Some patterns and their use in the chess ontology

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Worked Example: Chess

- **Establish a searchable repository for chess data.**

- **Starting point are PGN files.**
- **Should be extendable with other information from**
  - **Chess websites**
  - **Wikipedia**
  - **Geographic data**
  - **News**
  - **Etc.**

- **Use an ontology for information integration.**

- **Collaborative modeling, group ideally has**
  - **More than one domain experts.**
  - **People familiar with the base data.**
  - **People understanding possible target use cases.**
  - **An ontology engineer familiar with the modeling approach.**
  - **Somebody who understands formal semantics of OWL.**

- **Domain experts are queried as to the main notions for the application domain.**
  - **E.g. for chess, these would include**
    - **Chess game; move; opening; tournament; players; commentary**

GeoVoCamps modeling approach

- **From available data and from application use cases, devise competency questions, i.e. questions which should be convertible into queries, which in turn should be answerable using the data.**

1. Who played against Kasparov in the round 1994 Lineares tournament? Did (s)he play as a white or black player?
2. What is the first move taken by the black player in the Sicilian Defense opening?
3. Find all games in which Bobby Fischer, playing black, lost in the poisoned pawn variation of the Sicilian Defence opening.
4. Are there any recorded games using the Grünfeld Defence from before the 20th century?
5. What did Kasparov say about his opponent's first two moves in his commentary about his game against Topalov in the 1999 Tournament in Wijk ann Zee?
6. Who was the first non-Russian world champion after Fischer?
7. Did Bobby Fischer ever play against a grandmaster in Germany?
8. List all world championship games won by forfeit.

GeoVoCamps modeling approach

- **Then prioritize which notions to model first. In the chess case, e.g.**

> **chess game**
> **move/half-move**
> **players**
> **opening**
> **tournaments**
> **commentary**

