ACDC4JS

How to analyze a JavaScript garbage collector

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Related work

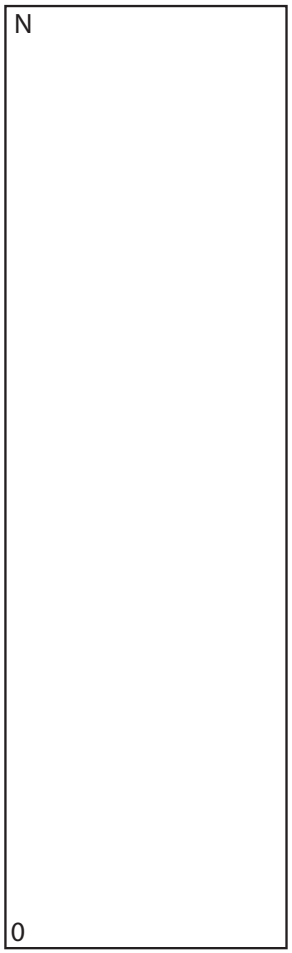
ACDC: Towards a Universal Mutator for Benchmarking Heap Management Systems

Authors
Martin Aigner
Christoph Kirsch

Memory management

- Typical memory structure
  1. Program code
  2. Constants (e.g. strings)
  3. Heap
  4. Stack

Memory management



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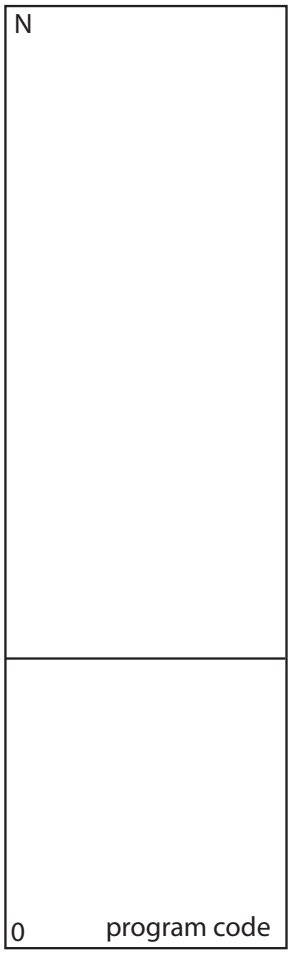

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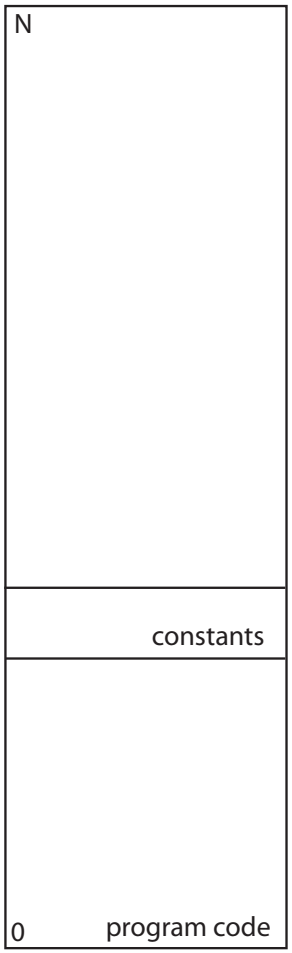

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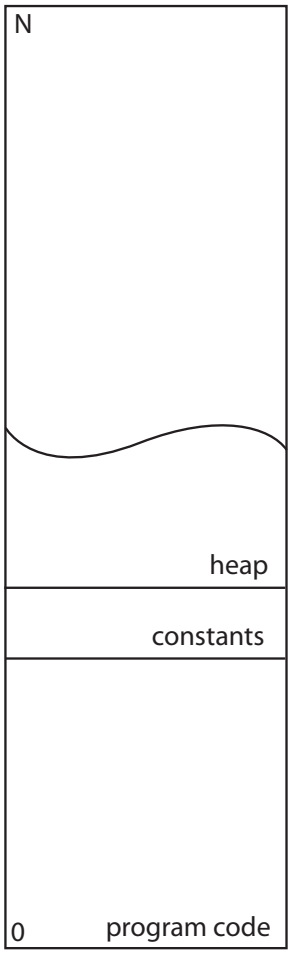

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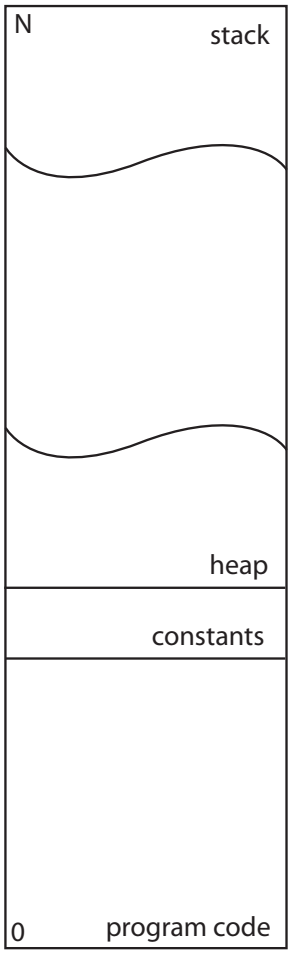

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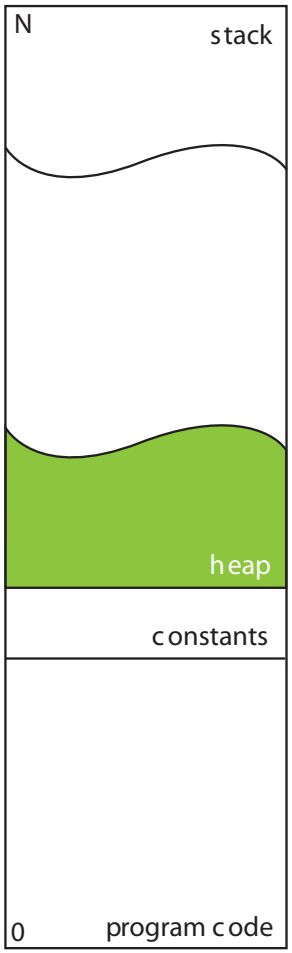
MEMORY MANAGEMENT



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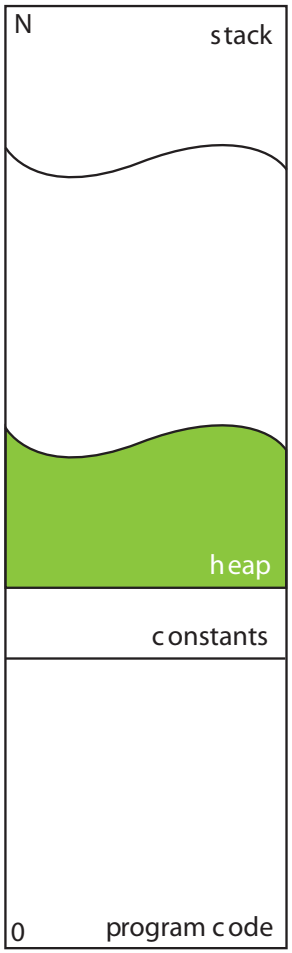

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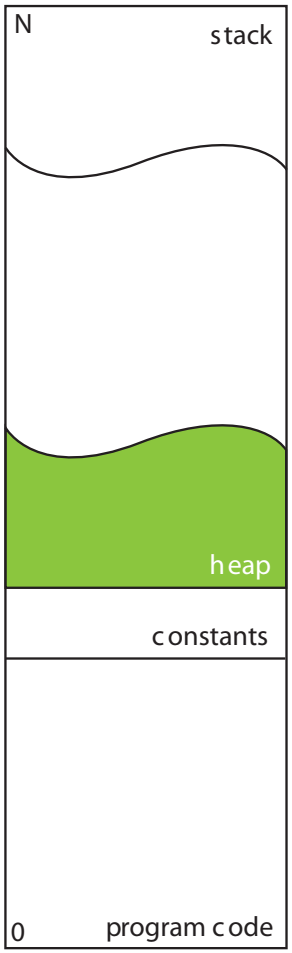

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- Memory management in C
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- Memory management in JavaScript
  - **Allocation** explicit / implicit
  - **Deallocation** implicit

Memory management

```
1  // C
2  char *s = malloc(4*sizeof(char)); // explicit allocation
3  strncpy(s, "abc\0", 4);
4  ...
5  access(s);
6  ...
7  free(s);                          // explicit deallocation
```

Memory management

```c
// C
char *s = malloc(4*sizeof(char)); // explicit allocation
strncpy(s, "abc\0", 4);
...
access(s);
...
free(s);                          // explicit deallocation
```

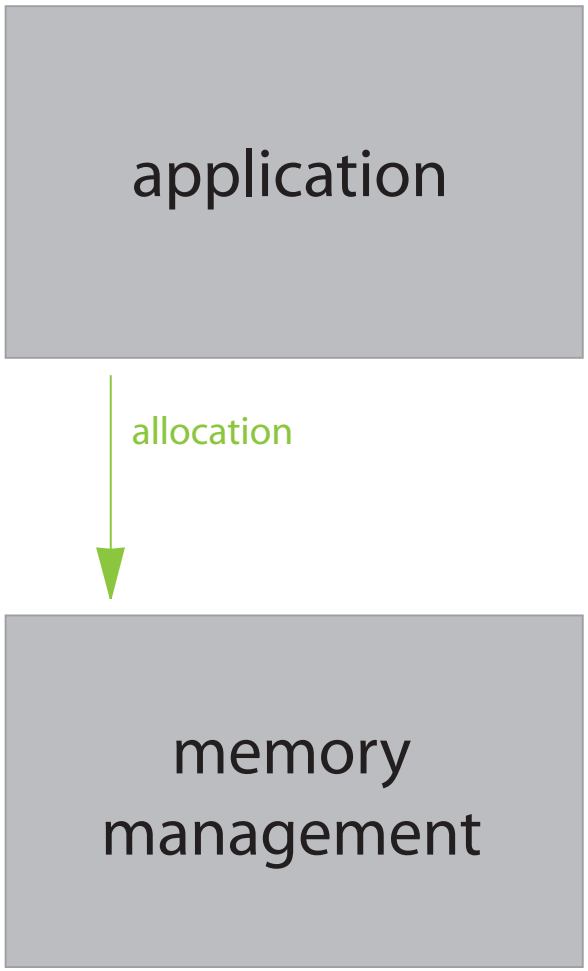
```javascript
// JS
function dosomething() {
  var s = "abc";                  // implicit allocation
  ...
}                                 // destroy references

dosomething();
```

MEMORY MANAGEMENT

application

memory management

Memory management



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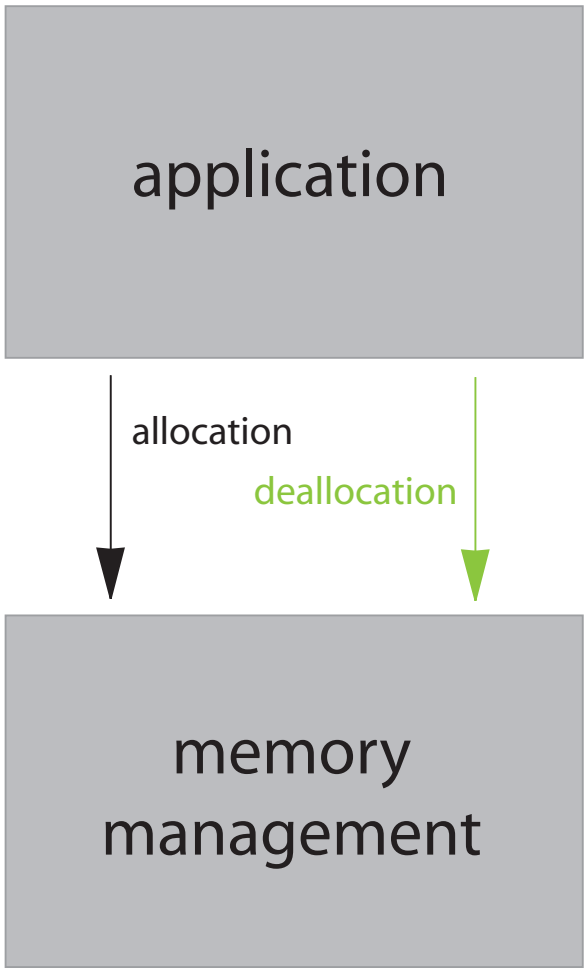

