Technische Universität Dresden

Computational Logic ∴ Group

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Knowledge Representation and Reasoning

Winter 2026 Term

Exercises 3

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Problem 1.
Consider again Problem 3 from Exercise Sheet 1 in which we were asked to design a FOL knowledge base about congenital heart conditions. Write down an $\mathcal{ALC}$-TBox $\mathcal{T}$ conforming to the same specifications. Use the unary predicates and binary predicates given in Problem 3 as atomic concepts and atomic roles, respectively. Indicate if there any statements from Problem 3 that cannot be expressed in $\mathcal{ALC}$ (you don't need to prove this).

Problem 2.
Build an $\mathcal{ALC}$ knowledge base: capture each of the following statements in a suitable GCI, equivalence axioms, or assertion, using only the concept names

`Vehicle`, `Boat`, `Bicycle`, `Car`, `Device`, `Wheel`, `Engine`, `Axle` , `Rotation`, `Water`
`Human`, `Driver`, `Adult`, `Child`

and the role names

`hasPart`, `poweredBy`, `capableOf`, `travelsOn` `controls`.

1. Cars are exactly those vehicles that have wheels and are powered by an engine.
2. Bicycles are exactly those vehicles that have wheels and are powered by a human.
3. Boats are exactly those vehicles that travel on water.
4. Boats have no wheels.
5. Cars and bicycles do not travel on water.
6. Wheels are exactly those devices that have an axle and are capable of rotation.
7. Drivers are exactly those humans who control a vehicle.
8. Drivers of cars are adults.
9. Humans are not vehicles.
10. Wheels or engines are not humans.
11. Humans are either adults or children.
12. Adults are not children.
13. Bob controls a car.

14. Bob is a human.
15. Bob controls QE2.
16. QE2 is a vehicle that travels on water.

Problem 3.
Which of the statements in your answer to problem 2 are GCIs, equivalence axioms, concept assertions, or role assertions? Moreover, which of these statements are part of the TBox and which are part of the ABox?