

# Using Ontologies For Modeling Virtual Reality Scenarios

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# Outline

1. Motivations
2. Our Contribution
  - a) The PRESTO Project
  - b) The Developed Ontology
  - c) The PRESTO Ontology in Action
3. Lessons Learned

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# What did we see in the video?

.

.

.

# What did we see in the video?

□ Items

.

.

# What did we see in the video?

- Items

- People

# What did we see in the video?

- Items
- People
- People behaviors

# What did we see in the video?

- Items

(table\_wood\_25, ch\_metal\_30, ...)

- People

(caucasian\_man\_40, african\_woman\_25, ...)

- People behaviors



# Motivations

.

.

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**REDUCE THE DEVELOPERS EFFORT**

# The PRESTO Project – 1/2

- ❑ Create a platform for developing serious games
  
- ❑ Address two important problems:
  1. modeling characters behaviors by making them context adapted, evolvable, and not predictable;
  2. making the development activity independent by the specific purpose

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## The PRESTO Project – 2/2

- A 4-year R&D effort, delivering a product hopefully late 2015
- Being tested in a pilot project for **Emergency Management Training** in a hospital

# Supporting the development: use Ontologies!

- Not an easy task due to different kind of scenarios
  
  
  
  
  
  
  
  
  
  
- Our idea is driven by:
  - 
  -



# Supporting the development: use Ontologies!

- ❑ Not an easy task due to different kind of scenarios
  
- ❑ Our idea is driven by:
  - ❑ maximize the reuse of already existing knowledge
  - ❑ revise and select this knowledge by using traditional approaches

# Building the PRESTO Ontology

- Starting point
  - abstract level: human common sense concepts (DOLCE ontology)
  - concrete level: catalogues of 3D-elements

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Endurant

# Building the PRESTO Ontology

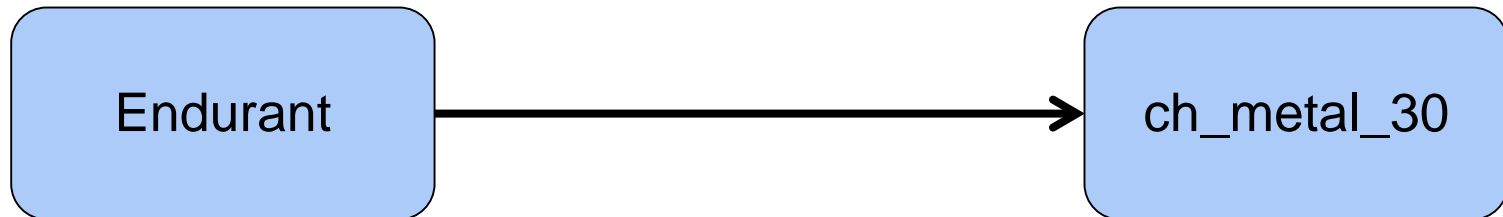
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Endurant

ch\_metal\_30

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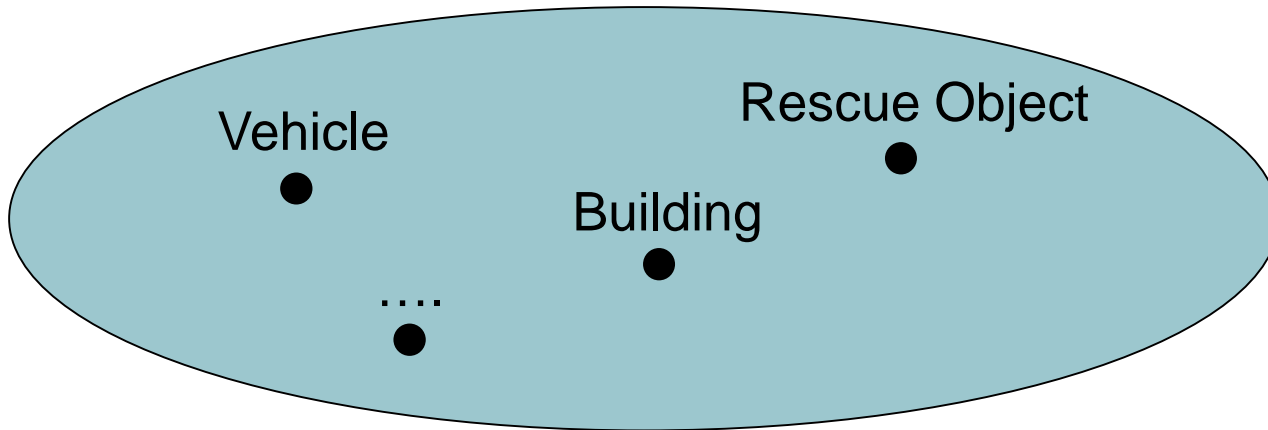


