Interaction is Meaning: A New Model for Communication in Open Systems

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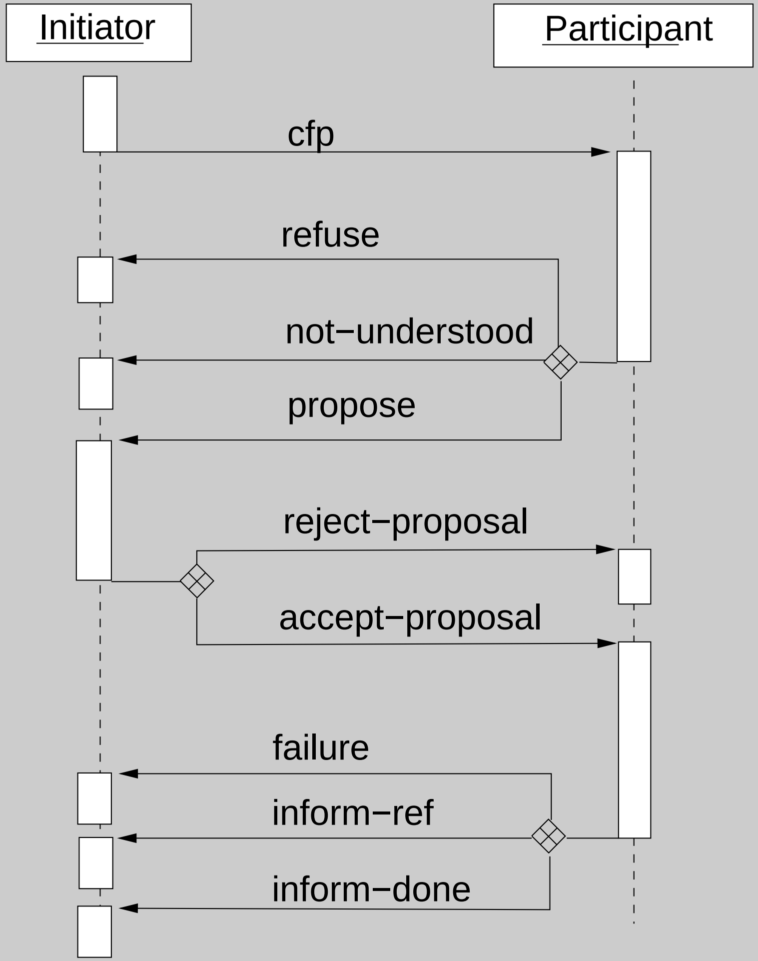
Motivation


Initiator
Participant
cfp
refuse
not−understood
propose
reject−proposal
accept−proposal
failure
inform−ref
inform−done

Overview

- Motivation
- Communication semantics: desiderata
- Empirical semantics framework
- Analysis
- Conclusion
- Future Work

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- how can we predict what agents will **do** seeing only what they **say**?
- how can we explain link between **illocution** and **perlocution**?
- view “semantics” as an emergent, evolving phenomenon

Goals

- function of semantics: predicting other agents' actions

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- semantics must be **expectation-based**

Expectations & Communication

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- two (potentially conflicting) goals:
  - reduce uncertainty
  - break undesirable expectations

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- ***empirical***: expectations grounded in past experience
- ***constructivist***: meaning is in the eye of the observer

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Probabilistic semantics

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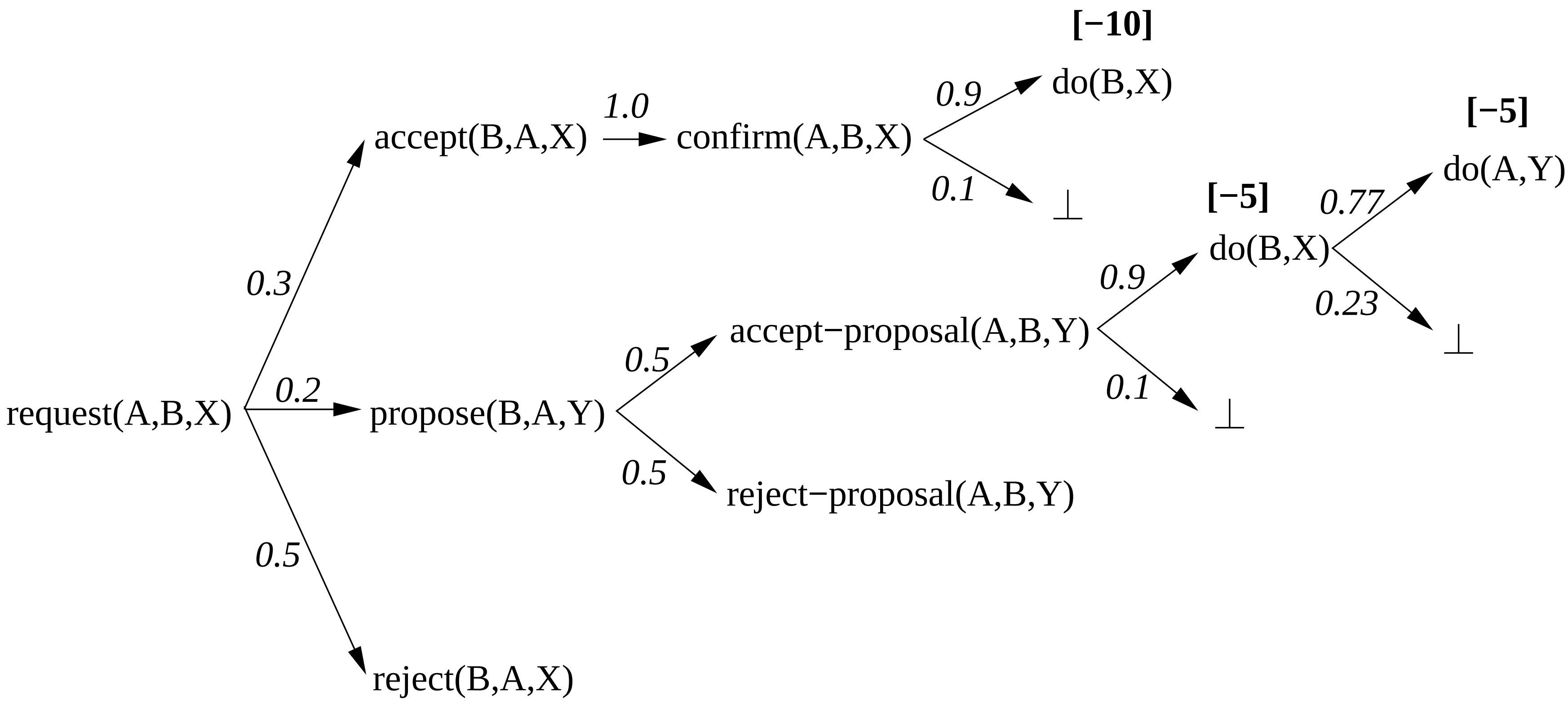

