

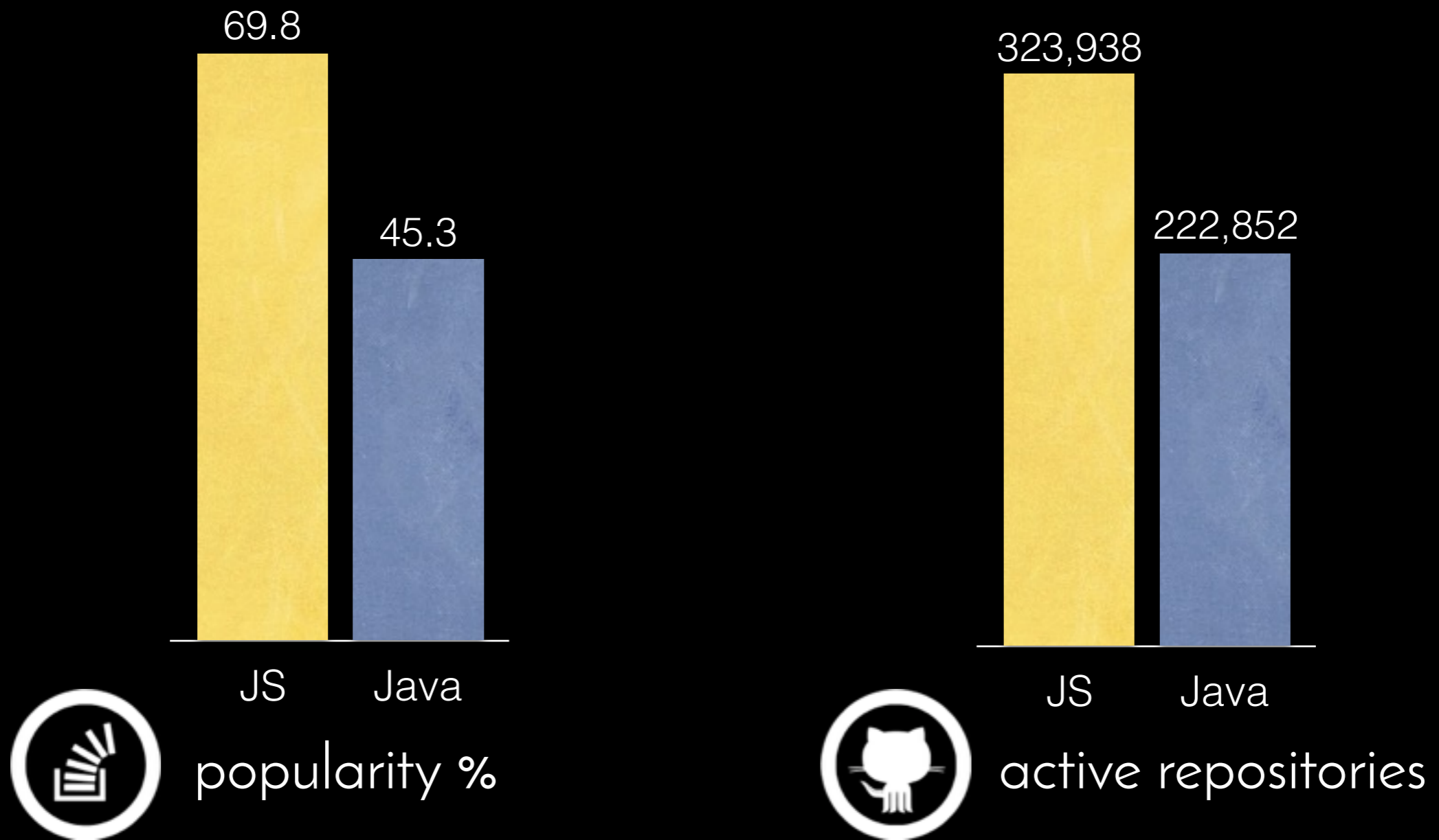
# Practical AJAX Race Detection For JavaScript Web Applications

