"Data -Driven" Ontologies for an Information Extraction System from Polish Mammography Reports

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Agenda

- Ontology - a method of knowledge representation for IE (Information Extraction) systems
- Reuse of existing resources
- BI-RADS based Mammographic Ontology
- Mammographic Report Ontology tailored for IE
- Mammography IE System and its evaluation
- Conclusions

Ontology - a method of knowledge representation for IE Systems

- Information extraction requires prior knowledge on data structures we would like to identify

- Information in mammography reports –composed and complicated - a theoretical approach of using the predefined domain knowledge is required

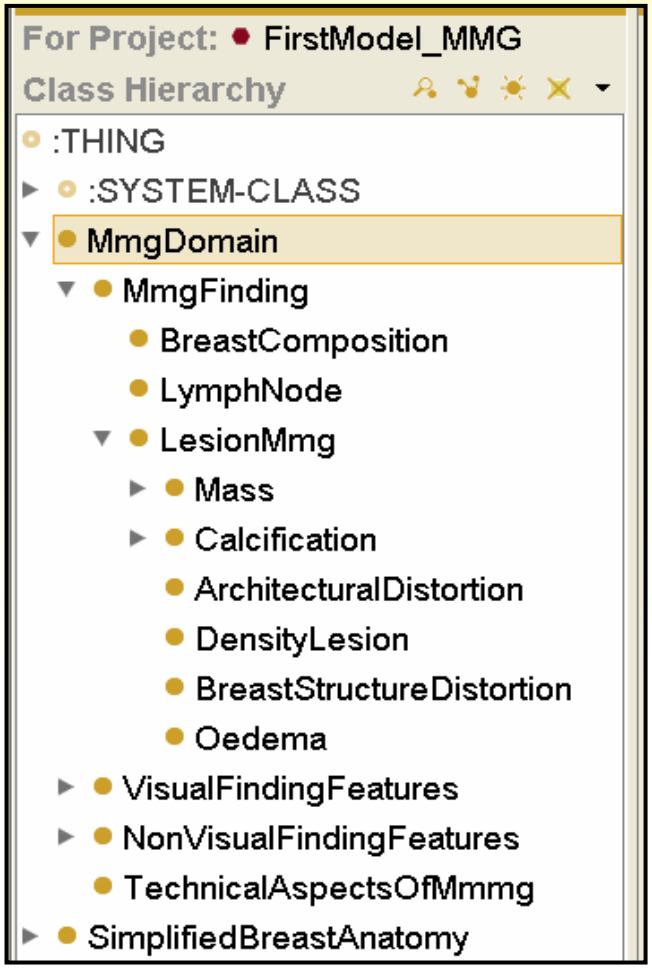
Reuse of existing resources

- Breast Cancer Image Ontology (BCIO) from MIAKT project
- NCI Cancer Ontology containing more than 17 000 concepts, but not mammography
- Basic Clinical Ontology for Breast Cancer from Stanford resources

no models suitable for reuse were found

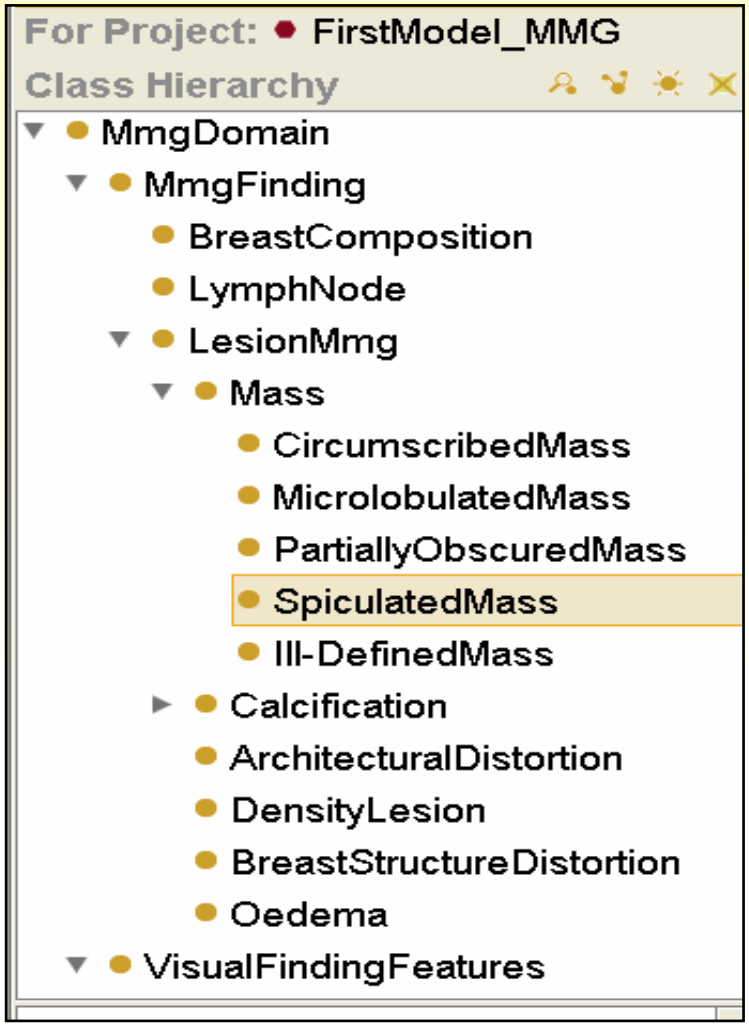
too general, or covered related, but in fact distinct domain

