Motivation

Positionalism
Standard view
Positionalist
Anti-positionalist

Assessment of FOM
FOM's basic elements
Conceptual analysis methodologies
Consequences on other usage of conceptual models

Conclusions

Positionalism of relations and its consequences for fact-oriented modelling

C. Maria Keet

KRDB Research Centre, Free University of Bozen-Bolzano, Italy
keet@inf.unibz.it

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- There exist several modelling paradigms (start from NL, examples, drawing diagrams)
- There exist several formalisations of Fact-Oriented Modelling languages with facts, roles, predicates, etc (Halpin's PhD, PSM, LISA-D, DL versions, etc.)
- The challenge of developing *one* core metamodel of FOM
- **Do they convey a fundamental, ontological, difference?**
  - A byproduct of the different interfaces available in the modelling tools?
  - A modeller's habits and personal preferences?
  - What if it does constitute a difference, and where?
  - Should a modeller care at all?

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- There is a difference, and one should be careful
- Different ontological commitments concerning the so-called positionalism of relations
- Consequences for, a.o.:
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On relations

- Early ideas were put forward by [Wil85] and have been elaborated on and structured in [Fin00, vI06, Leo08, Cro02]
- Three different ontological commitments about relations and relationships, which are, in Fine's [Fin00] terminology, the *standard view*, the *positionalist*, and the *anti-positionalist* commitment

The 'standard view' commitment

- Relies on linguistics and the English language in particular
- Take the fact *John loves Mary*, then one could be led to assume that *loves* is the name of the relation and *John* and *Mary* are the objects participating in the relation
- Then *Mary loves John* is not guaranteed to have the same truth value as the former fact—changing the verb does, i.e., *Mary is loved by John*
- We (seem to) have two relations, *loves* and its inverse *is loved by*

Problems with the 'standard view' (1/2)

- First, generally, for names *a* and *b*, *a loves b* holds iff what *a* denotes (in the reality we aim to represent) loves what *b* denotes.
- *John loves Mary* is not about language but about John loving Mary, so John and Mary are non-linguistic; cf. *'cabeza' translates into 'head'*
- Then, that John loves Mary and Mary is being loved by John refer to only one state of affairs between John and Mary
- Why should we want, let alone feel the need, to have *two relations* to describe it?

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Toward the 'positionalist' commitment

- Designate the two aforementioned facts to be relational expressions and not to let the verb used in the fact automatically also denote the name of the relation
- Then we can have many relational expressions standing in for the single relation that captures the state of affairs between John and Mary
- In analogy, we can have many relational expressions for one relationship at the type level

Problems with the 'standard view' (2/2)

- Second, the specific order of the relation: changing the order does not mean the same for verbs that indicate an asymmetric relation; different for some other languages.
- Consider *John kills the dragon*. In Latin we have:
  Johann<u>us</u> anguigen<u>am</u> caedit, or
  anguigen<u>am</u> caedit Johann<u>us</u>, or
  Johann<u>us</u> caedit anguigen<u>am</u>,
  which all refer to the same state of affairs
- But *Johann<u>um</u> anguigen<u>a</u> caedit* is a different story alltogether
- Likewise for *John loves Mary* and *Johannus Mariam amat* versus *Johannum Maria amat*.

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Toward the 'positionalist' commitment

- A linguistic version of *argument places* (roles) thanks to the nominative and the accusative that are linguistically clearly indicated
- The order of the argument places is not relevant for the relation itself
- English without such declensions that change the terms so as to disambiguate the meaning of a relational expression
- *Inverses for seemingly asymmetrical relations necessarily exist in reality and descriptions of reality in English, but not in other languages even when they represent the same state of affairs???*
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The 'positionalist' commitment

- Binary relation *killing* and identify the argument places—"argument positions" [Fin00] to have "distinguishability of the slots" [Cro02]—*killer* and *deceased* (loosely, a place for the nominative and a place for the accusative), assign *John* to *killer* and *the dragon* to *deceased* and order the three elements in any arrangement
- Relation(ship) and several distinguishable 'holes' and we put each object in its suitable hole.
- There are no asymmetrical relations, because a relationship R and its inverse R^{-}, or their instances, say, r and r', are *identical*, i.e., the same thing [Wil85, Fin00, Cro02]

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The 'positionalist' commitment

- Ingredients
  - (i) an n-ary relationship R with $A_1, \ldots, A_m$ participating object types ($m \leq n$),
  - (ii) n argument places $\pi_1, \ldots, \pi_n$, and
  - (iii) n assignments $\alpha_1, \ldots, \alpha_n$ that link each object $o_1, \ldots, o_n$ (each object instantiating an A_i) to an argument place ($\alpha \mapsto \pi \times o$)
- R, π_1, π_2, π_3, $r \in R$, $o_1 \in A_1$, $o_2 \in A_2$, $o_3 \in A_3$, then any of $\forall x, y, z(R(x, y, z) \rightarrow A_1(x) \wedge A_2(y) \wedge A_3(z))$ and its permutations with corresponding argument places—i.e., $R[\pi_1, \pi_2, \pi_3]$, and e.g., $R[\pi_2, \pi_1, \pi_3]$, and $[\pi_2\pi_3]R[\pi_1]$—all denote the same SoA under the same assignment o_1 to π_1, o_2 to π_2, and o_3 to π_3 for the extension
- Thus, $r(o_1, o_2, o_3)$, $r(o_2, o_1, o_3)$, and $o_2 o_3 r o_1$ are different representations of the same SoA where objects o_1, o_2, and o_3 are related to each other by means of relation r.

