Using Mind Mapping to Design Test Cases

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**Speaker Biographical Sketch**

- Senior Research Scientist & Project Manager
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- Guest Researcher
  Computer Security Division
  National Institute of Standards and Technology (NIST)

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- Secretary, ACM SIGAPP (Special Interest Group on Applied Computing)

- Founder & Steering Committee Chair for the SERE conference
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**Test Generation**

Program Specifications

\[\rightarrow\] Clues

\[\downarrow\] Test requirements

\[\downarrow\] Test specifications

\[\rightarrow\] Test driver

\[\downarrow\] Program

\[\text{Expected behavior}\]

Program output is correct

\[\text{Actual behavior}\]

Program execution failed; make a note and proceed with testing or get into the debugging mode.

Using Mind Mapping to Design Test Cases (© 2013-2015 Professor W. Eric Wong, The University of Texas at Dallas)
A mind map is a diagram used to visually outline information.
- It is often created around a single word or text, placed in the center, to which associated ideas, words, and concepts are added.

Elements of a mind map
- arranged intuitively according to the importance of the concepts
- classified into groups, branches, or areas
- aimed at representing semantic or other connections between portions of information

Mind maps can be used to generate, visualize, structure, and classify ideas.
**Mind Map: An Example (1)**

- Using a mind map to classify the months of a year
Mind Map: An Example (2)

- Using a mind map to classify the months of a year
• Suppose we have a computer program to compute the cost of each phone call, using the following scheme

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Evening/Weekend</th>
<th>Time unit (second)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>$0.05</td>
<td>$0.01</td>
<td>1</td>
</tr>
<tr>
<td>International</td>
<td>$1.00</td>
<td>$0.30</td>
<td>20</td>
</tr>
</tbody>
</table>

– If an invalid country code or an invalid phone number is used, there will be no charge
– If no country code is given or it equals “USA”, then the charge is based on a *domestic* call
– If the country code equals “Canada,” “Mexico,” or “Brazil,” then the charge is based on an *international* call.
– If the country code equals any other valid country names, the call cannot go through and there will be no charge
– The duration of each call is rounded up to the next highest time unit
The maximal duration of each call is 24 hours
- 86,400 units for a domestic call
- 4,320 units for an international call
- The “evening” rate applies between 8 pm and 6 am
- The “weekend” rate applies on Saturday and Sunday
- .............
**Test Generation using Mind Map (3)**

- Build a mind map

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**Invalid phone number**
- **Exceed time limit**
- **Bad country code**
  - **Country code (not supported)**
  - **Invalid country code**
    - **Canada**
    - **Mexico**
    - **Brazil**

**Duration**
- **Less than 1 second**
  - **1 second**
  - **1 – 20 second**
  - **20 – 40 second**
  - **10 minutes**
  - **24 hours**

**Price**
- **Good Calls**
  - **Destination**
    - **International**
    - **Domestic**
  - **Rate**
    - **Weekend**
    - **Weekday**
  - **Standard**
  - **Evening**
Test Generation using Mind Map (4)

- Create equivalence classes based on a mind map
  - Phone number:
    - {valid phone number}, {invalid phone number}
  - Country code:
    - {invalid country code}, {valid country code (supported)}, {valid country code (not supported)}, {no country code}, {USA}
  - Rate
    - {Weekday, Standard}, {Weekday, Evening}, {Weekend}
  - Duration
    - {less than 1 second}, {1 second}, {1 – 20 seconds}, {20 – 40 seconds}, {40 seconds – 10 minutes}, {10 minutes to 24 hours}, {24 hours}

- Apply unidimensional or multidimensional partitioning for test generation
Test Generation using Mind Map (5)

- Mind maps provide a visualization approach to classify the input domain.
- It can be easily combined with
  - ECP (Equivalence Class Partitioning)
  - BVA (Boundary Value Analysis)
  - etc.
**Tool Support**

- There are tools to help users generate mind maps
  - CAM editor ([http://www.cameditor.org](http://www.cameditor.org))
  - Docear ([http://www.docear.org/](http://www.docear.org/))