Requirements for Data-Driven Social Service Policy Evaluation: A Case-Study in Housing First

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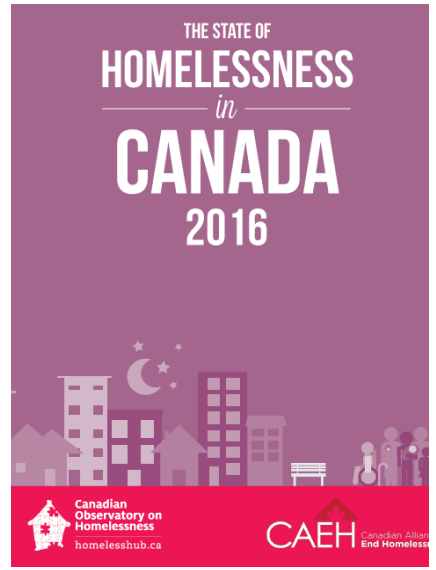
Outline

1. Motivation
2. Goals and Objectives
3. Requirements for Semantic Interoperability
4. Existing Ontologies
5. Use Cases
   - Use Case 1: Mapping SMIS to HIFIS
   - Use Case 2: CHF Housing First
     - Ontology Engineering
     - Ontology of Client Needs

Motivation

- Canada 2016 [Gaetz, 2016]
  - 35,000 homeless Canadians on any given night
  - (+17.5% from 2014)
  - 27% women, 19% youth, 24% aged 50+



- How to measure progress towards reducing homelessness?
  - Definitions of homelessness vary.
  - Causes of homelessness vary.
  - Homelessness is a complex problem:
    - Each city and province has unique challenges.
    - Each person living in poverty has unique life experiences and challenges.
    - Each site has different metrics, stakeholders, timelines, etc.

Goals and Objectives

- Goal
  - Enable data-driven policy evaluation by providing means to combine data from various sources.

- Objectives
  - Create a measurable high-fidelity model of service delivery.
  - Analyze data from multiple data sources, studies, and locations.
  - Create an ontological representation of target datasets.
  - Support the semantic interoperability between each dataset.

Challenge: Semantic Interoperability

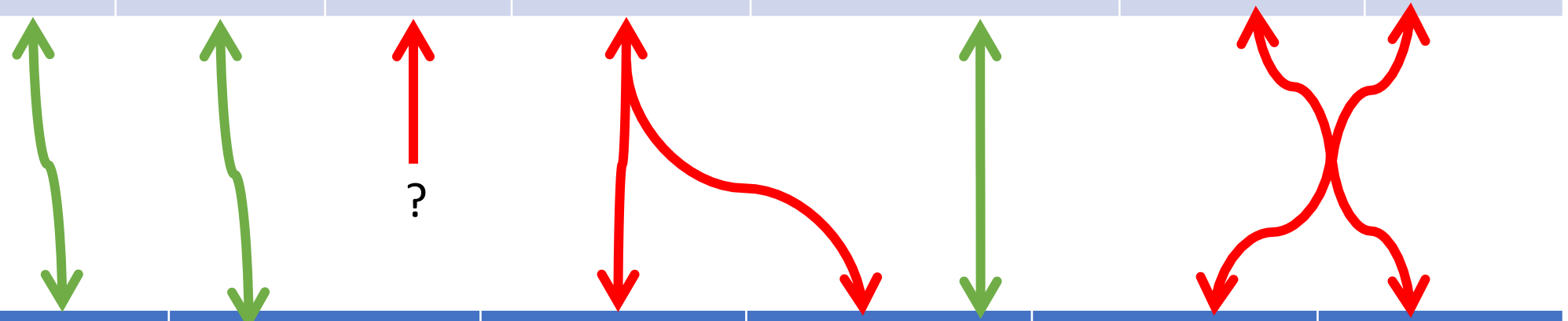
- Ability of computer systems to exchange data with unambiguous, shared meaning.

- A requirement for machine reasoning, knowledge discovery, and data federation across information systems.

Semantic Interoperability

SMIS: Service Restriction

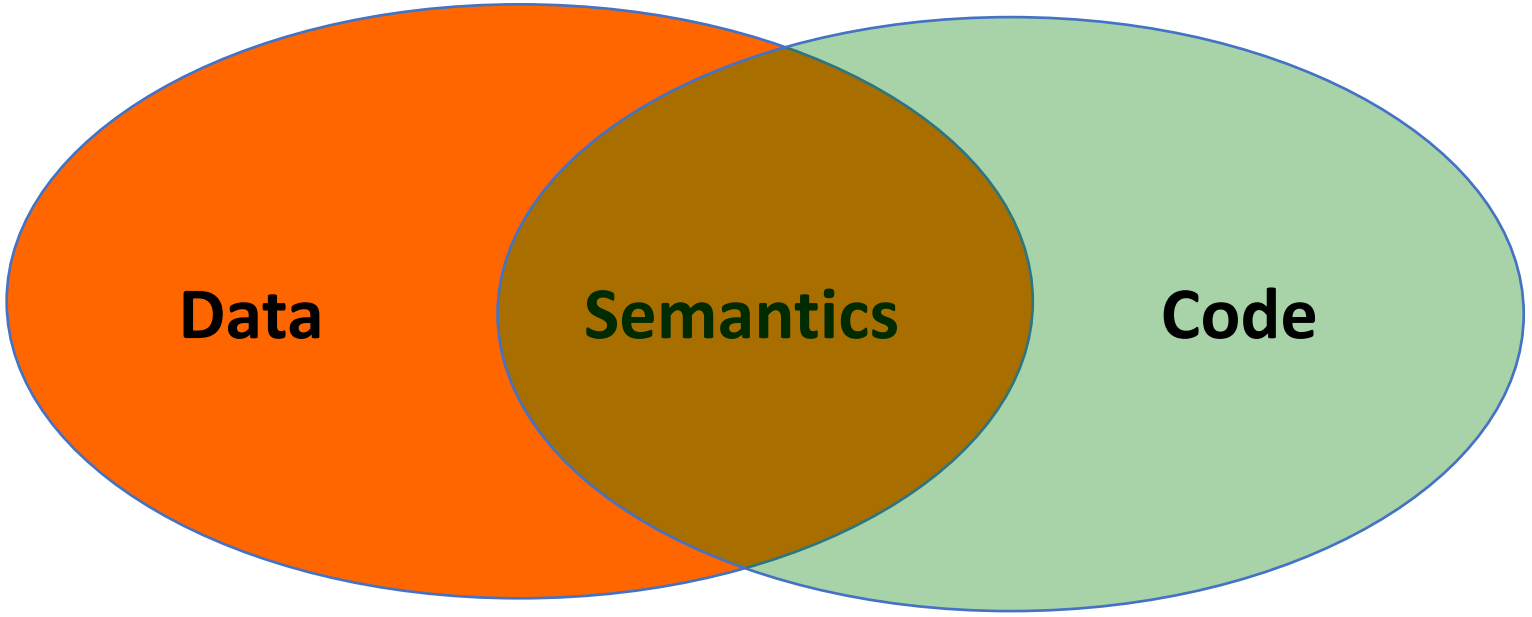
User	Client No.	Program	Restriction Reason	Notes	Date	Length (days)
Admin1	123	Detox	Assault of a client	fight over program resources	01/01/2018	60



