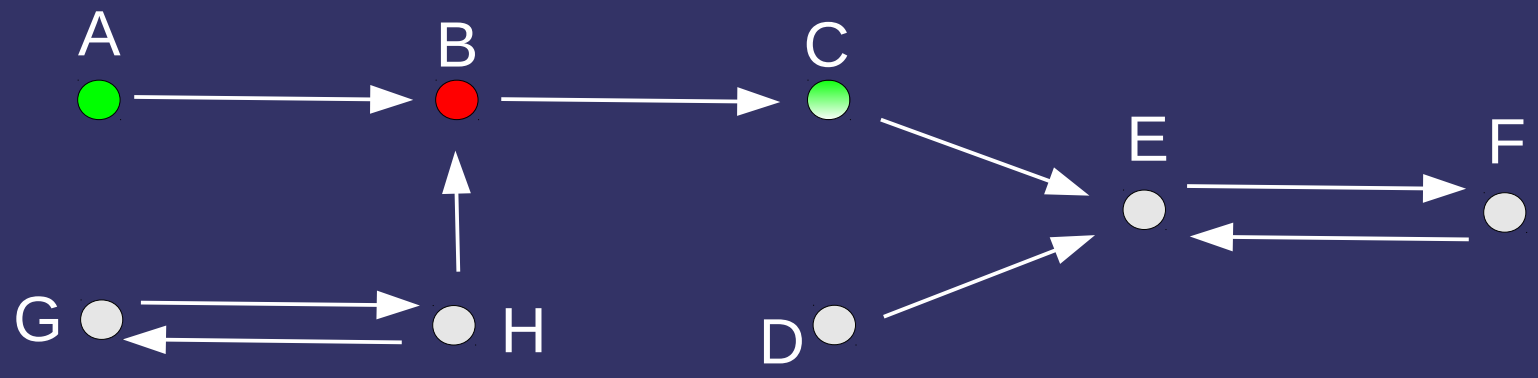

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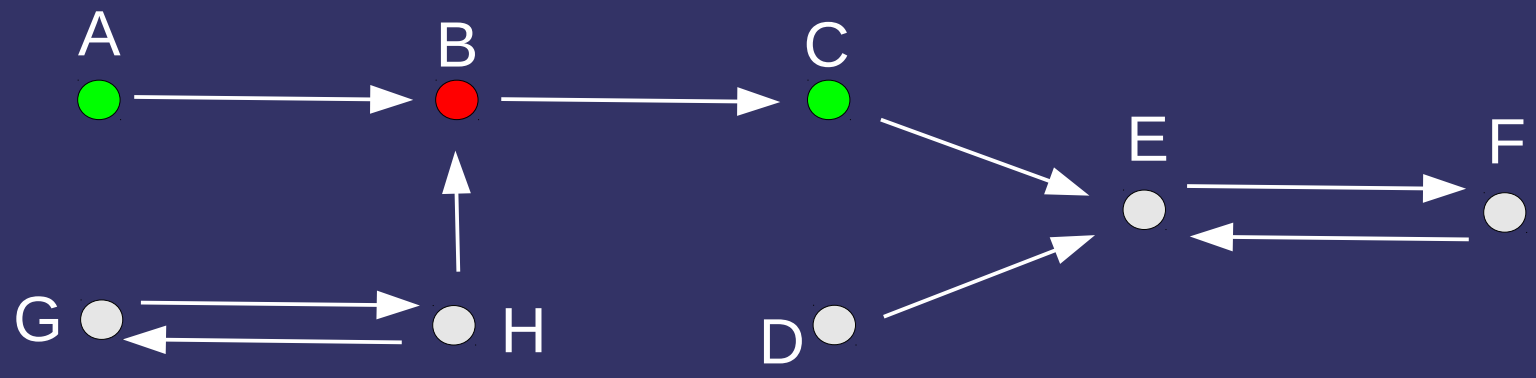

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additional condition for all moves no HTB-CB repeats have occurred

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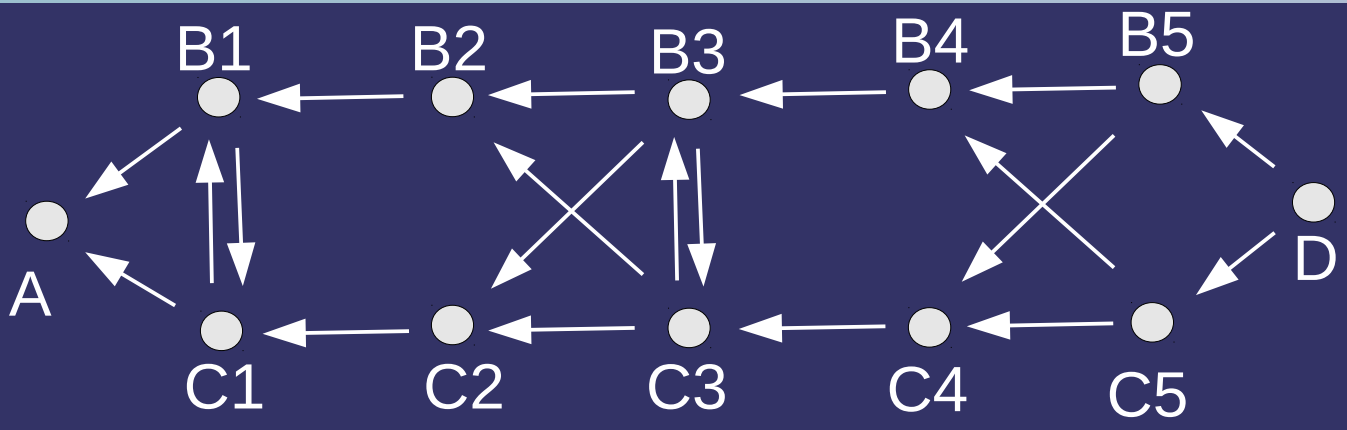

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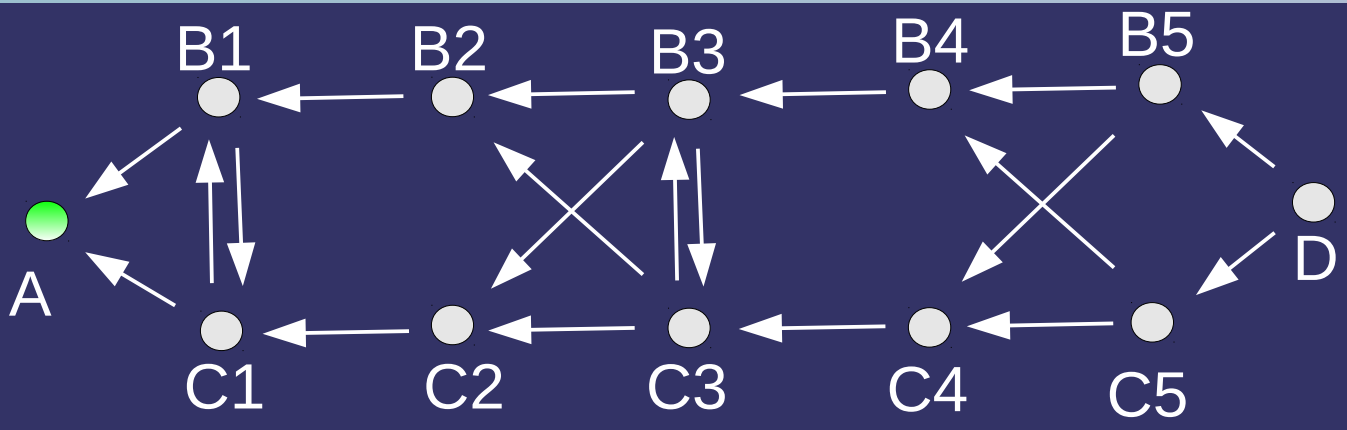

P: HTB(A)

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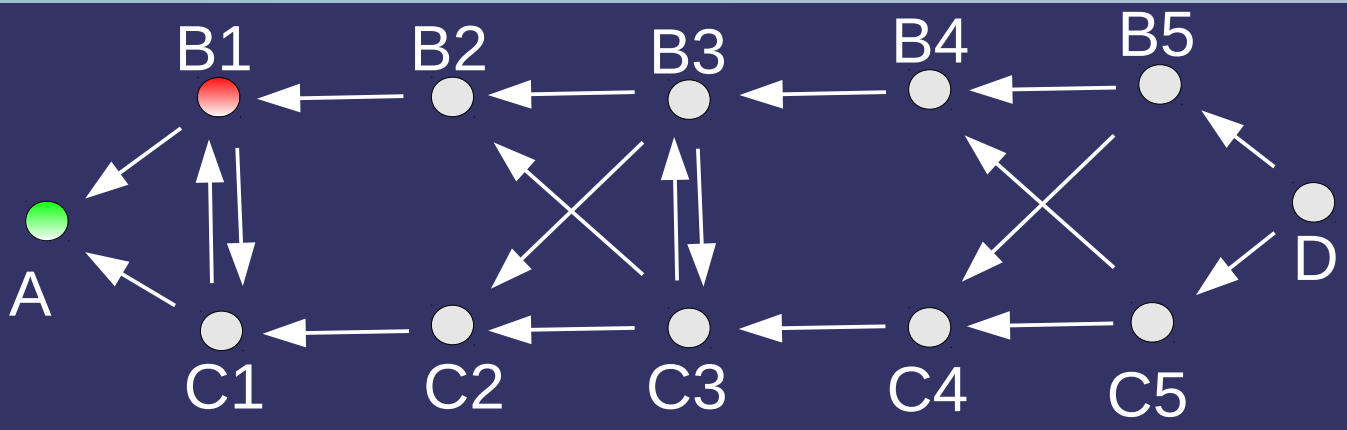

P: HTB(A)
O: CB(B1)

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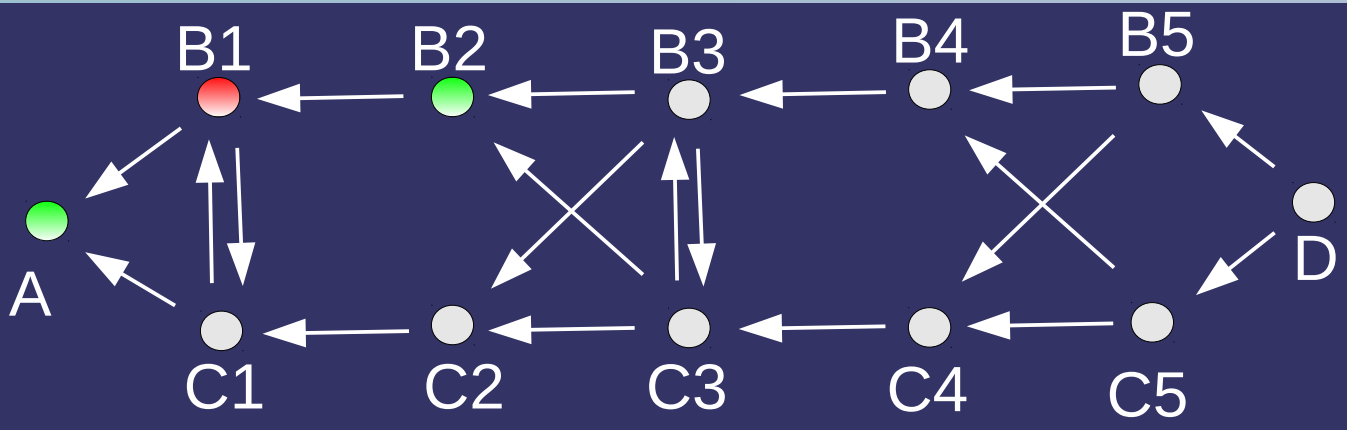

