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2006 q.26 Expert Systems Knowledge Representation Rule Trees

The following paragraph outlines a limited domain of knowledge about growing azaleas in various types of garden soil. This knowledge is to be represented by an expert system using an expert system shell. A user of the expert system should be given advice about the likely success of growing an azalea in their garden given the colour of the soil.

Name an expert system shell with which you are familiar.

- Represent the knowledge contained in paragraph A above, to conclude a soil's type, given its colour. **(3)**
- In paragraphs B - D, identify **two** words which indicate uncertainty in the information. **(2)**
- Represent the knowledge in paragraphs B and C, to give the conclusion "The soil is suitable for growing azaleas". Your rules should refer to your answer to (a), and include an appropriate certainty factor. **(4)**

A	Garden soils are generally one of three types: acid, loam or clay. Acid soils are dark in colour, loams are brown and clay soils are light in colour.
B	Acid soils are most suitable for growing coniferous trees, rhododendrons and azaleas.
C	Clay soils are often lumpy and difficult to drain. They are light in colour. Few plants will grow well in clay soils.

2007 22b Expert Systems Knowledge Representation Rule Trees

Here are the rules which are used to determine if the dragon is angry.

IF it is raining
THEN the dragon is awake.

IF the dragon is awake
AND the goblins are dancing
THEN the dragon is angry.

Draw a rule tree to show how Mogo could give the reasons for concluding "The dragon is angry". **(3)**

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2007 23 Expert Systems Knowledge Representation

The members of a knitting group are graded by their knitting experience, as grade 1, grade 2 or grade 3. A knitting expert system advises members on suitable patterns according to the members' knitting experience. The expert system makes use of the following information.

a. Using a factor table, represent the knowledge contained in paragraph B below. The factor table should show the pattern types and whether there are one or many colours or stitches. **(4)**

b. The following rule indicates whether a member can knit a complex scarf pattern:

IF garment IS scarf

AND pattern IS complex

AND grading IS > 1

THEN member can knit garment.

Represent the knowledge contained in paragraph C above to provide advice on the suitability of patterns for knitting scarves, jumpers, gloves and socks, given a member's knitting experience. The rules should be of the form IF <conditions> THEN <conclusions> as shown above. **(4)**

A	A grade 1 member is one who has never knitted anything before. Members who have knitted a scarf are classed as grade 2. Members are classed as grade 3 if they have knitted a jumper, gloves or socks.
B	The art of knitting involves following a pattern which describes the stitches to be used and colours and types of wool. Simple patterns involve using a single colour of wool and a single type of stitch. Complex patterns involve using a mix of colours of wool or a combination of different stitches or both.
C	Grade 1 members are only able to attempt a simple pattern. Grade 2 members can tackle complex patterns for scarves and simple patterns for socks and jumpers. Grade 3 members can tackle all knitting patterns.

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2007P q.29 Expert Systems Knowledge Representation

a. An expert system is being developed to identify and classify animals. The following knowledge is to be stored in the knowledge base of the expert system:

A mammal is an animal that has hair and provides milk for its young. A carnivore is a meat-eating mammal with claws and pointed teeth whereas an ungulate is a mammal that chews cud and has hooves. A cheetah is a carnivore with black spots and a tiger is a carnivore with black stripes. A giraffe is an ungulate with a long neck and a zebra is an ungulate with black stripes.

Derive attribute pairs from this information about all the animals provided above. The attribute pairs should be in the form:

ungulate (mammal, chews_cud, has_hooves)

cheetah (carnivore, has_black_spots) (5)

b. The developers of the expert system decide to represent knowledge about birds as factor tables. The factor tables are shown below.

(i). Represent the factor tables above as a decision tree.

(ii). Compare the use of factor tables and a decision tree to represent the knowledge about birds. **(6)**

Lays eggs	Has feathers	Classification
Yes	Yes	Bird

Bird	Can fly	Can swim	Classification
Yes	Yes	Yes	Duck
Yes	No	No	Ostrich
Yes	No	Yes	Penguin

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2008 23 Expert Systems Knowledge Representation

Colin and Sofie are fashion image consultants. They have been commissioned by an international jeans retailer to help construct an expert system. The expert system will advise customers on the style of jeans to buy.

