Practice Test

Thursday, September 16, 2021 1:45 PM

4453examOnePracW.001

Student Name:.. PID or NID:........................

CAP 4453W (On-line) ROBOT VISION PracticeTest One 50 points

1. (17 points) In the ADABoost procedure (not the cascade procedure), suppose there are 2 positive and 2 negative training images, and there are 3 features (experts). The table below shows how the experts do on the examples (V means correct, X means wrong). For the questions below, if you wish, you can leave all answers in fractions, not wasting time trying to get real numbered answers.

	Expert 1	Expert 2	Expert 3
Face 1	V	X	X
Face 2	X	V	V
Non-Face 1	X	V	V
Non-Face 2	V	X	V

a) At the beginning of $t = 1$, what will the weights attached to the training images be (please write down four answers)?

weights are : $\frac{1}{4}, \frac{1}{4}, \frac{1}{4}, \frac{1}{4}$

b) During $t = 1$, the error for each expert is computed. Write down these three numbers (first Expert 1, then Expert 2, then Expert 3).

$\frac{1}{2}, \frac{1}{2}, \frac{1}{4}$

c) Which expert will be chosen at $t = 1$? $\frac{1}{4}$ is the lowest so expert 3 is picked

check → d) At the end of $t = 1$, the weights of the training images are updated. First calculate and write *Beta*, and then write down the four new weights (first Face 1, then Face 2, ... till Non-Face 2). You can keep them as fractions.

$\frac{1}{4}, \frac{1}{12}, \frac{1}{12}, \frac{1}{12}$

1

a) n = # of examples

2 positive, 2 negative $\Rightarrow 2+2 = 4$

you find the weights using the following formula

$\text{weight} = \frac{1}{n}$

Remember you check that it's right if all the weights add to 1

Re-draw grid

from formula ↘

W_1			
$\frac{1}{4}$	V	X	X
$\frac{1}{4}$	X	V	V
$\frac{1}{4}$	X	V	V
$\frac{1}{4}$	V	X	V

So to find the error ... look at the table and for each column look at the weight I calculated

b)

W_1			
$\frac{1}{4}$	V	X	X
$\frac{1}{4}$	X	V	V
$\frac{1}{4}$	X	V	V
$\frac{1}{4}$	V	X	V
	$\frac{1}{4}+\frac{1}{4}$	$\frac{1}{4}+\frac{1}{4}$	$\frac{1}{4}$
Simplifies to:	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$

answer $\Rightarrow \frac{1}{2}, \frac{1}{2}, \frac{1}{4}$

c) at $t = 1$ the smallest error is choosen

so it would be $\boxed{\frac{1}{4}}$ since $\frac{1}{4} < \frac{1}{2}$

and that would be $\boxed{\text{Expert 3}}$

d) Find Beta $= \frac{\text{error}}{1 - \text{error}}$

Remember

the error is the error from the expert you just picked

so i picked expert 3 and it has an error of $\frac{1}{4}$

so.... $\text{Beta} = \frac{\frac{1}{4}}{1 - \frac{1}{4}} = \boxed{\frac{1}{3}}$

Now update the weights with Beta as a multiplicative factor

weight * beta = new weight

* Remember new weight is only applied to those that got it right

Look now my child

(we look at expert 3 due to it being picked)

W_1	Expert 1	2	3	New weight
$\frac{1}{4}$	V	X	X	$\boxed{\frac{1}{4}}$ (unchanged since it's wrong)
$\frac{1}{4}$	X	V	$\boxed{V}$	$\frac{1}{4} * \text{beta} \Rightarrow \frac{1}{4} * \frac{1}{3} = \boxed{\frac{1}{12}}$
$\frac{1}{4}$	X	V	$\boxed{V}$	$\frac{1}{4} * \frac{1}{3} \Rightarrow \boxed{\frac{1}{12}}$
$\frac{1}{4}$	V	X	$\boxed{V}$	$\frac{1}{4} * \frac{1}{3} \Rightarrow \boxed{\frac{1}{12}}$

new weights $= \frac{1}{4}, \frac{1}{12}, \frac{1}{12}, \frac{1}{12}$

e) At the beginning of $t = 2$, the training images' weights are normalised. You can write each of these four new normalised weights as a fraction quantity. It is OK to write out denominator as a whole sum, (with plus-symbols, etc).

