Intelligent Systems: Reasoning and Recognition

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ENSIMAG 2 / MoSIG M1 Final Exam - May 2017

Conditions: You have the right to use any notes or written material. You may answer questions in English or in French. When appropriate, illustrate your answer with mathematics. Your written answers must be clear and legible. Illegible text will not be graded. Duration: 3 hours.

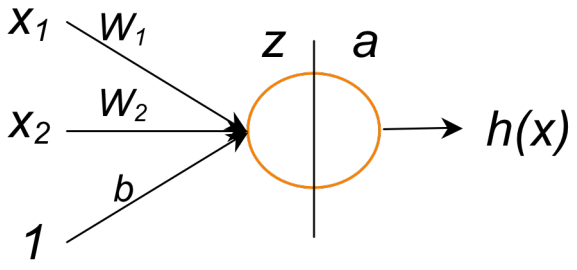
1) (4 points) What do we mean by intelligence? What qualities can be used to describe intelligence and how can they be measured or verified? How can intelligence be acquired?

2 (2 points) An ROC curve passes through the point (0.3, 0.7). What is the probability of error for the curve at this point?

3) (4 points) Describe whether or not it is possible to use the specified technique to construct a classifier for each of the following problems. If it IS possible, explain how to train and compute a model for $P(\omega_k \mid \vec{X})$. If it is not possible, explain why.

a) You have a training set composed of grades from 2 subjects for a population of 100 students from each of 10 countries. Can you use a ratio of histograms to determine the nationality of a student from their grades?
b) You have a training set composed of grades from 4 subjects for a population of 100 students from each of 20 countries. Can you use a K-nearest neighbor classifier to determine most likely nationality of a student from their grades?
c) You have a training set composed of the weight (kg), height (cm), age (y) and gender for a population of 100 people. Can you use a Kernel density estimator to determine most likely gender for an unknown person from their weight (kg), height (cm) and age (y)?
d) You have a training set composed of the eye-color 100 people from each of 10 countries. Can you use a ratio of histograms to determine most likely nationality of an unknown person from their eye-color ?

4) (6 points) You are presented with a single neuron with two inputs (X_1, X_2) and a single output a computed using a sigmoid $(F(z) = \sigma(z))$. Your network has been initialized with weights $W_1 = -0.2$ and $W_2 = +0.2$ and $b = -2.0$. Assume a learning rate of $\eta = 0.1$.



Your network should be trained to recognize the following training data:

m	x_1	x_2	y_m
1	1	0	1
2	0	1	1
3	0	0	1
4	1	1	0

a) Compute z, and a for $m=1$.
b) Computer $\delta_m^{(2)} = h(X_m)–y_m$ for $m=1$
c) Compute $\delta_m^{(1)}$ for $m=1$
d) Compute ΔW_1, ΔW_2, and Δb for $m=1$
e) Update W_1, W_2, and b for $m=1$.
f) Will your neuron converge for this training data?

5) (2 points) Given the following deftemplates in CLIPS:

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(deftemplate product (slot NAME)(slot KIND)(slot PRICE))
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Write a rule in CLIPS that will select and print the name and price of the least expensive product for a each kind of product.

Look-up Table of Sigmoid function:

$$f(z) = \frac{1}{1+e^{-z}}$$

z	f(z)	z	f(z)	z	f(z)	z	f(z)	z	f(z)
-5	0.007	-4	0.018	-3	0.047	-2	0.119	-1	0.269
-4.9	0.007	-3.9	0.020	-2.9	0.052	-1.9	0.130	-0.9	0.289
-4.8	0.008	-3.8	0.022	-2.8	0.057	-1.8	0.142	-0.8	0.310
-4.7	0.009	-3.7	0.024	-2.7	0.063	-1.7	0.154	-0.7	0.332
-4.6	0.010	-3.6	0.027	-2.6	0.069	-1.6	0.168	-0.6	0.354
-4.5	0.011	-3.5	0.029	-2.5	0.076	-1.5	0.182	-0.5	0.378
-4.4	0.012	-3.4	0.032	-2.4	0.083	-1.4	0.198	-0.4	0.401
-4.3	0.013	-3.3	0.036	-2.3	0.091	-1.3	0.214	-0.3	0.426
-4.2	0.015	-3.2	0.039	-2.2	0.100	-1.2	0.231	-0.2	0.450
-4.1	0.016	-3.1	0.043	-2.1	0.109	-1.1	0.250	-0.1	0.475

Look-up Table of Sigmoid function.

z	f(z)	z	f(z)	z	f(z)	z	f(z)	z	f(z)
0	0.500	1	0.731	2	0.881	3	0.953	4	0.982
0.1	0.525	1.1	0.750	2.1	0.891	3.1	0.957	4.1	0.984
0.2	0.550	1.2	0.769	2.2	0.900	3.2	0.961	4.2	0.985
0.3	0.574	1.3	0.786	2.3	0.909	3.3	0.964	4.3	0.987
0.4	0.599	1.4	0.802	2.4	0.917	3.4	0.968	4.4	0.988
0.5	0.622	1.5	0.818	2.5	0.924	3.5	0.971	4.5	0.989
0.6	0.646	1.6	0.832	2.6	0.931	3.6	0.973	4.6	0.990
0.7	0.668	1.7	0.846	2.7	0.937	3.7	0.976	4.7	0.991
0.8	0.690	1.8	0.858	2.8	0.943	3.8	0.978	4.8	0.992
0.9	0.711	1.9	0.870	2.9	0.948	3.9	0.980	4.9	0.993