EventBreak: Analyzing the Responsiveness of Web Applications

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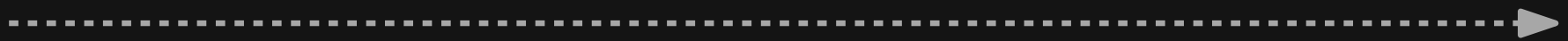
Motivation

Event-based UI applications should be responsive



single thread of execution

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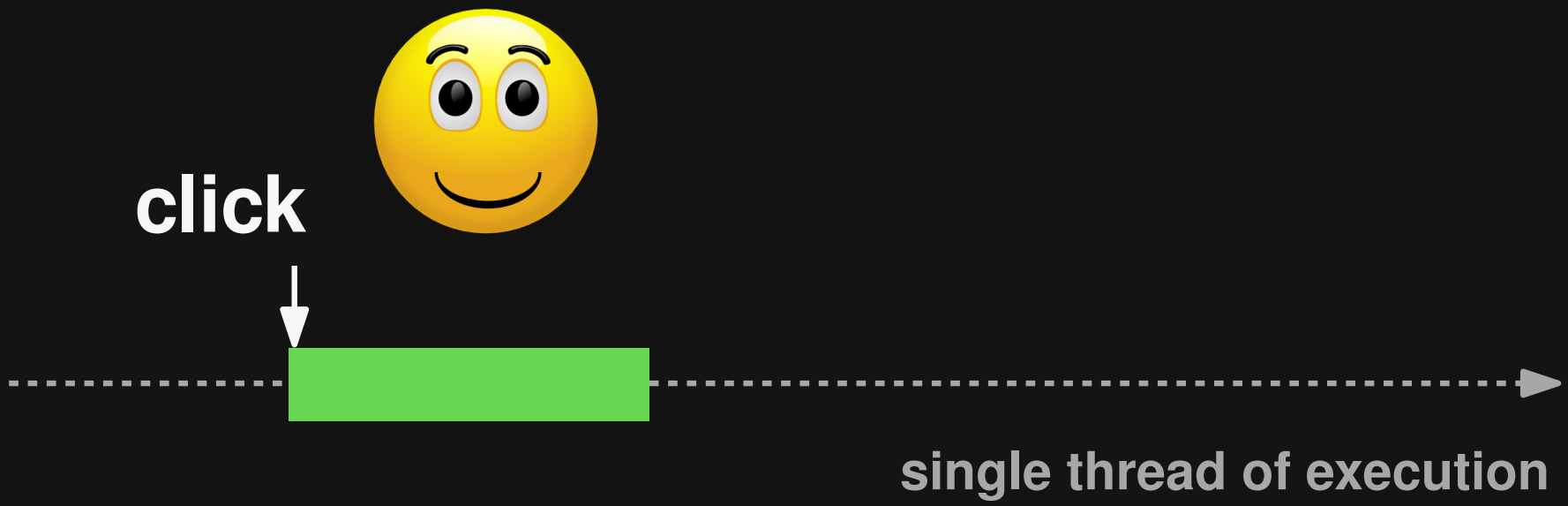

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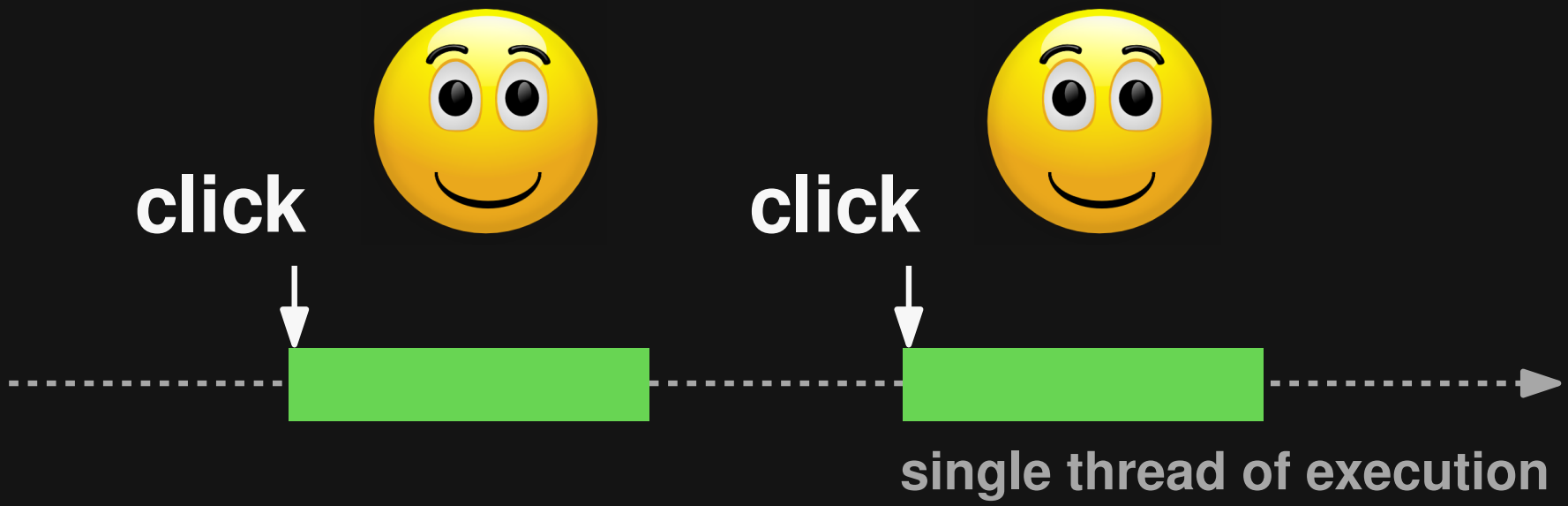

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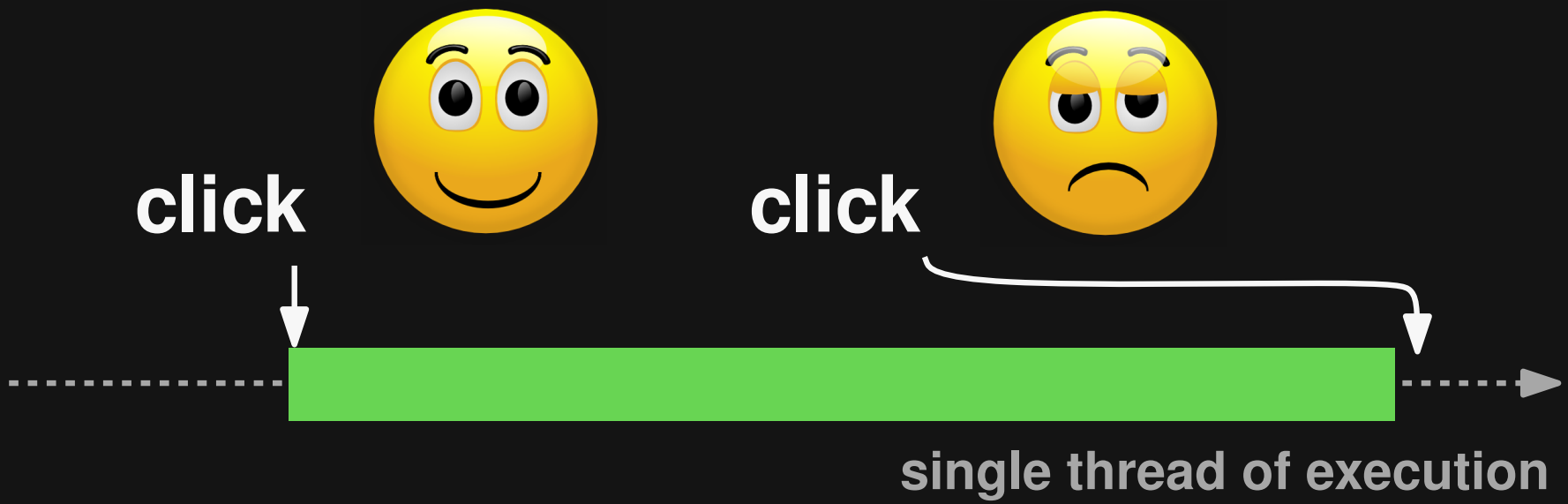

