Machine Learning: Homework 1

Laurent HAYEZ

October 9, 2016

Exercise 1. *Solve the problem (by hand) using the simple rule (1R) approach.*

Solution.

1. With the attribute `choice`, if `choice = T` we wait 4 times over seven, hence we derive the rule `if choice = T, then wait = T` with 3/7 errors. If `choice = F`, then we don't wait 3 times over 5, hence we derive the rule `if choice = F, then wait = F`, with 2/5 errors. In total, we have 5/12 errors with these rules.

2. In the case of the attribute `bar`, when `bar = T`, then we wait 3 times, and 3 other times we don't wait. The same happens when `bar = F`. Hence we choose randomly `if bar = T, then wait = T` and `if bar = F, then wait = T` (in every case we wait). For both cases, we have 3/6 errors, totaling 6/12 errors.

3. With the same reasoning as above, we derive the rules `if day = T, then wait = F` and `if day = F, then wait = T` having 2/5 and 3/7 errors respectively, hence a total of 5/12 errors.

4. With the same reasoning as above, we derive the rules `if hungry = T, then wait = T` and `if hungry = F, then wait = F` having 2/7 and 1/5 errors respectively, hence a total of 3/12 errors.

5. With the same reasoning as above, we derive the rules `if patron = some, then wait = T`, `if patron = full, then wait = F` and `if patron = none, then wait = F` having 0/4, 2/6 and 0/2 errors respectively, hence a total of 2/12 errors.

6. With the same reasoning as above, we derive the rules `if price = $, then wait = F`, `if price = $$, then wait = T` and `if price = $$$, then wait`

`= F` having 3/7, 0/2 and 1/3 errors respectively, hence a total of 4/12 errors.

7. With the same reasoning as above, we derive the rules `if rain = T, then wait = T` (random choice) and `if rain = F, then wait = F` (random choice) having 2/4 and 4/8 errors respectively, hence a total of 6/12 errors.

8. With the same reasoning as above, we derive the rules `if booking = T, then wait = T` (random choice) and `if booking = F, then wait = F` (random choice) having 2/4 and 4/8 errors respectively, hence a total of 6/12 errors.

9. With the same reasoning as above, we derive the rules `if type = french, then wait = T` (random choice), `if type = Thai, then wait = T` (random choice), `if type = swiss, then wait = T` (random choice) and `if type = italian, then wait = F` having 1/2, 2/4, 2/4 and 1/2 errors respectively, hence a total of 6/12 errors.

10. With the same reasoning as above, we derive the rules `if time = 0, then wait = T`, `if time = 20, then wait = F`, `if time = 40, then wait = T` (random choice) and `if time = 60, then wait = F` having 1/5, 1/3, 1/2 and 0/2 errors respectively, hence a total of 3/12 errors.

We can make a table to summarize what we have found so far (see Table 1). We see that the attribute minimizing the number of errors is `patron`, hence the one rule is:

if patron = none | full, then wait = false, else wait = true.

□

Exercise 2. *According to your rule: How would hungry Bob decide on a rainy Monday if there is neither a bar nor an alternative restaurant nearby but some customers are in this expensive Swiss restaurant where he doesn't have to wait for a table because he did make a reservation?*

Solution. According to the rule

if patron = none | full, then wait = false, else wait = true,

Bob would wait for a table. □

Table 1: Summary of the rules

Attributes	Rules	Errors	Total errors
Choice	True → True	3 / 7	5 / 12
	False → False	2 / 5	
Bar	True → True (random choice)	3 / 6	6 / 12
	False → True (random choice)	3 / 6	
Day	True → False	2 / 5	5 / 12
	False → True	3 / 7	
Hungry	True → True	2 / 7	3 / 12
	False → False	1 / 5	
Patron	None → False	0 / 2	2 / 12
	Some → True	0 / 4	
	Full → False	2 / 6	
Price	$ → False	3 / 7	4 / 12
	$$ → True	0 / 2	
	$$$ → False	1 / 3	
Rain	True → True (random choice)	2 / 4	6 / 12
	False → False (random choice)	4 / 8	
Booking	True → True (random choice)	2 / 4	6 / 12
	False → False (random choice)	4 / 8	
Type	French → True (random choice)	1 / 2	6 / 12
	Thai → True (random choice)	2 / 4	
	Swiss → True (random choice)	2 / 4	
	Italian → False (random choice)	1 / 2	
Time	0 → True	1 / 5	3 / 12
	20 → False	1 / 3	
	40 → True (random choice)	1 / 2	
	60 → False	0 / 2	