Christoffer Quist Adamsen, Anders Møller, Saba Alimadadi, Frank Tip

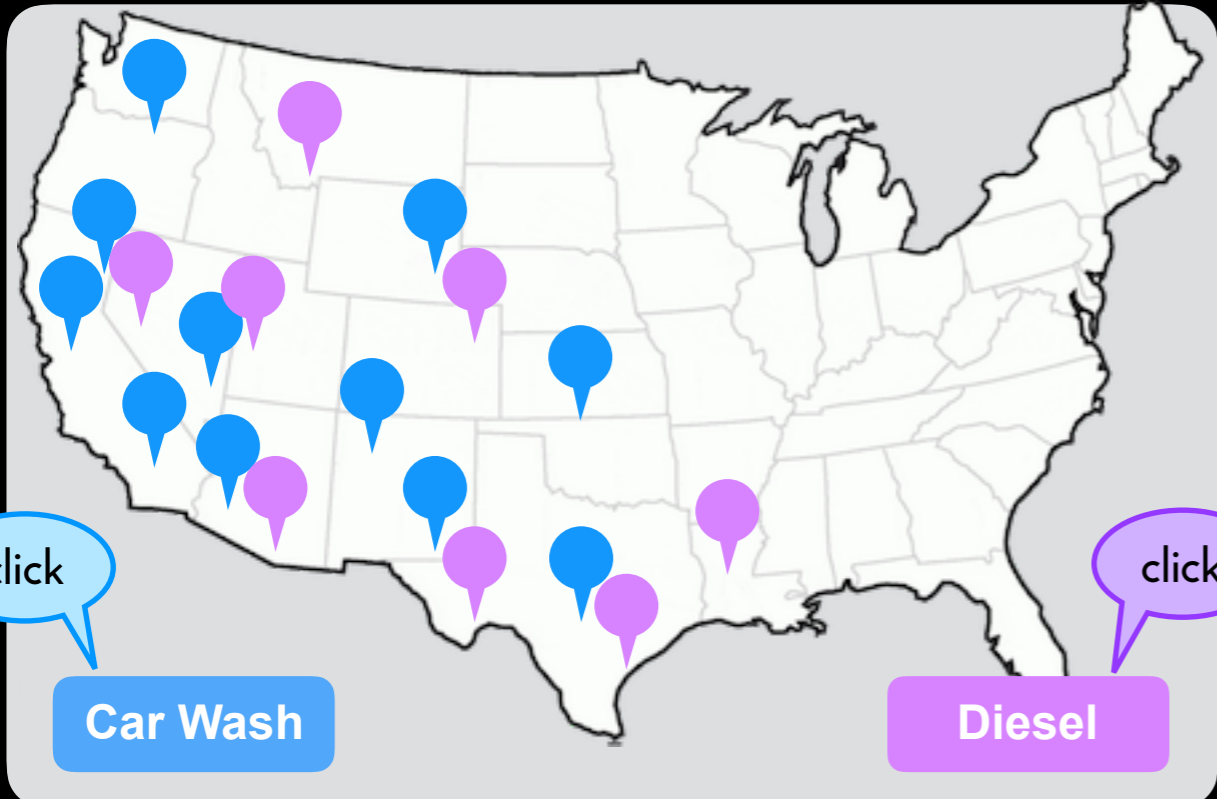
saba@northeastern.edu



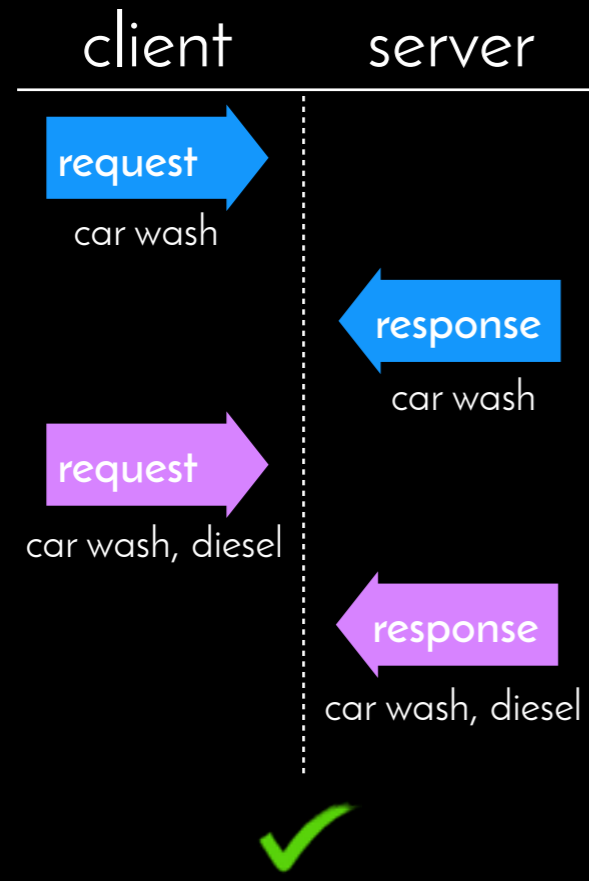
# JavaScript



simplified and modified example from [chevronwithtechron.com](http://chevronwithtechron.com)

