

EECS 837 HOMEWORK 1

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	Attributes				Decision	Conceptual Variables		
	Size	Color	Feel	Temperature	Attitude	$Attitude_{positive}$	$Attitude_{negative}$	$Attitude_{so-so}$
1	big	yellow	soft	low	positive	positive	SPECIAL	SPECIAL
2	big	yellow	hard	high	negative	SPECIAL	negative	SPECIAL
3	medium	yellow	soft	high	positive	positive	SPECIAL	SPECIAL
4	medium	blue	hard	high	positive	positive	SPECIAL	SPECIAL
5	medium	blue	hard	high	positive	positive	SPECIAL	SPECIAL
6	medium	blue	soft	low	negative	SPECIAL	negative	SPECIAL
7	big	blue	hard	low	so-so	SPECIAL	SPECIAL	so-so
8	big	blue	hard	high	so-so	SPECIAL	SPECIAL	so-so

$$\{d\}^* = \{\{1, 3, 4, 5\}, \{2, 6\}, \{7, 8\}\}$$

1. FOR THE ABOVE DECISION TABLE, DETERMINE A SET OF RULES USING CONCEPTUAL VARIABLES AND

1.1. a single global covering for each conceptual variable and then linear dropping condition technique (i.e. by the LEM1 algorithm).

$$Attitude_{positive}$$

$$\{Attitude_{positive}\}^* = \{\{1, 3, 4, 5\}, \{2, 6, 7, 8\}\}$$

$$\text{Size? } \{A - \{Size\}\}^* = \{Color, Feel, Temperature\}^* = \{\{1\}, \{2\}, \{3\}, \{4, 5, 8\}, \{6\}, \{7\}\} \not\leq \{Attitude_{positive}\}^*$$

$$\text{Color? } \{A - \{Color\}\}^* = \{Size, Feel, Temperature\}^* = \{\{1\}, \{2, 8\}, \{3\}, \{4, 5\}, \{6\}, \{7\}\} \leq \{Attitude_{positive}\}^*$$

$$\text{Feel? } \{A - \{Color, Feel\}\}^* = \{Size, Temperature\}^* = \{\{1, 7\}, \{2, 8\}, \{3, 4, 5\}, \{6\}\} \not\leq \{Attitude_{positive}\}^*$$

$$\text{Temperature? } \{A - \{Color, Temperature\}\}^* = \{Size, Feel\}^* = \{\{1\}, \{2, 7, 8\}, \{3, 6\}, \{4, 5\}\} \not\leq \{Attitude_{positive}\}^*$$

$$\text{Single Global Covering for } Attitude_{positive} = \{Size, Feel, Temperature\}$$

Creating a rule set for $Attitude_{positive}$

$$(\text{Size, big}) \ \& \ (\text{Feel, soft}) \ \& \ (\text{Temperature, low}) \rightarrow (\text{Attitude, positive}) \quad \text{Covers: } \{1\}$$

$$(\text{Size, medium}) \ \& \ (\text{Feel, soft}) \ \& \ (\text{Temperature, high}) \rightarrow (\text{Attitude, positive}) \quad \text{Covers: } \{3\}$$

$$(\text{Size, medium}) \ \& \ (\text{Feel, hard}) \ \& \ (\text{Temperature, high}) \rightarrow (\text{Attitude, positive}) \quad \text{Covers: } \{3, 4, 5\}$$

$$Attitude_{negative}$$

$$\{Attitude_{negative}\}^* = \{\{2, 6\}, \{1, 3, 4, 5, 7, 8\}\}$$

$$\text{Size? } \{A - \{Size\}\}^* = \{Color, Feel, Temperature\}^* = \{\{1\}, \{2\}, \{3\}, \{4, 5, 8\}, \{6\}, \{7\}\} \leq \{Attitude_{negative}\}^*$$

