INTELLIGENT SYSTEMS M – Michela Milano

June 9, 2017 – Exam A

Exercise 1 (8 points)

Given the following training set S:

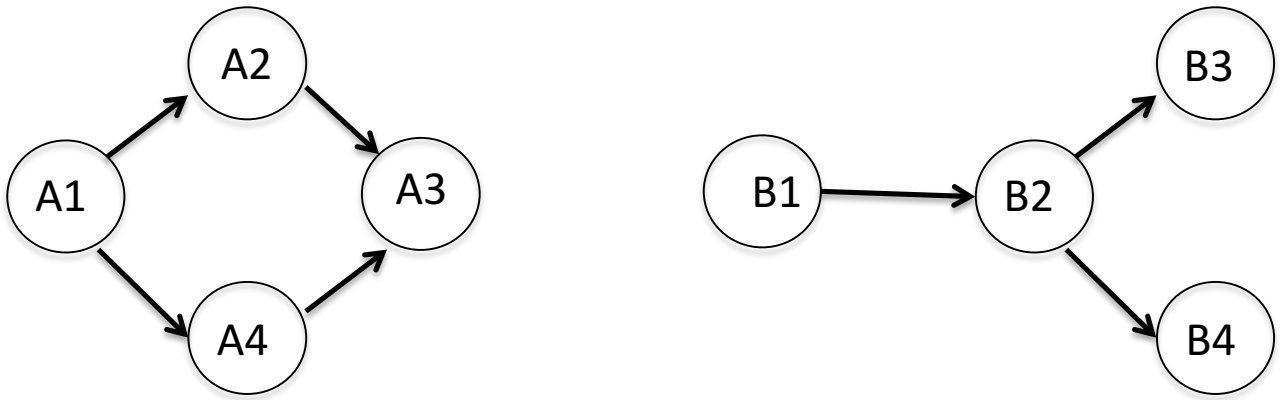
Level	Employment	Tax
Low	worker	Yes
High	secretary	No
High	worker	No
Low	director	Yes
Low	worker	No
High	secretary	No
Low	?	Yes
Low	secretary	No
High	director	Yes
Low	worker	No
High	secretary	Yes
Low	?	No
High	director	Yes
High	director	Yes

a) Compute the entropy of the training set w.r.t. the attribute Tax
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:

Low	?

Exercise 2 (8 points)

A multiprocessor system is organized in 4 processors each with a limited scratchpad memory with capacity cMem_i. Two processors are slower and two are faster so that tasks on the slower last twice as much than the ones running on the faster processors. We have to run on the architecture two applications of four tasks each organized as follows:



Nodes are tasks with the same duration (tasks in application A last two units of time, while tasks in B last four units of time on the slower processors). Each task has a memory consumption C_req.
Each core can run one task at a time but the memory is permanently allocated to the task (it is not released when the task ends). Arcs are precedence constraints.

The slower processors can host maximum two tasks each.

Model the problem as a CSP using reified and global constraints.

Exercise 3 (8 points)

Given the following initial state
robot_at(location_a), handempty, colour(blue), colour(red), object_at(plate, location_a), object_at(cube, location_b),

We have to reach the goal: **coloured(plate, blue), coloured(cube,red)**

Actions are modelled as follows:

colour(Object, Location, Colour)
PRECOND: object_at(Object, Location), robot_at(Location), robot_has(Colour)
ADD: coloured(Object, Colour)

go(X,Y)
PRECOND: robot_at(X)
DELETE: robot_at(X)
ADD: robot_at(Y)

pickColour(C)
PRECOND: handempty
DELETE: handempty
ADD: robot_has(C)

releaseColour(C)
PRECOND: robot_has(C)
DELETE: robot_has(C)
ADD: handempty

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

Exercise 4 (7 points)

1) Compute the lgg of the two clauses
   a. C1= g(a,f(X)) ← parent(X,f(a)), parent(a,b)
   b. C2= g(a,f(Y)) ← parent(Y,f(g(a))), parent(a,Y)

2) Build two levels of graph plan for the exercise 3
3) What is swarm intelligence and which are the main algorithms?
4) What is a multilayer network and which problems it solves best
5) What is conditional planning and why it is useful.