GeoVoCamps modeling approach
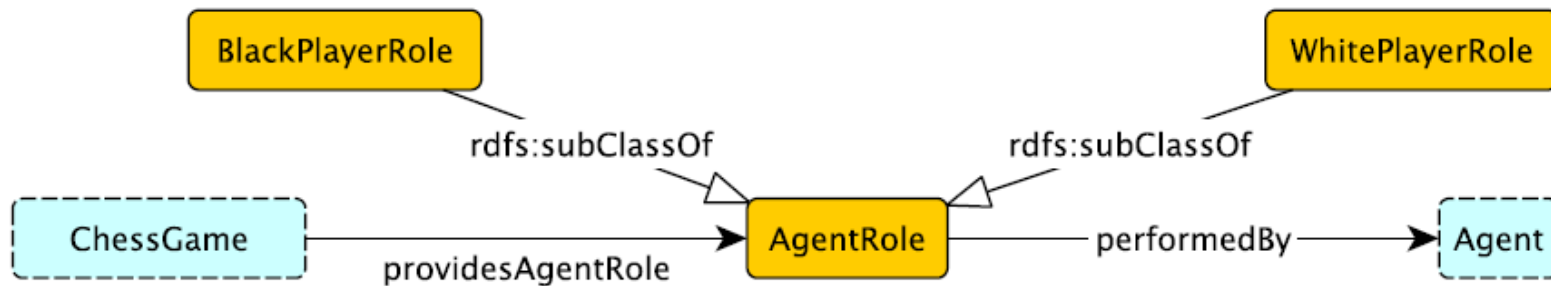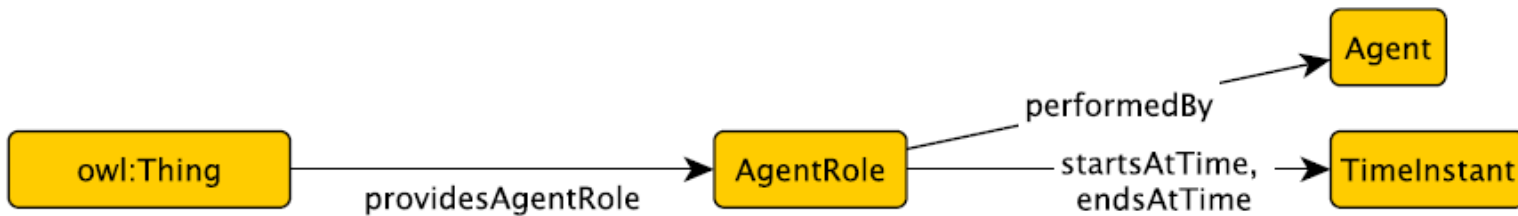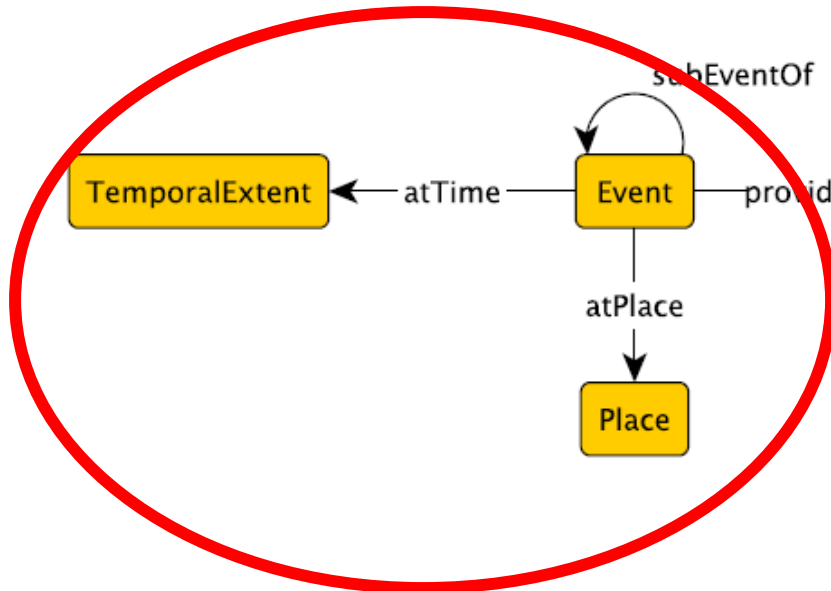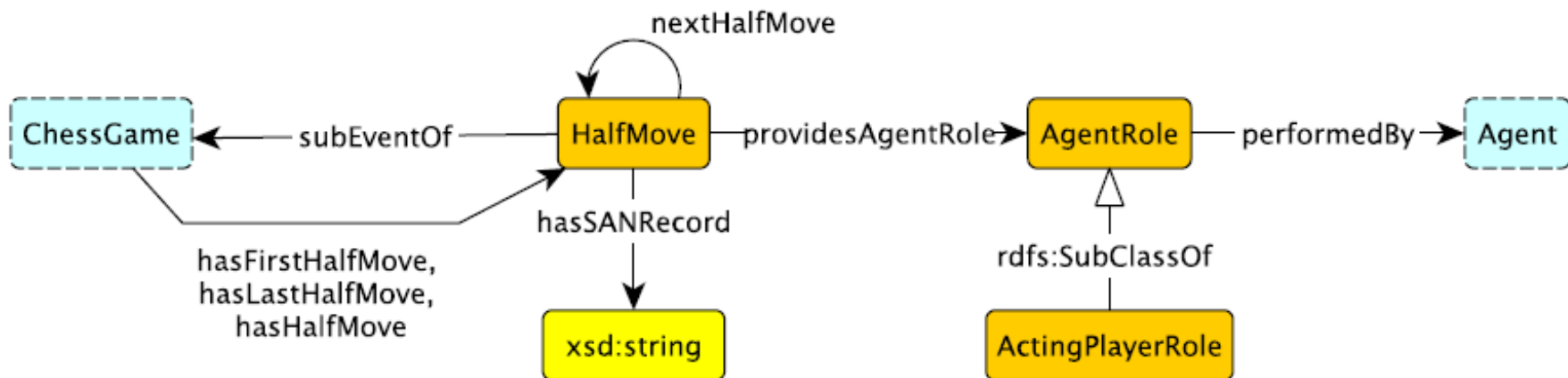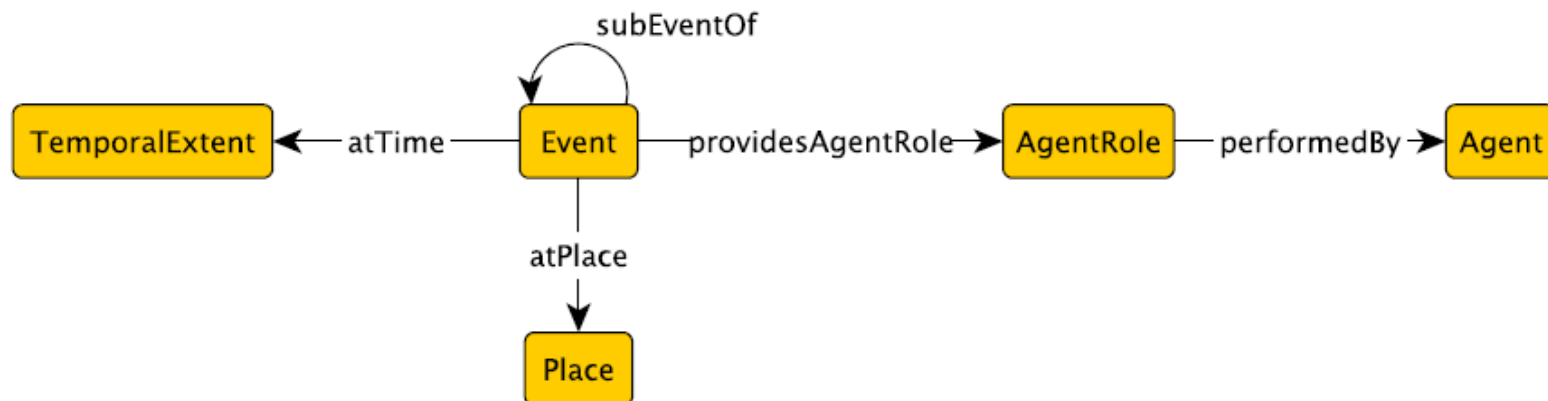
- **Understand the nature of the things you are modeling.**

Chess game	**...**	**An Event**
Half-move	**…**	**A Subevent of a chess game**
Player	**…**	**The Role of an Agent**
Opening	**…**	**this is probably complex**
tournaments	**…**	**Events**
commentary	**…**	**this is again more complex**