BI-RADS based Mammographic Ontology (1)



Model is based on knowledge contained in BI-RADS, only extensions are concepts describing technical attributes of breast X-ray films mentioned in reports

BI-RADS based Mammographic Ontology (2)

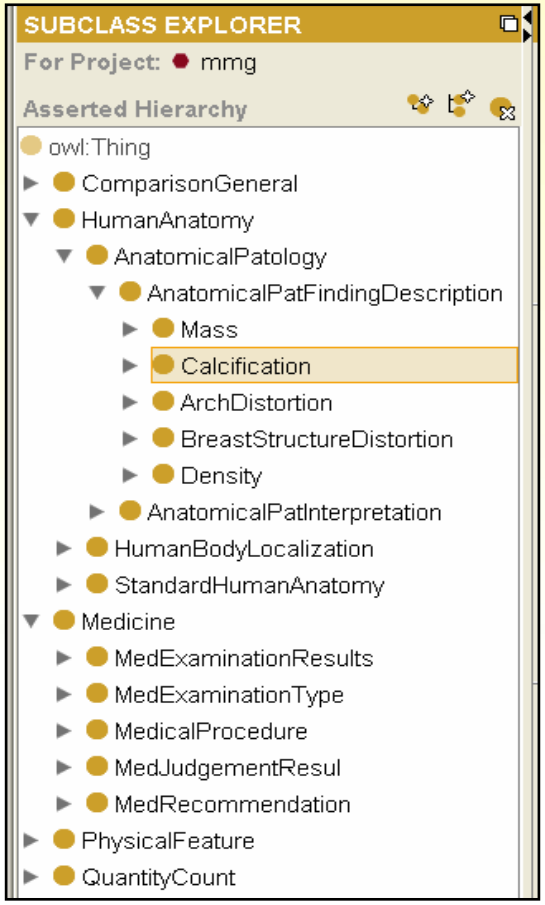


instances of class **Lesion MMG** form knowledge base of the model and are compared to masses description in authentic reports

Mammographic Report Ontology tailored for IE (1)

- Why the need for the second model – after firsts IE experiments it was found that there is a discrepancy between mammographic terminology and the scope of general notions found in BI-RADS and those used in real life Polish radiology reports
- Second model (Mammographic Report Ontology) is needed extending the scope of the first model and its granularity
- Knowledge acquisition stage has been repeated
  - medical literature, additional reports, consultations with radiologists
- Main problems when developing Mammographic Report Ontology :
  - difficulties in delimiting a domain
  - difficulties with representing formal differences which are often neglected in real life texts

Mammographic Report Ontology tailored for IE (2)

