EECS 837 HOMEWORK 2

ELISE MCELLHINEY

	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	so-so	SPECIAL	SPECIAL	so-so
5	medium	blue	hard	high	negative	SPECIAL	negative	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	low	positive	positive	SPECIAL	SPECIAL

Determine sets of certain and possible rules for all three concepts by the LEM2 algorithm.

$$A^* = \{\{1\},\{2\},\{3\},\{4,5\},\{6\},\{7,8\}\}$$
$$\{d\}^* = \{\{1,3,8\},\{2,5,6\},\{4,7\}\}$$
$$A^* \not\leq \{d\}^*$$

$$Attitude_{positive} = \{1,3,8\} \qquad \underline{Attitude_{positive}} = \{1,3\} \qquad \overline{Attitude_{positive}} = \{1,3,7,8\}$$
$$Attitude_{negative} = \{2,5,6\} \qquad \underline{Attitude_{negative}} = \{2,6\} \qquad \overline{Attitude_{negative}} = \{2,4,5,6\}$$
$$Attitude_{so-so} = \{4,7\} \qquad \underline{Attitude_{so-so}} = \{\} \qquad \overline{Attitude_{so-so}} = \{4,5,7,8\}$$

(a,v)	[(a,v)]	{1,3}	{1,3}	{2,6}	{2,6}
(Size, big)	{1,2,7,8}	{1}	{1}	{2}	{2}
(Size, medium)	{3,4,5,6}	{3}	{3}	{6}	{6}
(Color, yellow)	{1,2,3}	{1,3}	-	{2}	-
(Color, blue)	{4,5,6,7,8}	-	-	{6}	{6}
(Feel, soft)	{1,3,6}	{1,3}	{1,3}	{6}	{6}
(Feel, hard)	{2,4,5,7,8}	-	-	{2}	{2}
(Temperature, low)	{1,6,7,8}	{1}	{1}	{6}	{6}
(Temperature, high)	{2,3,4,5}	{3}	{3}	{2}	{2}
		{1,2,3} $\not\subseteq$ {1,3}	{1,2,3} $\cap$ {1,3,6} = {1,3} $\subseteq$ {1,3}	{1,2,3} $\not\subseteq$ {2,6}	{1,2,3} $\cap$ {1,3,6} = {1} $\not\subseteq$ {2,6} & {1} $\not\supseteq$ {2,6}

{2,6} can't occur in one rule since all their attributes are contradictory, so we split them apart.

Date: September 19, 2017.

(a,v)	[(a,v)]	{2}	{2}	{2}
(Size, big)	{1,2,7,8}	{2}	{2}	-
(Size, medium)	{3,4,5,6}	-	-	-
(Color, yellow)	{1,2,3}	{2}	-	-
(Color, blue)	{4,5,6,7,8}	-	-	-
(Feel, soft)	{1,3,6}	-	-	-
(Feel, hard)	{2,4,5,7,8}	{2}	{2}	{2}
(Temperature, low)	{1,6,7,8}	-	-	-
(Temperature, high)	{2,3,4,5}	{2}	{2}	{2}
		$\{1,2,3\} \not\subseteq \{2,6\}$	$\{1,2,3\} \cap \{1,2,7,8\} = \{1,2\} \not\subseteq \{2,6\}$	$\{1,2,3\} \cap \{1,2,7,8\} \cap \{2,3,4,5\} = \{2\} \subseteq \{2,6\}$

(a,v)	[(a,v)]	{6}	{6}	{6}
(Size, big)	{1,2,7,8}	-	-	-
(Size, medium)	{3,4,5,6}	{6}	{6}	-
(Color, yellow)	{1,2,3}	-	-	-
(Color, blue)	{4,5,6,7,8}	{6}	{6}	{6}
(Feel, soft)	{1,3,6}	{6}	-	-
(Feel, hard)	{2,4,5,7,8}	-	-	-
(Temperature, low)	{1,6,7,8}	{6}	-	-
(Temperature, high)	{2,3,4,5}	-	-	-
		$\{1,3,6\} \not\subseteq \{2,6\}$	$\{1,3,6\} \cap \{3,4,5,6\} = \{3,6\} \not\subseteq \{2,6\}$	$\{1,3,6\} \cap \{3,4,5,6\} \cap \{4,5,6,7,8\} = \{6\} \subseteq \{2,6\}$

Certain Rules:
(Color, yellow) & (Feel, soft) → (Attitude, positive)
~~(Color, yellow)~~ & (Size, big) & (Temperature, high) → (Attitude, negative)
(Feel, soft) & ~~(Size, medium)~~ & (Color, blue) → (Attitude, negative)

(a,v)	[(a,v)]	{1,3,7,8}	{1,3,7,8}
(Size, big)	{1,2,7,8}	{1, 7, 8}	-
(Size, medium)	{3,4,5,6}	{3}	{3}
(Color, yellow)	{1,2,3}	{3}	{3}
(Color, blue)	{4,5,6,7,8}	{7,8}	{7,8}
(Feel, soft)	{1,3,6}	{1,3}	{1,3}
(Feel, hard)	{2,4,5,7,8}	{7,8}	{7,8}
(Temperature, low)	{1,6,7,8}	{1,7,8}	{1, 7, 8}
(Temperature, high)	{2,3,4,5}	{3}	{3}
		$\{1,2,7,8\} \not\subseteq \{1,3,7,8\}$	$\{1,2,7,8\} \cap \{1,6,7,8\} = \{1,7,8\} \subseteq \{1,3,7,8\}$

