INTELLIGENT SYSTEMS M – Michela Milano
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Exercise 1 (8 points)

Given the following training set S:

Language	**Duration**	**Class**
Yes	Short	Go
No	Medium	NoGo
Yes	Short	Go
Yes	Medium	NoGo
No	Long	Go
?	Long	NoGo
Yes	Short	Go
No	Short	NoGo
Yes	Long	Go
No	Short	NoGo
No	Medium	NoGo
?	Medium	Go
No	Long	NoGo

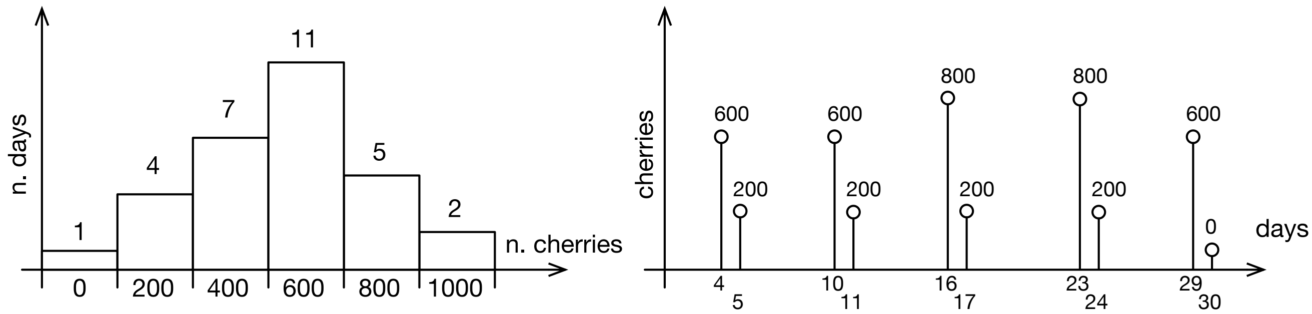
a) Compute the entropy of the training set w.r.t. the attribute Class
b) Compute the gain of the two attributes with respect to these training examples
c) Build the decision tree with one level for the training set, and compute the labels of each leaf.
d) Classify the instance:

?	Long

Esercizio 2 (punti 8)

Turner, the picky farmer

Mr Turner runs a small farm he purchased in central Italy (beloved vacation spot of an unbelievable number of subjects of her majesty the queen of England). After moving in, he developed the habit of approximately counting the cherries on the tree in his garden, *on every harvest day*. This (questionable) practice has quickly caused the accumulation of a massive amount of data, of which he is overly proud. For some reason his neighbours don't seem to understand at all, and usually react with a suspicious pat on the shoulder, or are mysteriously nowhere to be found. More than anything else, mr. Turner loves his cherry-meter, a graph reporting (for a typical harvest month) the number of times (y axis) that he found the tree loaded with a given number of cherries (x axis).



Whatever his neighbours may think, years of improvement have made the cherry-meter a practically exact tool: every year, the cherry load will invariably follow the distribution given by the cherry-meter, whatever the weather, the crows, and the bugs may do. Mr. Turner than naturally starts to wonder whether his beloved jewel could be use to boost the cherry production: every year he knows how many cherries were on the tree on the harvest day and on the day after, but what about the *other* days?

Formulate the problem as a CSP, keeping in mind that the cherry load can be discretized in steps of 200 units, and that from one day to the other the load never changes by more than 200 units (harvest days of course do not respect this rule).

Esercizio 3 (punti 8)

Given the following initial state
at(robot,home), at(cashmachine,bank), at(supermarket, milk), at(supermarket,coffee), has(robot, money), near(home, shop), near(shop, home) near(home, bank) near(bank, home) near(shop, bank) near(bank shop), to_be_mixed(milk, coffee, cappuccino)

We have to reach the goal: **has(robot, cappuccino)**

Actions are modelled as follows:

mix(ItemA, ItemB, ProductC)
PRECOND: has(Robot, ItemA), has(Robot, ItemB), to_be_mixed(ItemA, ItemB, ProductC)
DELETE: has(Robot, ItemA), has(Robot, ItemB)
ADD: has(Robot, ProductC)

buy(Robot,Item)
PRECOND: has(Robot, money), at(Robot,Location), at(Location,Item),
DELETE: has(Robot, money)
ADD: has(Robot,Item)

getMoney(Robot)
PRECOND: at(Robot,X), at(cashmachine, X), not has(robot, money)
ADD: has(robot, money)

go(X,Y)
PRECOND: at(robot,X), near(X,Y)
DELETE: at(robot,X)
ADD: at(robot,Y)

Solve the problem with the POP algorithm, identifying threats and their solution during the process.