e) normalize the weights by:

1. adding up all the new weights

$\frac{1}{4} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12} = \boxed{\frac{1}{2}}$

divide each weight by the new number $\frac{1}{2}$

e) At the beginning of $t = 2$, the training images' weights are normalised. You can write each of these four new normalised weights as a fraction quantity. It is OK to write out denominator as a whole sum, (with plus-symbols, etc).

$\boxed{\frac{1}{2}, \frac{1}{6}, \frac{1}{6}, \frac{1}{6}}$

e) Normalize the weights by:

1. adding up all the new weights

$\frac{1}{4}+\frac{1}{12}+\frac{1}{12}+\frac{1}{12} = \boxed{\frac{1}{2}}$

2. divide each weight by the new number $\frac{1}{2}$

$\frac{1}{4} \div \frac{1}{2} = \frac{1}{2}$
$\frac{1}{12} \div \frac{1}{2} = \frac{1}{6}$
$\frac{1}{12} \div \frac{1}{2} = \frac{1}{6}$
$\frac{1}{12} \div \frac{1}{2} = \frac{1}{6}$
$\Rightarrow$ normalized

check by adding them up to equal 1

$\frac{1}{2}+\frac{1}{6}+\frac{1}{6}+\frac{1}{6} = 1$ ✓ checks out

f) Write (possibly long) expressions for the error for each expert computed at $t = 2$.

at $t=2$ the errors are $= \frac{1}{3}, \frac{2}{3}, \frac{1}{2}$

f) Find error again with normalized weights

W_2	Expert 1	2	3
$\frac{1}{2}$	√	X	X
$\frac{1}{6}$	X	√	√
$\frac{1}{6}$	X	√	√
$\frac{1}{6}$	√	X	√
	$\frac{1}{6}+\frac{1}{6}$	$\frac{1}{2}+\frac{1}{6}$	$\frac{1}{2}$
$\Rightarrow$	$\boxed{\frac{1}{3}}$	$\frac{2}{3}$	$\frac{1}{2}$

find the smallest

so.... $t=2 \Rightarrow \frac{1}{3}$

g) Get a final number for each expression above; then, based on these final numbers, state which one of Experts 1, 2, or 3 will be selected at $t = 2$.

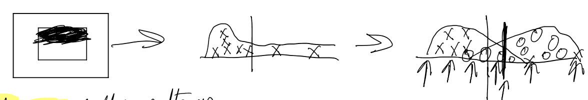
Expert 1 since error is smallest

2. (?? points) DO NOT WORRY ABOUT Question 2; this will not appear on this test One.

Check

3. (4 points) In words and with small figures, describe how to construct an "expert" that will say 'yes' or 'no'; the expert must be based on performing convolution. (Hint: one figure shows how to separate the resulting histogram numbers from the two types of training).

3.



- Pick one of the patterns
- We will use that pattern and convolve it with the faces, eventually getting a histogram
- We will do the same for non-faces too, giving us a histogram too
- We will then pick a threshold choice, from the arrows, To minimize the error

The final expert is the pattern, the threshold and the parity

Confirm this

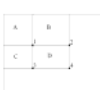
Pattern + threshold + parity

Check

4. (2 points) Using the following figure and the concept of the integral image (I.I.), write down what is the simplified computation (in terms of letters) for

$$2 + (4 - 3 - 2 + 1) - (2 + 3).$$

(ASSUME that a number means the I.I. at that number's location)



4.

