1 Rules

• Please send your solutions (in English) as ps or pdf files\(^1\) by e-mail.

• Deadline: 4\(^{th}\) June 2007.

• Grading: there are four exercises. Each exercise gives maximum 10 points (40 points together).

  The correspondence between points and grades is given in the table:

<table>
<thead>
<tr>
<th>Number of points</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 points or more</td>
<td>VG</td>
</tr>
<tr>
<td>20-29 points</td>
<td>G</td>
</tr>
<tr>
<td>19 points or less</td>
<td>NOT PASSED</td>
</tr>
</tbody>
</table>

2 Exercises

1. Design a modal logic, where one of modalities is intended to mean “A is acceptable”. Decide whether this modality is to be □ or ♦, and provide:

   (a) the meaning of the modality which is dual to “be acceptable”

   (b) description of the intended semantic structures (relating your solution to a particular chosen real-world context)

   (c) discussion whether three traditional modal axioms of your choice are valid or invalid wrt semantic structures defined in (b).

2. Consider a situation, in which some properties might express strange situations (as opposite to “normal”), e.g., in certain circumstances “to sleep during lectures” might be such a property.

   (a) Design a suitable four-valued logic, where the truth values are True, False, Strange, Normal.

   (b) Discuss whether the designed logic could be replaced by a three-valued logic, keeping good intuitions.

3. Consider a robot with three wheels (one in it’s front, two in it’s back) traversing an irregular surface. The front wheel allows the robot to make turns. The robot’s task is to follow a marked line. It is able to observe the angle between it’s front wheel and the line.

   (a) Provide two exemplary rules for a fuzzy controller equipping the robot with the functionality to move along a marked line.

   (b) “Test” your rules on a couple of examples reflecting some relevant situations and briefly discuss the outcome.

\(^1\)If you prefer other file formats, please check them with me.
4. Assume that we model observations concerning flying objects. Assume that, due to perceptual limitations, some objects are not classified, i.e., it might be unknown whether a given object is a helicopter or a small airplane, etc.

(a) Design a deductive database (extensional plus intensional parts) with approximate relations allowing one to store information about observed objects including speed, type (helicopter, airplane, bird,...) etc. containing, among others, information about objects in their close neighborhood.

(b) Provide sample default rules for classifying an object to be an airplane.

(c) Formulate in (the classical or fixpoint) logic:
   i. a query selecting all objects moving with a high speed in the close neighborhood of a given object
   ii. a query selecting all objects which are in the chain neighborhood of a given object, where we say that an object $Q$ is in the chain neighborhood of object $P$ if there is a natural number $n \geq 1$ and objects $O_1, \ldots, O_n$ such that $O_1 = P, O_n = Q$ and for all $1 < i \leq n$, $O_i$ is in the close neighborhood of $O_{i-1}$. 