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O: CB(B1)
P: HTB(B2)

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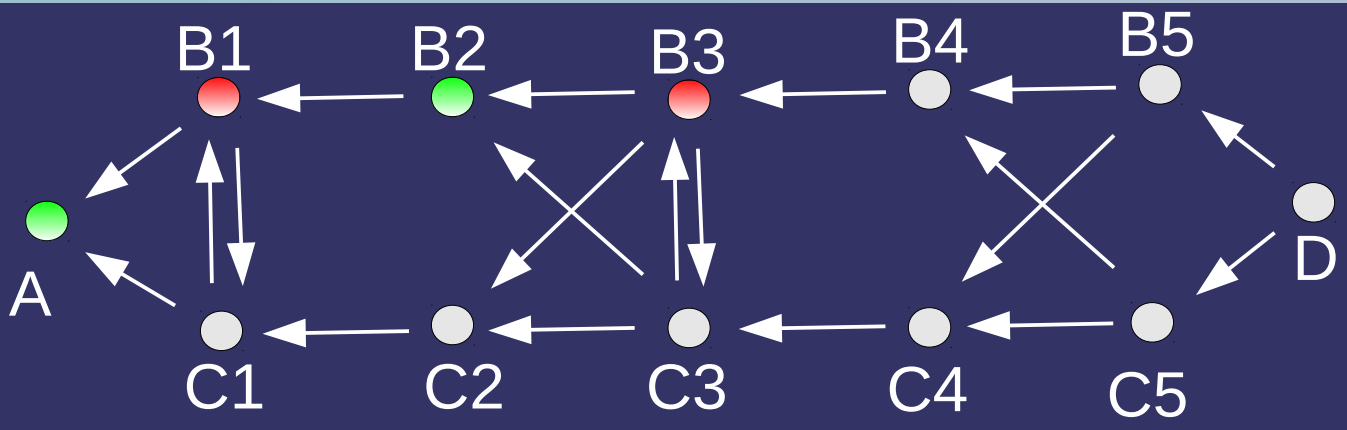

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O: CB(B1)
P: HTB(B2)
O: CB(B3)

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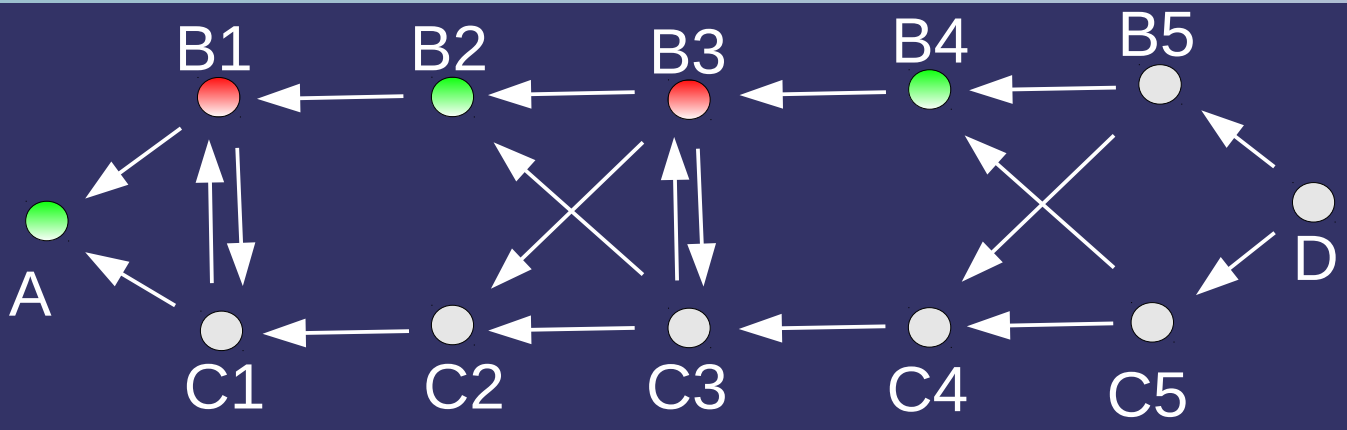
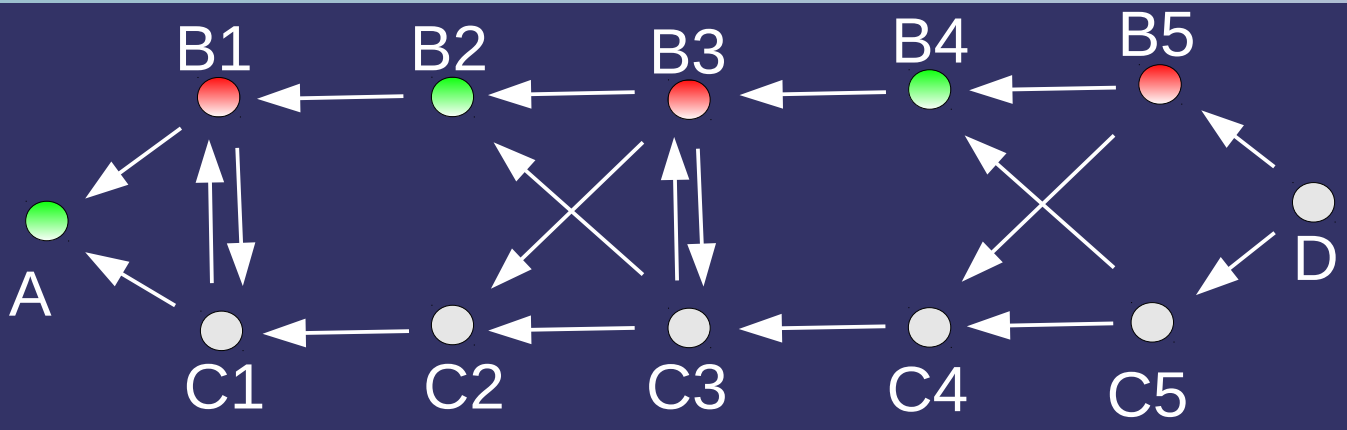


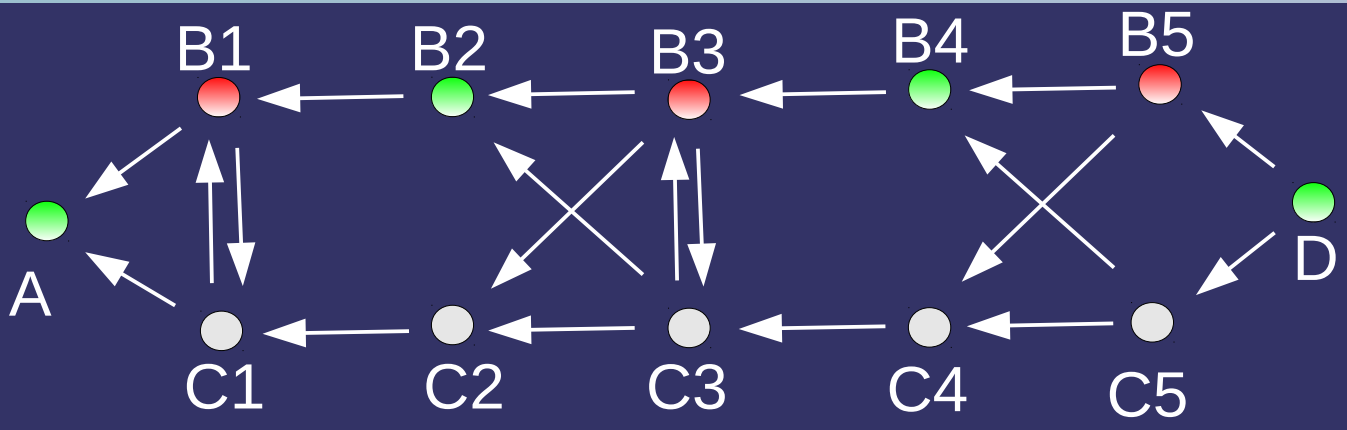
P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)

Example



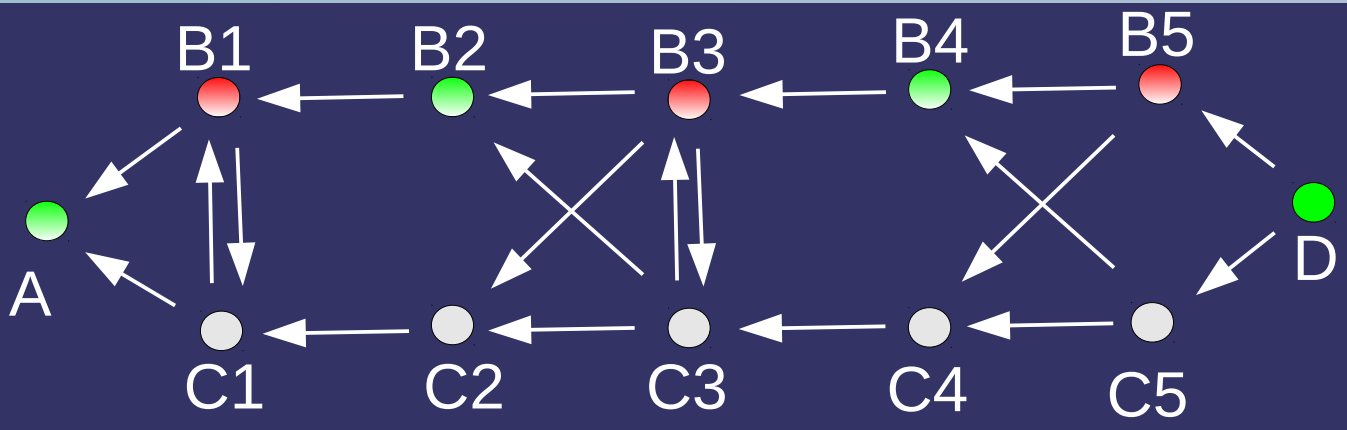
P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)