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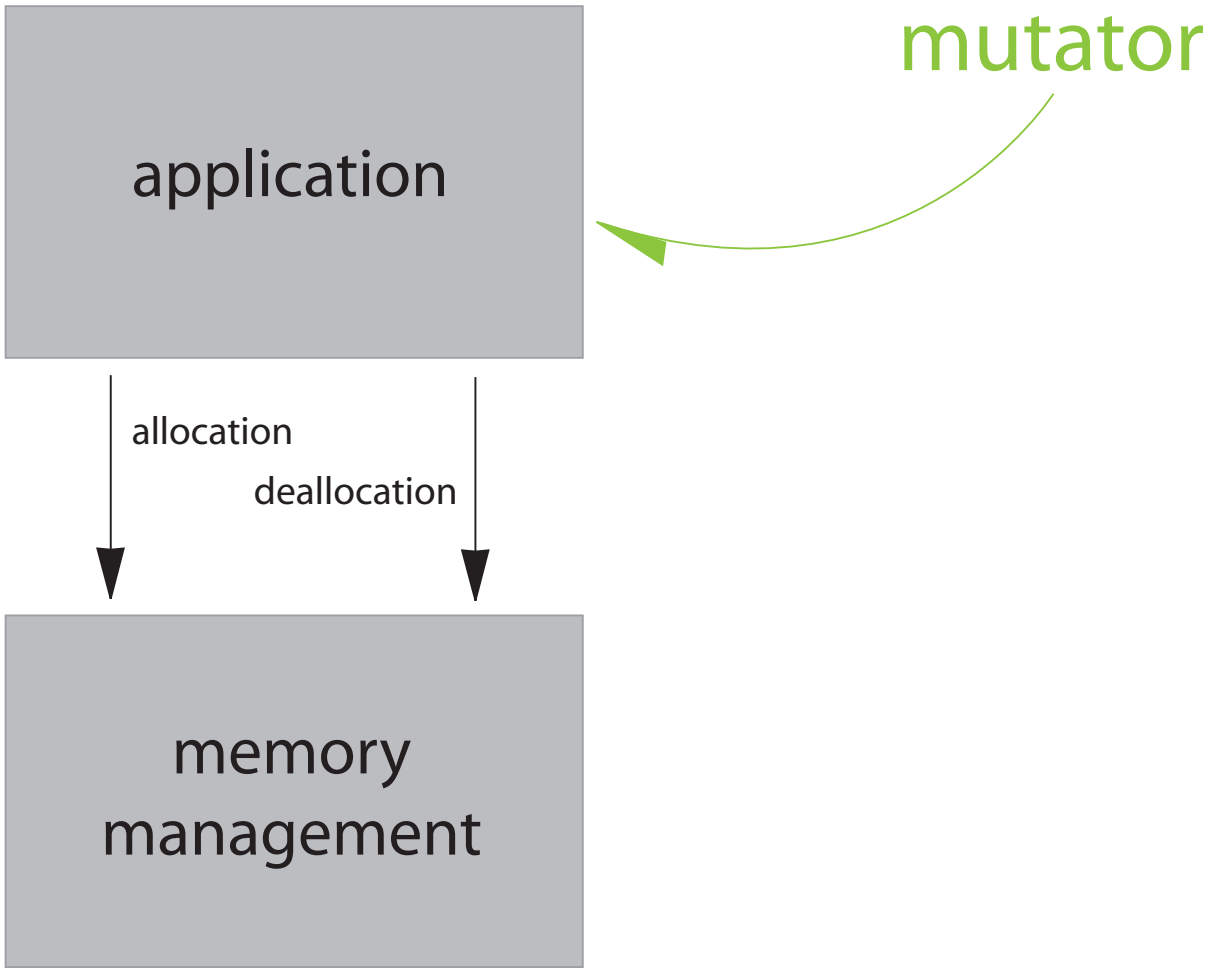

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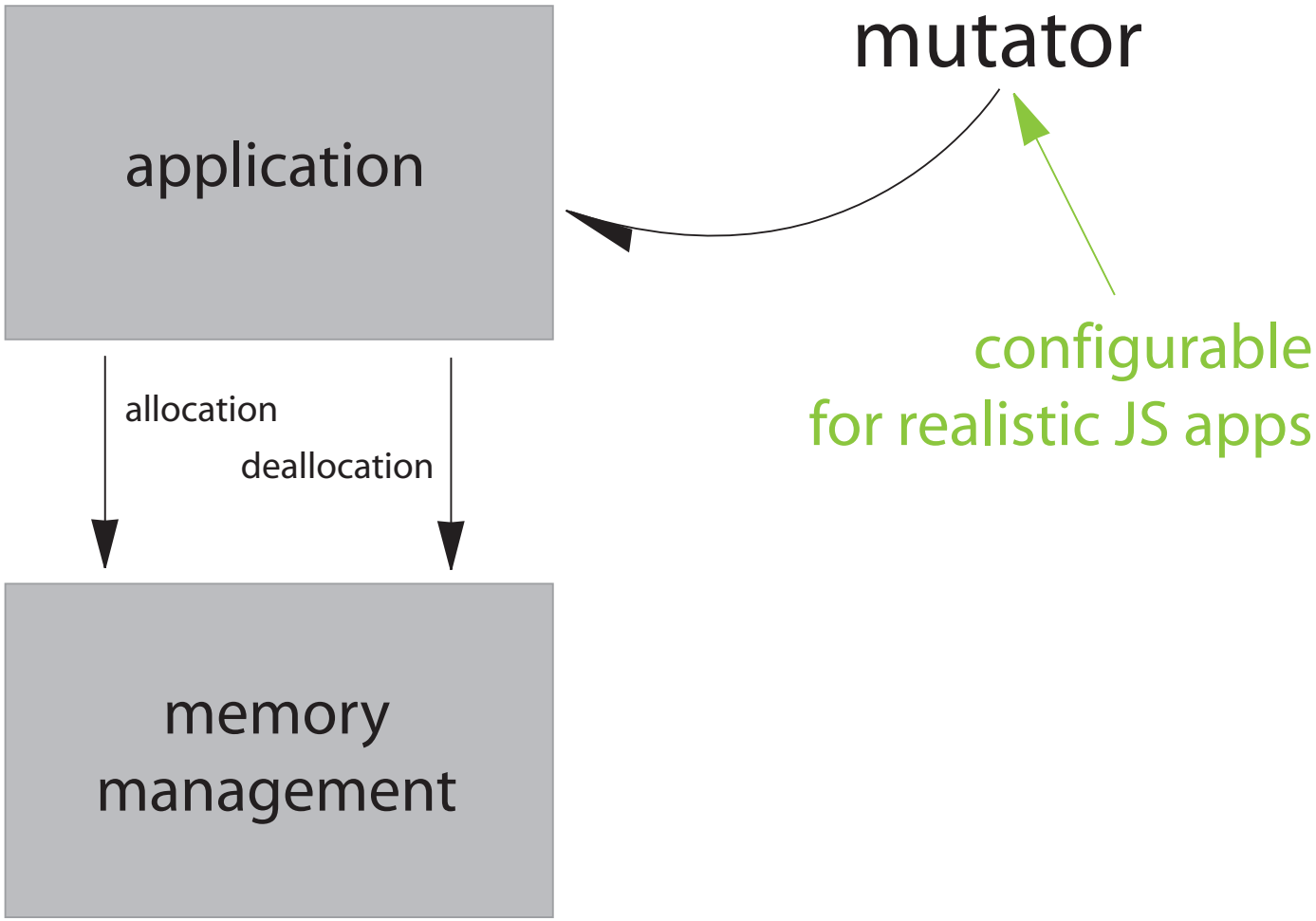

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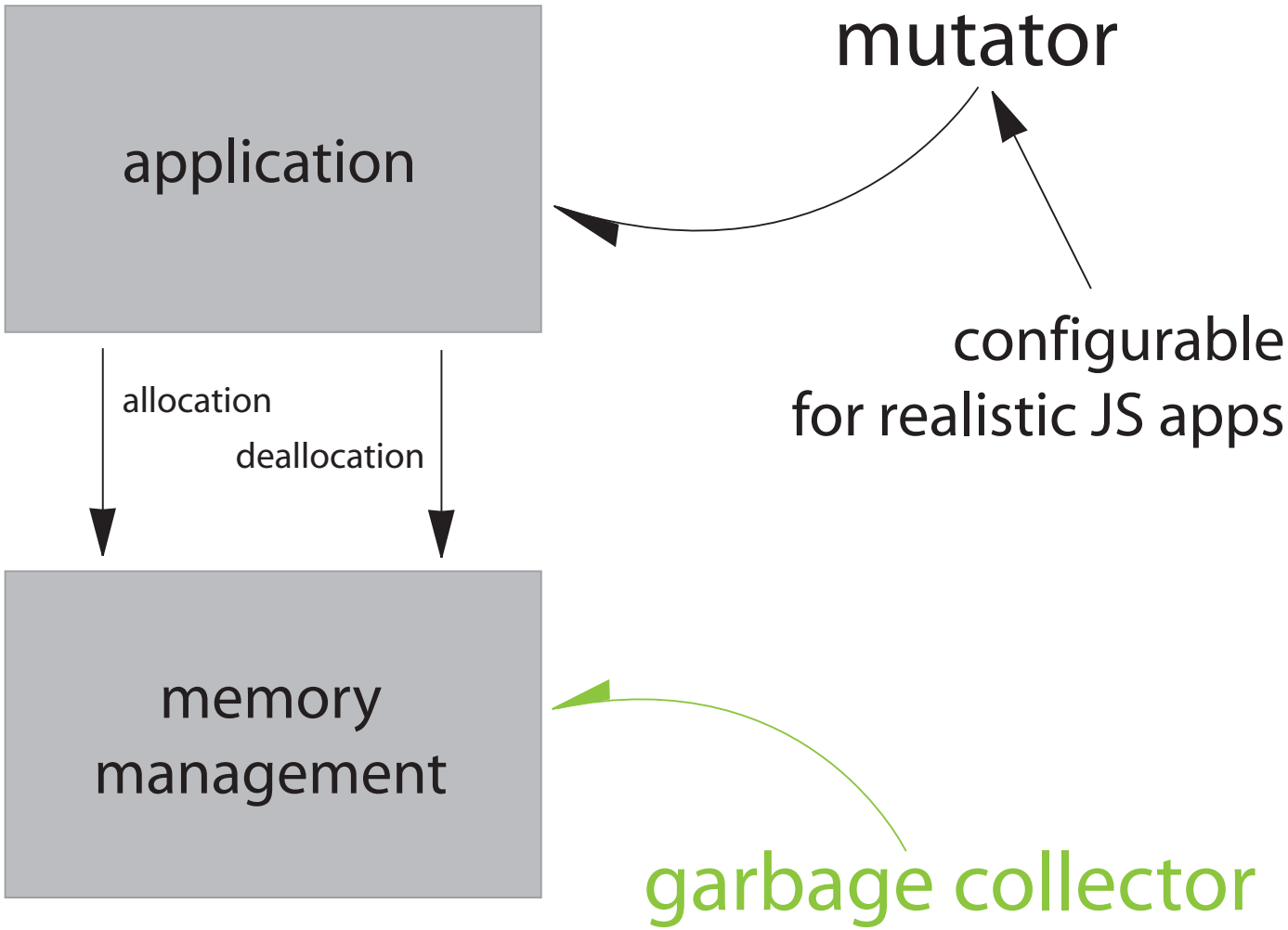

