General Knowledge Representation And Sharing For Disaster Management

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Goal: *General* Knowledge Sharing

Knowledge (Representations; KRs):

information, at least partially, represented and organized

– in some logics

– via by semantic relations

(subtype, part, instrument, result, time, place, ... and 100s more)

Knowledge Base (KB):

– ontology (set of formal terms + KRs *defining* them)

– base of facts (KRs about objects that are not types)

Not just a database!

Goal: *General* Knowledge Sharing

***General* Knowledge Sharing (KS):**

designing+relating KBs so that their KRs are reusable for/by ANY application

- → not just what most KS techniques (e.g. those of the W3C) only support:
  - "B2B KS"
  - a "Semantic Web" aptly renamed "Dataweb" by the W3C

- useful for *disaster management* (not restricted to particular applications)

Plan

1. **Panorama of complementary ways** to support general knowledge sharing
   1.1. Tools to ***import/export*** *any kind of knowledge,* ***in any formal language***
   1.2. ***General-purpose ontologies*** aligning top-level ones and lexical ones
   1.3. KB servers that support ***non-restricting KB Sharing*** by Web users
   1.4. KB servers that support ***networked KBs***

2. **Examples** of representations for general Knowledge Sharing
   in *disaster management*

1.1. Tools to *import/export any* kind of knowledge, *in any formal language*

- Problems: most KR languages (KRLs)
  - have expressiveness restrictions (→ restrict or bias KS), and/or
  - are low-level (→ hard to read, not normalizing)

- Solutions:
  - concise+expressive+high-level KR notations, e.g. FE and FL
  - exploitation of an ontology of KR models and notations

1.2. *General-purpose* ontologies aligning top-level ones and lexical ones

- Problems: “reusable” ontologies are hardly reused and hard to reuse together.

  E.g.:

  – different KBs hardly top-level ontologies and lexical ones, or the same ones, because

  – most reusable ontologies (top-level ontologies, lexical ones, ...) are not/poorly aligned.

- Solution: general-purpose ontologies aligning top-level ones and lexical ones, in KB servers (cf. 1.3 and 1.4).
  Example of core for that: the MSO of the WebKB-2 server.

1.3. KB servers that support *non-restricting* KB Sharing by Web users

- Problem: searching/merging/sharing/reusing/... knowledge is made difficult by the lack of relations between terms/knowledge from different users (and hence also by the inconsistencies and redundancies between these KRs)

  – are insufficiently used (e.g. because the W3C guidelines and most research are about (semi-)independently developped KBs)

  – restrict what can be entered: restricted KRLs/domains, unscalable ways of keeping the KB consistent (commitees, consensus, ...)

  – lack features for keeping an unrestricted "multi-authored KB" organized and easy to search/use/...

1.3. KB servers that support *non-restricting* KB Sharing by Web users

- Solution: using KB servers with KS protocols that maintain the organisation of shared KBs without requiring any restriction of content/KRL/...
  [details are given by the next slide but, because of time constraints will only be discussed, if needed, at question time]

1.3. [question time] KB servers that support *non-restricting* KB Sharing by Web users

- Solution: using a system (KRL + KS protocol + interface) that
  - leads each term and KR to be associated to its author
    → each statement becomes eit+her a belief or a term definition
    (note: such an association cannot be represented/exploited in OWL)
  - leads each “newly entered KR k1 that is inconsistent or redundant with an already entered KR k2” to be related to k2 (by k1's author) via a relation of correction and/or implication and/or specialization
    (plus, in case of correction, a formal or semi-formal argument for it)
    → conceptual searches can be performed by navigating or querying these relations even if the KRs are semi-formal
    → for inference purposes, choices between conflicting KRs can be automatically made based on their relations and information about their authors
    → information orverload is avoided by its organization and the possibility to set filters for not seing particular kinds of KRs or KRs from particular authors
    → edit wars and discussions are resolved/avoided by leading to the accumulation of precisions (hence more and more formal ones; the process converges to a fully specified formal and consistent KB)
  - handle removals/updates by
    - storing and exploiting statements about correction relations, or
    - term cloning mechanisms