Example



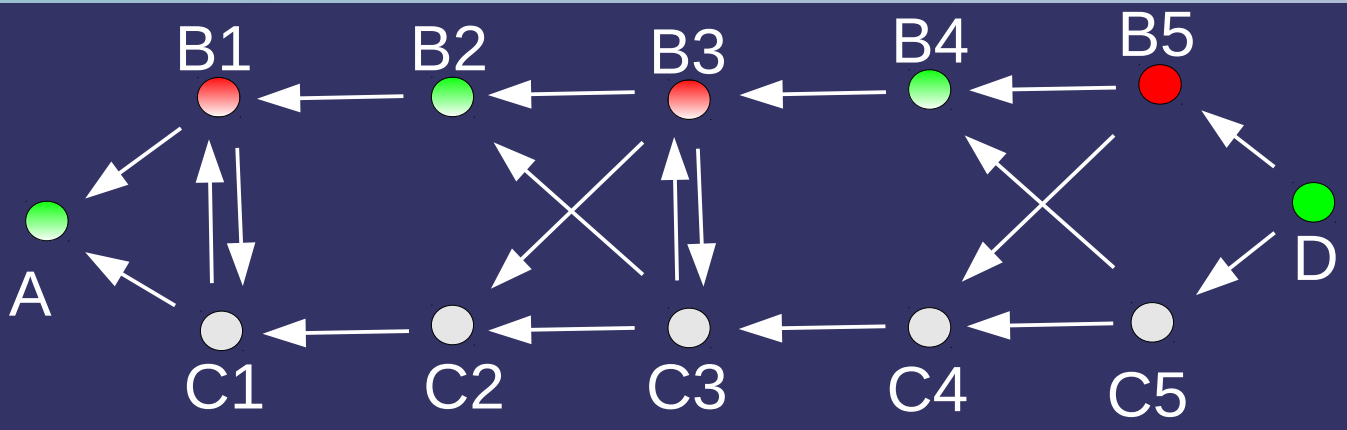
P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)

Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

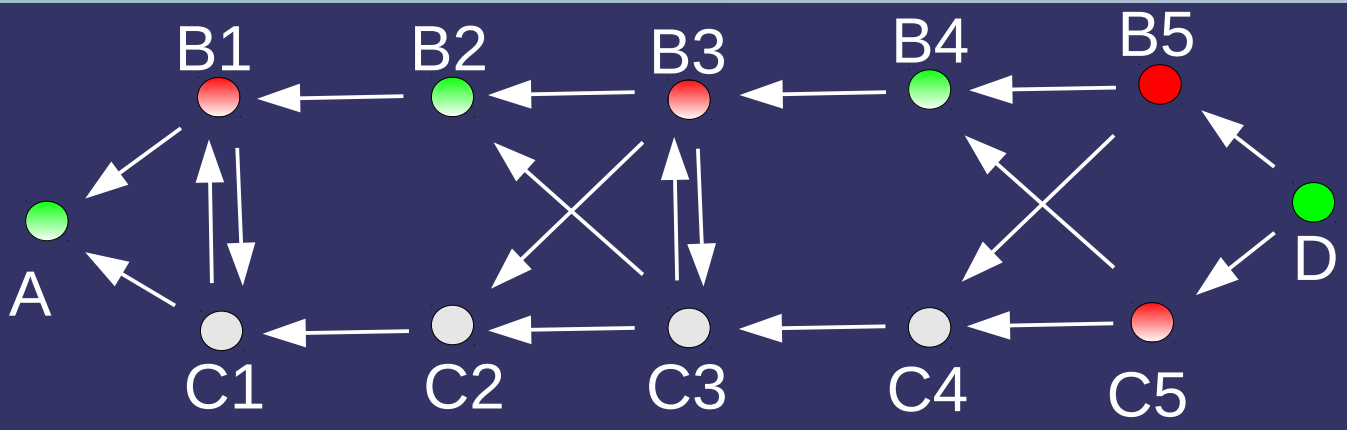
Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)

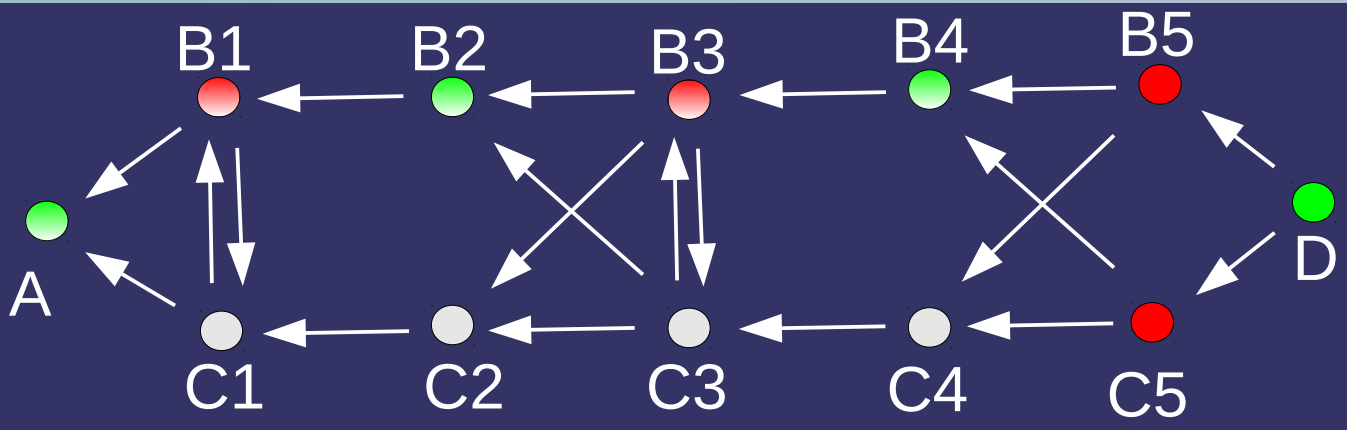
Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)

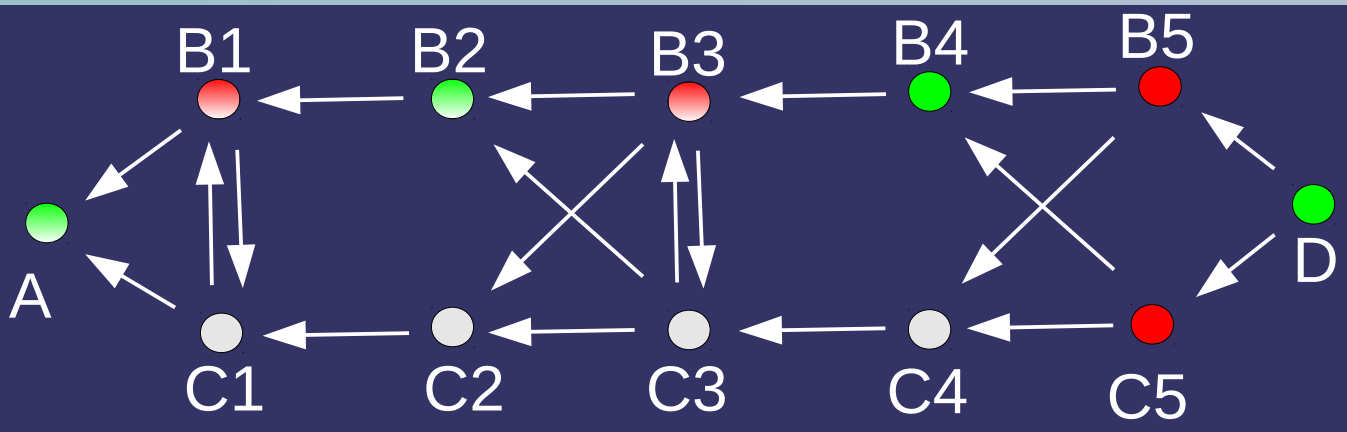
Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)

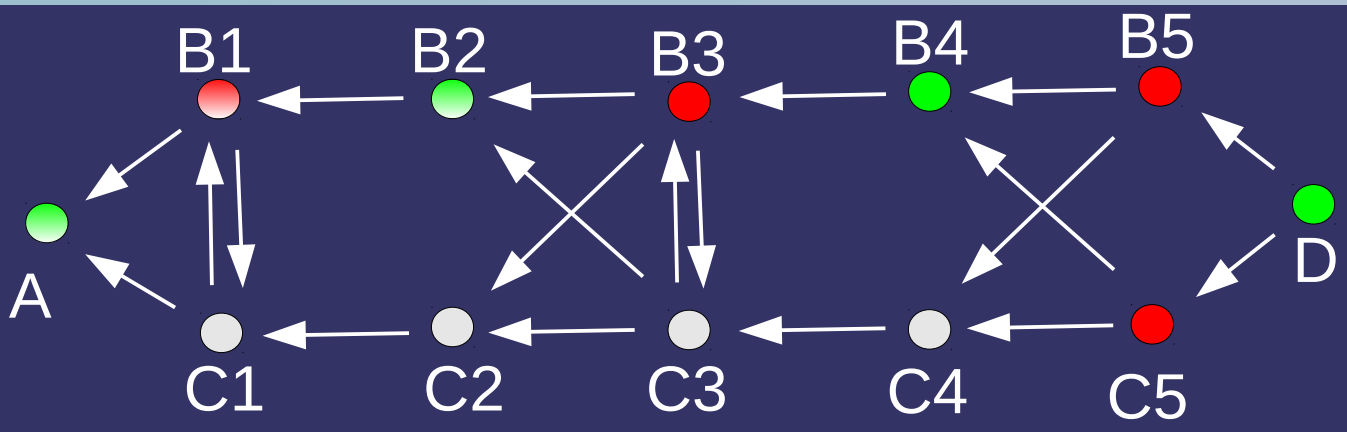
Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)

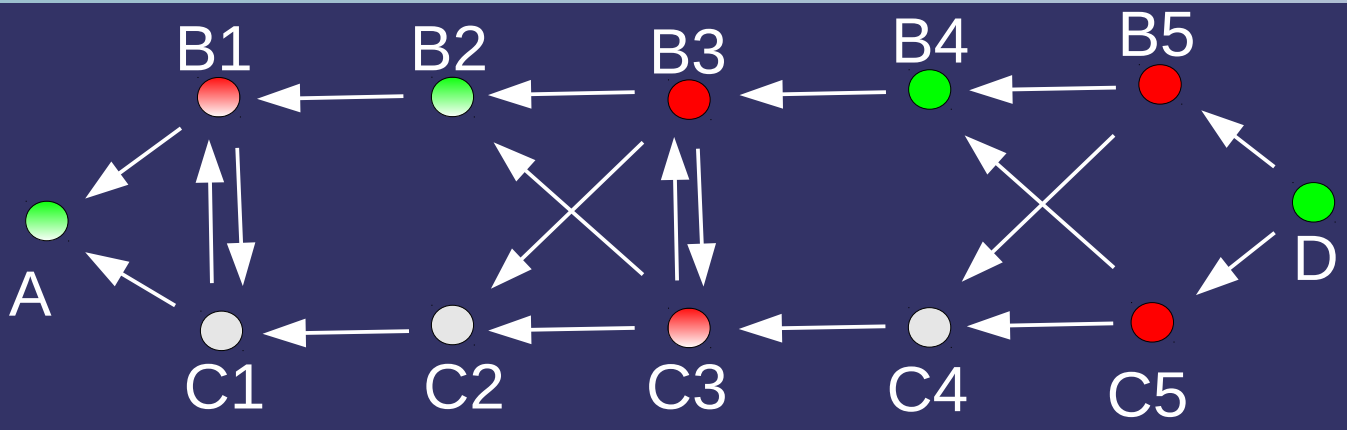
Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)

