Assessing the Difficulty and Complexity of ELICIT Factoid Sets

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Difficulty due to experience

Target Problem Difficulty

Perceived Problem Difficulty

Setter View

Solver View

Target Solver Experience Factor

Puzzle Category

Actual Solver Experience Factor

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Factoid complexity and problem type

- Complexity
- Nature of the problem/solution
- Data/information relating to the problem/solution
- Problem Type
Area of correlation

Complexity

Problem Type

Simple

Tame

Wicked

Complex
ELICIT Factoids
What is ELICIT?

ELICIT provides an experiential education facility for investigating effects of different structures for information-sharing on problem-solving.

U.S. DoD (OASD/NII) Command and Control Research Program (CCRP) sponsored the design and development of the ELICIT platform for exercises focused on information-sharing and problem-solving.

Principal purpose of ELICIT-related Exercises and Analysis is to investigate the impacts of edge versus hierarchical network structures on problem-solving performance.
Attributes

1. Sharing
   1. Just Factoids
   2. Factoids and guesses
   3. Factoids and sub-answers
   4. Factoids guesses and sub-answers

2. Factoid Content
   1. Just facts that are part of a logical argument
   2. Solutions or sub-solutions
   3. Both

3. Factoid Characterisation
   1. Obvious which sub-solution the Factoid contributes to (including multiple sub-solutions)
   2. Factoid required for non-obvious sub-solution

4. Factoid Distribution
   1. Factoids only distributed to the appropriate sub-solution teams
   2. Factoids distributed to any team

5. Logic
   1. Factoids contain all information required and are unambiguous
   2. Factoids contain all information required and are ambiguous
   3. Factoids do not contain all information required and are unambiguous
   4. Factoids do not contain all information required and are ambiguous

6. Answer
   1. There is a single answer and it is used as the metric.
ELICIT attributes

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Complexity

Problem Type

Area of correlation
What can we change?

- Cannot changed ‘Problem Type’ without major changes to ELICIT and experimental set-up.
- Can change ‘Complexity’.
- Can say something about ‘Experience’.
Parameters

Conceptual level
What is the puzzle ‘big picture’.

Logic level
What logical structure has been employed within each sub-solution.

Factoid level
What is the language used in each Factoid (e.g. clarity/vagueness and categorisation).

Distribution level
How are the Factoids distributed between the players.

Number of Factoids required to deduce sub-solution
Number of relationships between the Factoids
Number of candidate sub-solutions

Positive or negative language
Clarity of Factoid - Defines key or support Factoid?
Single or multiple Factoid Categorisation
Factoid Categorisation not deducible from the Factoid language
Sub-solution within Factoid
Noise Factoids?

Factoids relating to sub-solution sent to appropriate team only
Factoids relating to sub-solution sent to numerous teams
Factoids with non-deducible categorisation sent to other sub-solution team
Key Factoid distribution – but what is a key Factoid?
Conceptual level

<table>
<thead>
<tr>
<th>Logic level</th>
<th>Factoid level</th>
<th>Distribution level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Few logic streams</td>
<td>-ve</td>
<td>Single</td>
</tr>
<tr>
<td>Many logic streams</td>
<td>-ve</td>
<td>Compound</td>
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<tr>
<td>Not applicable</td>
<td>-ve</td>
<td>Multiple</td>
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<tr>
<td>Few Factoids</td>
<td>-ve</td>
<td>Deducible</td>
</tr>
<tr>
<td>Many Factoids</td>
<td>-ve</td>
<td>Not Deducible</td>
</tr>
<tr>
<td>Not applicable</td>
<td>-ve</td>
<td>No sub-sol</td>
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</table>

Experience

<table>
<thead>
<tr>
<th>Appropriate team</th>
<th>Spread between teams</th>
<th>Appropriate team</th>
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<tr>
<td>Appropriate</td>
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Ordered Parameters

**Conceptual level**
1. Mixed logic streams
2. Number of logic streams per sub-solution

**Logic level**
1. Number of Factoids required to deduce sub-solution
2. Number of relationships between the Factoids
3. Number of candidate sub-solution

**Factoid level**
1. Factoid Categorization not deducible from the Factoid language
2. Compound Factoid (or)
3. Clarity of Factoid - Defines key or support Factoid
4. Positive or negative language
5. Compound Factoid (and)
6. Single or multiple Factoid Categorisation
7. Noise Factoids
8. Sub-solution within Factoid

**Distribution level**
- Distribution to teams of Factoids based upon category
- Distribution of non-deducible Factoids
- The order in which the Factoids are distributed
General form common to all the Factoid Sets

<table>
<thead>
<tr>
<th>Key Factoid</th>
<th>Logic Stream of Factoids</th>
<th>Sub-solution</th>
<th>Sub-solution</th>
<th>Sub-solution</th>
<th>Sub-solution</th>
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<tbody>
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## Comparison

<table>
<thead>
<tr>
<th>Factoid Set 1</th>
<th>Factoid Set 2</th>
<th>Factoid Set 3</th>
<th>Factoid Set 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic Streams:</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Factoids per sub-solution:</td>
<td>5,5,5,9 (24)</td>
<td>5,11,8,10 (34)</td>
<td>10,8,14,4 (36)</td>
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<td>Number of relationships:</td>
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<tr>
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<td>16</td>
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<tr>
<td>Factoids per sub-solution</td>
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<td>36</td>
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<tr>
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</thead>
<tbody>
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<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Factoids per sub-solution</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
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<tr>
<td>Number of relationships</td>
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<td>1</td>
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<tr>
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<td>2=</td>
<td>1</td>
<td>4</td>
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<tr>
<td><strong>AL</strong></td>
<td><strong>10</strong></td>
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<td><strong>16</strong></td>
</tr>
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‘Experience’
Why is ‘distribution of Factoids’ a parameter of difficulty?

- Degree of difficulty involves the ‘experimental set-up’.
  - The environment you sit in when you do the exam can make it more difficult.
  - Giving them a calculator can make it easier.
- In the ELICIT experiments the ‘information sharing’ regimes act as the environment in which the problem is being solved.
- When organising the distribution of the Factoids, difficulty can be altered using knowledge of the ‘info sharing’ regimes.
- So – Distribution of factoids acts as an ‘experience’ factor and as such it directly affects the degree of difficulty in problem-solving.
Summary

- A measurement method can be developed for factoids.
- It measures the relative difficulty of problems.
- It is sensitive enough to be used to distinguish between the ELICIT Factoids
  - However, ELICIT in its current form can only deal with ‘tame’ problems.
- The experimental set-up is critical to deriving the difficulty of a problem.
  - And could be used to ‘skew’ the outcome.
- ELICIT could be used to examine different problem types, but the experimental set-up would have to be very different.
  - And some cosmetic changes would be required, eg graphic interface.