Validation

Phases to Validation

- Phase I
  - Really is justification
- Phase II
  - Functional validation
  - K-base validation
- Phase III
  - Performance validation

Phase I: Justification

Technical, economic, organizational
>>See first half of course

Phase II: Functional Validation
Validation

Functional Validation (Phase II)

- Takes place throughout the development cycle
- Based on evaluation of actual system to design specifications

Functional Validation (cont2)

- Specifications include:
  - Goals of the expert system
  - System features
  - Method of development
  - Sources of expertise
  - Expected outcomes

Specification Example

<table>
<thead>
<tr>
<th>Rating</th>
<th>OVERALL SYSTEM SPECS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Teaches new assembly technicians to inspect parts.</td>
</tr>
<tr>
<td>5</td>
<td>Advises experienced assembly technicians to inspect parts.</td>
</tr>
<tr>
<td>5</td>
<td>The expertise domain is sufficiently comprehended and bounded.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rating</th>
<th>K-BASE SPECS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Contains rules for all possible characteristics.</td>
</tr>
<tr>
<td>4</td>
<td>Rule Base easily updated.</td>
</tr>
<tr>
<td>1</td>
<td>Fields questions outside of the domain.</td>
</tr>
<tr>
<td>4</td>
<td>Explains why a conclusion is reached.</td>
</tr>
<tr>
<td>1</td>
<td>Addresses confidence levels.</td>
</tr>
</tbody>
</table>

Knowledge Base Validation

- Rule consistency
- Rule completeness
Validation

Rule Consistency

- Redundant rules
- Conflicting rules
- Subsumed rules
- Circular rules

Redundant Rules

Rule 1:
If A = X
and B = Y
Then C = Z

Rule 2:
If A = X
and B = Y
Then C = Z
and D = W

Conflicting Rules

Rule 1:
If A = X
and B = Y
Then C = Z

Rule 2:
If A = X
and B = Y
Then C = W

Subsumed Rules

Rule 1:
If A = X
and B = Y
Then C = Z

Rule 2:
If A = X
Then C = Z
Validation

Circular Rules

Rule 1:
If $A = X$
then $B = Y$

Rule 2:
If $B = Y$
Then decision = yes

Rule 3:
If decision = yes
Then $A = X$

Rule Completeness

• Unreferenced or illegal attribute values
• Unachievable conclusions, premises, or goals

Unreferenced Attribute Values

• Most common error
• Each attribute value must appear in at least one rule's premise clause
• Use an Attribute-Premise matrix to check

Unachievables

• Object does not appear in premise
• Lack of query prompts
• Rules not written to prove object
Validation

Use of Dependency Matrix

<table>
<thead>
<tr>
<th>Premises/Conclusions &gt;&gt;</th>
<th>Rule 1</th>
<th>Rule 2</th>
<th>Rule 3</th>
<th>Query</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rule 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rule 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part II: Performance Validation

Performance Validation (Phase III)

- Types of Errors
- Absolute standards
- Relative criteria
  - Human experts
  - Turing Test
  - Field testing

Performance Validation Procedure

- Run system
- Compare to Absolute Standard
  - Correct Solution?
  - Minimize Errors
- Compare to Human Experts
- Field Test
- Users and Mgmt satisfied?
Validation

Types of Errors

<table>
<thead>
<tr>
<th>Description</th>
<th>System Conclusion</th>
<th>Actual Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1 &quot;False Negative&quot;</td>
<td>Ho is false</td>
<td>Ho is T</td>
</tr>
<tr>
<td>Type 2: &quot;False Positive&quot;</td>
<td>Ho is true</td>
<td>Ho if F</td>
</tr>
</tbody>
</table>

Absolute Standards

- Application
  - Systems that have a finite set of unequivocal outcomes
  - E.g., decision tree based

- Criteria
  - Based on closeness of match to right answer
  - Assumes there is a correct answer for each set of conditions

Evaluation by Human Experts

- Opinion of domain expert(s)
- Opinion of independent expert(s)

Turing Test

- Suggested by Alan Turing (1930's)
- Set-up
  - Human evaluator
  - Set of communication interactions between expert system and user
  - Interface: type screen
  - Q: Computer or human?
Validation

Field Testing

- Application
  - When technically, politically, and organizationally appropriate
- Criteria
  - Satisfaction of users and management