Evaluating the Relationships between User Interaction and Financial Visual Analysis

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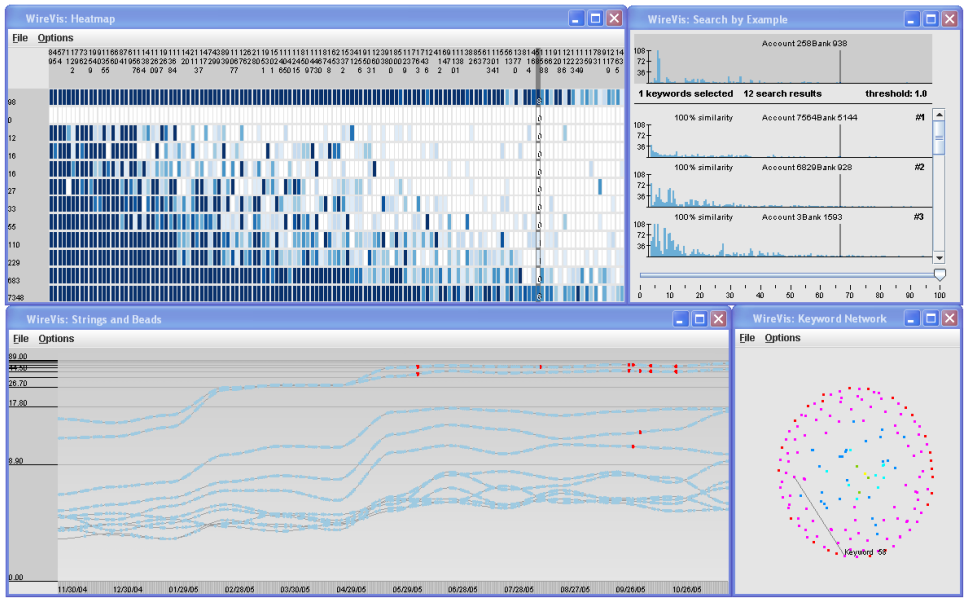
Last Year This Time…

- I presented our work on WireVis in collaboration with Bank of America (BoA).
  - WireVis is a visual analytical tool for discovering suspicious financial wire transactions.
  - It is scalable and has proven to be useful to the financial analysts at BoA.



WireVis: What It Is and What It Is Not

- What it is…
  - An investigative tool.
  - Interactive, allows exploration.
  - It helps an analyst see overviews, see temporal patterns, and drill-down into specific transactions and examine details.
  - (Without bragging), it is pretty good for what it is designed to do.

- What it is not…
  - It is not an end-to-end system:
    - No evidence collection.
    - Does not externalize the analysts' reasoning processes or the discovered knowledge products (report generation).

What's Next?

- Seems that it's clear what we need to do to improve WireVis.
  - Add a component in WireVis that captures the user's investigation process and assists in report generation…
- But, wait… Let's take a step back.
- I'm lazy… Do I really have to do this?
- What is this component going to accomplish?

What's Next?

- Before we start implementing, let's ask some necessary questions.
- Question 1: Is this component necessary?
  - i.e. Is there something wrong with the current reporting method at BoA?
- Question 2: How do we assist the capturing of the analyst's strategies, methods, and findings during an investigation?
- Question 3: Is our solution better than what they do right now?

Disclaimer

- This is an on-going work, and we are reporting on findings from multiple publications and papers that are **still in submission**.
- Not all findings in this presentation are in the VAST publication.
- Unpublished results will be deliberately kept vague during the talk. But feel free to talk to me afterwards if you are interested in specific details.

Question 1:

What's wrong with the current reporting process?

Question 1:
What do they do now?

- Is there something wrong with the current reporting method?

- What analysts do now:
  - Do analysis
  - Prepare reports
  - Rely on their memory
  - Need to recall strategies, methods, and findings.

Question 1:
Hypothesis and Implications

- **Hypothesis**: Analysts' memories are not 100% reliable.
  - Strategies and methods are dynamic
  - Long, complex analysis

- **Implications:**
  - Resulting reports have errors and gaps.
  - Process cannot be repeated.
  - Diminishes trustworthiness of the analysts and usefulness of the reports.

Question 1: Conclusion

- **Conclusion**:
  - Quantitative and qualitative results are in submission
  - Based on the results of our experiment of real financial analysts
  - Analysts forget their analysis paths.
  - And then they make things up.

- This suggests that
  - Capturing analysis process is necessary
  - Help the recall strategies, methods, and findings.

Question 2:

How do we capture analysts' reasoning processes?

