Semantic Descriptor for Intelligence Services

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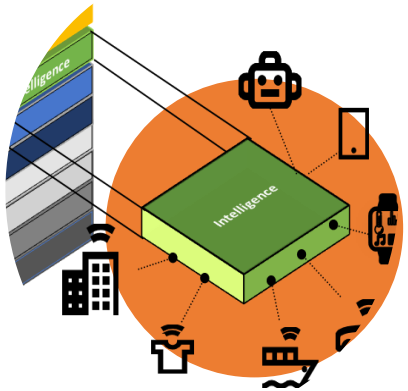
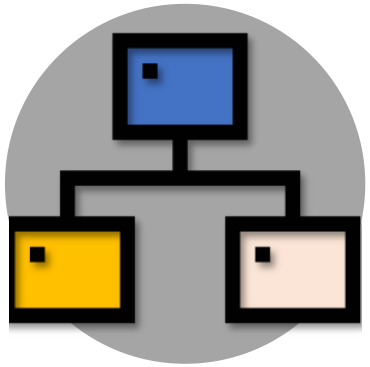
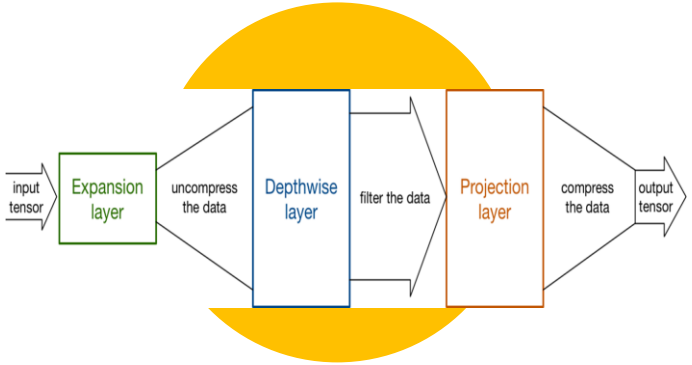
Outline



INTELLIGENCE SERVICES



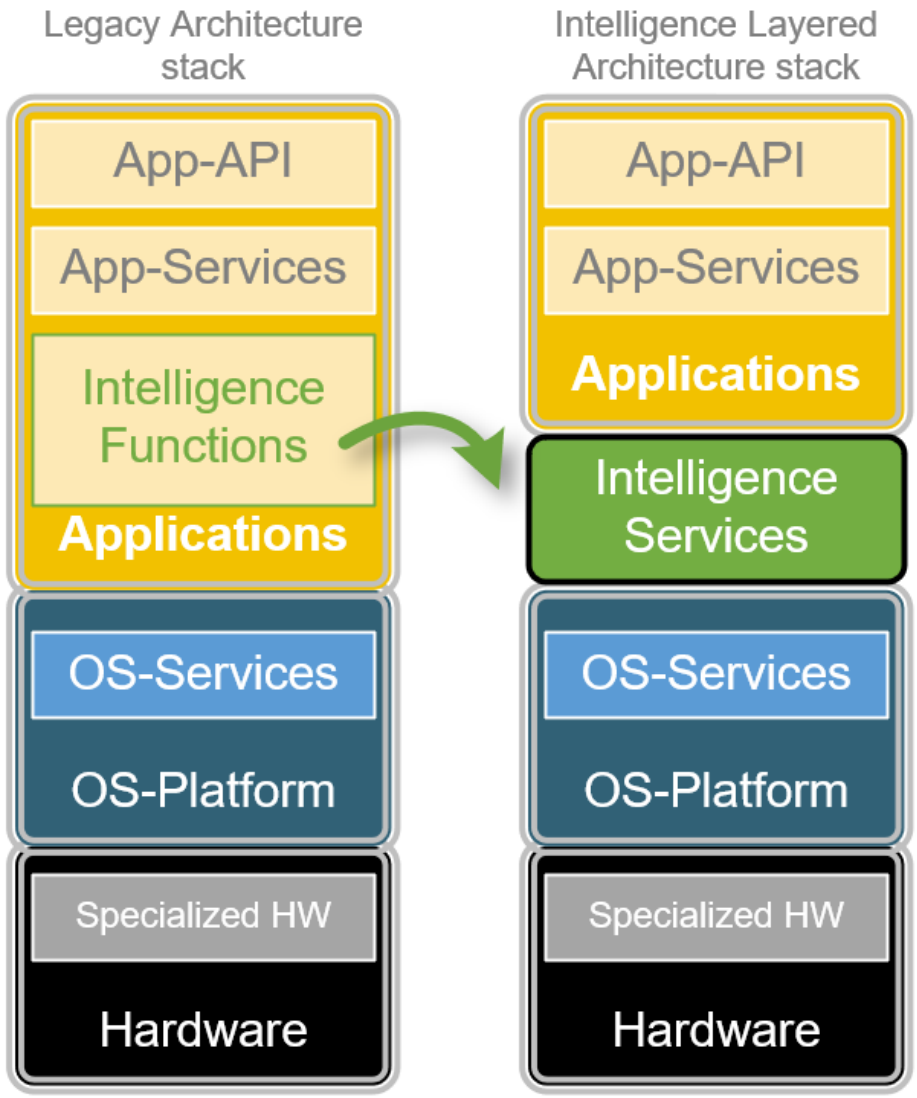
TAXONOMY OF SEMANTIC DESCRIPTIONS OF INTELLIGENCE SERVICES



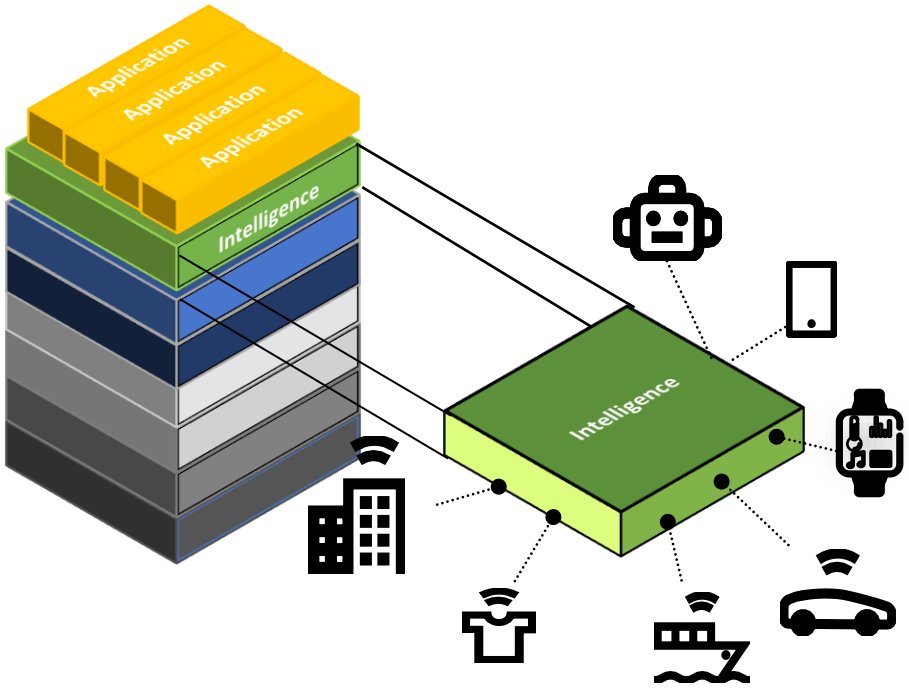
TAXONOMY USE CASE EXAMPLE

An **Intelligence Plane** to better control Intelligence Services

- The Decentralization of Intelligence Services requires a layering approach
  - Decouple concerns
  - Allow more atomic management
  - Offer Interoperability potential
  - Provide data and processing management at the service level instead of the application level