- Middle-out approach

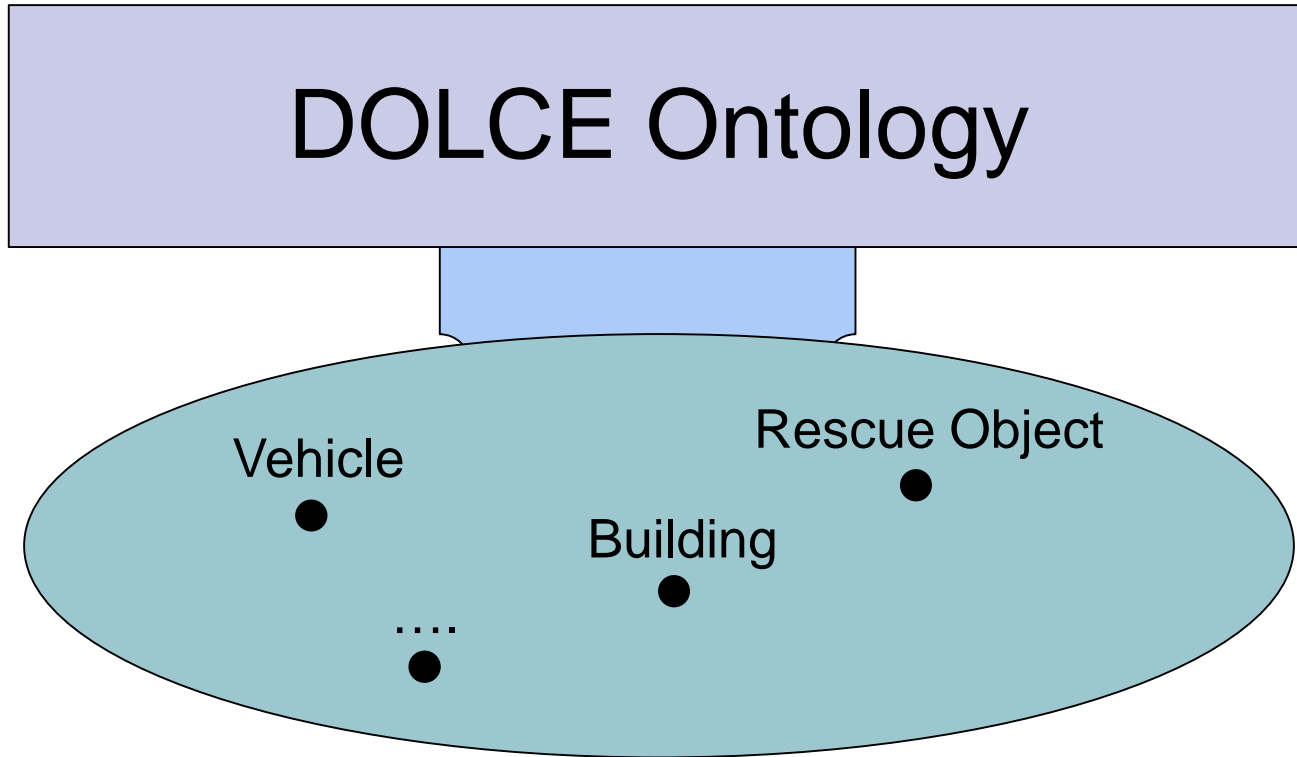
# Building the PRESTO Ontology



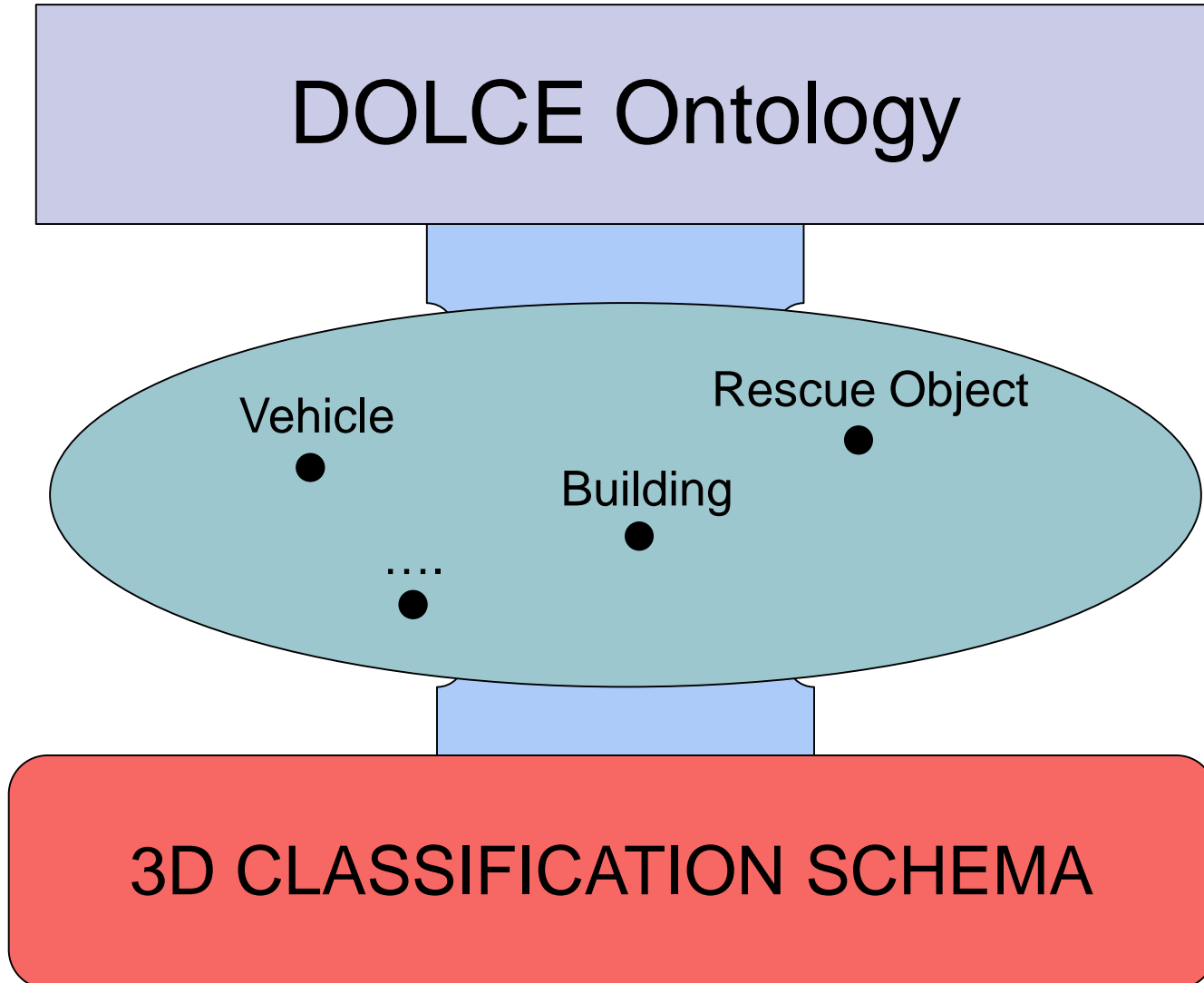
# Building the PRESTO Ontology



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# Updating/Maintaining the PRESTO Ontology