Question 2: Related Work

- Related Work:
  - Papers this year in InfoVis and VAST.
  - Use visualization to communicate user history
    - Chimera – Kurlander and Feiner. UIST. 1992
    - Visage – Derthick and Roth. Knowledge-Based Systems. 2001
    - VisTrails – Bavoil et al. Visualization. 2005
    - Capturing User Interactions – Jankun-Kelly and Ma. TVCG. 2007
    - Graphical Histories – Heer et al. InfoVis. 2008
  - **Problem**: **User history = Reasoning process?**
  - Externalizing the user's reasoning process
    - GlassBox. Greitzer. PNNL. 2005
    - Aruvi – Shrinivasan and van Wijk. CHI. 2008
    - Scalable Reasoning System – Pike et al. HICSS 2007 (VAST 2008).
  - **Problem: Too low level, or too labor-intensive**.

Question 2:
Related Work (continued)

- Problems with analysts constantly update their reasoning processes (node-link diagram):
  - Lose their focus or concentration
  - Lose the train of thought
  - Analysts often become “zoned in” to what they are doing.
    - Forget to update the reasoning model

- “Transparent” reasoning process capturing?

Question 2:
Hypothesis and Proposal

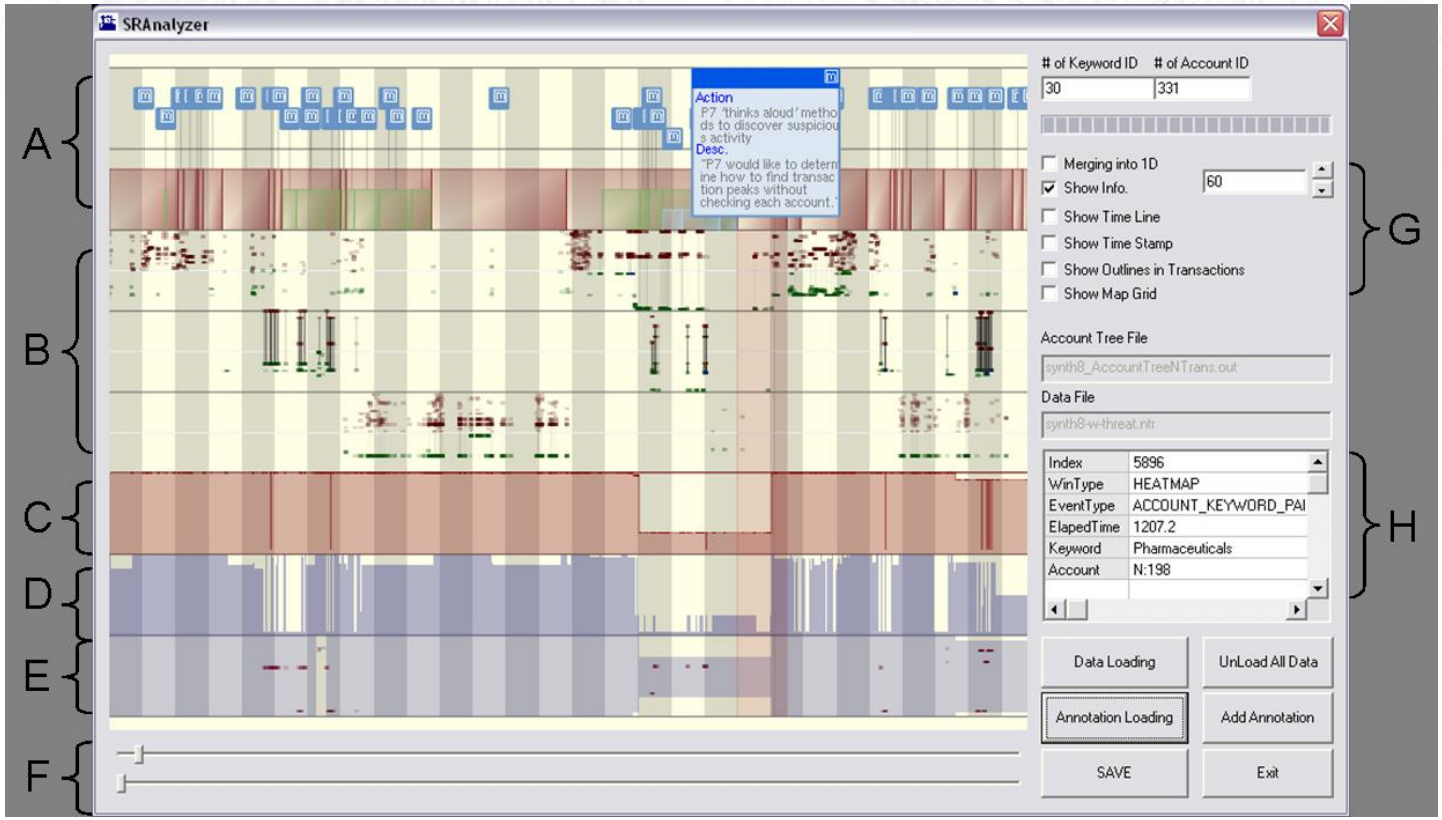
- **Hypothesis**: We can capture the analysts' high-level semantic interaction, and extract the strategies, methods, and findings through examination of interaction logs.
  - Low-level interactions: mouse clicks, window activation, copy, paste, etc.
  - High-level (semantic) interactions: the selected keyword. The transaction being examined.
  - Heer et al. [InfoVis 2008], Gotz and Zhou [VAST 2008]