The following rules represent advice on what type of jeans to buy if you have long legs:

IF legs are long
AND build IS regular
AND wearing boots IS yes
THEN advice IS to buy bootcut jeans.

IF legs are long
AND build IS regular
AND wearing boots IS no
THEN advice IS to buy square cut jeans.

IF legs are long
AND build IS slim
AND wearing boots IS yes
THEN advice IS to buy bootcut jeans.

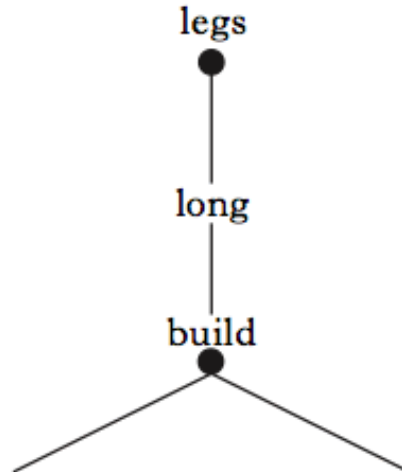
IF legs are long
AND build IS slim
AND wearing boots IS no
THEN advice IS to buy slimfit jeans.

The start of the decision tree to represent the rules above is shown below.

Copy and complete the decision tree to represent the rules above. **(6)**

b. Describe **one** advantage of using a decision tree to represent knowledge in an expert system. **(2)**

c. The expert system has to be expanded to cater for short leg lengths. Add to the list of



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2008P q.26 Expert Systems Knowledge Representation Production Rules

Tom is interested in sailing and has decided to make an expert system regarding pleasure boats. He has consulted an expert and received the following advice.

Expert: Pleasure boats are boats used by people for their enjoyment and leisure. A pleasure boat powered by humans using oars is a rowing boat. A pleasure boat powered by an engine is known as a powerboat. When the engine is mounted outside the stern of the boat this is an outboard engine. An engine inside the hull of the boat is an inboard engine. A pleasure boat powered by wind is a sailboat.

a. Make up design rules to represent the knowledge from the expert. The rules should be expressed in a form with which you are familiar, as shown in the first two rules below:

IF boat is used for enjoyment and leisure
THEN vessel is pleasure boat.

IF vessel is pleasure boat AND
power is by humans using oars
THEN this boat is a rowing boat. **(4)**

b. State the category of this expert system. Justify your answer. **(2)**

2008P q.28 Expert Systems Knowledge Representation Attribute-Value Pairs

An expert system is being developed to identify and classify geographical features. The following knowledge is to be stored in the knowledge base of the expert system:

A landform is a part of the terrain and is categorised by its elevation, slope and position. A mountain is a landform that extends above the surrounding terrain and has steep cliffs. A gorge is a landform which extends beneath the surrounding terrain and has steep cliffs. A gorge is formed by erosion. A valley is a depression between two mountains. A river valley is formed by a river. A glacial valley is formed by a glacier.

a. Derive attribute pairs from this information about geographical features provided above. The attribute pairs should be in the form:

landform(part_of_terrain, has_elevation, has_slope, has_position)
mountain(landform, extends_above_terrain, has_steep_cliffs) (5)

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2008P q.28b Expert Systems Knowledge Representation

An expert system is being developed to identify and classify geographical features. The developers of the expert system decide to represent knowledge about glacial moraines as factor tables. The factor tables are shown below.

- (i). Represent the factor tables above as a decision tree. **(4)**
- (ii). Compare the use of factor tables and a decision tree to represent the knowledge about glacial moraines. **(2)**

Formed by Glacier	From Debris	Classification
Yes	Yes	Moraine

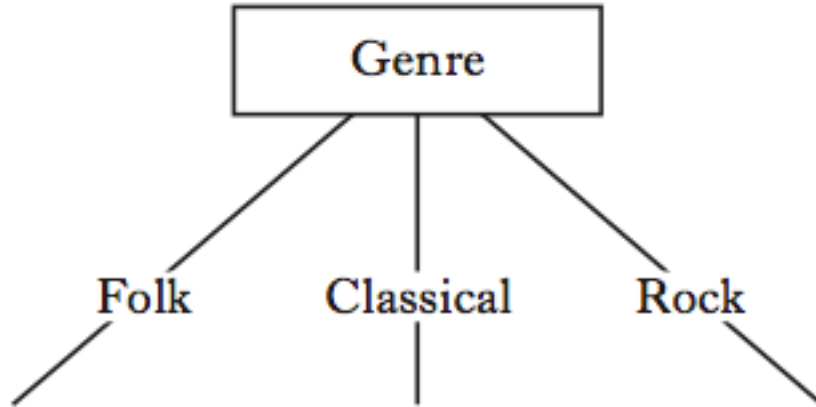
Moraine	Subglacial	Raised Feature	Classification
Yes	No	No	Terminal Moraine
Yes	No	Yes	Lateral Moraine
Yes	Yes	No	Ground Moraine
Yes	Yes	Yes	Ribbed Moraine