Intelligence Services examples



Intelligence models

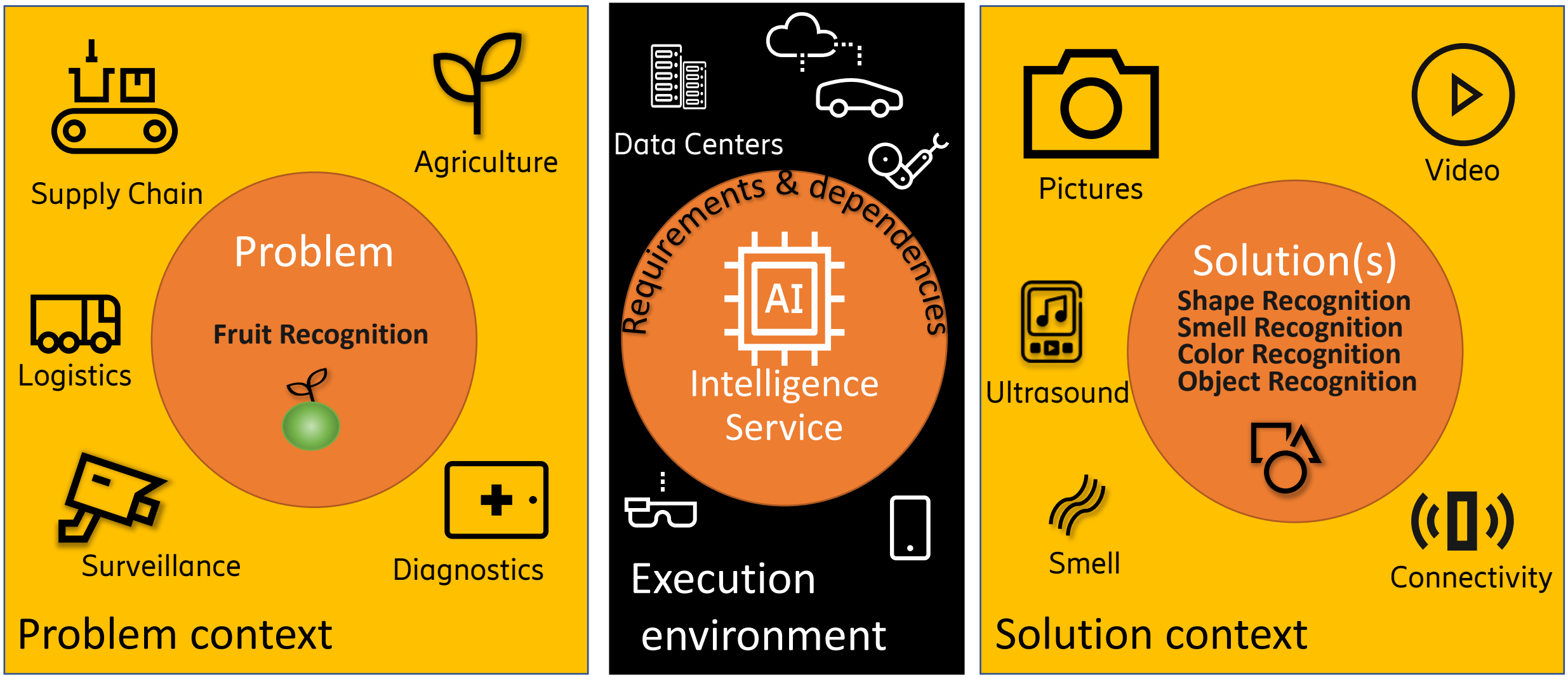
Almost any type of ML model can be expressed as a service:

- Recognition (speech, object , face, etc.)
- Prediction (text, actions, etc.)
- Anomaly detection
- Synthetic generation
- Clustering
- Recommendation (based in pattern recognition, rating, etc.)
- Analytics, etc.

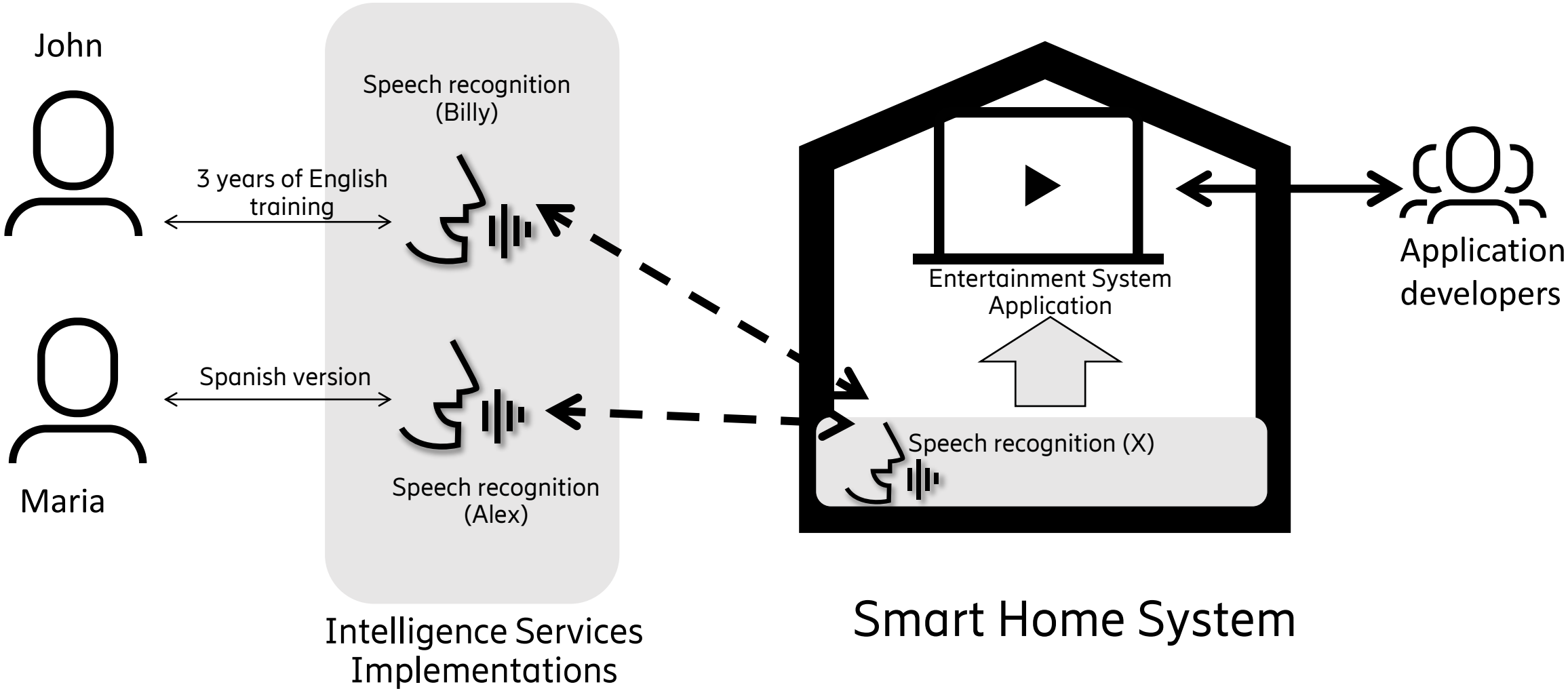
Applications makes use of APIs to access intelligence services from an “intelligence layer”