- **Proposed Solution**: Use visual analytical tools to examine semantic interaction logs!

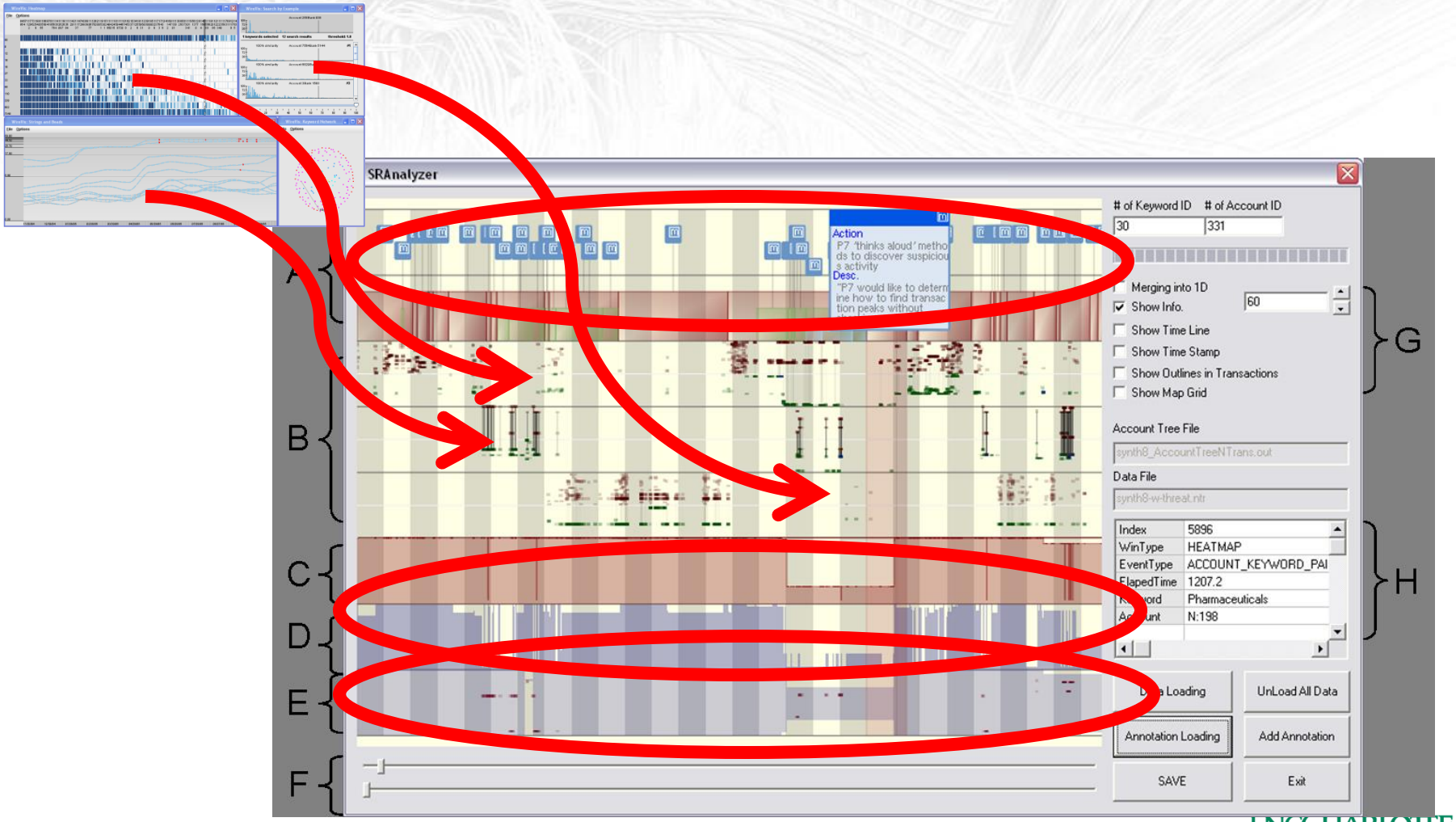
Question 2: Experiment

- Synthetic Data Generation
  - Can't use the BoA data…
  - Had to manually create our own (300+ transactions)
  - Based on the characteristics of real financial transaction data
  - Inserted known threat scenarios
  - This task took forever…
- Experiment
  - 10 participants (visualization students) using WireVis.
  - Capturing high-level (semantic) interaction.
- Two tools to examine semantic interaction logs:
  - Operational Analysis tool
  - Strategic Analysis tool

