Conflict Search Graph for Common Ground Consistency checks in Dialogue Systems

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Definitions

Common Ground Inconsistencies

the incompatibility between the listener belief and the new evidence provided by the speaker.

Communal Common Ground [CCG]

The amount of information shared with people that belong to the same community [1].

Personal Common Ground [PCG]

The amount of information collected over time through communicative exchanges with an interlocutor [1].

The domain D is defined as a set of frames F corresponding to the set of sequential actions $A \in T_{task}$

Each $a_i \in A$ is associated with a set of states S_i (pre-conditions s_pre or post-conditions s_post)

Conflicts arise when:

- i) s_pre is incompatible with the rules of the CCG.
- ii) s_pre is incompatible with the current a, as it cannot co-exist with the s_post resulting from a preceding a, saved in the PCG.

Architecture

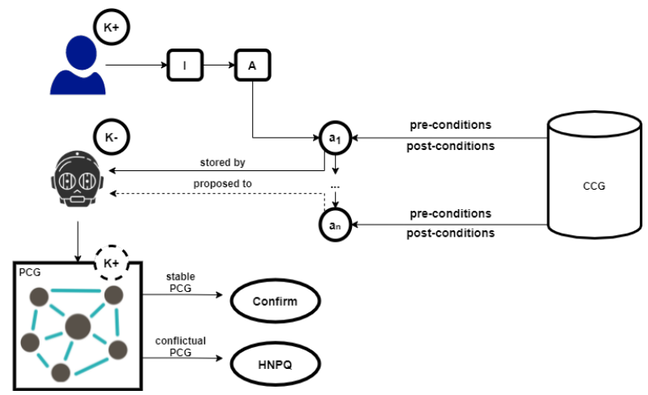

Fig. **1**. Model of the system applying inconsistencies recovery strategies to the dialogue, i.e., High Negation Polar Questions (HNPQ) as a Clarification strategy.

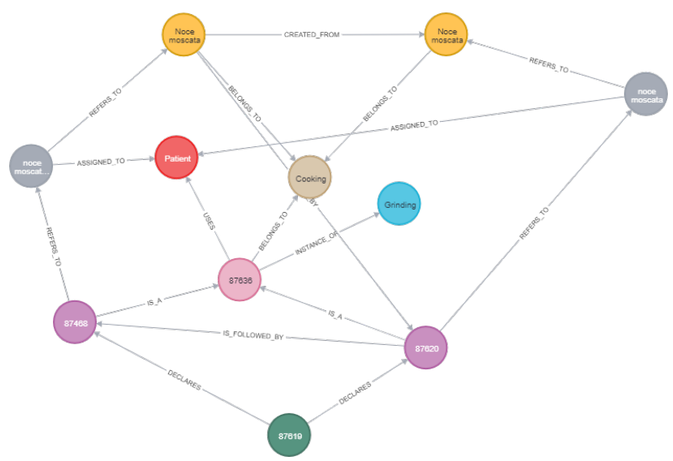

Fig. **2**. Conflict Representation in the PCG.

Conflict Detection

The Conflict Search Graph is a Neo4j-based [2]) graph

$$D = \langle V, E \rangle$$

E are defined as functions between $v_1, v_2 \in V$.

$stable(PCG) \implies \forall a_i \in A, \forall a_j \in A | j < i \wedge pre(a_i, p) \wedge post(a_j, p)$
$conflict(PCG) \implies \exists a_i \in A, \exists a_j \in A | j < i \wedge pre(a_i, p) \wedge post(a_j, \neg p)$

A new candidate action to be included in the CG can be defined as the following tuple

$$X = \langle a_n \rangle, < \bar{N}, \bar{E} >$$

where a_n is a new action, $\bar{N}$ is a set of named entities, $\bar{E}$ is a set of new edges. At any time t, G_t represents the CG configuration at time t. Updating G by accepting X means creating a new graph $G' =< V', E' >$ where $V' = V \cup a_n \cup \bar{N}$ and $E' = E \cup \bar{E}$. G', can be accepted only if G' is stable, so

$$G_{t+1} = G' \; if \; stable(g') \; else \; G$$

With the use of specific queries on a set of 20 different recipes, the graph detected **85%** of the conflicts.

References

[1] Eve V. Clark. 2015. *Common ground.* The Hand-book of Language Emergence, page 328–353. Wiley, Chichester, UK.

[2] Jim Webber. 2012. *A programmatic introduction to neo4j.* InProceedings of the 3rd annual conferenceon Systems, programming, and applications: soft-ware for humanity, pages 217–218.