$$\text{Color? } \{A - \{Size, Color\}\}^* = \{Feel, Temperature\}^* = \{\{1, 6\}, \{2, 4, 5, 8\}, \{3\}, \{7\}\} \not\leq \{Attitude_{negative}\}^*$$

$$\text{Feel? } \{A - \{Size, Feel\}\}^* = \{Color, Temperature\}^* = \{\{1\}, \{2, 3\}, \{4, 5, 8\}, \{6, 7\}\} \not\leq \{Attitude_{negative}\}^*$$

$$\text{Temperature? } \{A - \{Size, Temperature\}\}^* = \{Color, Feel\}^* = \{\{1, 3\}, \{2\}, \{4, 5, 7, 8\}, \{6\}\} \leq \{Attitude_{negative}\}^*$$

$$\text{Single Global Covering for } Attitude_{negative} = \{Color, Feel\}$$

Creating a rule set for $Attitude_{negative}$

$$(\text{Color, yellow}) \ \& \ (\text{Feel, hard}) \rightarrow (\text{Attitude, negative}) \quad \text{Covers: } \{2\}$$

$$(\text{Color, blue}) \ \& \ (\text{Feel, soft}) \rightarrow (\text{Attitude, negative}) \quad \text{Covers: } \{6\}$$

$$Attitude_{so-so}$$

$$\{Attitude_{so-so}\}^* = \{\{1, 2, 3, 4, 5, 6\}, \{7, 8\}\}$$

Size? $\{A - \{Size\}\}^* = \{Color, Feel, Temperature\}^* = \{\{1\}, \{2\}, \{3\}, \{4, 5, 8\}, \{6\}, \{7\}\} \not\leq \{Attitude_{so-so}\}^*$
 Color? $\{A - \{Color\}\}^* = \{Size, Feel, Temperature\}^* = \{\{1\}, \{2, 8\}, \{3\}, \{4, 5\}, \{6\}, \{7\}\} \not\leq \{Attitude_{so-so}\}^*$
 Feel? $\{A - \{Feel\}\}^* = \{Size, Color, Temperature\}^* = \{\{1\}, \{2\}, \{3\}, \{4, 5\}, \{6\}, \{7\}, \{8\}\} \leq \{Attitude_{so-so}\}^*$
 Temperature? $\{A - \{Feel, Temperature\}\}^* = \{Size, Color\}^* = \{\{1, 2\}, \{3\}, \{4, 5, 6\}, \{7, 8\}\} \leq \{Attitude_{so-so}\}^*$

Single Global Covering for $Attitude_{so-so} = \{Size, Color\}$

Creating a rule set for $Attitude_{so-so}$

(Size, big) & (Color, blue) \rightarrow (Attitude, so-so) Covers: $\{7, 8\}$

Complete rule set using LEM1 algorithm

(Size, big) & (Feel, soft) \rightarrow (Attitude, positive) Covers: $\{1\}$
 (Size, medium) & (Temperature, high) \rightarrow (Attitude, positive) Covers: $\{3, 4, 5\}$
 (Color, yellow) & (Feel, hard) \rightarrow (Attitude, negative) Covers: $\{2\}$
 (Color, blue) & (Feel, soft) \rightarrow (Attitude, negative) Covers: $\{6\}$
 (Size, big) & (Color, blue) \rightarrow (Attitude, so-so) Covers: $\{7, 8\}$

1.2. all global coverings for each conceptual variable and then linear dropping condition technique.