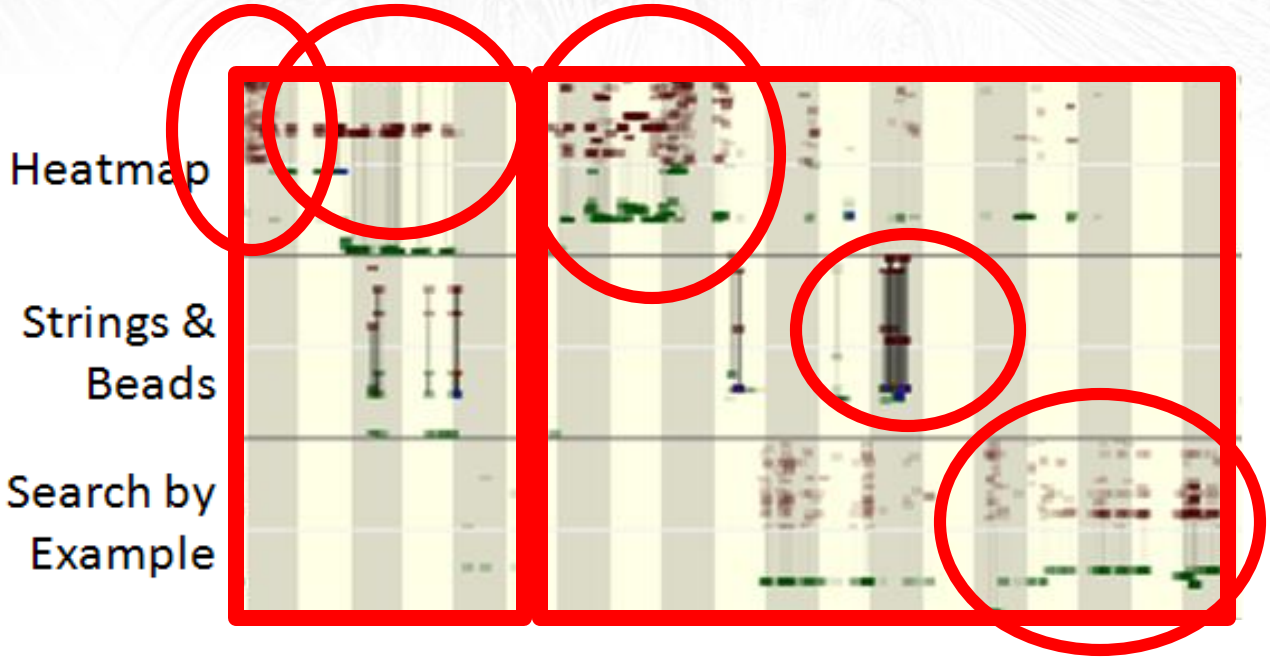
Question 2:
Operational Analysis Tool



Question 2:
Operational Analysis Tool - Design



Question 2:
Operational Analysis Tool - Example



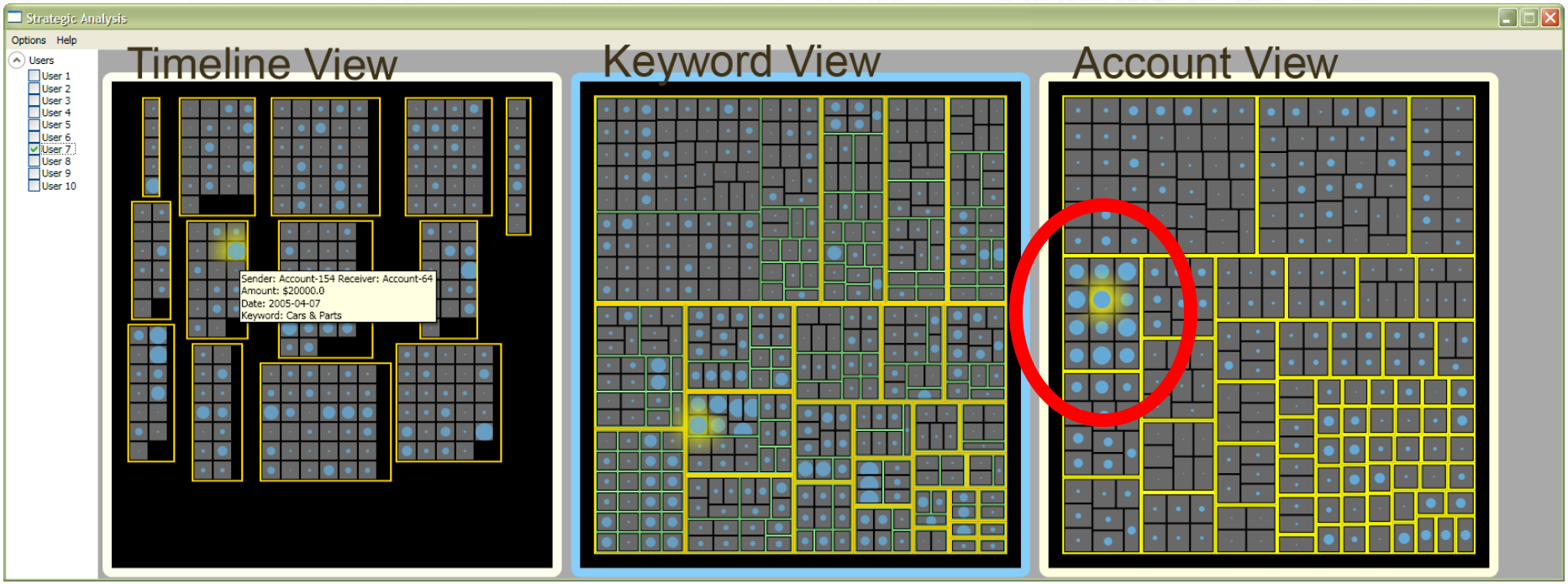