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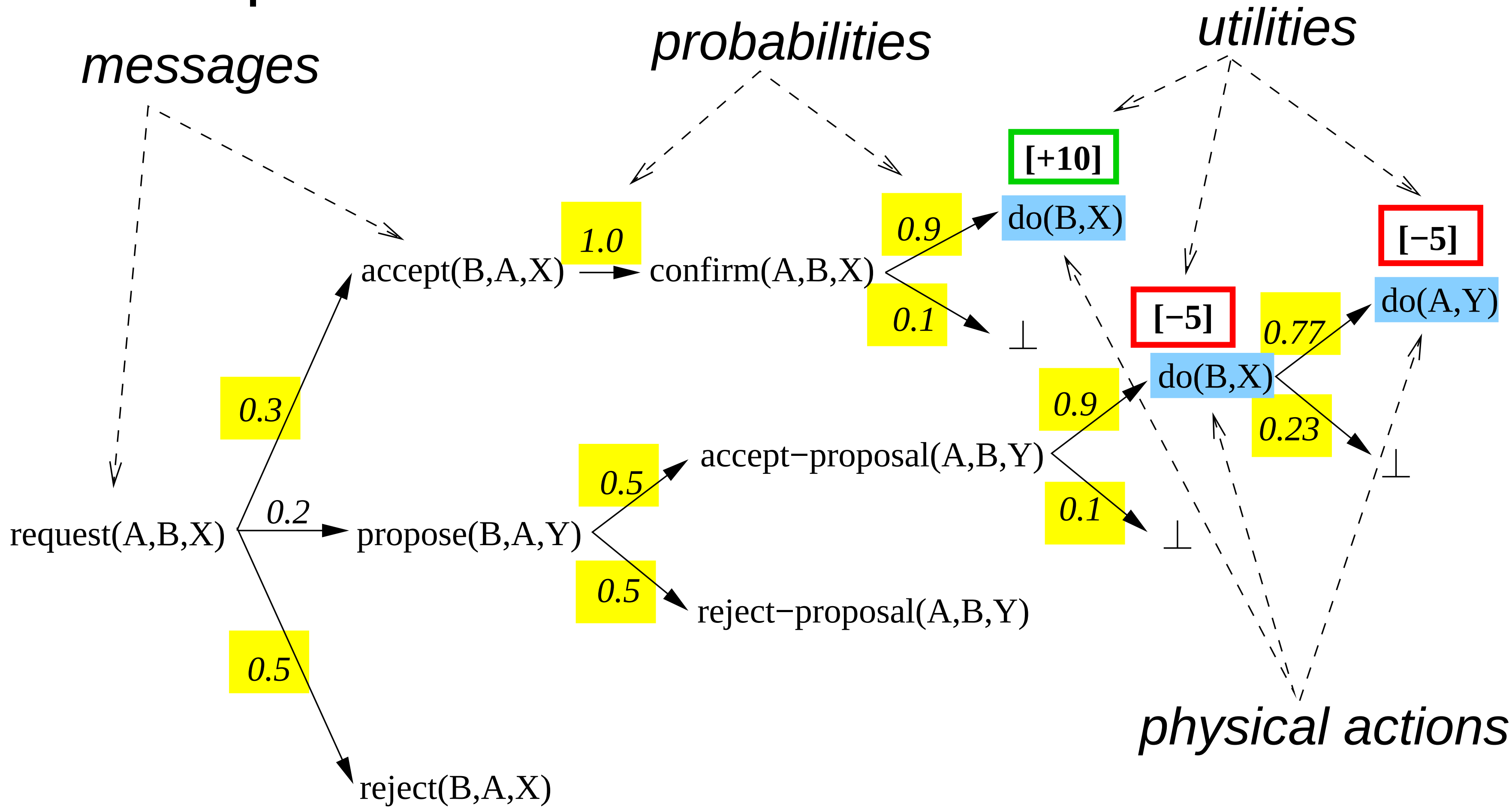

Probabilistic semantics

- assume agent maintains such a tree $\mathcal{F}$, and encounters are sequences $w = w_1 w_2 \cdots w_n$

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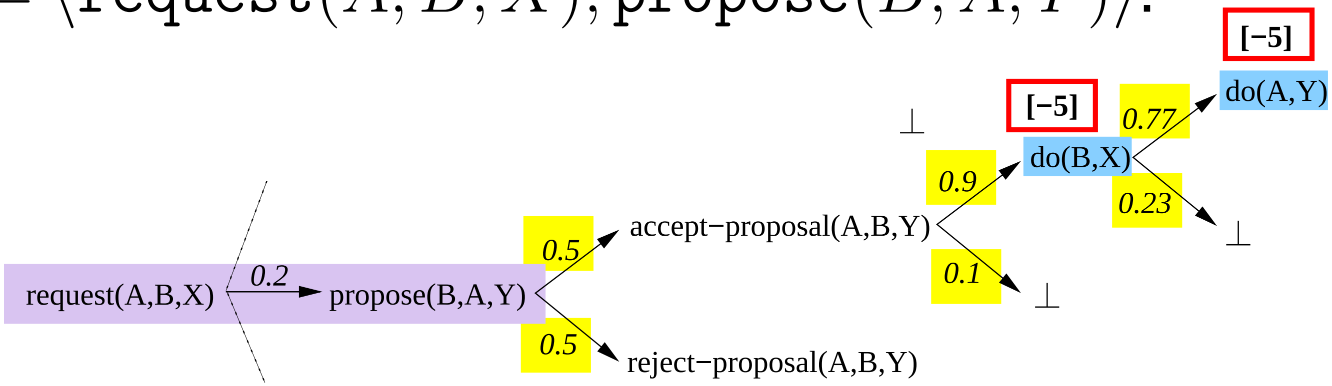
- calculate expected utility after encounter prefix w:

$$\bar{u}(w) = \sum_{w'} I_{\mathcal{F}}(w)(w') \cdot u(w')$$

- assuming that $u(w') =$sum of the utilities of physical actions along w'

Example

Let $w = \langle \texttt{request}(A, B, X), \texttt{propose}(B, A, Y) \rangle$:



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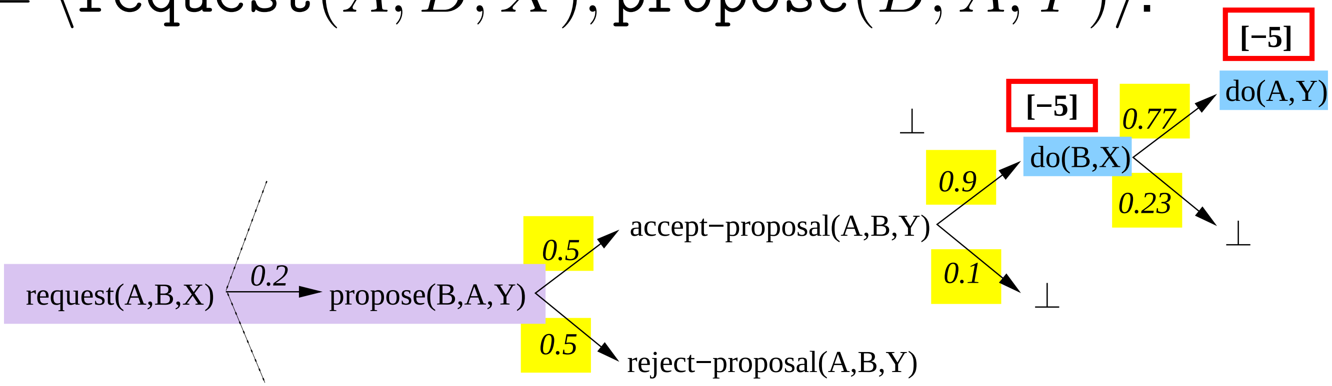

$$I_{\mathcal{F}}(w) = \{ (\langle \texttt{accept-proposal}(A,B,Y), \texttt{do}(B,X), \texttt{do}(A,Y) \rangle, 0.3456)$$

$$\langle \texttt{accept-proposal}(A,B,Y), \texttt{do}(B,X) \rangle, 0.1035),$$

$$\langle \texttt{accept-proposal}(A,B,Y) \rangle, 0.05),$$

$$\langle \texttt{reject-proposal}(A,B,Y) \rangle, 0.5) \}$$

$$\bar{u}(w) = -10 \cdot 0.3456 + (-5) \cdot 0.103 + (0 \cdot 0.05 + 0 \cdot 0.5) = -3.971$$

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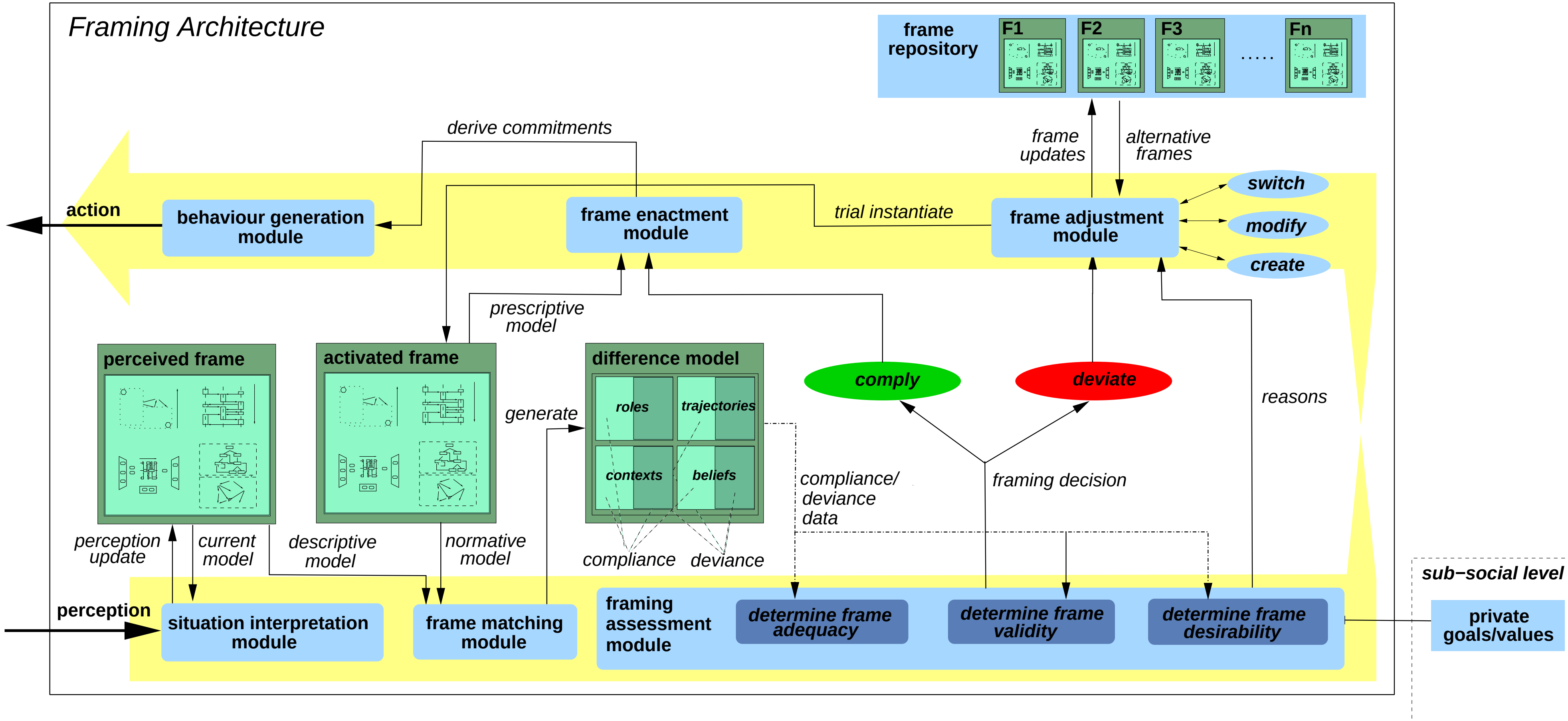
- total ***entropy*** as combined measure:

$$\mathcal{E}_{\mathcal{F}}(w) = EE_{\mathcal{F}}(w) \cdot UD_{\mathcal{F}}(w)$$

InFFrA architecture



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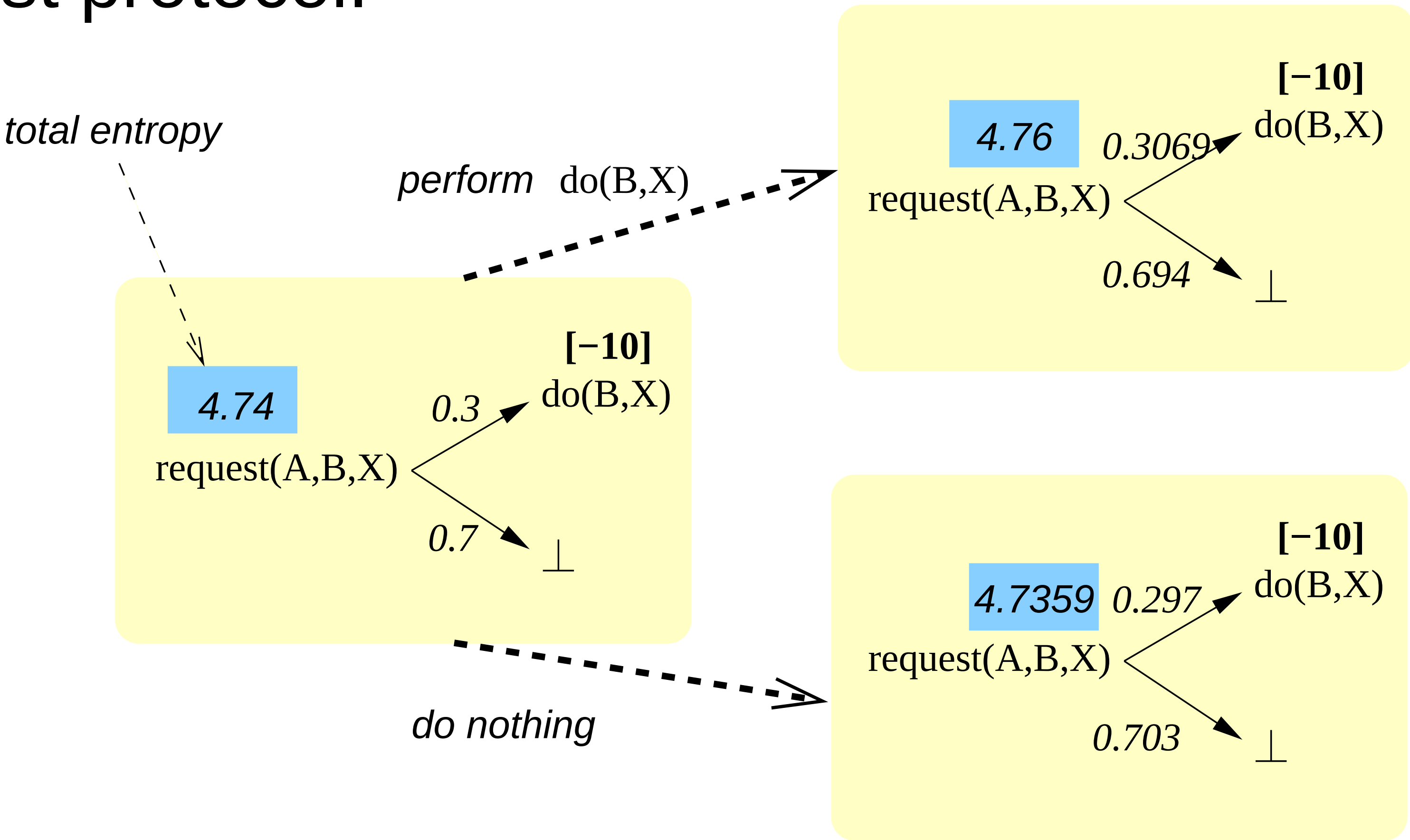
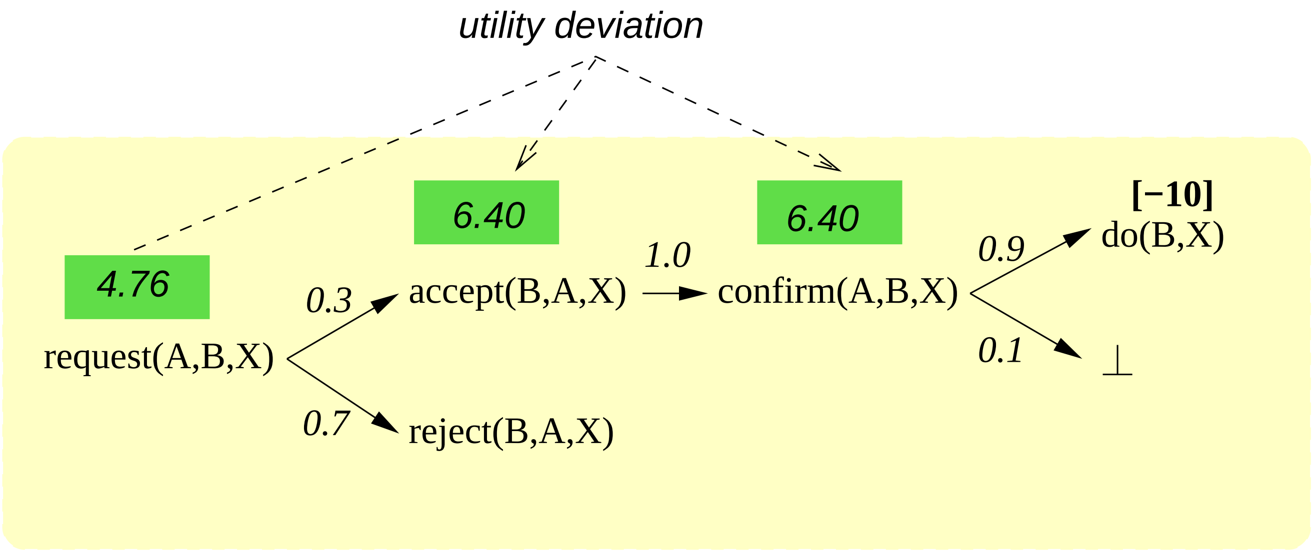
Considering undesirable action in a simple request protocol:



Example

Slightly more sophisticated protocol:



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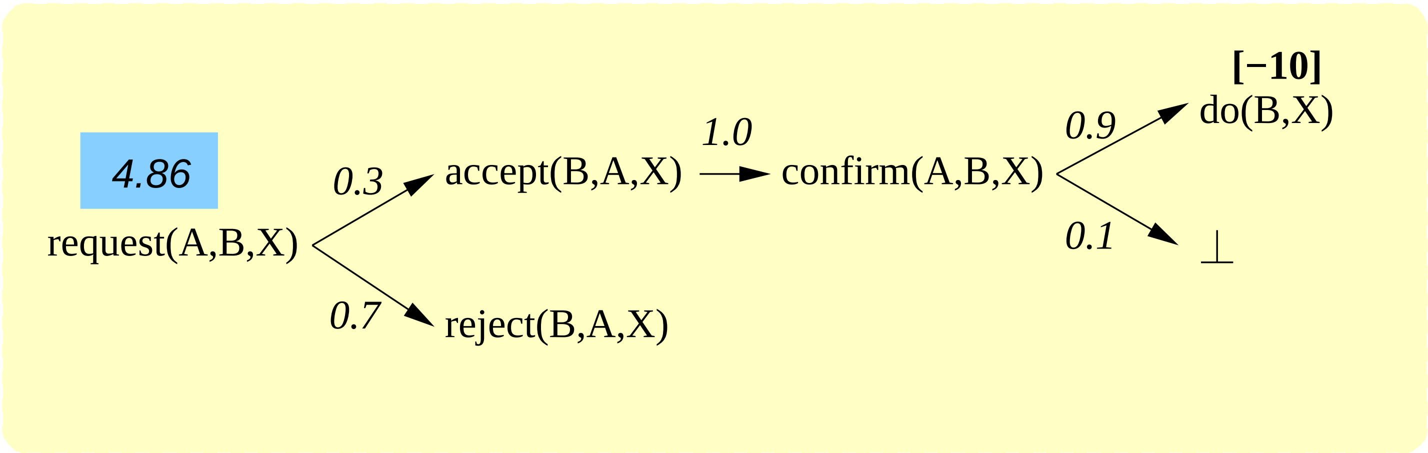
Entropies: before executing undesirable action



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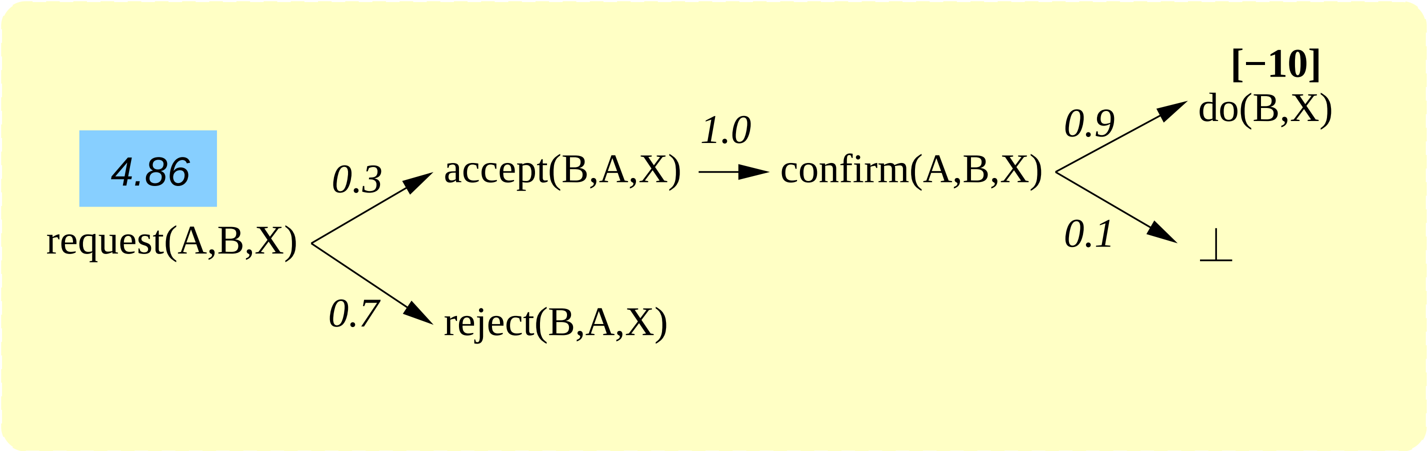
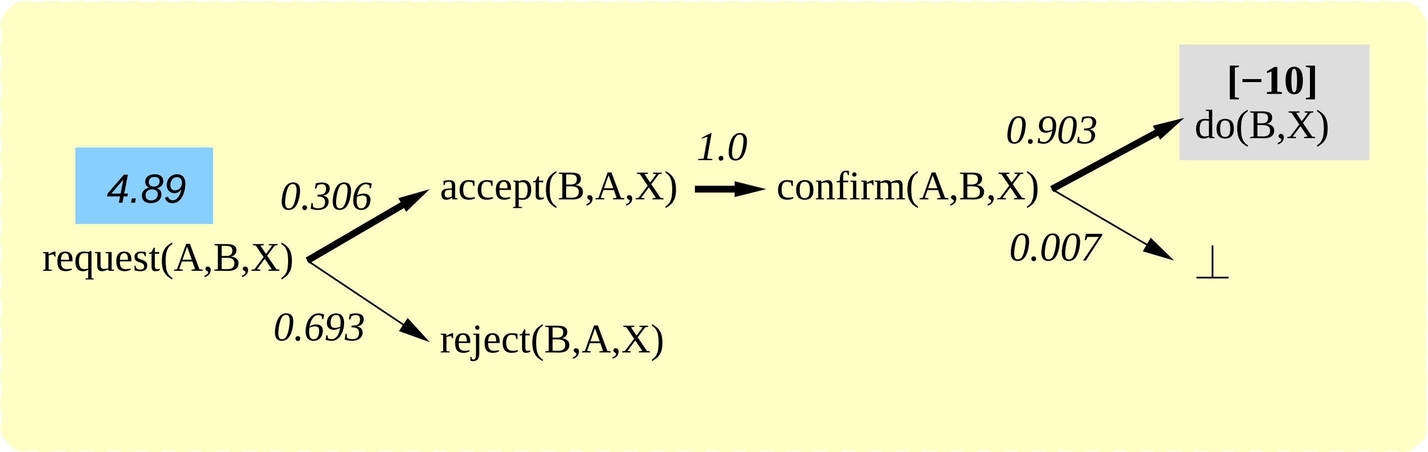
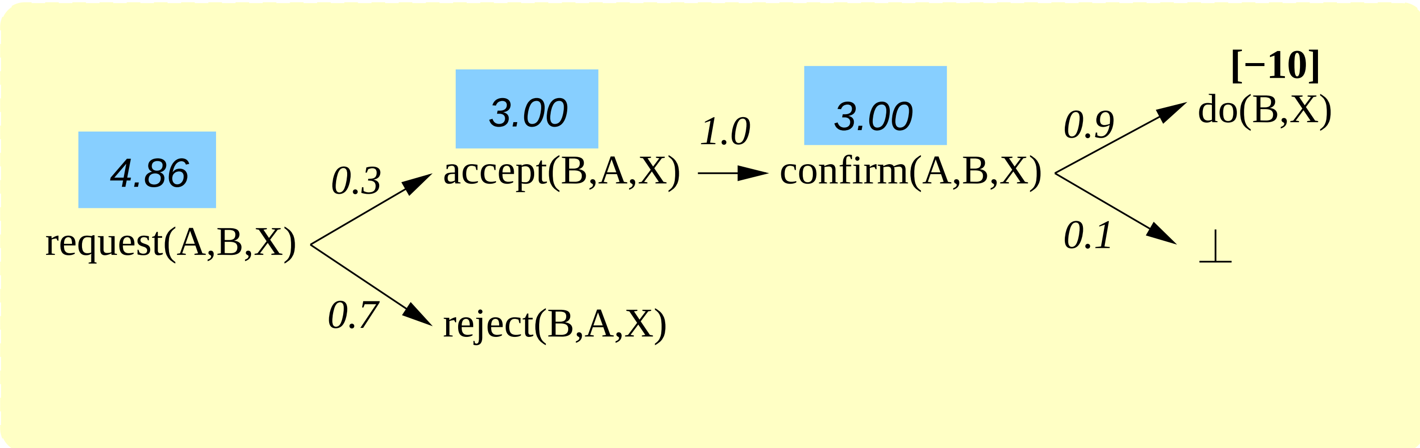
Entropies: after executing undesirable action