Intelligence Stratum for IoT. Architecture Requirements and Functions

Intelligence Services in **perspective**



Life cycle management of Intelligence Services



Requirements and dependencies

Performance Requirements

Networking Requirements

Security Requirements

…

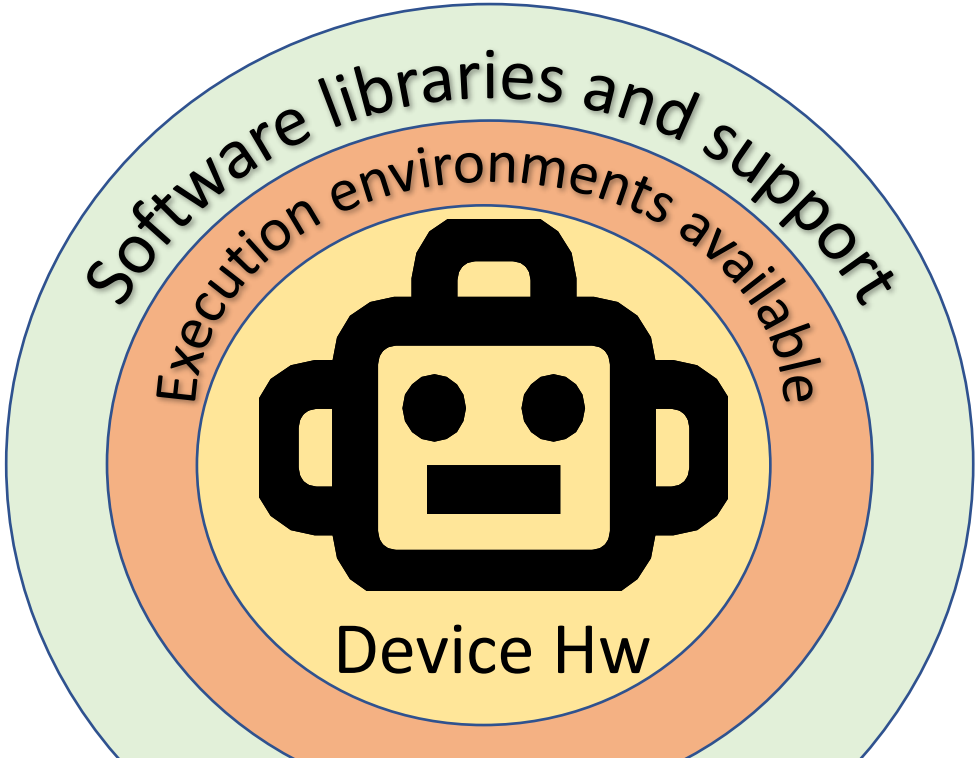
Policies

Execution environment

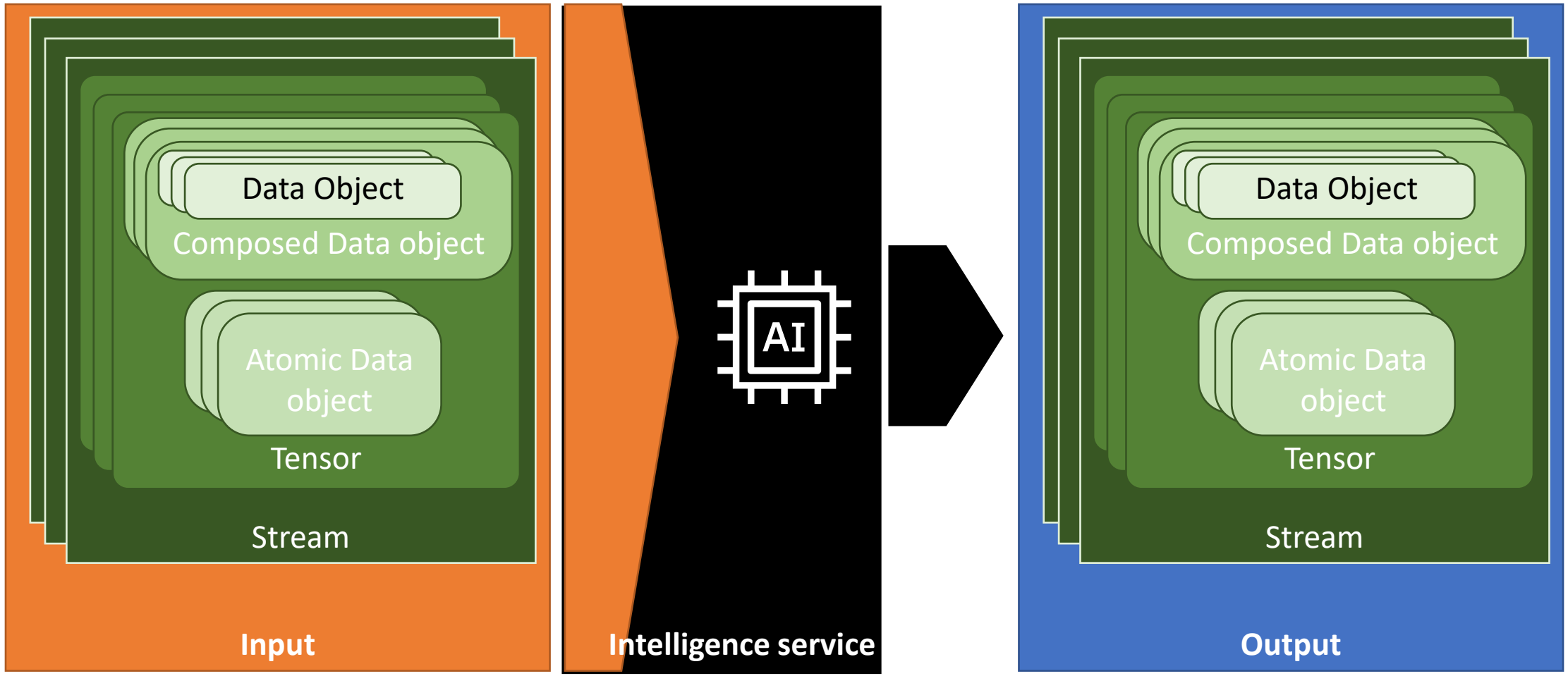
Software dependencies

Hardware dependencies

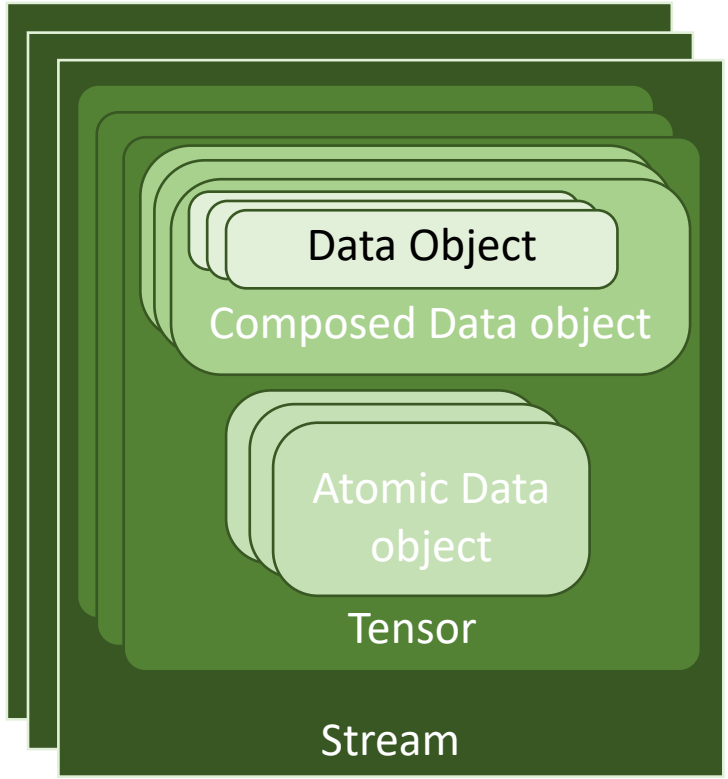
Service Implementation

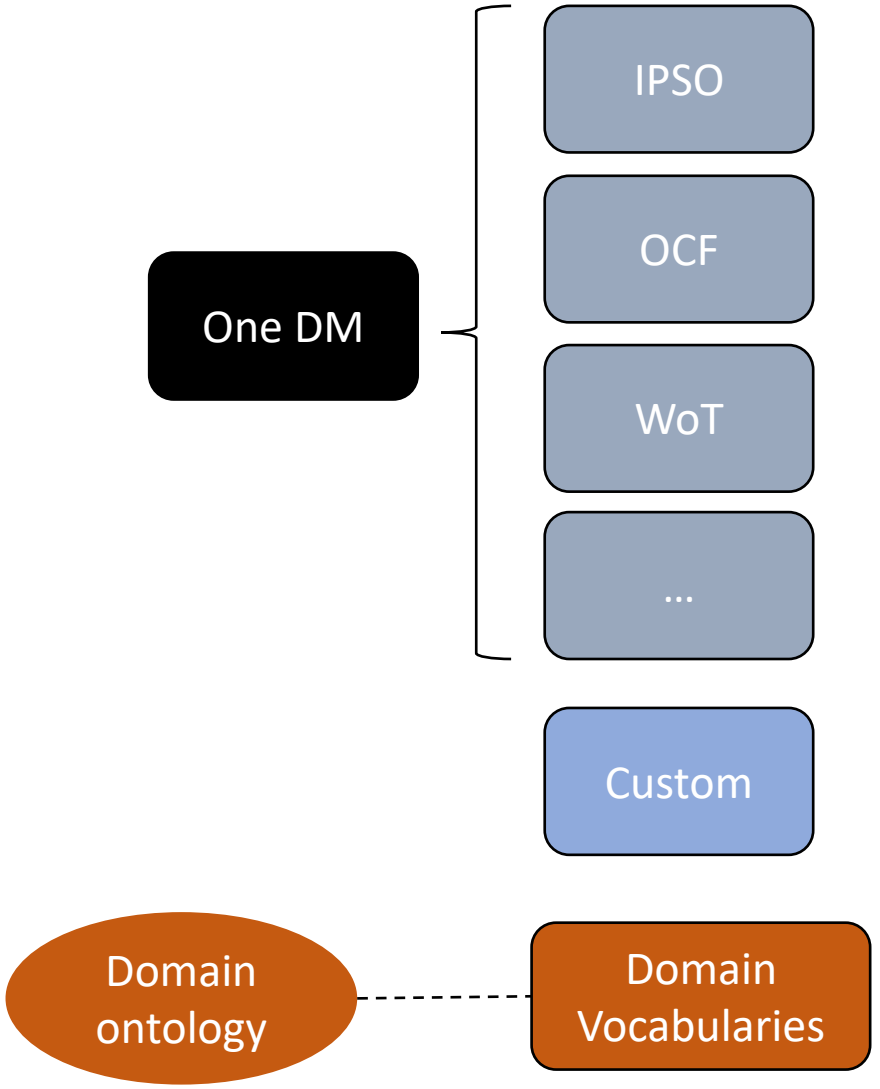


Services Input/output description structure



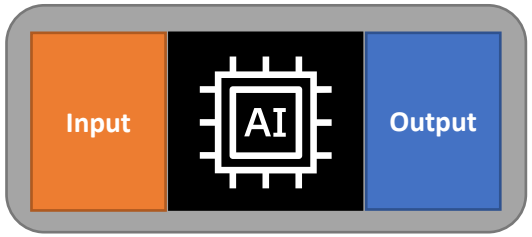
Mapping to standardized data models & ontologies



