

IX. Business Rules

Business Rules

Structured English

Decision Tables and Decision Trees



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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 ≥ 10 yrs 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(BR6) Before a withdrawal, the balance of the account must be greater than the amount being withdrawn.

(BR7) After the withdrawal, the balance will be equal to the balance before, minus the amount that has been withdrawn.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 pseudo code. 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

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

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” \leftrightarrow 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, \dots, k_n values, then make up a table with $k_1 * k_2 * \dots * k_n$ 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 ≥ half full ≥ \$350/seat	Y Y N N N Y N * Y N * * Y N N
Free cocktails	X
Charge cocktails	X X
No cocktails	X X

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

Simplification

Going Places

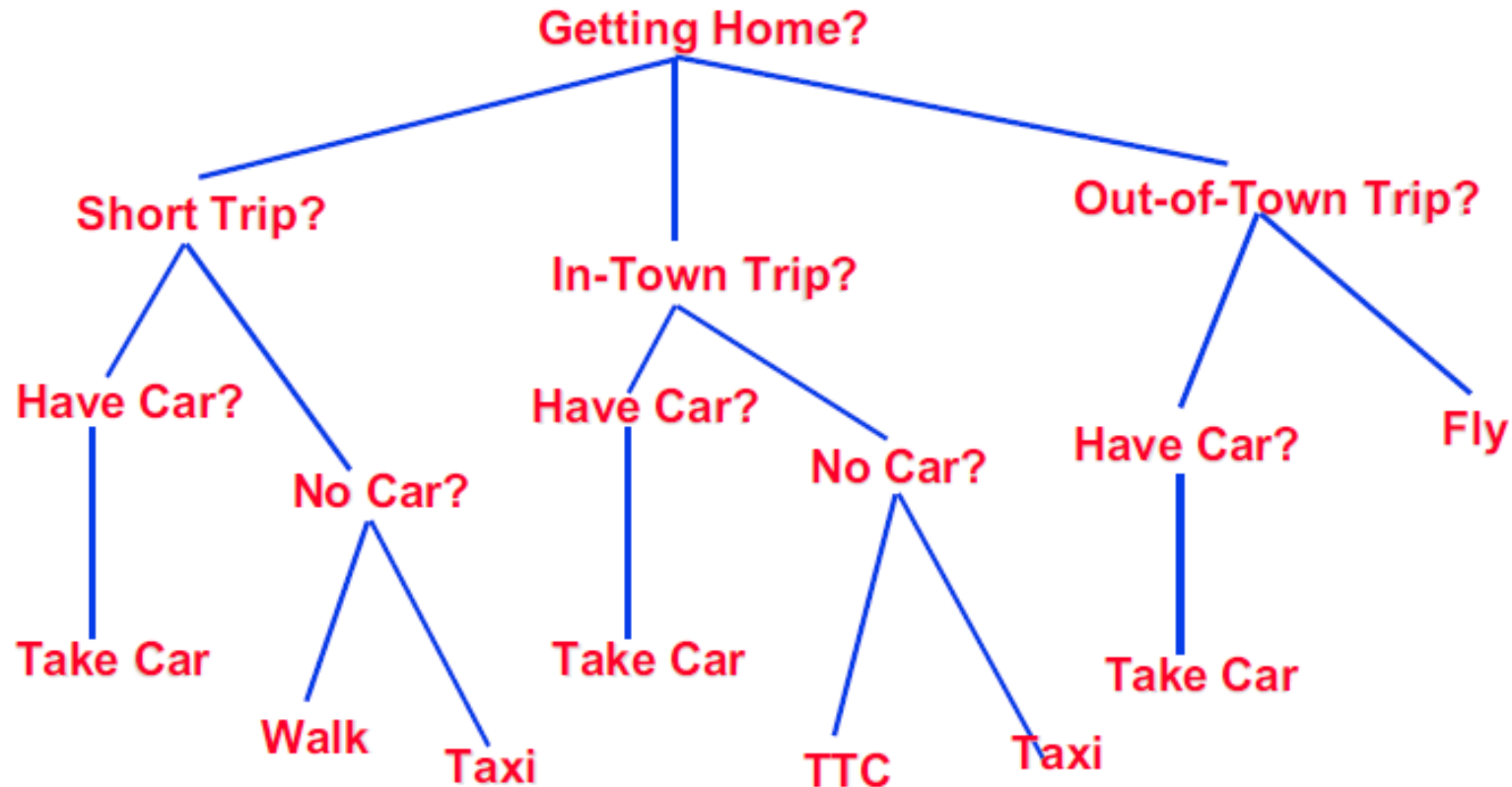
<i>In town?</i>	Y	Y	Y	Y	Y	N	N	N
<i>Short distance?</i>	Y	Y	Y	N	N	Y	N	N
<i>Good weather?</i>	Y	N	N	*	*	*	*	*
<i>Can afford?</i>	*	Y	N	Y	N	*	Y	N
<i>Walk!</i>	X							
<i>Take TTC!</i>			X		X			
<i>Take taxi!</i>		X		X				
<i>Take train!</i>						X		X
<i>Fly!</i>							X	