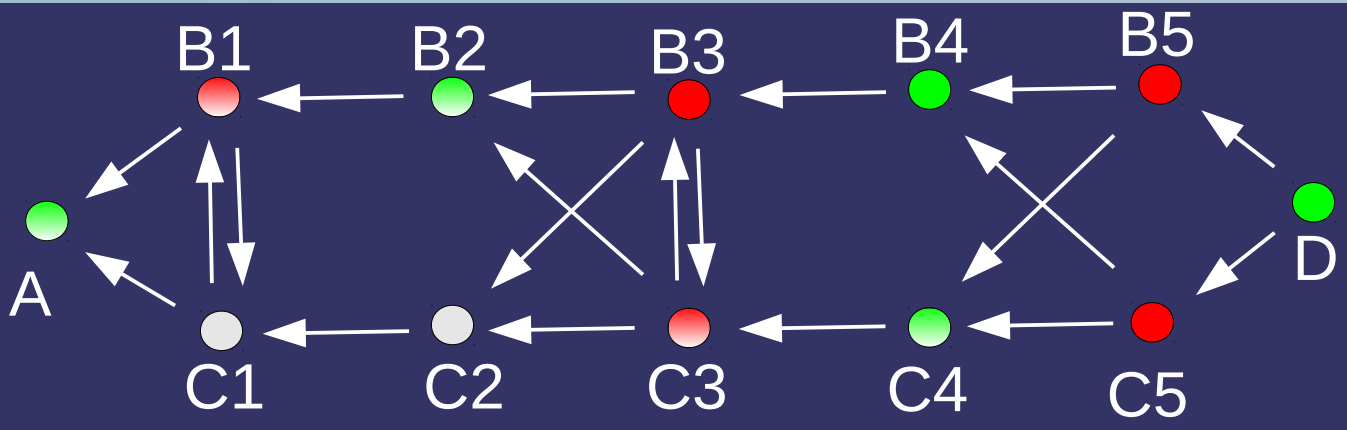
Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)

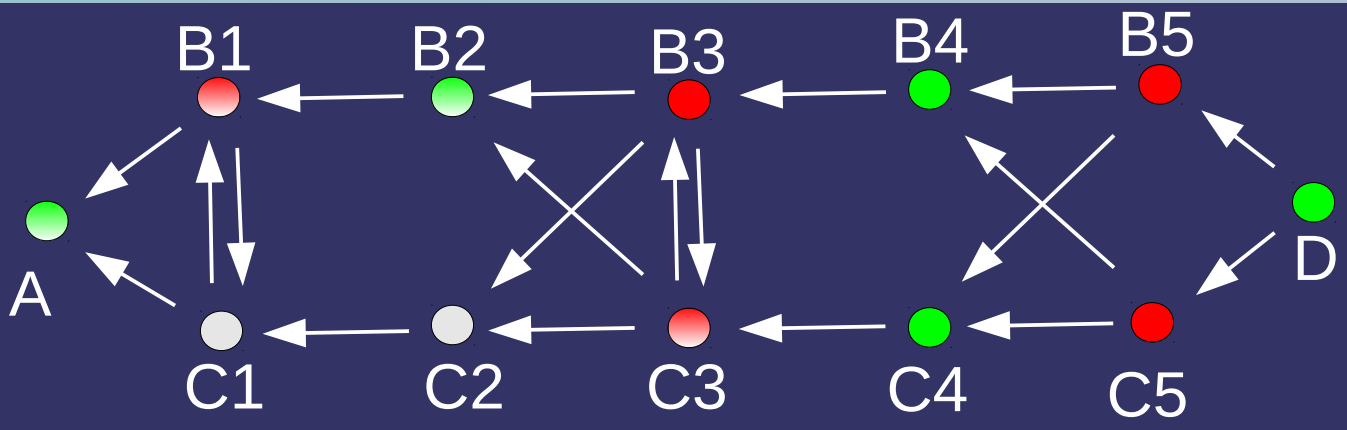
Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)

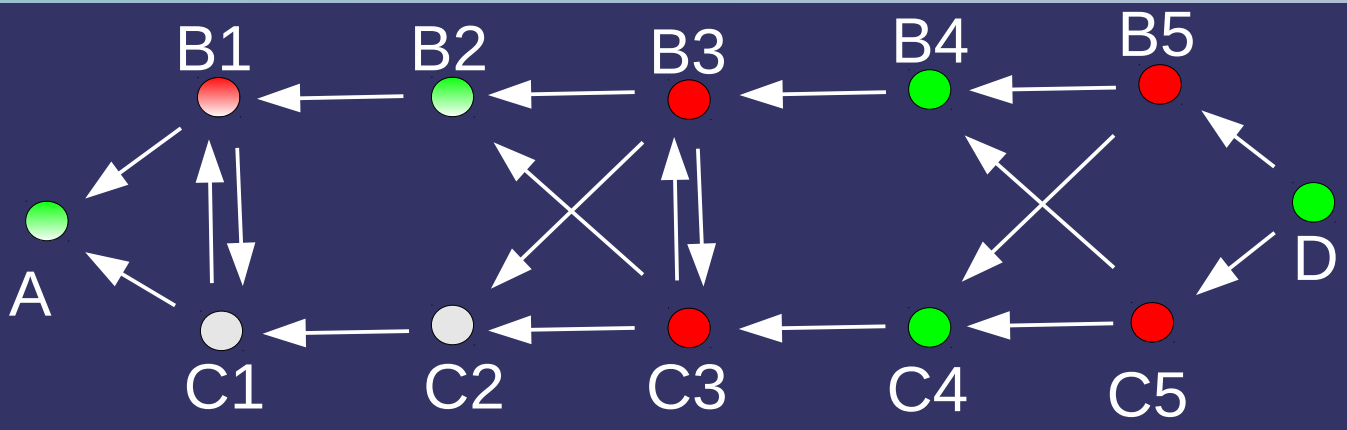
Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

Example

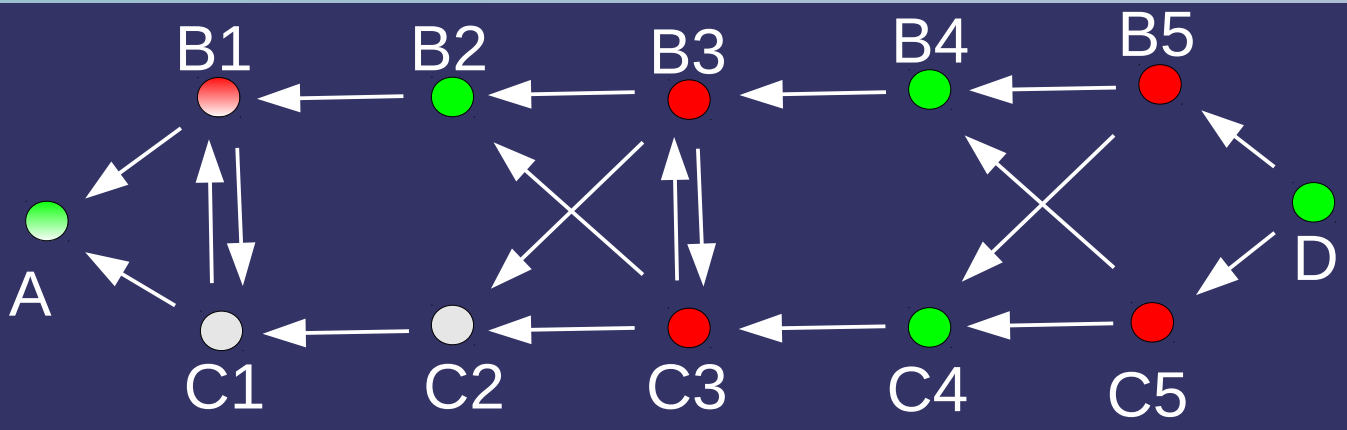


P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

O: RETRACT(C3)

Example

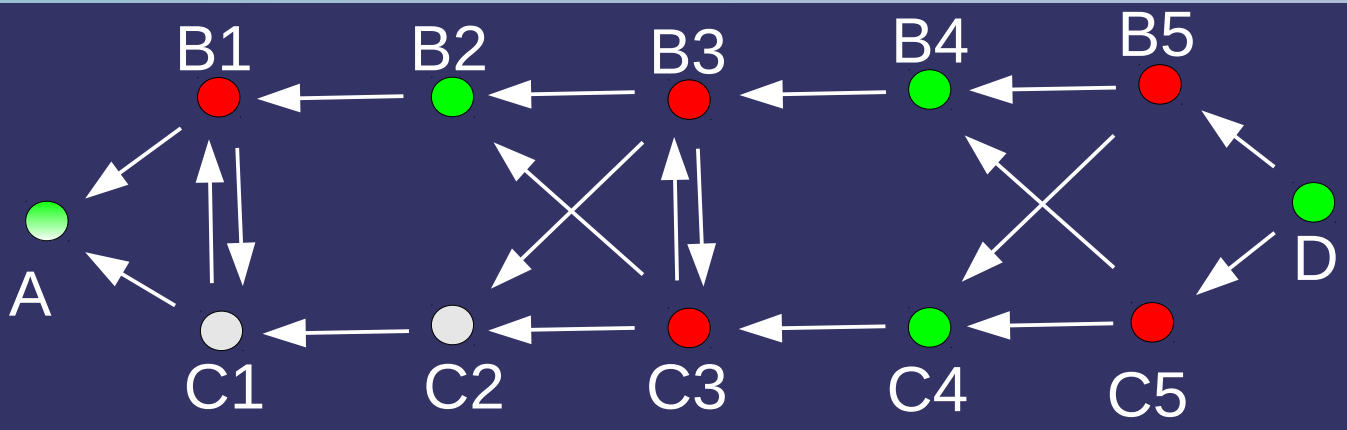


P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

O: RETRACT(C3)
O: CONCEDE(B2)

Example

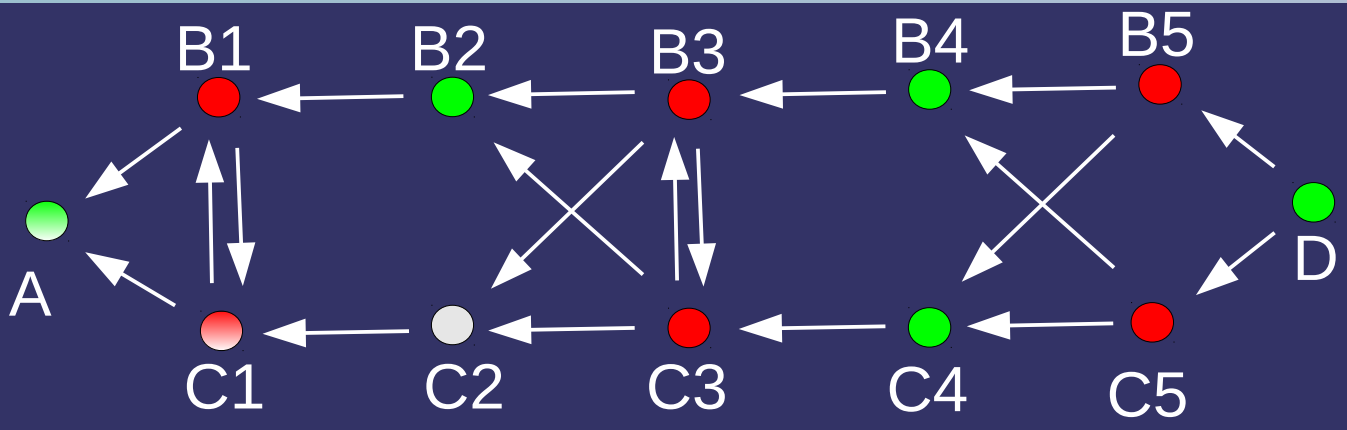


P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

O: RETRACT(C3)
O: CONCEDE(B2)
O: RETRACT(B1)

