Trajectory ontology inference over domain and temporal rules

Inference complexity analyzing

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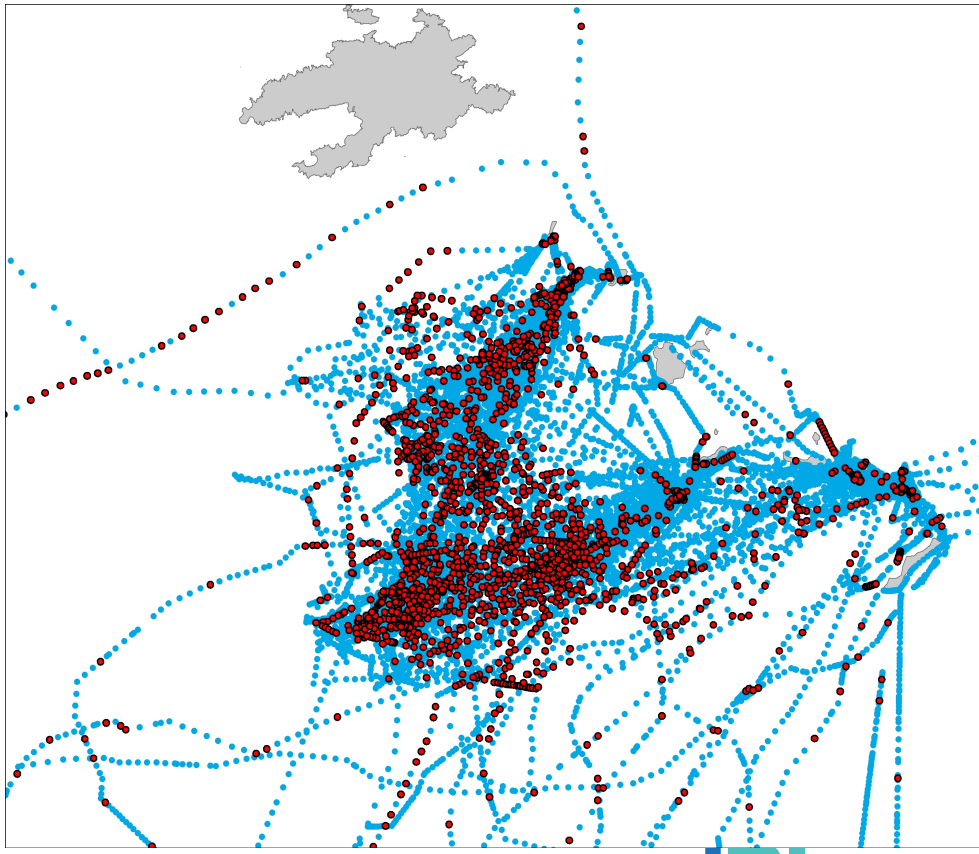
Rouen, July 01, 2014

Outline

Context

- Mobile object movements
- Capture trajectories



Request on moving object trajectory

We aim at answering queries, such as:

1. activities;
2. activities after a given time;
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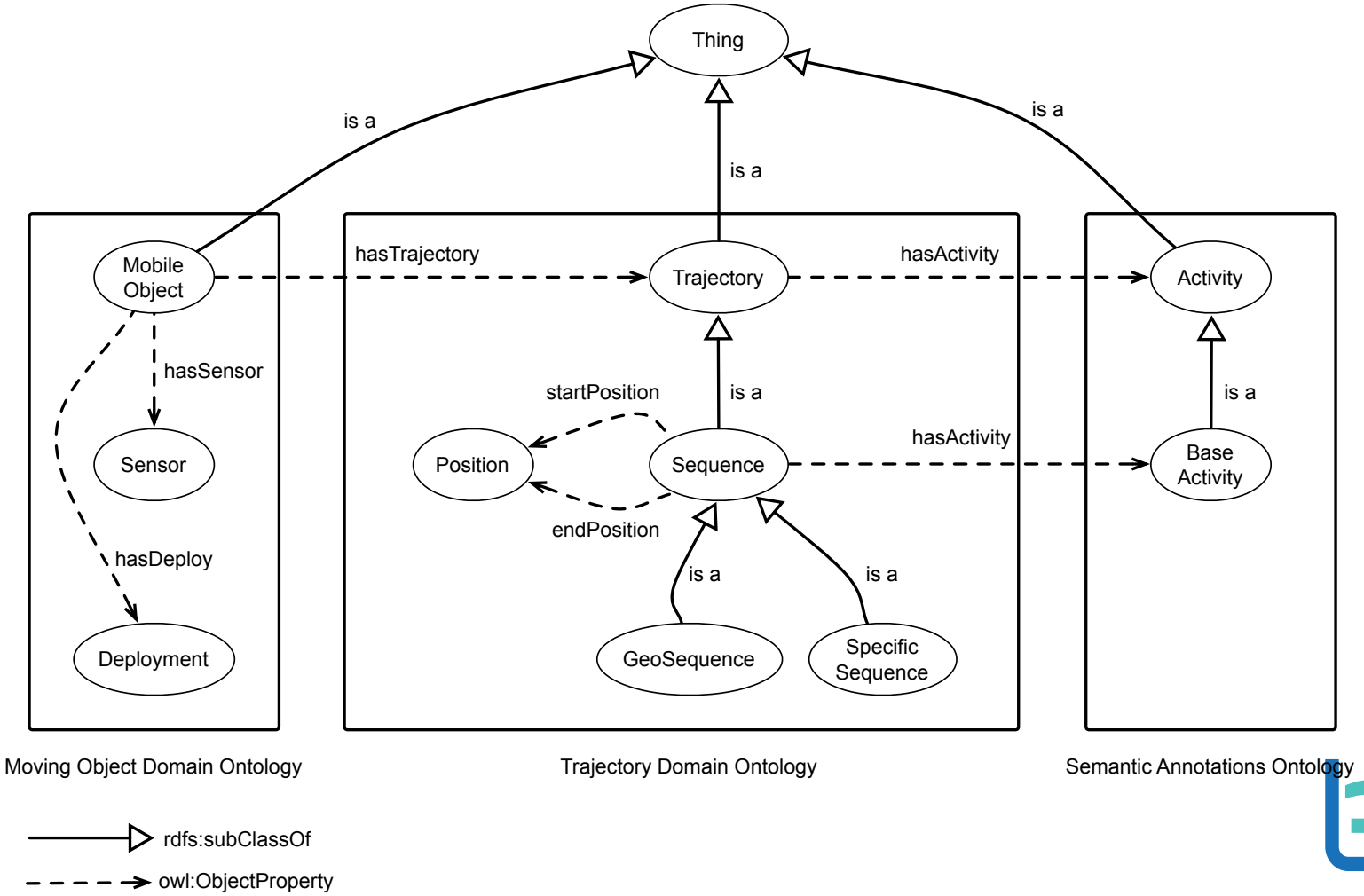
Concepts	Domain	Moving object