  → solves the problems of module/document based versionning systems

1.4. KB servers that support *networked KBs*

- Problems:
  - same ones as in 1.3
  - Web users need to know (and choose) which KBs to update or query
  - current knowledge distribution mechanisms are "database schema based" or centralized

- Solution: a network of KBs that acts as a unique shared KB, based on notions of
  - intensional scope: specification of the kinds of objects (terms or KRs) that a KB is committed to accept from Web users
  - KR update/query forwardings to all *relevant* KBs, given their Web-published scopes

2. *Examples* of representations for general Knowledge Sharing

2.1. Organization of a small **terminology** about Disaster Risk reduction

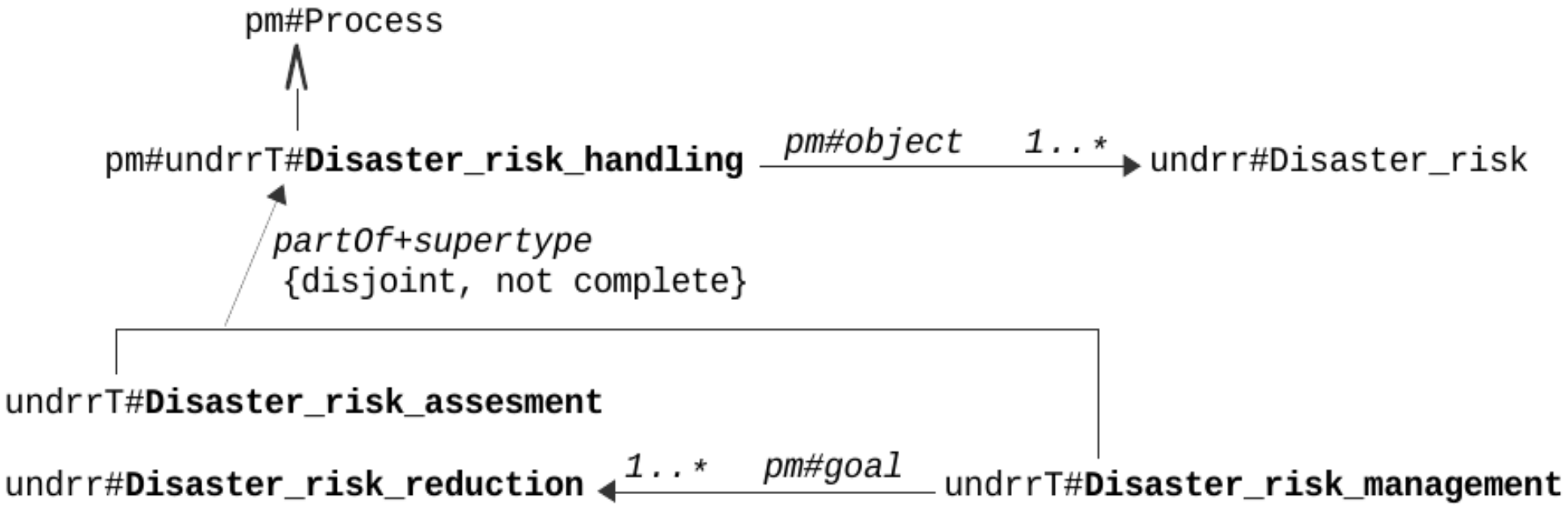
2.2. A **general model** to represent and organize Search&Rescue information

2.3. **Representations** about automatic explorations of a disaster area

[The last two will only be discussed, if needed, at question time]

2.1. Organization of a small *terminology* about Disaster Risk reduction: UNDRRT

Top concept types (out of about 50 concept types):



2.1. Organization of a small *terminology* about Disaster Risk reduction: UNDRRT

Advantages of this ontology over this terminology:

– organization → conceptual search via queries/navigation

– usability in other ontologies → eases knowledge retreival/sharing/checking

– discovering of ambiguities, e.g. about *Exposure*, *Vulnerability* and *Resilience* (Characteristic/dimension/measure or State)?