Player as AgentRole
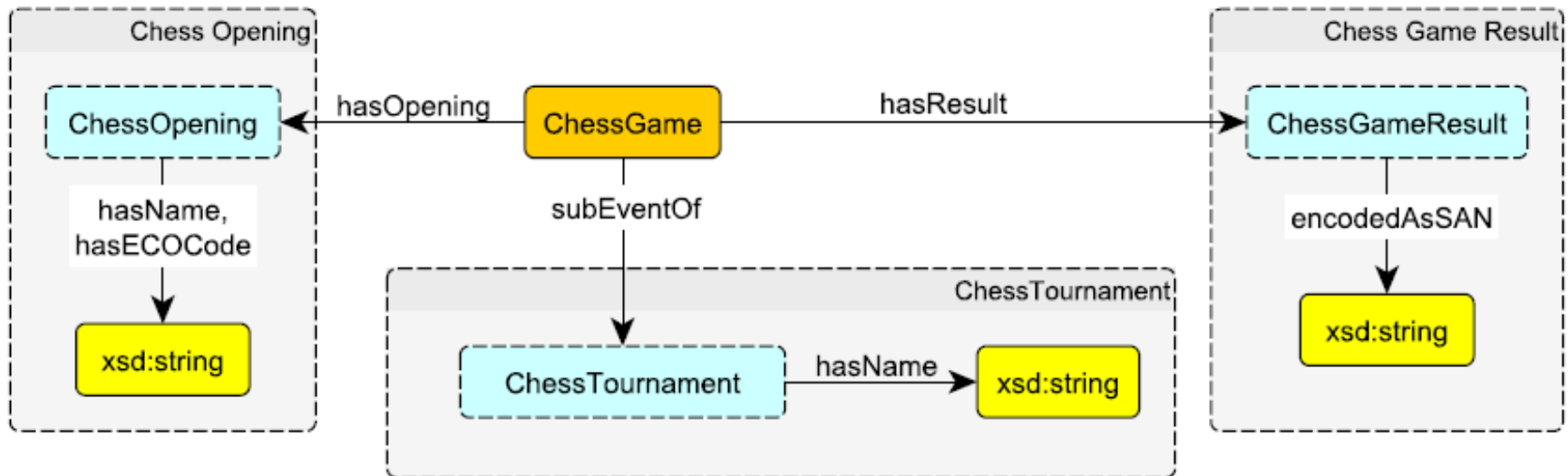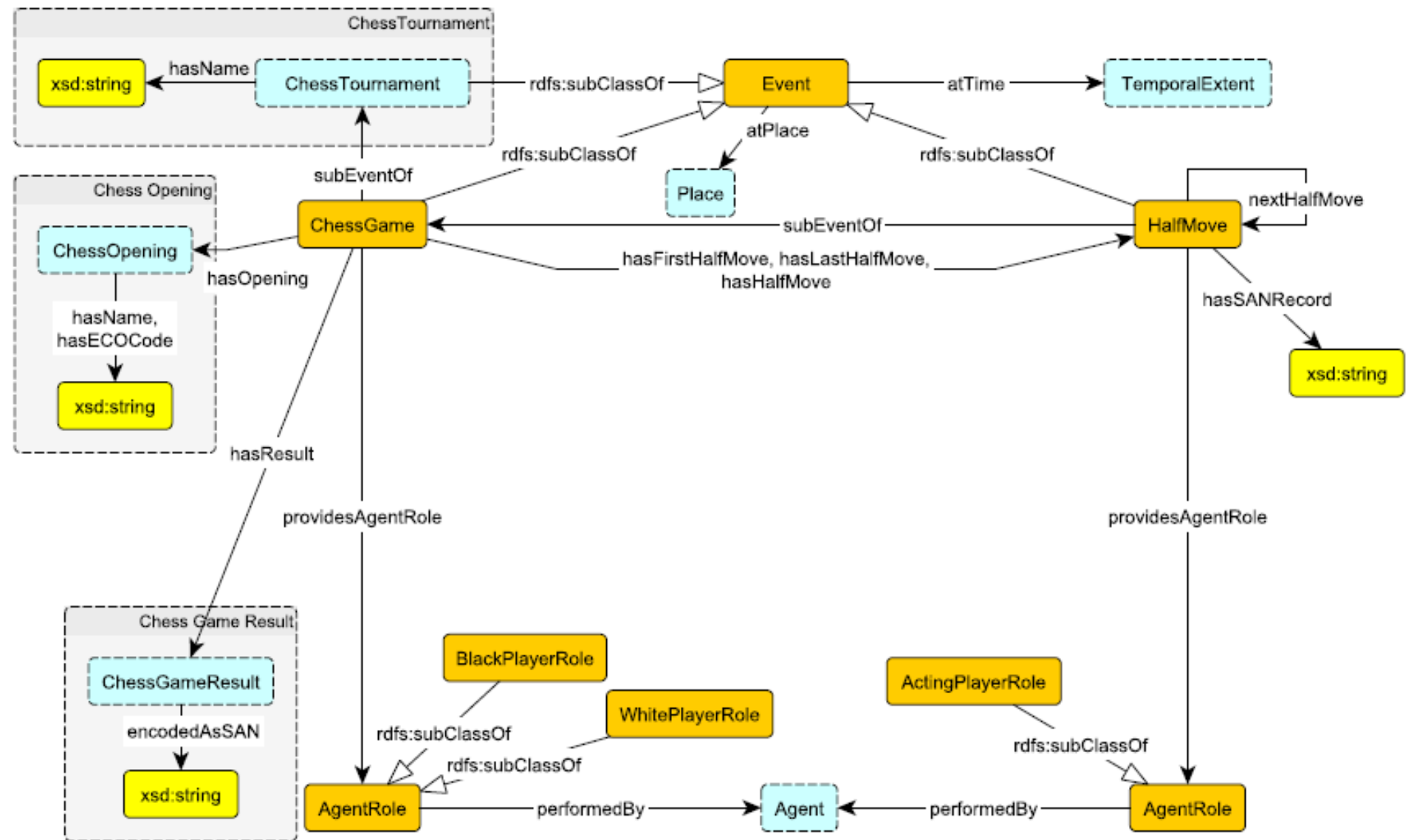
Opening, game result, etc.
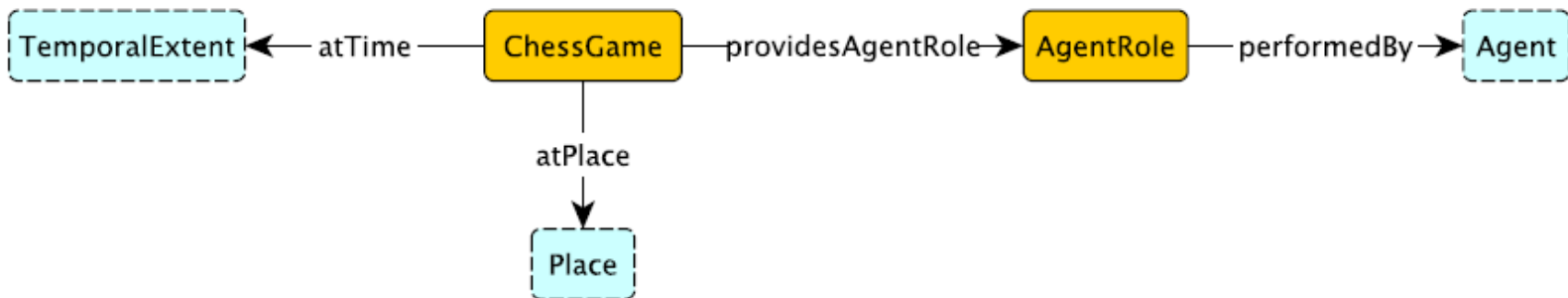
We call these "stubs".