	Time	Temporal interval
Rules	Domain	Activity
	Time	Interval after

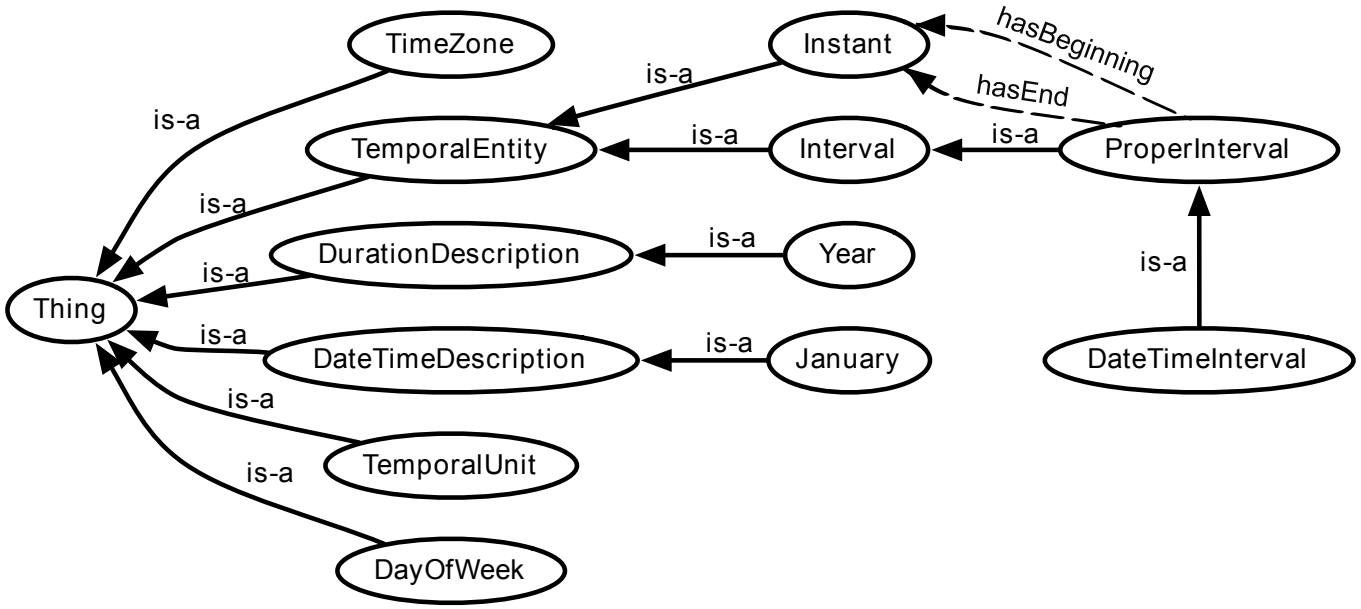
Query 2: domain and temporal concepts and rules