Red dots: Keywords

Green dots: Accounts

Stripped Background: Time (1 minute)

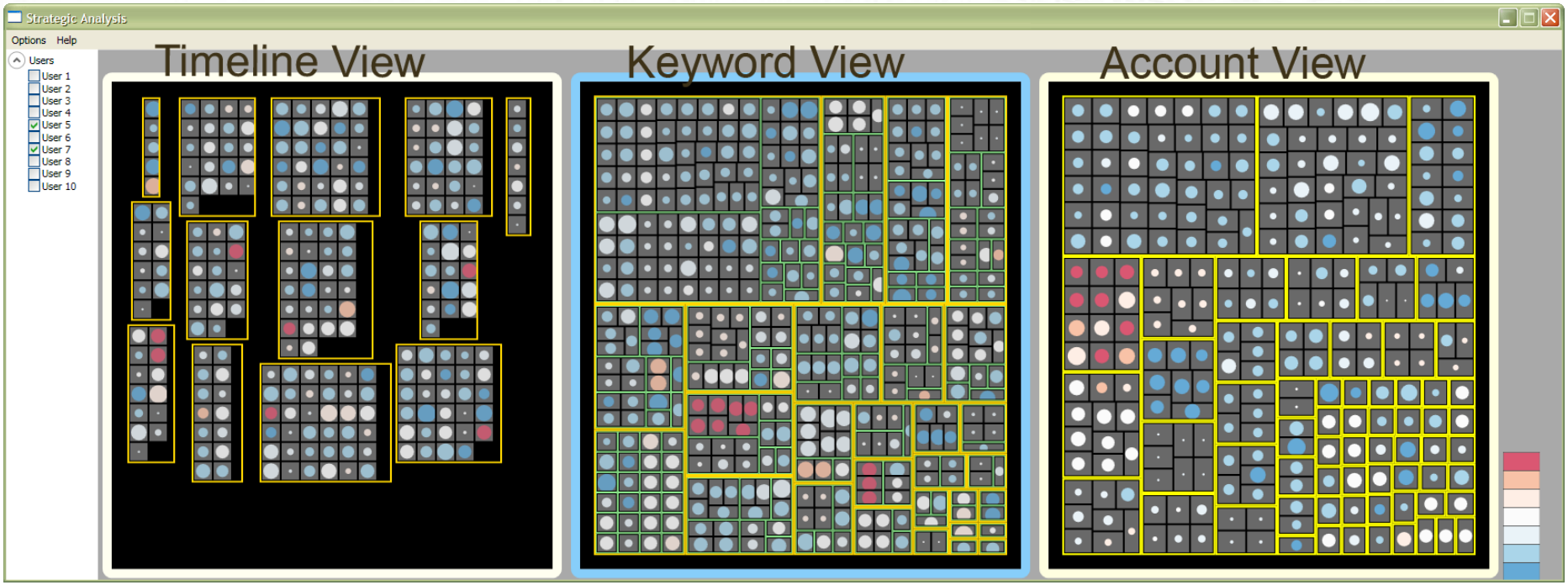
Question 2:
Strategic Analysis Tool

- Size of circle indicates the amount of time spent on that data item.