Another Example

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

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 (...):

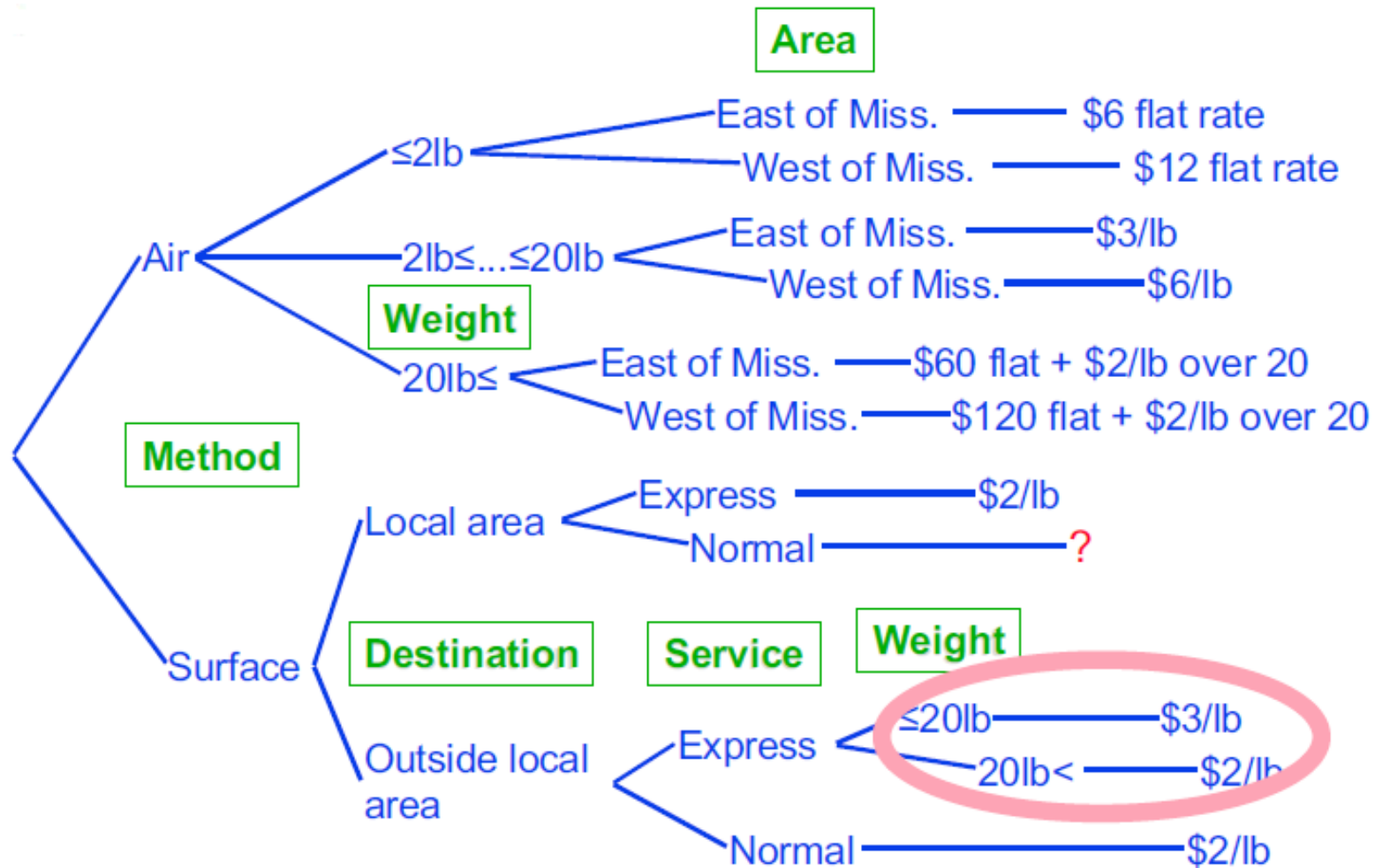
“Air shipping charges are set depending on the weight of a parcel. The basic rate is \$3/lb, reducing to \$2/lb for excess over 20 lb, with a minimum of \$6. Surface freight is \$2/lb for express delivery. However, this rate only applies in the local delivery area. If the shipping address is outside 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.