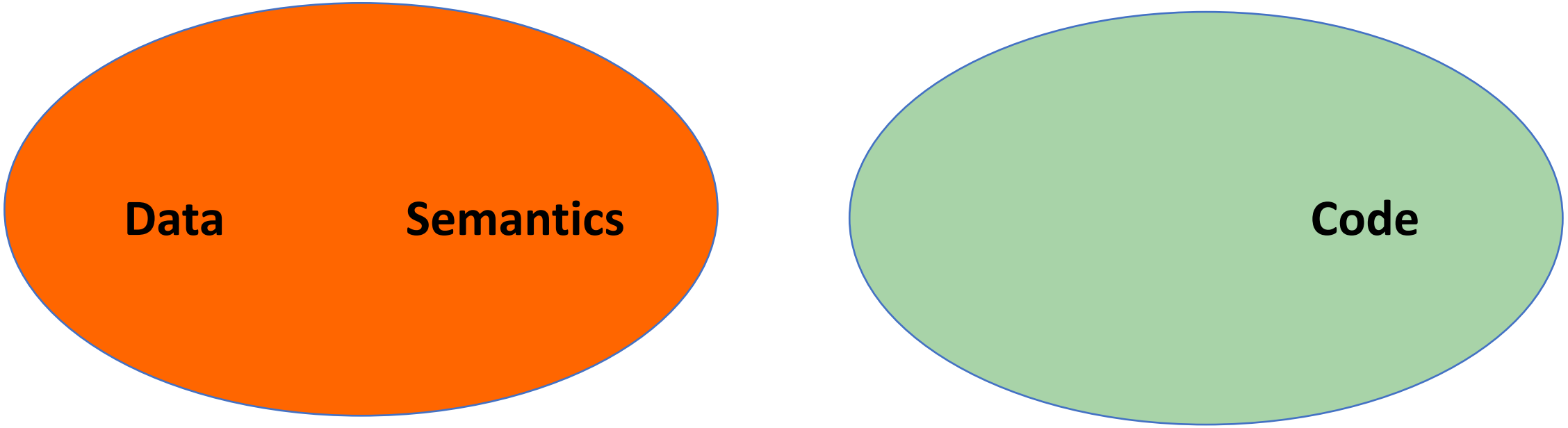
HIFIS: Barred

User	Client	Reason	Comment	Start Date	End Date
Admin1	G456	Safety / Security Risk	assaulted a client	01/01/2018	03/03/2018
Admin1	G456	Disruptive Behaviour	threatening a client	01/01/2018	03/03/2018

The Source Of Problem



The Source Of Problem



Ontology Design is a Way of Thinking

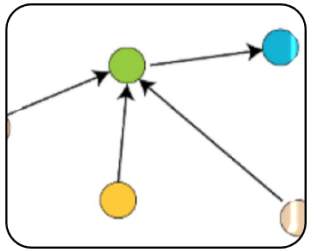
- What are the core concepts and properties that span social service data?
  - To what extent can we generalize them and still be useful?

- What are the key distinctions?
  - Can we formally define necessary and/or sufficient conditions (using properties) for something to be an example (member) of a concept?
  - Examples:
    - What is a homeless client? relatively versus absolutely homeless?
    - What is a resource? available beds? employee skills?
    - What prevents a client from meeting a shelter's curfew?
    - What motivates clients? short-term goals? long-term goals?