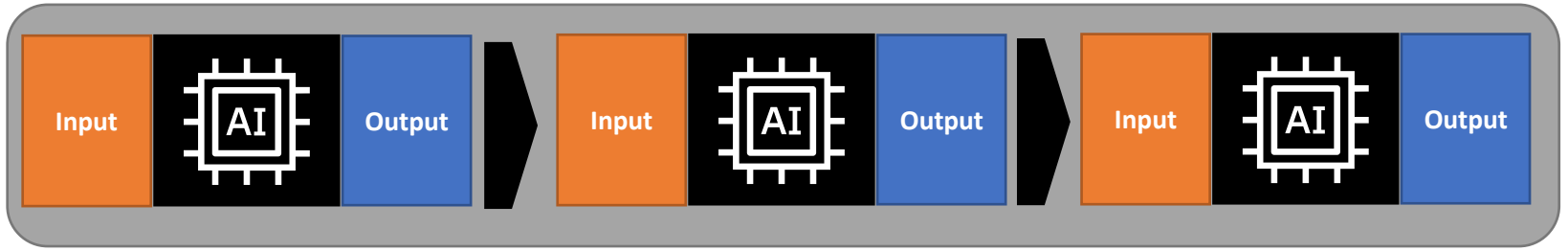


Pipelining and service **composition**

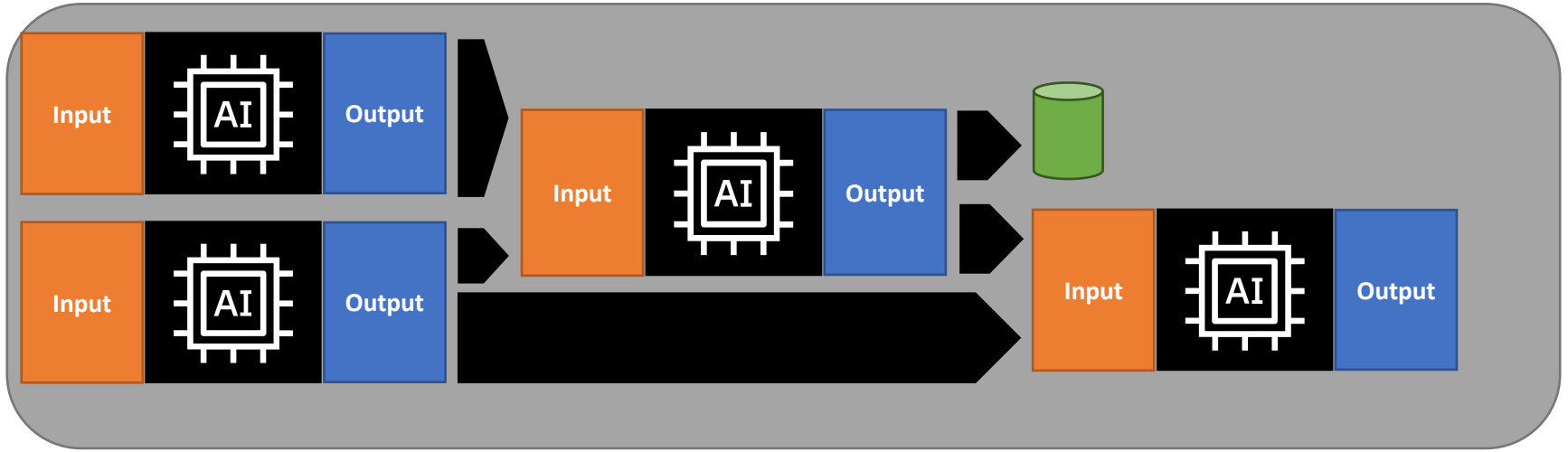
Single model service



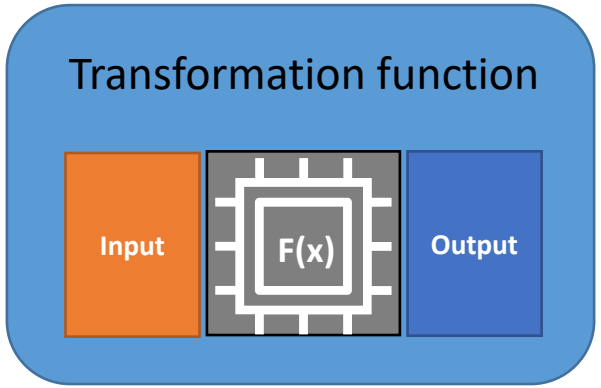
Sequential pipelined service

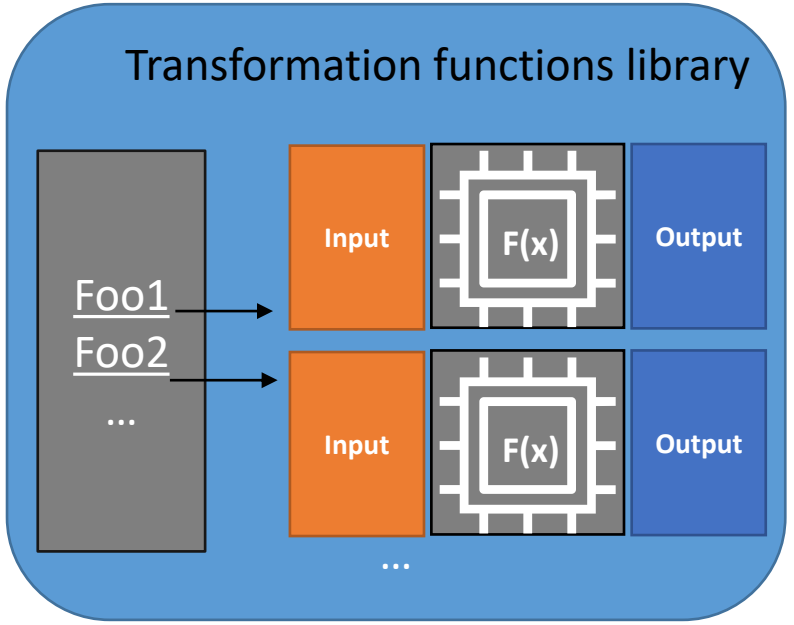


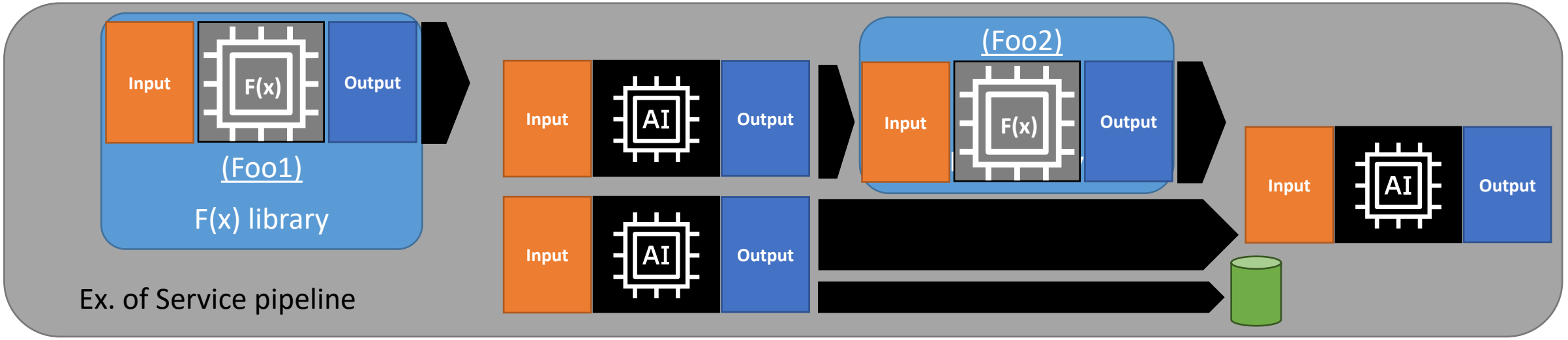
Custom pipelined service



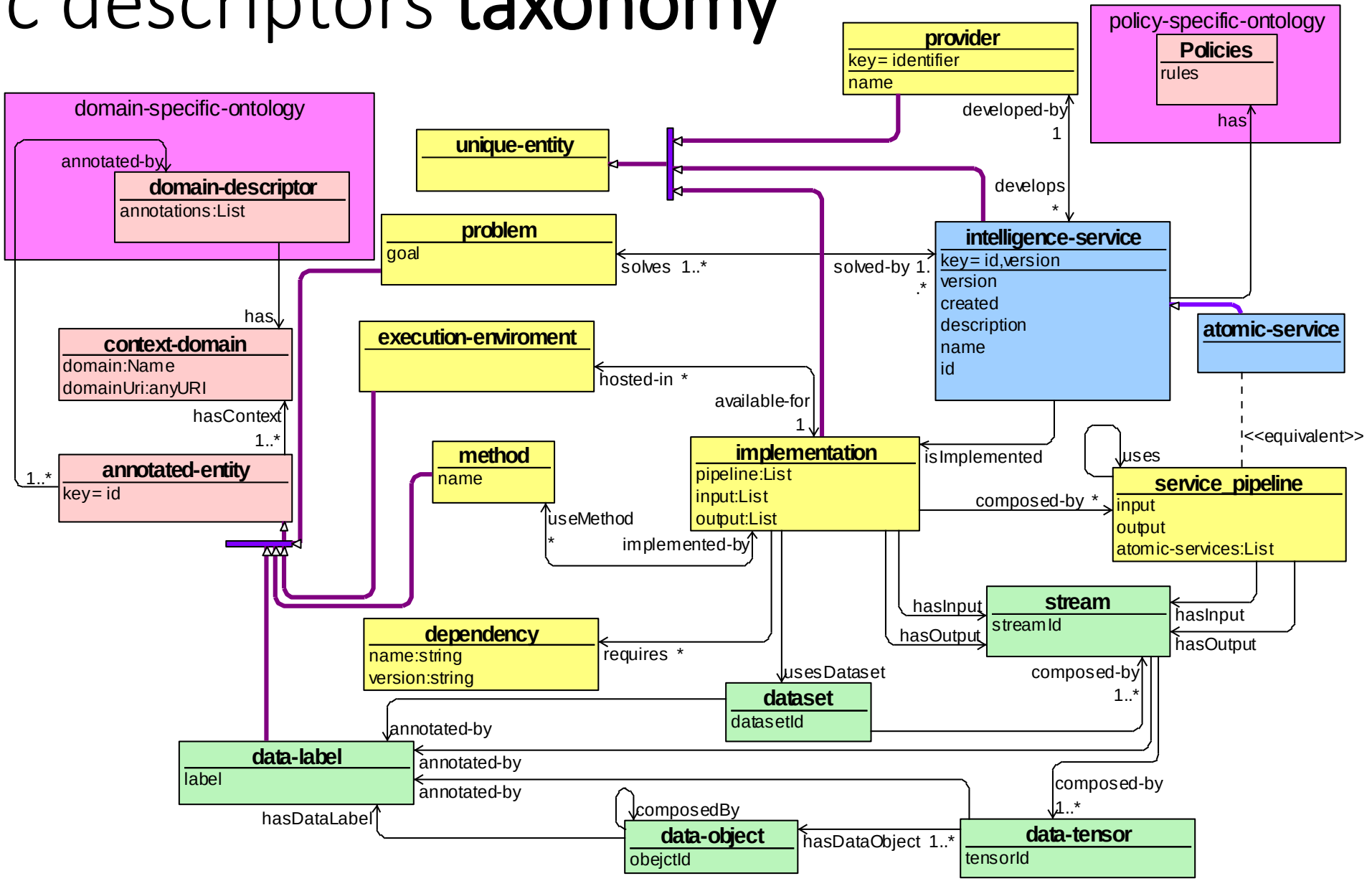
Data preparation - Preprocessing/postprocessing