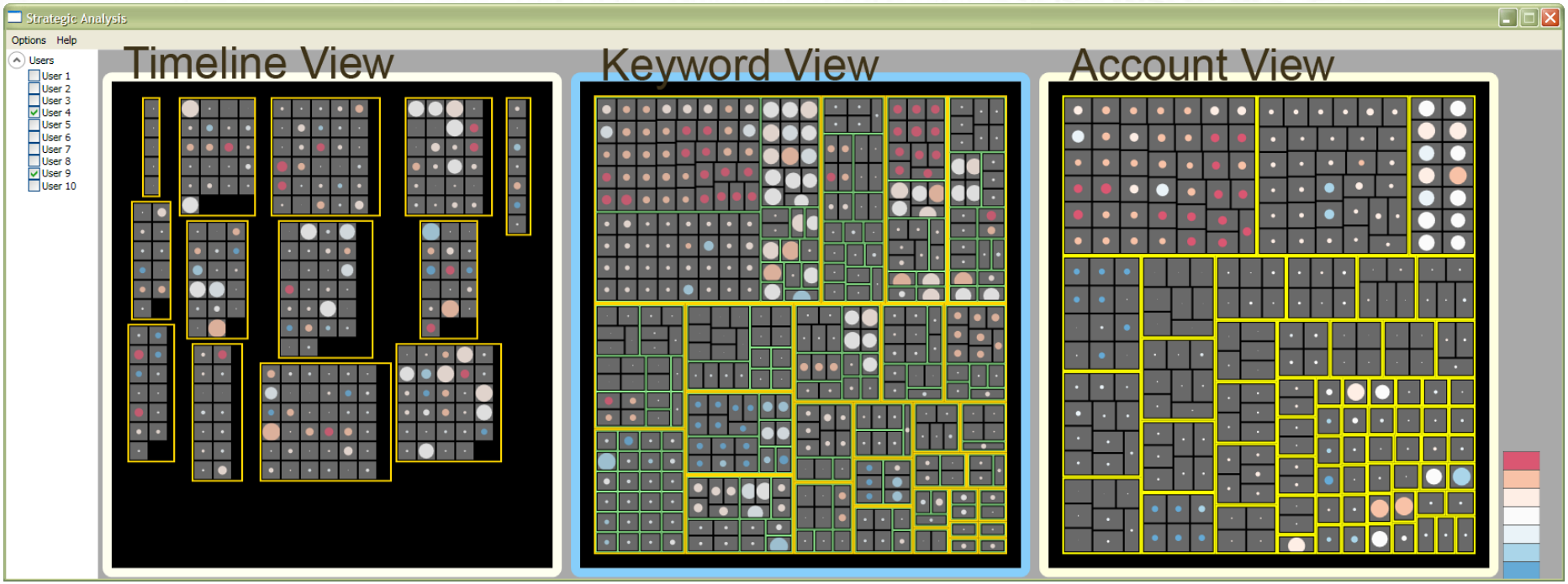
Question 2:
Strategic Analysis Tool - Comparison