Trajectory modeling

Trajectory modeling

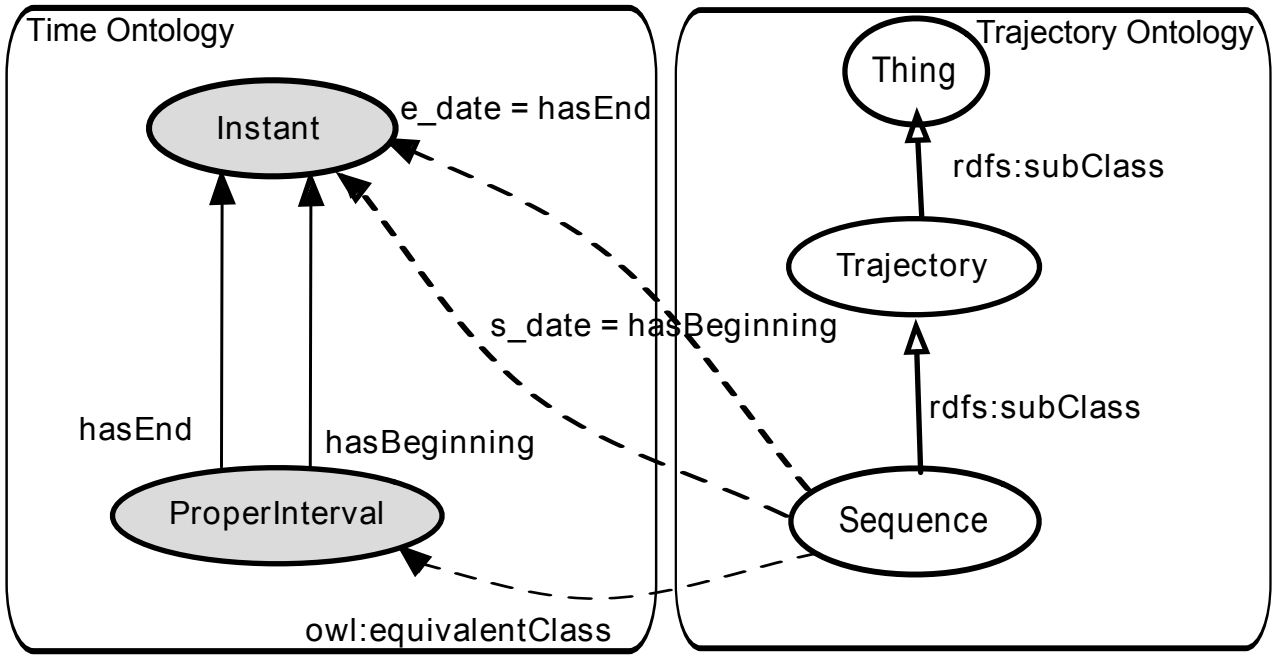


Temporal modeling



W3C OWL-Time ontology

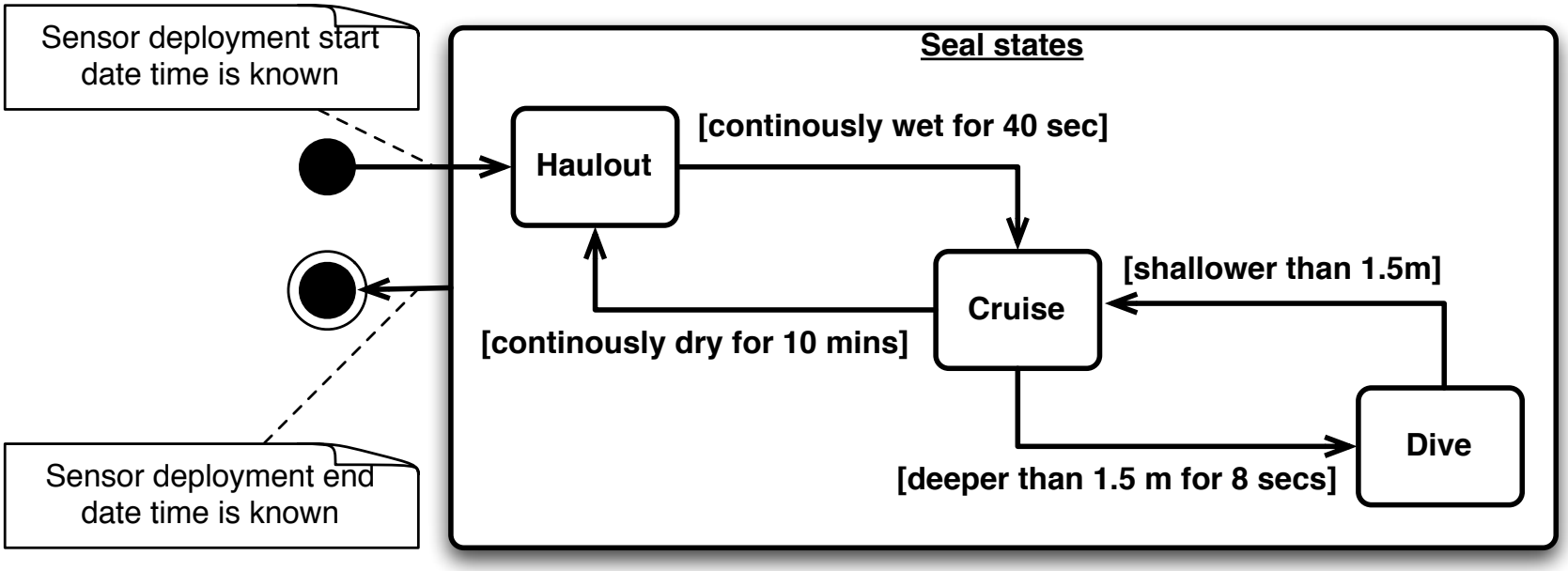
Trajectory and time ontologies mapping



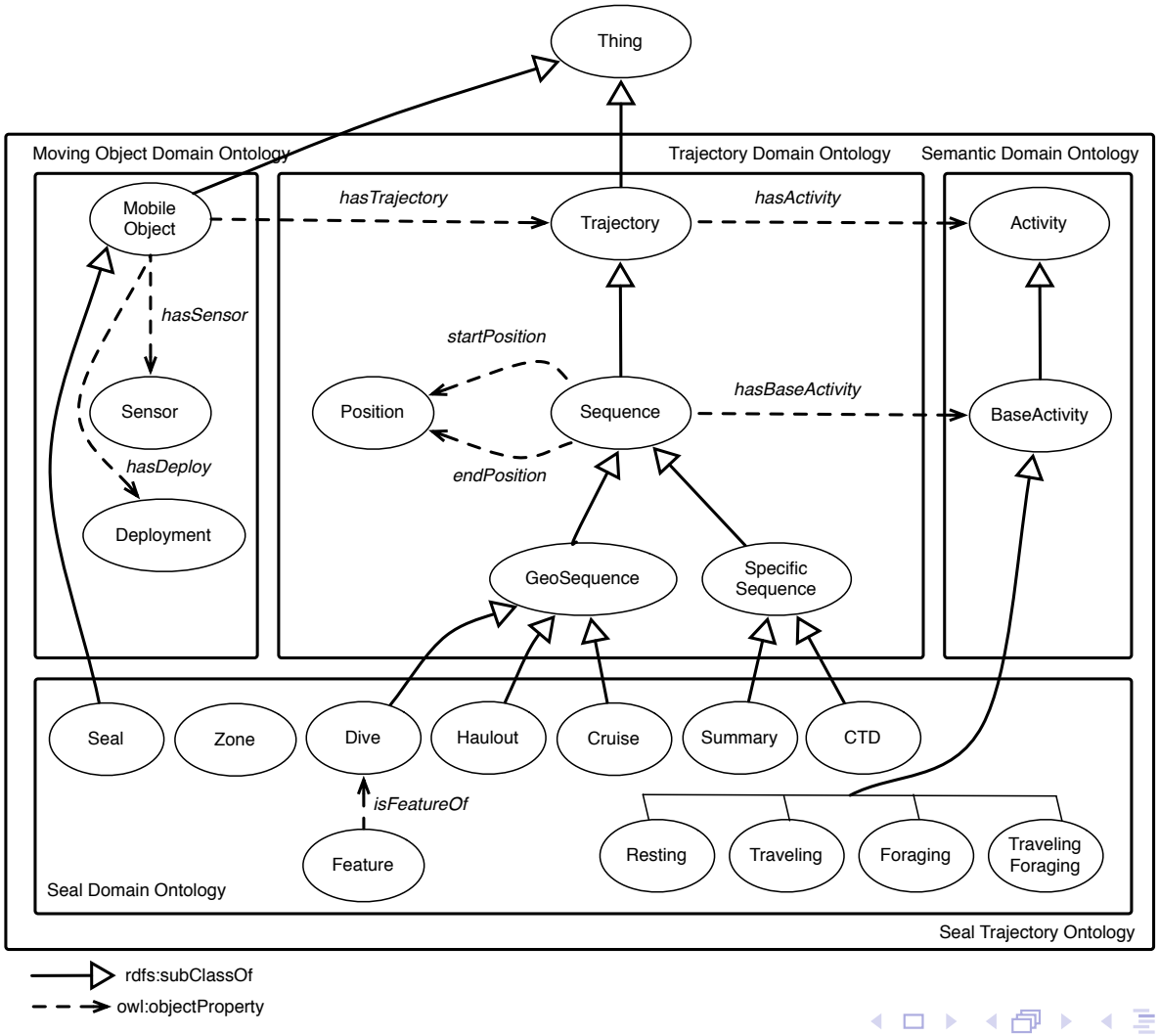
= is owl:equivalentProperty

Application scenario

State of seal trajectory



Seal trajectory ontology



General framework implementation

We are based on RDF triple store:

1. create declarative parts of ontologies;
2. populate the domain and the time ontologies;
3. create imperative parts of ontologies (domain trajectory activities and temporal ontology rules)

Seal trajectory ontology rules

Rules	Maximum dive depth (meter)	Dive shape or TAD	Surface ratio = surface dur/dive dur
Resting	< 10	all	> 0.5
Travelling	> 3	> 0 & < 0.7	< 0.5
Foraging	> 3	> 0.9 & < 1	< 0.5
Travelling_Foraging	> 3	> 0.7 & < 0.9	< 0.5