2.2. A *general* model to represent and organize Search&Rescue information

Abstract_map /^ Abstract_representation,

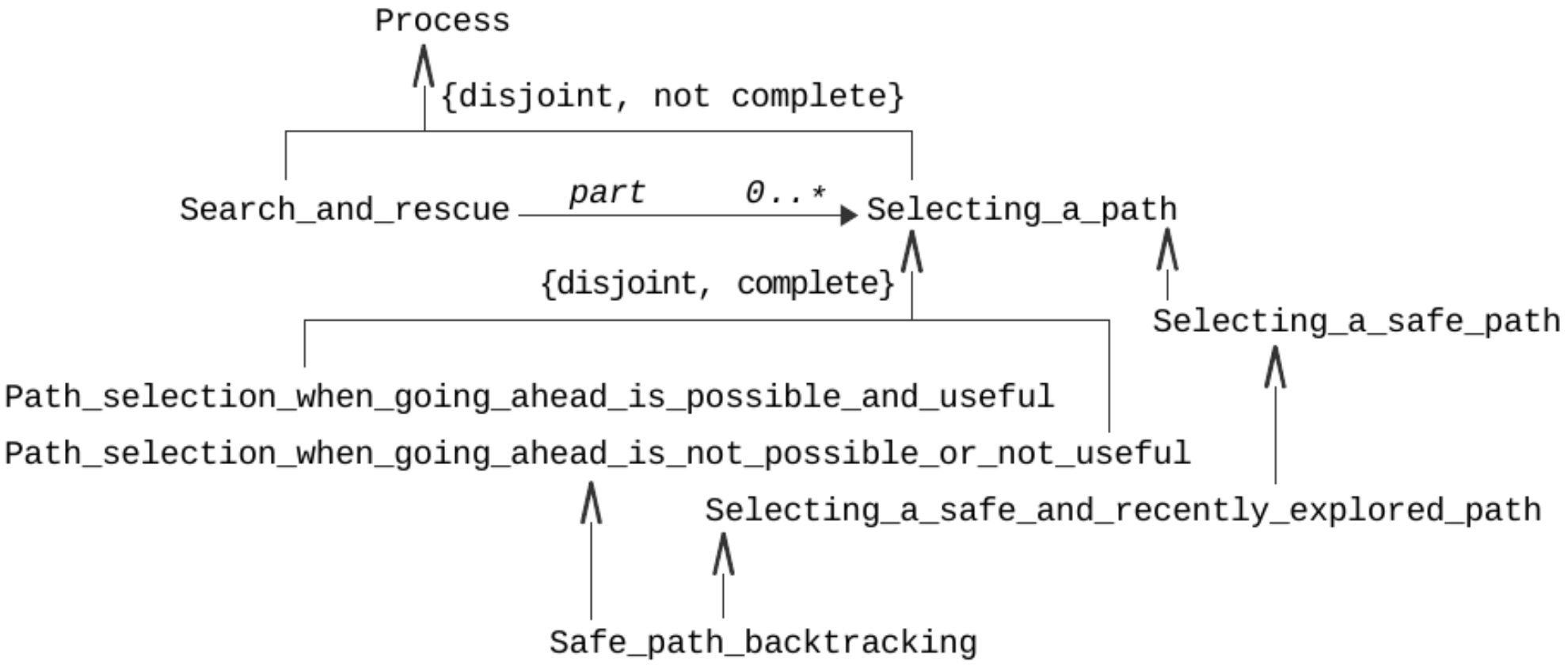
_{ *attribute*: 1 Map_scale,
1 Temporal-point-or-region_coordinate ?timeStamp,
1..3 Spatial-point-or-region_coordinate;

part: 1..* ***Physical_object_representation_in_an_abstract_map***;

method:
Abstract_map___objects_possibly_at
(1 ***Abstract_map***, 1..3 Spatial-point-or-region_coordinate,
0..* Type ?typeOfAtLeastOneOfTheSearchedPhysicalObjects,
0..* Attribute ?attributeOfAtLeastOneOfTheSearchedPhysicalObjects)
-> .{1..* ***Physical_object_representation_in_an_abstract_map***};

...
}.

2.3. *Representations* about automatic explorations of a disaster area



3. Conclusion

General KS

– is possible

– is affordable and desirable: more work, especially at the beginning,
but MUCH more reuse and exploitation possibilities
(in the end: much less waste of efforts and of overall global work)

– can be achieved incrementally.