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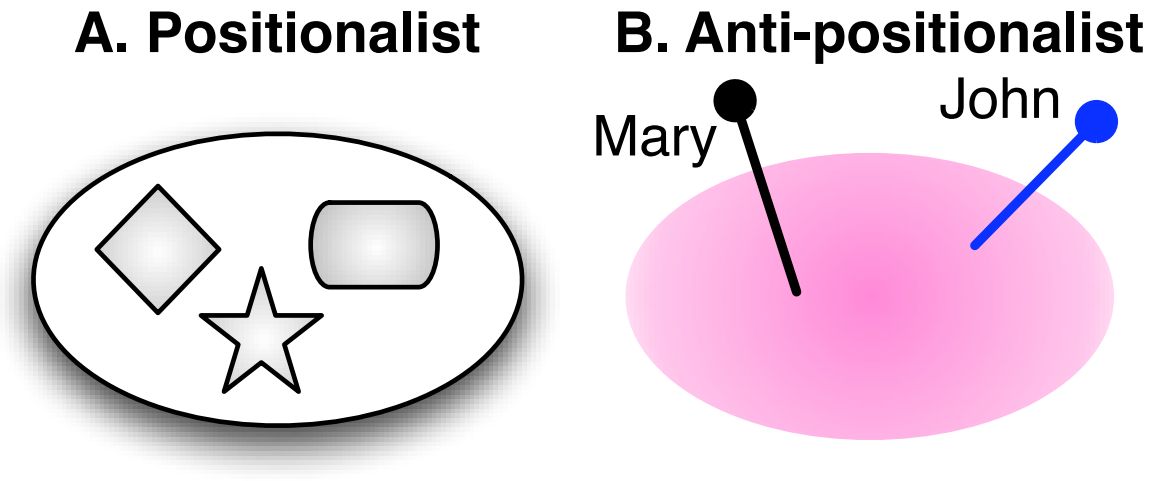
Graphical depictions



Problems with the 'positionalist' commitment

- From an ontological viewpoint, it requires identifiable argument positions to be part of the fundamental furniture of the universe.
- Practically, it requires something to finger-point to, i.e, to reify the argument places, and use it in the signature of the formal language, which is not clean and simple
- Symmetric relations, such as *adjacent to*, and relationships are problematic:
  i. Take π_a and π_b of a symmetric binary relation r, assign o_1 to position π_a and o_2 to π_b in state s.
  ii. One can do a reverse assignment of o_1 to position π_b and o_2 to π_a in state s'
  iii. But then o_1 and o_2 do not occupy the same positions as they did in s, so s and s' must be different, which should not be the case.

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The ‘anti-positionalist’ commitment

- No argument positions, but just a relation and objects that yield states by “combining” into “a single complex” [Fin00]
- Solves the problems with the standard view
- Solves the positionalist’s problem with symmetric relations
- (How to formalise this idea in a KR language is another problem)

