

Instituto Superior Técnico

Mestrado em Engenharia Informática e de Computadores
Representação de Conhecimento e Raciocínio
Knowledge Representation and Reasoning

2nd test 20 May 2014 11:00h – 12:30h

Nome: _____ Número: _____

Escreva o seu número em todas as folhas do teste. O tamanho das respostas deve ser limitado ao espaço fornecido para cada questão. O teste tem 11 páginas com 7 perguntas, estando assinalada no princípio de cada pergunta, entre parêntesis, a sua cotação. Além de caneta, lápis, borracha e cartão de estudante, não são permitidos quaisquer outros objectos na sua secretária. **Boa sorte!**

Write you number on each page of your test. Your answers should be limited to the amount of space available for each question. This test has 11 pages with 7 questions, The grades are between brackets in the beginning of each question. Other than pen, pencil, rubber and your student card no other objects are allowed on your desk. **Good Luck!**

1. [4.0] Consider KEE and the following sentences (adapted from Wikipedia):

A **boat** is a watercraft [of any size designed to float or plane, to work or travel on water. In naval terms, a boat is a vessel small enough to be carried aboard another vessel (a ship). Boats have a wide variety of shapes and sizes and construction methods due to their intended purpose, available materials or local traditions.] Canoe type boats have a long history and various versions are used throughout the world for transportation, fishing or sport. Fishing boats vary widely in style partly to match local conditions. Pleasure boats include ski boats, pontoon boats, and sailboats. House boats may be used for vacationing or long-term housing. Small boats can provide transport or convey cargo (lightering) to and from large ships. Lifeboats have rescue and safety functions.

Boats can be categorized into three main **types**:

- Human-powered boats include canoes, kayaks, gondolas and boats. They can have different propulsion means, such as rowing, paddling, setting pole, etc.
- Sailboats, which are propelled solely by means of sails.
- Motorboats, which are propelled by mechanical means, such as engines. Ski boats are specialized motorboats specifically designed to safely tow one or more water skiers.

Catharina is a motorboat that was built in December 1985.

Consider knowledge about boats. We want to represent knowledge about the main types of boats, their forms of propulsion and possible purposes/uses. We also know that any boat has a construction date and want to represent this fact. We want to represent knowledge about Catharina.

Number: _____

a) [0.5] Start by graphically representing the hierarchy that you will be considering.

b) [3.0] Represent in KEE the needed frames, slots and facets. **Discuss** your representation choices.

- c) [0.5] Consider that we also want to know how many years a given boat has. Represent and describe all that is required to calculate such fact and discuss your representation choices and how this would be calculated.

2. [3.0] Represent the following sentences in KL-ONE (adapted from Wikipedia). If you cannot represent any sentence, explain why you could not do it.

Ships and boats are watercraft devices. Ships are used on lakes, seas, and rivers for a variety of activities, such as the transport of people or goods, fishing, entertainment, public safety, and warfare. Ships are operated by a crew of mariners. Among the crew, a ship must have a Captain. A ship must transport at least one boat, a lifeboat. Watercrafts are characterized by their sizes (their lengths). A ship is larger than a boat. Ships can usually be distinguished from boats based on the ship's ability to operate independently for extended periods.

3. [2.0] Consider the Description Logics family. Present a formal semantics in the style seen in the Book for the concept-forming operator:

a) [1.0] [AT-MOST n r], Maximum role cardinality – something with at most n r 's.

b) [1.0] [SOME r], Role existence – something with at least 1 r

4. [1.5] Consider an ontology.

a) [0.5] Which are the main components of an ontology?

b) [0.5] How are concepts defined in an ontology?

c) [0.5] Why are ontologies important for the Semantic Web?

5. [2.0] Consider the classical example from the literature on Inheritance:

Russel was a Philosopher and a Nobel Prize
Philosophers are usually academic people.
Academic people are usually Intellectuals
Intellectuals are usually boring people.
Nobel Prizes are usually stimulant people.
Stimulant people are usually not boring

a) [0.5] Represent the assertions in an inheritance network.

b) [0.5] What are the credulous extensions of the network? Justify.

c) [0.5] Which of them are preferred extensions? Justify.

d) [0.5] Give a conclusion that a credulous reasoner might make but that a skeptical reasoner would not. Justify.

6. [3.5] Consider the classical example from the literature:

Mollusks usually have shell
Cephalopods are mollusks
Cephalopods usually do not have shell
All Nautilus are Cephalopods
Nautilus usually have a shell
Nay-nay is a nautilus

a) [1.0] Represent this knowledge base in Reiter' default logic, using normal default rules.

b) [2.0] What can you conclude about Nay-nay using this default logic theory? Justify your answer.

- c) [0.5] In case, there were ambiguities, represent the same problem in such a way that they would not arise.

7. [4.0] Consider Frame Systems in general, Description Logics in general, and Default Logic by Reiter. Consider for each one the following criteria: richness of primitives/language to represent knowledge, how natural those primitives are to represent knowledge, kinds of assertions that can be represented (certain knowledge, knowledge with exceptions), reasoning capabilities provided by the system, efficiency of those reasoning capabilities, semantics defining the system.
 - a) [3.0] Describe each family of systems in terms of the mentioned criteria. Make a table to summarize your discussion.

- b) [1.0] Compare all systems in terms of those criteria, highlighting the advantages and disadvantages of each.

END