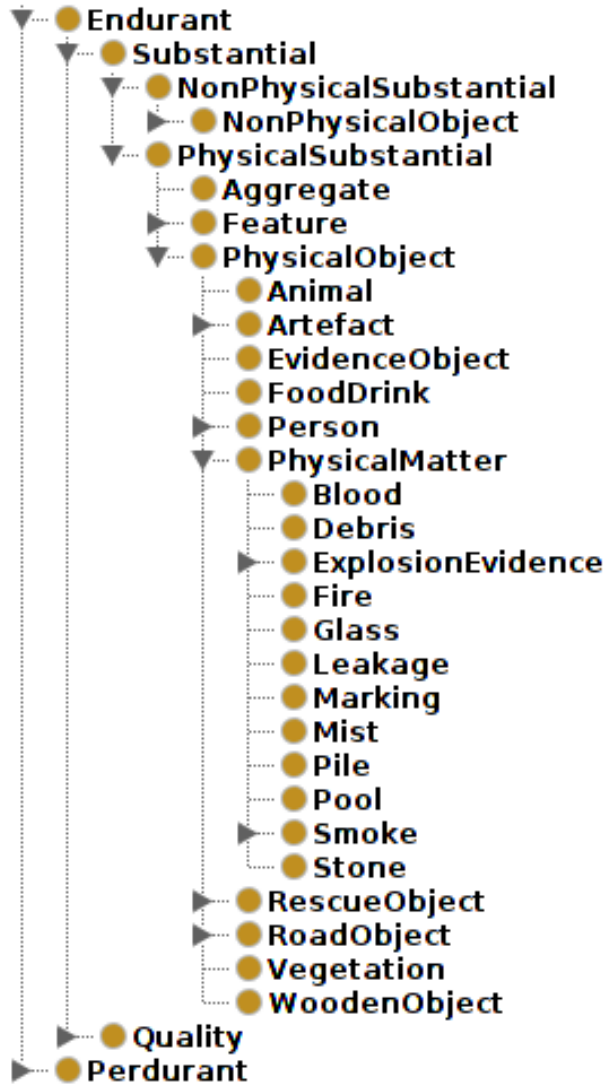
- ❑ **Semi-automatic mapping** from ground level entities to mid-levels of ontology
  - ❑ Step 1: **automatic procedure**<sup>[1]</sup>
  - ❑ Step 2: **manual check**
  
- ❑ Approach and procedure **potentially re-applicable** to other VRs, games, etc.

# Updating/Maintaining the PRESTO Ontology

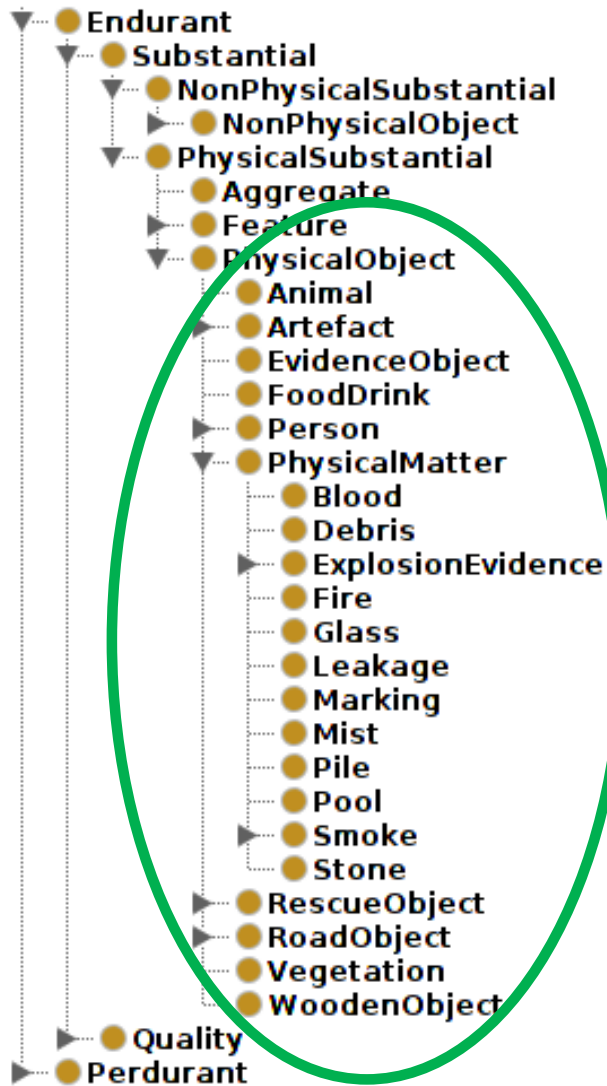
- **Semi-automatic mapping** from ground level entities to mid-levels of ontology
    - Step 1: **automatic procedure**<sup>[1]</sup>
    - Step 2: **manual check**
- 60%
- Approach and procedure **potentially re-applicable** to other VRs, games, etc.