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Example

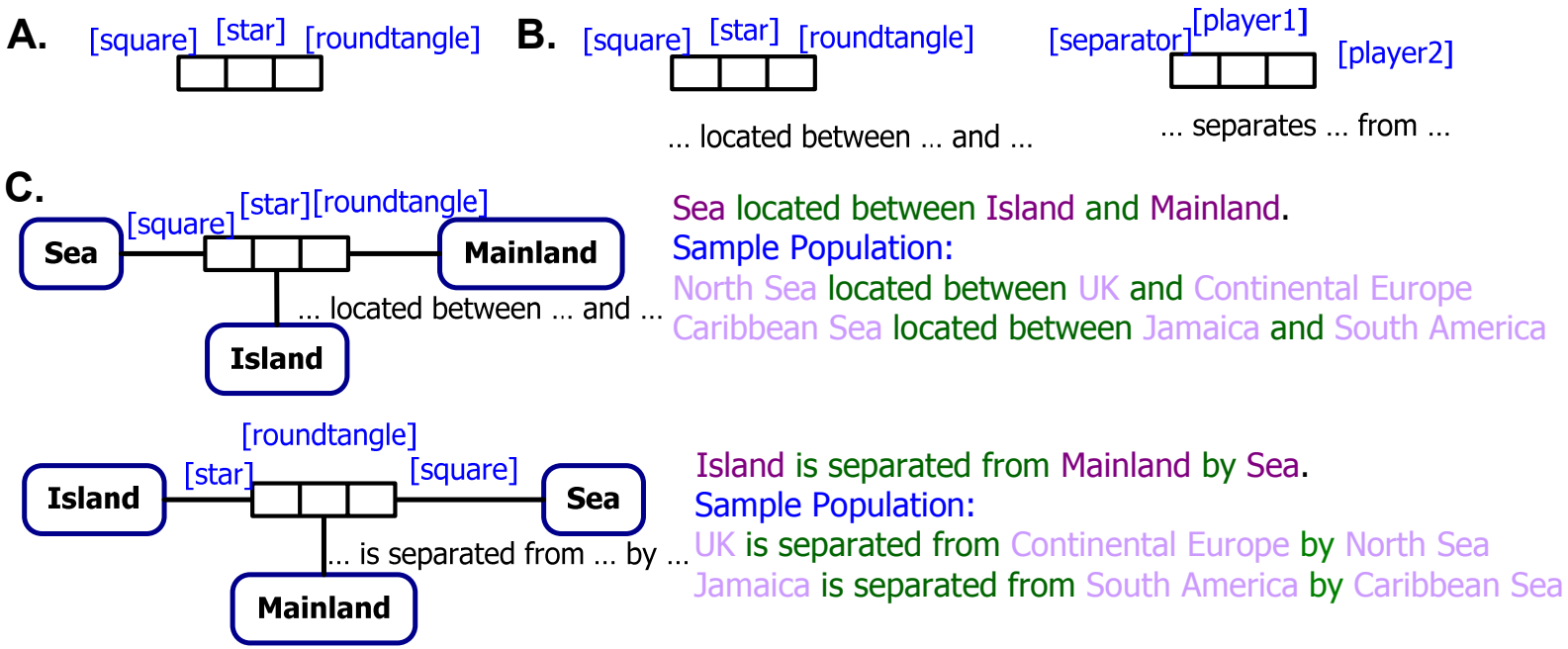

Figure: Positionalist examples in ORM. A: an ORM diagram rendering of Fig. 7-A; B: a reading added and a possible generalization of it, naming the relationship, e.g. *betweenness*; C: sample fact types and populations.

Different formalisations—different commitments

- Halpin [Hal89]: "$\forall xy(xRy \rightarrow Ax\&By)$" and "[w]e regard our ordered predicate notation and the unordered role notation as different only in their focus... In both approaches we see a linguistic structure in which objects play various roles with respect to the verb or relationship" (p4-3)
- Ter Hofstede's PSM and LISA-D [tHPvdW93, tHP98], Keet [Kee07]:
  - finite set $\mathcal{R}$ of roles, a function $Roles : \mathcal{F} \mapsto \mathcal{R}^{+}$ that "provide[s] a partition of roles over the relationship types", relationship types, and several auxiliary functions
  - "DL role elements" that correspond to ORM roles; one of the concept constructors in $\mathcal{DLR}_{ifd}$ is $[\$i]\mathbf{R}$ where i denotes a component of the relationship $\mathbf{R}$; e.g., a typed relation *loving* between two classes C and D is represented as `loving` $\sqsubseteq$ `[lover]C` $\sqcap$ `[beloved]D`.

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Different formalisations—different commitments

- Jarrar and Meersman [JM08]: "[a] lexon is a binary relationship between context-specific linguistic terms, or in other words, a lexical rendering of a binary conceptual relation.", denoted with $< \gamma : T_1, r, r', T_2 >$,
  "r and r' are lexicalizations of the pair roles of a binary conceptual relationship R; the role r' is the inverse of the role r".
  Their FOL as "$\forall x.y\ r(x, y) \leftrightarrow r'(y, x)$"

Development, use, and reuse

- No asymmetry constraint in an ORM diagram
- 'Wait' until a/several verbalisation(s) is agreed upon (standard-view) vs. the relationship (positionalist)
- Easier (re)use of (parts of) conceptual data models and ontologies with the positionalist:
  - Reuse of relations (e.g., part-whole relations [KA08]), alike UML's stereotyped association
  - Reuse of (parts of) conceptual data models, alike conceptual model design patterns
- FOM tools make different commitments (principal incompatibility), even within the tool
  - Constrain the diagrams to the standard view
  - E.g., enforce other readings, alike introducing the notion of argument places "the role played by X is called ..." or "Xs play the role of ... in relation R"

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Other issues

- Interoperability with other conceptual data modelling languages (UML positionalist, ER anti-positionalist) and going back- and forward between them
- Database reverse engineering easier with the positionalist and anti-positionalist
- Generating models from text easier with the positionalist and anti-positionalist
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Conclusions and future directions

- The underlying ontological commitments concerning the positionalism of relation(ship)s in FOM differ, being the standard view and positionalist commitments
- This duality demonstrates itself in the extant formalisations of and tools for FOM
- This affect transparency, hamper transition between the two approaches, and influence the modelling methodologies, and model use and reuse

Conclusions and future directions

- Options either to adopt the limited standard view only and remove the flexibility of arbitrary role positions in FOM diagrams, or to accept that some fact types that may not be verbalisable
- FOM's standard view vs. positionalist: The positionalist commitment has the advantages that it facilitates data integration, conceptual model interoperability, reusability of FOM models, and model quality enhancements through use of ontologically-well founded relationships

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