# Knowledge Representation and Reasoning
# Description Logic - Problems 1

**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*

$$\mathsf{Vehicle},\ \mathsf{Boat},\ \mathsf{Bicycle},\ \mathsf{Car},\ \mathsf{Device},\ \mathsf{Wheel},\ \mathsf{Engine},\ \mathsf{Axle}\ ,\ \mathsf{Rotation},\ \mathsf{Water}$$
$$\mathsf{Human},\ \mathsf{Driver},\ \mathsf{Adult},\ \mathsf{Child}$$

*and the role names*

$$\mathsf{hasPart},\ \mathsf{poweredBy},\ \mathsf{capableOf},\ \mathsf{travelsOn}\ \mathsf{controls}.$$

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?*