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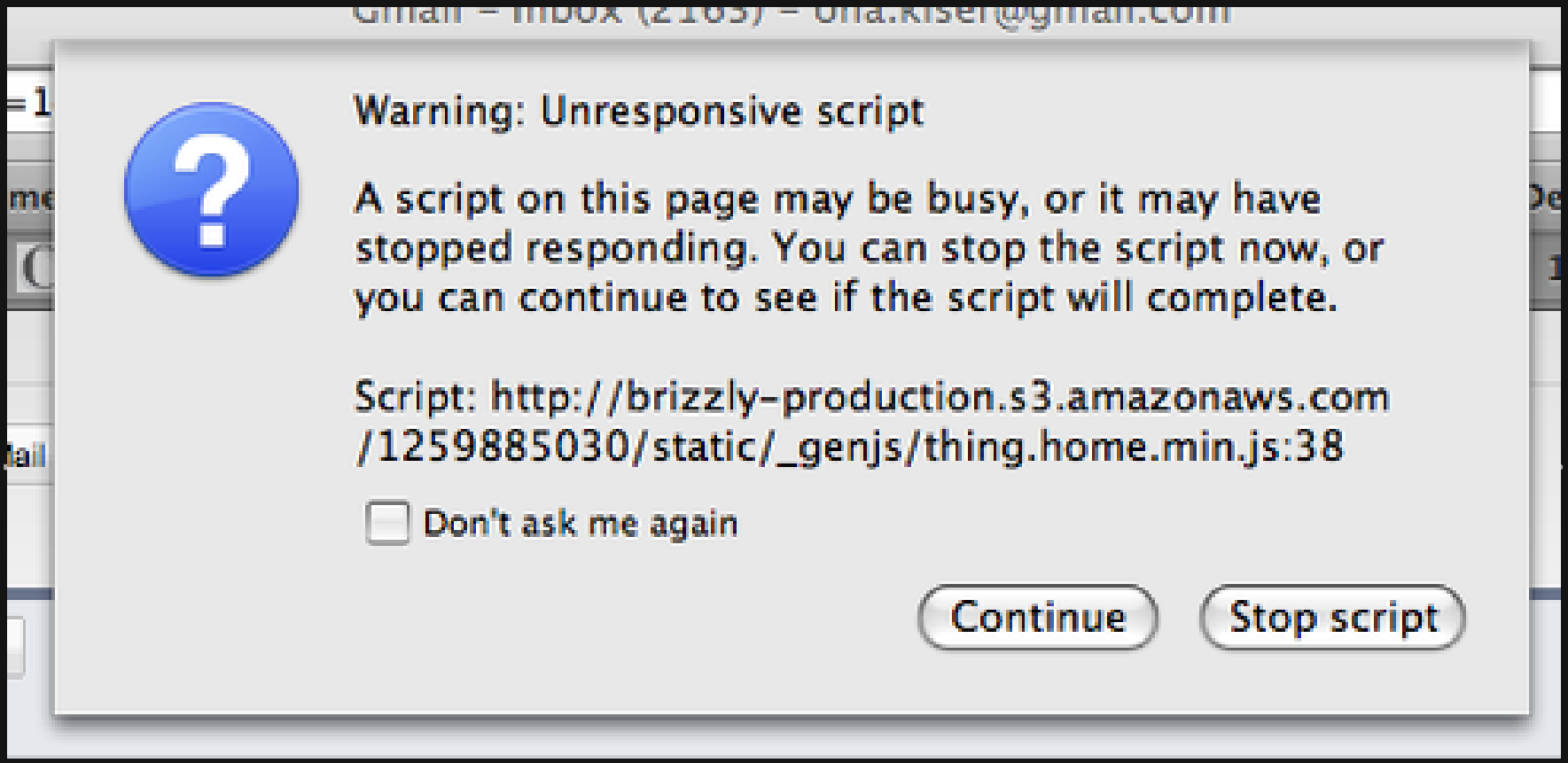
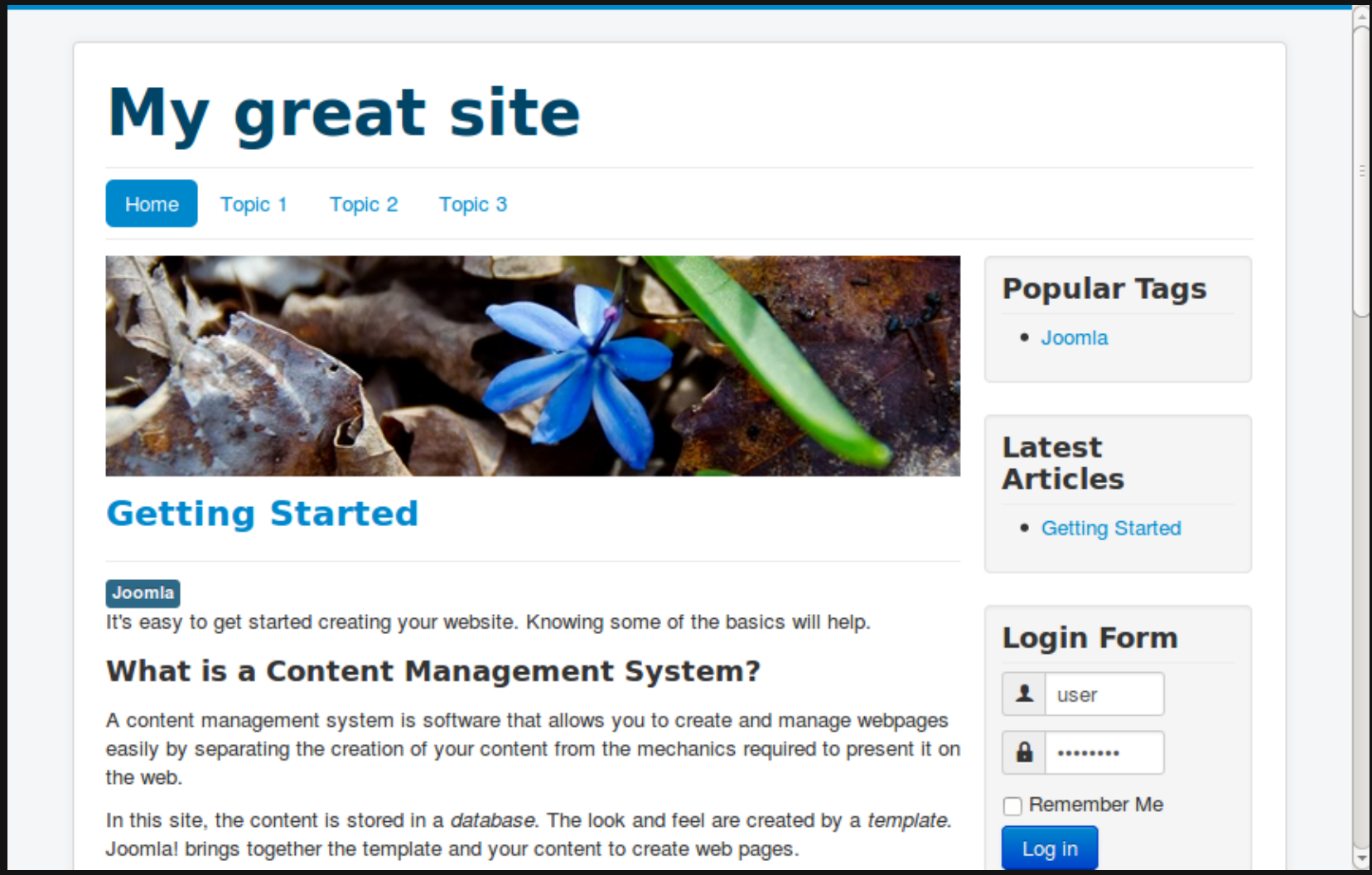


Real-World Example



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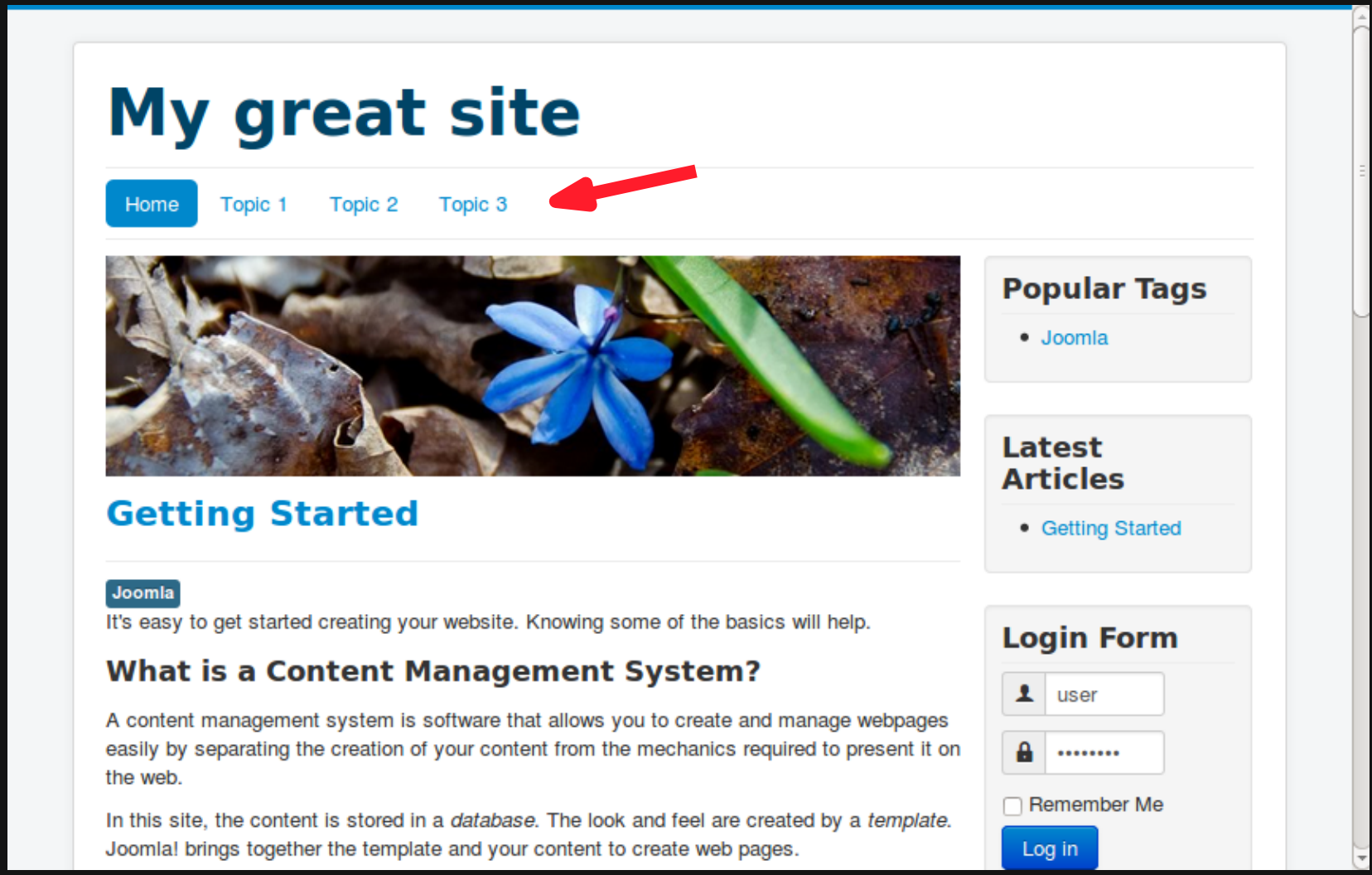

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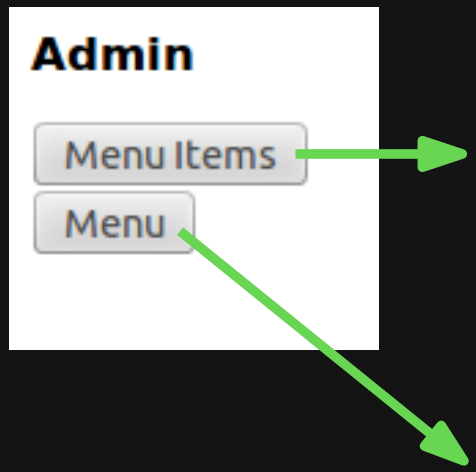

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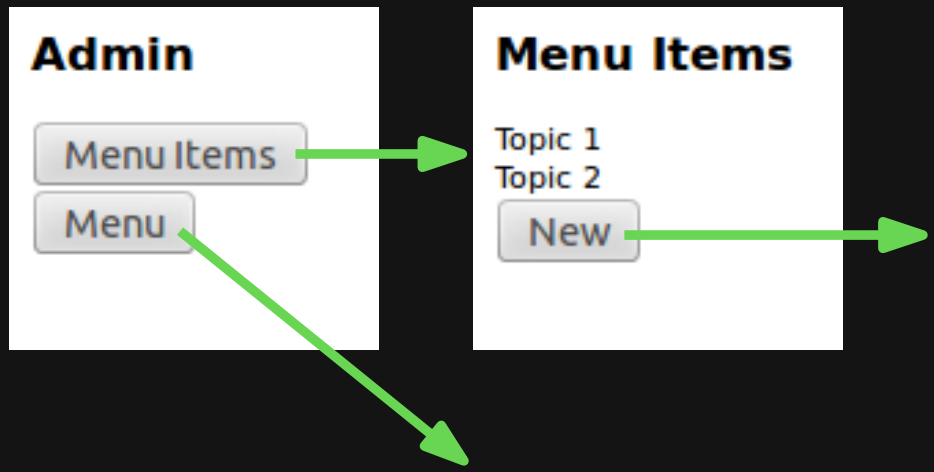

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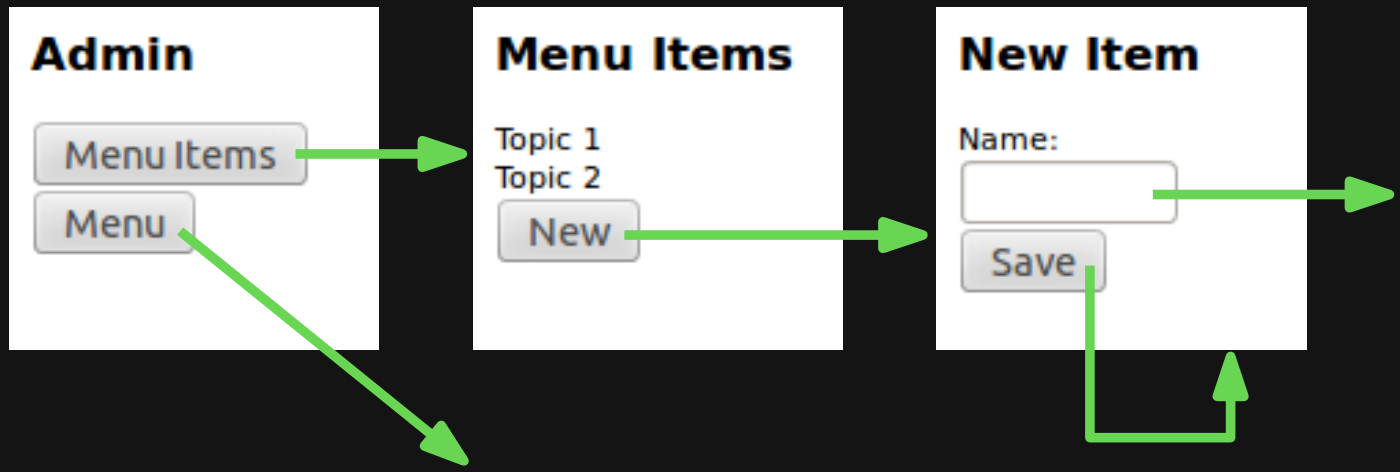