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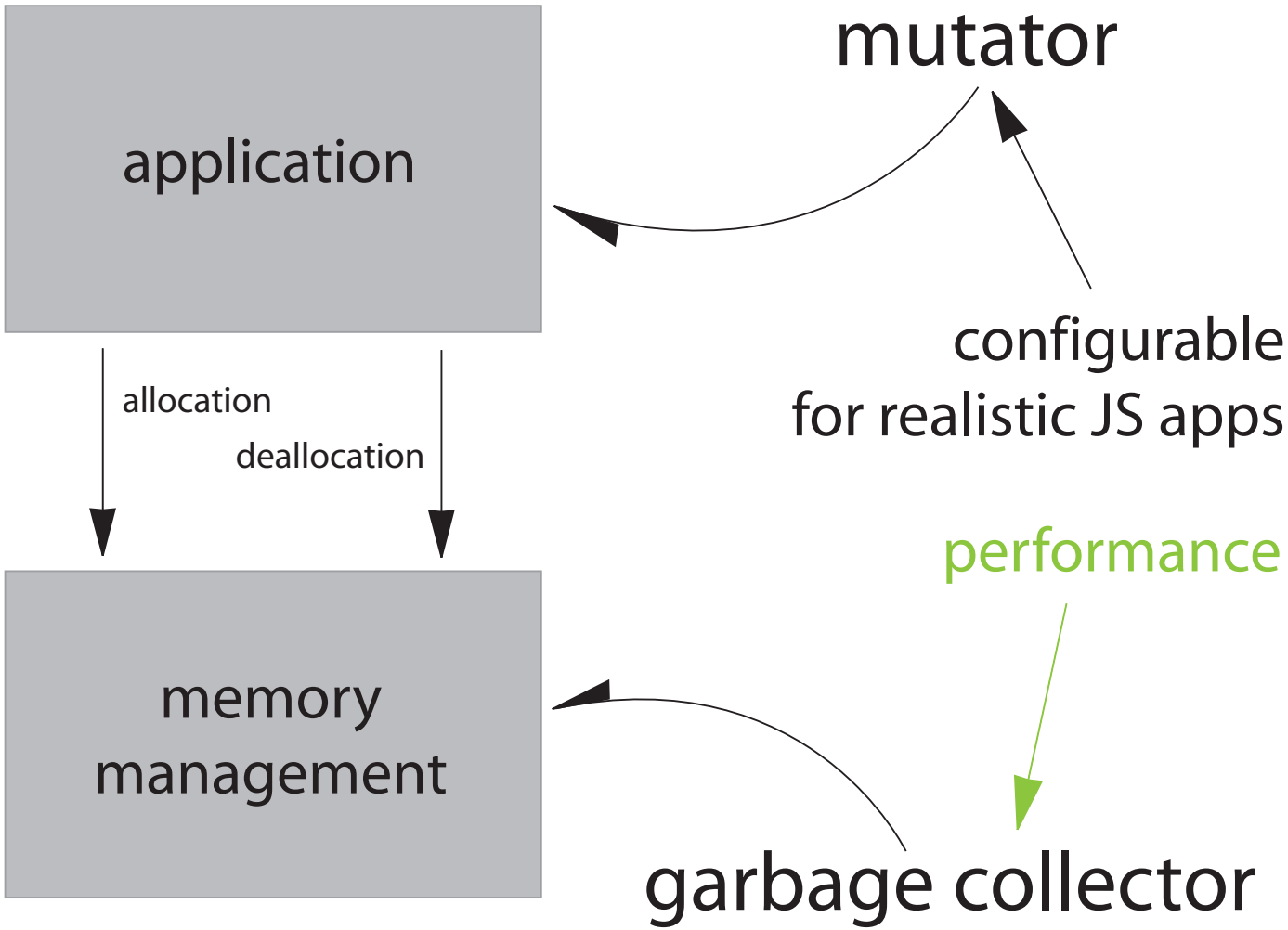

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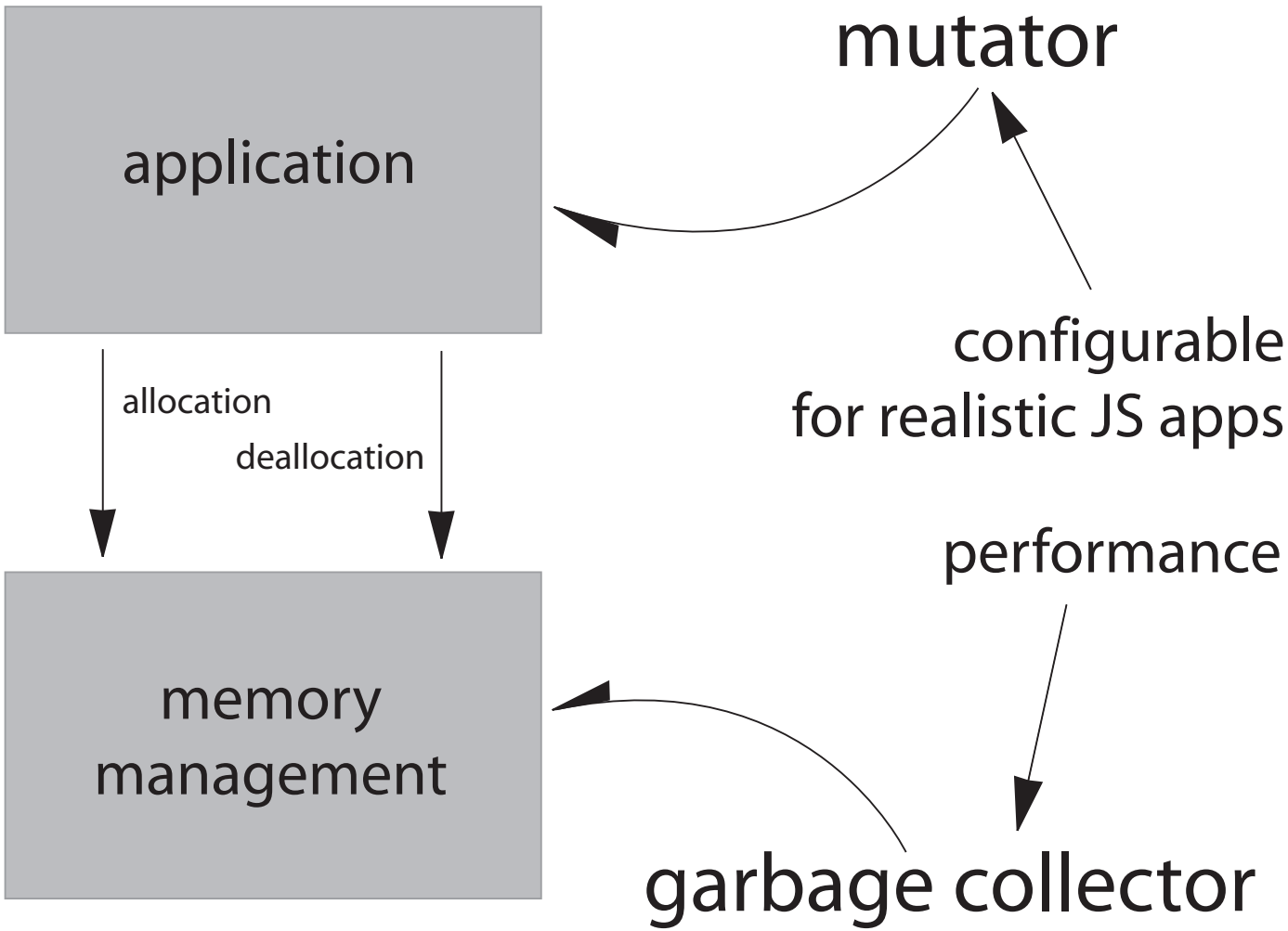
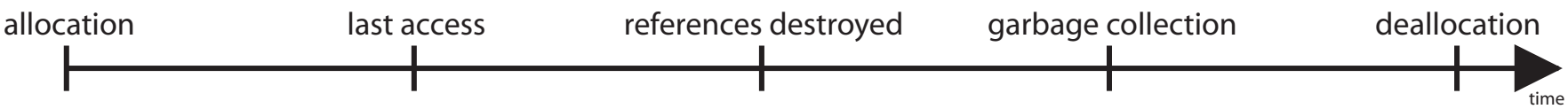


Garbage Collector

- differs between live memory and dead memory
- deallocates dead memory for reuse

DIFFERENCE BETWEEN LIVE AND DEAD MEMORY



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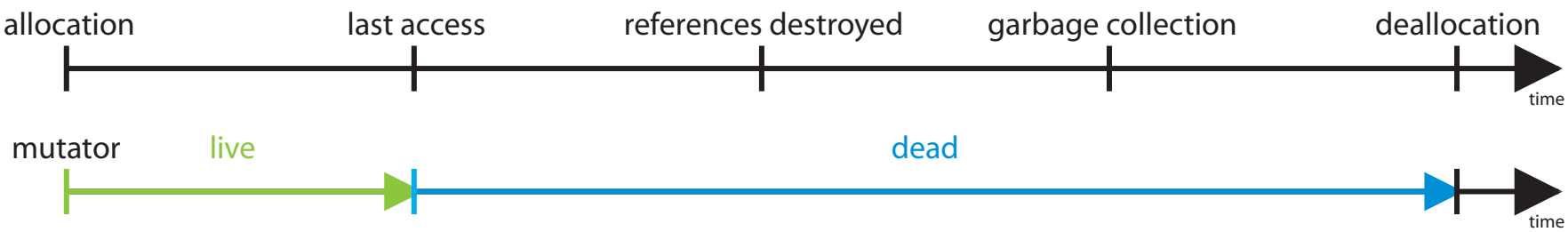

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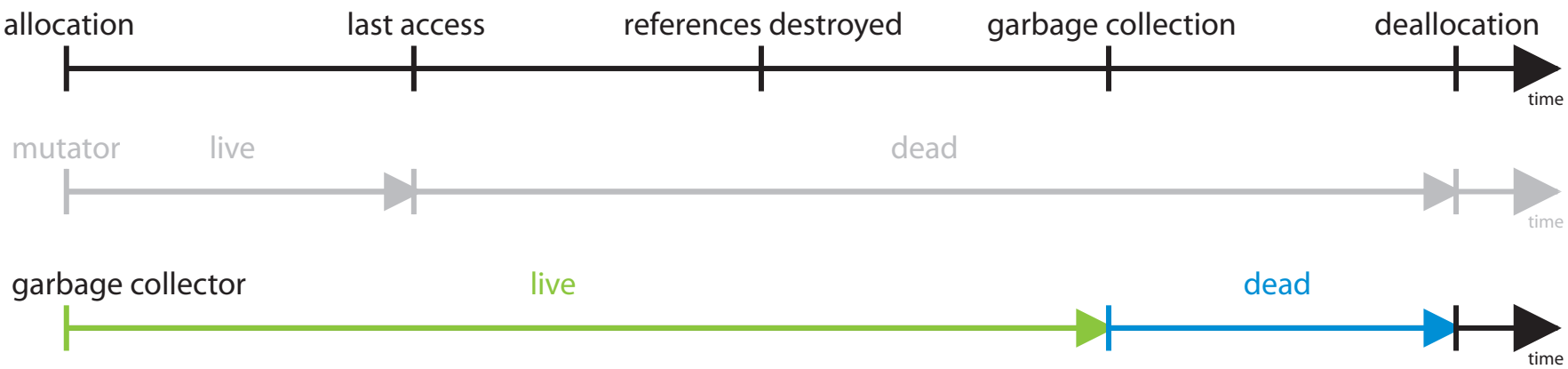

