Ambiguity in Requirements Engineering

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Scope

- Ambiguity in written requirements (a little)
- Ambiguity in requirements elicitation interviews (a little more)
- I will not mention ambiguity in other phases (analysis, negotiation)
- Pointers to papers will be provided

(Sorry if you already saw part of the content of this presentation)
Definition(s) of Ambiguity (from Berry, Kamsties and Krieger, 2003)

- Focus on WRITTEN natural language (NL) requirements
- **Dictionary Definition:** (1) the capability of being understood in two or more possible senses or ways; (2) uncertainty
- **Software Engineering:** There are two major types of ambiguities:
  - Language ambiguities (lexical, syntactic, etc.)
  - Software engineering ambiguities – depend on the domain involved, require domain knowledge to be identified
- Some authors consider only **expression inadequacy** as source of ambiguity
- Others consider **missing information** as an additional source – people leave out self-evident facts
- Ambiguity is related to **incompleteness**

“ambiguity” is ambiguous!
Ambiguity in RE (from Berry, Kamsties and Krieger, 2003)

Property of an expression of being interpreted in multiple ways

- **Vagueness:** the sentence admits borderline cases (e.g., *Avoid long C functions*)

- **Generality:** the sentence/term needs to be specified more (e.g., *The interface shall be coded in Java*)

- **Lexical ambiguity:** term has different unrelated vocabulary meanings (e.g., *bank*)

- **Syntactic ambiguity:** sentence has more than one syntax tree (e.g., *Structured approaches and tools*)

- **Semantic ambiguity:** sentence can be translated into more than one logic expression (e.g., *All lights have a switch*)

**Pragmatic ambiguity:** the meaning depends on the context – other sentences, domain knowledge, common-sense, viewpoint
There is a MOLE at WORK
mh...
Towards Ambiguity in Interviews (RE’15)

- Several automated procedures for other types of ambiguity (QuARS, ARM, SREE, etc.)
- We wanted to study pragmatic ambiguities, but we needed data
- With Paola Spoletini, we started to perform interviews, to get the data we needed
- We performed 34 unstructured interviews
- We annotated all the cases that the analyst perceived as ambiguous (232)
- It became clear that a new classification was needed
Example: Fitness Tamagochi

Customer: You can decide what type of character you want to create.

Requirements Analyst: So you can choose the character?

Customer: Actually, you cannot. You can possibly become a specific character.

Requirements Analyst: Tamagochi does not let you choose the character.
Customer: I want the train to stop within 50 meters if a red signal is passed.

Requirements Analyst: It may not be possible if you go at 130 km/h.

Customer: I meant, in shunting mode [max: 30 km/h].

Requirements Analyst: Trains going at full speed need hundreds of meters to stop.
Ambiguity seemed to be connected to incompleteness and inconsistency!
Definition of Ambiguity

Ambiguity in Interviews

An ambiguity occurs in a requirements elicitation interview when a customer articulates a unit of information, and the meaning assigned by the requirements analyst to this articulation differs from the meaning intended by the customer.

- **Unit of information**: system need or domain-related aspect
- **Articulation**: any speech fragment
- **Meaning**: contextual meaning

We include cases in which the analyst cannot give any interpretation
The Context of the Analyst (REJ’16)

INTERPRETATION

ACCEPTANCE

SPEECH

FRAGMENT

ACCESS

Requirements

Goals

Domain

Specifications

D-Goals

D-Rules

D-Application

Context
Ambiguity Types: Correct Disambiguation
Ambiguity Types: Correct Disambiguation

- What I hear has an interpretation
- The interpretation matches with the one intended by the customer
- The interpretation is consistent with the context
- The interpretation appears sufficiently complete
Ambiguity Types: Interpretation Unclarity

Customer

Requirements Analyst
Ambiguity Types: Acceptance Unclarity (Train)

Customer

Requirements Analyst
Ambiguity Types: Detected Incorrect Disambiguation (Tamagochi)
Ambiguity Types: Undetected Incorrect Disambiguation
Ambiguity Types: Multiple Understanding

Customer

Requirements Analyst
Which are the Triggers? (RE’16)

- **Under-specified terms (U):** people, knowledge, movement, area, rule, data, category, interface, thing, detail
  - “The interface shall be coded in Java”

- **Vague terms (V):** minimal, as much as possible, later, taking into account, based on, appropriate
  - “The loading time shall be minimal”

- **Pronouns (P):** he, she, it, this, those, which, that
  - “The system sends a message to the receiver, and it sends an acknowledge message”

- **Quantifiers (Q):** all, for each, many, some, both
  - “All lights have a switch”

- **Domain-specific terms (D-S):** connoisseurship method, herpes zoster, systemic disease, Program
Same Category of Trigger, but Different Ambiguity Type

Example 1 - Under-specified Term → Multiple Understanding

- Mobile application that monitors the use of the mobile phone
- **Example:** “Maybe the system could give me also some recommendations”
- Interpretations: *positive* (this app could be useful to you) or *negative* recommendations (do not use this app)
Example 2 - Under-specified Term → Undetected Incorrect Disambiguation

- A system to monitor the diet of patients for research purposes
- **Example**: “We analyse a representative sample of the population”
- representative sample == volunteers (Undetected incorrect disambiguation)
- “People tell lies about their diet” (Acceptance unclarity)
- representative sample == randomly selected people
Observations

- The majority of ambiguity cases were due to under-specified terms and by fragments.
- Example: “I want the train to stop within 15 meters if a red signal is passed”; “I can go and ask for a product” (go WHERE?)

- Current research concerning triggers in NL requirements accounts for about 10% of the ambiguity cases in interviews (pronouns, quantifiers and vague terms).
- The remaining 90% of the cases (under-specified, domain-specific and fragments) require further research.
I take a sample of the population to survey.

The sample is composed of volunteers.

The sample is composed of randomly selected people.

People lie.

Volunteers do not lie.
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