Approach: Ontology

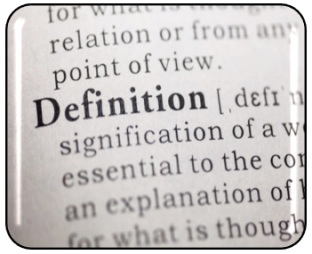
- Ontology
  - A **shared understanding of a particular domain** through conceptualization, and the use of **explicit definitions** and the relationships between those concepts [Uschold, 1996].
  - An **Ontology** is the specification of:
    - a **Terminology**, that specify the classes, properties and data types of the domain, and
    - **Axioms**, that define and constrain the interpretation of the terminology (in FOL, DL), and can be used to infer new information

Ontology Components



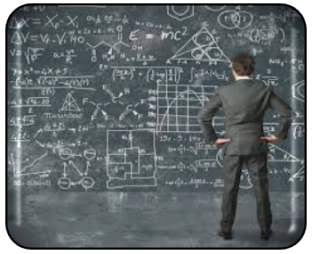
Knowledge Graph

- Classes and Properties
- Taxonomy and Inheritance



Definitions and Constraints

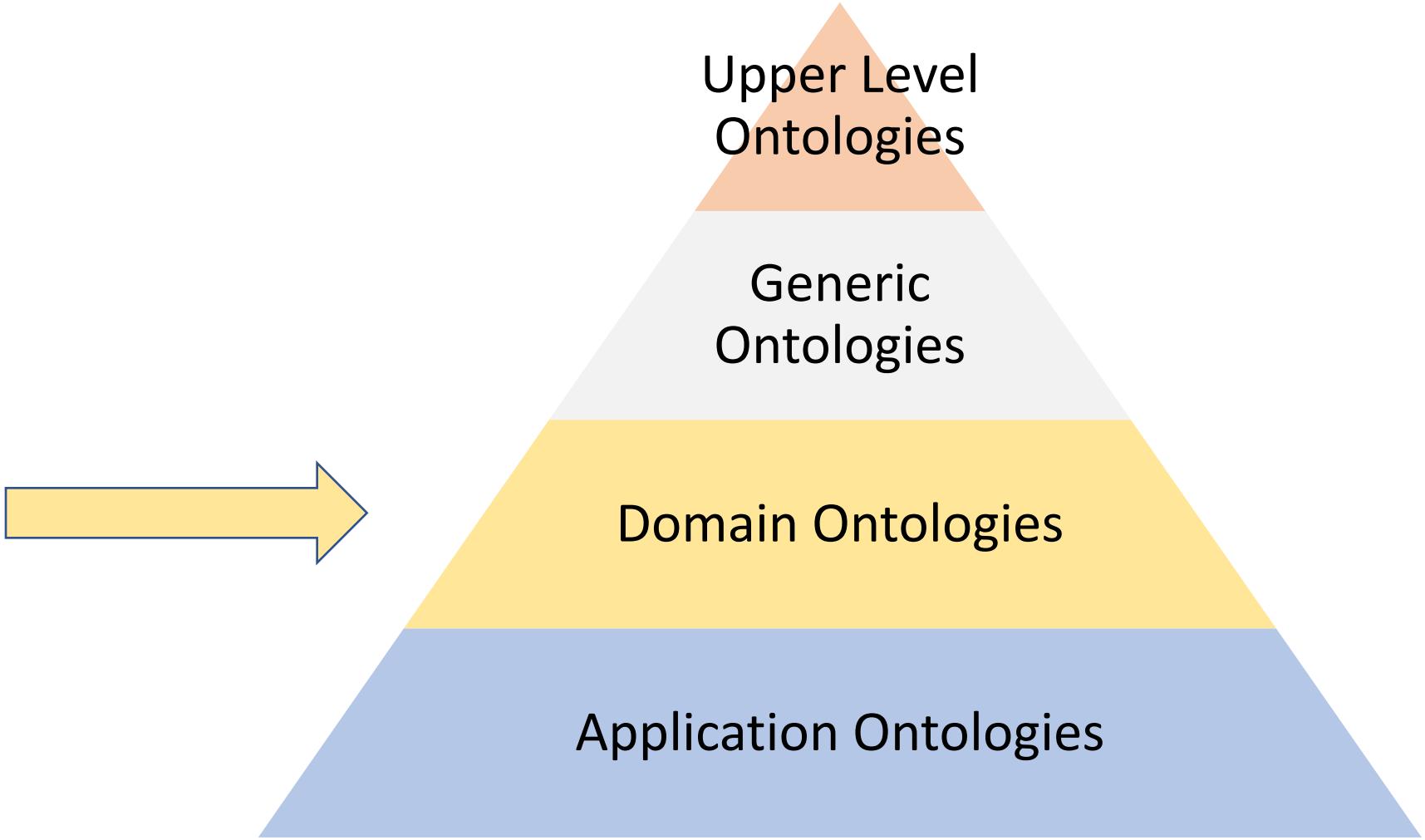
- Class Definitions (in Logic)
- Automated classification