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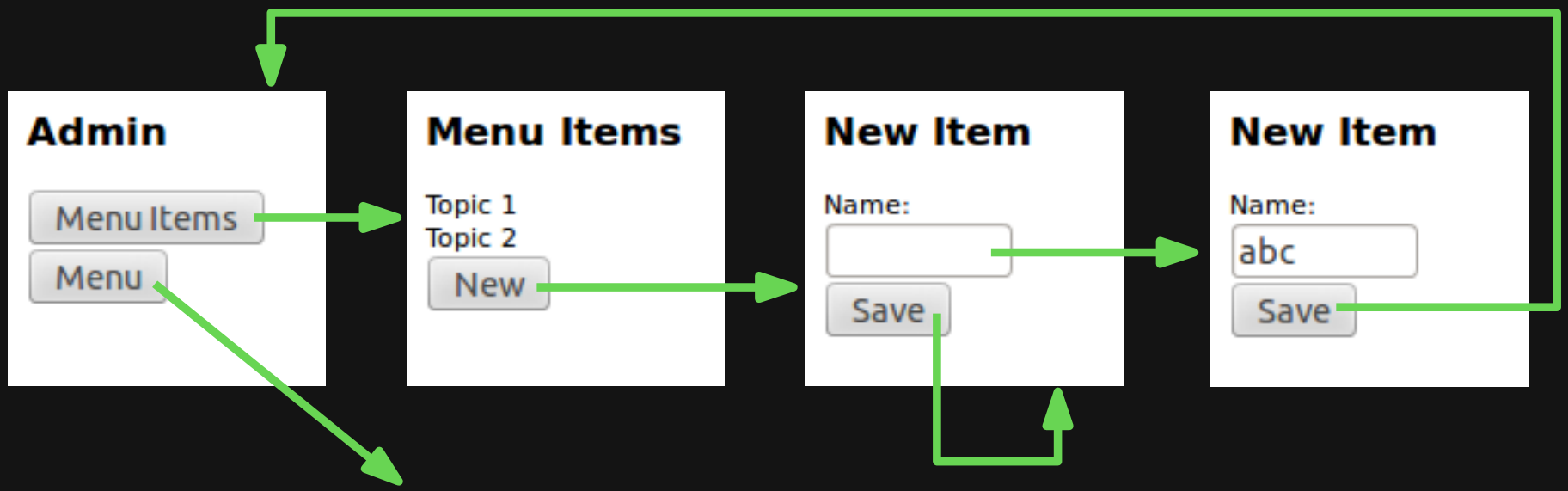

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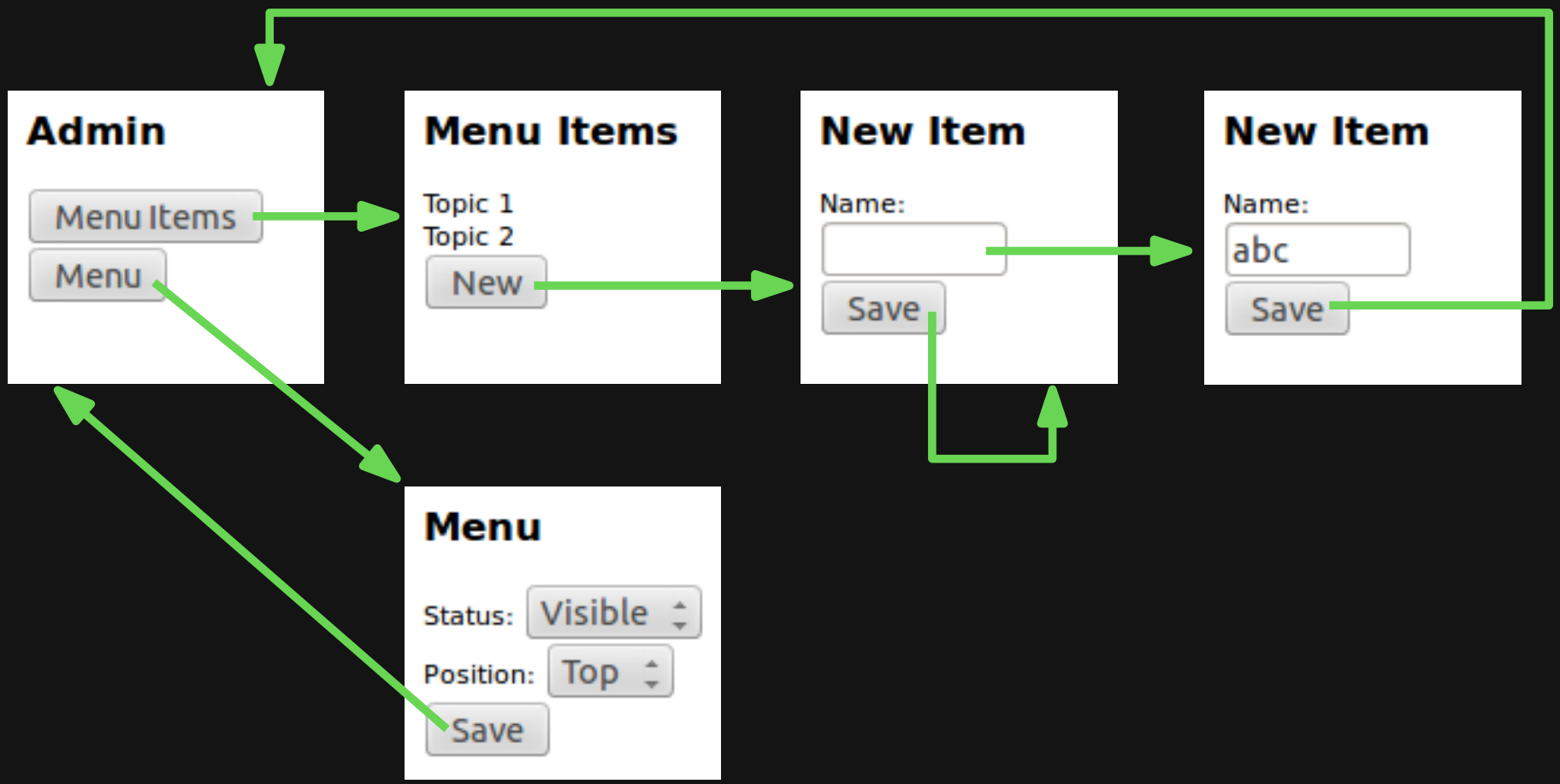

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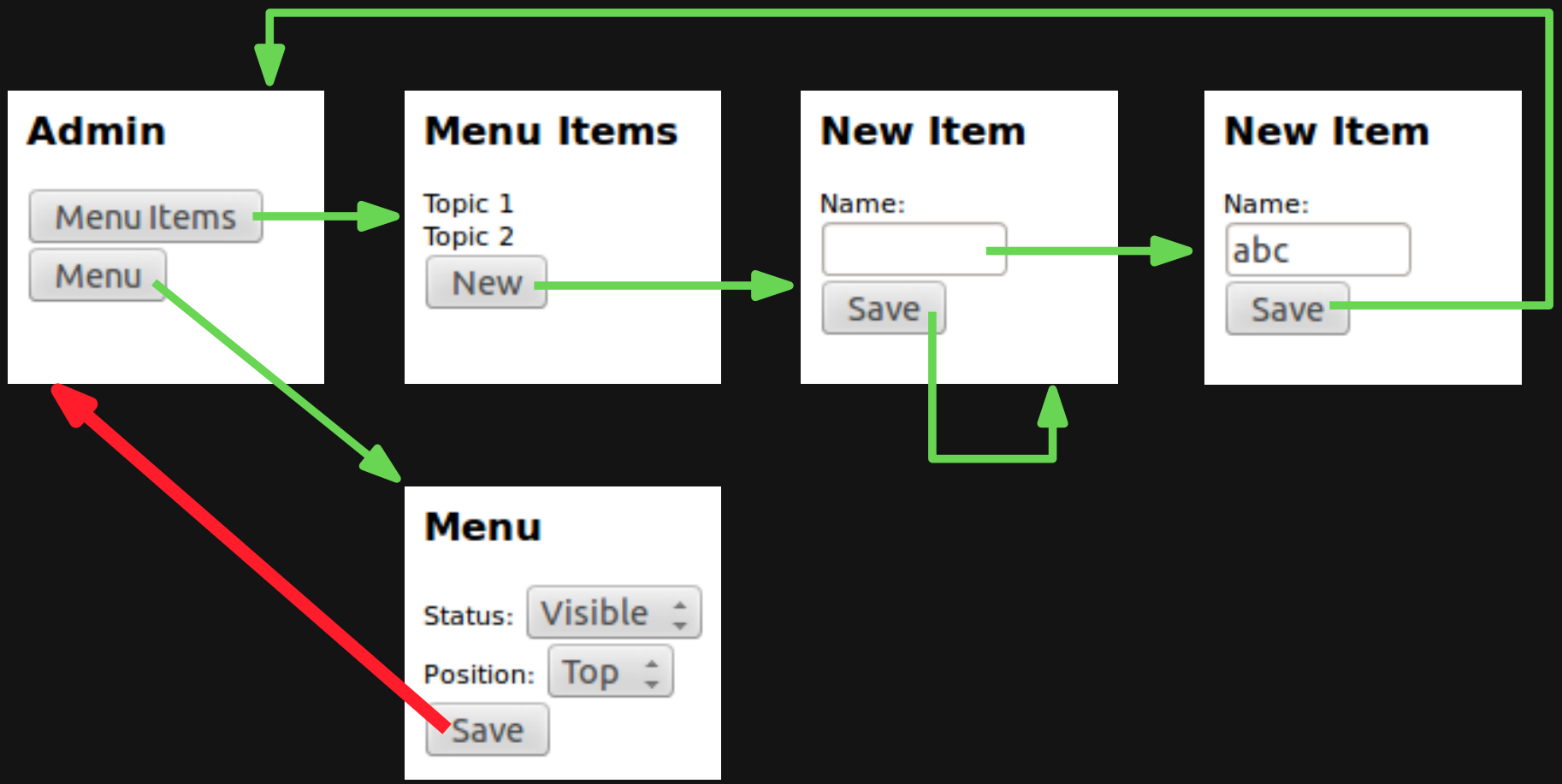

