**COMP 3710 Artificial Intelligence**

Fall 2013

Term test II

Student Name: Student Number:

1. (2 marks) Prove ~(~*p* ∧ *q*) ∧ (*p* ∨ *q*) = *p* by using equivalence, not the truth table.
2. (3 marks) Convert *A* ↔ (*B* ∨ *C*) to a CNF.
3. (2 marks) List the two major reasons why rule-based expert systems have not been successful.
4. (2 marks) Convert the following rules to Horn clauses.

Rule 1. IF *A* and *B* THEN *C*

Rule 2. IF *A* THEN *D*

Rule 3. IF *C* and *D* THEN *E*

Rule 4. IF *A* and *E* THEN *H*

Rule 5. IF *D* and *E* and *H* THEN *I*

1. (3 marks) With the rules in the previous question and the facts *A*, *B*, *F*, do backward chaining to prove the hypothesis *I*. You need to show step-by-step how the backward chaining works.
2. Consider the inverted pendulum problem.
	1. (2 marks) The input for *Theta* is NS:0.6 and ZE:0.3, and the input for *dTheta* is NS:0.4 and ZE:0.5. Find the output fuzzy sets with membership values, using the next fuzzy rules. (Note that the numbers after fuzzy sets are membership values.)

|  |  |
| --- | --- |
|   | *Theta* |
| *dTheta* |   | NM | NS | ZE | PS |
| NM |   |   | PM |   |
| NS |   |   | PS | ZE |
| ZE | PM | PS | ZE | NS |
| PS |   | ZE | NS |   |
| PM |   |   | NM |   |

* 1. (3 marks) Defuzzify the output fuzzy sets obtained in (a), using the centroid method with the next fuzzy membership functions.

1. (3 marks) Compute the information gain for *Genre*. You do not have to compute the logarithms. (Here are the related formulas.

Information Gain = 1 - ∑ (the weighted entropies)

Entropy = – p0 × (log2 p0) – p1 × (log2 p1) – ...

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Film**  | ***Country***  | ***Big Star***  | ***Genre***  | **Success**  |
| Film 1  | *USA*  | *Yes*  | *SF*  | True  |
| Film 2  | *USA*  | *No*  | *Comedy*  | False  |
| Film 3  | *USA*  | *Yes*  | *Comedy*  | True  |
| Film 4  | *Europe*  | *No*  | *Comedy*  | True  |
| Film 5  | *Europe*  | *Yes*  | *SF*  | False  |
| Film 6  | *Europe*  | *Yes*  | *Romance*  | False  |
| Film 7 | *Other*  | *Yes*  | *Comedy*  | False  |
| Film 8  | *Other*  | *No*  | *SF*  | False  |
| Film 9  | *Europe*  | *Yes*  | *Comedy*  | True  |
| Film 10  | *USA*  | *Yes*  | *Comedy*  | True  |

1. (3 marks) Here is a training data set. Classify (2, 4) by using the 2-nearest neighbor algorithm.

|  |  |  |
| --- | --- | --- |
| *X* | *Y* | *Class* |
| 1 | 1 | *Blue* |
| 1 | 2 | *Blue* |
| 2 | 1 | *Blue* |
| 2 | 2 | *Green* |
| 2 | 3 | *Green* |
| 3 | 1 | *Green* |
| 3 | 2 | *Green* |
| 4 | 1 | *Green* |
| 3 | 3 | *Red* |
| 4 | 2 | *Red* |
| 4 | 3 | *Red* |