06-23069 *Introduction to AI*
Autumn Semester 2015
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Exercise 2

This exercise consists of four questions, which make up 7% of the overall module mark.

Submission The assignment is due 12^{th} **November 2015, 4pm**. The usual late submission penalties apply.

Please submit your solution electronically in Canvas by uploading a single PDF file. Handwritten are fine, but please try to use black ink; please scan or photograph them and collate them into a single PDF file. Please also put your ID number on the front page.

1. Draw a semantic net that represents the following data: [20%]

   Tom is a cat.
   Tom caught a bird.
   Tom is owned by John.
   Tom is ginger in colour.
   Cats like cream.
   The cat sat on the mat.
   A cat is a mammal.
   A bird is an animal.
   All mammals are animals.
   Mammals have fur.

2. There are three hardware companies manufacturing graphics cards. The table below gives the single joint probability distribution for the following two random variables: [20%]

   (a) a card is good or defective,

   (b) a card has been manufactured by company X.

Company	Good	Defective
Alf-Leiters	0.475	0.025
Biodes & Son	0.279	0.021
Condictors Ltd.	0.180	0.020

   Consider the following questions:

   (a) What is the market share of Alf-Leiters?

   (b) What is the probability a randomly selected card is defective?

   (c) What is the likelihood of Condictors Ltd. producing a defective card?

(d) What is the probability that a defective product came from Biodes & Son?

(e) Show whether or not the two events "Product is defective" and "Product is from company X" are independent.

3. The following is a small planning problem, involving moving passengers using planes. The predicates for the domain are [30%]

`at(Person, Airport)`, `place(Airport)`, `passenger(Person)`,

`atPlane(Airport)`, `emptyPlane`, `onPlane(Person)`, `planeless(Airport)`

The Strips operators are:

BOARD(X,Y)

`Preconditions:`	at(X,Y), place(Y), passenger(X), atPlane(Y), emptyPlane
`Delete List:`	at(X,Y), emptyPlane
`Add List:`	onPlane(X)

FLY(X,Y)

`Preconditions:`	atPlane(X), place(X), place(Y), planeless(Y)
`Delete List:`	atPlane(X), planeless(Y)
`Add List:`	atPlane(Y), planeless(X)

DISEMBARK(X,Y)

`Preconditions:`	onPlane(X), passenger(X), place(Y), atPlane(Y)
`Delete List:`	onPlane(X)
`Add List:`	at(X,Y), emptyPlane

Show how STRIPS would solve this planning problem using forward chaining for the initial and goal state below. Assume that STRIPS always makes the correct choice. Write down carefully all the intermediate states.

Initial State:	`place(bhx)`, `place(cdg)`, `passenger(john)`, `at(john, bhx)`, `passenger(mary)`, `at(mary, cdg)`, `atPlane(bhx)`, `planeless(cdg)`, `emptyPlane`
Goal State:	`at(john, cdg)`, `at(mary, bhx)`

4. Take the previous planning example: [30%]

(a) Extend the formalisation to allow for multiple planes.

(b) Reformulate the previous problem to include two planes: one at CDG and one at BHX.

(c) Read up on Partial Order Plans in the textbook AI:AMA. Give a partial order plan to solve the planning problem.

(d) How many total order plans can you compile from the partial order plan?