Unresponsive

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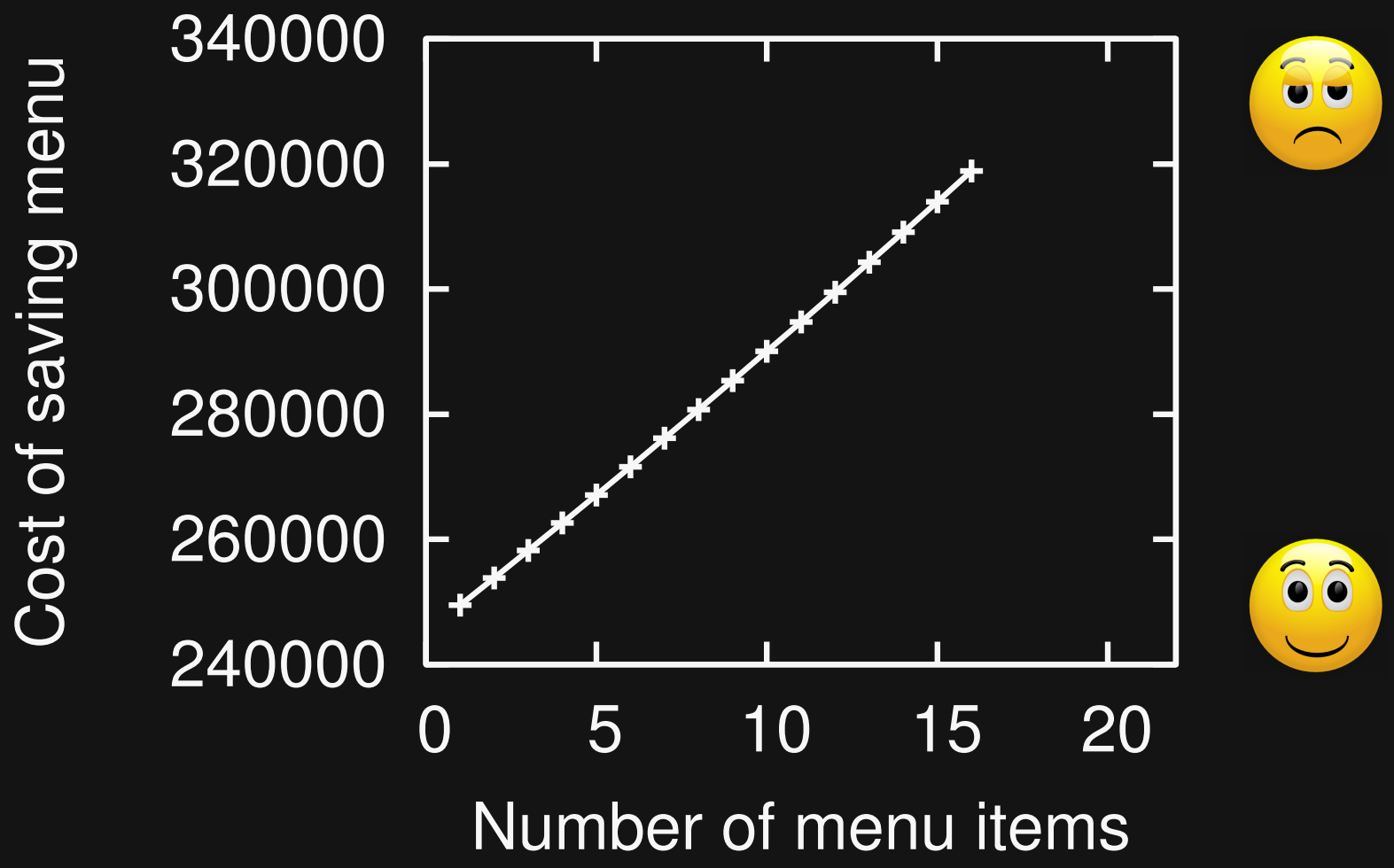
Real-World Example

Cost plot for responsiveness problem



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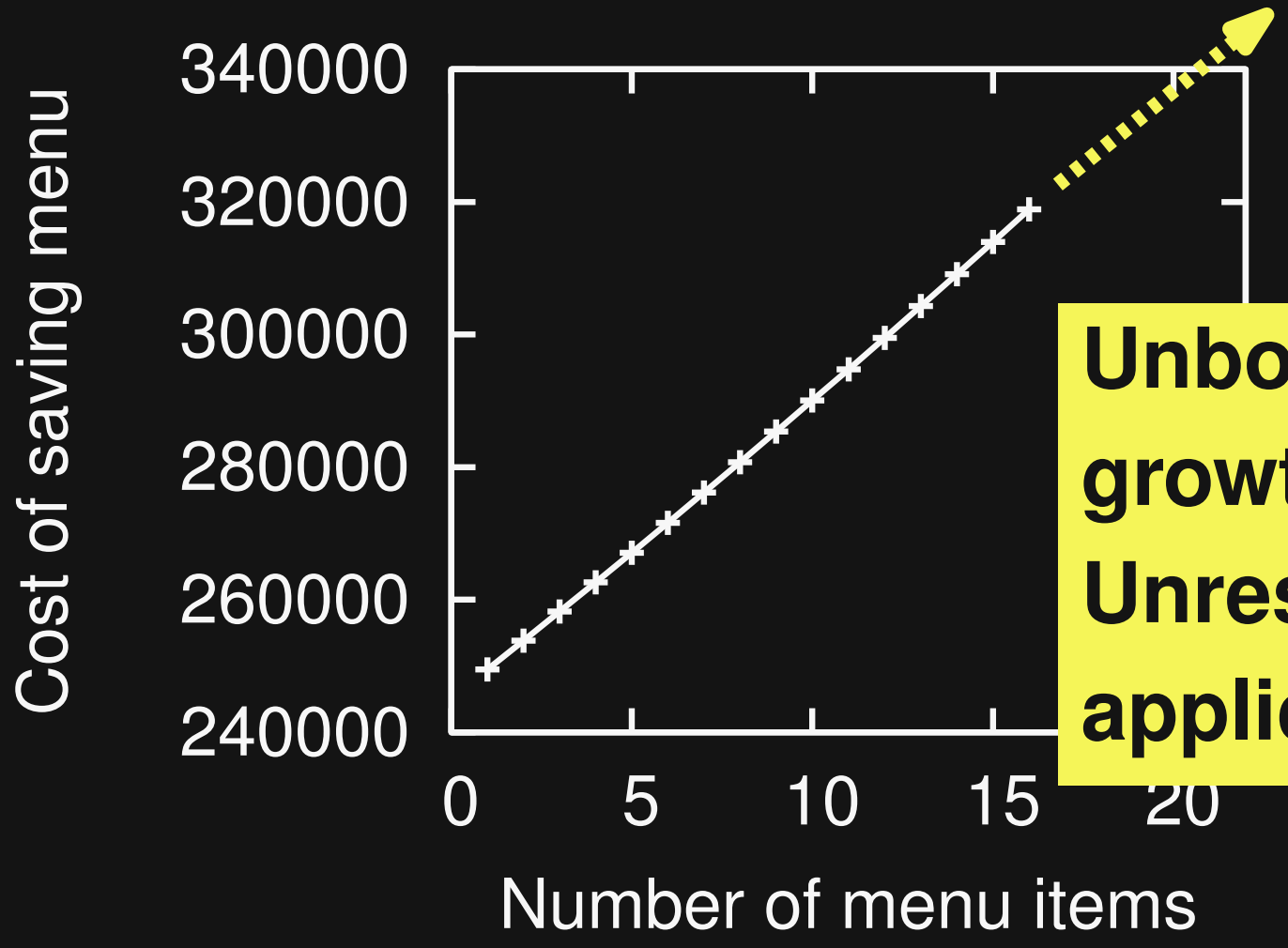

Unbounded growth: Unresponsive application

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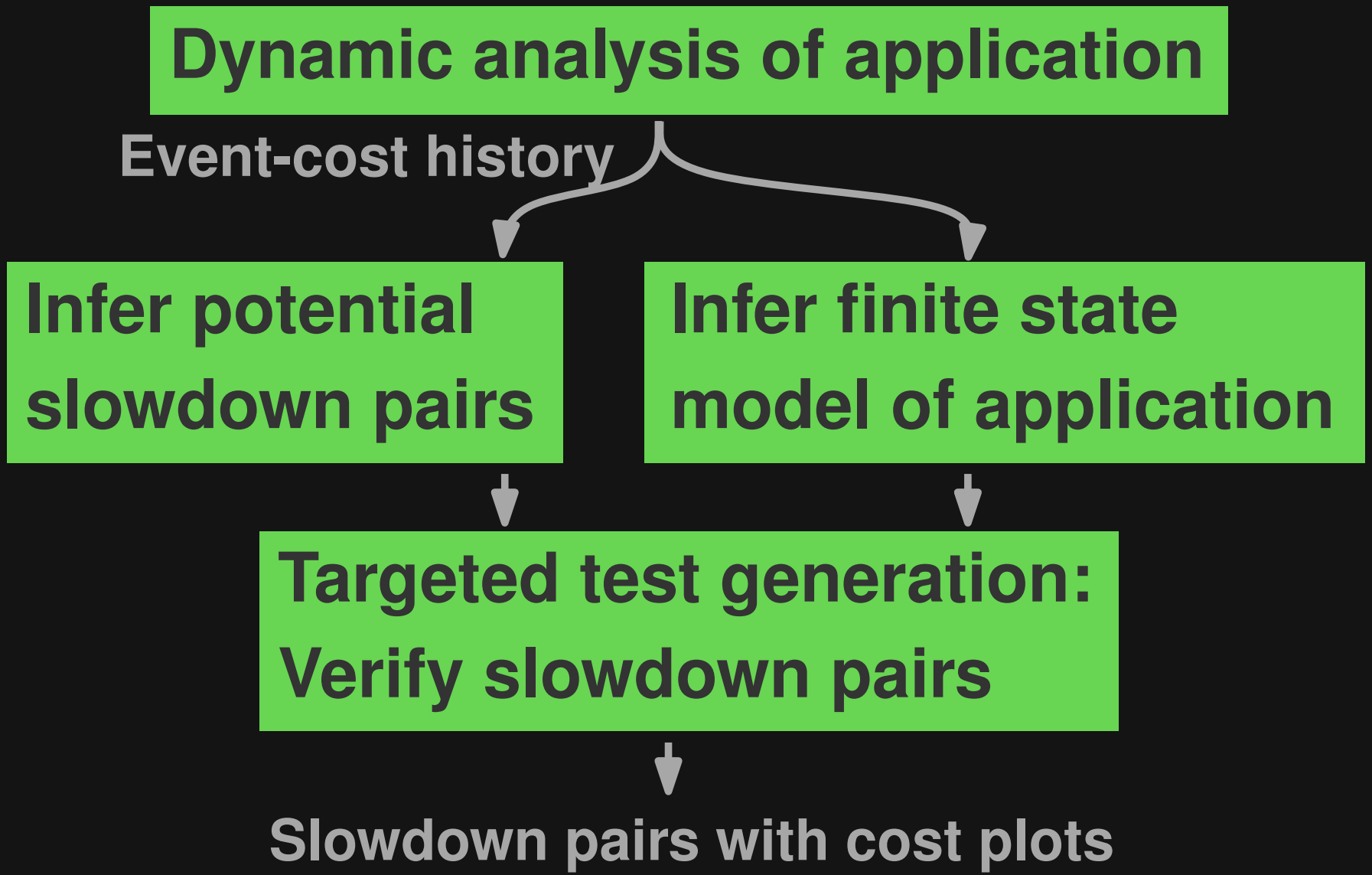
Goal