Micro-Theory

- Axioms/Rules
- Deduction – answering questions

Ontology Hierarchy

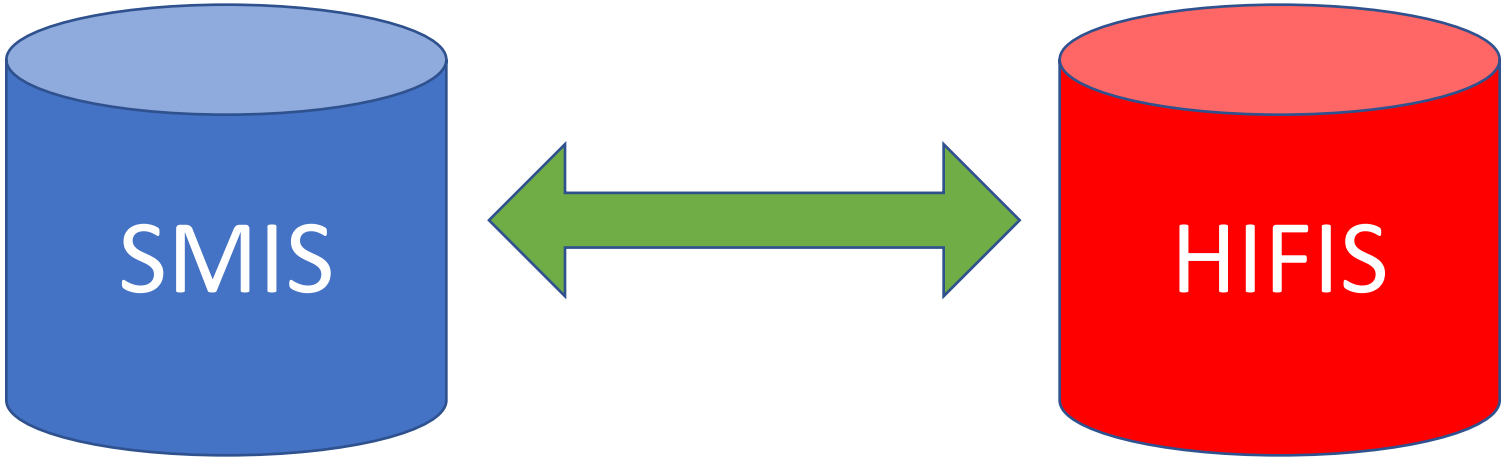


Existing Ontologies

1. Shelter Ontology for Global City Indicators (GCI) [Wang, 2015]
   - Semantic representation of the ISO 37120, 100 indicators for sustainable development.
   - Includes concepts of shelters, slums, households and homelessness.
   - Limited definition of homeless a person and their needs.
2. The INSPIRE Ontology [Pourabbas, 2017]
   - Focused on processes and resources of the service provider.
   - A client may have a physical need, a social need, or a combination of the two. Each need also has an urgency associated with it
3. Open Eligibility Project [OEP, 2017]
   - A taxonomy of services offered to clients.
   - No details about client needs are included.

- Problem:
  - Majority focus on services only.
  - Clients model is of low-fidelity.

Use Case 1: Mapping SMIS to HIFIS



Use Case 1: SMIS Data Dictionary

- SMIS: Shelter Management Information System [SMIS, 2014]
  - Owner: City of Toronto

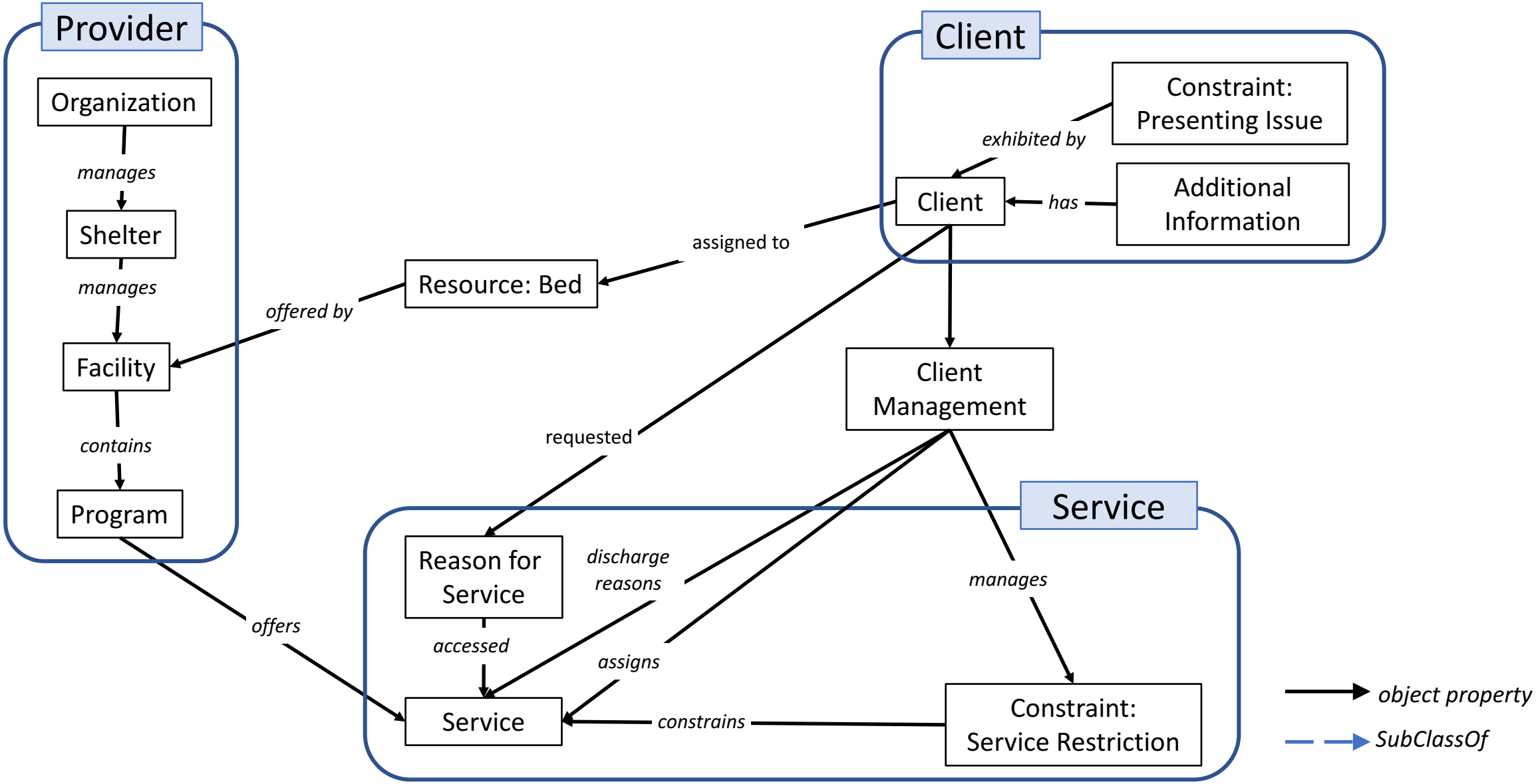
- 11 Forms used to register, evaluate, and log clients in the system.
  - intake, admission, discharge, service restrictions, admission status, referrals.