Decision table associated to seal activities

TAD: Time Allocation at Depth, shape of dives

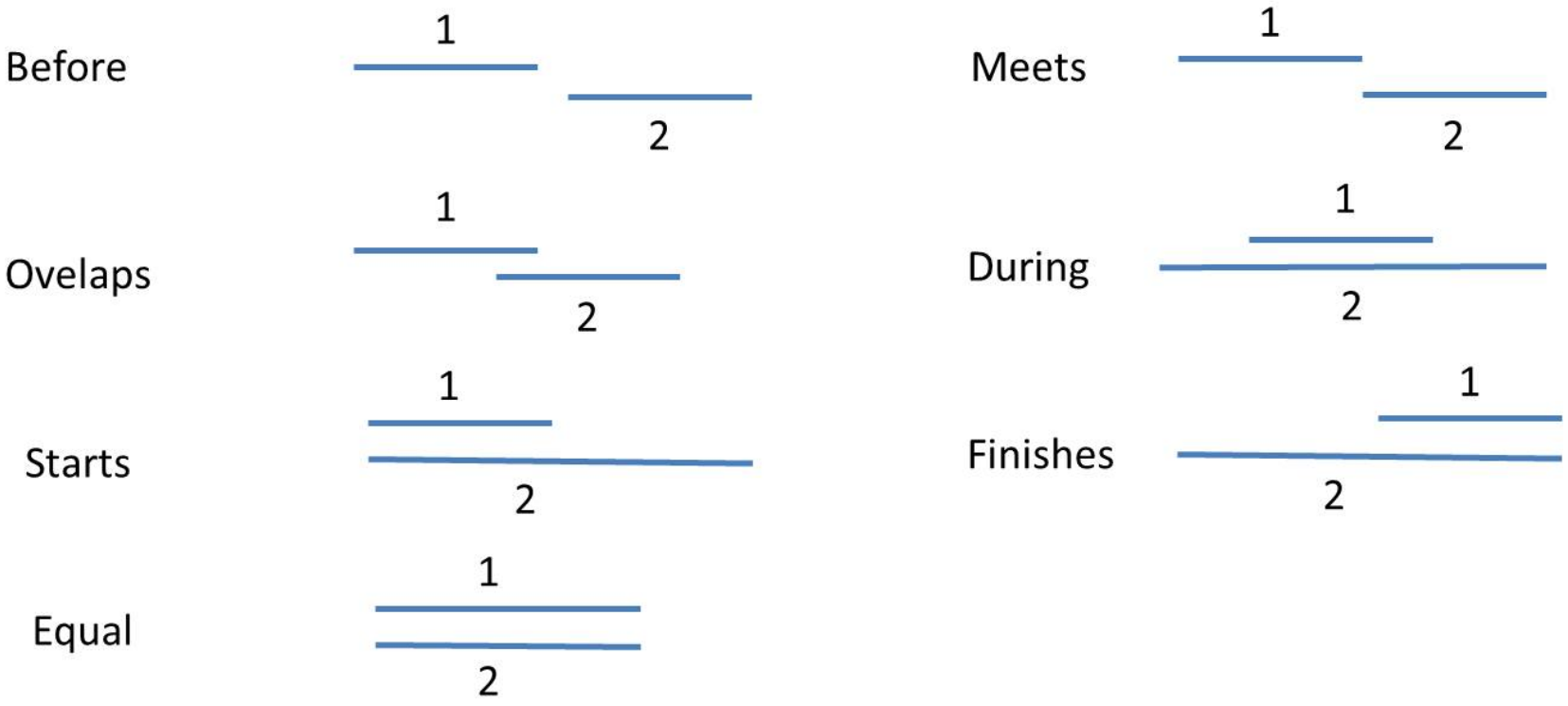
Seal trajectory ontology rules

```
rdf:type(?diveObject, s:Dive) ^
s:max_depth (?diveObject, ?maxDepth) ^
s:tad (?diveObject, ?diveTAD) ^
s:dive_dur (?diveObject, ?diveDur) ^
s:surf_dur (?diveObject, ?surfaceDur) ^
s:seqHasActivity (?diveObject, ?activityProberty) ^
> (maxDepth, 3) ^
> (diveTAD, 0.9) ^
< (surfaceDur/diveDur, 0.5) ^
  ===>
rdf:type (?activityProberty, s:Foraging)
```

The imperative part of the seal activity foraging

Time ontology rules

Time ontology rules



13 Allen temporal rules

IntervalAfter rule

```
rdf:type(?timeObject1, owltime:ProperInterval) ^
owltime:hasEnd(?timeObject1, ?EndDateTime1) ^
rdf:type(?timeObject2, owltime:ProperInterval) ^
owltime:hasBeginning(?timeObject2, ?BeginDateTime2) ^
>(BeginDateTime2, EndDateTime1)
 ===>
owltime:intervalAfter(?timeObject2, ?timeObject1)
```