Analyze **responsiveness** of web applications through **automated testing**

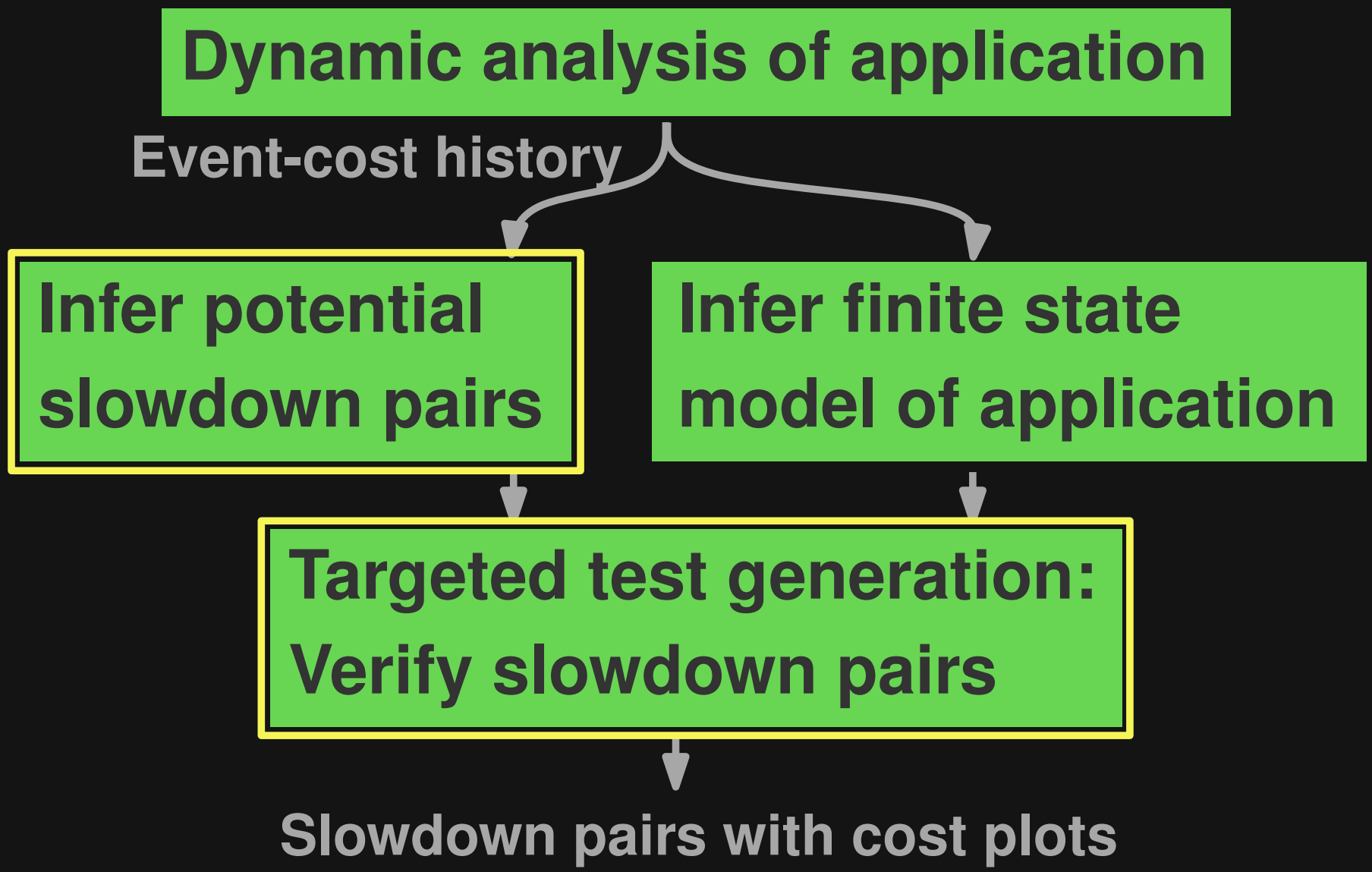
Focus: **Slowdown pairs**

Event E_{cause} increases cost of event E_{effect}

Overview


Dynamic analysis of application
Event-cost history
Infer potential slowdown pairs
Infer finite state model of application
Targeted test generation: Verify slowdown pairs
Slowdown pairs with cost plots

Overview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Event-Cost History

Sequence of event-cost pairs

- DOM element
- Type of event
- Pre-state
- Post-state

Number of conditionals evaluated in event handler

Potential Slowdown Pairs

Does A increase cost of B?

Event	Cost
B	5
A	3
B	10
B	12
A	3
B	12

Supporting evidence S

Refuting evidence R

$$Supp = |S| = 1 \qquad Conf = \frac{|S|}{|S| + |R|} = 33\%$$

Targeted Test Generation

Confirm or reject slowdown pair:

Alternate between E_{effect} and E_{cause}

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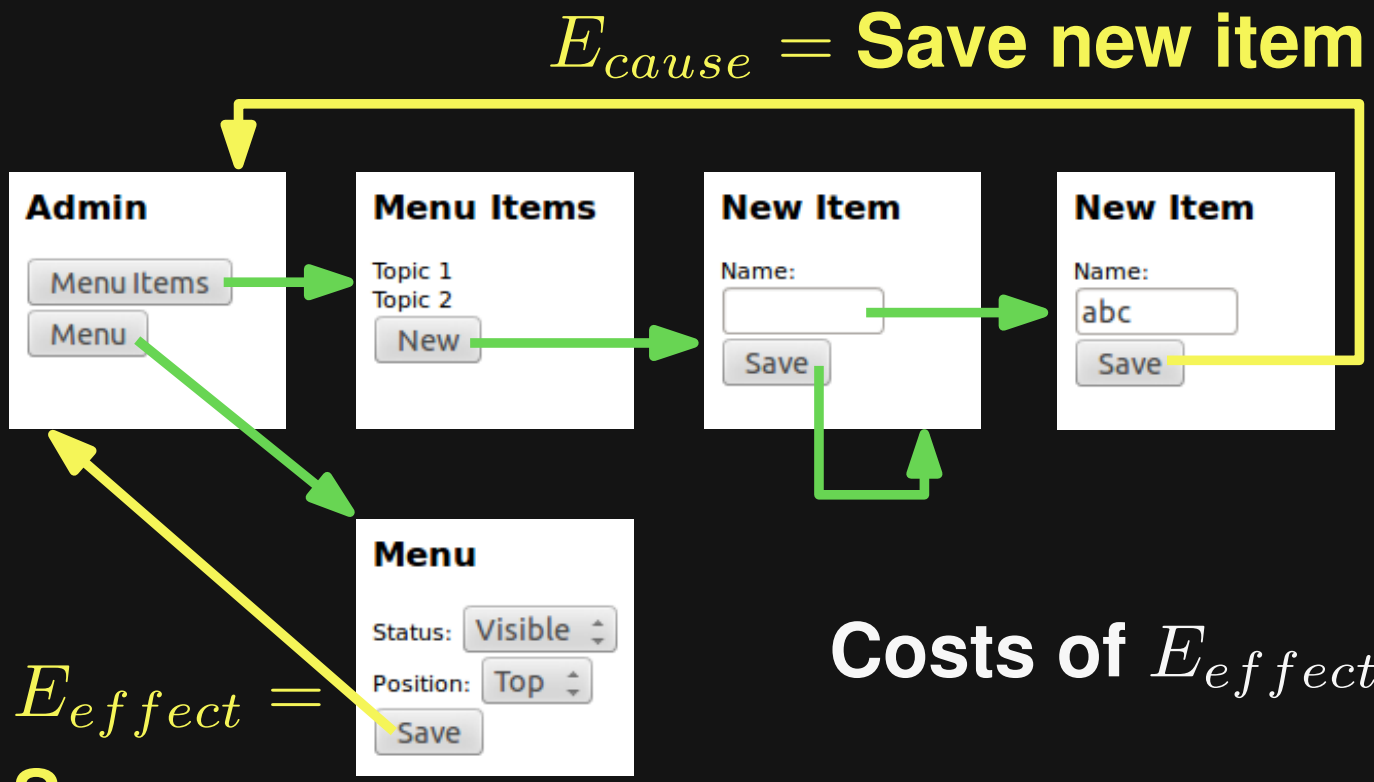

Costs of E_{effect}:

current state → target event

Targeted Test Generation

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Costs of E_{effect}:

5

current state → target event

Targeted Test Generation

Confirm or reject slowdown pair:

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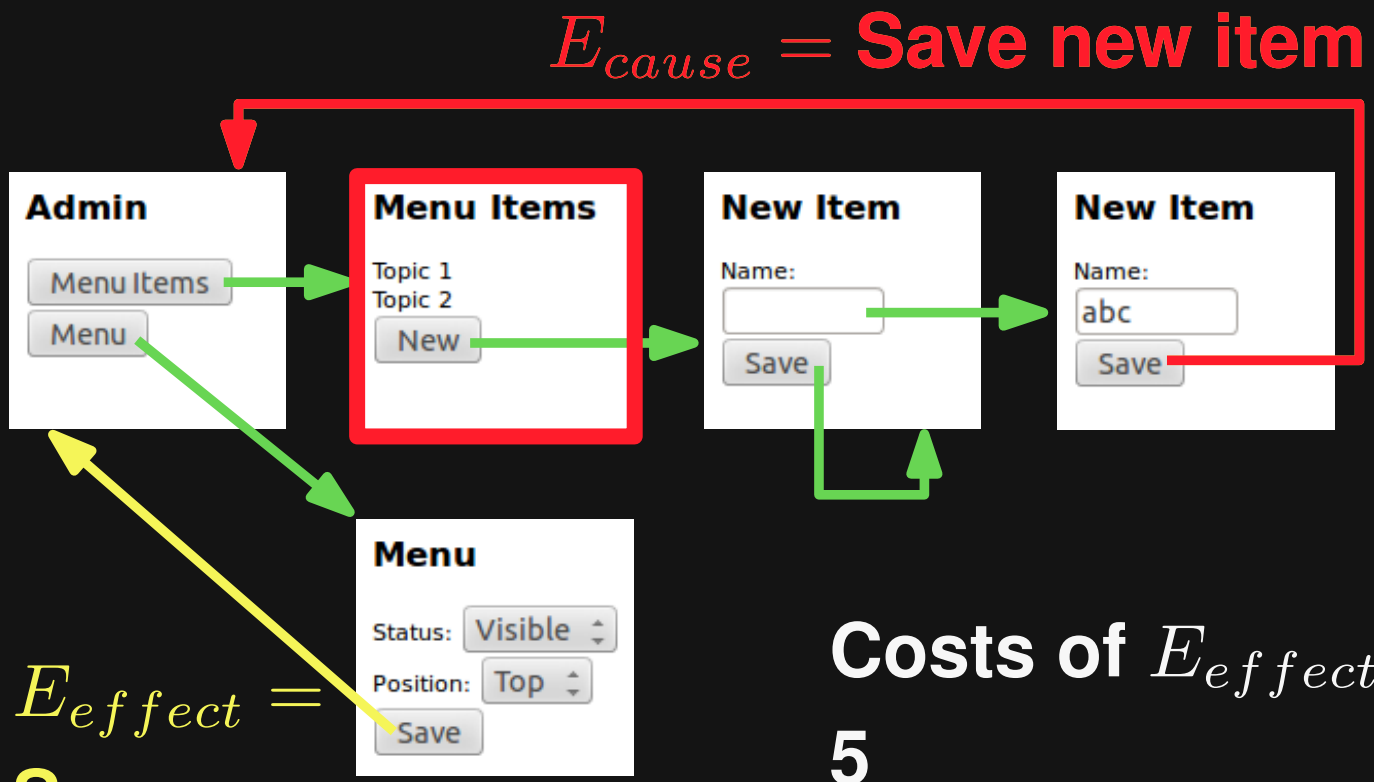

Costs of E_{effect}:

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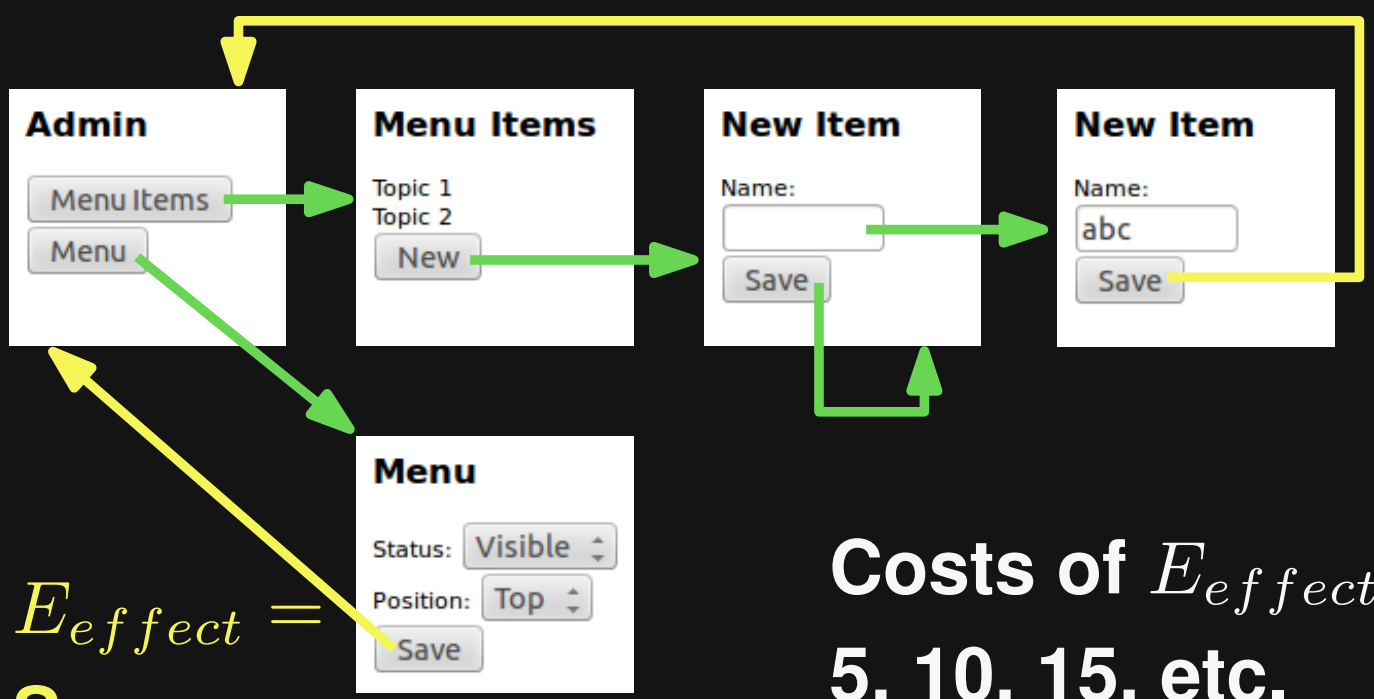
Alternate between E_{effect} and E_{cause}

E_{cause} = **Save new item**



E_{effect} = **Save menu**

Costs of E_{effect}: 5, 10, 15, etc.

current state → target event

Navigation: Challenge

Shortest event sequence in model may be infeasible in application

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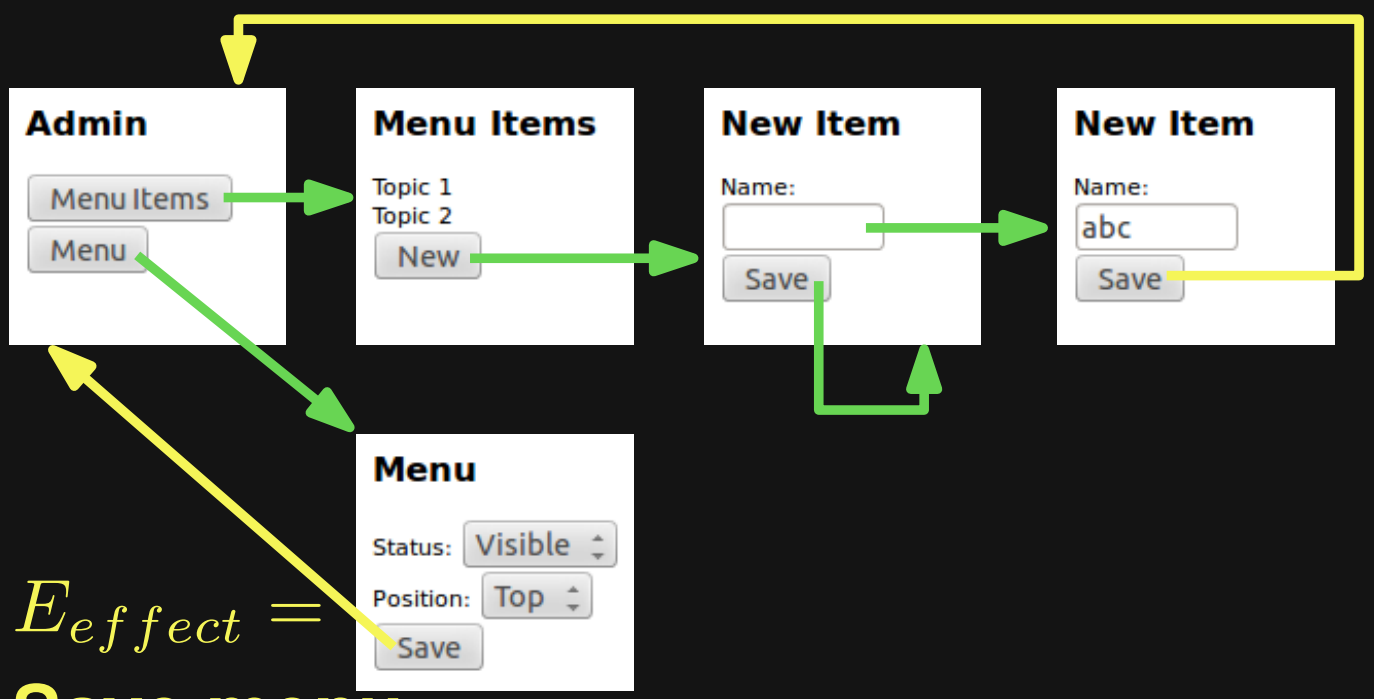

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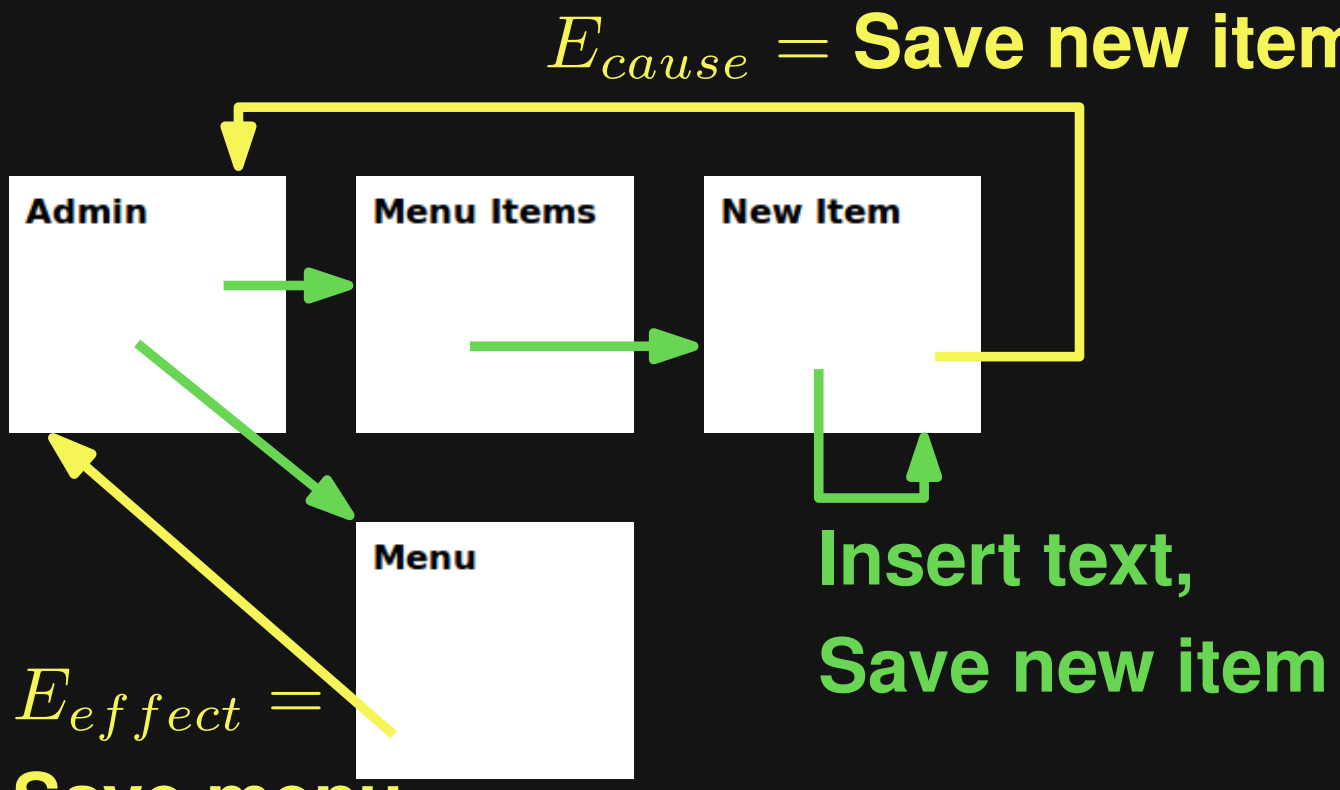
Navigation: Challenge