- Classes covered:
  - Client
  - Service Provider
  - Resources

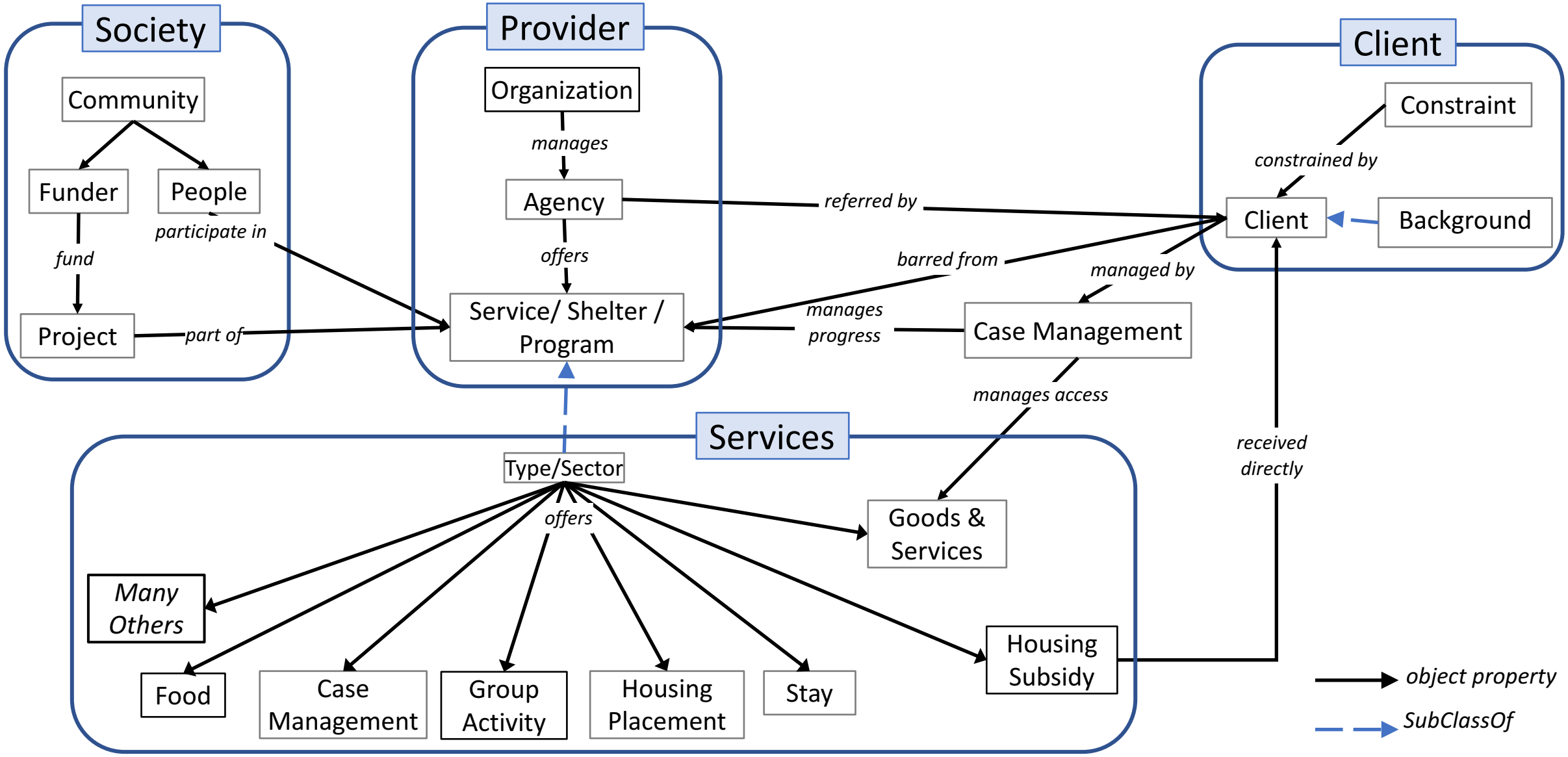
Use Case 1: HIFIS Data Dictionary

- HIFIS: Homeless Individuals and Families Information System [HIFIS, 2015]
  - Owner: Government of Canada
  - *Draft: May 2015*
- Data dictionary:
  - Includes 111 tables and an additional 118 lookup tables.
- Classes covered:
  - Client
  - Society
  - Provider
  - Services