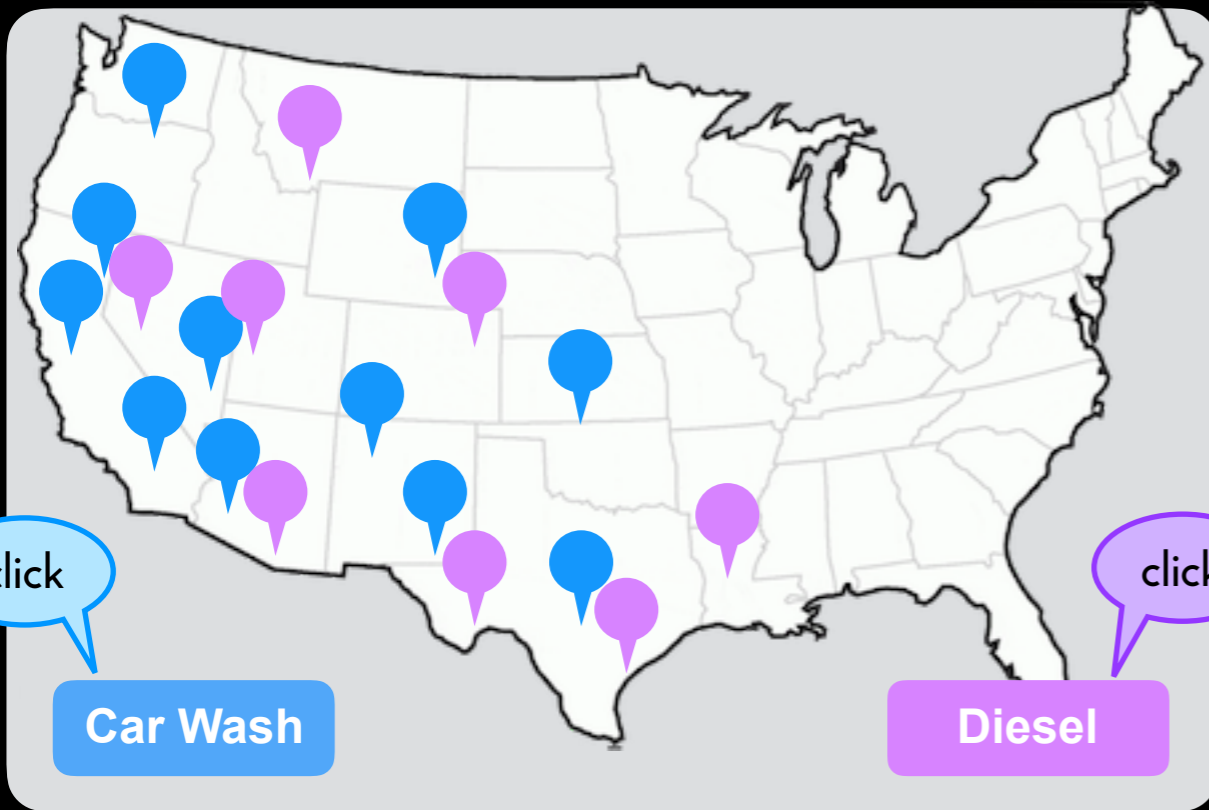


```
function addRemoveFilter (fId) {  
  filters = toggleFilter(fId);  
  url = createUrl(server, filters);  
  $.ajax({  
    url: url,  
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  });  
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```

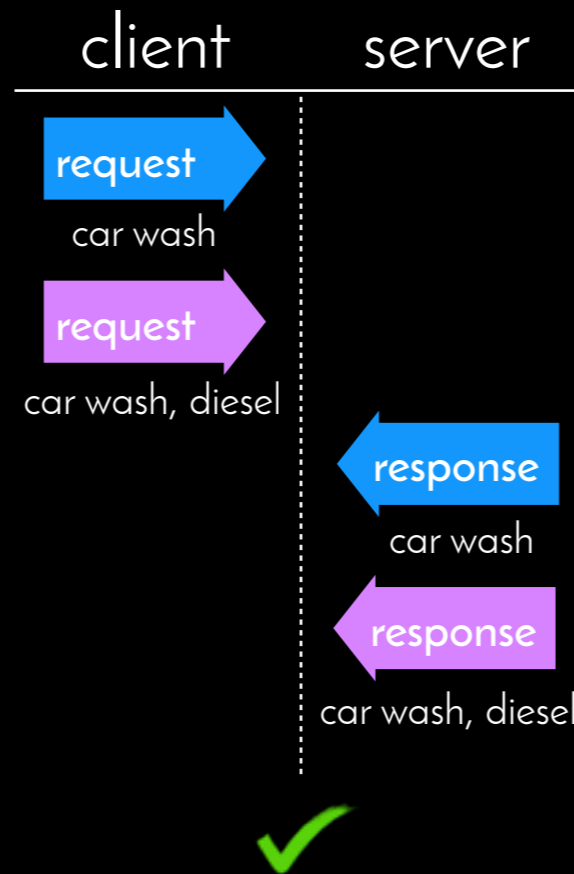
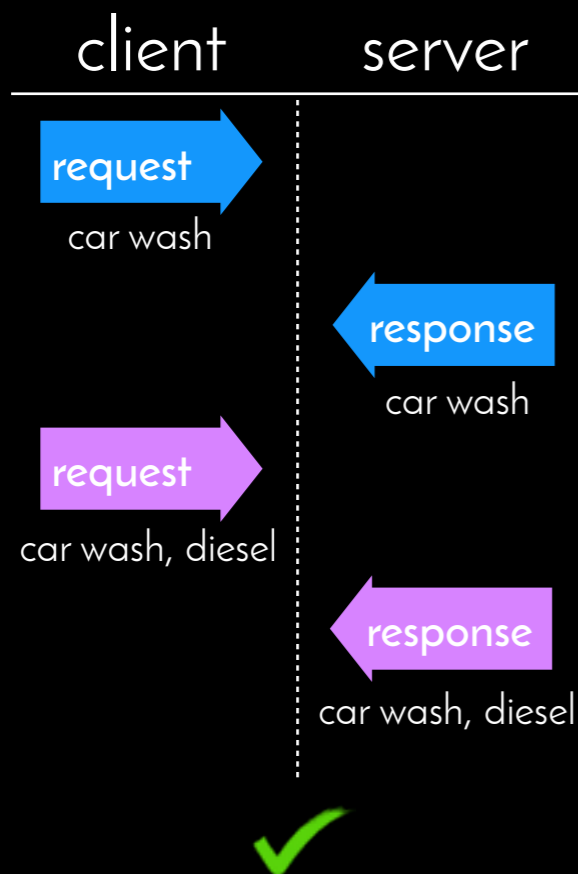




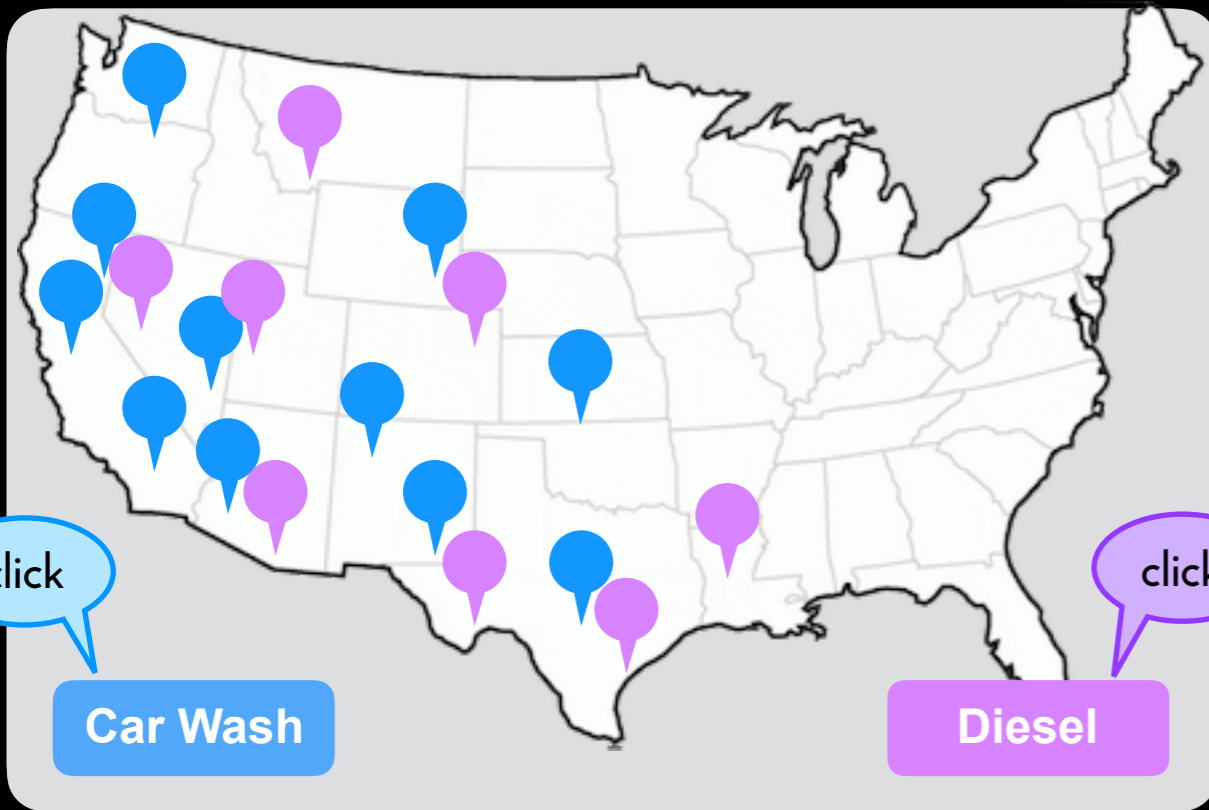
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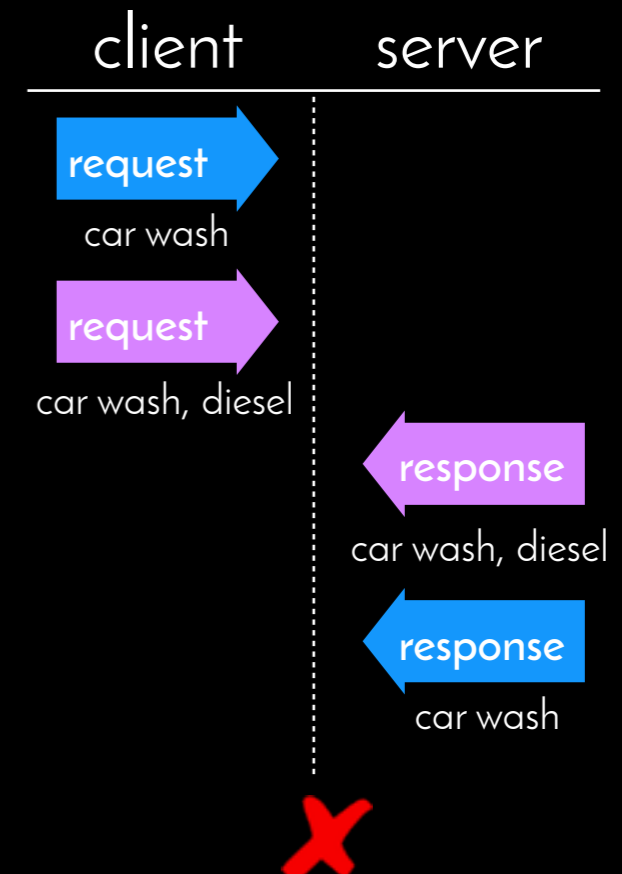
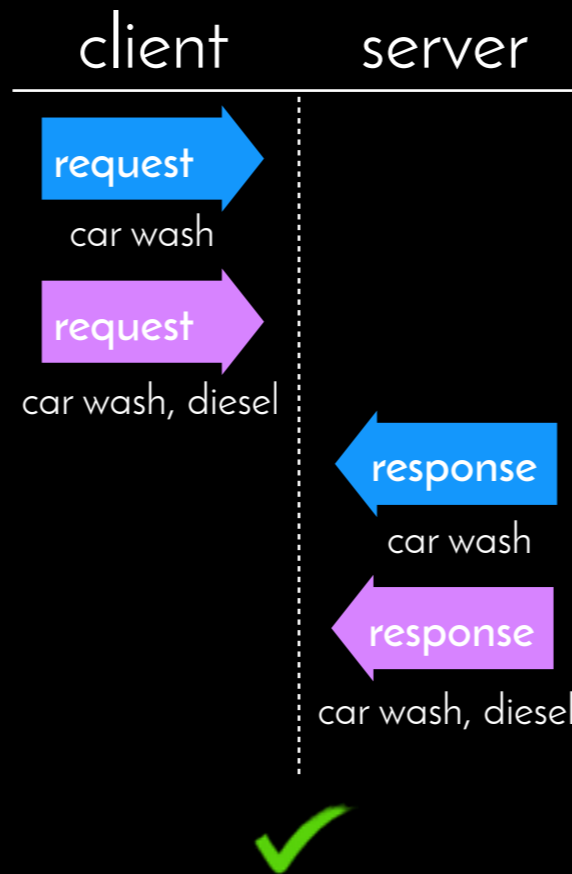
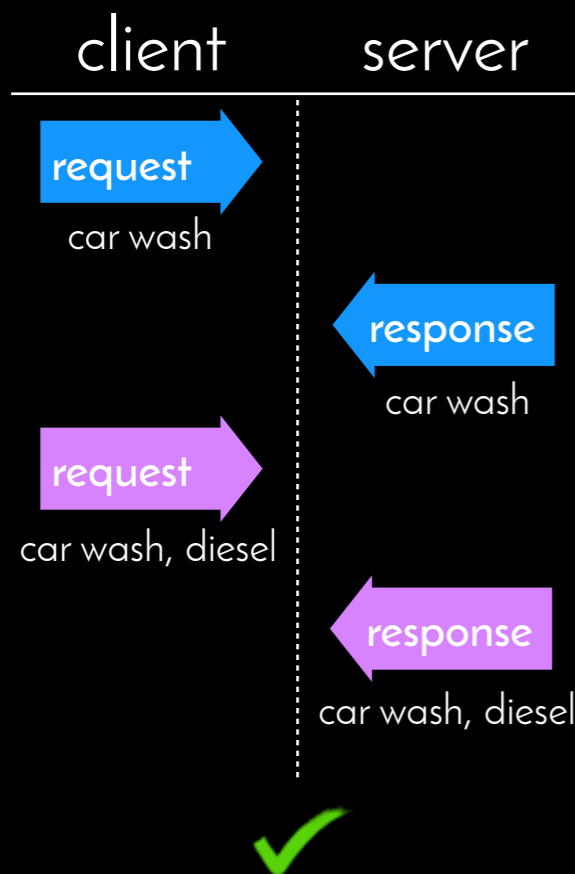
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# *Event Races*