Shortest event sequence in model may be infeasible in application



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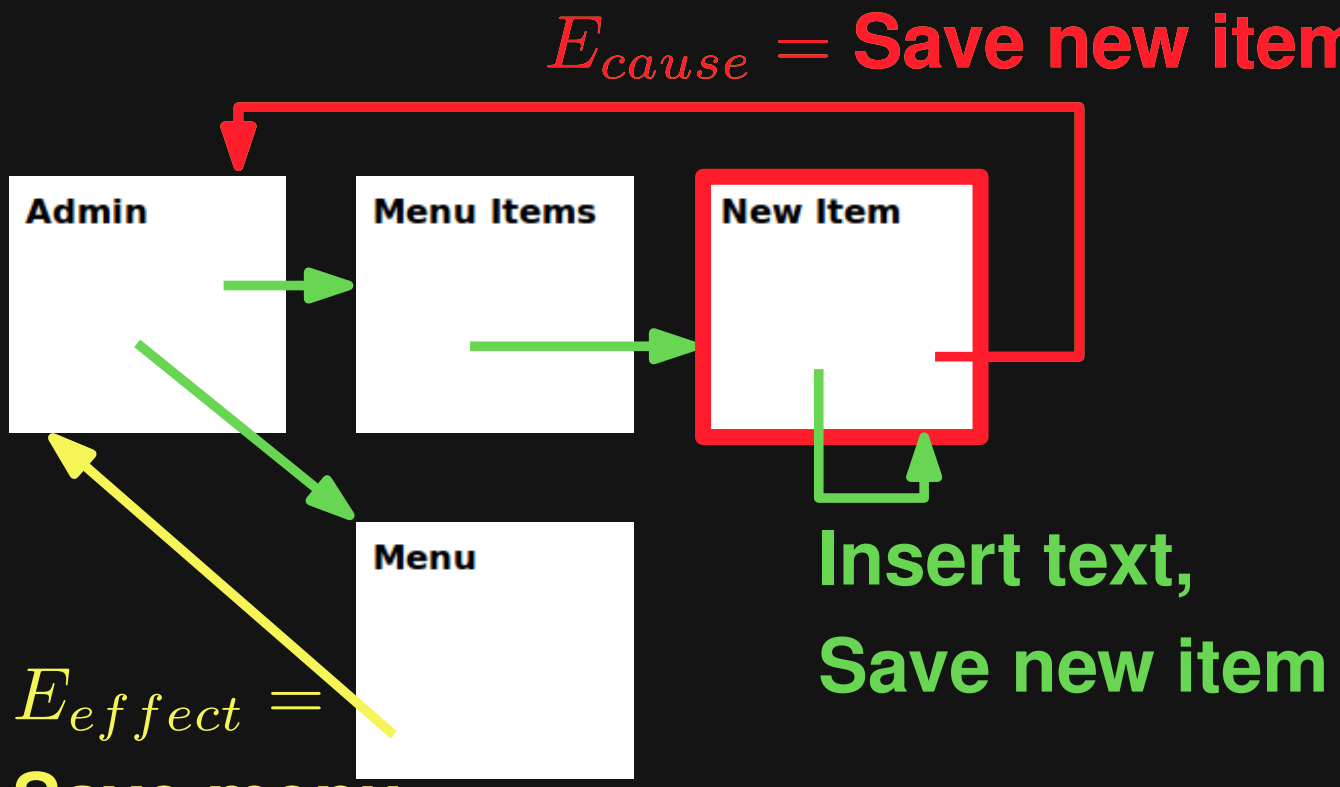
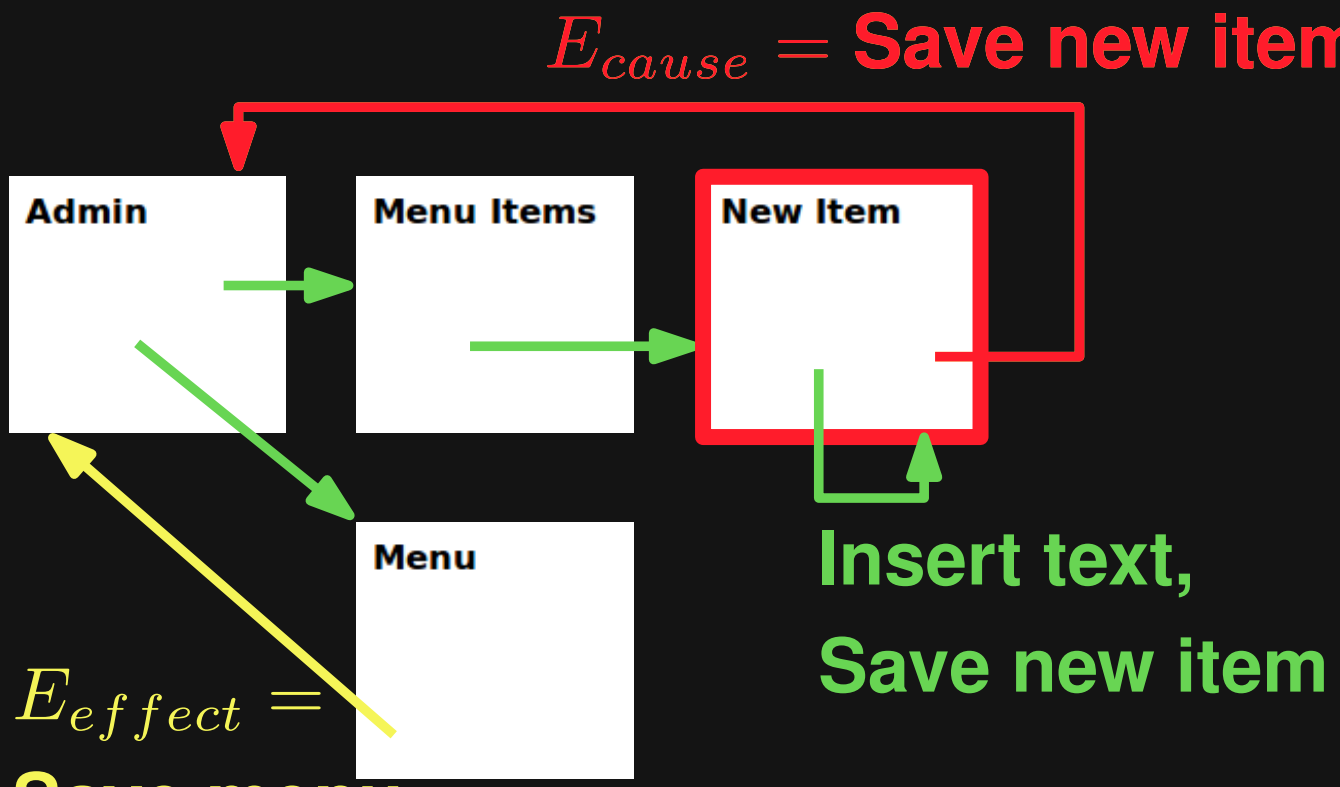


Navigation: Approach

- Compute sequences to target event
- Randomly pick from set of first steps



Evaluation

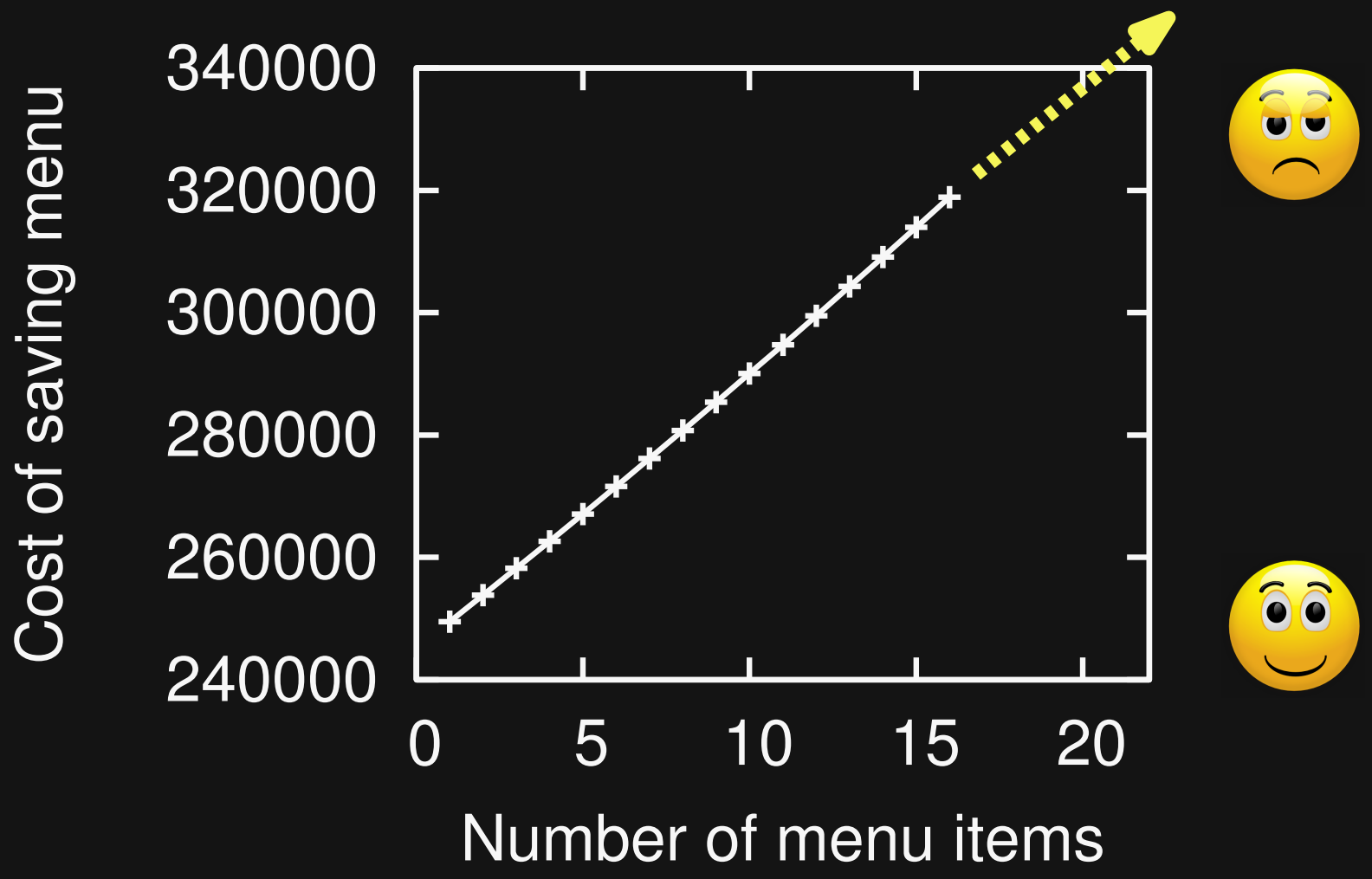
Find responsiveness problems?

- 2 known + 4 previously unknown

Effectiveness of targeted test generation?

- Reaches 89% of all target events
- Invalidates $>$ 99% of all potential slowdown pairs

