Summary of FAIKR module 2

Knowledge Representation Languages

First Order Logic (*FOL*)

Also known as Predicate Calculus, it can be considered a standard for knowledge representation.

Syntax:

- An infinite set of object constants.
- An infinite set of variables.
- An infinite set of functional symbols of all arities.
- An infinite set of predicates symbols of all arities.
- Connectives: $\wedge, \vee, \rightarrow, \neg$
- Quantifiers: $\forall, \exists$

Description Logic (*DL*)

Notations that are designed to describe definitions and properties of categories, formalizing what a semantic network means and studying the reasoning mechanisms.

A DL knowledge base is composed by a **TBox** (a set of "schema" axioms) and an **ABox** (a set of "data" axioms, or ground facts).

Attributive Language (*AL*)

It does not support disjunction and provides limited forms of negation and existential quantifier only.
The syntax is composed by

- Atomic concepts

- Roles (relationships)

- Individuals (nominals)

- Boolean operators

  - Conjunction $\sqcap$
  - Disjunction $\sqcup$
  - Negation $\neg$, applicable only to atomic concepts
- Restricted quantifiers: $\exists, \forall$

- Universal and bottom concepts ($\top, \bot$)

- Value restriction

  - Universal restriction $\forall R.\, C$
  - Existential restriction $\exists R.\, C$
- Concept subsumption ($\sqsubset, \sqsubseteq, \sqsupset, \sqsupseteq$)

- Concept equivalence ($\equiv$)

AL extensions

- Attributive Language with Complements (**ALC**): AL extension where, unlike AL, the complement of any concept is allowed (e.g. $\neg(A \sqcup \exists R.\,(\forall S.\,B \sqcap \neg A))$), not only the complement of atomic concepts.

- Attributive Language with role Hierarchy (**ALH**): AL extension where it is possible to have role hierarchy (e.g. $\mathrm{hasDaughter} \sqsubseteq \mathrm{hasChild}$).

- Attributive Language with Inverse roles (**ALI**): AL extension where it is possible to use qualified number restrictions (e.g. $inverse(\mathrm{hasSister}, \mathrm{sisterOf})$).

- Attributive Language with Number restrictions (**ALN**): AL extension where it is possible to use number restrictions without qualification (e.g. $\leq 2\,\mathrm{hasChild}.\,\top$).

- Attributive language with Nominal/Singleton classes (**ALO**).

- Attributive Language with Qualified number restrictions (**ALQ**): AL extension where it is possible to use number restrictions with qualification (e.g. $\leq 2\,\mathrm{hasChild}.\,\mathrm{Female}$).

Extensions can be combined, for example creating **ALCN**, but each extension increases computational cost.