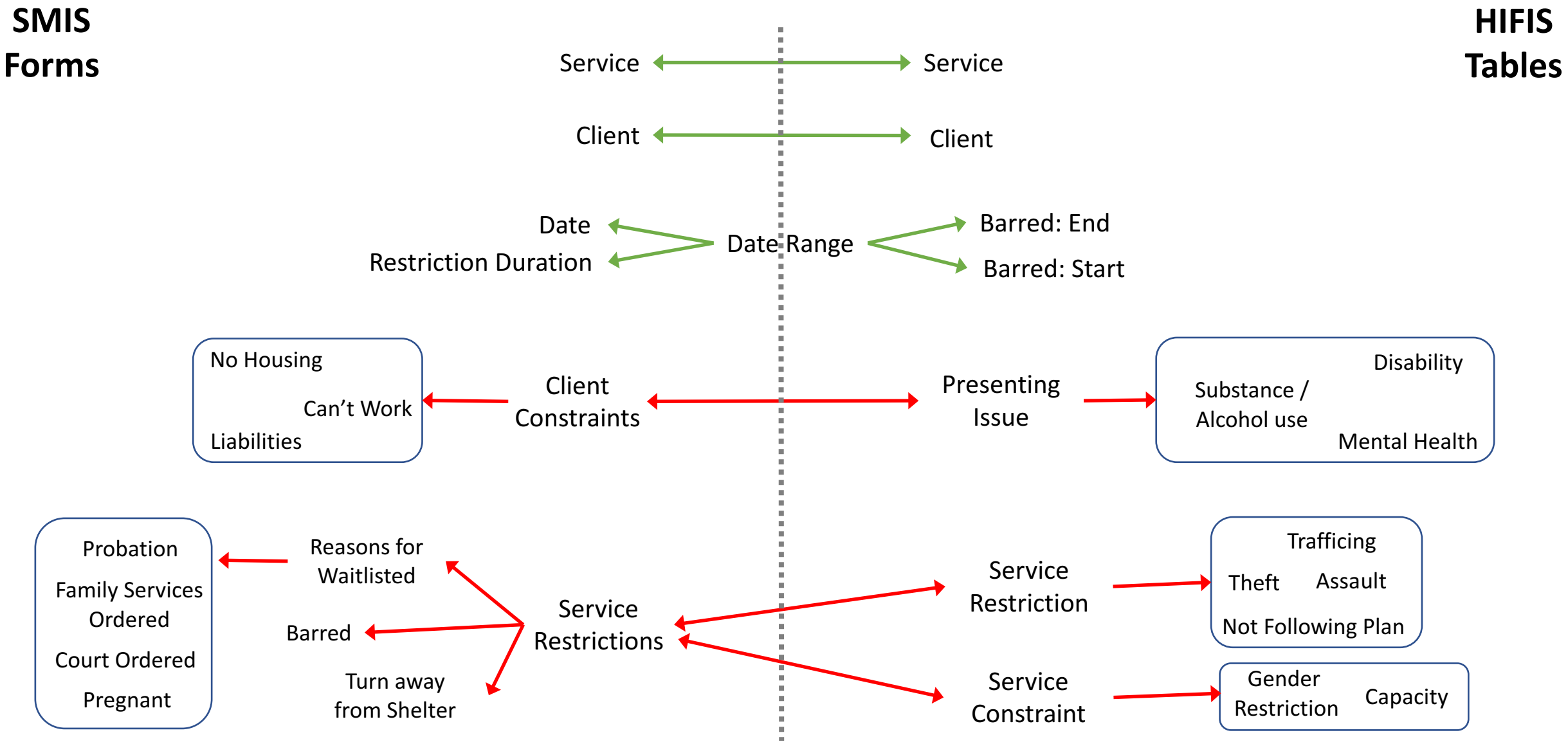
Use Case 1: SMIS Ontology (knowledge graph)



Use Case 1: HIFIS Ontology (knowledge graph)