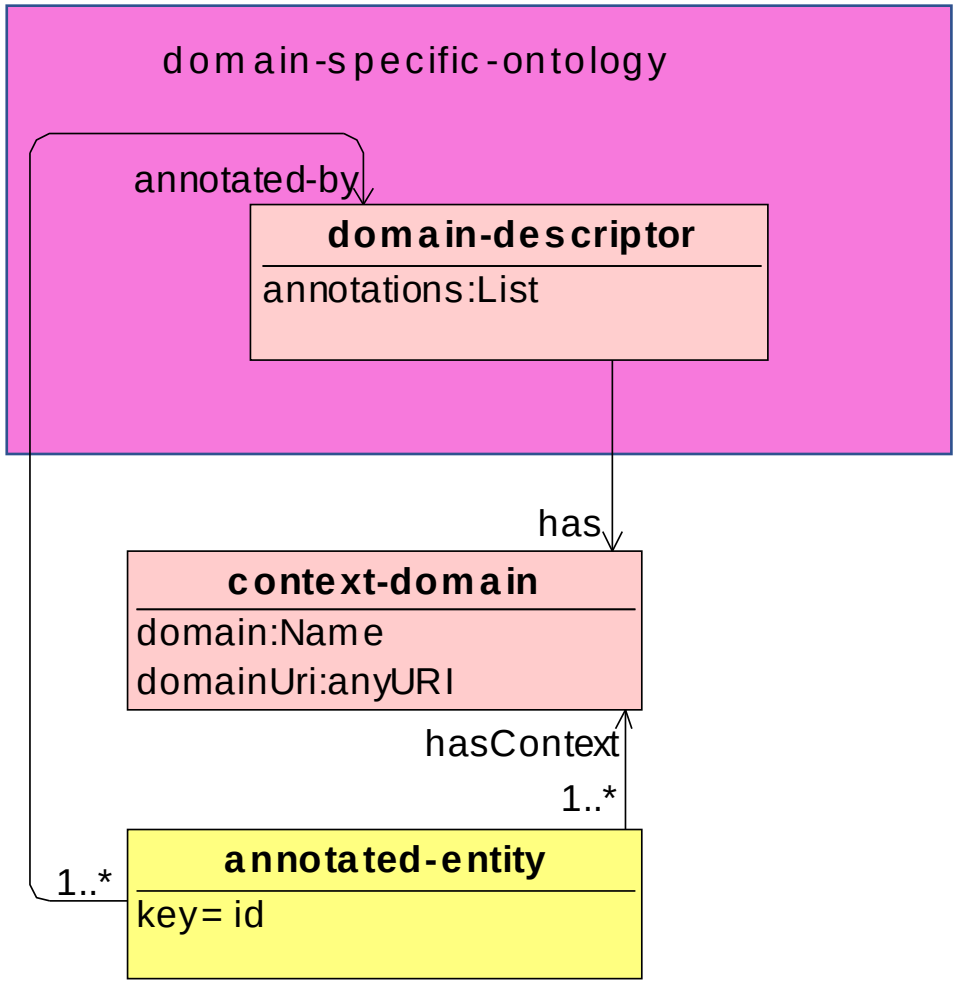


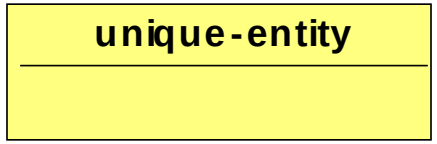


Semantic descriptors **taxonomy**

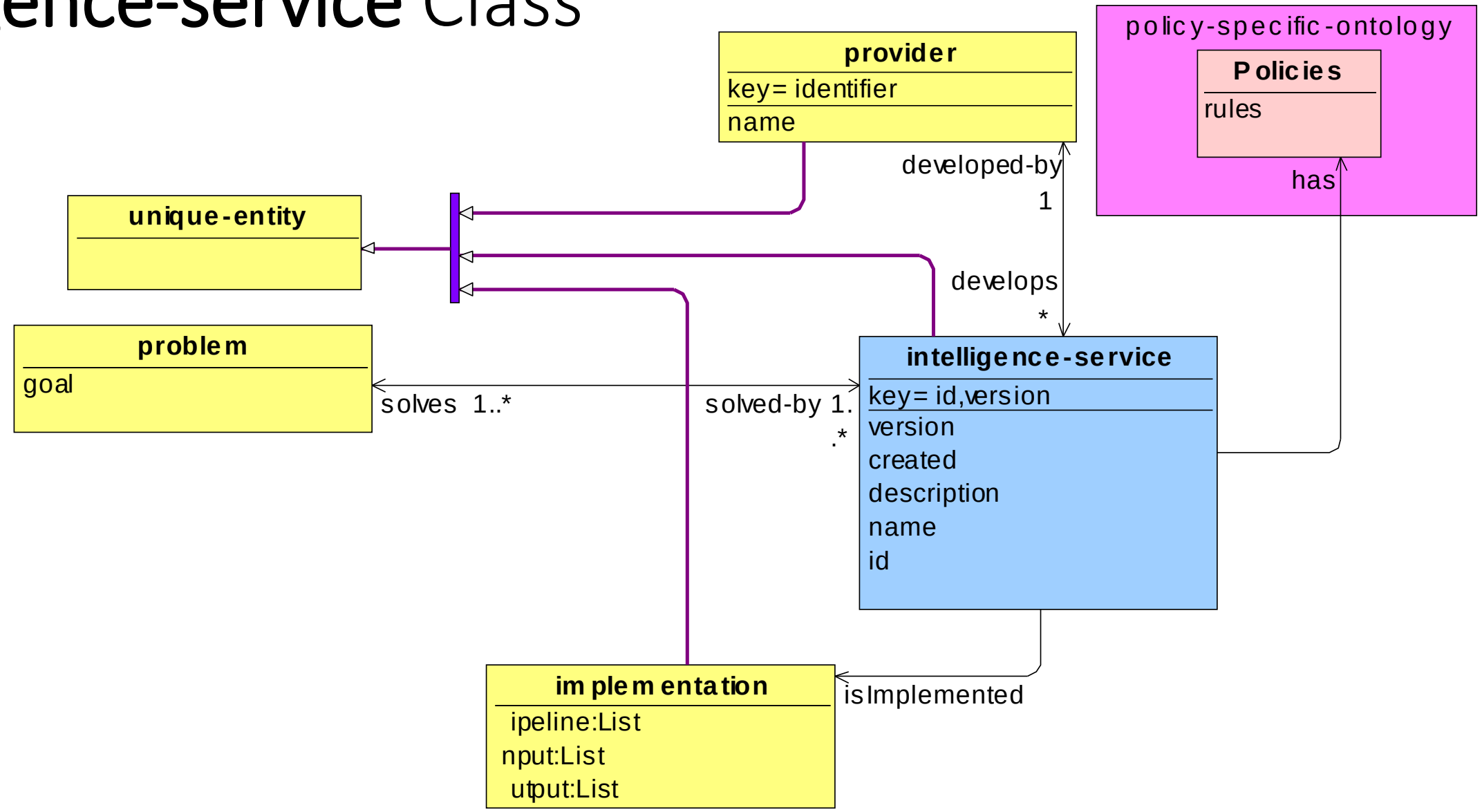


Baseline Abstract Classes

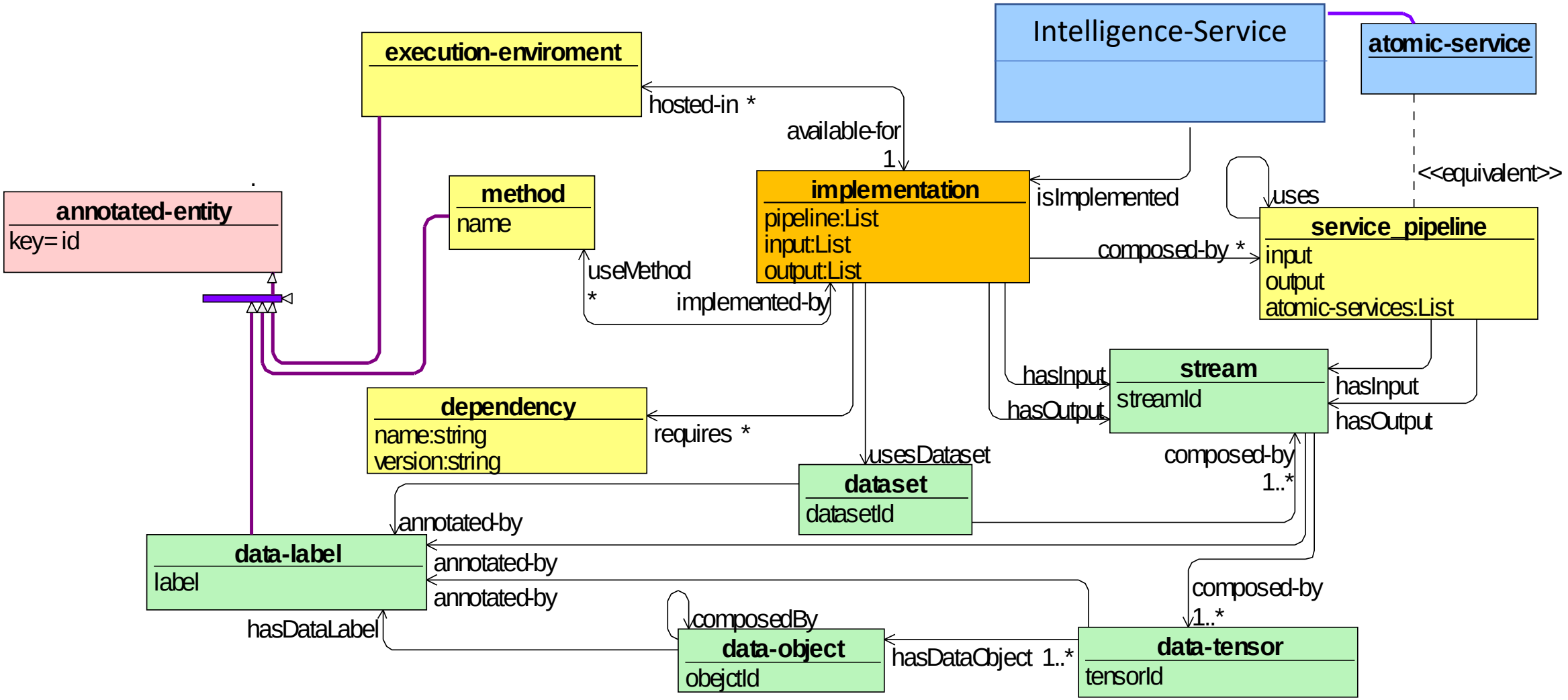




Intelligence-service Class