# *Event Races*



Zheng et al., 2011

Petrov et al., 2012

Raychev et al., 2013

Hong et al., 2014

Jensen et al., 2015

Mutlu et al., 2015

Wang et al., 2016

Zhang & Wang, 2017

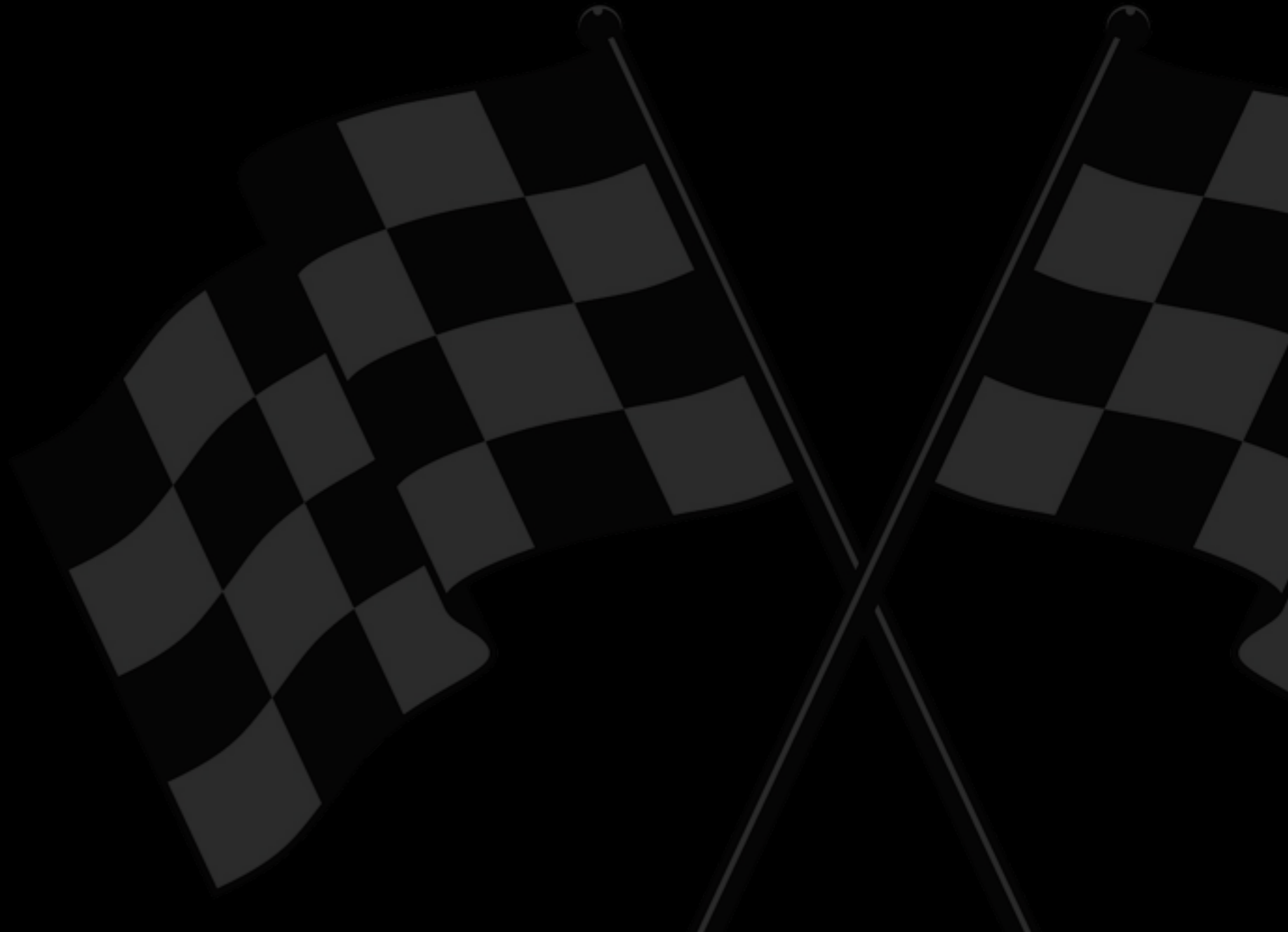
Adamsen et al., 2017a, 2017b



detecting harmful races  
reducing benign warnings  
providing helpful reports  
performance and practicality



AJAXRacer



application →  
user events → 1. Generating event graphs

2. Testing potential conflicts → event races

application →  
user events → 1. Generating event graphs

Instrument automatically



Trigger user events



Generate event traces