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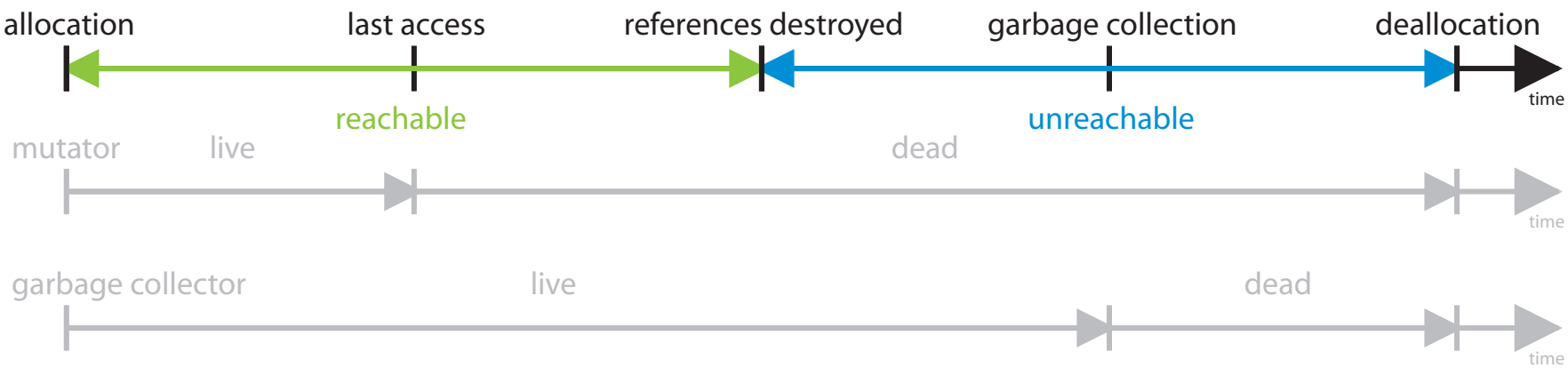
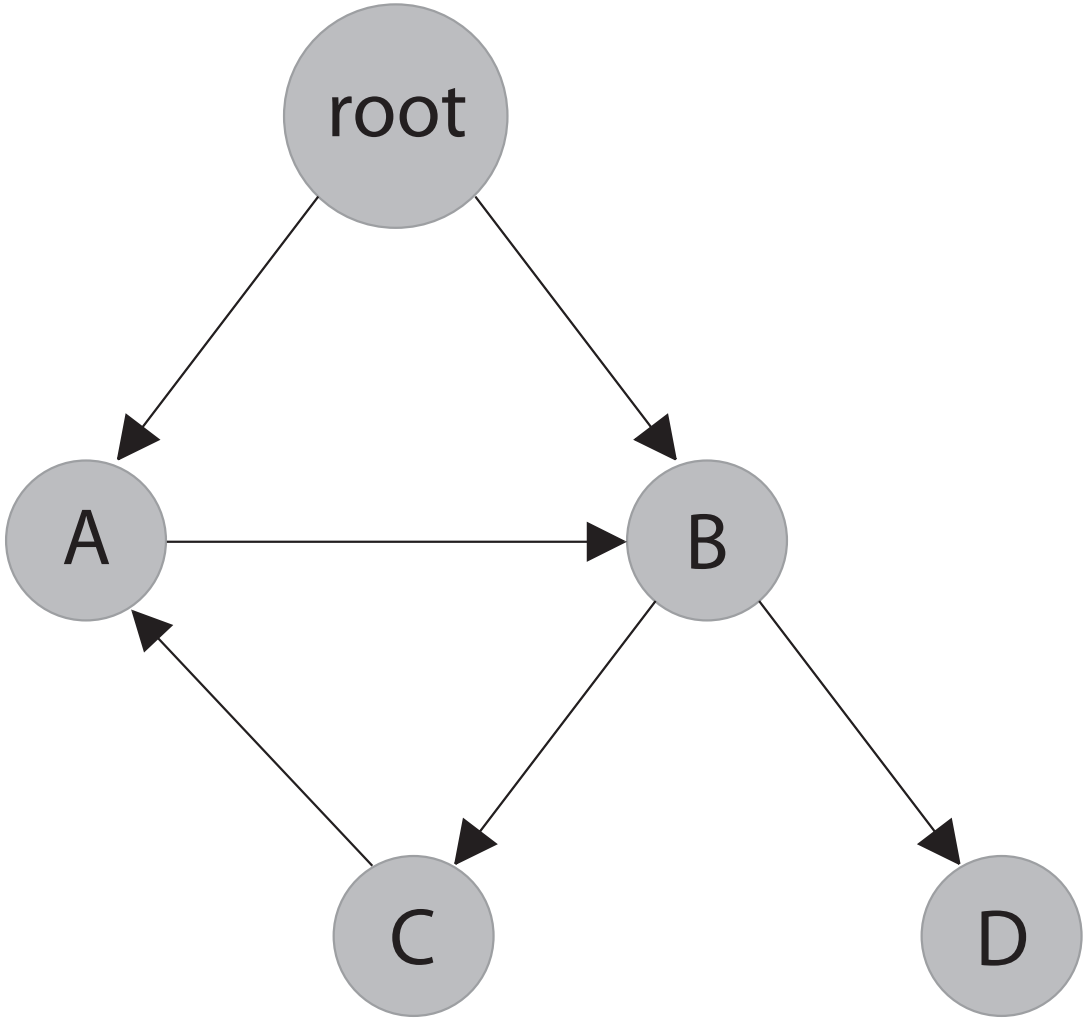


TRACING



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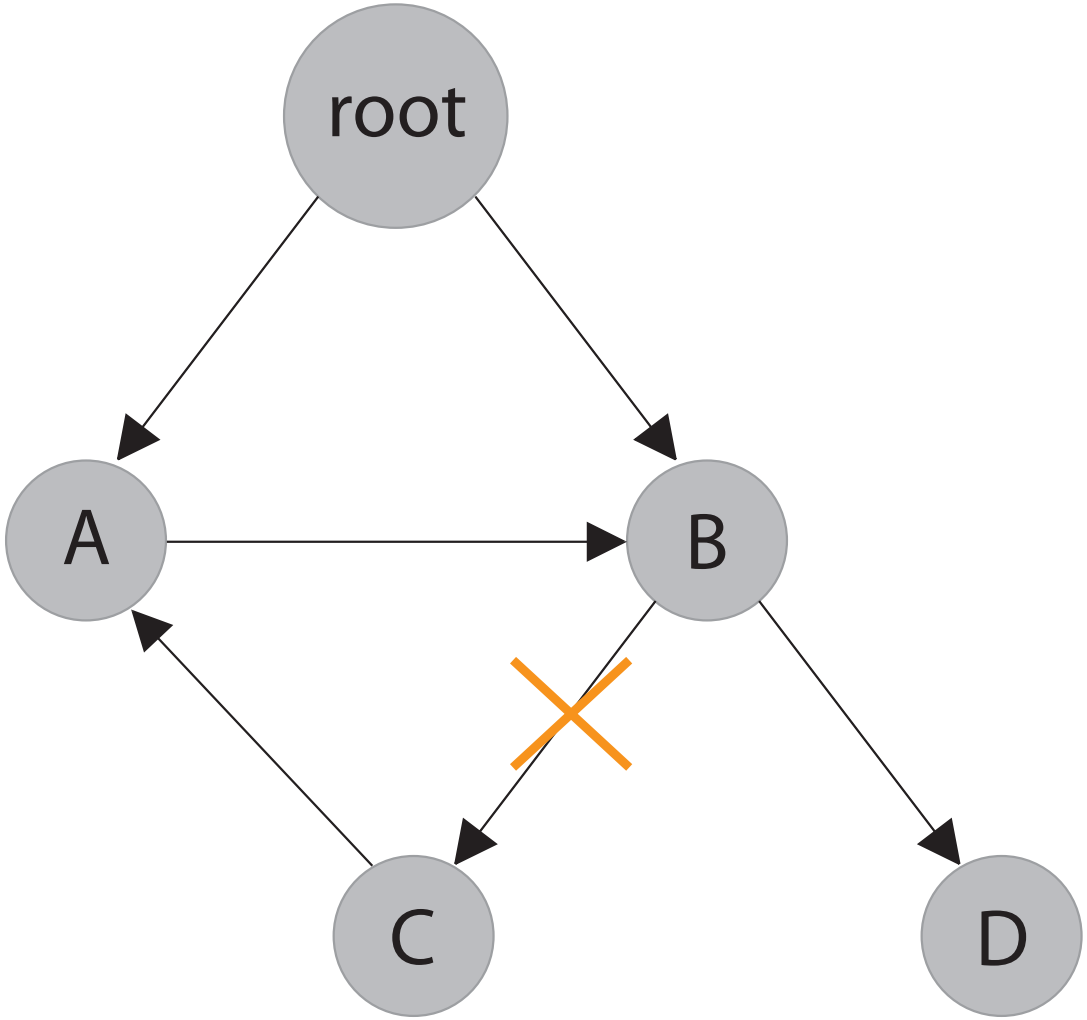