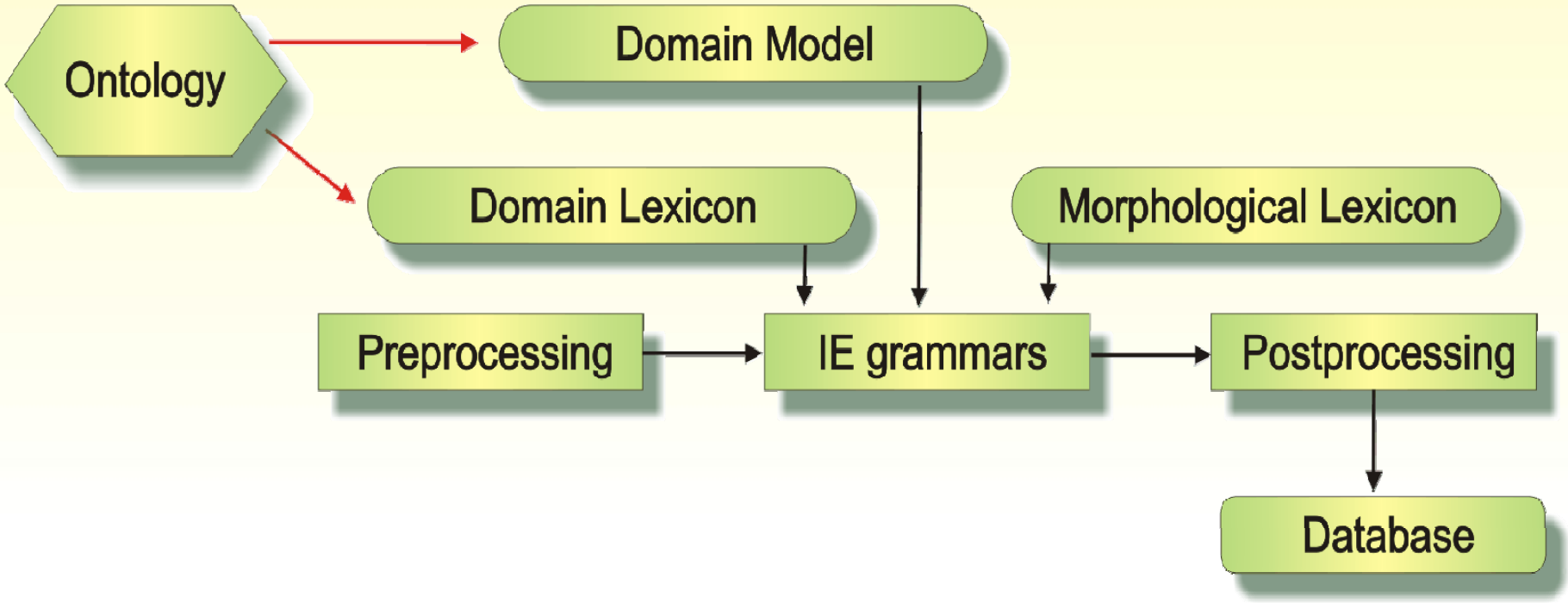


- class **HumanAnatomy** - a part of human anatomy model
- class **Medicine** - containing informations related to mmg examination
- class ***PhysicalFeature*** - describing such physical features of mammmographiv lesions like shape, size, contour, density etc.
- class ***Comparison*** includes concepts used while comparing various types of features, e.g. number, level and size
- class **Time**

model adapted to needs of IE tools - enlarged scope of general notions

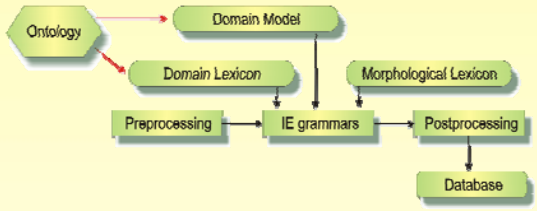
Information Extraction System (1)

The overall processing schema



The **IE** application is implemented using the general system **SProUT**

Information Extraction System (2)



- The **IE** application is implemented using the general system **SProUT**
- For the purpose of being used inside the **SProUT** systems grammars, the ontology had to be translated into a **T**yped **F**eature **S**tructures hierarchy
- The class hierarchy is repeated as the **TFS** type hierarchy omitting only the highest level ontology classes which are outside the mammography domain
- The properties are just attributes of type features structures used in **SProUT**
- The main difference is introducing structures which combine elements of the ontology

Evaluation of IE System

Type of information	precision	recall
pathological findings' blocks beginnings	81,25	97,07
breasts' composition blocks	96,48	99,07
pathological findings	92,44	97,46
pathological findings interpretation	98,19	93,69
all path. findings (also those for which only interpretation was given)	90,76	97,38
localization	98,42	99,59
recommndation	98,63	99,5

Evaluation of a random set of 705 reports

Thank you

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Sample Rule

```
wch_zm :>
        (morph & [POS noun, STEM  "węzeł", INFL infl_noun &
                  [ NUMBER_NOUN #nb] ] |
         token & [SURFACE "ww"] |
         gazetteer &  [GTYPE gaz_med_wezel, G_CONCEPT lymph_node,
                       G_NUMBER #nb  ] )

-> interpret_str & [INTERPRETATION  intr_lymph_node,
                    MORPH  agr & [N #nb]].
```

Mammography – a sample report

- 775
  Sutki o utkaniu z przewagą tłuszczowego. W sutku prawym przybrodawkowo widoczny guzek o śr. 10mm z makrozwapnieniami w jego obrębie odpowiadający f-a degenerativa (zmiana łagodna).

- 775
  Breasts with the dominant fat tissue. In the right breast in subareolal, there is a tumor of 10mm diameter with macrocalcifications corresponding to f-a degenerativa (benign finding).

Mammography – Results

EXAM_ID:775
up
LOC|BODY_PART:breast||LOC|L_R:left-right
utp
LOC|BODY_PART:breast||LOC|L_R:left-right
BTISSUE:fat_gl
utk
uk
zp
LOC|BODY_PART:breast||LOC|L_R:right
ANAT_CHANGE:mass||GRAM_MULT:singular
DIM:mm||NUM1:10||NUM2:10
C_GRAM_MULT:plural||WITH_CALC:macro
INTERPRETATION:f-a_deg
DIAGNOSIS_RTG:benign
zk
MMG_REL:reliable
REPORT_CLASS:diag_benign
REPORT_WITH_FINDINGS:yes

tissue block

finding description

overall diagnosis