Example

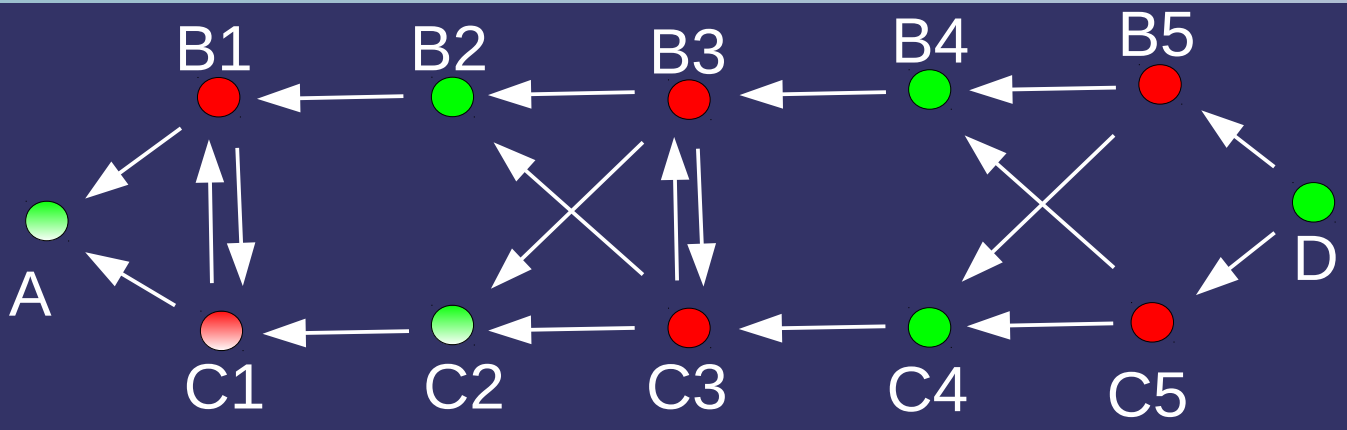


P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

O: RETRACT(C3)
O: CONCEDE(B2)
O: RETRACT(B1)
O: CB(C1)

Example

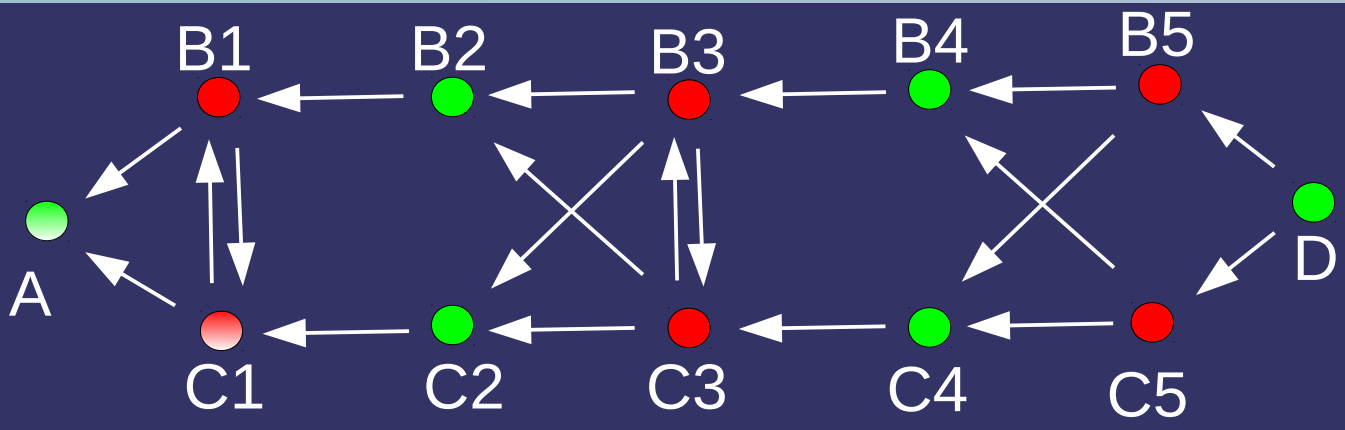


P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

O: RETRACT(C3)
O: CONCEDE(B2)
O: RETRACT(B1)
O: CB(C1)
P: HTB(C2)

Example

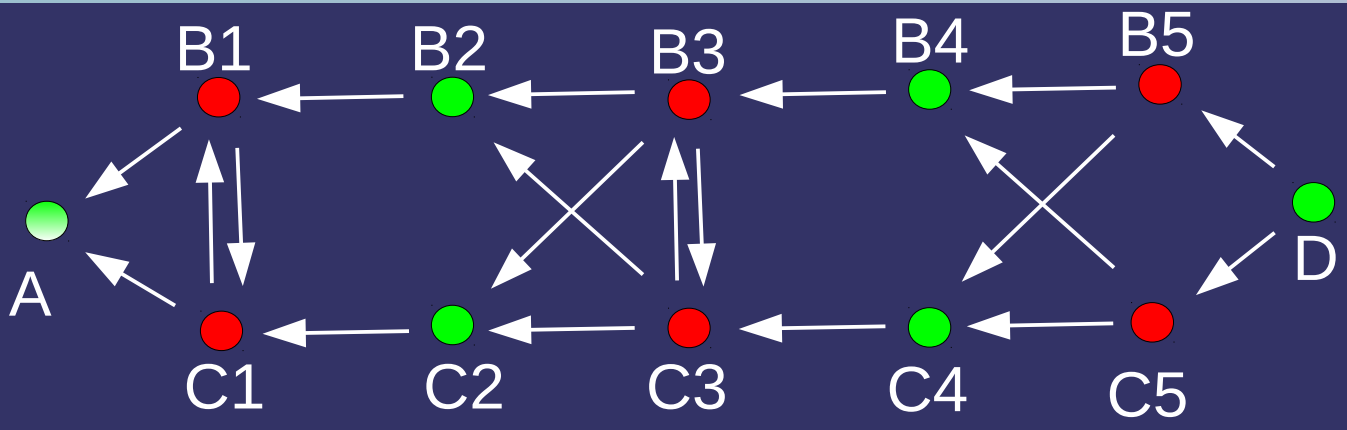


P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

O: RETRACT(C3)
O: CONCEDE(B2)
O: RETRACT(B1)
O: CB(C1)
P: HTB(C2)
O: CONCEDE(C2)

Example

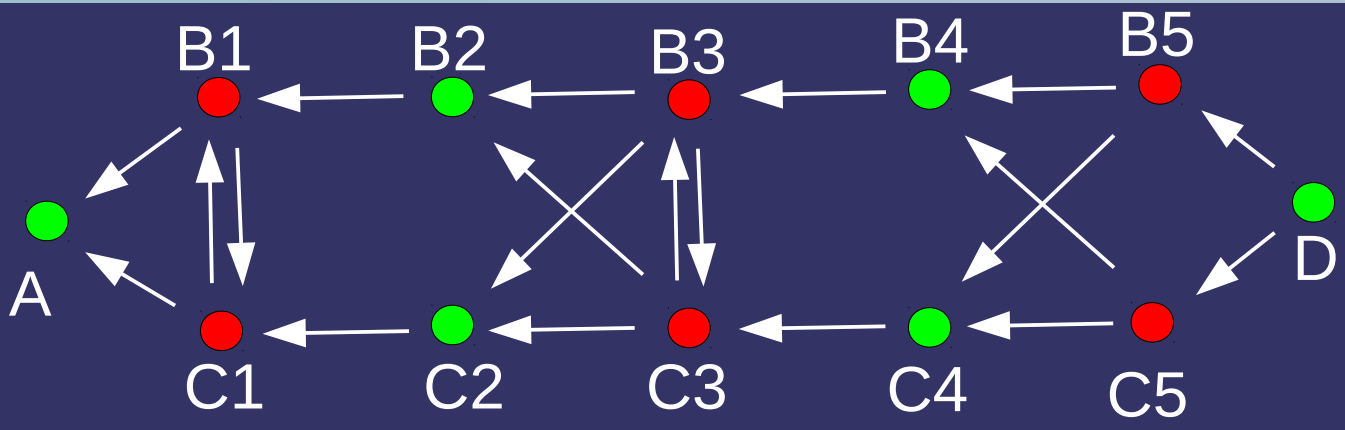


P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

O: RETRACT(C3)
O: CONCEDE(B2)
O: RETRACT(B1)
O: CB(C1)
P: HTB(C2)
O: CONCEDE(C2)
O: RETRACT(C1)

Example



P: HTB(A)
O: CB(B1)
P: HTB(B2)
O: CB(B3)
P: HTB(B4)
O: CB(B5)
P: HTB(D)
O: CONCEDE(D)

O: RETRACT(B5)
O: CB(C5)
O: RETRACT(C5)
O: CONCEDE(B4)
O: RETRACT(B3)
O: CB(C3)
P: HTB(C4)
O: CONCEDE(C4)

O: RETRACT(C3)
O: CONCEDE(B2)
O: RETRACT(B1)
O: CB(C1)
P: HTB(C2)
O: CONCEDE(C2)
O: RETRACT(C1)
O: CONCEDE(A)

Example

Example

P: HTB(D)

Example

P: HTB(D)
O: CB(C)

Example

P: HTB(D)
O: CB(C)
P: HTB(B)

Example

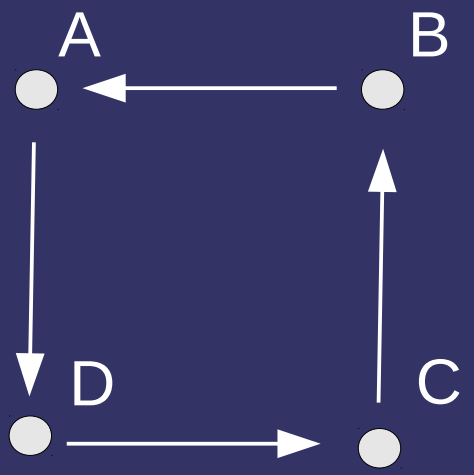
P: HTB(D)
O: CB(C)
P: HTB(B)
O: CB(A)

Example

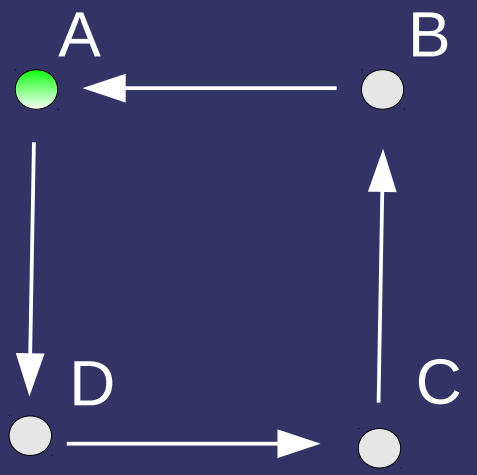
P: HTB(D)
O: CB(C)
P: HTB(B)
O: CB(A)

Proponent cannot move anymore, so discussion is terminated.
Main claim not CONCEDEd, so proponent loses.