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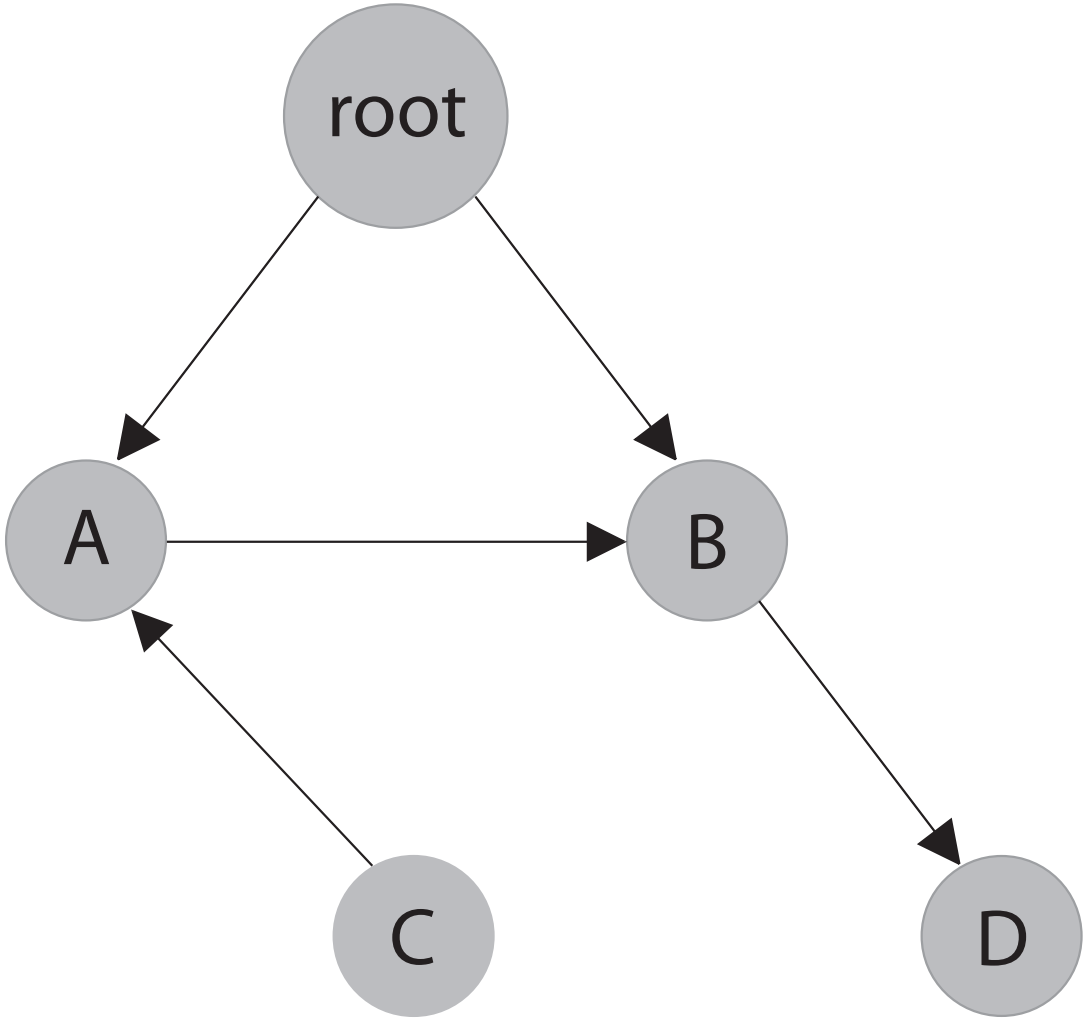

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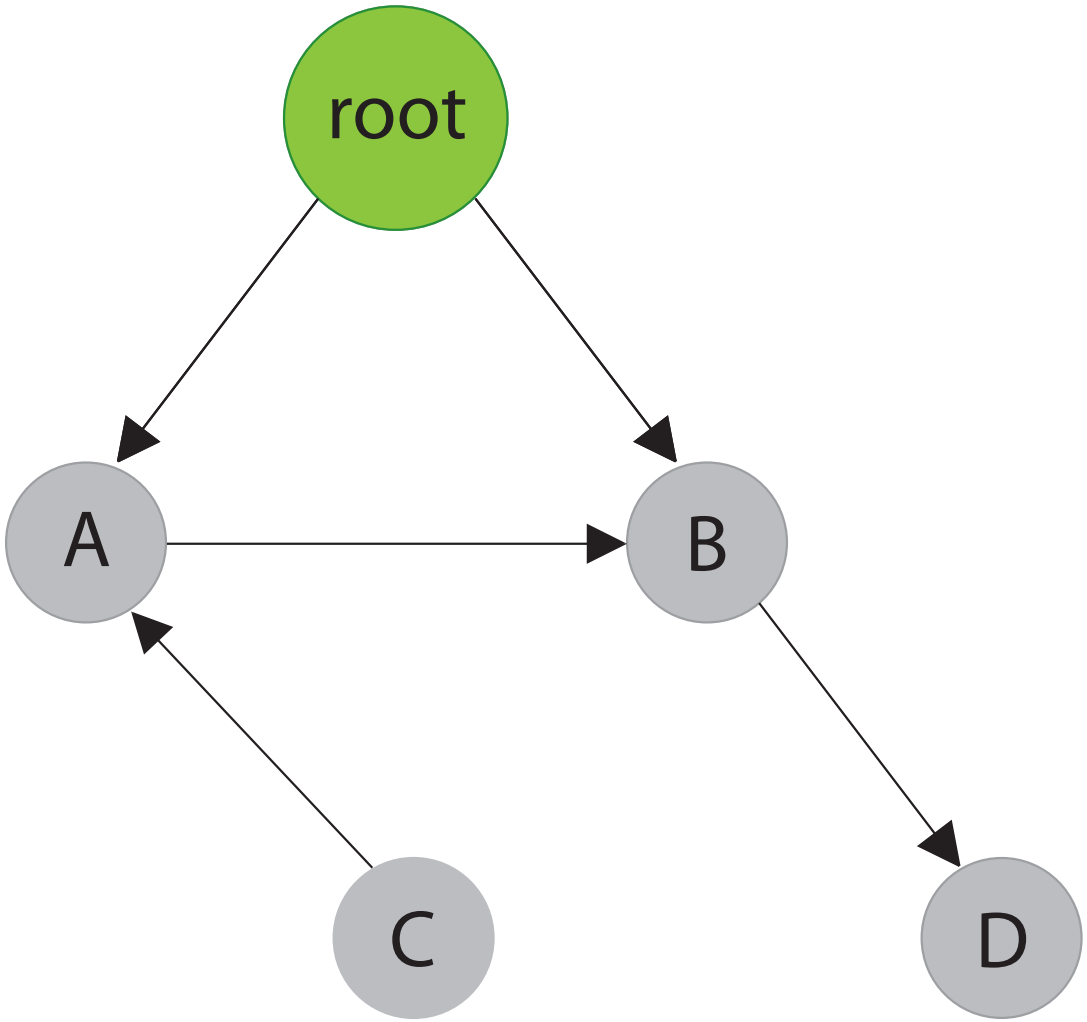

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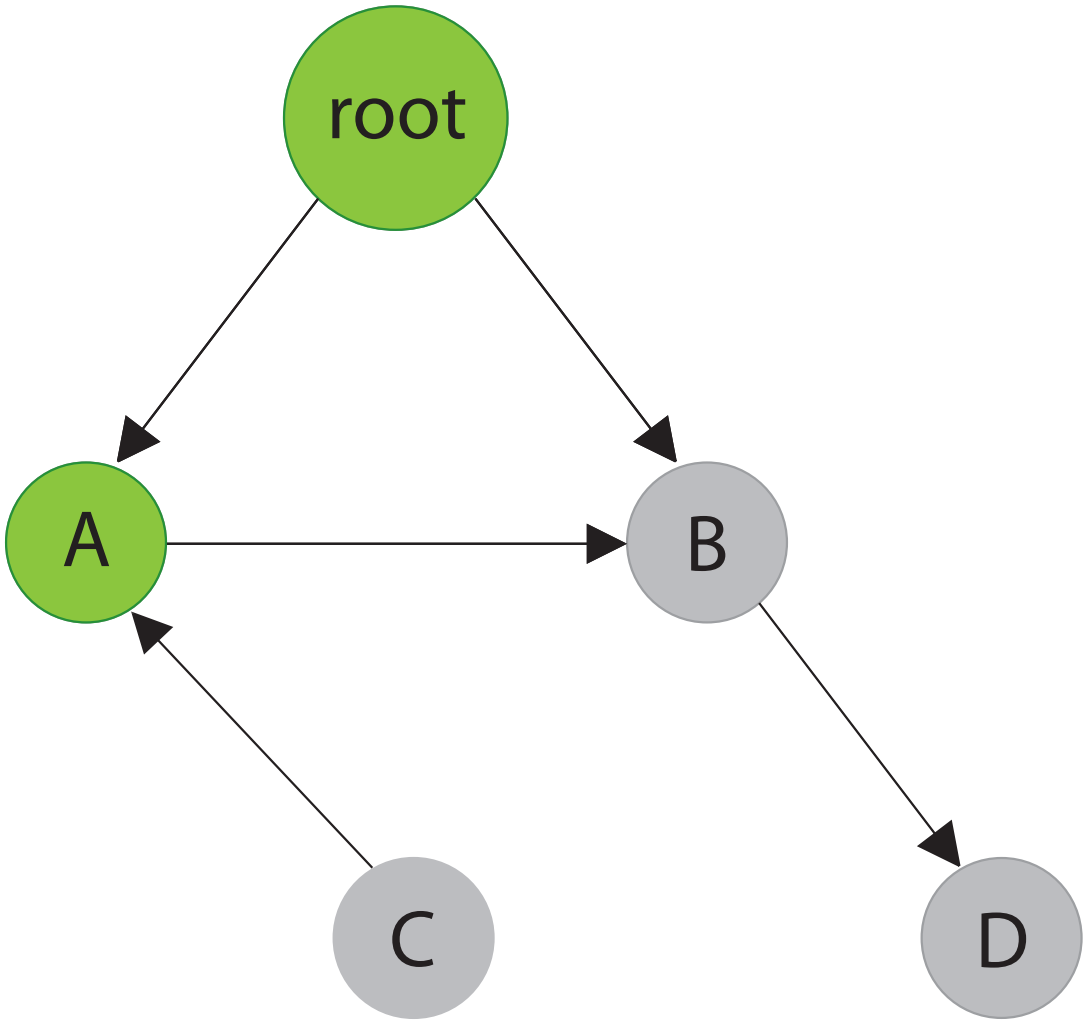

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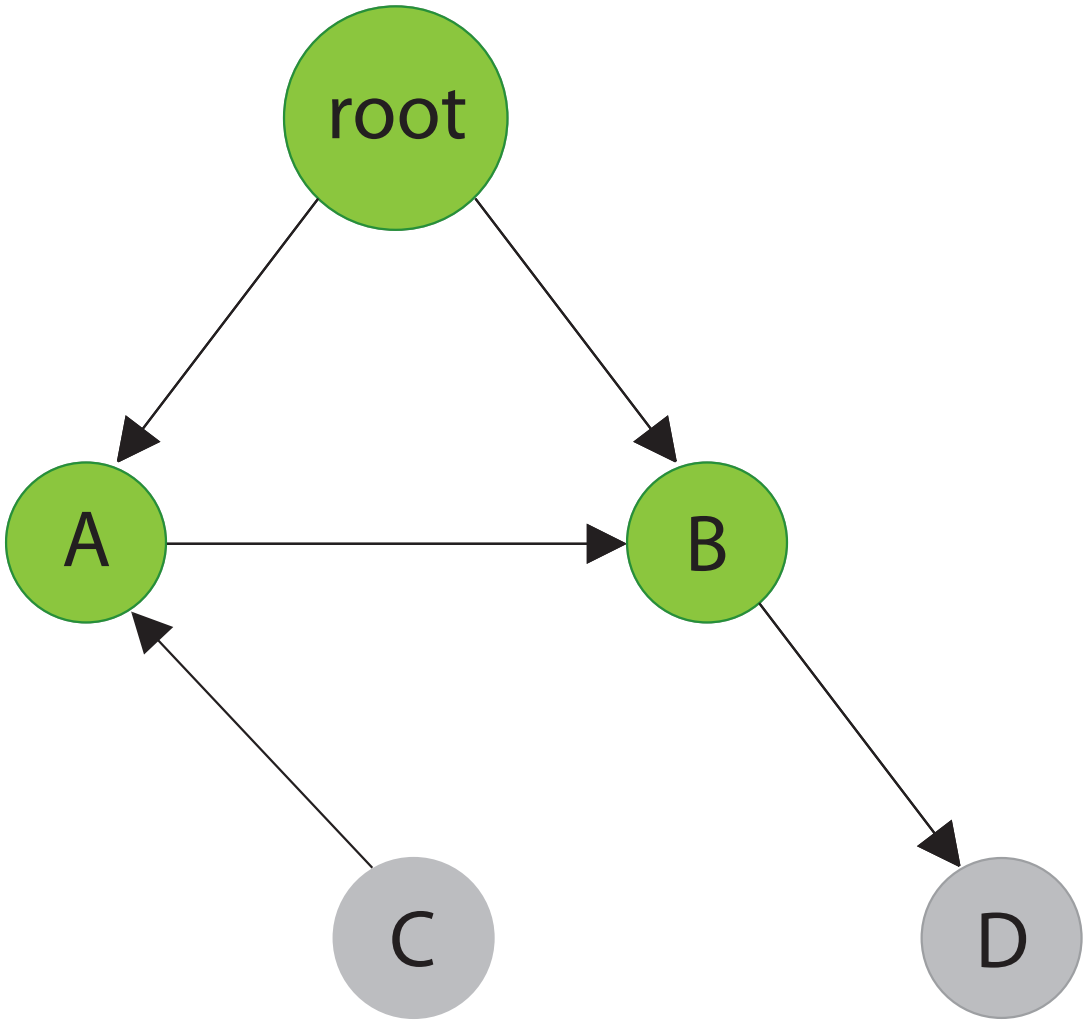