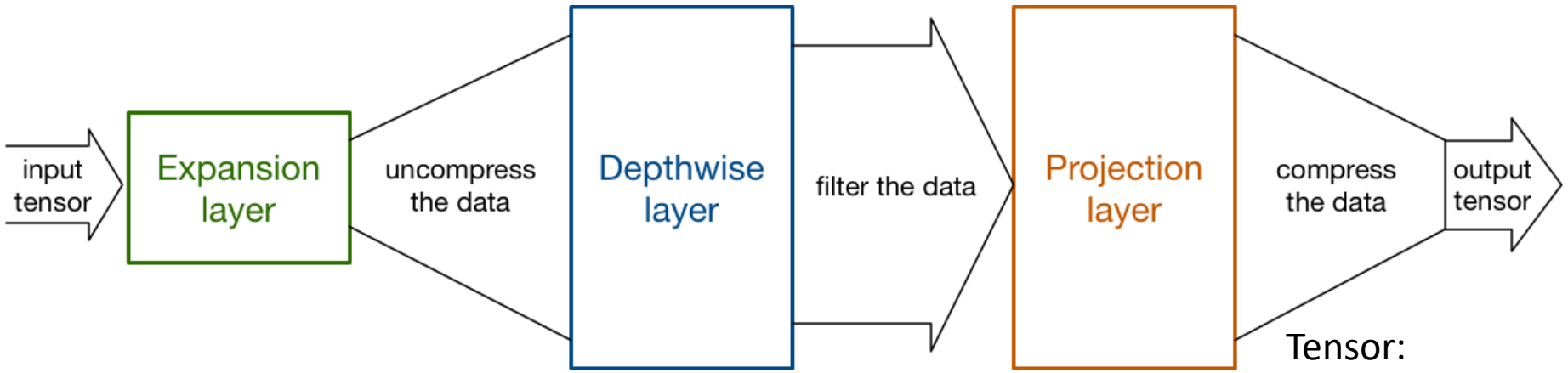


Implementation Class



MobileNet
(object recognition based in ImageNet dataset)

MobileNet V2 Model

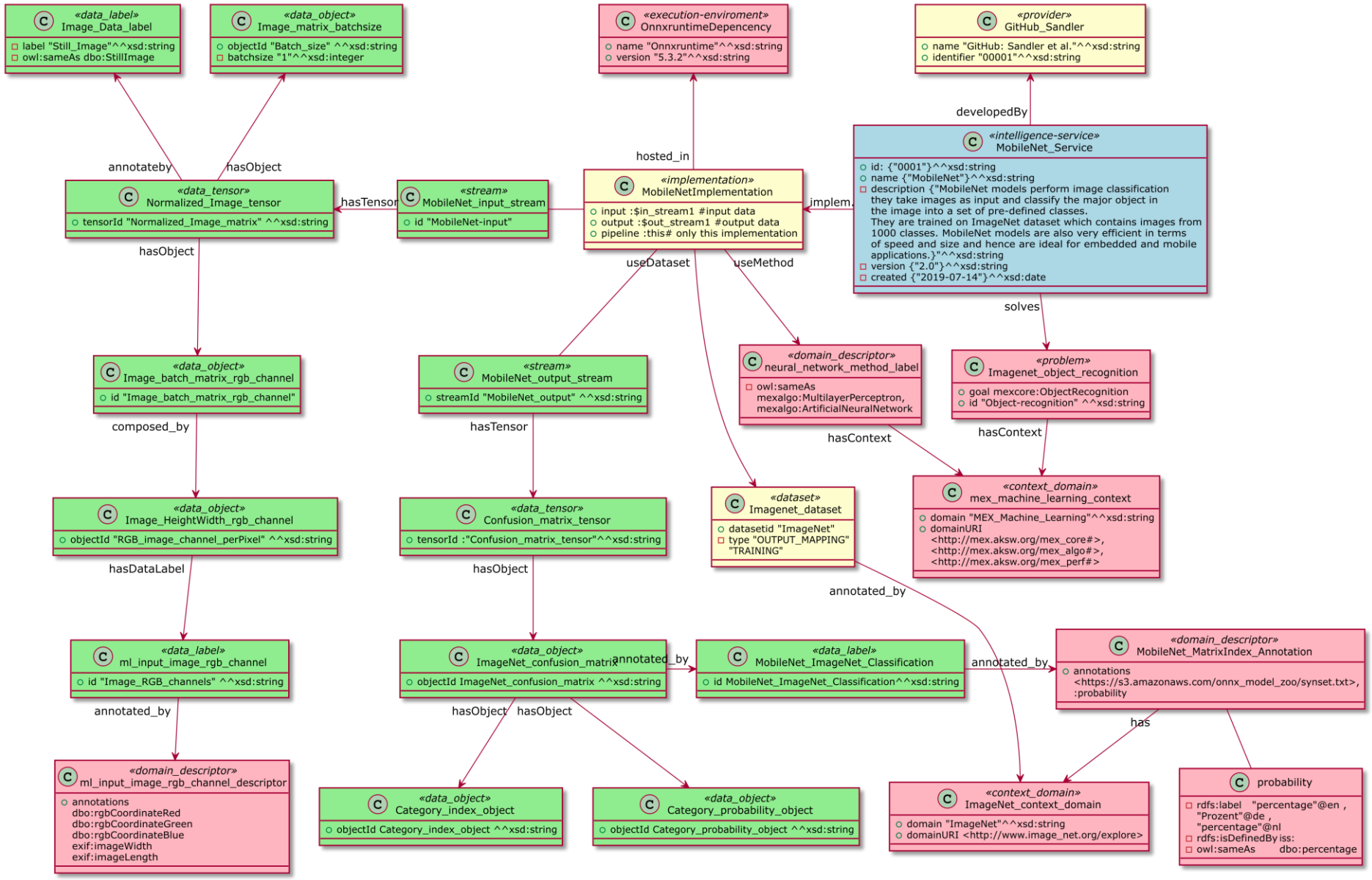


Tensor:
Matrix
Batch size (1) x RGB channel (3) x Img. High(<224) x Img. Width (>224)