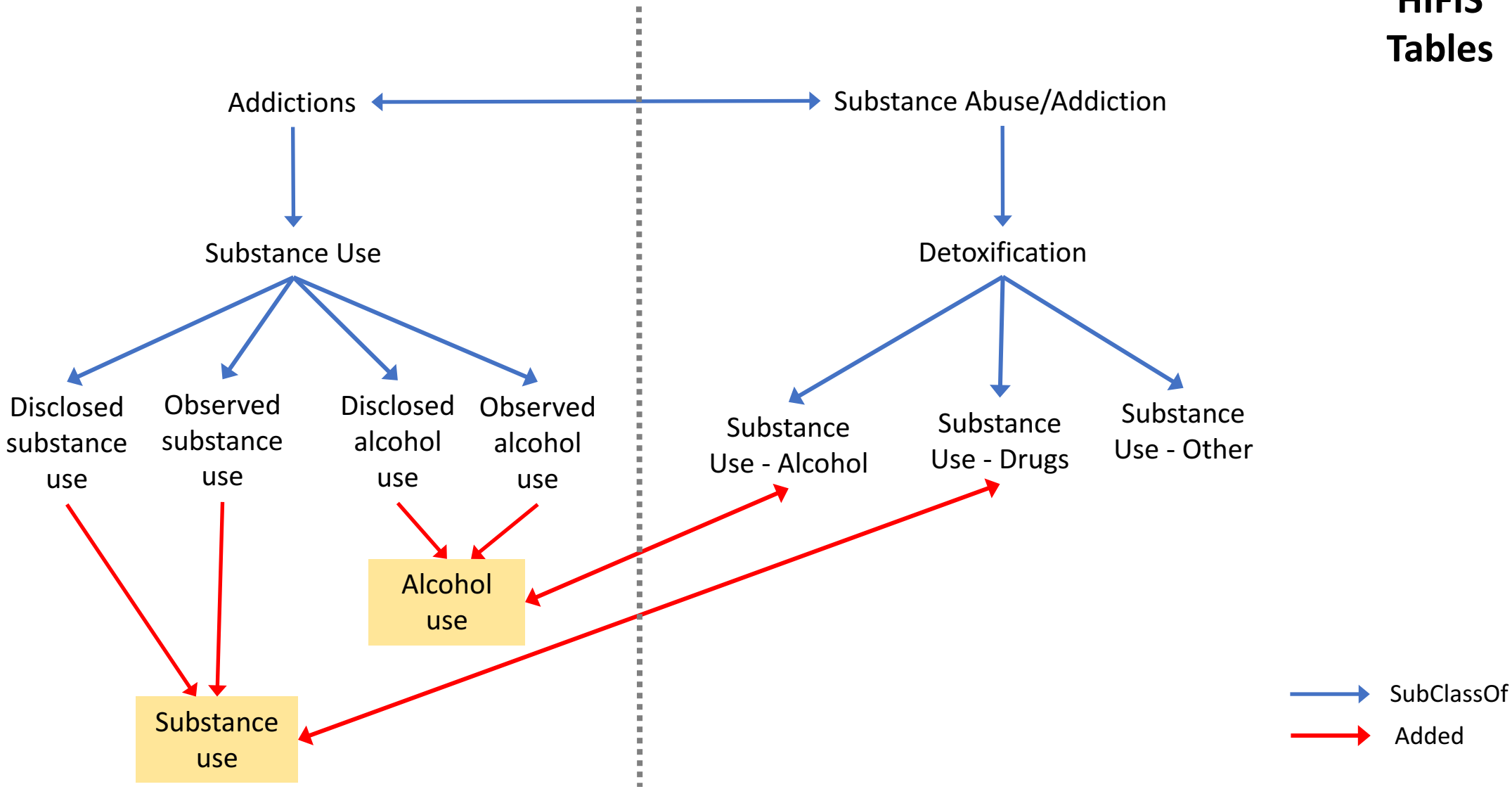
Use Case 1: Mapping SMIS to HIFIS



Use Case 1: Mapping Client Needs

SMIS Forms

HIFIS Tables



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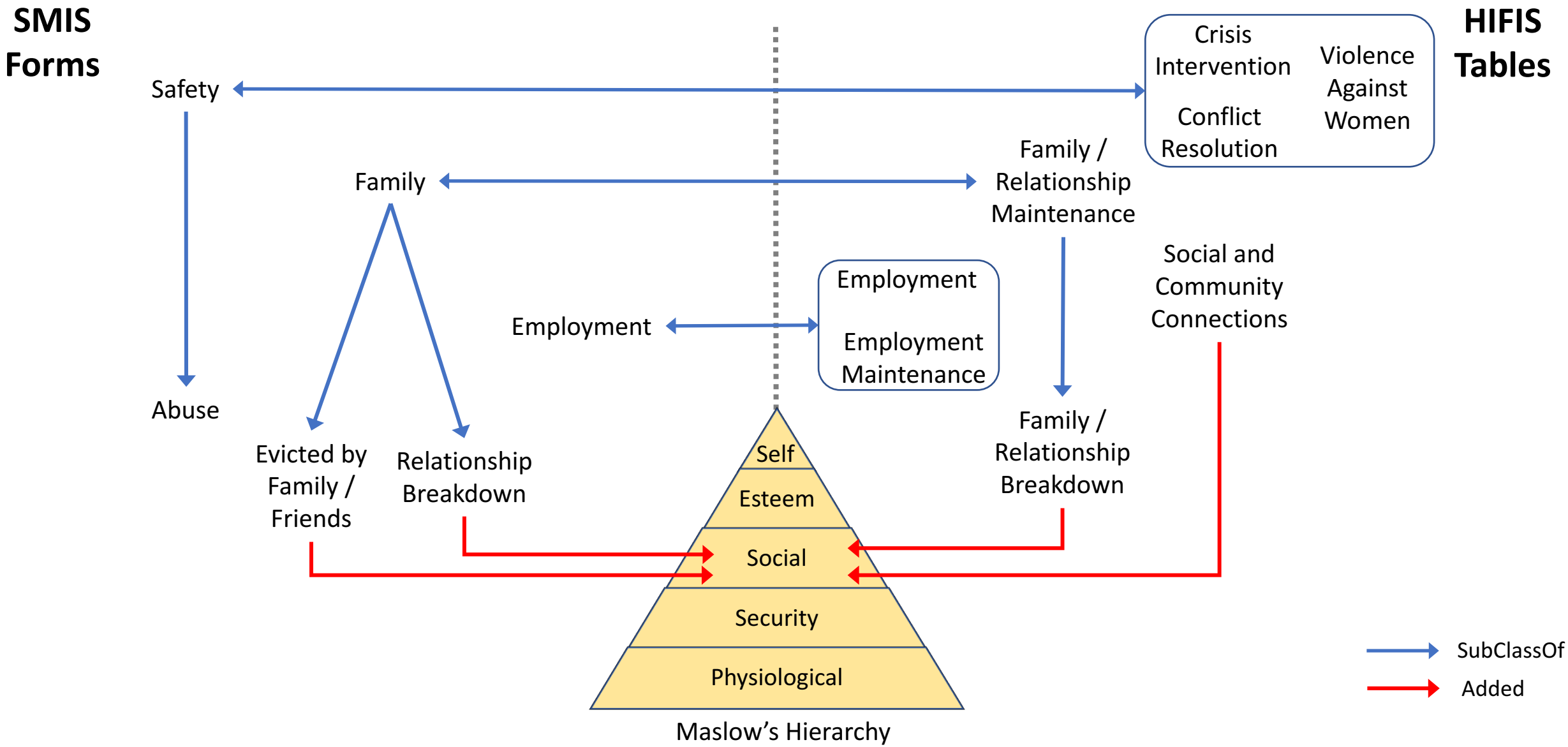


Use Case 2: CHF Housing First

- Objective:
  - Identify needs of clients.
  - How do needs change as clients participate in the HF program?
  - Connect client needs to services being offered, from the client's perspective.
- Method:
  - Data: SPDAT Form, taken at 3-month intervals.
  - Identified, categorized and ranked client requests based on client demographics.
  - 781 different request, combined into 50 categories.
  - Apply Ontology Engineering: systemic way of constructing ontological representation of domain [Grüninger, 1995].
- Develop Ontology of Social Service Needs (OSSN):
  - Focus on metrics for client needs.

Use Case 2: CHF Housing First

- Ontology Engineering (4 steps) [Grüninger, 1995]

Step 1: Motivational scenarios:

a) How to evaluate intervention programs in the social service space?

b) How to monitor client progress?

c) How to monitor service delivery performance?