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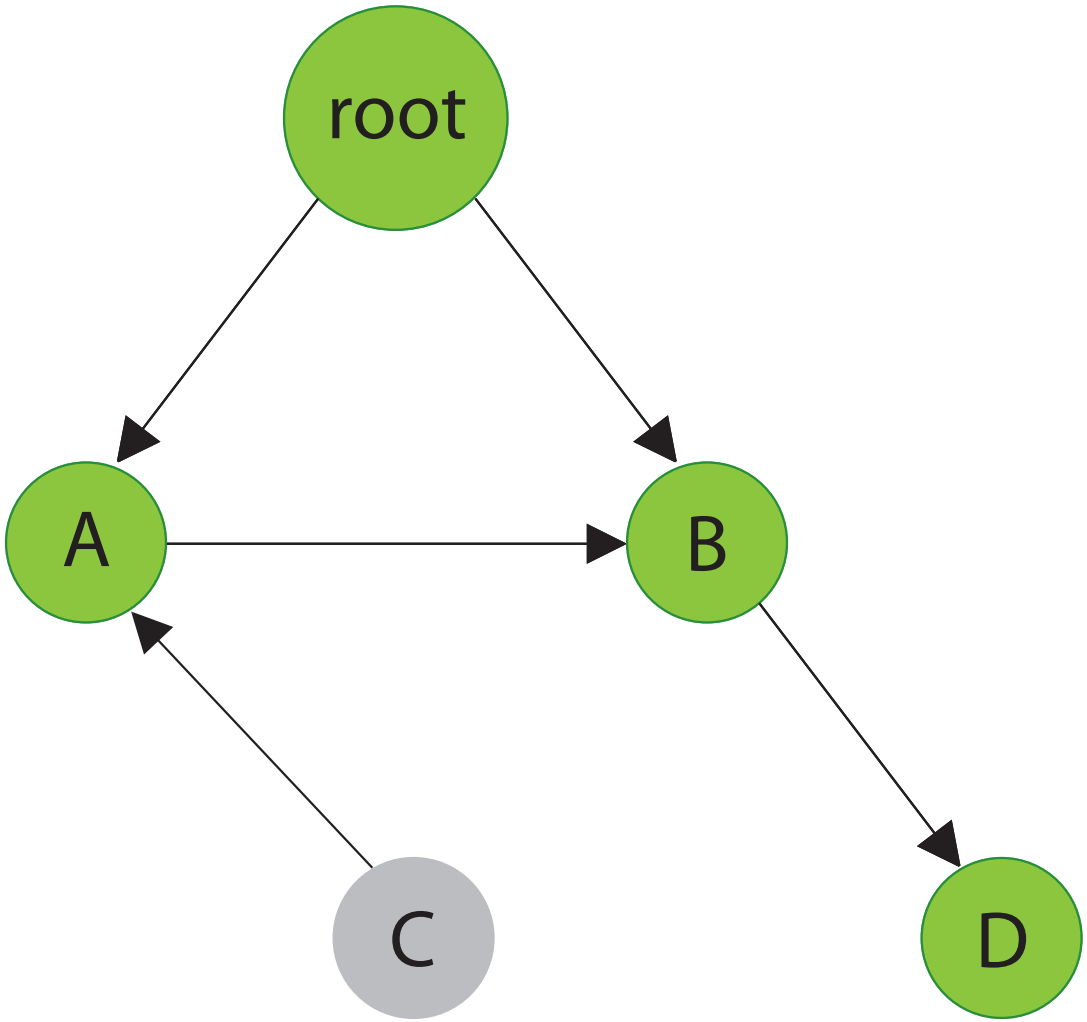

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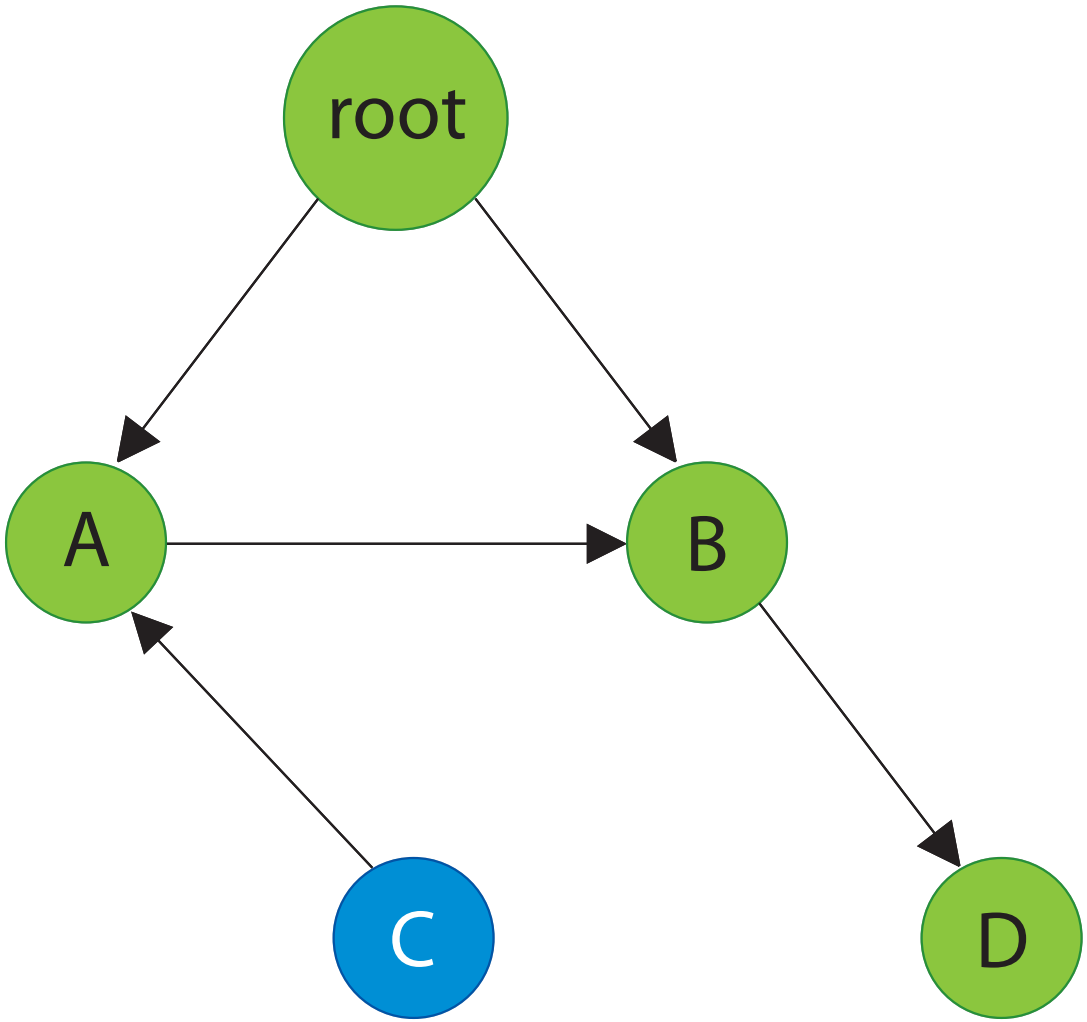

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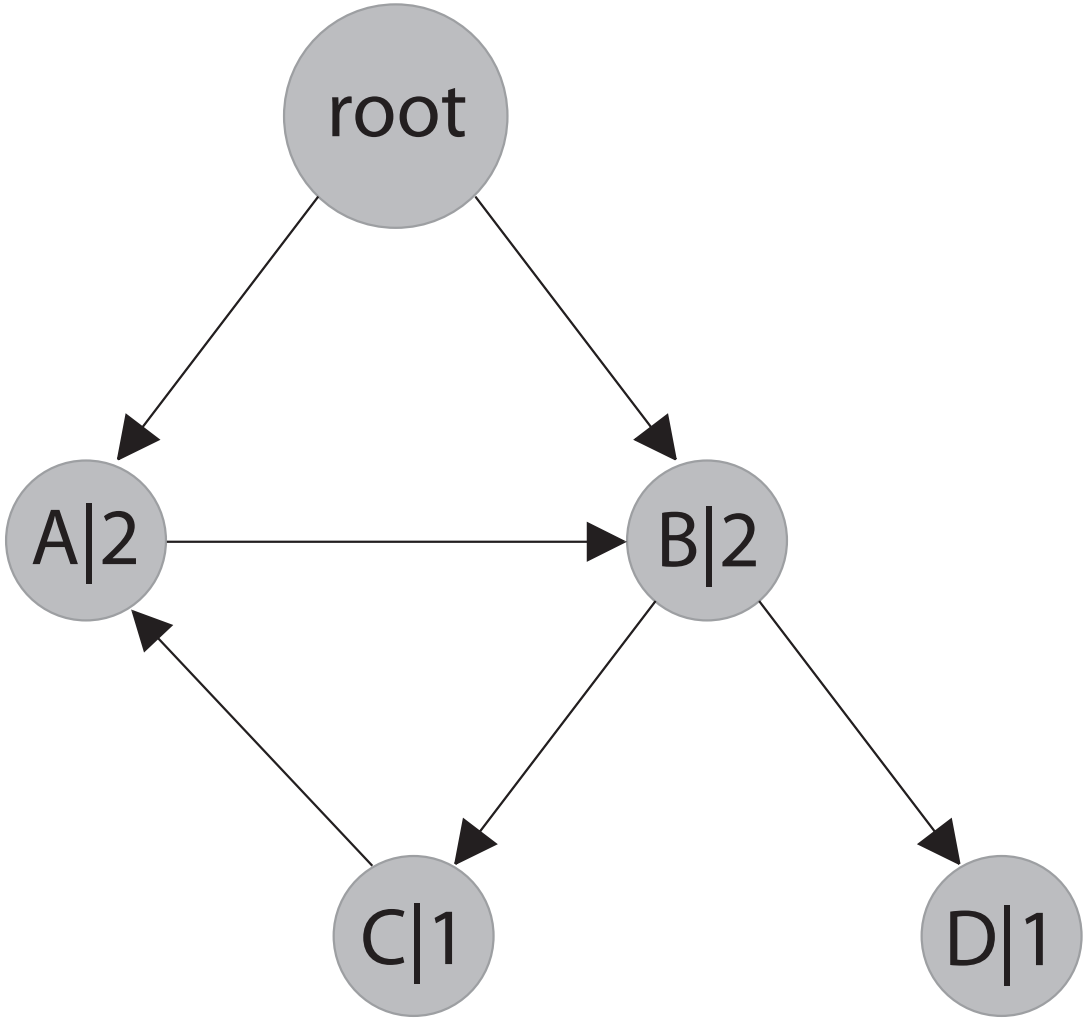