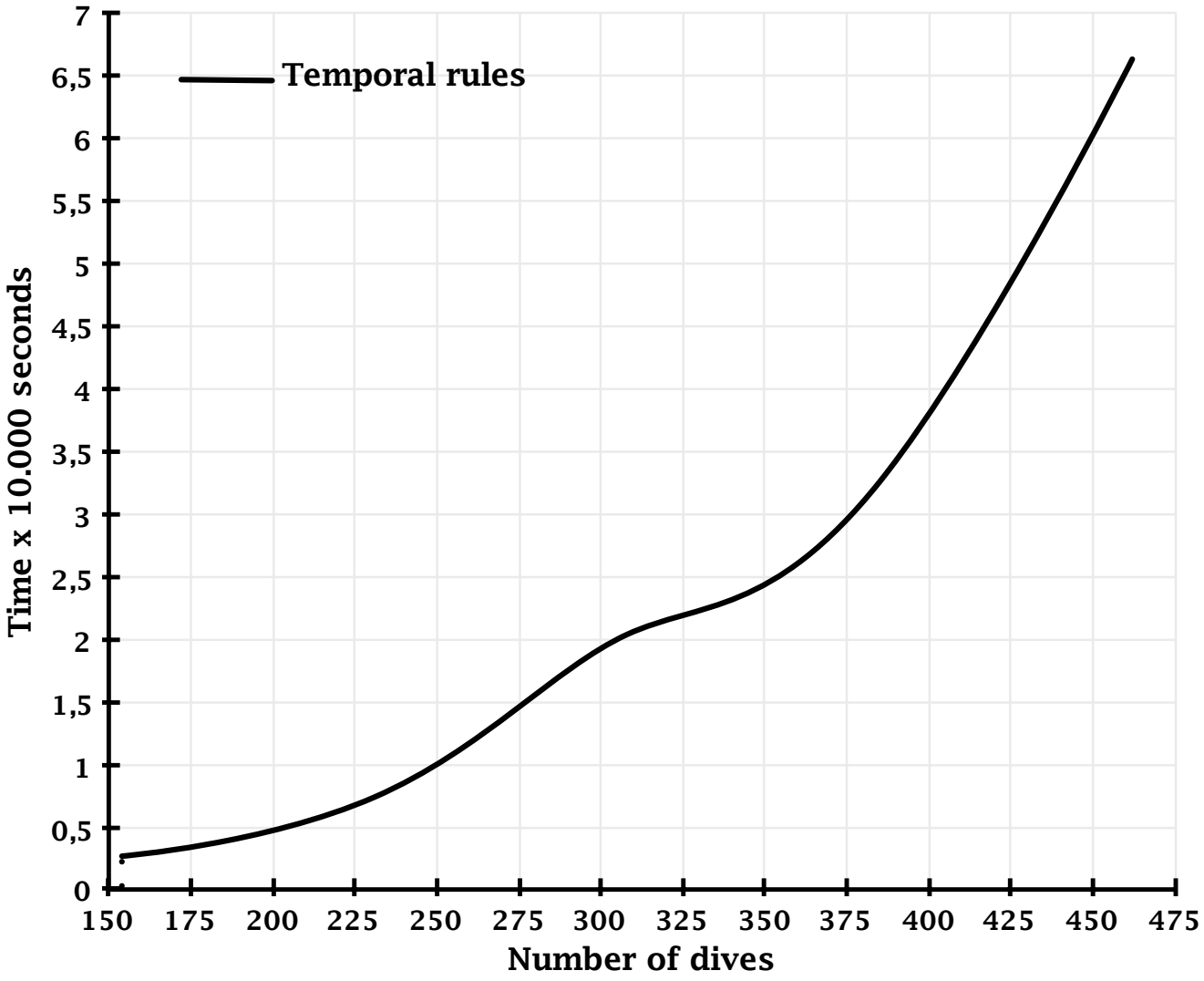
The imperative part of Allen temporal relationship `intervalAfter`

Ontology inference

```
SEM_APIS.CREATE_ENTAILMENT('owlSealTrajectory_idx',
SEM_MODELS('owlSealTrajectory','owlTime'),
SEM_RULEBASES('OWLPrime','sealActivities_rb', '
     owlTime_rb'),
SEM_APIS.REACH_CLOSURE, NULL, 'USER_RULES=T');
```

Ontology inference entailment over trajectory and temporal rules

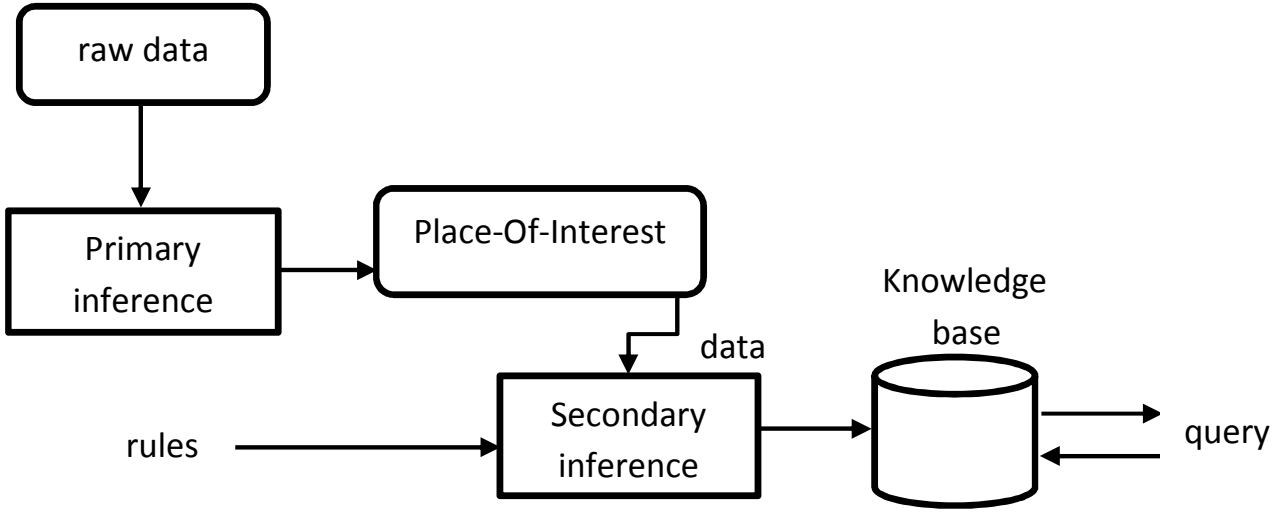
Experiments over tempral ontology inference