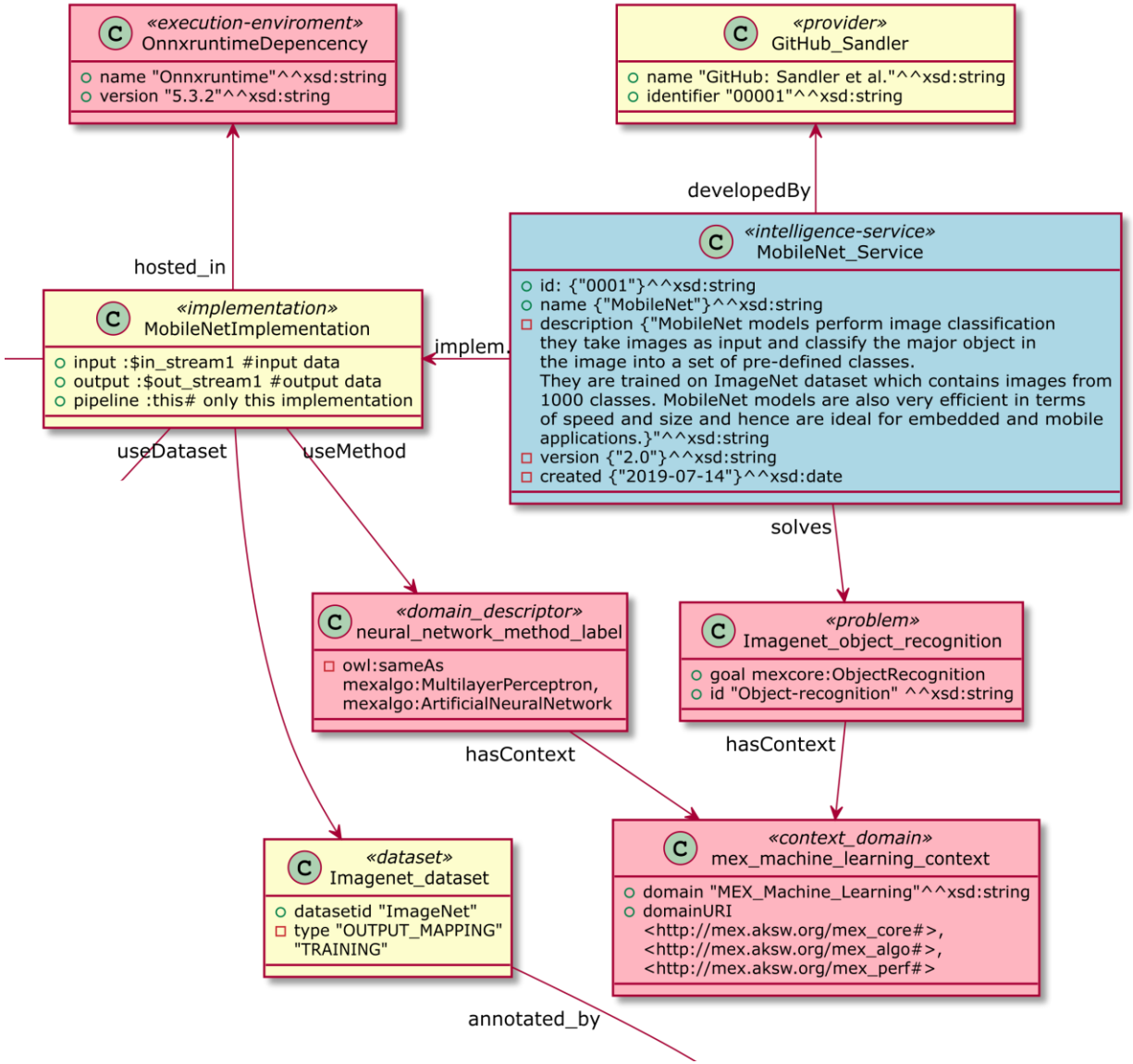
Tensor:
Matrix
1000 (ImageNet classes) x Score (probability of match)

The images have to be normalized using mean = [0.485, 0.456, 0.406] and std = [0.229, 0.224, 0.225].

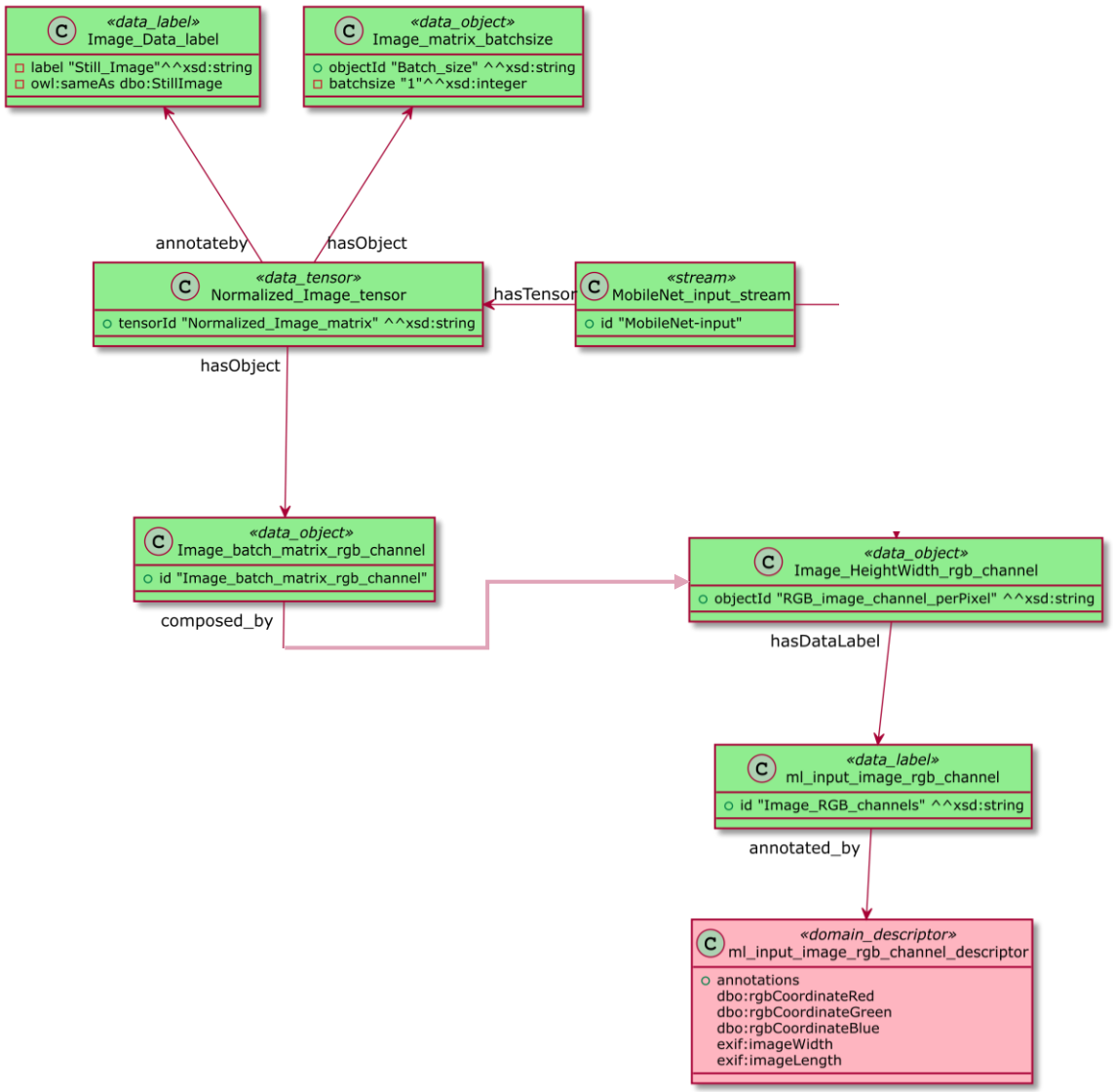
MobileNet Service (UML representation)



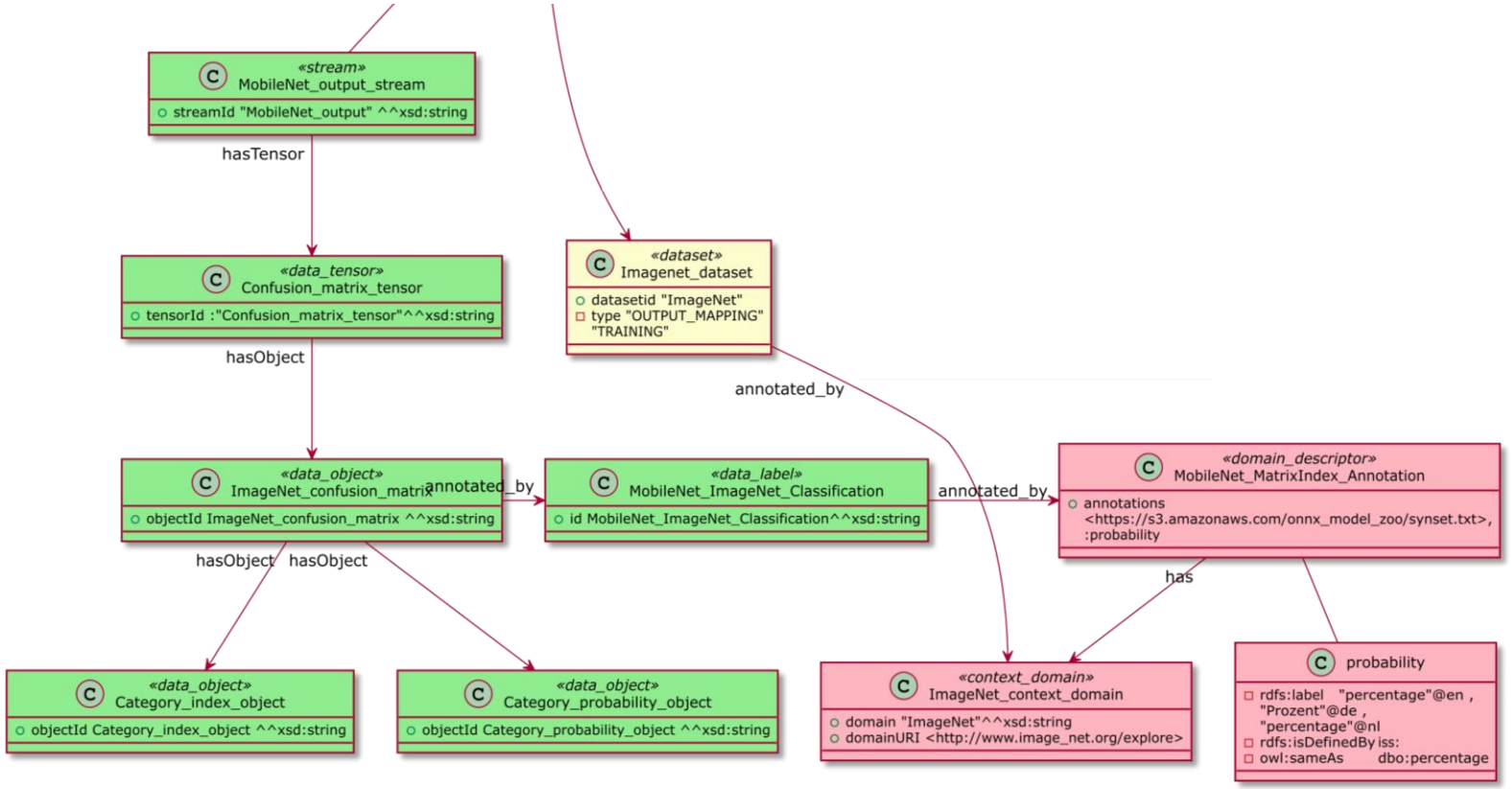
MobileNet (Intelligence-Service)



