# Introduction to AI - Exercise II

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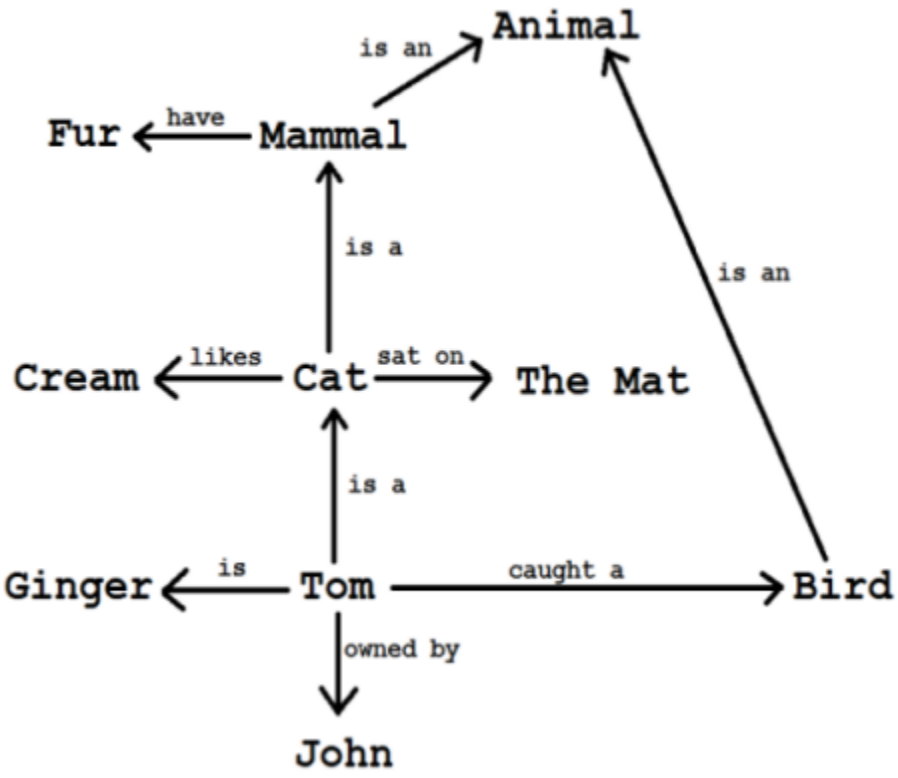
# 1 Question One

## 1.1 Brief

*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.*

## 1.2 Answer



# 2 Question Two

## 2.1 Brief

*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.*

| | | **G** | **D** |
|---|---|---|---|
| | *Company* | *Good* | *Defective* |
| **A** | *Alf-Leiters* | 0.475 | 0.025 |
| **B** | *Biodes & Son* | 0.279 | 0.021 |
| **C** | *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.*

## 2.2 Answer - (a)

Market share of **A** is:

$$0.475 + 0.025 = 0.5$$

## 2.3 Answer - (b)

Randomly selected card is defective =

$$\sum_{D_i} P(D), \quad D_i = (A_D, B_D, C_D)$$
$$= 0.025 + 0.021 + 0.020 = 0.066$$

## 2.4 Answer - (c)

Since we are finding the probability that the card is defective given that it was manufactured by company **C**,

$$P(D|C) = \frac{P(D \cap C)}{P(C)}$$

$$P(D \cap C) = 0.020, \ \textit{which is the probability that it is defective and from company } \mathbf{C}.$$

$$P(C) = 0.120 + 0.080, \ \textit{which is the market share of } \mathbf{C}.$$

$$\textit{Hence}, \quad P(D|C) = \frac{0.020}{0.200} = 0.1$$

## 2.5 Answer - (d)

Since we are finding the probability that company **B** make the card, given that it is defective,

$$P(B|D) = \frac{P(B \cap D)}{P(D)}$$

$$P(B \cap D) = 0.021 \textit{ which is the probability that it is defective and from company } \mathbf{B}.$$

$$P(D) = 0.066, \ (\textit{see Answer } \mathbf{(b)}).$$

$$\textit{Hence}, \quad P(B|D) = \frac{0.021}{0.066} = \frac{7}{22} \approx 0.\overline{318}$$

## 2.6 Answer - (e)

Two events, A and B, are independent iff $P(A \cap B) = P(A)P(B)$. This means we need to test the following cases for independence:

$$P(D) \wedge P(A)$$

$$P(D) \wedge P(B)$$

$$P(D) \wedge P(C)$$

$$P(D \cap A) = 0.025$$
$$P(D)P(A) = 0.066 \cdot 0.5 = 0.033$$

Since $P(D \cap A) \neq P(D)P(A)$, the two are dependent.

$$P(D \cap B) = 0.021$$
$$P(D)P(B) = 0.066 \cdot 0.3 = 0.0198$$

Since $P(D \cap B) \neq P(D)P(B)$, the two are dependent.

$$P(D \cap C) = 0.020$$
$$P(D)P(C) = 0.066 \cdot 0.2 = 0.0132$$

Since $P(D \cap C) \neq P(D)P(C)$, the two are dependent.

Hence, the events "Product is defective" and "Product is from company X" are dependent.