X. Business Rules

Business Rules
Structured English
Decision Tables and Decision Trees

Business Rules

- *(We saw earlier that…) Business rules describe properties of an application.*
- *A business rule can be associated to a class, to define common properties of instances, or to an operation, to define its effects.*
- *The types of rules we will discuss in this unit include:*
  - ✓ ***Integrity constraints*** *on the data of the application;*
  - ✓ ***Derivation rules****, whereby information can be derived from other information;*
  - ✓ ***Operation rules*** *that describe the effects of an operation.*

Examples of Business Rules

Constraints
(BR1) The manager of a department must belong to that department. (BR2) An employee cannot earn more than her manager. (BR3) A department of the Toronto office can only be managed by an employee who has ≥ 10yrs experience. (BR4) An employee can only participate in projects associated with her department.
Derivations
(BR5) The budget of a project is the sum of all salaries of participating employees, multiplied by 3.
Operation Rules
(BR6) Before a withdrawal, the balance of the account must be greater than the amount being withdrawn. (BR7) After the withdrawal, the balance will be equal to the balance before, minus the amount that has been withdrawn.

Specifying Business Rules

How do we specify more precisely business rules?

- ✓ **Natural Language** -- use unrestricted natural language...but such descriptions can be highly ambiguous;
- ✓ **Structured English** -- use a subset of a natural language (both syntactically and vocabulary-wise) to minimize ambiguities...this has been used with some success;
- ✓ **Decision Tables** -- use table representation of alternative outcomes (similar to truth tables);
- ✓ **Decision Trees** -- use tree representation of alternative outcomes

We need representations that are precise, but also understandable by end user

Structured English

Looks a lot like pseudocode. Here is an operation rule:

For each LOAN ACCOUNT NUMBER in the LOAN ACCOUNT FILE
do the following steps:
If the AMOUNT PAST DUE is greater than $0.00 then
while there are LOAN ACCOUNT NUMBERS for the CUSTOMER NAME do the following:
sum the OUTSTANDING LOAN BALANCES
sum the MINIMAL PAYMENTS
sum the PAST DUE AMOUNTS
report the CUSTOMER NAME, LOAN ACCOUNT on OVERDUE CUSTOMER, LOAN ANALYSIS

Takes some effort to specify, not very readable, too close to an implementation

Another Example

```
do while there are more staff in the list
    calculate staff bonus
    store bonus amount
    begin case
     case bonus > £250
          add name to StarOfTheMonth list
     case bonus < £25
          print warning letter
    end case
end do
```


Some Rules for Structured English

- Use only nouns and terms defined in the project dictionary
- Avoid compound sentences because they can be highly ambiguous
- Avoid undefined adjectives and adverbs (such as "good", "nice" etc.) unless if clearly defined in the dictionary in terms of value ranges (e.g., "good" ↔ 65-75%)
- Avoid language that destroys the natural flow of control within the process (i.e., goto's)
- Use a limited set of flow constructs, such as sequencing, if-then-else, while do etc.

Decision Tables

- If there are n parameters (or, **conditions**) to a decision, each of which can take k_1, k_2,...k_n values, then make up a table with k_1 * k_2 *... * k_n columns and as many rows as there are possible actions (or, **outcomes**).
- Consider conditions "married?" and "under 30?", and outcomes "send promotion letter!", "remove from list!":

Married?	**N**	**N**	**Y**	**Y**
Under 30?	**N**	**Y**	**N**	**Y**
Send letter!	**X**	**X**		
Remove from list!			**X**	

Example

- *For example: "If the plane is more than half full and the flight costs more than $350 per seat, serve free cocktails, unless it is a domestic flight. Charge for cocktails in all domestic flights where cocktails are served, i.e., those that are more than half full"*

conditions	**Domestic?**	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**N**	**N**
	≥ half full?	**Y**	**Y**	**N**	**N**	**Y**	**Y**	**N**	**N**
	≥ $350/seat?	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
outcomes	**Serve cocktails**	**X**	**X**			**X**	**?**	**?**	**?**
	Free cocktails					**X**			

How to Construct Decision Tables

1. Identify all conditions and all outcomes
2. Create the decision table, with one column for each possible combination of condition values and one row for every possible outcome
3. Fill in the table
4. Eliminate ambiguities, uncover cases, contradictions, redundancy

Completion and Simplification of a Decision Table

Completion
(includes additional external input)

Domestic	Y	Y	N	N	N
≥ half full	Y	N	*	Y	N
≥ $350/seat	*	*	Y	N	N
Free cocktails			X		
Charge cocktails	X			X	
No cocktails		X			X

Simplification

Domestic	Y	Y	Y	Y	N	N	N	N
≥ half full	Y	Y	N	N	Y	Y	N	N
≥ $350/seat	Y	N	Y	N	Y	N	Y	N
Serve cocktails	X	X			X	X	X	
Free cocktails					X		X	
Charge cocktails	X	X				X		
No cocktails			X	X				X