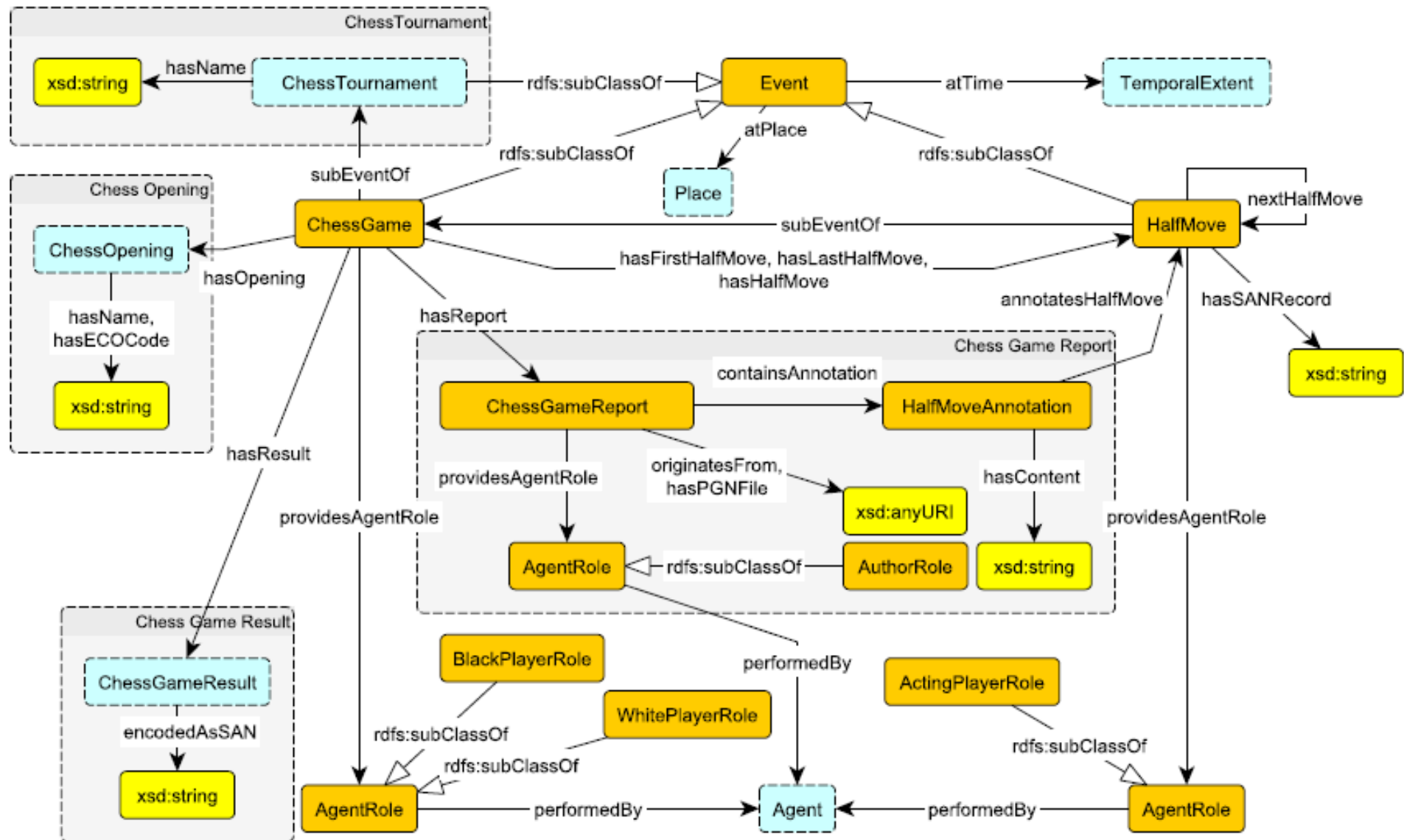I.e. we're aware that more fine-grained modeling will be needed for some use cases.