- Comparing strategies of two users
  - Different strategies



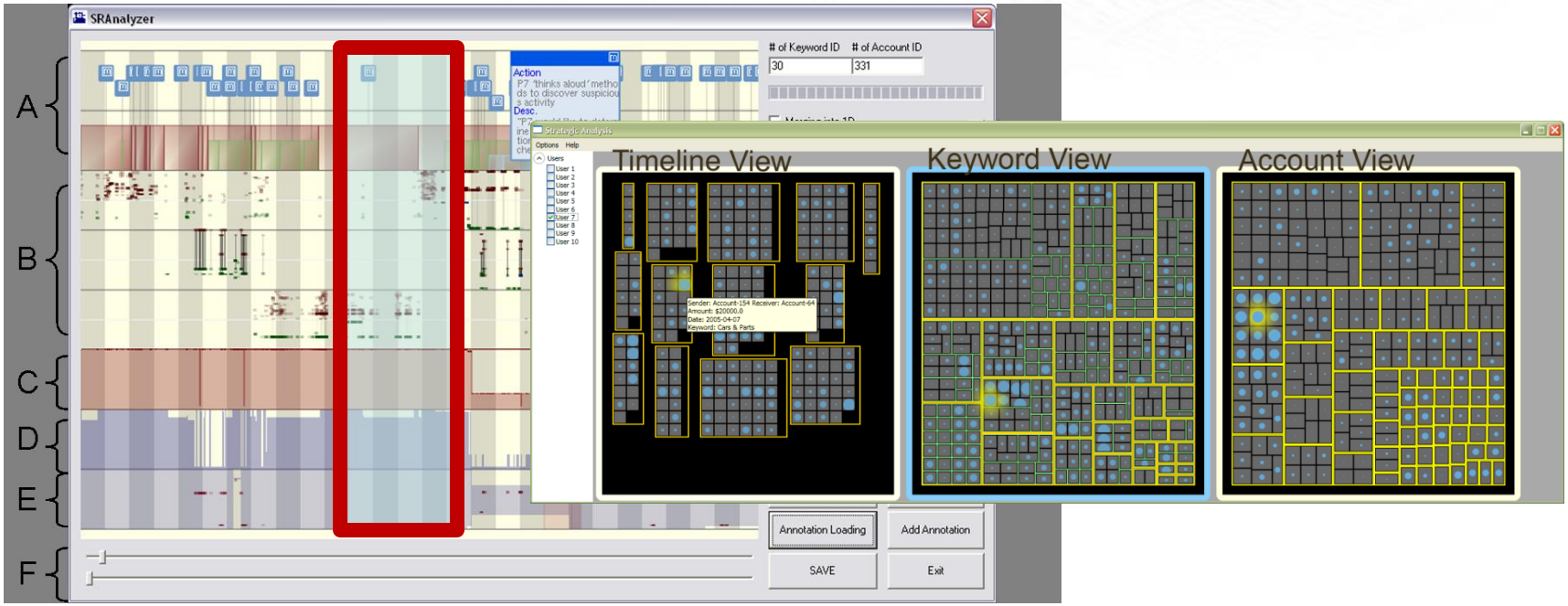
Question 2:
Strategic Analysis Tool – Comparison (continued)

- Comparing strategies of two users
  - Similar strategies



Question 2:
Operational + Strategic Analysis Tools

- Integration…
  - Brushing Time



Question 3:

How effective is this method and the tools?

Question 3:
Claim and Hypothesis

- Claim:
  - Capture high-level (semantic) interaction
  - Use Operational and Strategic Analysis tools
  - We can extract strategies, methods, and findings!

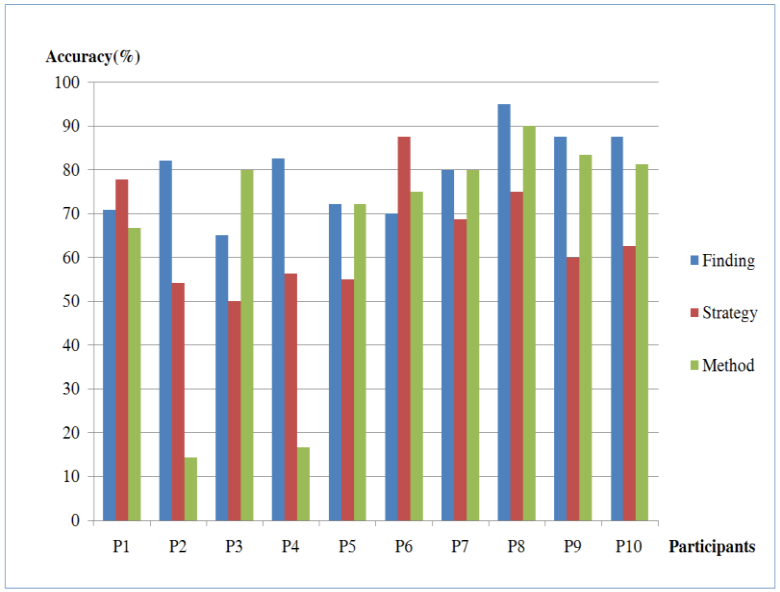
- But really, how good is this?

- **Hypothesis**:
  - A good amount can be recovered…
  - But not 100%.

- Experiment with 10 financial analysts
- Their interaction logs were examined by visualization students.

Question 3: Results

- On average, between 60-80% of findings, strategies, and methods are recovered.
  - Quantitative and qualitative results are in submission
- Learning effect: (stats. significant)
  - More experience = better results.
  - Extracted reasoning artifacts are not random or by chance.
  - Reasoning process extraction is a trainable skill.