# Update the PRESTO Ontology

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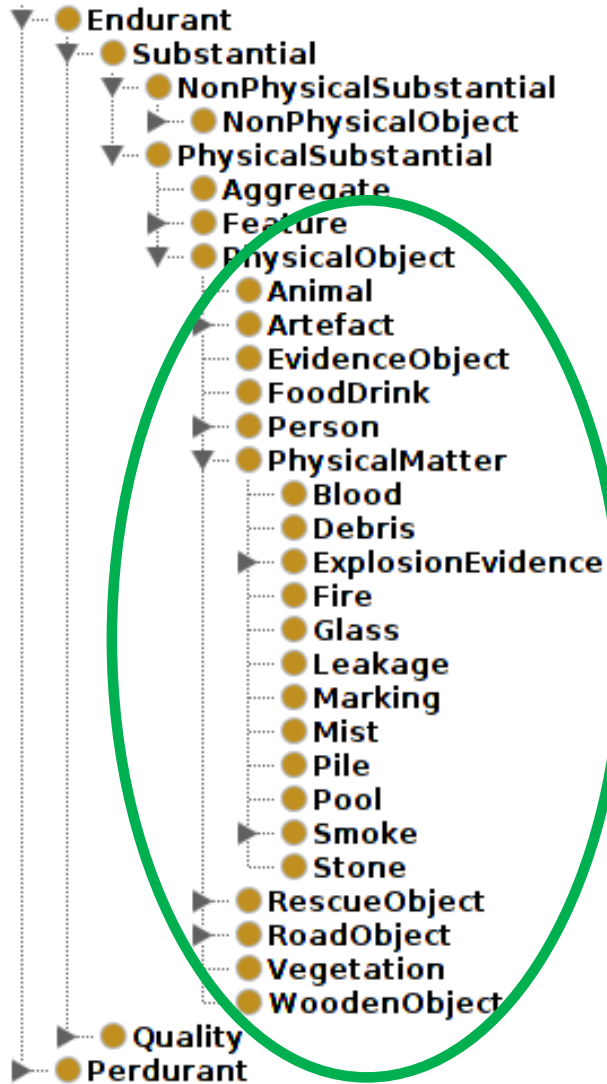


# Update the PRESTO Ontology





# Update the PRESTO Ontology



# Update the PRESTO Ontology

- Endurant
  - Substantial
    - NonPhysicalSubstantial
      - ▶ ● NonPhysicalObject
    - PhysicalSubstantial
      - Aggregate
        - ▶ ● Feature
      - PhysicalObject
        - Animal
        - Artefact
        - EvidenceObject
        - FoodDrink
        - ▶ ● Person
        - PhysicalMatter
          - Blood
          - Debris
          - ▶ ● ExplosionEvidence
          - Fire
          - Glass
          - Leakage
          - Marking
          - Mist
          - Pile
          - Pool
          - ▶ ● Smoke
          - Stone
        - ▶ ● RescueObject
        - ▶ ● RoadObject
        - ▶ ● Vegetation
        - ▶ ● WoodenObject
- ▶ ● Quality
- ▶ ● Perdurant



- ▼ ● Thing
  - ▼ ● Environment\_human
    - ▶ ● Airport\_professionals
    - ▶ ● Civilian\_officials
    - ▶ ● Criminals
    - ▶ ● Elderly\_male
    - ▶ ● Environment\_human\_Adult\_female
    - ▶ ● Environment\_human\_Adult\_male
    - ▶ ● Environment\_human\_Children\_female
    - ▶ ● Environment\_human\_Children\_male
    - ▶ ● Environment\_human\_Civilian\_professionals
    - ▶ ● Environment\_human\_Elderly\_female
    - ▶ ● Environment\_human\_Industrial\_safety
    - ▶ ● Environment\_human\_Offshore\_professionals
    - ▶ ● Environment\_human\_Road\_service\_professionals
    - ▶ ● Environment\_human\_Sport\_professionals
    - ▶ ● Festivity\_characters
  - ▶ ● Environment\_object
  - ▶ ● Environment\_vehicle
  - ▶ ● Incident\_human
  - ▶ ● Incident\_object
  - ▶ ● Incident\_vehicle