But currently there's no reason to do it (not in use case, no data), so we only provide "hooks" for future development of the ontology.

Adequacy check

- **Triplify sample data using the ontology.
  Does it work?**

- **Check if competency questions can be answered.**

- **Add axioms as appropriate (the graph is only for intuition, the OWL axioms are the actual ontology).**

- **(there are more post-hoc details to be taken care of, but let's leave it at that)**

Axioms

Axioms in this case are mostly straightforward:

- **Inherited from Event or AgentRole**
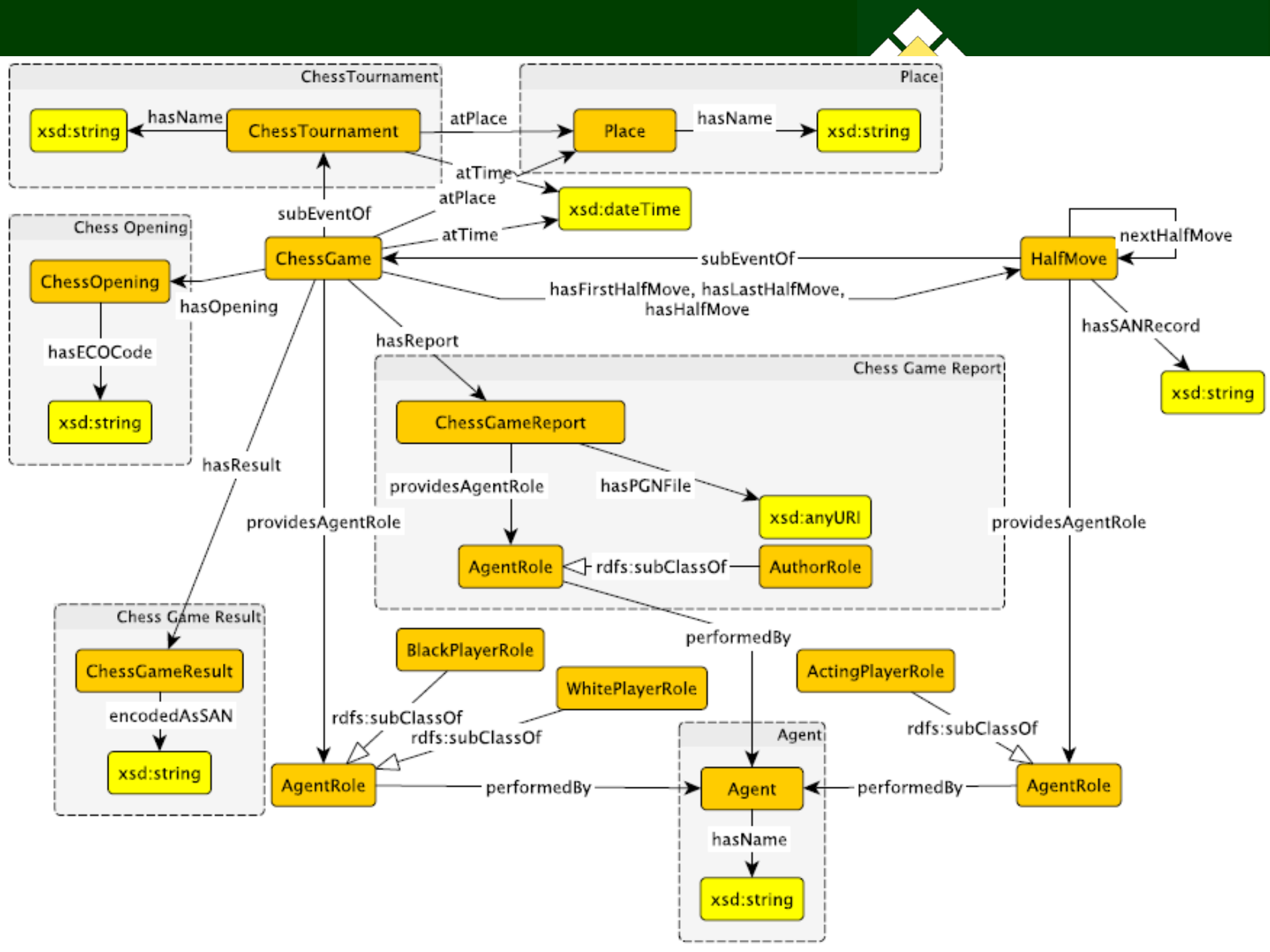- **Scoped domain/range restrictions, possibly with some cardinalities**
- **Basic existentials**
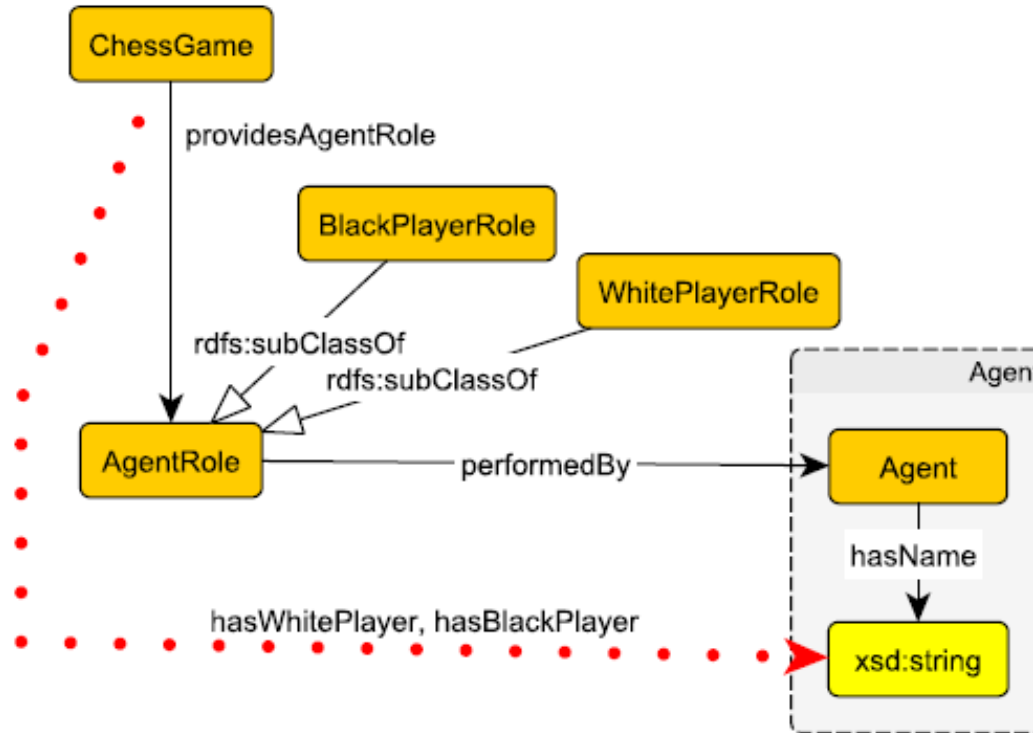- **Non-cyclicity of half-move sequence**