MobileNet (inputs)



MobileNet (Outputs)



Android MobileNet Service

Input :
Image File

Python Script

ImageNet preprocessing function for MobileNet

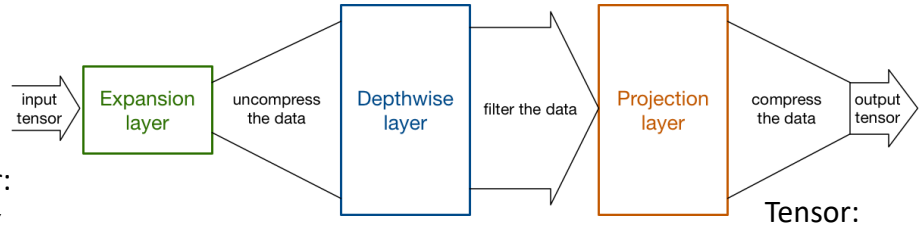
```python
import mxnet
from mxnet.gluon.data.vision import transforms

# Pre-processing function for ImageNet models
def preprocess(img):
    '''
    Preprocessing required on the images for inference with mxnet gluon
    The function takes path to an image and returns processed tensor
    '''
    transform_fn = transforms.Compose([
    transforms.Resize(224),
    transforms.CenterCrop(224),
    transforms.ToTensor(),
    transforms.Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225])
    ])
    img = transform_fn(img)
    img = img.expand_dims(axis=0) # batchify

    return img
```

Normalized image in a matrix structure

MobileNet V2 Model



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Tensor:
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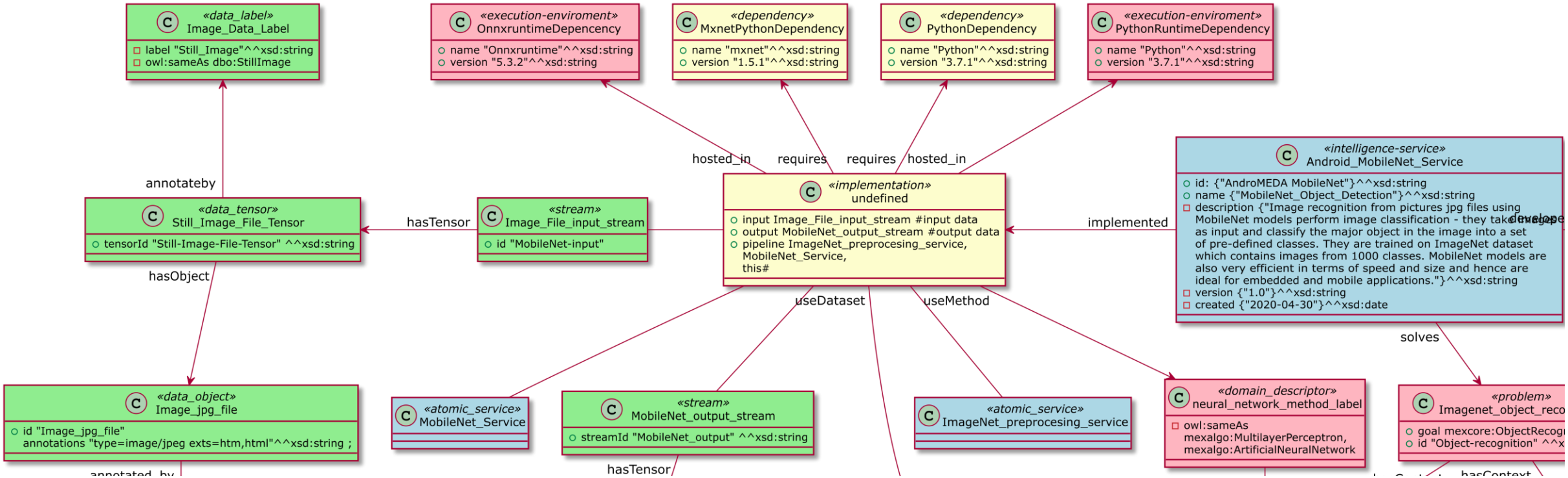
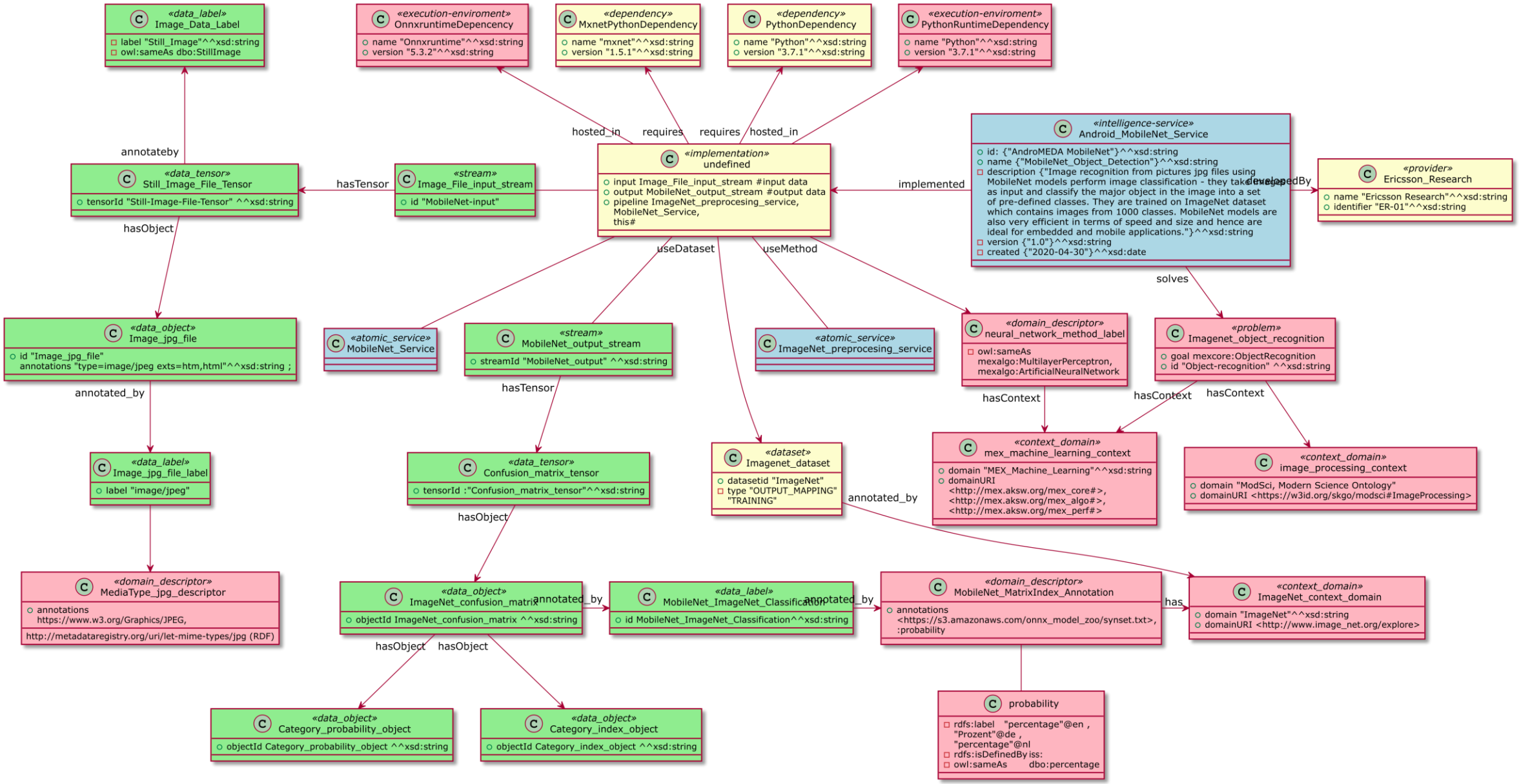
1000 (ImageNet classes) x Score (probability of match)

Android MobileNet Service (Abstract)



Android MobileNet Service (complete UML)



Conclusion

- Intelligence Services require context and domain specific semantic definitions to be efficiently enabled
- Data sets, execution environment and model requirements needs to be considered, along with policies (in further work) to adequately describe the tasks at hand
- Consequently a taxonomy of semantic descriptors provides a path towards the automation of intelligence services and their orchestration across a variety of applications especially in the innovative IoT space