Two examples:

- ❑ Entity Instantiation
- ❑ Behavior Assignment

```
IPhysicalEntity entity = (IPhysicalEntity) scene.GetEntity(id.as_string());  
if(entity.getModel().equals("asset_object_int_chair"))  
{  
    currentDistance = agentPosition.Distance((Vector)position.as_object());  
    if (currentDistance < minDistance)  
    {  
        seat = entity;  
        minDistance = currentDistance;  
    }  
}
```

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IPhysicalEntity entity = (IPhysicalEntity) scene.GetEntity(id.as_string());  
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}
```

```
 IEntity entity = scene.GetEntity(id.as_string());  
 if(ontology.IsA(entity, CorePresto.seatable))  
 {  
     currentDistance = agentPosition.Distance((Vector)position.as_object());  
     if (currentDistance < minDistance)  
     {  
         seat = entity;  
         minDistance = currentDistance;  
     }  
 }  
 }
```

```
Entity entity = scene.GetEntity(id.as_string());
if(ontology.IsA(entity, CorePresto.seatable))
{
    currentDistance = agentPosition.Distance((Vector)position.as_object());
    if (currentDistance < minDistance)
    {
        seat = entity;
        minDistance = currentDistance;
    }
}
```

# PRESTO Ontology in Action – 3/3

```
<scenes>
  <scene name="Mech approaching">
    <updateAgent name="Mech1">
      <role>BOT</role>
      <behaviouralModel>Interpreter:Robot</behaviouralModel>
      <goal>GoToLocation</goal>
    </updateAgent>
    <updateAgent name="Mech2">
      <role>BOT</role>
      <behaviouralModel>Interpreter:Robot</behaviouralModel>
      <goal>GoToLocation</goal>
    </updateAgent>
    <updateAgent name="Mech3">
      <role>BOT</role>
      <behaviouralModel>Interpreter:Robot</behaviouralModel>
      <goal>GoToLocation</goal>
    </updateAgent>
  </scene>
</scenes>
```



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      <role>BOT</role>
      <behaviouralModel>Interpreter:Robot</behaviouralModel>
      <goal>GoToLocation</goal>
    </updateAgent>
  </scene>
</scenes>
```

```
<scenes>
  <scene name="Mech approaching">
    <updateAgent concept="http://Presto/UnityItems#Robot">
      <role>BOT</role>
      <behaviouralModel>Interpreter:Robot</behaviouralModel>
      <goal>GoToLocation</goal>
    </updateAgent>
  </scene>
</scenes>
```

```
<scenes>
  <scene name="Mech approaching">
    <updateAgent concept="http://Presto/UnityItems#Robot">
      <role>BOT</role>
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      <goal>GoToLocation</goal>
    </updateAgent>
  </scene>
</scenes>
```

# What did we learn? – 1/3

## RESEARCH QUESTIONS:

- ❑ Is the use of an ontology-based system useful for simplifying the development of virtual reality scenario?
- ❑ Is the use of an ontology-based system enough for managing the behavior of the characters deployed in the scenario?

# What did we learn? – 2/3

## POSITIVE ASPECTS:

- 
- 
-

# What did we learn? – 2/3

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- Code Re-usability
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-

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### POSITIVE ASPECTS:

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# What did we learn? – 3/3

## CRITICALITIES:

- 

- 

-

# What did we learn? – 3/3

## CRITICALITIES:

- ❑ Behaviors assignment

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- ❑ Ontology maintenance

# What did we learn? – 3/3

## CRITICALITIES:

- ❑ Behaviors assignment
- ❑ Ontology maintenance
  - ❑ data coverage

## To sum up...

- ❑ The PRESTO Project
- ❑ The developed ontology
- ❑ The benefits of using an ontology-based methodology for developing virtual reality scenarios



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