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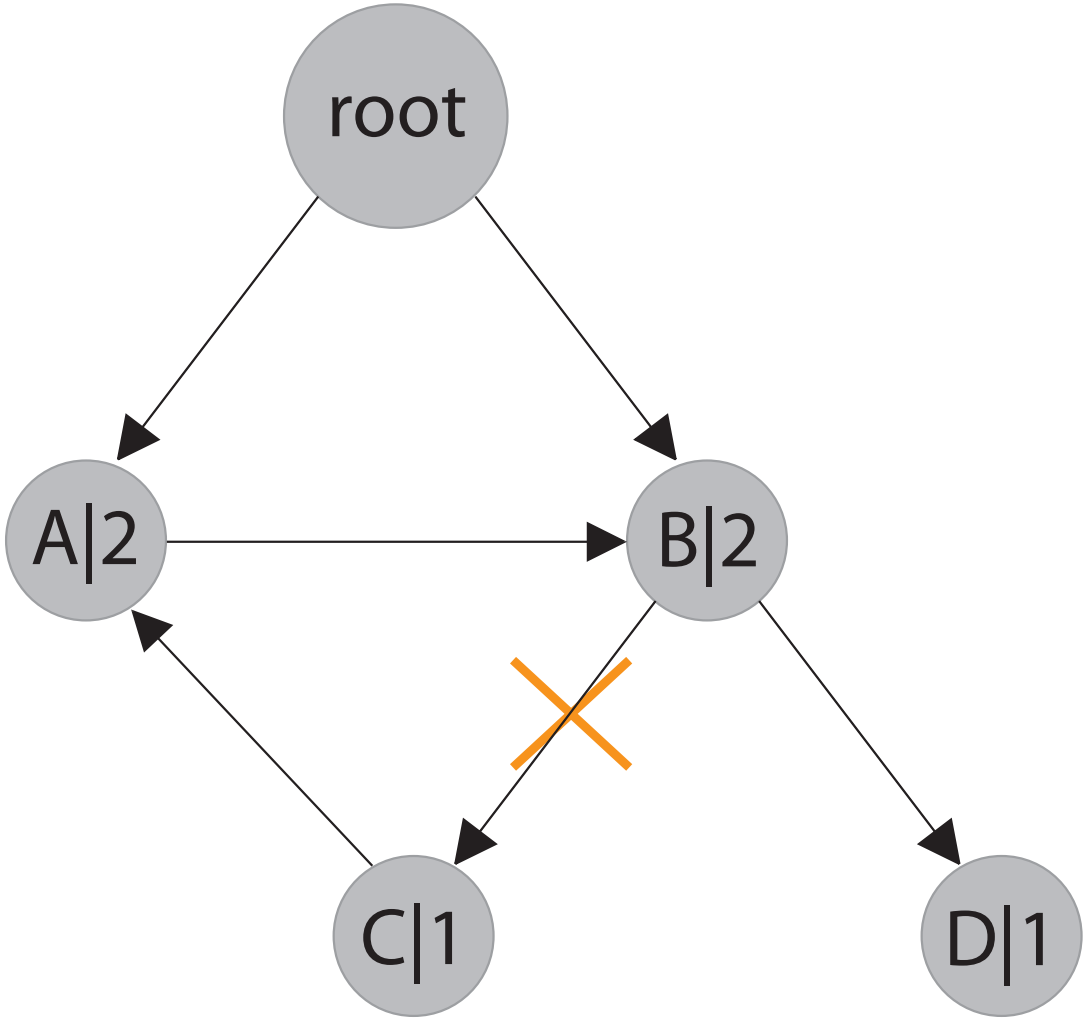

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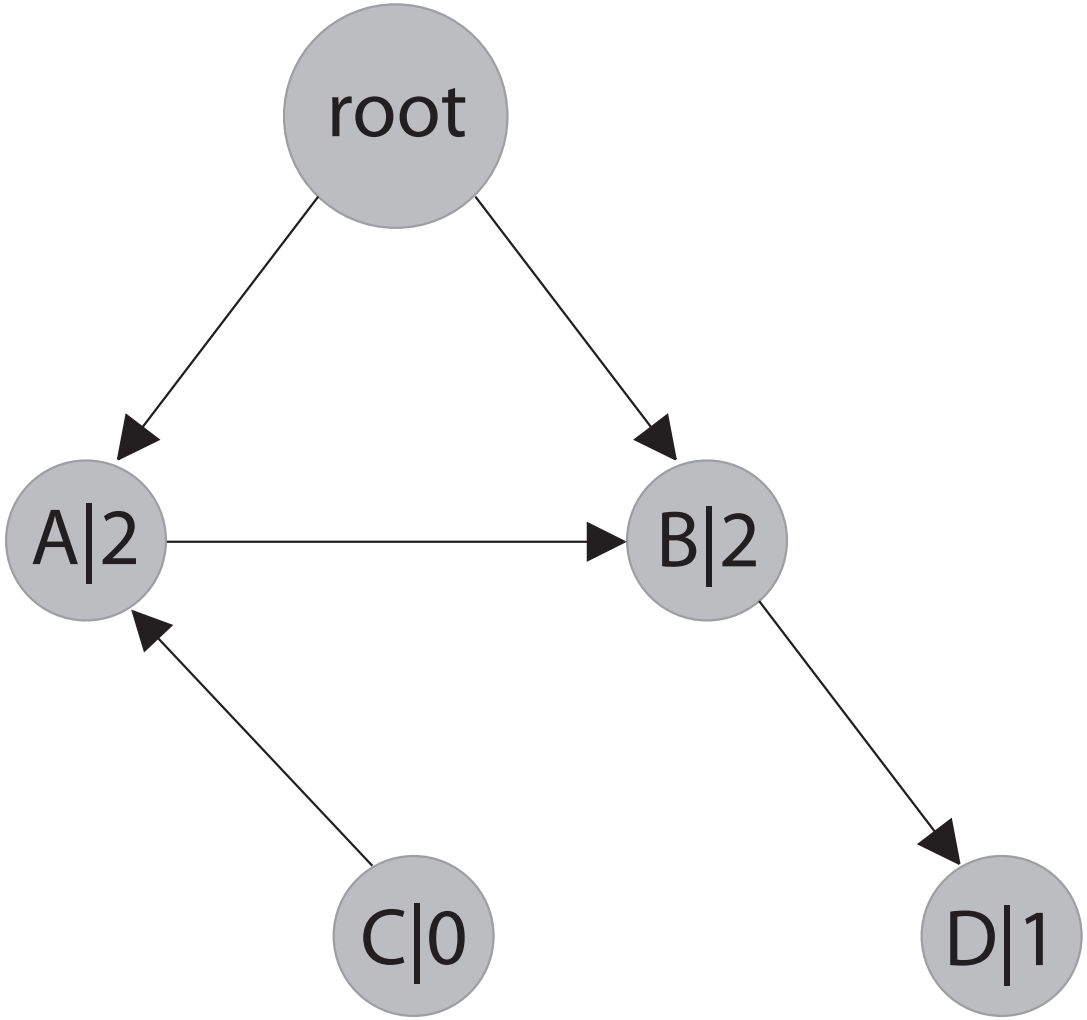

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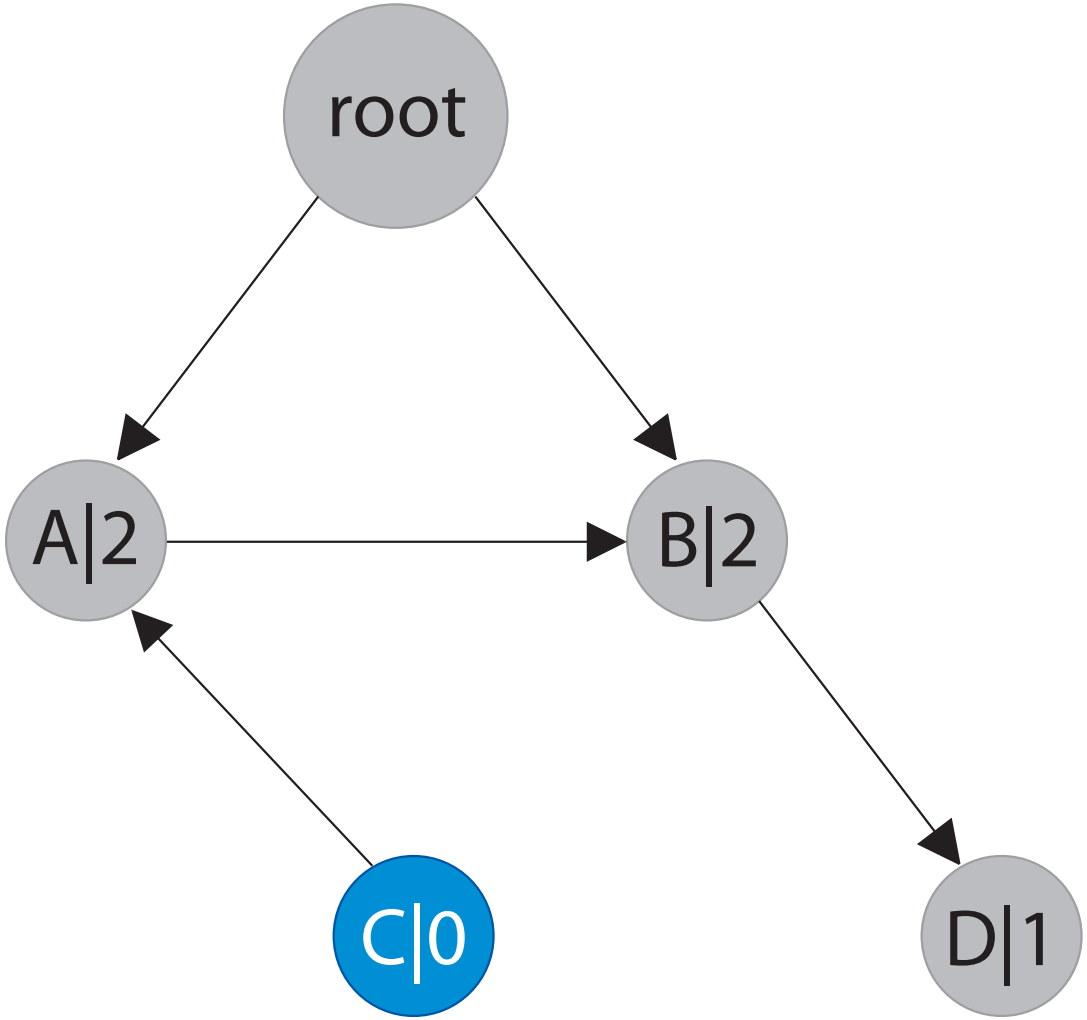

Problem definition

The purpose of ACDC4JS is to analyze the efficiency of the garbage collector in JavaScript virtual machines, especially Google's V8.