SOLUZIONE

Esercizio 1

a) info(S)=-7/14*$\log_2$ 7/14-7/14*$\log_2$ 7/14= 1

b)

$info_{Laurea}(S)$= 7/14*(-3/7*$\log_2$3/7-4/7*$\log_2$ 4/7) + 7/14*(-4/7*$\log_2$4/7-3/7*$\log_2$ 3/7) = 0.5*0.985+0.5 *0.985=0.985
gain(Laurea) =1 -0.985=0.015
splitinfo(Laurea)= - 7/14*$\log_2$(7/14) - 7/14*$\log_2$(7/14)= 1
gainratio(Laurea) =0.015/ 1=0.015

Per calcolare il guadagno dell'attributo Occupazione non si usa l'entropia calcolata su tutto il training set ma solo sugli esempi che hanno Occupazione noto (insieme F):
info(F)=-6/12*$\log_2$ 6/12– 6/12*$\log_2$ 6/12=1
$info_{Occupazione}(F)$=4/12*(-1/4*$\log_2$1/4-3/4*$\log_2$ 3/4)+4/12(-4/4*$\log_2$ 4/4-0/4*$\log_2$ 0/4) +4/12(-1/4*$\log_2$ 1/4-3/4*$\log_2$ 3/4)=0.333 *0.811 +0.333 *0+0.333 *0.811=0.540
gain(Occupazione) =12/14*(1-0.540) =0.394
splitinfo(Occupazione) =-6/14*$\log_2$(6/14)-6/14*$\log_2$(6/14)-2/14*$\log_2$(2/14)= 1.449
gainratio(Occupazione) =0.394/1.449=0.272

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

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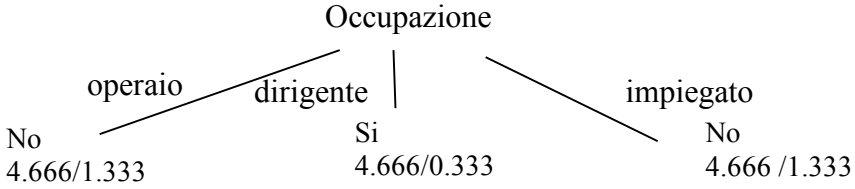

d) l'istanza viene divisa in tre parti, di peso rispettivamente 4.666/14=0.333, 4.666/14=0.333 e 4.666/14=0.333. La prima parte viene mandata lungo il ramo operaio e classificata come No con probabilità 3.333/4.666=71.4% e come Si con probabilità 1.333/4.666=28.6%. La seconda parte viene mandata lungo il ramo dirigente e classificata come Si con probabilità 4.333/4.666=92.9% e come No con probabilità 0.333/4.666=7.1%. La terza parte viene mandata lungo il ramo impiegato e classificata come No con probabilità 3.333/4.666=71.4% e come Si con probabilità 1.333/4.666=28.6%. Quindi in totale la classificazione dell'istanza è
P(Si) =0.333*28.6%+0.333*92.9%+0.333*28.6%=0.5
P(No) = 0.333*28.6%+0.333*7.1%+0.333*28.6%=0.5

Esercizio 2

C1= samebib(a,b) ←author(a,a(a)),author(b,a(a))
C2= samebib(a,p(b)) ←author(a,a(X)),author(p(b),a(Y))

lgg(C1,C2)=samebib(a,A) ← author(a,a(B)),author(C,a(D)),author(E,a(B)),author(A,a(D)).

A/b,p(b)
B/a,X
C/a,p(b)
D/a,Y
E/b,a
F/b,p(b)