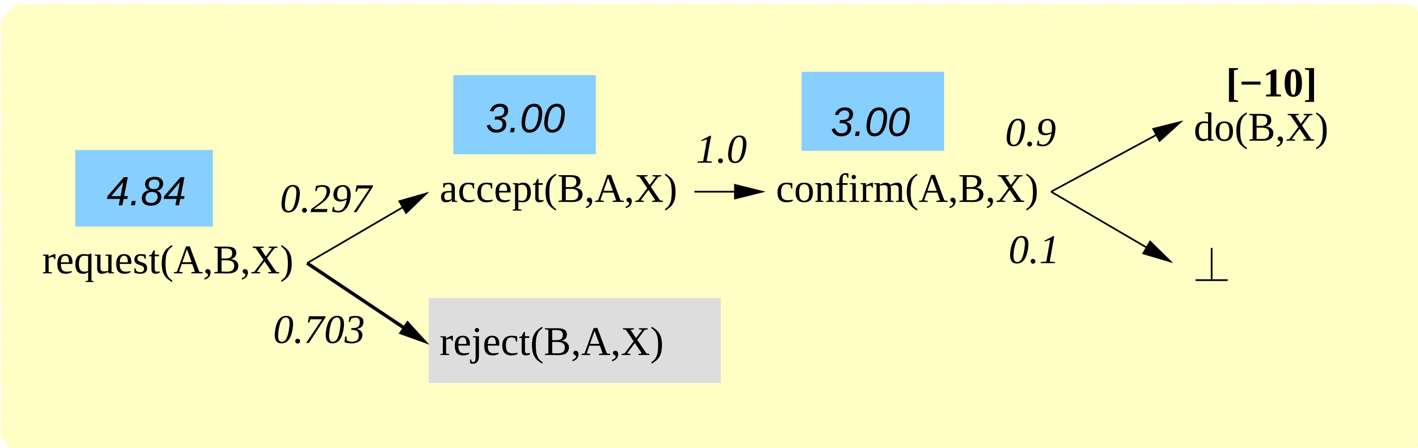




Example

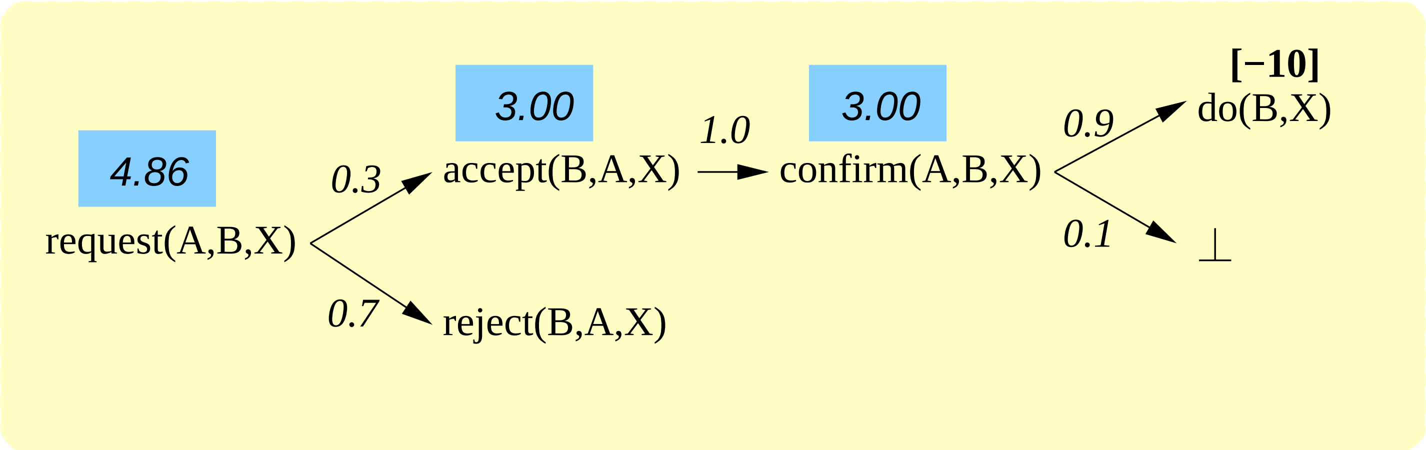
External paths: the effect of “reject”

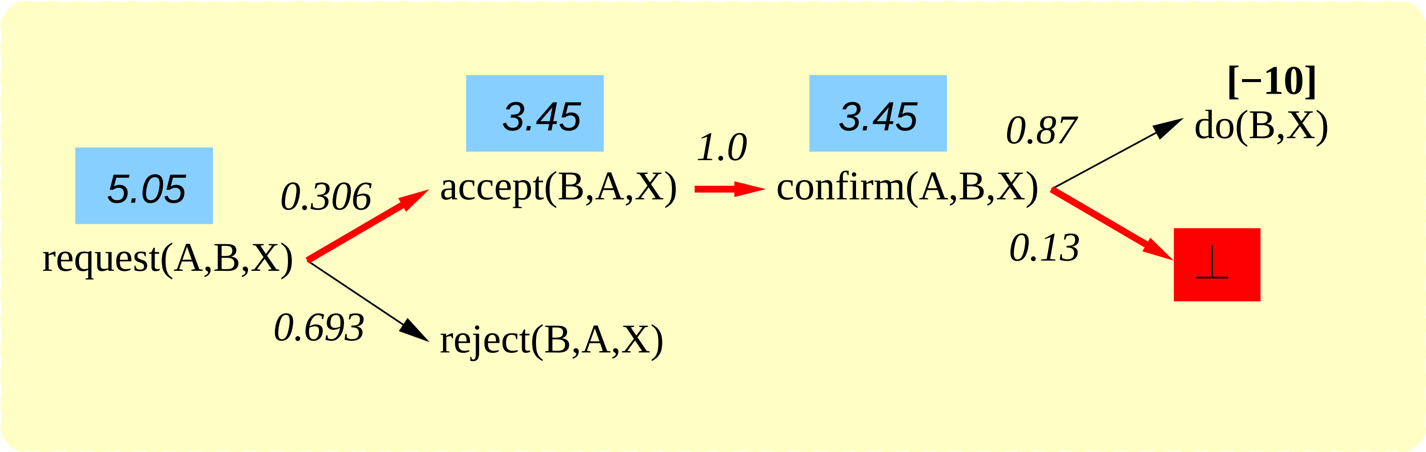




Example

Critical paths: the effect of “cheating”





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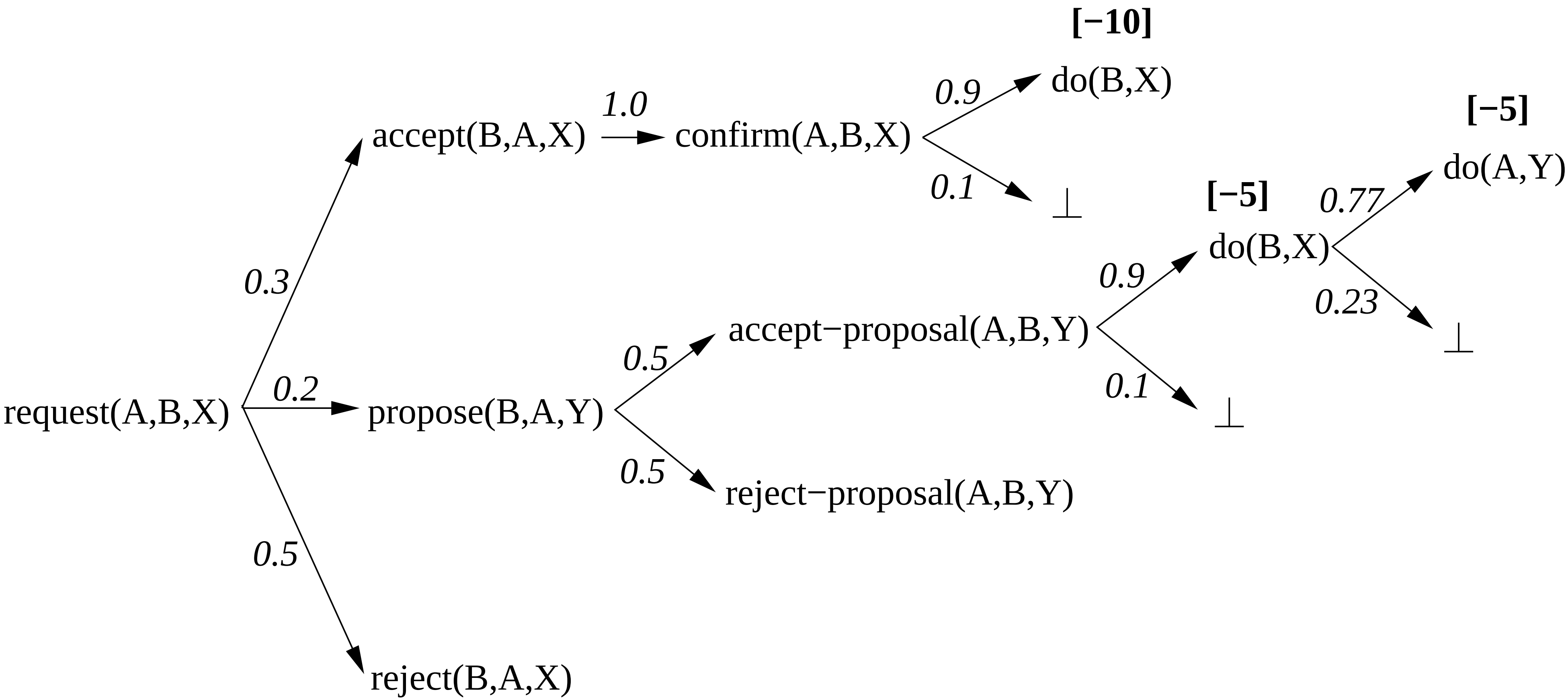
Back to complex protocol:



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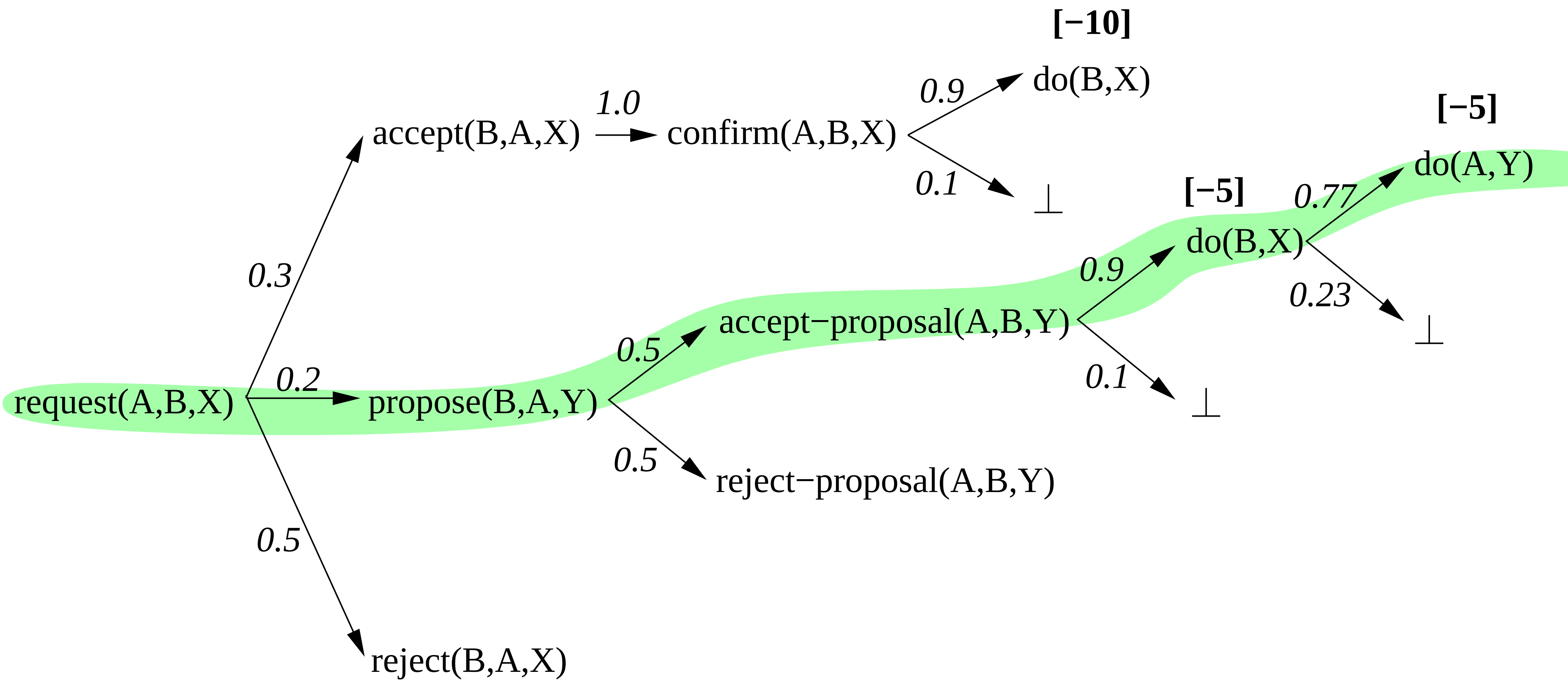
Successful completion:



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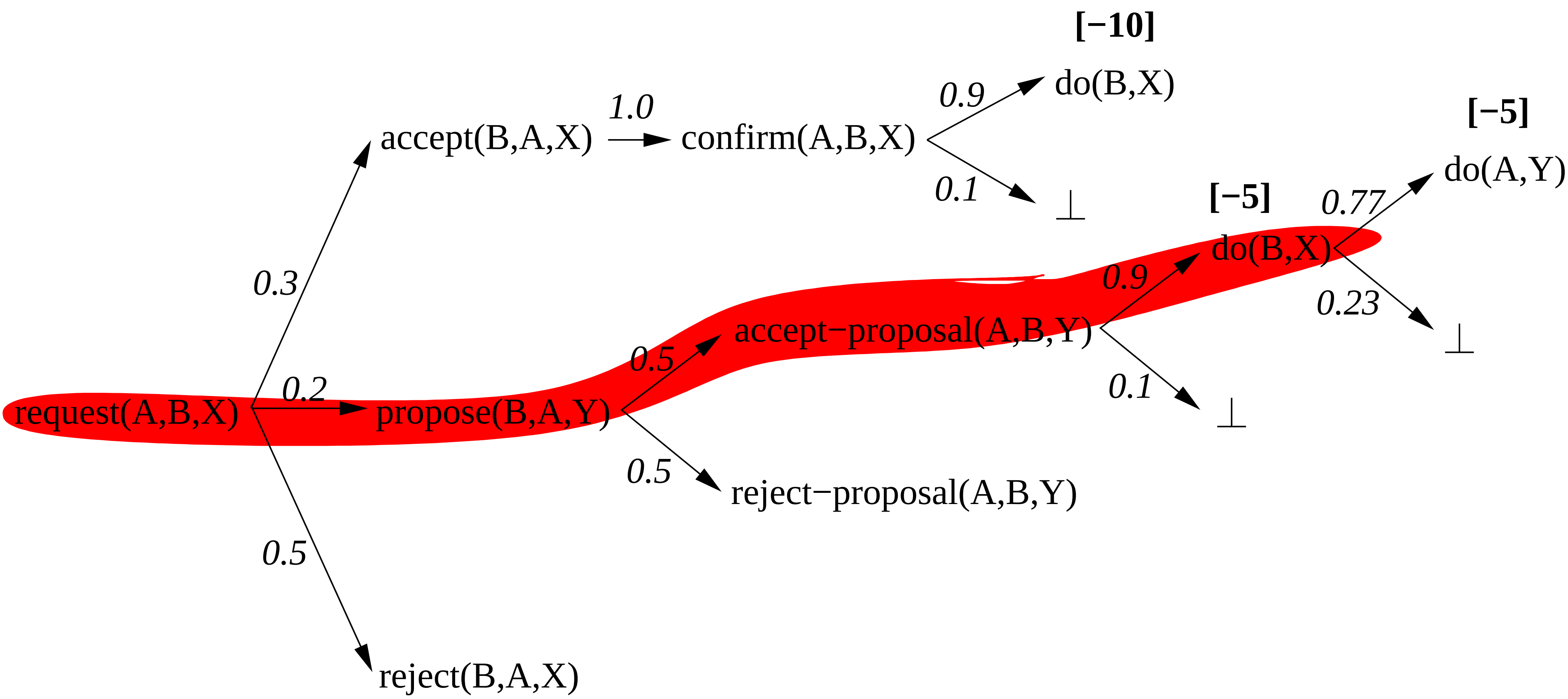
A cheats:



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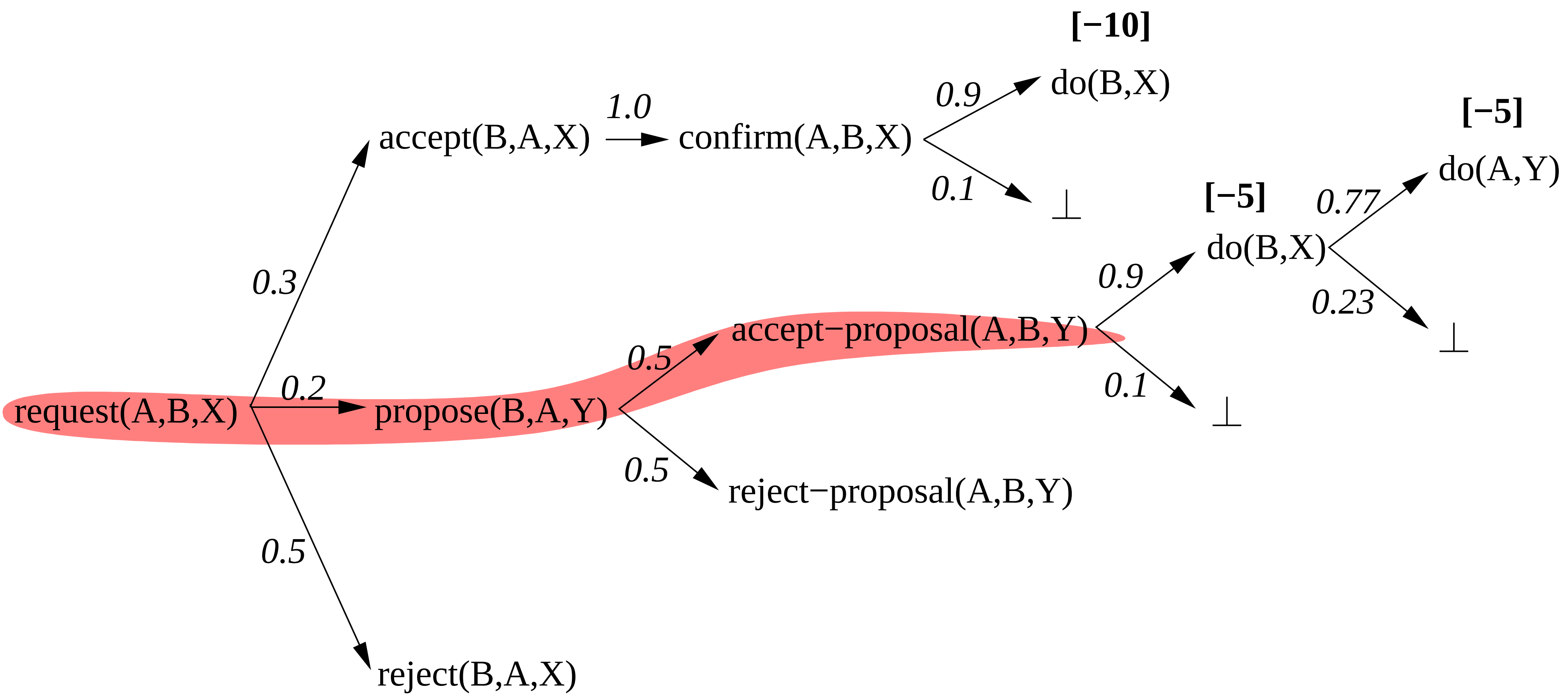
B cheats:



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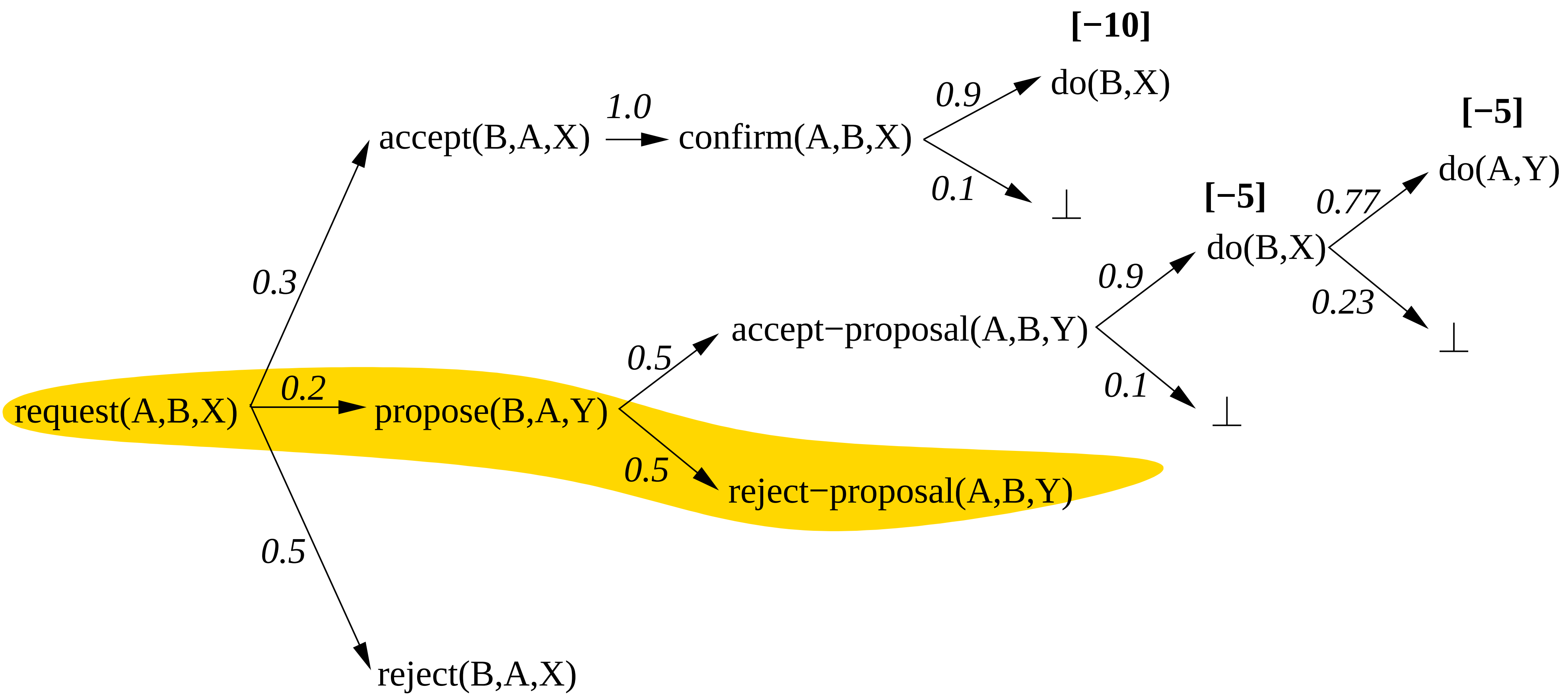
Rejection:



Trajectory Shapes

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- "perfect" entropy curves consist of **autonomy** and **commitment** part

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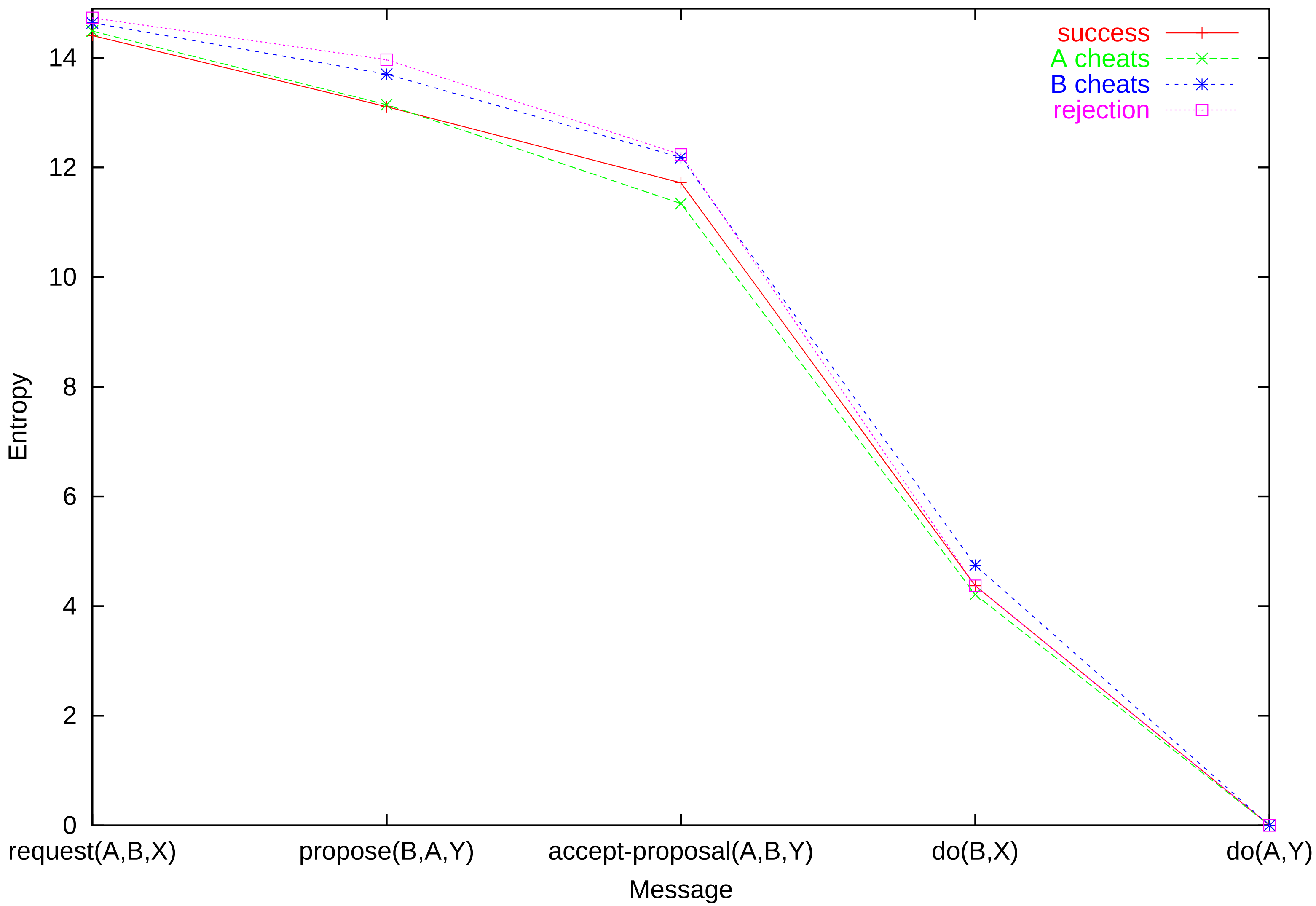

