Visual Analytics for Temporal Event Sequence Recommendation

Fan Du, Catherine Plaisant, Neil Spring, Ben Shneiderman
University of Maryland
Scenario: Student Advising

What should I do?

2nd year PhD student
Want a faculty job

What jobs did other students get?

What did those who became professors do?

Internships? Papers? Teaching? How Many & When?

Meet with Advisors
Scenario: Student Advising

Prof. A: Department policy requires you to...

Prof. C: Several of my students got faculty jobs...

Prof. B: Publications are most important...

Are these recommendations suitable for me?
EventAction Workflow for Student Advising

<table>
<thead>
<tr>
<th>Scenario</th>
<th>EventAction</th>
<th>Evaluation</th>
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<tbody>
<tr>
<td></td>
<td>1. Find <strong>Similar</strong> Archived Students</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Explore Potential <strong>Outcomes</strong></td>
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<td></td>
<td>3. Review <strong>Activity</strong> Patterns</td>
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<td>4. Make &amp; Tune <strong>Action Plan</strong></td>
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- Campus Archives
# Potential Applications

<table>
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<tr>
<th><strong>Scenario</strong></th>
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## Potential Applications

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**EventAction Demo**

### Current Student

<table>
<thead>
<tr>
<th>Ref.</th>
<th>All</th>
<th>Show</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similar</td>
<td></td>
<td></td>
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</tbody>
</table>

### Activities of those who became Acad. Post.

- Advanced course
- Award
- Core course
- Internship
- Paper
- Pick advisor
- RA
- Start
- TA

###評価

- 2014-1
- 2016-1
- 2017-1
- 2018-1

### Outcome Distribution

- Acad. Post.
- Engineer
- Ind. Post.
- Asst. Prof.

Unknown outcome: 5% of all archived students

### Similar Archived Students

<table>
<thead>
<tr>
<th>Similar Archived Students</th>
<th>Show Only Acad Postdoc</th>
<th>Hide Privacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>148</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td></td>
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</tbody>
</table>

### Correlation

- Advanced course
- Award
- Core course
- Internship
- Paper

### Similarity Distribution

- Most similar: 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5
- Least similar: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5

- All Archived Students: 500
- Similar Archived Students: 148
- Similar & Became Acad. Post.: 33
- Sampling Fraction: 30%
- Avg. Distance of Similar: 2.87
# Exploratory Evaluation

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<td>Advisor</td>
<td>exploring alone</td>
</tr>
<tr>
<td>Advisor</td>
<td>guiding students</td>
</tr>
<tr>
<td>Students</td>
<td>alone</td>
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**Professor** who manages the computer science department’s review of graduate student progress

Three computer science **students**
User: Advisor

**Scenario**

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**User: Advisor**

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**Three 2-Hour Sessions** (using a real dataset of 520 archived records):

- **Session 1** (advisor alone)
  - Check if the students’ performance matched the *department’s expectations*

- **Session 2** (advisor and student)
  - A third-year PhD student served as the advisee and *made a plan* with the advisor

- **Session 3** (advisor and student)
  - A student needs help with both *determining a goal* and *making a plan*
## Results

### Session 1

A few students had “start school” events in the 3rd year. The most common time for **advancing to candidacy** was the 4th year instead of the 5th (*department deadline*) or the 6th (*graduate school deadline*).
Results

Session 1
A few students had “start school” events in the 3rd year.
The most common time for advancing to candidacy was the 4th year instead of the 5th (department deadline) or the 6th (graduate school deadline).

Session 2
A plan that increases the student’s likelihood of getting a faculty job by 5%.

Session 3
“If this student’s goal is to become an assistant professor, I would recommend pursuing a postdoc position first.”

Advisor’s Feedback
“Recalling a few memorable prior students and applying the knowledge to advise current students is biased. I tend to trust the data and statistics.”
User: Student

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<td>Three computer science students</td>
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**Study Process**

Imagine the selected *current students* were them

Use EventAction to **make a plan** to increase the likelihoods of achieving their *desired outcomes*

Report their *difficulties* and any *findings* of interest
EventAction is easy to learn and the data-driven approach is appreciated

“I know things that are green in the timeline are important and need to pay attention to.”

“The correlation view tells me what to do and the activity summary view tells me when to do.”

“The feedback enable me to make and compare alternative plans.”

“I appreciated that EventAction is evidence based. It is easy to understand.”
Similarity Measure

Current Record

1. Find Similar Archived Records

2. Explore Potential Outcomes

3. Review Recommended Actions

4. Review and Tune Plans

Action Plan
Similarity Measure

**Similarity Measure**

- Research (Data Mining)
- Job (Interview)
- Classmate
- Research (Bioinformatics)
- Hobby (Baseball)
- Hobby (Golf)

**Generalizability**

**Ethical Issues**

- Louisiana
- Missouri
- South Carolina
- South Dakota
Similarity Measure

Current Student’s Timeline

- Advanced course
- Award
- Core course
- Internship
- Paper
- Pick advisor
- RA
- Start
- TA

# of Events

Similarity Measure

Generalizability

Ethical Issues
## Generalizability

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<tr>
<td>Advanced course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Award</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internship</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
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<tr>
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<td></td>
<td></td>
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<tr>
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### Similar Length
- Advanced course
- Award
- Core course
- Internship
- Paper
- Pick advisor
- RA
- Start
- TA

### Small # of Event Categories
- Advanced course
- Award
- Core course
- Internship
- Paper
- Pick advisor
- RA
- Start
- TA

### Semester Time Buckets
- Advanced course
- Award
- Core course
- Internship
- Paper
- Pick advisor
- RA
- Start
- TA
Generalizability

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Ethical Issues

“Presenting data to learners showing poor performance or poor predicted outcomes might be de-motivating for them…that is, it may have the opposite effect than the one intended.”

(comments from Leah Macfadyen)

A person’s trajectory could be unique and never seen in the past.

Archived data from the past may be no longer valid in today’s world.
Conclusion

This talk introduces a data-driven approach that enables analysts to conduct similarity-based action planning.

Future Work
Understand EventAction’s Generalizability
Improve Algorithm and Interface for Finding Similar Records
Compare EventAction to Automated Tools
Visual Analytics for Temporal Event Sequence Recommendation

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For more information, visit hcil.umd.edu/eventaction