What about adding, e.g., the following?

$$\text{ChessGame} \sqsubseteq \geq 0 \, \text{subEventOf.ChessTournament}$$

If one of the roles of axiomatization is to improve human understanding of the ontology, then such axioms are helpful!

Shortcuts and Views

$$\text{ChessGame}(x) \wedge \text{pAR}(x,y) \wedge \text{WhitePlayerRole}(y) \wedge \text{performedBy}(y,z)$$
$$\wedge \text{Agent}(z) \wedge \text{hasName}(z,s) \rightarrow \text{hasWhitePlayer}(x,s)$$
$$\text{ChessGame}(x) \wedge \text{pAR}(x,y) \wedge \text{BlackPlayerRole}(y) \wedge \text{performedBy}(y,z)$$
$$\wedge \text{Agent}(z) \wedge \text{hasName}(z,s) \rightarrow \text{hasBlackPlayer}(x,s)$$

Translating the rules

$\text{ChessGame}(x) \land \text{pAR}(x, y) \land \text{WhitePlayerRole}(y) \land \text{performedBy}(y, z)$
$\land \text{Agent}(z) \land \text{hasName}(z, s) \rightarrow \text{hasWhitePlayer}(x, s)$
$\text{ChessGame}(x) \land \text{pAR}(x, y) \land \text{BlackPlayerRole}(y) \land \text{performedBy}(y, z)$
$\land \text{Agent}(z) \land \text{hasName}(z, s) \rightarrow \text{hasBlackPlayer}(x, s)$

$$\text{ChessGame} \sqsubseteq \exists R_1.\text{Self}$$
$$\text{WhitePlayerRole} \sqsubseteq \exists R_2.\text{Self}$$
$$\text{Agent} \sqsubseteq \exists R_3.\text{Self}$$

$$R_1 \circ \text{pAR} \circ R_2 \circ \text{performedBy} \circ R_3 \circ \text{hasName} \sqsubseteq \text{hasWhitePlayer}$$

However note that the introduction of additional role chains may cause violations of regularity restrictions.

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Modeling OWL with Rules (ROWLTab)

- **Protégé Plug-In**

  - Md. Kamruzzaman Sarker, David Carral, Adila A. Krisnadhi, Pascal Hitzler, Modeling OWL with Rules: The ROWL Protege Plugin. Proceedings Posters and Demos Track at ISWC 2016.

  - Md Kamruzzaman Sarker, Adila A. Krisnadhi, David Carral, Pascal Hitzler, Rule-based OWL Modeling with ROWLTab Protege Plugin. In: Proceedings ESWC 2017.