Create event graphs



Find event conflicts

2. Testing potential conflicts

# 1. Generating event graphs

application →

Instrument automatically

user events →

Trigger user events

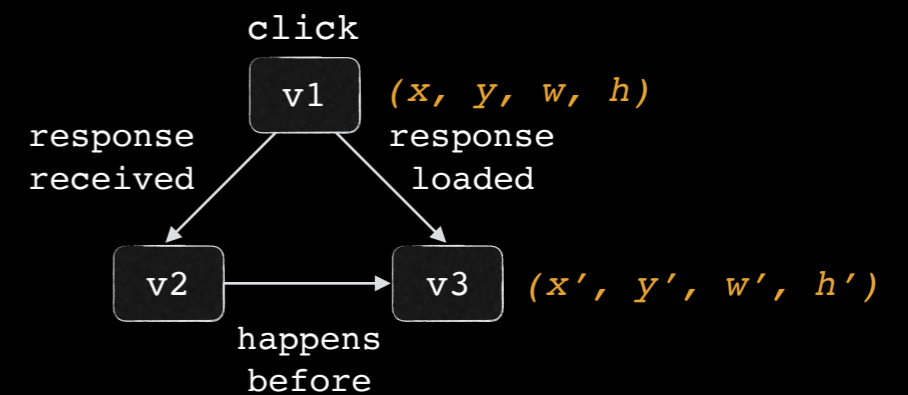
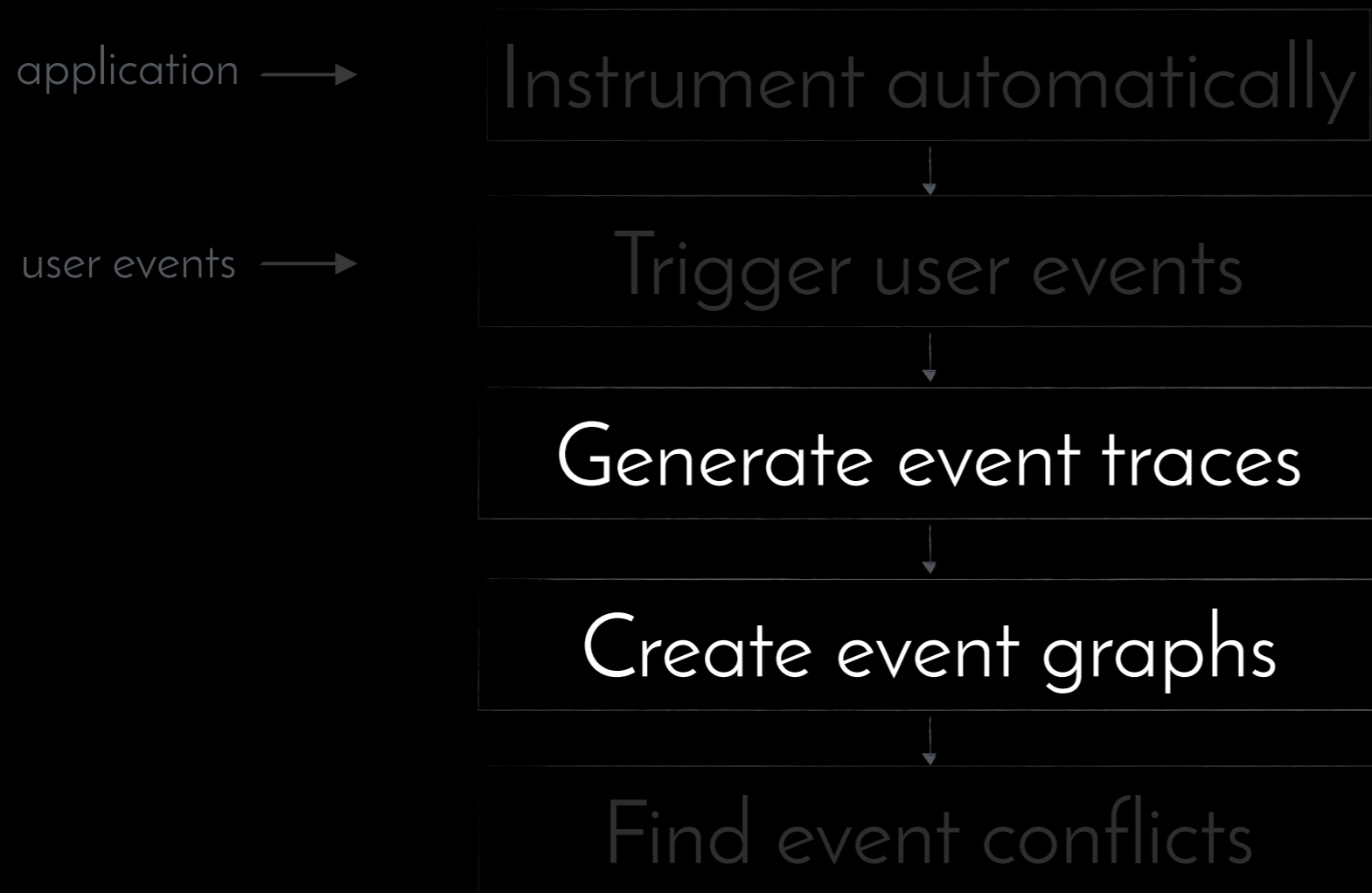
Generate event traces

Create event graphs

Find event conflicts

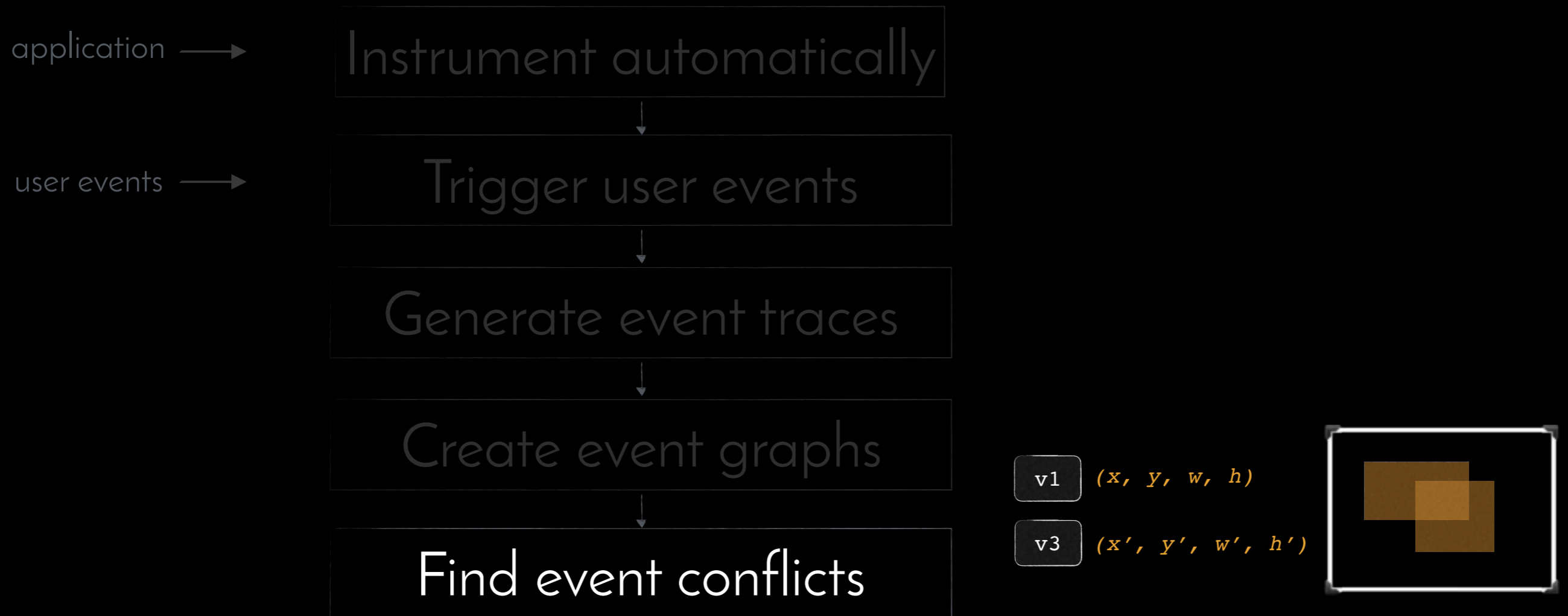
# 2. Testing potential conflicts

# 1. Generating event graphs



# 2. Testing potential conflicts

# 1. Generating event graphs



# 2. Testing potential conflicts

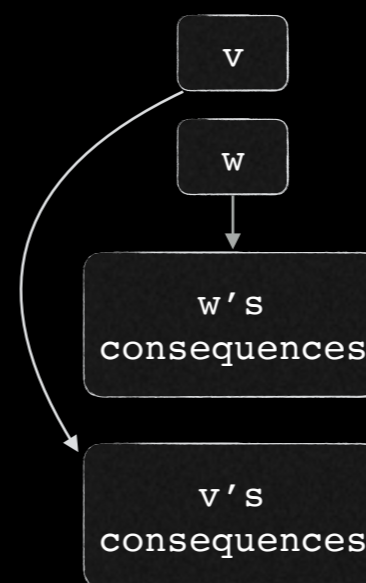
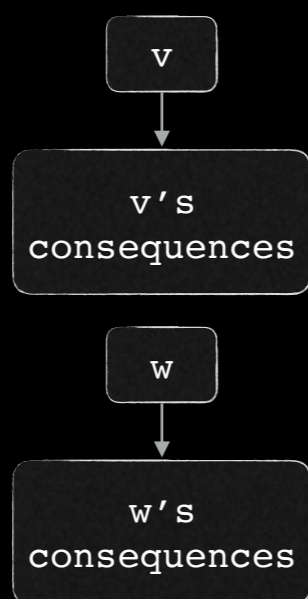
# 1. Generating event graphs

potentially  
