Knowledge Modeling for Breast Cancer Grading using OWL-DL formalism

Keywords
Breast cancer grading, ontology-based modeling

Background
Histopathological grading of breast carcinoma has become a highly relevant assessment for accurate breast cancer diagnosis and prognosis of modern pathology. Sharing this domain knowledge among people (pathology community/academia) or software agents stands as an important need and therefore a modeling of terminology consensus is required. With the advent of ontologies in the semantic web world, the trend of using this formalism in medical domain captured a lot of interest in the recent years.

Method
We propose a novel ontology-based modeling of breast cancer grading (BCG) in an iterative approach. We use Ontology Web Language-Description Logics (OWL-DL) combined with Semantic Web Rules Language (SWRL), which provides a high level of expressivity and reasoning. Nottingham Grading System’s concepts such as tubular formation, nuclear pleomorphism, hypercromatic figures are encoded as classes in Protégé OWL-DL. Medical rules/definitions assigned to each criterion, complemented with visual information from the slide analysis are represented as properties.

Results
Based on expert guidance from the Pathology Department of Singapore National University Hospital which provided us core-biopsies specimens, we collected the domain knowledge information and translated into a BCG ontology model. Validation in terms of consistency checking and class hierarchy automated classification was achieved under Pellet reasoner.

Conclusions
Whilst we gained expressiveness, concept satisfiability via OWL-DL reasoning service and overcome some restrictions using SWRL rules, decidability is yet tradeoff in complex ontologies development. Currently, integration in a virtual microscope platform to assist in breast cancer diagnosis is ongoing.