$(A+B) + [(\cancel{A}+\cancel{B}+\cancel{C}+D) - (\cancel{A}+\cancel{C}) - (\cancel{A}+\cancel{B}) + \cancel{A}] - [(A+B)+(A+C)]$

~~A - A - A + A~~
~~B - B~~
~~C - C~~

$A+B+D$

$-(2A+B+C)$

$-2A-B-C$

$\Rightarrow A+\cancel{B}+D-2A-\cancel{B}-C$

$\boxed{-A+D-C}$

D

Check

5. (3 points) Suppose a cascade system is training with 2000 faces and 2000 non-faces. Suppose the requirements for each Team are a False Positive Rate of 30 percent, and a Missed Detection Rate of 0.105 percent. Supposing our teams are titled Team 1, Team 2, Team 3, etc. After the system is fully trained, and is being tested with the Training data, how many faces and non-faces will make it to be tested by Team 3?

5.

For each stage
2000 * .30 = 600.0 that would be for stage 2
Do it again.....
600 * .30 = 180.0
180 is the answer (non-faces)

Now with the .105 percent
.105/100 * 2000 = 2.1 => round down so 2
2000 - 2 = 1998 that's for stage 2
Do it again for stage 3
.105/100 * 1998 = 2.0979 ==> round down so 2 again
1998 - 2 = 1996 so 1996 is the faces

6. (2 points) What are the two formulas used to compute Canny's X-mask and Y-mask?

$x e^{-\frac{x^2+y^2}{2\sigma^2}}, \quad y e^{-\frac{x^2+y^2}{2\sigma^2}}$

Check the equation

Need Help

7. (4 points) Sketch the Sobel edge detection method, but also include the actual numbers used in the final convolution masks.

Write down convolution mask, x and y
Convolve picture with each of those tables

Convolve each table with the picture, producing blah output
Now plug those into the magnitude equation so that's c = sqrt (blah^2 + blah2^2)

Then you apply the threshold to the combined image, to produce final image

Magnitude
c= sqrt(x^2 + y^2)

produces these two – 3X3 convolution masks.

-1	0	+1
-2	0	+2
-1	0	+1

G_x

+1	+2	+1
0	0	0
-1	-2	-1

G_y

8. (5 points) Suppose the Canny Direction (of gradient) and Magnitude (of gradient) images are as in the array below; indicate all pixels that will be selected as peaks.

Need Help

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Magnitude
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images. This combined with the Roberts
produces these two – 3X3 convolution masks.

G_x

-1	0	+1
-2	0	+2
-1	0	+1

G_y

+1	+2	+1
0	0	0
-1	-2	-1

8. (5 points) Suppose the Canny Direction (of gradient) and Magnitude (of gradient) images are as in the array below; indicate all pixels that will be selected as peaks.

0	0	0	0	0	0
0	|, 13	\\, 3	-, 23	|, 3	0
0	|, 13	/, 23	\\, 23	|, 23	0
0	-, 13	\\, 35	\\, 23	\\, 13	0
0	\\, 15	|, 23	|, 23	-, 23	0
0	0	0	0	0	0

Peak

Look at the numbers in the direction next to magnitude
So if the one you're on is greater than the numbers around it, it's a peak

These are the peak, they must be greater based on the direction of the arrow for the one you're on

9. (5 points) Suppose the Canny Magnitude of gradient is:

~~[illegible]~~	0	0	0	0	0
~~[illegible]~~	~~13~~	~~3~~	23	~~3~~	~~7~~
~~9~~	~~13~~	23	23	23	~~7~~
~~9~~	~~13~~	35	23	~~13~~	~~7~~
~~9~~	~~15~~	23	23	23	~~7~~
0	0	0	0	0	0

35 is automatically in final

look for neighbors now

Suppose the Peaks array is as below, and HI is 30, and LO is 20. Mark the positions in Peaks that will be in FINAL.

0	0	0	0	1	0
0	1	0	1	0	0
0	1	0	0	0	0
0	1	1	1	1	0
0	0	0	0	1	0
0	0	0	0	0	0

A negibhor is within the grid of 8 so 1,2,3,
4, 5, 6, 7
8

use this to see the ones on

The End

VERY IMPORTANT NOTE, for values higher than the peak, so getter than 30, you NEED to make sure that it matches the 1 and 0 graph FIRST before the other graph

SO for example ….. IF 35 correspondent value in the 0 and 1 table was a 0, then it would not be in FINAL