Results: Joomla



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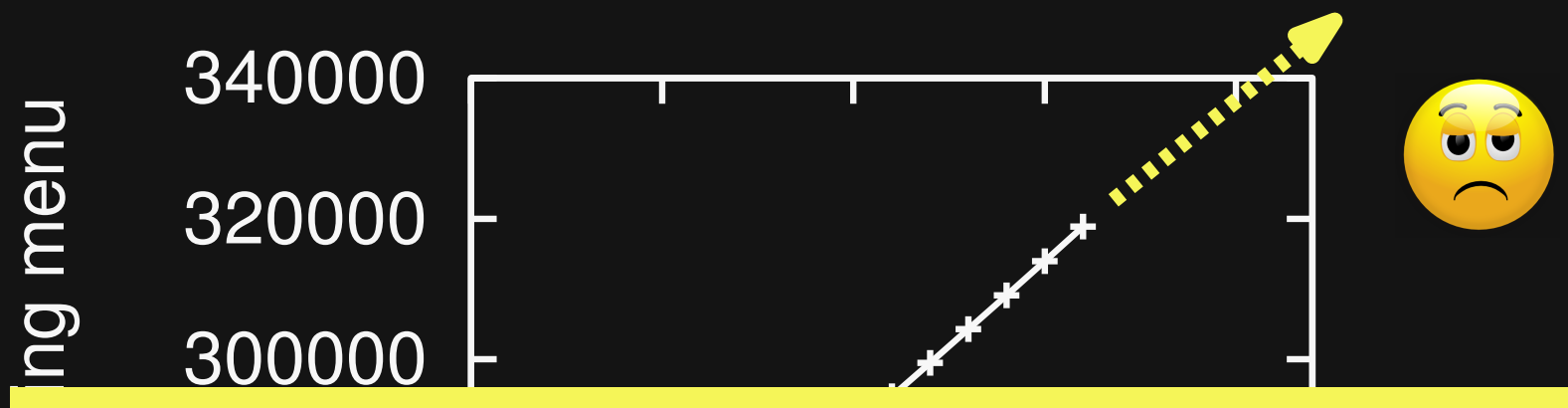
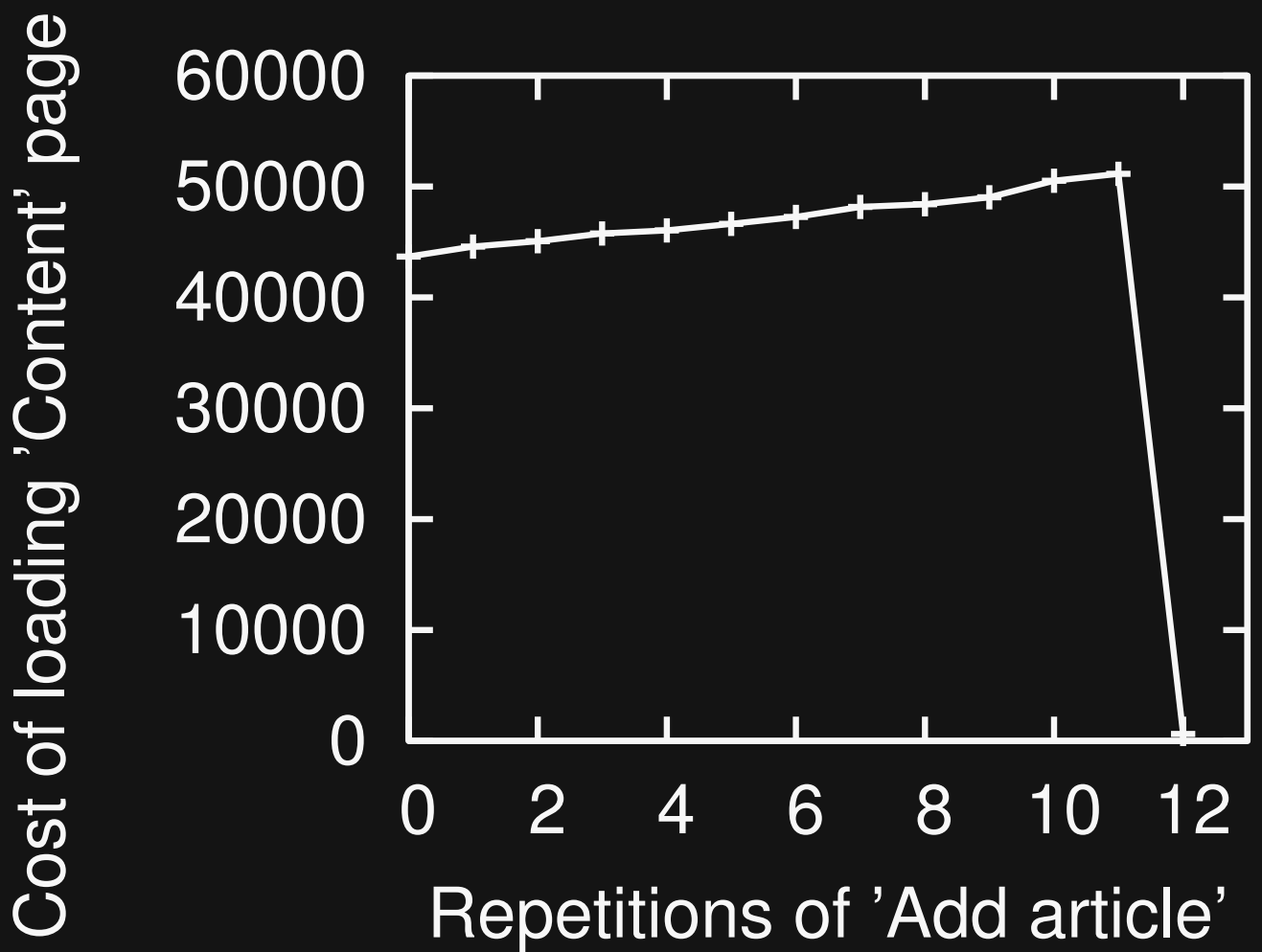


Several similar examples:

- E_{cause} **accumulates data items**
- E_{effect} **processes all of them and has unbounded cost**

Results: Drupal



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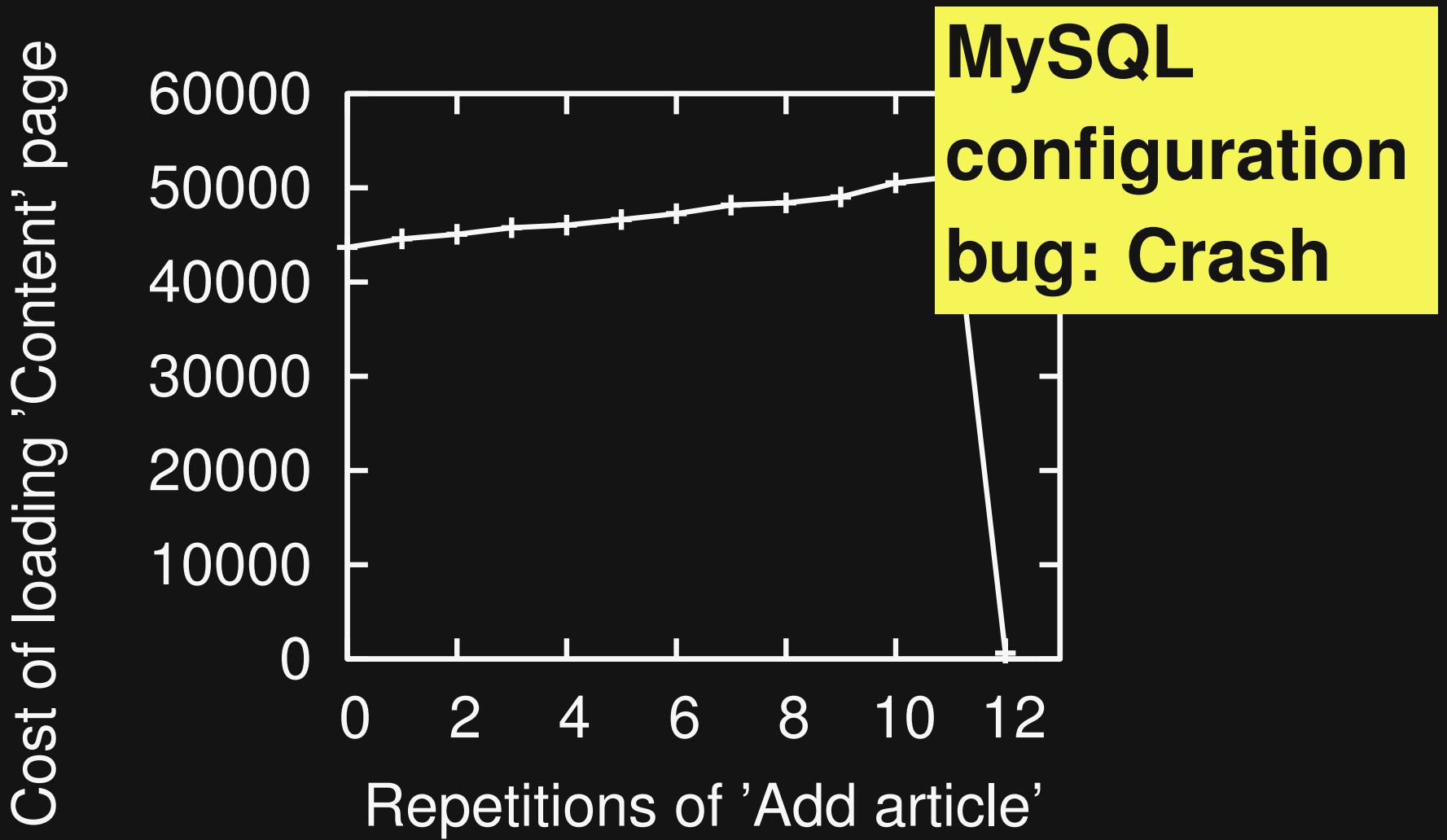
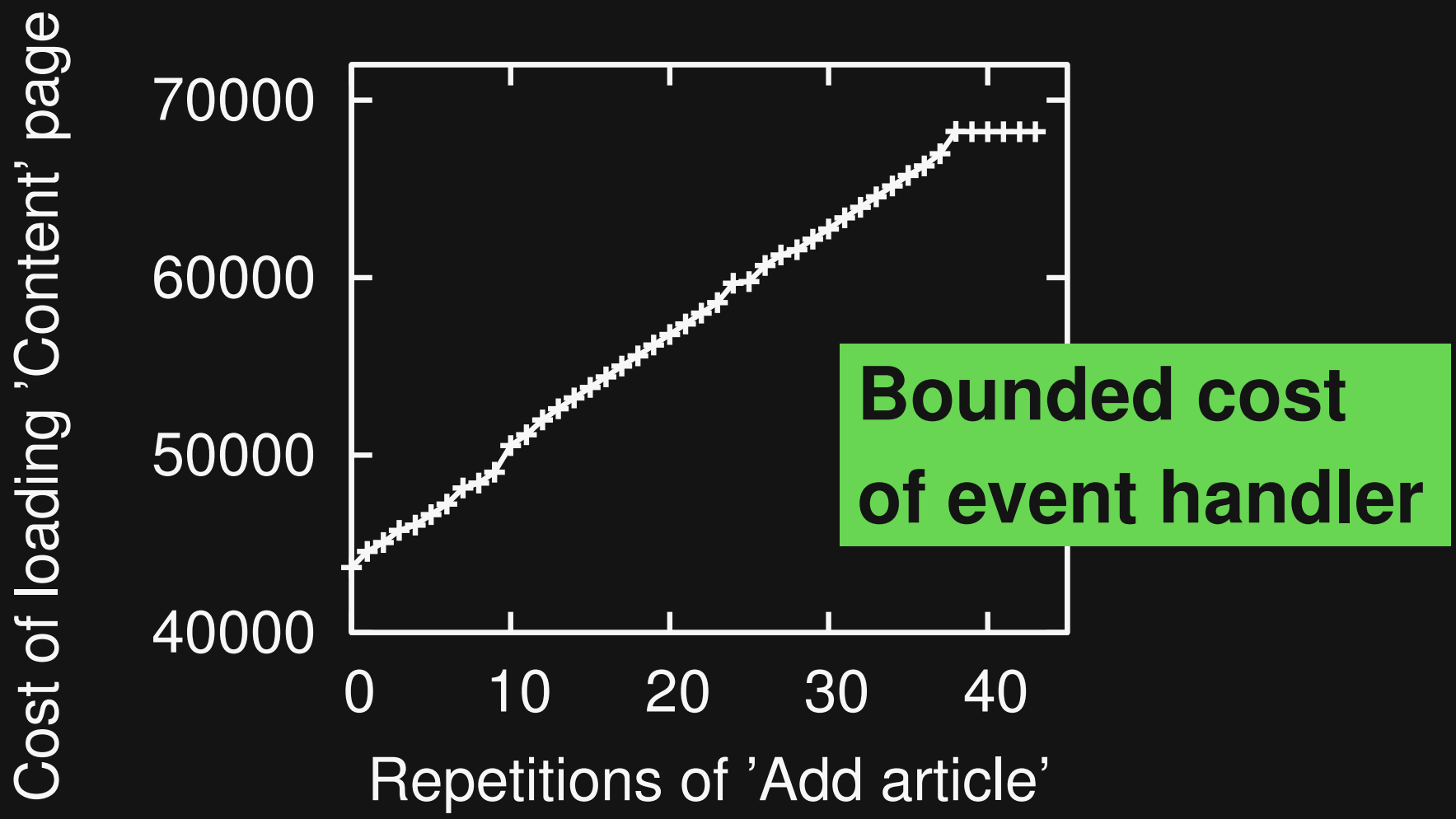


Results: Drupal (2)



Limitations

- **False negatives**
  - Bounded by initial execution
  - Focus on pairs of events

  But: No false positives

- **Explores event space, ignores input space**

Conclusion

Automated analysis of web application responsiveness

- **Slowdown pairs**
- **Targeted test generation for event-driven applications**

https://github.com/michaelpradel/WebAppWalker

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I'm looking for students to join my group at TU Darmstadt!