Esercizio 4 (punti 7)

Build two levels of graph plan for the exercise 3

Compute the least general generalization of the following clauses:

- `C1= f(q(a)) ← c(X,a), c(q(X),b)`
- `C2= f(q(Z)) ← c(a,Z),c(q(Z),Y),c(r(Z),a)`

Describe the Kohonen networks and what are they useful for.

Which is the difference between an alldifferent([X1….Xn]) constraint and a set of pairwise difference constraints Xi ≠ Xj for i≠j

What is particle swarm optimization?

SOLUZIONE

Esercizio 1

a) info(S)=-6/13*$\log_2$ 6/13-7/13*$\log_2$ 7/13= 0.996

b)

Per calcolare il guadagno dell'attributo Internazionale non si usa l'entropia calcolata su tutto il training set ma solo sugli esempi che hanno Internazionale noto (insieme F):

info(F)=-5/11*$\log_2$ 5/11– 6/11*$\log_2$ 6/11= 0.994

$info_{Internazionale}$(S)= 5/11*(-4/5*$\log_2$ 4/5-1/5*$\log_2$ 1/5) + 6/11*(-1/6*$\log_2$ 1/6-5/6*$\log_2$ 5/6) = 0.455*0.722+0.545*0.650=0.68276

gain(Internazionale) =11/13*(0.994 -0.68276)= 0.263

splitinfo(Internazionale)= - 5/13*$\log_2$(4/13) -6/13*$\log_2$(6/13) -2/13*$\log_2$(2/13)= 1.460

gainratio(Internazionale) =0.263/ 1.460=0.180

$info_{Durata}$(S)= 5/13*(-3/5*$\log_2$ 3/5-2/5*$\log_2$ 2/5) + 4/13*(-1/4*$\log_2$1/4-3/4*$\log_2$ 3/4)+4/13*(-2/4*$\log_2$2/4-2/4*$\log_2$ 2/4)= 0.385 *0.971+0.308 *0.811 +0.308*1=0.932

gain(Durata) =0.996 -0.932=0.064

splitinfo(Durata)= - 5/13*$\log_2$(5/13) - 4/13*$\log_2$(4/12) - 4/13*$\log_2$(4/12)= 1.577

gainratio(Durata) =0.064/ 1.577=0.041

c) L'attributo scelto per la radice dell'albero è Internazionale

.

d) l'istanza viene divisa in due parti, di peso rispettivamente 5.910/13=0.455 e 7.090/13=0.545. La prima parte viene mandata lungo il ramo Si e classificata come Si con probabilità 4.455/5.910=75.4% e come No con probabilità 1.455/5.910=24.6%. La seconda parte viene mandata lungo il ramo No e classificata come No con probabilità 5.545/7.090=78.2% e come Si con probabilità 1.545/7.090=21.8%. Quindi in totale la classificazione dell'istanza è

P(Si) =0.455*75.4%+0.545*21.8%=46.2%

P(No) = 0.455*24.6%+0.545*78.2%=53.8%

Esercizio 3

STACK	STATO	PIANO
~~crew_has(ice).~~ ~~GIVE(X1).~~ ~~robot_at(X1), crew_at(X1), robot_has(ice).~~ ~~robot_at(X1).~~ ~~crew_at(X1).~~ ~~robot_har(ice).~~ ~~GET(X2).~~ ~~robot_at(X2), fridge_at(X2), robot_has(nothing).~~ ~~robot_at(X2).~~ ~~fridge_at(X2).~~ ~~robot_has(nothing).~~ ~~MOVE(X3,C).~~ ~~X3≠C, robot_at(X3).~~ ~~X3≠C.~~ ~~robot_at(X3).~~ ~~MOVE(X4,A).~~ ~~X4≠C, robot_at(X4).~~ ~~X4≠C.~~ ~~robot_at(X4).~~	crew_at(A), ~~robot_at(B),~~ ~~robot_has(nothing),~~ fridge_at(C), ~~robot_at(C),~~ ~~robot_has(ice),~~ robot_at(A), robot_has(nothing), crew_has(ice).	X2=C X3=B MOVE(B,C) GET(C) X1=A X4=C MOVE(C,A) GIVE(A)

Dunque lo stato finale del sistema è:
crew_at(A), fridge_at(C), robot_at(A), robot_has(nothing), crew_has(ice).
e la sequenza di azioni che compongono il piano trovato dall'algoritmo STRIPS è:
MOVE(B,C), GET(C), MOVE(C,A), GIVE(A).

Esercizio 4

Si calcoli la probabilità P(E|A,B)

P(E|A,B)=P(E,A,B)/P(A,B)

P(E,A,B)= P(B)P(E)P(A|EB)=0.1*0.05*0.99=0.00495

P(B,A)=P(B,A,E)+P(B,A,~E)

P(~E,A,B)= P(B)P(~E)P(A|~EB)=0.1*0.95*0.9=0.0855

P(B,A)= 0.00495+0.0855=0.09045

P(E|A,B)= 0.00495/0.09045=0.05473