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Motivations:

- Each type of emergency responder usually responds to a disaster according to its professional responsibilities
- Conflicting objectives
- Various data sources with different formats and scales

Data:

- Census data
- Twitter data
- Flood hazard map
- NOAA storm events database
CyberGIS is Geographic Information Science and Systems based on advanced cyberinfrastructure.

Cyberinfrastructure includes:
- High-performance computing systems
- Data storage systems
- Advanced instruments
- Data repositories
- Visualization environments
- People
- Linked by high speed networks
Motivation

Concept

Research Questions

Method

Results

Future Work

CyberGIS

Data and Knowledge

Geospatial Middleware

Visualization

User Centric

Parallel and Distributed Processing

Component-Based

Spatial

Computational Intensity

Analysis

Cyber

Infrastructure

Systems

Provenance-Aware Workflow

High-Performance Computers (HPC)

Virtual Organization

Collaborative Problem-Solving

Service-Oriented
Intelligent Decision Support System - An Expert System Workflow

**Decision Goal 1**: which area should a rescue personnel go to first in order to save more lives?

**Decision Goal 2**: which area had the most significant economic loss and needs the greatest financial support to recover from a flooding event?
Social Media Data Analysis

Step 1
- 18,382 I
- 16,581 to
- 15,493 the
- 13,626 a
- 11,868 in
- 8,893 and
- 8,499 my
- 8,486 you
- 8,404 @
- 8,399 for
- 8,384 at
- 6,776 I’m
- 6,725 of
- 6,666 is
- 6,592
- 6,266

Step 2
- Normalized number of Tweets
- Number of Tweets
- Number of Flood

Step 3
- Map with markers
- Text: Helicopters & Ambulances Had To a Rescue 3 The People From The Flood Already #NoBeuno

Motivation
Concept
Research Questions
Method
Results
Future Work
## Multi-Criteria Decision Making: Weighted Sum Model

### ALTERNATIVE

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>CRITERIA (NORMALIZED)</th>
<th>TOTAL SCORE (weighted sum model)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C₁</td>
<td>C₂</td>
</tr>
<tr>
<td>Audi A4</td>
<td>a₁₁</td>
<td>a₁₂</td>
</tr>
<tr>
<td>Toyota Camry</td>
<td>a₂₁</td>
<td>a₂₂</td>
</tr>
</tbody>
</table>

### Decision Making

- **Cost Effectiveness**
- **Reliable**

### Method

- **Cost**
- **Effectiveness**

### Results

- **Weight**
  - W₁
  - W₂
  - W₃
  - W₄

### Future Work
## Multi-Criteria Decision Making: TOPSIS Model

### Decision Maker
- Cost Effectiveness
- Reliable

### Table of Alternatives and Criteria

<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>CRITERIA (NORMALIZED)</th>
<th>POSITIVE SEPARATION</th>
<th>NEGATIVE SEPARATION</th>
<th>TOTAL SCORE TOPSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C₁</td>
<td>C₂</td>
<td>C₃</td>
<td>C₄</td>
</tr>
<tr>
<td>Repair Cost</td>
<td>Price</td>
<td>Make</td>
<td>Miles Driven</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>W₁</td>
<td>W₂</td>
<td>W₃</td>
<td>W₄</td>
</tr>
<tr>
<td>Audi A4</td>
<td>V_{11}=a_{11}*W₁</td>
<td>V_{12}</td>
<td>V_{13}</td>
<td>V_{1j}</td>
</tr>
</tbody>
</table>

---

**Notes:**
- The table above illustrates a Multi-Criteria Decision Making (MCDM) approach using the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) model.
- Alternatives are compared based on criteria such as Repair Cost, Price, Make, and Miles Driven.
- Weighting factors (W₁, W₂, W₃, W₄) are assigned to each criterion.
- The TOPSIS model calculates the positive and negative separations to determine the total score.
User Interface
## Results

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Decision goal 1</th>
<th>Decision goal 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>74</td>
<td>83</td>
</tr>
<tr>
<td>People over 75 years old</td>
<td>87</td>
<td>70</td>
</tr>
<tr>
<td>People without health</td>
<td>60</td>
<td>82</td>
</tr>
<tr>
<td>insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>People in poverty</td>
<td>63</td>
<td>83</td>
</tr>
<tr>
<td>Minority group</td>
<td>60</td>
<td>68</td>
</tr>
<tr>
<td>Area median house value</td>
<td>47</td>
<td>66</td>
</tr>
<tr>
<td>Education attainment</td>
<td>41</td>
<td>56</td>
</tr>
<tr>
<td>Number of children</td>
<td>93</td>
<td>79</td>
</tr>
<tr>
<td>People without a vehicle</td>
<td>78</td>
<td>58</td>
</tr>
</tbody>
</table>
## Sensitivity Analysis

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Objective 1 (Rank of Criticality Degrees of the Criteria)</th>
<th>Objective 2 (Rank of Criticality Degrees of the Criteria)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOPSIS</td>
<td>WSM</td>
</tr>
<tr>
<td>Total population</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>People over 75 years old</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>People without health insurance</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>People in poverty</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>People in a minority group</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Area median house value</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Education attainment</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Number of children</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>People without a vehicle</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
### Model Validation

<table>
<thead>
<tr>
<th>Blocks</th>
<th>WSM Model</th>
<th>TOPSIS Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Objective 1</td>
<td>Objective 2</td>
</tr>
<tr>
<td>1</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>4</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>7</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>8</td>
<td>0.3</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>10</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Average Error</strong></td>
<td><strong>0.44 (44%)</strong></td>
<td><strong>0.24 (24%)</strong></td>
</tr>
</tbody>
</table>
1. Developed a decision support tool that combines high-performance geospatial computing, advanced decision-making techniques, and various types of social indicators for flood hazard management.

2. The major objective is to create a program that allows for better communication between citizens and emergency management and provides consistent results.

3. Twitter text mining techniques can be used to categorize tweets in order to support different types of decision problems.

5. More indicators such as income status of the family, family structures, and housing characteristics should be included in order to make the framework more useful for different kinds of disaster scenarios.
Thank You!
Questions?

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