- **Enter rules using interface very similar to SWRLTab.**

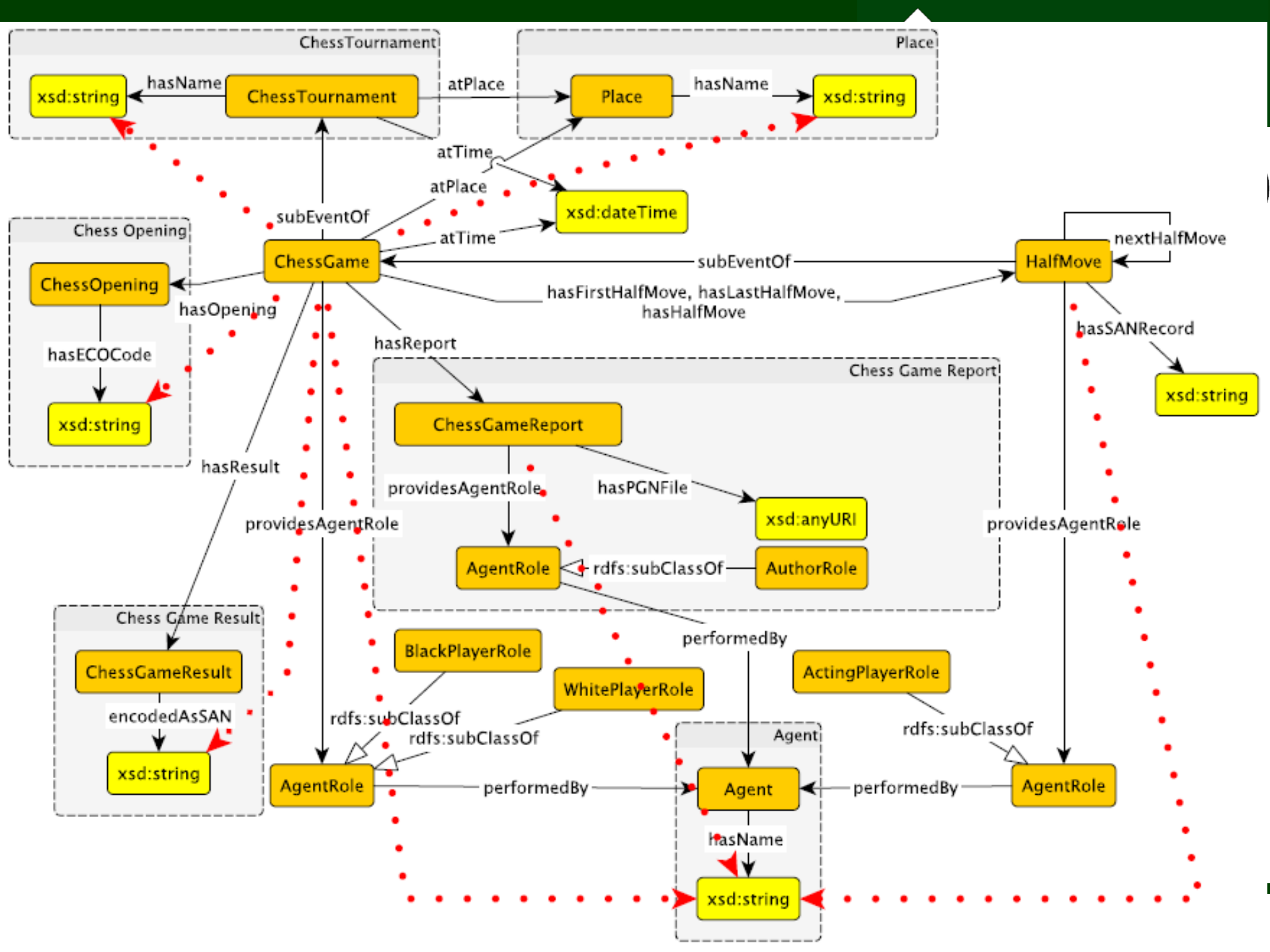- **But rules are converted into OWL axioms (whenever possible) instead of DL-safe rules.**

E.g., $\mathrm{Pig}(x) \rightarrow \mathrm{Mammal}(x)$ **becomes** $\mathrm{Pig} \sqsubseteq \mathrm{Mammal}$ **and thus carries the correct semantics.**

http://dase.cs.wright.edu/content/modeling-owl-rules

We evaluated that ROWL leads to quicker modeling with fewer errors.