Example

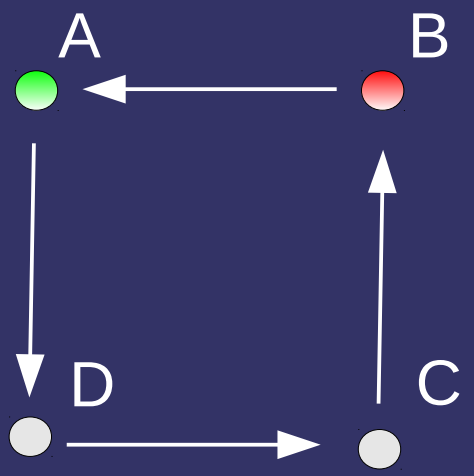


Example



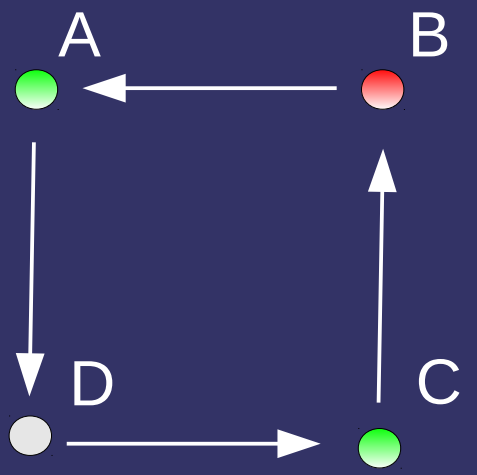
P: HTB(A)

Example



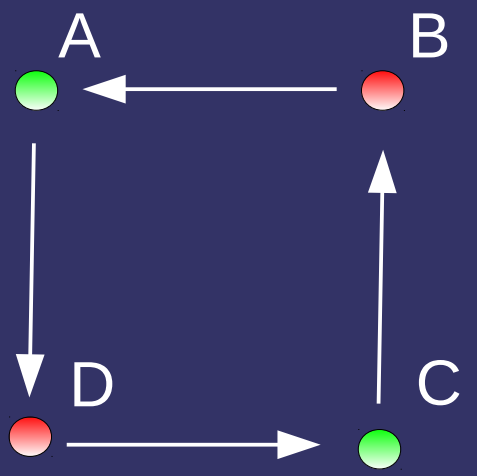
P: HTB(A)
O: CB(B)

Example



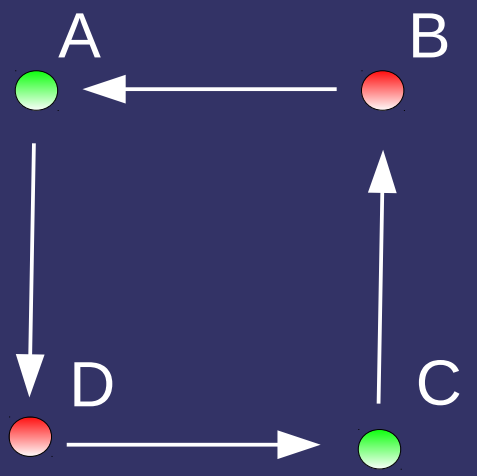
P: HTB(A)
O: CB(B)
P: HTB(C)

Example



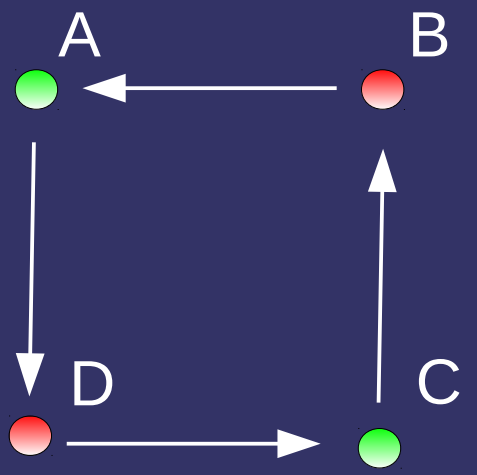
P: HTB(A)
O: CB(B)
P: HTB(C)
O: CB(D)

Example



P: HTB(A)
O: CB(B)
P: HTB(C)
O: CB(D)
P: HTB(A)

Example



P: HTB(A)
O: CB(B)
P: HTB(C)
O: CB(D)
P: HTB(A)

Now we have a HTB(A)-HTB(A) repeat, so all following moves are blocked: discussion terminated.

Main claim not CONCEDEd, so proponent loses

A Discussion Game for Grounded Semantics (3/3)

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- A discussion is *terminated* iff no next move is possible

A Discussion Game for Grounded Semantics (3/3)

- A discussion is *terminated* iff no next move is possible
- A terminated discussion (starting with HTB(A)) is won by the proponent iff the opponent has moved CONCEDE(A)

A Discussion Game for Grounded Semantics (3/3)

- A discussion is *terminated* iff no next move is possible
- A terminated discussion (starting with HTB(A))
  is won by the proponent iff
  the opponent has moved CONCEDE(A)
- in(Lab_o) = all CONCEDEd arguments
  out(Lab_o) = all RETRACTed arguments

A Discussion Game for Grounded Semantics (3/3)

- A discussion is *terminated* iff no next move is possible
- A terminated discussion (starting with HTB(A)) is won by the proponent iff the opponent has moved CONCEDE(A)
- in(Lab_o) = all CONCEDEd arguments

  out(Lab_o) = all RETRACTed arguments
- At any point of the discussion, Lab_o is strongly admissible

A Discussion Game for Grounded Semantics (3/3)

- A discussion is *terminated* iff no next move is possible
- A terminated discussion (starting with HTB(A)) is won by the proponent iff the opponent has moved CONCEDE(A)
- in(Lab_o) = all CONCEDEd arguments

  out(Lab_o) = all RETRACTed arguments
- At any point of the discussion, Lab_o is strongly admissible
- correctness: if a discussion is won by the proponent, then the main argument is in in the grounded labelling

A Discussion Game for Grounded Semantics (3/3)

- A discussion is *terminated* iff no next move is possible
- A terminated discussion (starting with HTB(A)) is won by the proponent iff the opponent has moved CONCEDE(A)
- in(Lab_o) = all CONCEDEd arguments

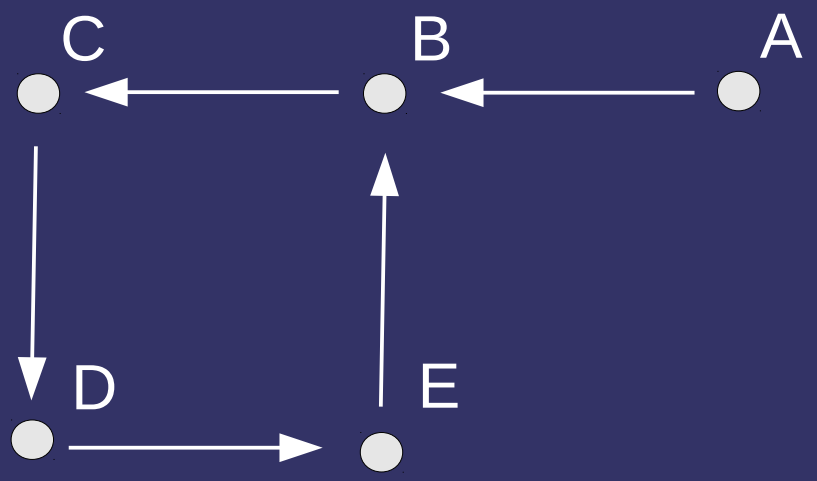
  out(Lab_o) = all RETRACTed arguments
- At any point of the discussion, Lab_o is strongly admissible
- correctness: if a discussion is won by the proponent, then the main argument is in in the grounded labelling
- completeness: if an argument is in in the grounded labelling, then the proponent has a winning strategy for it

A Discussion Game for Grounded Semantics (3/3)

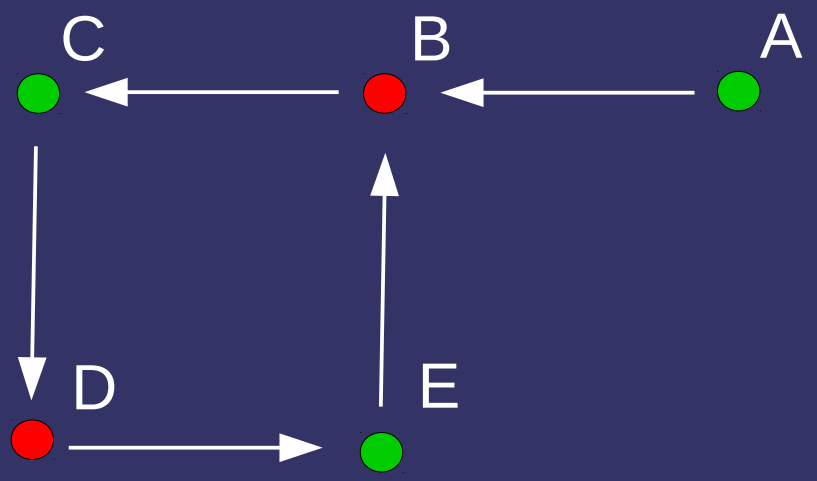
- A discussion is *terminated* iff no next move is possible
- A terminated discussion (starting with HTB(A)) is won by the proponent iff the opponent has moved CONCEDE(A)
- in(Lab_o) = all CONCEDEd arguments

  out(Lab_o) = all RETRACTed arguments
- At any point of the discussion, Lab_o is strongly admissible
- correctness: if a discussion is won by the proponent, then the main argument is in the grounded extension
- completeness: if an argument is in the grounded extension, then the proponent has a winning strategy for it