conflicted  
events

→ 2. Testing potential conflicts → event races

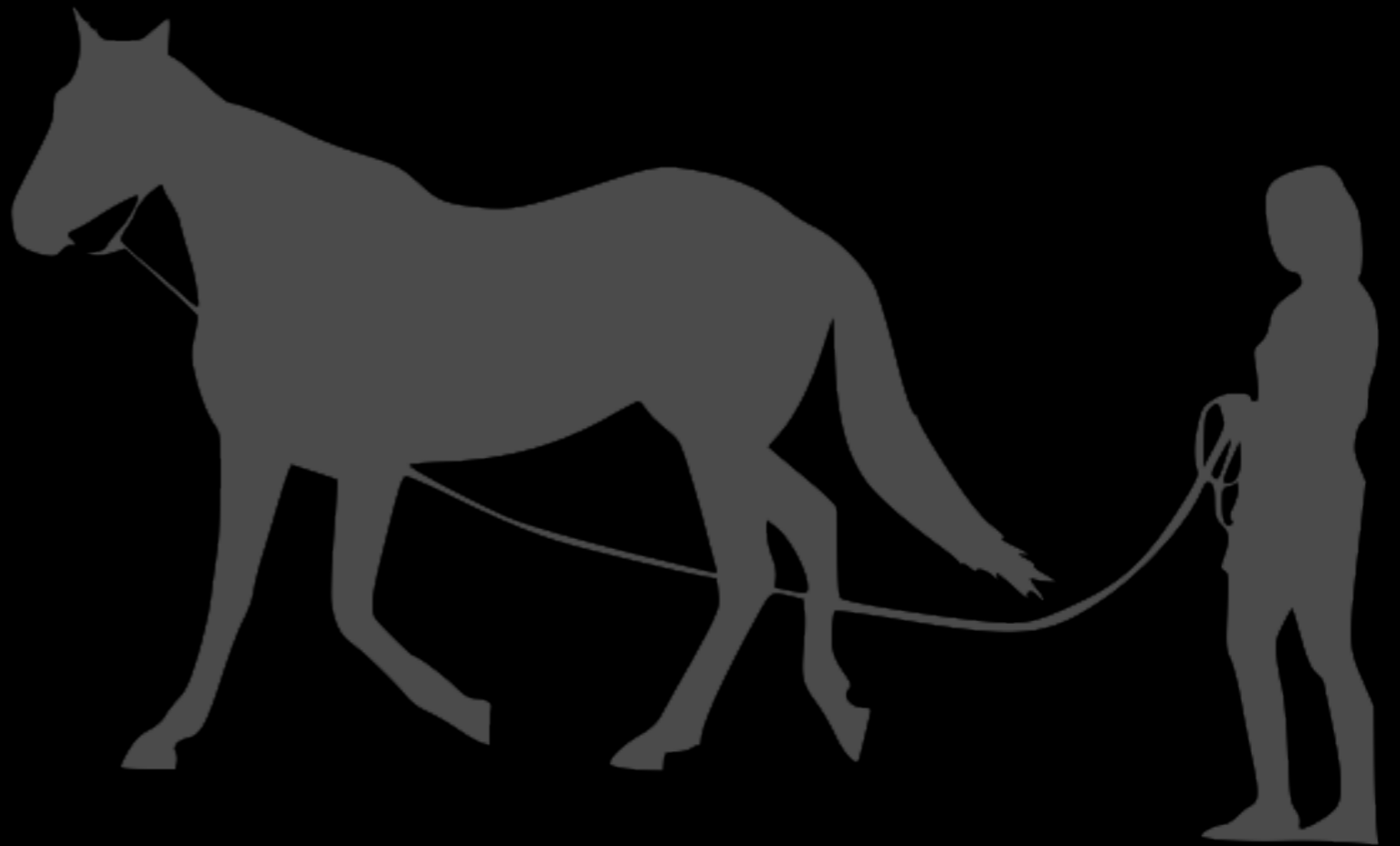
*synchronous mode*

*adverse mode*



Does **A↕AXRacer**

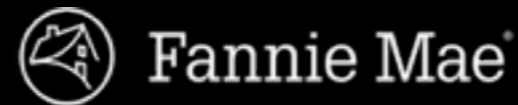
help us find and understand **A↕AX** races?





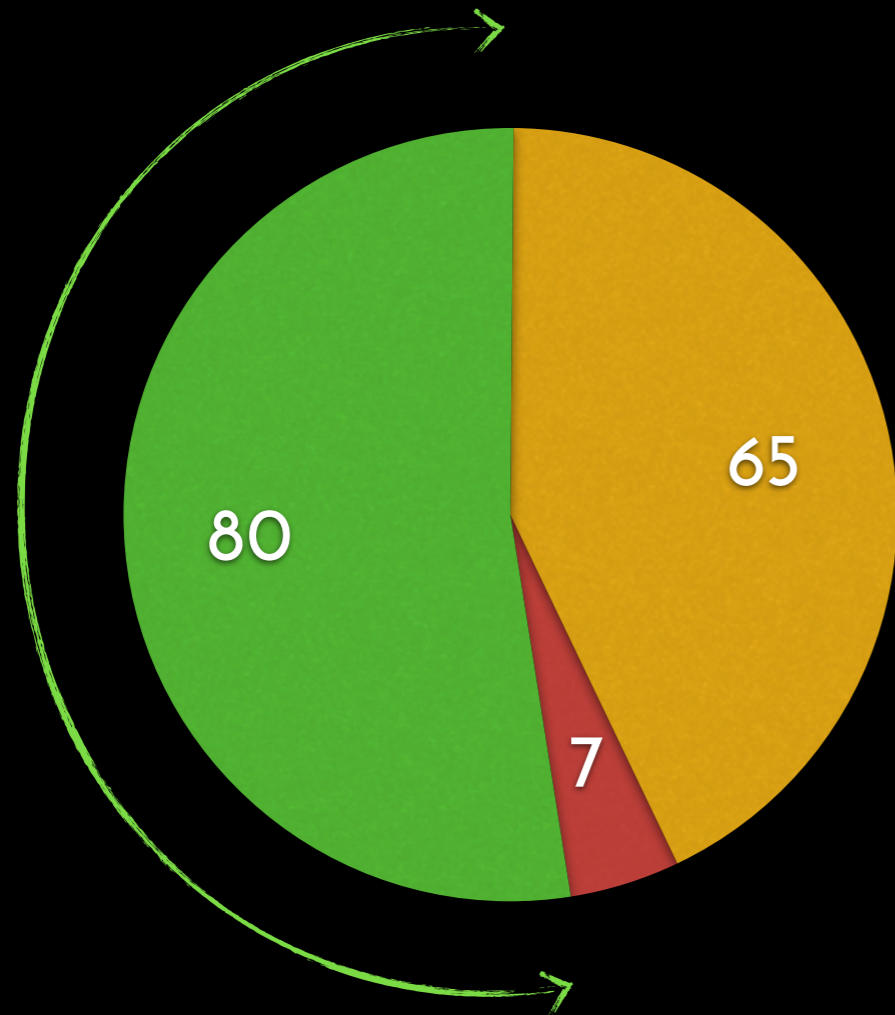
**FORTUNE  
500**

12 web applications, 20 pages



# effectiveness

152 tests

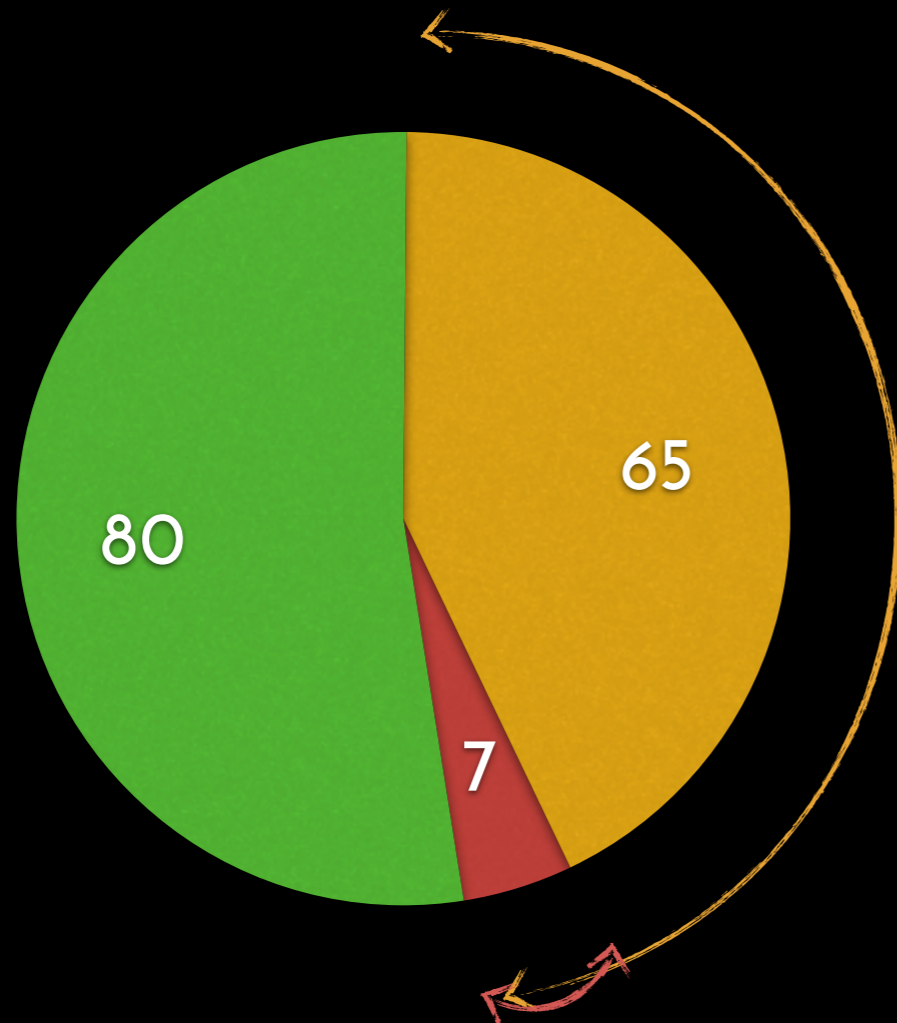


● Pass ● Fail ● False Positive

effectiveness

false positives

152 tests



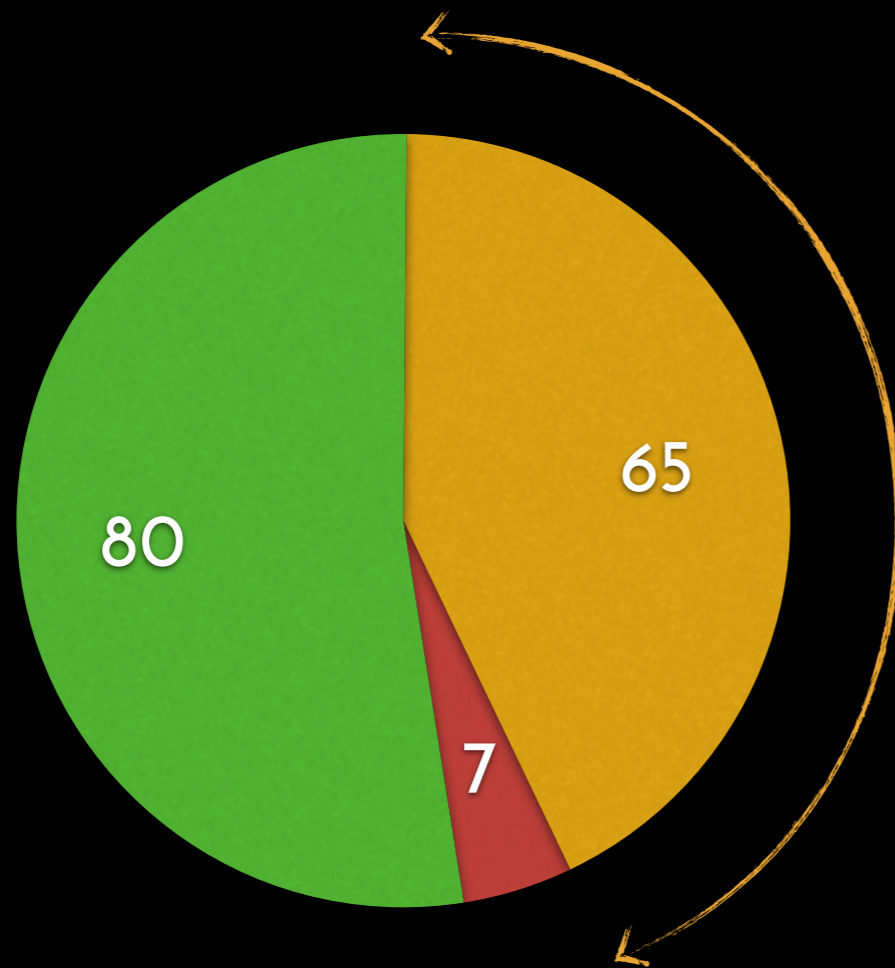
● Pass ● Fail ● False Positive

effectiveness

race characteristics

dataset queries  