http://dase.cs.wright.edu/content/rowl
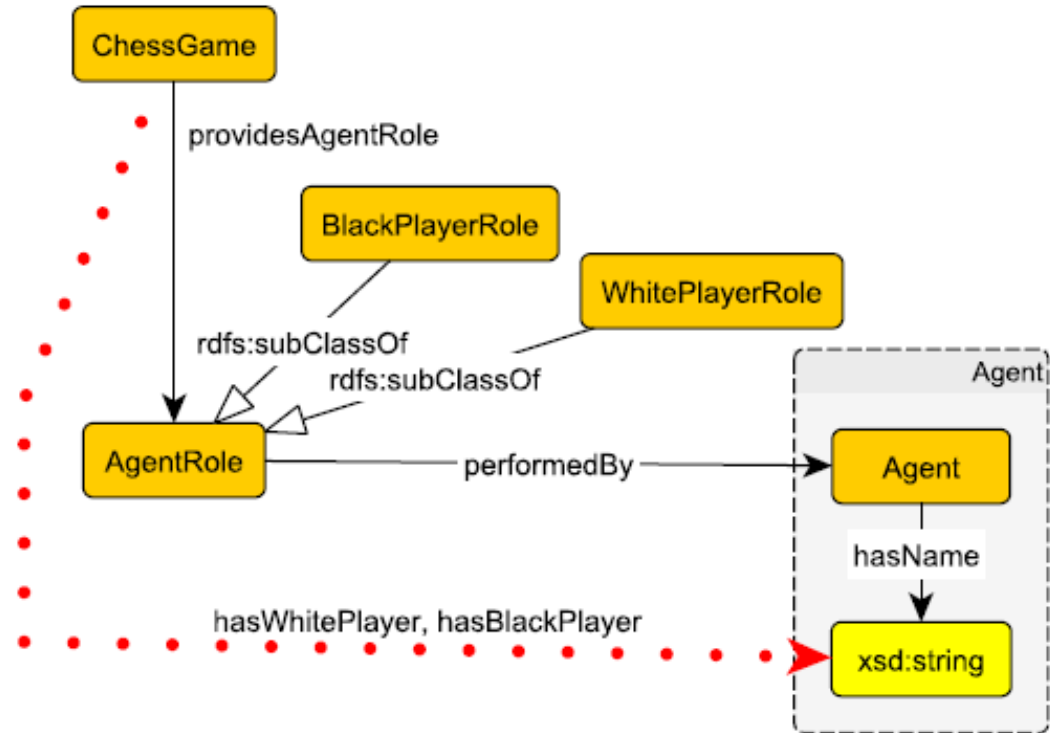
And see full paper here at ESWC2017
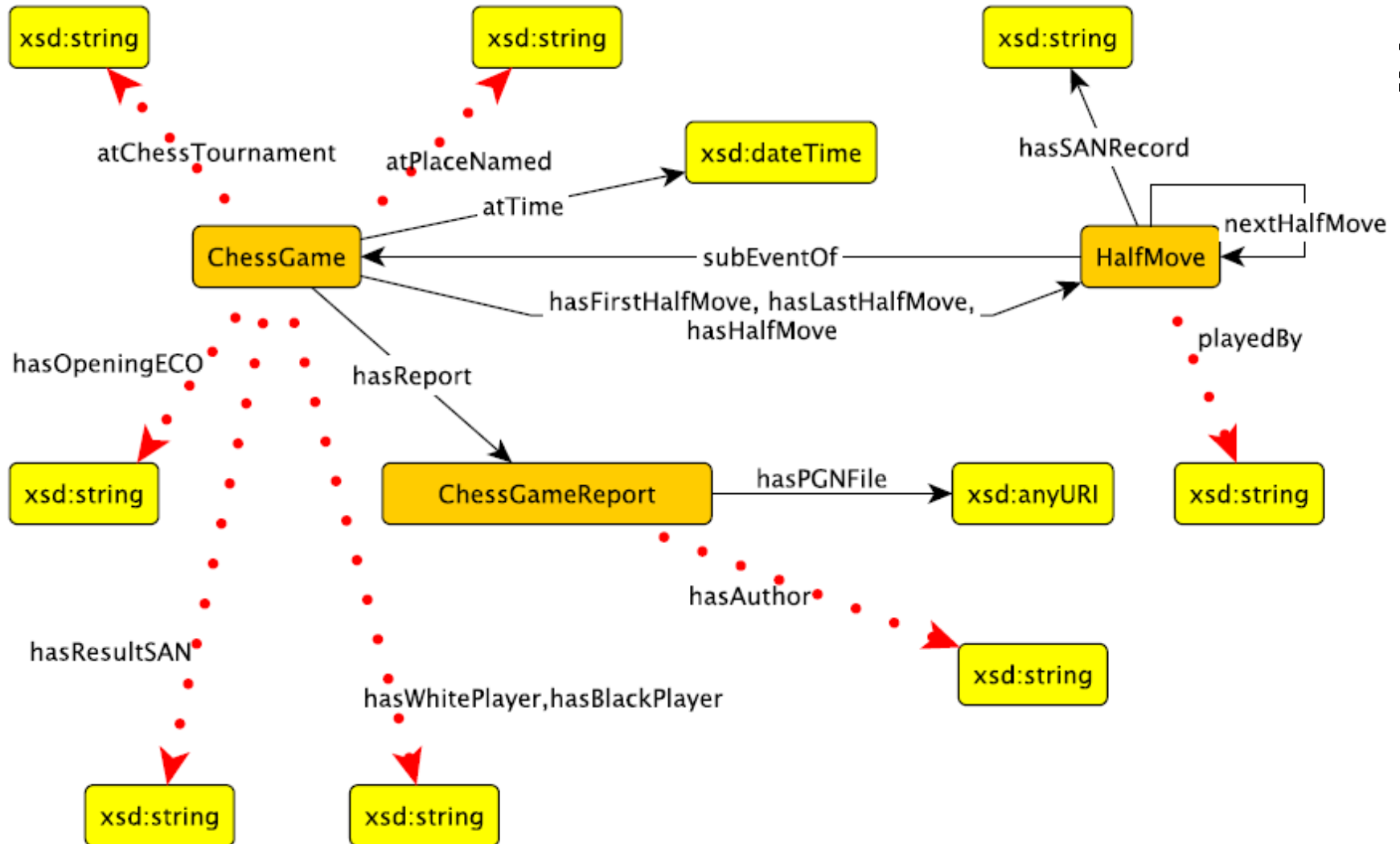
Mapping from Views

We used rules (axioms) to express the mapping from the ontology to the view.

The reverse direction is much more tricky.

$$\text{ClassA}(x) \land \text{ClassB}(y) \land C_1(x_1) \land \cdots \land C_n(x_n) \land R_1(y_1, y_2) \land \cdots \land R_k(y_k, y_{k+1})$$
$$\rightarrow \text{shortcut}(x, y).$$

$$\text{shortcut}(x, y) \rightarrow \text{ClassA}(x) \land \text{ClassB}(y) \land \exists x_1 \dots \exists x_n \exists y_1 \dots \exists y_n (C_1(x_1) \land \dots$$
$$\cdots \land C_n(x_n) \land R_1(y_1, y_2) \land \cdots \land R_k(y_k, y_{k+1}))$$

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Existential rules may be suitable in principle.

$$\text{shortcut}(x,y) \rightarrow \text{ClassA}(x) \wedge \text{ClassB}(y) \wedge \exists x_1 \ldots \exists x_n \exists y_1 \ldots \exists y_n (C_1(x_1) \wedge \ldots$$
$$\cdots \wedge C_n(x_n) \wedge R_1(y_1, y_2) \wedge \cdots \wedge R_k(y_k, y_{k+1}))$$

However automated reasoning with the potentially rather complex rule heads requires investigations, in particular if it is to be integrated with ontology reasoning.

A specific case are right-hand-side role chains:

$$R \sqsubseteq R_1 \circ \cdots \circ R_n,$$

Thanks!

References

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