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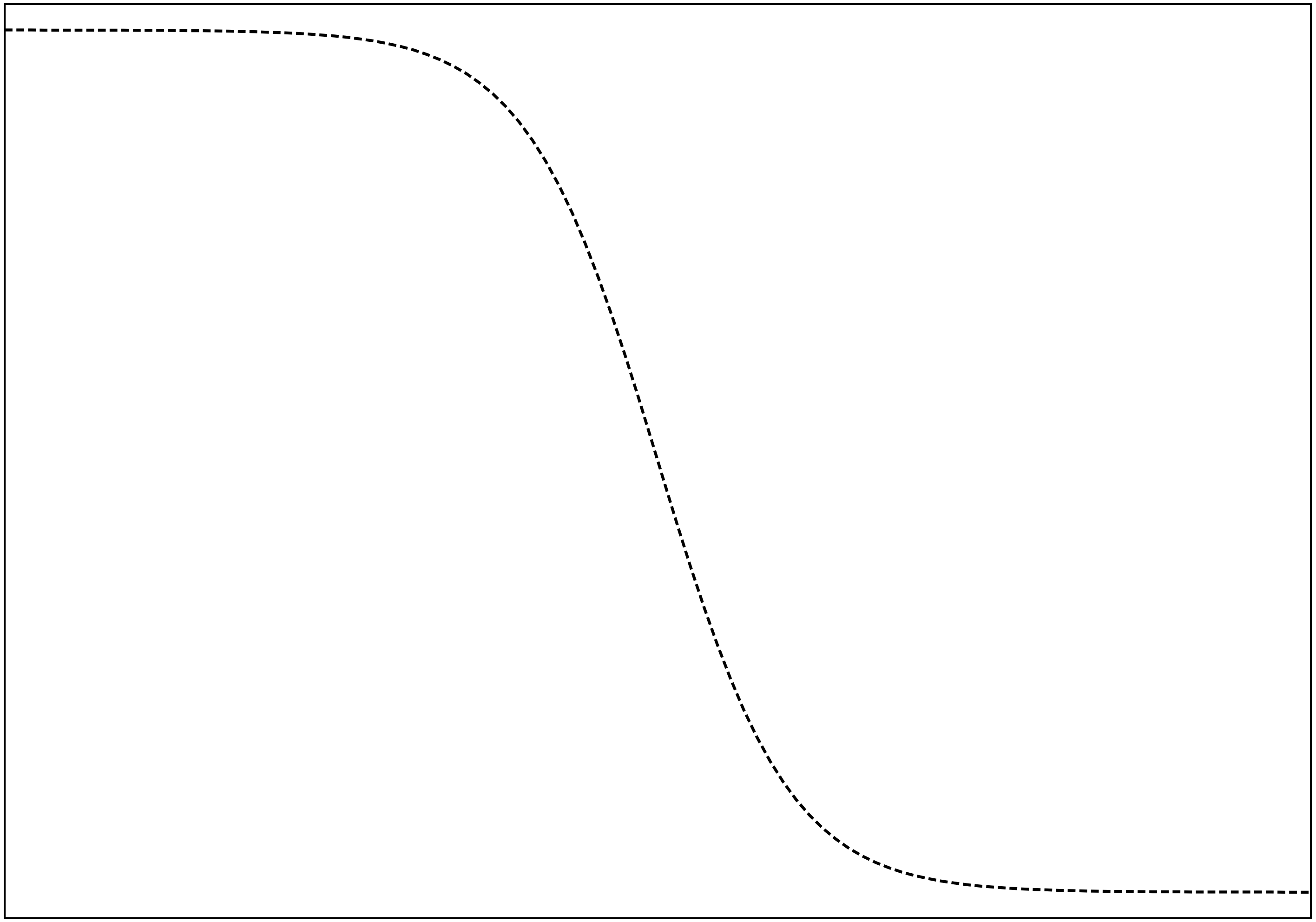

Conflict Potential

- If $\mathcal{F}'$ is the product of w' in $\mathcal{F}$, define:

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- Example:

$$\Delta\mathcal{E}(\text{“success”}, \text{“A cheats”}) - \Delta\mathcal{E}(\text{“success”}, \text{“success”})$$

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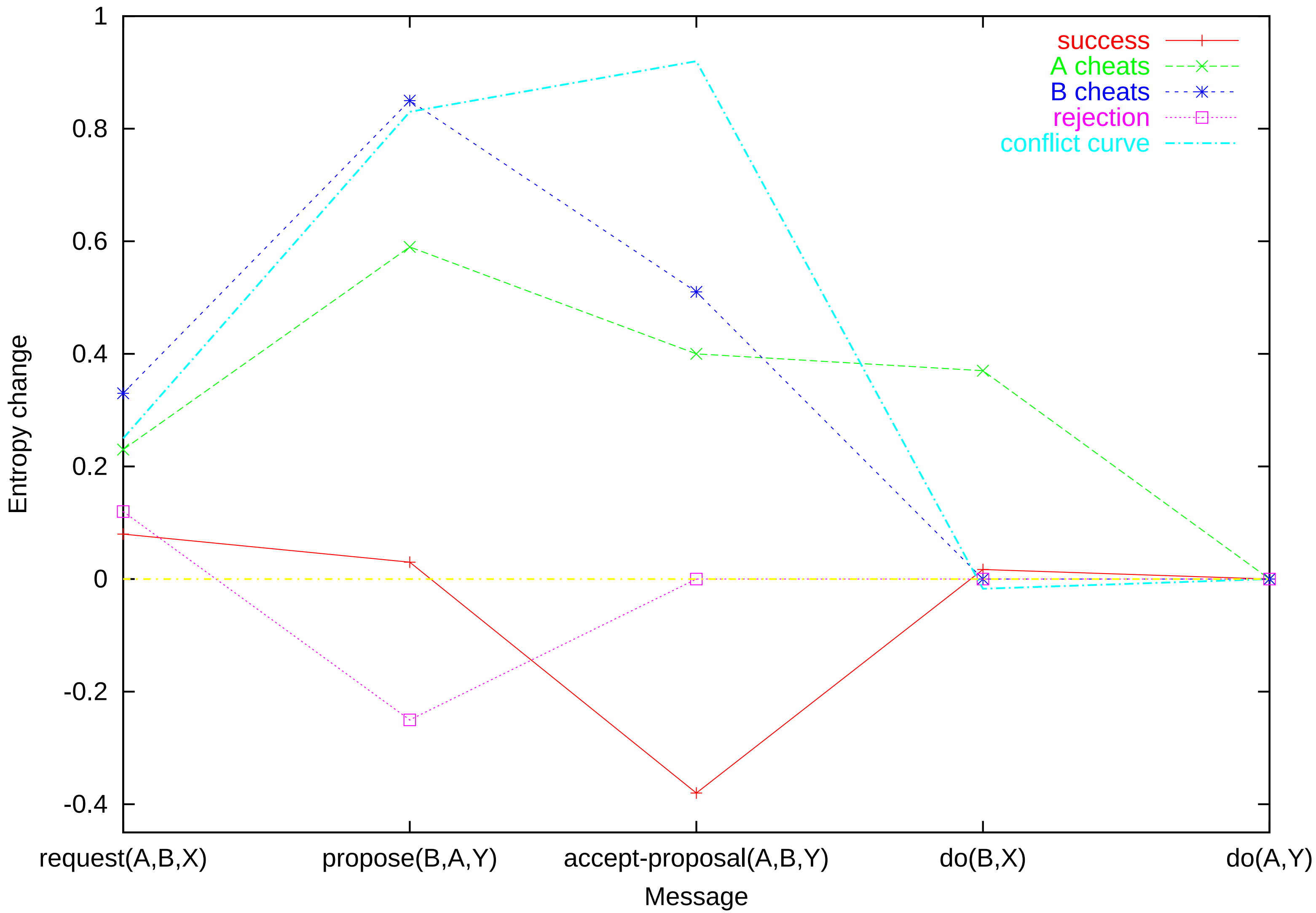

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- suggested methods for analysis
- domain-independent definition of conflict (potential)
- ready to be used by *agents* (and designers)

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- reasoning about “utility” of semantics
  ➡ link to agent interests ➡ meaning

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Thank you for your attention!