人工智能 A 复习卷 I

COMP130031.01

2023 年 6 月 期末真题卷

1. (10 points) Rewrite the following rule to make it more efficient.

```
(defrule bad-rule
    (items (x ?x1) (y ?y1) (z ?z1))
    (items (x ?x2) (y ?y2) (z ?z2))
    (items (x ?x3) (y ?y3) (z ?z3))
    (test (and (or (eq ?x3 green)
                   (eq ?x3 red))
               (eq ?z2 ?y3)
               (> ?y1 ?x1)
               (< ?z1 ?x1)
               (neq ?z3 ?x1)))
=>
```

第 2 题涉及的知识点没讲。

3.(10 points) Please use Genetic Algorithm to calculate the max value of the function:

$$f(x) = x + 10 * \sin(5 * x) + 7 * \cos(4 * x), x \in [0, 9]$$

Just describe your solution briefly and you don't need to show every step of your solution in details. When necessary, you can write some pseudocodes to make your solution clear.

4.(10 points) Use resolution to solve the following problem.

1）Every child loves monkey king.

2）Everyone who loves monkey king loves any monkey.

3）Bblythe is a monkey, and Bblythe has a red ass.

4）Anything which has a red ass is weird or is sick.

5）Bblythe is not sick.

6）Mary does not love anything which is weird.

Question: Is Mary a child?

5. (10 points) Given the Rough set information table, where *e* is decision attribute, calculate its reduction and write the corresponding rules.

U	a	b	c	d	e
(1)	1	0	2	2	1
(2)	0	1	1	1	2
(3)	2	1	1	1	0
(4)	0	0	1	0	0
(5)	1	1	0	2	0
(6)	2	1	1	2	1
(7)	0	2	0	2	2
(8)	1	1	2	2	1

6. (10 points) Fuzzy Set. Given numeric truth values.

μ_A(A) = 0.95/0.6 + 0.65/0.9 + 0.4/1.0

μ_A(B) = 0.35/0.6 + 0.15/0.9 + 0.7/1.0

calculate the fuzzy logic truth of the following:

(1) NOT A

(2) A AND B

(3) A OR B

(4) A → B

(5) B → A

7. (15 points) Given a hidden Markov model consisting of a box and a ball, $\lambda = (A, B, \pi)$

$$A = \begin{bmatrix} 0.5 & 0.1 & 0.4 \\ 0.3 & 0.5 & 0.2 \\ 0.2 & 0.2 & 0.6 \end{bmatrix}, B = \begin{bmatrix} 0.5 & 0.5 \\ 0.4 & 0.6 \\ 0.7 & 0.3 \end{bmatrix}, \pi = (0.5, 0.3, 0.2)^T$$

A is the state-transition probabilities matrix. B is the emission probabilities matrix. π is the initial state probabilities matrix .

Box state collection *{box1, box2, box3}*

Color of ball collection *{red, white}*

Let $T = 3$, observation sequence $O =$ (red, white, white). Please compute the best path.

8. (10 points) Let $p = f(x)$ be the output of the network's soft-max layer of some neural network classifier with K layers when the network's input is x. The classifier's output is then

$$\hat{y} = \arg\max p$$

If y_n is the true label corresponding to training input x_n, the loss is $\ell_n = \ell(y_n, f(x_n))$ for some appropriate loss function $\ell(y, p)$.

We saw in class that if $x^{(k)}$ is the output from layer k and $w^{(k)}$ is a vector with all the parameters in layer k, then back-propagation computes the partial derivatives by the following recursion, where $x^{(0)} = x$ is the input to the network and $x^{(K)} = p$:

$$\frac{\partial \ell_n}{\partial w^{(k)}} = \frac{\partial \ell_n}{\partial x^{(k)}} \frac{\partial x^{(k)}}{\partial w^{(k)}} \text{ for } k = K, \ldots, 1$$

$$\frac{\partial \ell_n}{\partial x^{(k-1)}} = \frac{\partial \ell_n}{\partial x^{(k)}} \frac{\partial x^{(k)}}{\partial x^{(k-1)}} \text{ for } k = K, \ldots, 1$$

$$\frac{\partial \ell_n}{\partial x^{(K)}} = \frac{\partial \ell_n}{\partial p}$$

The derivatives above are computed for the n-th training sample (x_n, y_n) and for the values of $w^{(k)}$ that are current at any given point during training.

Suppose that the network has only fully-connected layers (with ReLU nonlinearities) before the soft-max.

Refer in detail to the equations given above to explain clearly why training would not work if the parameter vector $w = \left[w^{(1)}, \ldots, w^{(K)}\right]^T$ is initialized with zeros for training. (Hints: consider $b = 0$ and $b \neq 0$.)

9. (15 points) Consider a convolutional network model A, which contains convolutional layer 1, pooling layer and convolutional layer 2 respectively.

The parameters of each layer are shown in the table: assume that the input image size is 1×32×32 (including 1 channel, each channel size is 32×32).

	Input Channel	Output Channel	Kernel Size	Step Size	Padding Size
Convolution Layer 1	1	1	3	1	1
Max Pooling	1		2	2	0
Convolution Layer 2	1	3	3	1	0

(1) (5 points) If the input $I = \begin{bmatrix} 2 & -1 \\ 1 & 2 \end{bmatrix}$, convolution kernel $K = \begin{bmatrix} 2 & 1 & 2 \\ 1 & 3 & 2 \\ 3 & 1 & 4 \end{bmatrix}$, padding value is 0, calculate the output of **convolution layer 1**.

(2) (5 points) 1×1 convolution is the layer with convolution kernel size=1, step size=1, padding size = 0. What is the meaning of 1×1 convolution?

(3) (5 points) Now it is necessary to classify the input images (input size is 1×32×32, 5 classification). Please add a new layer after the convolution layer 2 to realize this task. Please describe your added network structure and corresponding parameters (such as the size of the convolution kernel) and the selection of loss function.

人工智能 A 期末复习大纲

COMP130031.01

2023 年 12 月

上学期期末真题见上。

真题卷重点：

第 1 题，**必考**。
第 3 题，遗传算法如何解 function。
第 4 题，**必考**。逻辑推理，把每一句变为逻辑表达式，再变为析取范式，再用消解原理消解出来。
第 5 题，粗糙集，也可能考决策树。
第 6 题，fuzzy。
第 7 题，HMM 模型。
第 8~9 题，深度学习/神经网络题目，深度学习/神经网络今年考卷中占比大。

复习重点：

CLIPS 高效算法。
不确定性理论：粗糙集、fuzzy、置信度理论、certainty factor
知识表示：概念图
逻辑：自然语言描述的知识库
决策树/粗糙集**（两个必考其中一个）**
CRF/HMM 序列标注
神经网络/深度学习**（重点考核内容）**：卷积神经网络、softmax、激活函数、梯度的计算与推导
遗传算法怎么用