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2009 23a Expert Systems Knowledge Representation Rule Trees

Strathcraig Music Centre hosts an annual Music Festival. The centre has several venues and hosts several genres of music each year. The proposed program for this year is shown below.

Use the table to complete the following rule tree using Genre as the root. **(8)**



Genre	Week	Price	Performer
Folk	1	Cheap	Paul Bennett @ Banner Hall
Folk	2	Cheap	The Purdie Family @ The Port
Classical	1	Cheap	Aiko @ The Kane Rooms
Classical	2	Cheap	Guitar Ensemble @ The Kane Rooms
Classical	1	Expensive	Warsaw Concert Orchestra @ The Auditorium
Classical	2	Expensive	Edison String Quartet @ Banner Hall
Rock	1	Cheap	China Cats @ The Port
Rock	2	Cheap	Diesel @ The Auditorium

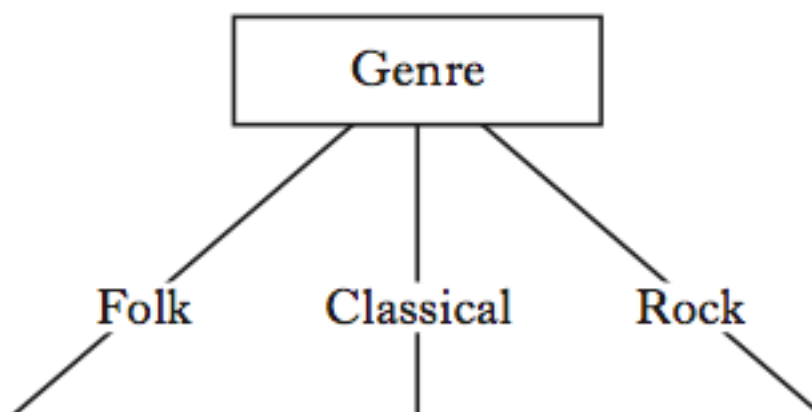
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2009 23b Expert Systems Knowledge Representation Production Rules

David has been asked to create an expert system to assist staff at the Music Centre advise customers which performance meets their needs.

Write rules to represent the knowledge for Classical music. **(8)**

Genre	Week	Price	Performer
Folk	1	Cheap	Paul Bennett @ Banner Hall
Folk	2	Cheap	The Purdie Family @ The Port
Classical	1	Cheap	Aiko @ The Kane Rooms
Classical	2	Cheap	Guitar Ensemble @ The Kane Rooms
Classical	1	Expensive	Warsaw Concert Orchestra @ The Auditorium
Classical	2	Expensive	Edison String Quartet @ Banner Hall
Rock	1	Cheap	China Cats @ The Port
Rock	2	Cheap	Diesel @ The Auditorium



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2009P q.23 Expert Systems Knowledge Representation Production Rules

Ferve Micros is a small manufacturer of laptop computers. Features of a sample of the computers it produces are shown in the table below.

• indicates the laptop has this feature

To help customers choose which laptop may suit them best Ferve Micros has developed an expert system. Some of the rules from the expert system are shown below:

IF weight IS low AND
battery life IS long
THEN type is NM.

IF screen IS wide AND
battery life IS long AND
processor speed IS high
THEN advice is buy LF600.

IF type IS NM AND
screen IS wide
THEN advice IS buy NM200.

a. Write rules to give advice to buy LF400 and NM400 using forward chaining as above.

(4)

b. Rewrite the rule giving the advice to buy NM200 in backward chaining form. **(1)**

	Low Weight	Wide Screen	Long Battery Life	High Speed Processor
LF 600		•	•	•
LF400	•	•		
NM200	•	•	•	
NM400	•		•	•