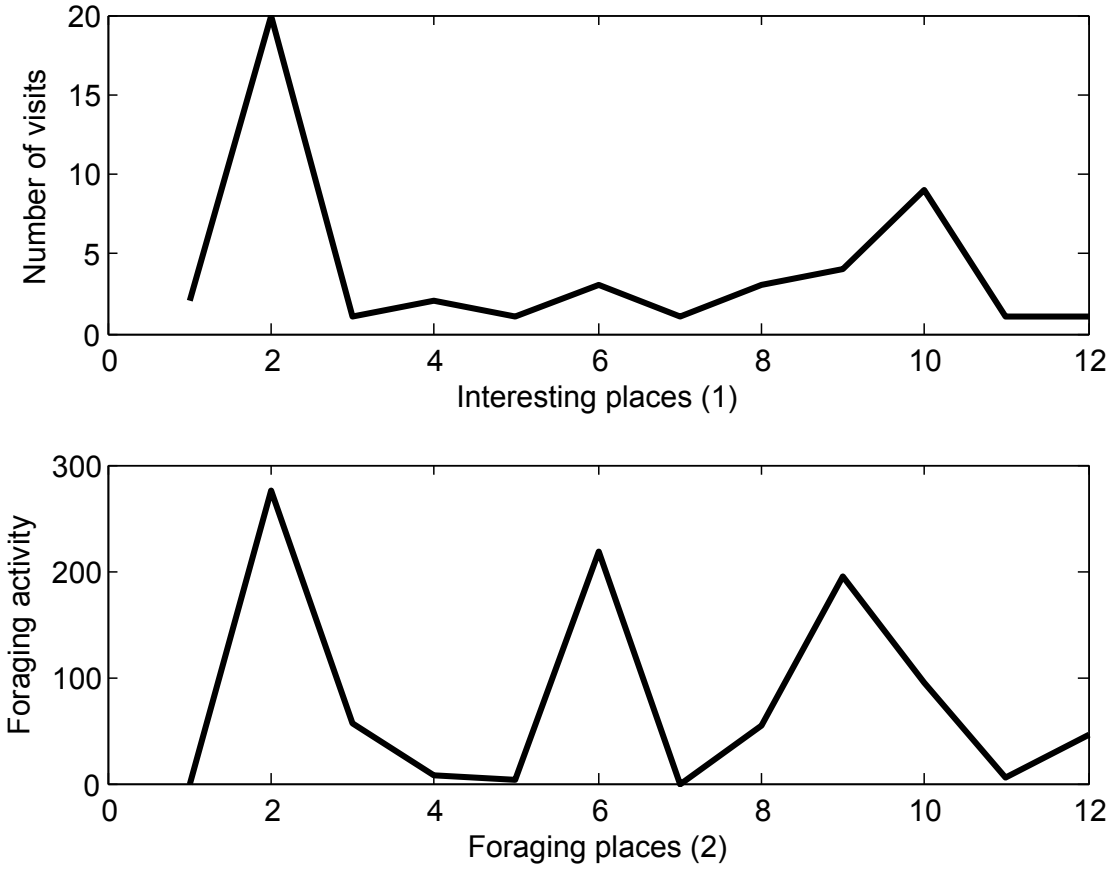
Ontology inference

Demo

Tow-tier inference filters



Evaluation



Interesting places and foraging places

Conclusion

1. Trajectories lack semantic information

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1. Trajectories lack semantic information
   - Built semantic trajectory ontology
2. Semantic trajectories need other sources
   - Integrate time ontology and temporal relationships
3. Complexity of computing the inference mechanism
   - Define two-tier inference filters
   - Verify the positive impact of the proposal on reducing the complexity of the inference mechanism on real GPS data