(a,v)	[(a,v)]	{3}	{3}
(Size, big)	{1,2,7,8}	-	-
(Size, medium)	{3,4,5,6}	{3}	{3}
(Color, yellow)	{1,2,3}	{3}	-
(Color, blue)	{4,5,6,7,8}	-	-
(Feel, soft)	{1,3,6}	{3}	{3}
(Feel, hard)	{2,4,5,7,8}	-	-
(Temperature, low)	{1,6,7,8}	-	-
(Temperature, high)	{2,3,4,5}	{3}	{3}
		$\{1,2,3\} \not\subseteq \{1,3,7,8\}$	$\{1,2,3\} \cap \{1,3,6\} = \{1,3\} \subseteq \{1,3,7,8\}$

Possible Rules:
(Size, big) & (Temperature, low) → (Attitude, positive)
(Color, yellow) & (Feel, soft) → (Attitude, positive)

(a,v)	[(a,v)]	{2,4,5,6}	{2,4,5,6}	{2,4,5,6}
(Size, big)	{1,2,7,8}	{2}	{2}	{2}
(Size, medium)	{3,4,5,6}	{4, 5, 6}	-	-
(Color, yellow)	{1,2,3}	{2}	{2}	{2}
(Color, blue)	{4,5,6,7,8}	{2,5,6}	{2,5,6}	{2, 5, 6}
(Feel, soft)	{1,3,6}	{6}	{6}	{6}
(Feel, hard)	{2,4,5,7,8}	{2,4,5}	{2,4,5}	{2,4,5}
(Temperature, low)	{1,6,7,8}	{6}	{6}	{6}
(Temperature, high)	{2,3,4,5}	{2,4,5}	{2, 4, 5}	-
		$\{3,4,5,6\} \not\subseteq \{2,4,5,6\}$	$\{3,4,5,6\} \cap \{2,3,4,5\} = \{3,4,5\} \not\subseteq \{2,4,5,6\}$	$\{3,4,5,6\} \cap \{2,3,4,5\} \cap \{4,5,6,7,8\} = \{4,5\} \subseteq \{2,4,5,6\}$

We know the rules associated with {2,6} from figuring out the certain rules above

Possible Rules:
~~(Size, medium)~~ & (Temperature, high) & (Color, blue) → (Attitude, negative)
~~(Color, yellow)~~ & (Size, big) & (Temperature, high) → (Attitude, negative)
(Feel, soft) & ~~(Size, medium)~~ & (Color, blue) → (Attitude, negative)

(a,v)	[(a,v)]	{4,5,7,8}	{4,5,7,8}
(Size, big)	{1,2,7,8}	{7,8}	{7,8}
(Size, medium)	{3,4,5,6}	{4,5}	{4,5}
(Color, yellow)	{1,2,3}	-	-
(Color, blue)	{4,5,6,7,8}	{4, 5, 7, 8}	-
(Feel, soft)	{1,3,6}	-	-
(Feel, hard)	{2,4,5,7,8}	{4,5,7,8}	{4, 5, 7, 8}
(Temperature, low)	{1,6,7,8}	{7,8}	{7,8}
(Temperature, high)	{2,3,4,5}	{4,5}	{4,5}
		$\{4,5,6,7,8\} \not\subseteq \{4,5,7,8\}$	$\{4,5,6,7,8\} \cap \{2,4,5,7,8\} = \{4,5,7,8\} \subseteq \{4,5,7,8\}$

Possible Rules:

(Color, blue) & (Feel, hard) → (Attitude, so-so)

Certain Rules:
(Color, yellow) & (Feel, soft) → (Attitude, positive)
(Size, big) & (Temperature, high) → (Attitude, negative)
(Feel, soft) & (Color, blue) → (Attitude, negative)

Possible Rules:
(Size, big) & (Temperature, low) → (Attitude, positive)
(Color, yellow) & (Feel, soft) → (Attitude, positive)
(Temperature, high) & (Color, blue) → (Attitude, negative)
(Size, big) & (Temperature, high) → (Attitude, negative)
(Feel, soft) & (Color, blue) → (Attitude, negative)
(Color, blue) & (Feel, hard) → (Attitude, so-so)

In general, for subsets X and Y of the universe U

$$\bar{A}X - \bar{A}Y \subseteq \bar{A}(X - Y)$$

where A is the set of all attributes.

Show a decision table, and subsets X and Y of U with

$$\bar{A}X - \bar{A}Y \subset \bar{A}(X - Y)$$

	Price	Sale
1	High	Yes
2	High	No
3	Low	Yes
4	Low	Yes

$$A^* = \{\{1,2\},\{3,4\}\}$$
$$X = (Sale, yes) = \{1,3,4\}$$
$$Y = (Sale, no) = \{2\}$$

$$\bar{A}X - \bar{A}Y = \{1,2,3,4\} - \{1,2\} = \{3,4\}$$
$$\bar{A}(X - Y) = \bar{A}(\{1,3,4\} - \{2\}) = \bar{A}(\{1,3,4\}) = \{1,2,3,4\}$$
$$\{3,4\} \subset \{1,2,3,4\}$$