Conclusion and Future Work

Conclusion

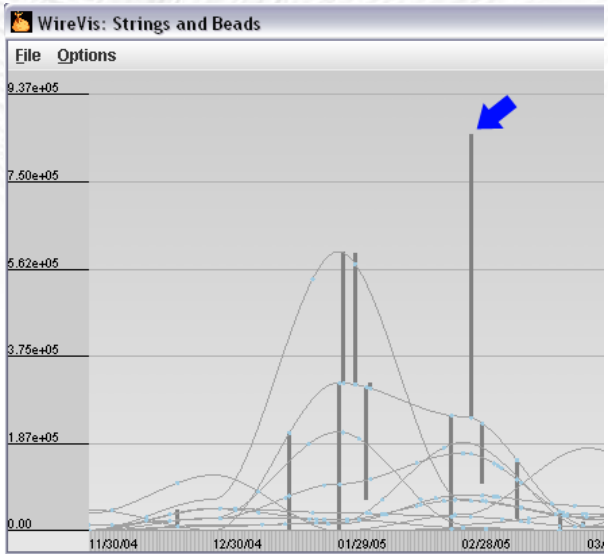
- **Question 1**: Is here something wrong with the current reporting process?
  - Answer: Yes, analysts' memories are not reliable.

- **Question 2**: How do we capture and extract reasoning processes?
  - Answer:
    - Do this transparently.
    - Capture high-level (semantic) interactions in the visualization
    - Examining the interaction logs using visual analytical tools.

- **Question 3**: How effective are these capturing tools?
  - Answer: Pretty good - between 60-80%.

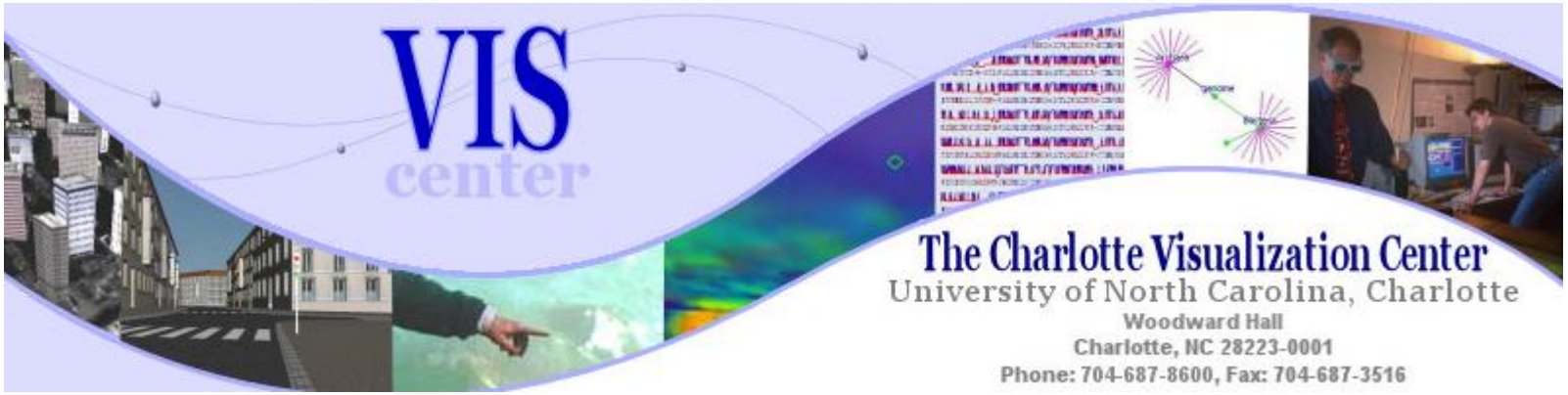
Future Work

- Why only 60-80%?
  - Not all analysis appears in interaction logs.
  - Understanding of perception is necessary.
  - Analysis in the analyst's head
  - Implies that an entirely transparent approach is insufficient…
- Assist report generation…



Questions?

- Thank you!



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Backup Slides

Future Work Ideas

- Different apps?
- Integrate reviewing of videos?

Question 1: (continued)
What's wrong with the current reporting process?

- So, how accurate are the analysts' memories of investigations?

- Found out that they can remember their initial strategies, but:
  - Have trouble if the strategies morph, and
  - cannot remember most of the methods used in implementing the strategies.
  - Implies that the reports that analysts create today are not reproducible because they contain gaps and errors.

Question 3: (continued)
How effective are these capturing tools?

- **Experiment**:
  - We asked 10 financial analysts to perform fraud detection
  - These analysts have an average of 9.9 years in financial analysis from major banks and financial institutions in Charlotte.
  - The interactions of the financial analysts were recorded as explained earlier.
  - We then recruited 4 “coders” (students in visualization)
    - We asked them to use the Strategic and Operational Analysis tools to examine the 10 analysts’ interaction logs
    - They were asked to write down what they thought were the analysts’:
      - Strategies, Methods, and Findings
  - We then compared what the coders wrote down with what the analysts did.