interactive maps  
auto completion

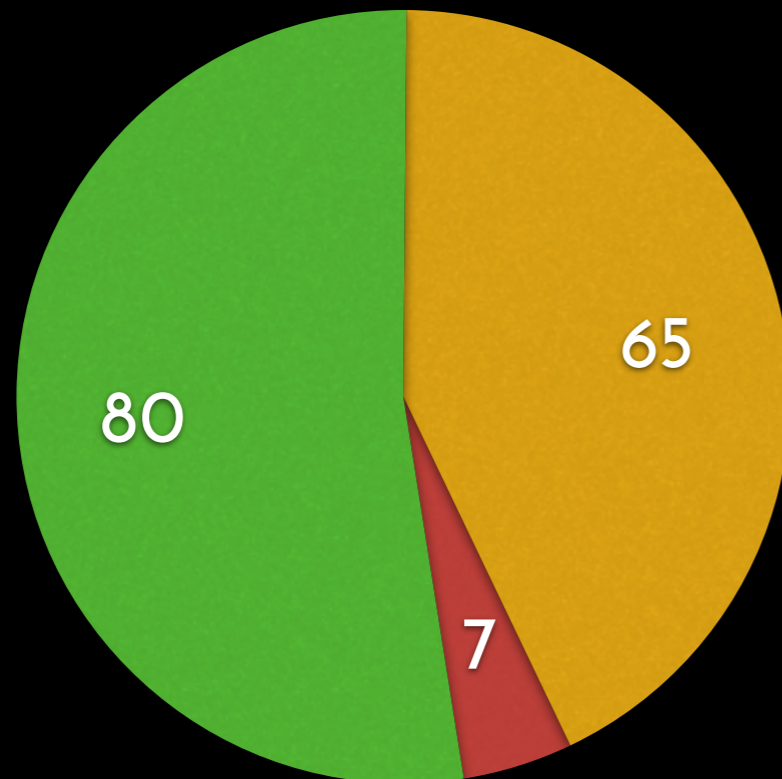
152 tests



● Pass ● Fail ● False Positive

# comparison

152 tests



● Pass ● Fail ● False Positive

EVENTRACER \*



2 events  
~130,000 races  
~37,000 locations  
~740 uncovered

Raychev et al. OOPSLA'13 \*  
<https://eventracer.org/>

# usefulness

1.4GHz dual-core 7th-generation Intel Core i7 processor, Turbo Boost up to 3.6GHz + \$150.00

**\$1,399.00** Add to Bag

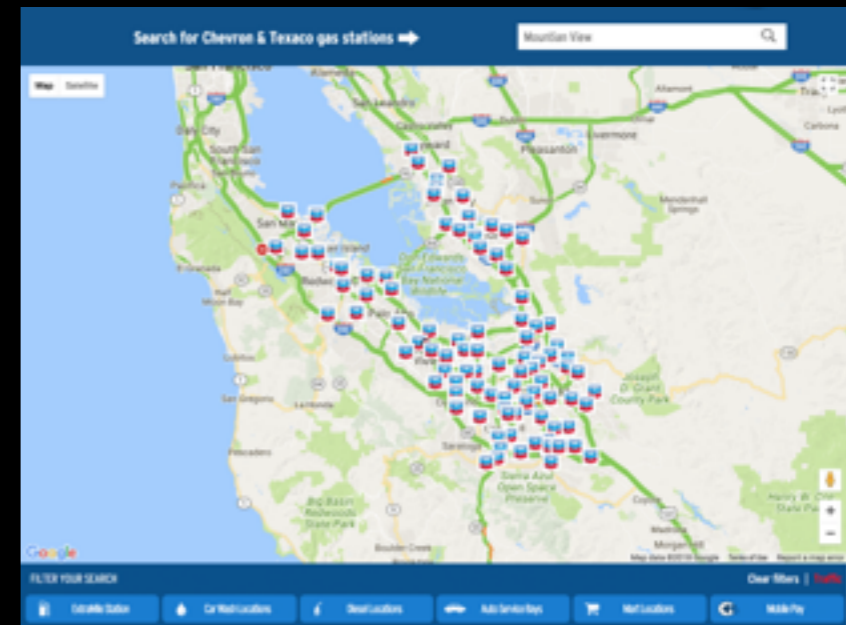
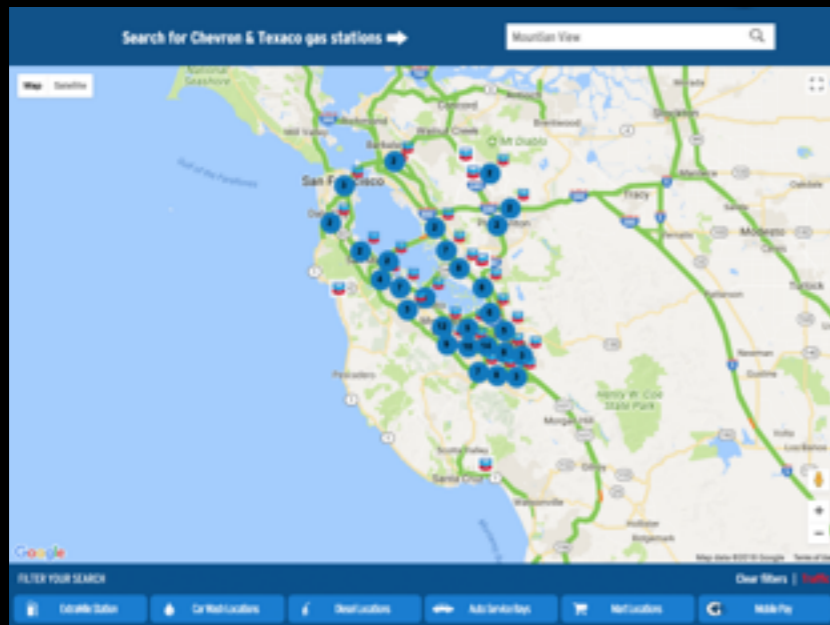
Up to 18 months of special financing >



1.4GHz dual-core 7th-generation Intel Core i7 processor, Turbo Boost up to 3.6GHz + \$150.00

**\$1,509.00** Add to Bag

Up to 18 months of special financing >



# performance

## phase 1



## phase 2 (per test)




# common developer practices






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}
```



### 1. Generating event graphs


- application → Instrument automatically.
- user events → Trigger user events.
- Generate event traces.
- Create event graphs.
- Find event conflicts.



### 2. Testing potential conflicts

AJAXRacer

### usefulness



### performance

phase 1

duration (s)	18	8	avg: 26s
	page load	execution	

phase 2 (per test)

duration (s)	36	28	5	avg: 69s
	page load	execution	report	