Going Places

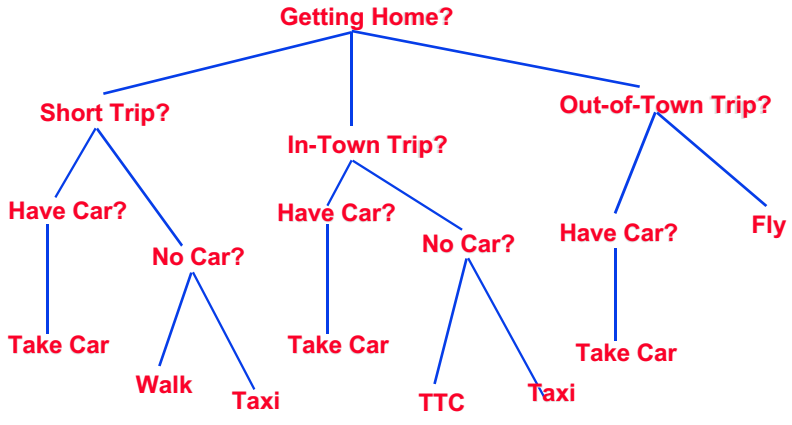
In town?	Y	Y	Y	Y	Y	N	N	N	
Short distance?		Y	Y	Y	N	N	Y	N	N
Good weather?		Y	N	N	*	*	*	*	*
Can afford?		*	Y	N	Y	N	*	Y	N
Walk!	X								
Take TTC!			X		X				
Take taxi!		X		X					
Take train!						X		X	
Fly!							X		

Another Example

Is budget likely to be overspent?	N	Y	Y
Is overspent likely to be over 2%?	*	N	Y
No action!	X		
Write letter!		X	X
Set up meeting!			X

Decision Trees

- *Nodes of a decision tree represent partial outcomes, successors of a node represent mutually exclusive alternatives.*



Decision Trees: An Example

Note: This is a real example (...):

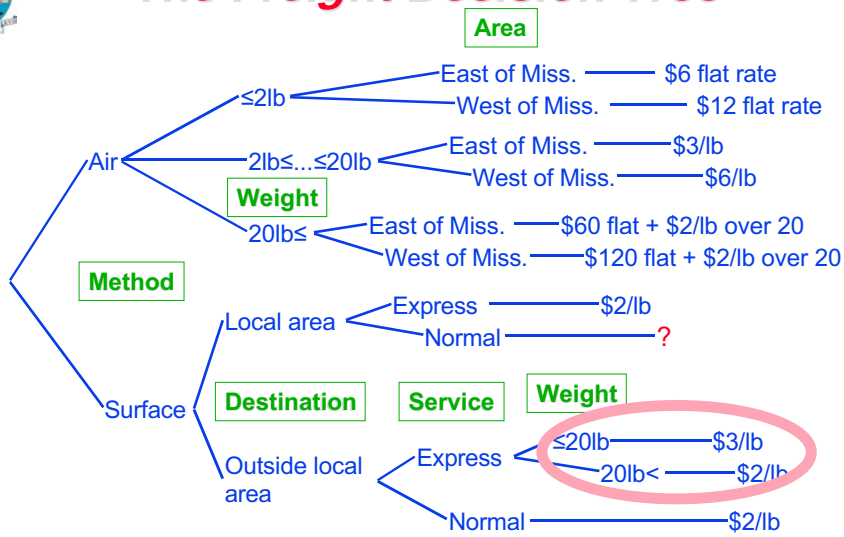
"Air shipping charges are set depending on the weight of a parcel. The basic rate is $3/lb, reducing to $2/lb for excess over 20 lb, with a minimum of $6. Surface freight is $2/lb for express delivery. However, this rate only applies in the local delivery area. If the shipping address is outside the local area and the parcel weighs more than 20lb, or express delivery is not required, the surface rate is the same as for local delivery (express). Normal delivery of packages is $2/lb up to 20lb is $2/lb, with $1 express surcharge (per pound).

Notwithstanding the provisions of the previous paragraph, air freight to destinations west of the Mississippi is charged at double rate"

Clarifications

- ***Question:*** *Is there a difference between freight shipping and handling?*
- ***Answer:*** *No, all rates include freight and handling.*
- ***Question:*** *The description mentions "up to 20lbs" and "over 20lbs". Which rate applies for exactly 20lbs?*
- ***Answer:*** *It's generally understood that "up to 20lbs" means "up to and including 20lbs".*
- ***Question:*** *The fourth sentence could be read in two ways: "both outside the local area and also over 20lbs, or, alternatively, express not required" or "outside the local area and, in addition, either over 20lbs or express not required". Which is correct?*
- ***Answer:*** *The second one.*

The Freight Decision Tree



It costs $57 to send 19lbs outside local area, express, but only $42 to do the same for 21lbs...

Summary

- ***Decision trees*** *are best used with applications involving up to 15-20 outcomes*
- ***Decision tables*** *are more appropriate for problems involving complex combinations of up to 5-6 conditions (but can handle much larger number of outcomes)*
- ***Structured English*** *(and state-oriented models) are most appropriate for problems involving sequential considerations of alternative steps.*

Additional Readings

- *[Yourdon89] Yourdon, E. Modern Structured Analysis. Prentice Hall, 1989.*
- *[Meyer97] Meyer, B. Object Oriented Construction. Prentice Hall, 1997.*
- *[Senn89] Senn, J. A. Analysis & Design of Information Systems. McGraw-Hill, 1989.*