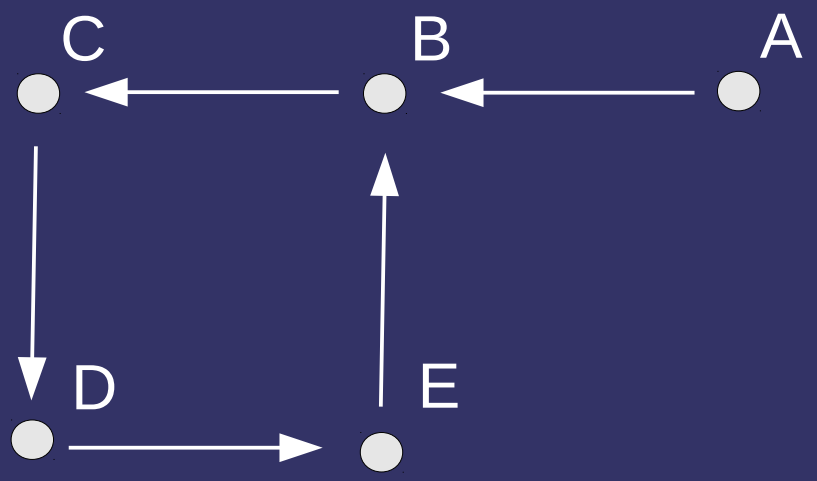
Example



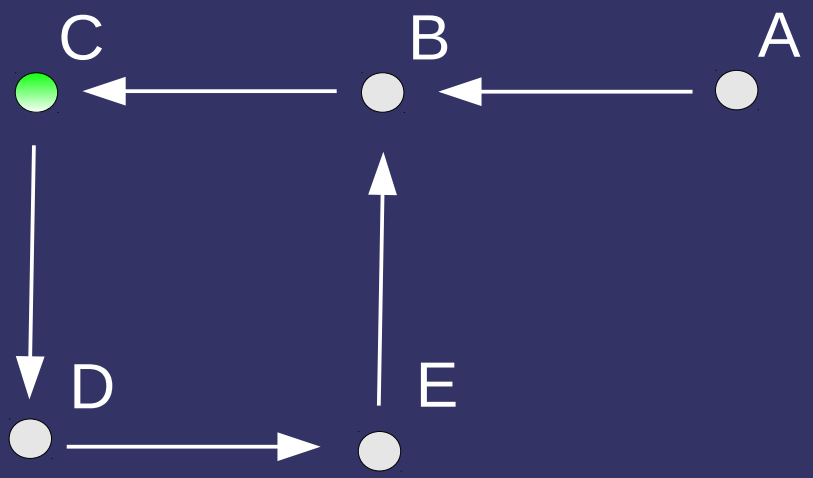
Example



Example

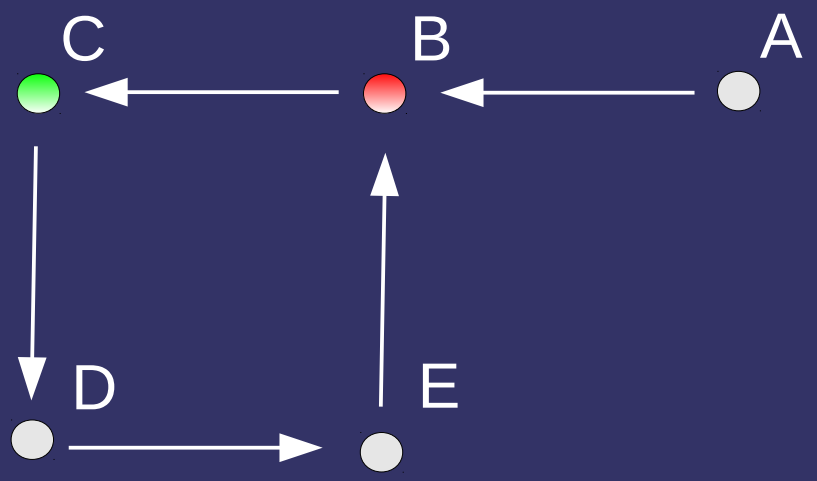


Example



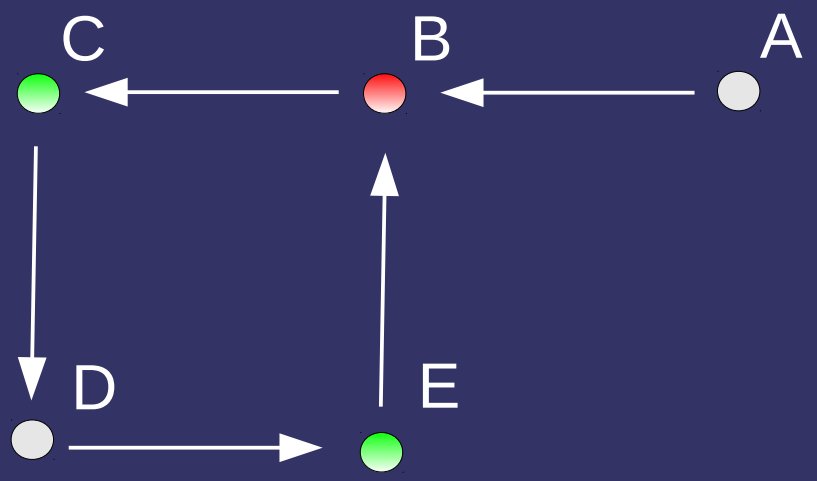
P: HTB(C)

Example



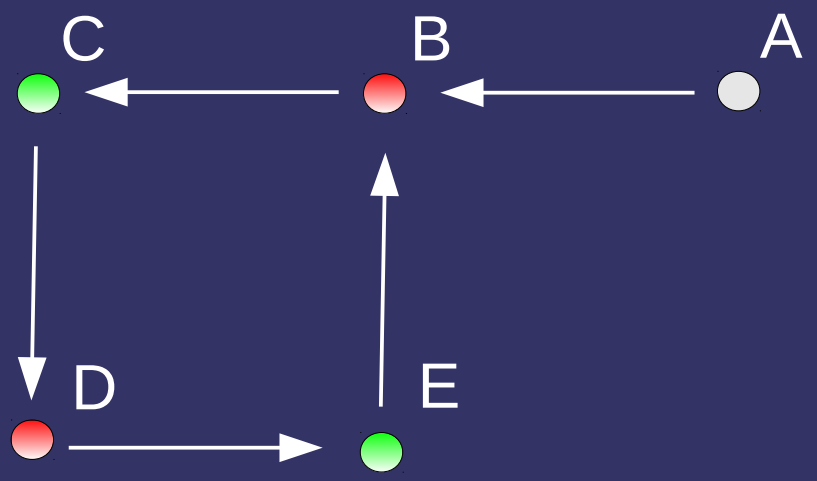
P: HTB(C)
O: CB(B)

Example



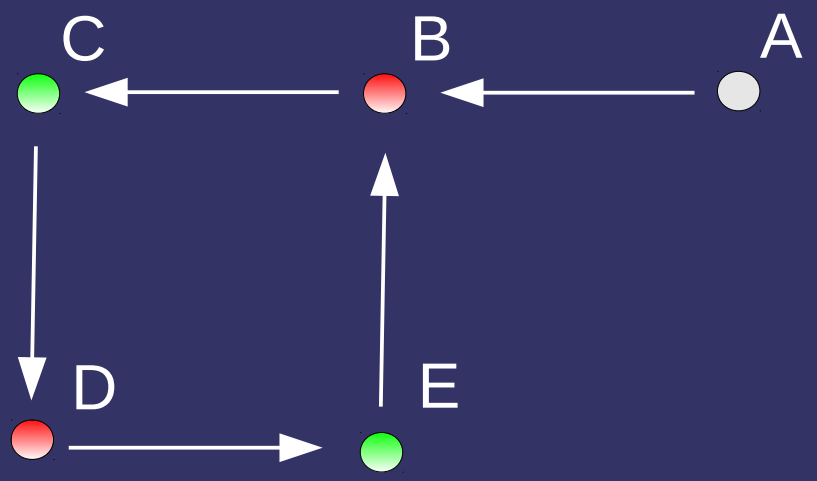
P: HTB(C)
O: CB(B)
P: HTB(E)

Example



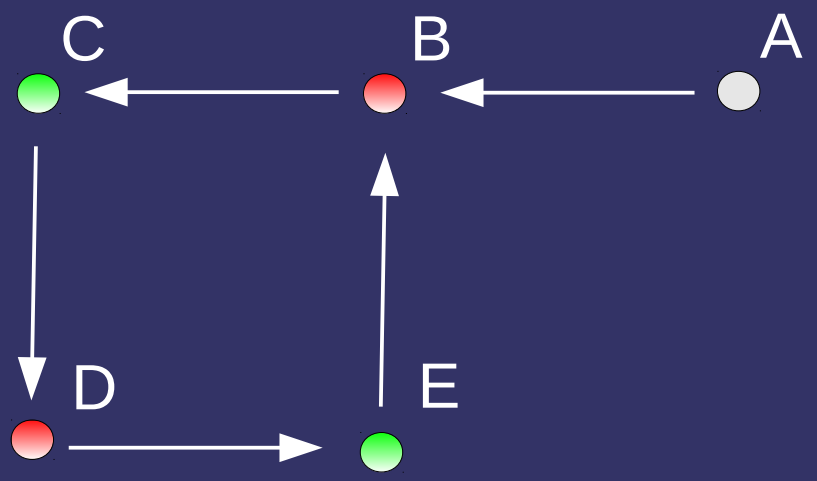
P: HTB(C)
O: CB(B)
P: HTB(E)
O: CB(D)

Example



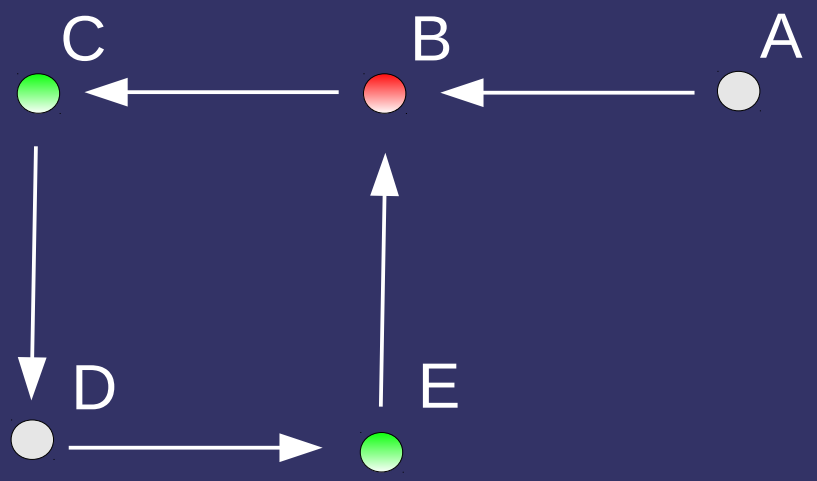
P: HTB(C)
O: CB(B)
P: HTB(E)
O: CB(D)
P: HTB(C)

Example



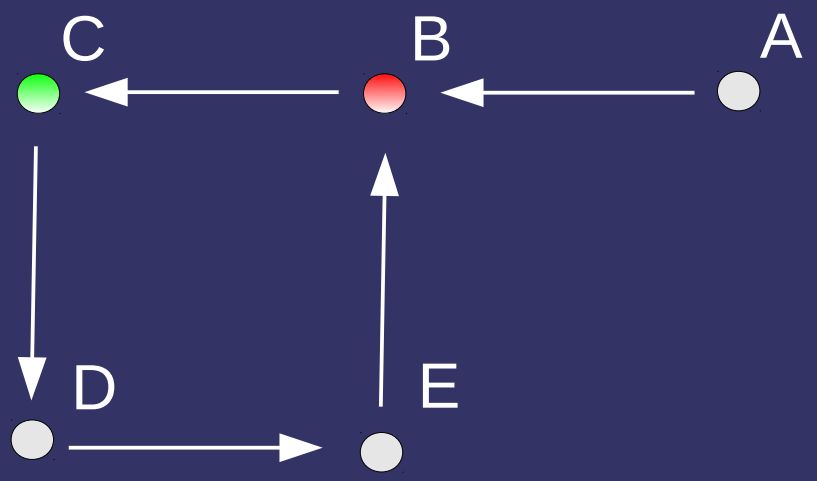
P: HTB(C)
O: CB(B)
P: HTB(E)
O: CB(D)