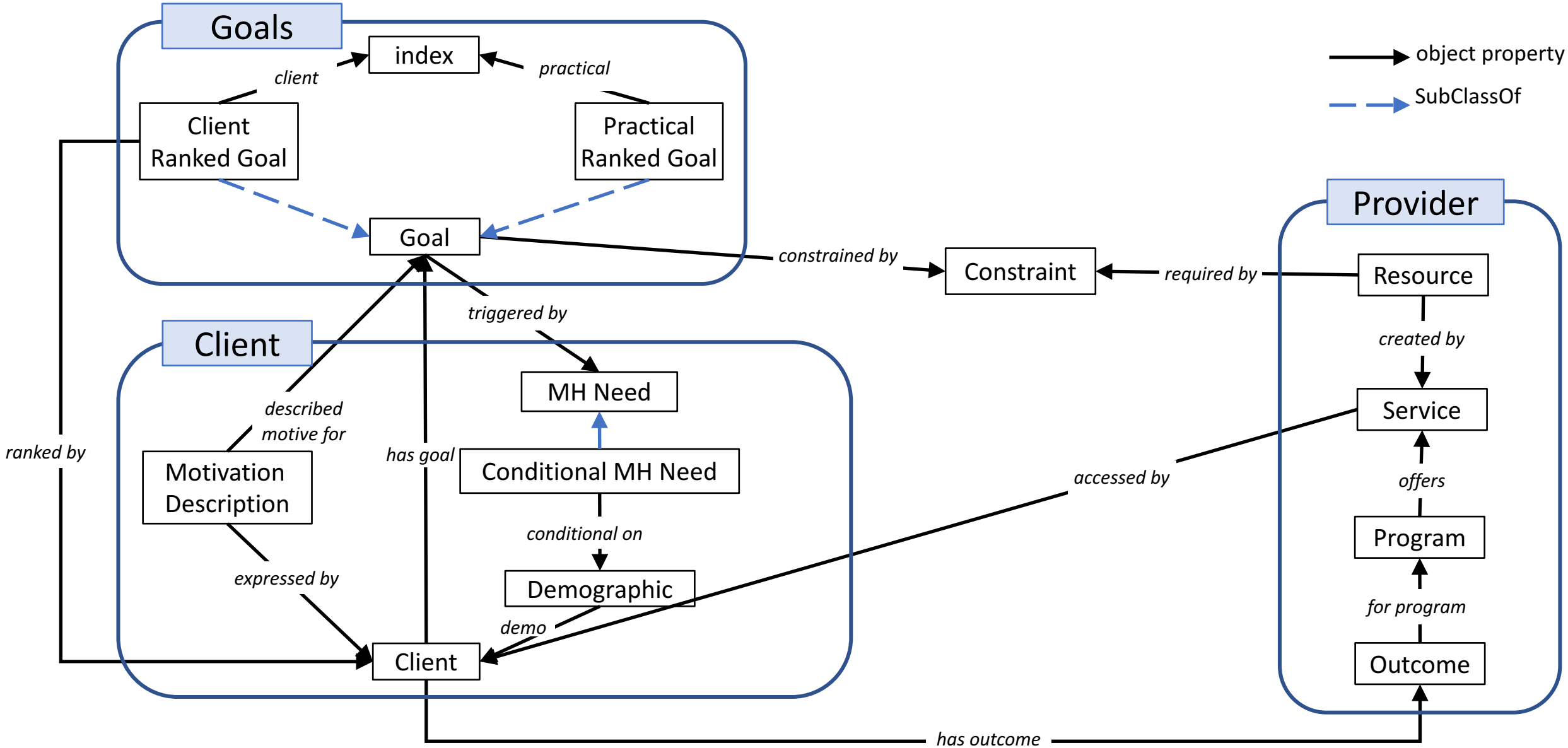
Step 2: Informal competency questions:

a) What level of needs is client with ID="G123" requesting?

b) What do "relatively homeless" clients need most?

c) What motivates clients to use case management services?

Step 3: Ontology of Social Service Needs (OSSN)



Step 4: Answer Competency Questions

a) What level of needs is client with **ID=“G123”** requesting?

```
SELECT DISTINCT ?mhneed
WHERE {
   :g123       :hasGoal       ?goal
   ?goal       :triggeredBy   ?mhneed
}
```

Results

mhneed
security
esteem
physiological

Step 4: Answer Competency Questions

b) What do "**relatively homeless**" clients need most?

```
SELECT (str(COUNT(?goal)) AS ?countg) ?goaltype
WHERE {
   ?agent      rdf:type        :RelHomelessClient   .
   ?agent     :hasGoal         ?goal                .
   ?goal       rdf:type        ?goaltype            .
} GROUP BY ?goaltype
  ORDER BY DESC(?countg)
```

Results

countg	goaltype
50	Child care
32	Clothing
10	Advocacy

Step 4: Answer Competency Questions

c) What **motivates** clients to use **case management** services?

```
SELECT DISTINCT ?motive
WHERE {
   ?motive    :motiveFor          ?goal                .
   ?service    rdf:type           :ServiceCaseManager  .
   ?goal      :constrainedBy      ?constraint          .
   ?resource  :requiredBy         ?constraint          .
   ?resource  :createdBy          ?service             .
} ORDER BY ?motive
```

Results

motive
assistance during emergencies
keep friends in the loop
protect kids
reduce stress for owning money
resolve critical conflicts with landlord

Conclusion

1. Semantic Interoperability is needed to evaluate social service policies from multiple data sources.
2. Some ontologies exist to map existing systems (e.g. SMIS and HIFIS).
3. Some important components are missing (e.g. client needs).
4. Ontology Engineering is a systemic way of constructing ontologies.

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Thank You

Any Questions?

Source: http://what-if.xkcd.com/14/

Discussion Questions

1. How are data schemas designed in the homeless domain?
2. What homeless intervention policies would benefit from an integrated approach?
3. What attributes are important for integrated policy evaluation?
4. What tools exist for integrating datasets in the homeless domain?
5. What database schemas exist now that can be extended to facilitate semantic interoperability?
6. What ontologies exist now in the homeless domain?

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