$\{Size\}^* = \{\{1, 2, 7, 8\}, \{3, 4, 5, 6\}\}$
 $\{Color\}^* = \{\{1, 2, 3\}, \{4, 5, 6, 7, 8\}\}$
 $\{Feel\}^* = \{\{1, 3, 6\}, \{2, 4, 5, 7, 8\}\}$
 $\{Temperature\}^* = \{\{1, 6, 7\}, \{2, 3, 4, 5, 8\}\}$

$\{Size, Color\}^* = \{\{1, 2\}, \{3\}, \{4, 5, 6\}, \{7, 8\}\} \leq \{Attitude_{so-so}\}^*$
 $\{Size, Feel\}^* = \{\{1\}, \{2, 7, 8\}, \{3, 6\}, \{4, 5\}\}$
 $\{Size, Temperature\}^* = \{\{1, 7\}, \{2, 8\}\{3, 4, 5\}, \{6\}\}$
 $\{Color, Feel\}^* = \{\{1, 3\}, \{2\}, \{4, 5, 7, 8\}, \{6\}\} \leq \{Attitude_{negative}\}^*$
 $\{Color, Temperature\}^* = \{\{1\}, \{2, 3\}, \{4, 5, 8\}, \{6, 7\}\}$
 $\{Feel, Temperature\}^* = \{\{1, 6\}, \{2, 4, 5, 8\}, \{3\}, \{7\}\}$

$\{Size, Color, Feel\}^* = \{\{1\}, \{2\}, \{3\}, \{4, 5\}, \{6\}, \{7, 8\}\} \leq \{Attitude_{positive}\}^*$
 $\{Size, Color, Temperature\}^* = \{\{1\}, \{2\}, \{3\}, \{4, 5\}, \{6\}\{7\}, \{8\}\} \leq \{Attitude_{positive}\}^*$
 $\{Size, Feel, Temperature\}^* = \{\{1\}, \{2, 8\}, \{3\}, \{4, 5\}, \{6\}, \{7\}\} \leq \{Attitude_{positive}\}^*$
 $\{Color, Feel, Temperature\}^* = \{\{1\}, \{2\}, \{3\}\{4, 5, 8\}, \{6\}, \{7\}\}$

$\{Size, Color, Feel\}$ rules for $\{Attitude_{positive}\}$
~~(Size, big)~~ & (Color, yellow) & (Feel, soft) \rightarrow (Attitude, positive) Covers: $\{1, 3\}$
 (Size, medium) & (Color, blue) & (Feel, hard) \rightarrow (Attitude, positive) Covers: $\{4, 5\}$

$\{Size, Color, Temperature\}$ rules for $\{Attitude_{positive}\}$
~~(Size, big)~~ & (Color, yellow) & (Temperature, low) \rightarrow (Attitude, positive) Covers: $\{1\}$
 (Size, medium) & ~~(Color, blue)~~ & (Temperature, high) \rightarrow (Attitude, positive) Covers: $\{3, 4, 5\}$

Rules for $\{Attitude_{positive}\}$ are equally complex for global coverings $\{Size, Color, Temperature\}$ and $\{Size, Feel, Temperature\}$

Complete rule set using all global coverings and linear dropping technique

(Size, big) & (Feel, soft) \rightarrow (Attitude, positive) Covers: $\{1\}$
 (Size, medium) & (Temperature, high) \rightarrow (Attitude, positive) Covers: $\{3, 4, 5\}$
 (Color, yellow) & (Feel, hard) \rightarrow (Attitude, negative) Covers: $\{2\}$
 (Color, blue) & (Feel, soft) \rightarrow (Attitude, negative) Covers: $\{6\}$
 (Size, big) & (Color, blue) \rightarrow (Attitude, so-so) Covers: $\{7, 8\}$

2. FOR THE ABOVE DECISION TABLE GIVE A RULE SET EXAMPLE THAT IS:

2.1. complete but not consistent.

Ruleset that is complete but not consistent

(Size, big) \rightarrow (Attitude, positive) Covers: { 1, 2, 7, 8 }
(Size, medium) \rightarrow (Attitude, negative) Covers: { 3, 4, 5, 6 }

2.2. neither complete nor consistent.

Ruleset that is neither complete nor consistent

(Size, big) \rightarrow (Attitude, positive) Covers: { 1, 2, 7, 8 }

A rule set R is consistent if and only if every rule from R is consistent with the data set (decision table). A rule set R is complete if and only if every concept from the data set is completely covered by R..