Example



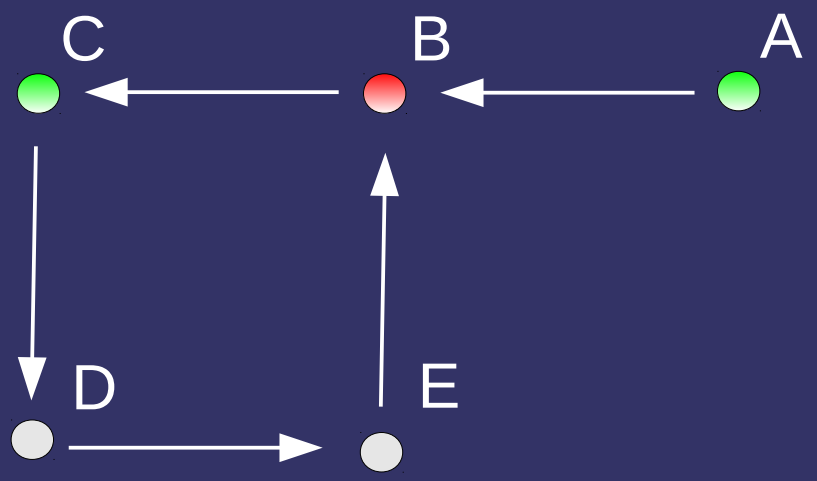
P: HTB(C)
O: CB(B)
P: HTB(E)

Example



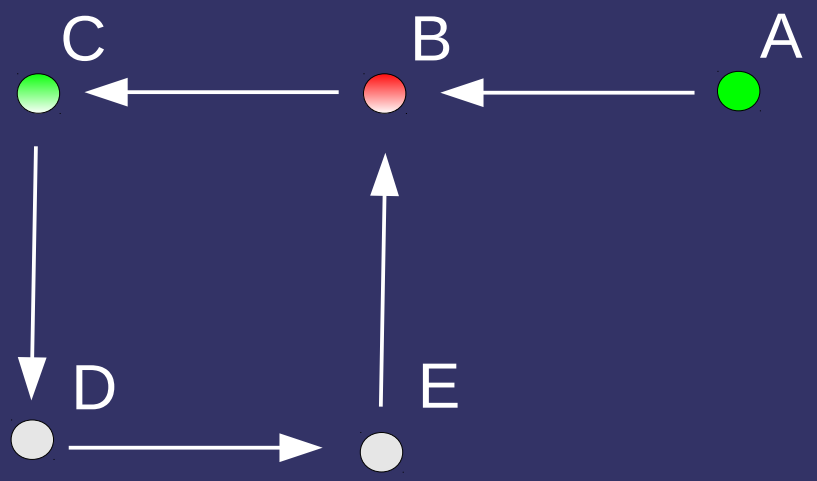
P: HTB(C)
O: CB(B)

Example



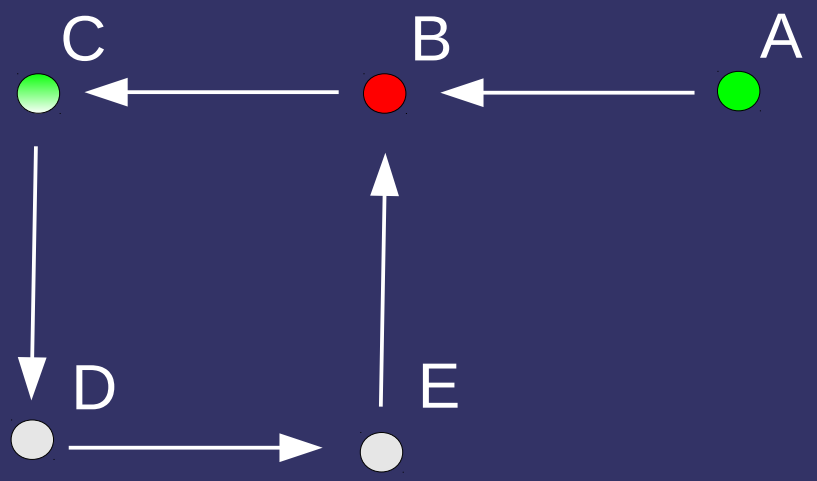
P: HTB(C)
O: CB(B)
P: HTB(A)

Example



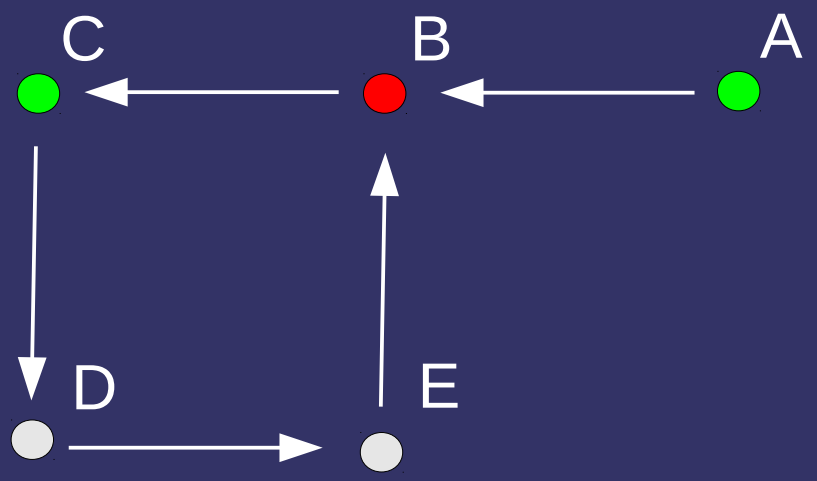
P: HTB(C)
O: CB(B)
P: HTB(A)
O: CONCEDE(A)

Example



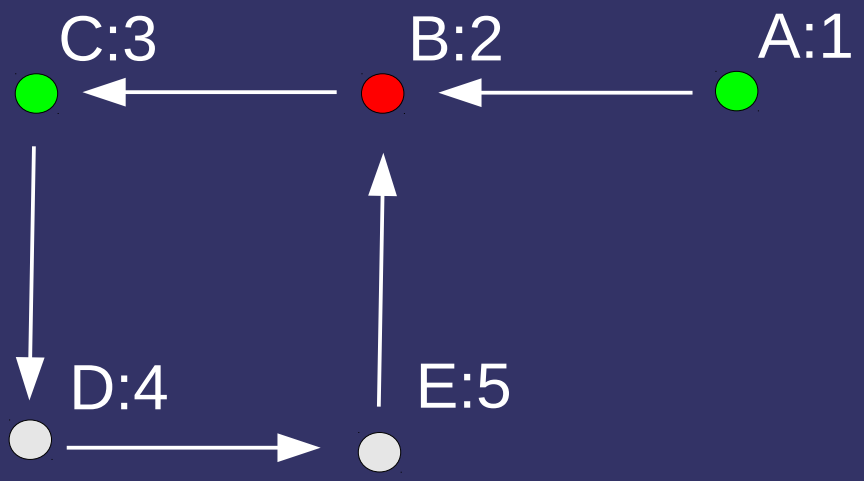
P: HTB(C)
O: CB(B)
P: HTB(A)
O: CONCEDE(A)
O: RETRACT(B)

Example



P: HTB(C)
O: CB(B)
P: HTB(A)
O: CONCEDE(A)
O: RETRACT(B)
O: CONCEDE(C)

Example



P: HTB(C)
O: CB(B)
P: HTB(A)
O: CONCEDE(A)
O: RETRACT(B)
O: CONCEDE(C)

Example [Prakken]

Example [Prakken]

Paul: My car is very safe, because it has an airbag.
Olga: I do not think having an airbag makes your car safe,
because airbags are unreliable: the newspapers had
several reports on cases where airbags did not work.
Paul: A recent scientific study shows that airbags are in fact 99%
reliable, and scientific studies are more important than
newspaper reports.
Olga: OK, I admit that airbags are reliable.
However, your car is not very safe,
since its maximum speed is much too high.

Example [Prakken]

P: My car is very safe, because it has an airbag.

O: I do not think having an airbag makes your car safe, because airbags are unreliable: the newspapers had several reports on cases where airbags did not work.

P: A recent scientific study shows that airbags are in fact 99% reliable, and scientific studies are more important than newspaper reports.

O: OK, I admit that airbags are reliable.
However, your car is not very safe,
since its maximum speed is much too high.

Example [Prakken]

P: HTB(airbag ⇒ safe)

O: I do not think having an airbag makes your car safe, because airbags are unreliable: the newspapers had several reports on cases where airbags did not work.

P: A recent scientific study shows that airbags are in fact 99% reliable, and scientific studies are more important than newspaper reports.

O: OK, I admit that airbags are reliable. However, your car is not very safe, since its maximum speed is much too high.

Example [Prakken]

P: HTB(airbag ⇒ safe)
O: CB(npr ⇒ ¬airbagrel ⇒ ¬[airbag ⇒ safe])

P: A recent scientific study shows that airbags are in fact 99% reliable, and scientific studies are more important than newspaper reports.
O: OK, I admit that airbags are reliable.
However, your car is not very safe,
since its maximum speed is much too high.

Example [Prakken]

P: HTB(airbag ⇒ safe)
O: CB(npr ⇒ ¬airbagrel ⇒ ¬[airbag ⇒ safe])

P: HTB(study ⇒ airbagrel)

O: OK, I admit that airbags are reliable.
However, your car is not very safe,
since its maximum speed is much too high.

Example [Prakken]

P: HTB(airbag ⇒ safe)
O: CB(npr ⇒ ¬airbagrel ⇒ ¬[airbag ⇒ safe])

P: HTB(study ⇒ airbagrel)

O: CONCEDE(study ⇒ airbagrel)
However, your car is not very safe,
since its maximum speed is much too high.

Example [Prakken]

P: HTB(airbag ⇒ safe)
O: CB(npr ⇒ ¬airbagrel ⇒ ¬[airbag ⇒ safe])

P: HTB(study ⇒ airbagrel)

O: CONCEDE(study ⇒ airbagrel)
RETRACT(npr ⇒ ¬airbagrel ⇒ ¬[airbag ⇒ safe])

Example [Prakken]

P: HTB(airbag ⇒ safe)
O: CB(npr ⇒ ¬airbagrel ⇒ ¬[airbag ⇒ safe])

P: HTB(study ⇒ airbagrel)

O: CONCEDE(study ⇒ airbagrel)
RETRACT(npr ⇒ ¬airbagrel ⇒ ¬[airbag ⇒ safe])
CB(highspeed ⇒ ¬safe)

Previous Discussion Games

	Standard Grounded Game	Grounded Persuasion Game	Grounded Discussion Game
#moves needed to show str. adm.	exponential	linear	linear
RETRACT/ CONCEDE moves	no	yes	yes
single successful game is sufficient	no	yes	yes
in grounded implies ∃ winning strategy	yes	no	yes