Experiments

- Step 1: Simple but artificial mutator
- Step 2: Obtaining a realistic heap model
- Step 3: Developing a realistic JavaScript mutator (TODO)

Step 1: Simple but artificial mutator

- Get information about the garbage collector
  - Collection frequency
  - Quantity of collected memory
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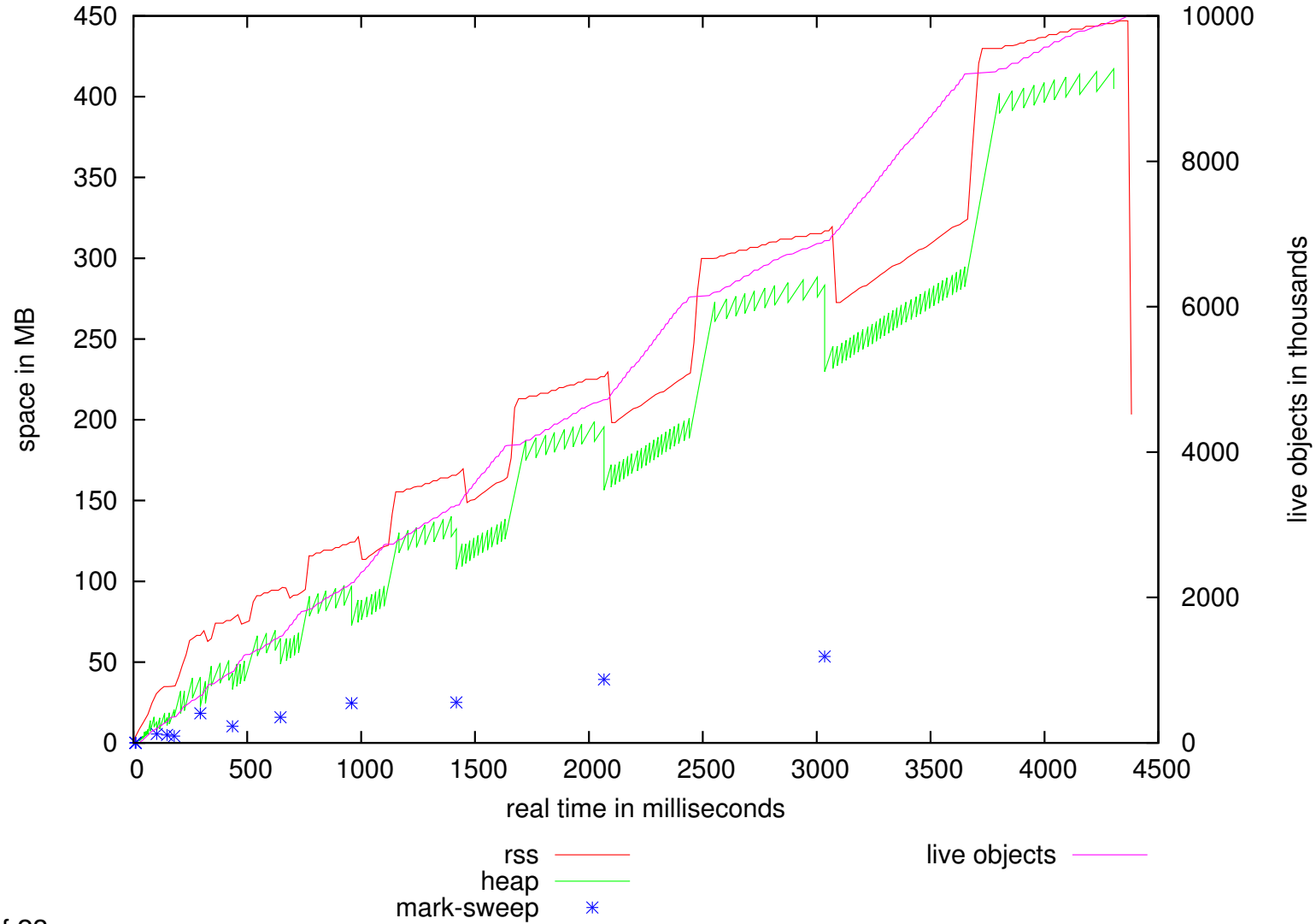
  - Size of an object
- Wrap system measurements
  - Execution time
  - Real memory (resident set size ... rss)

STEP 1: MEASUREMENTS - ALLOCATION ONLY



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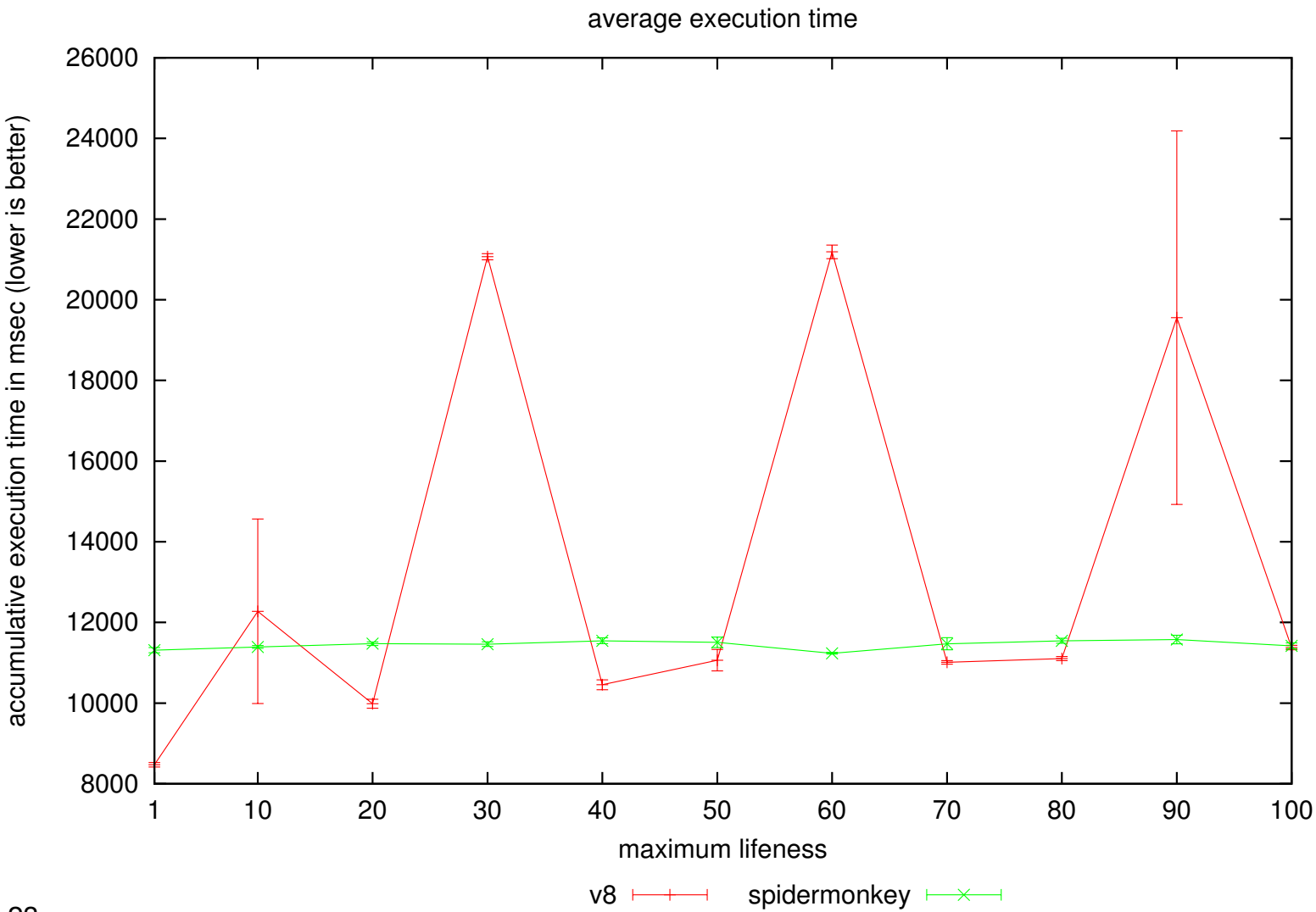

Step 2: Obtaining a realistic heap model

- Important for mutator implementation
- Customizations
  - Custom Chromium binary
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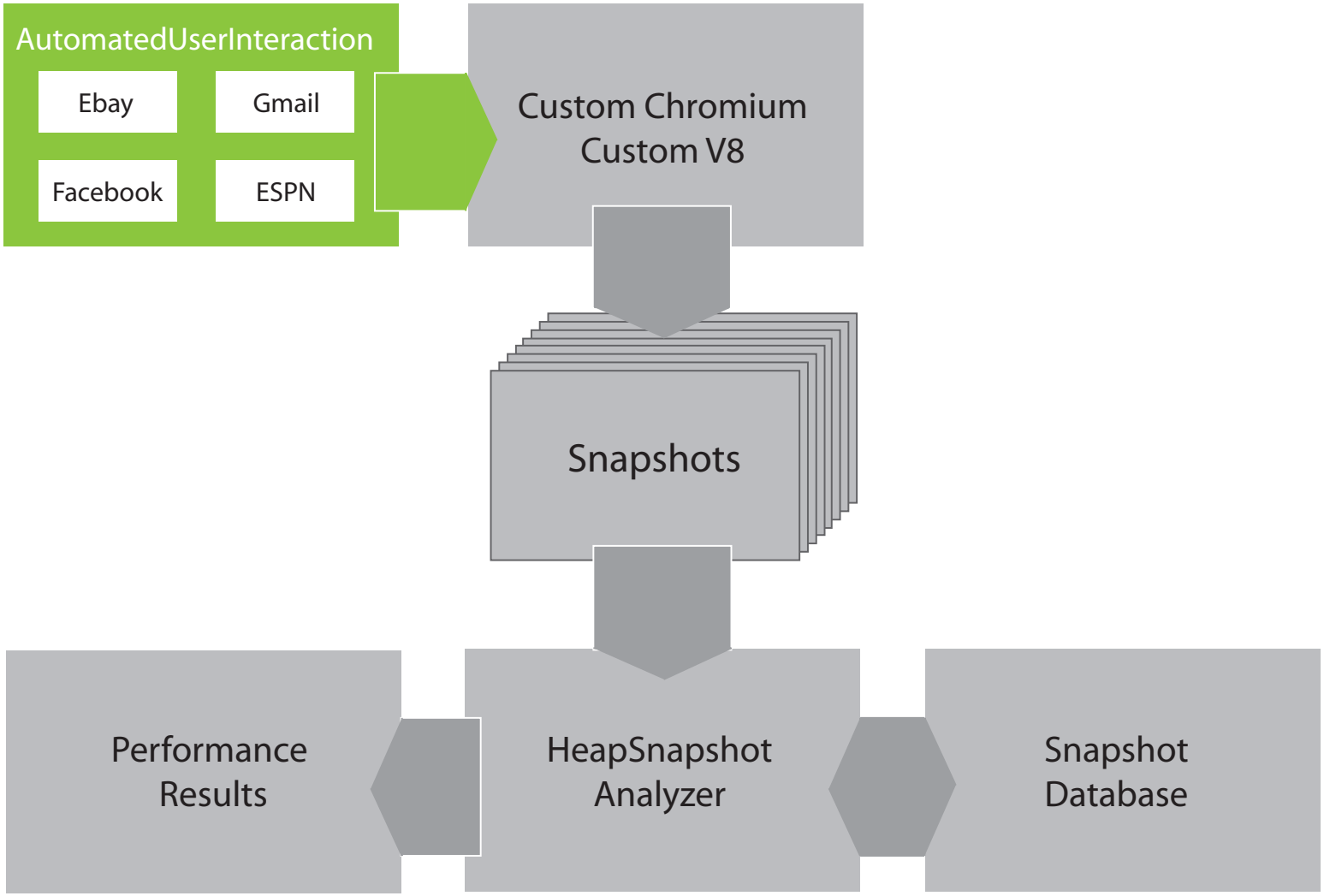
  - Custom Chromium binary
  - Custom V8 binary
- Tools for JavaScript heap analysis
  - AutomatedUserInteraction
  - HeapSnapshotAnalyzer

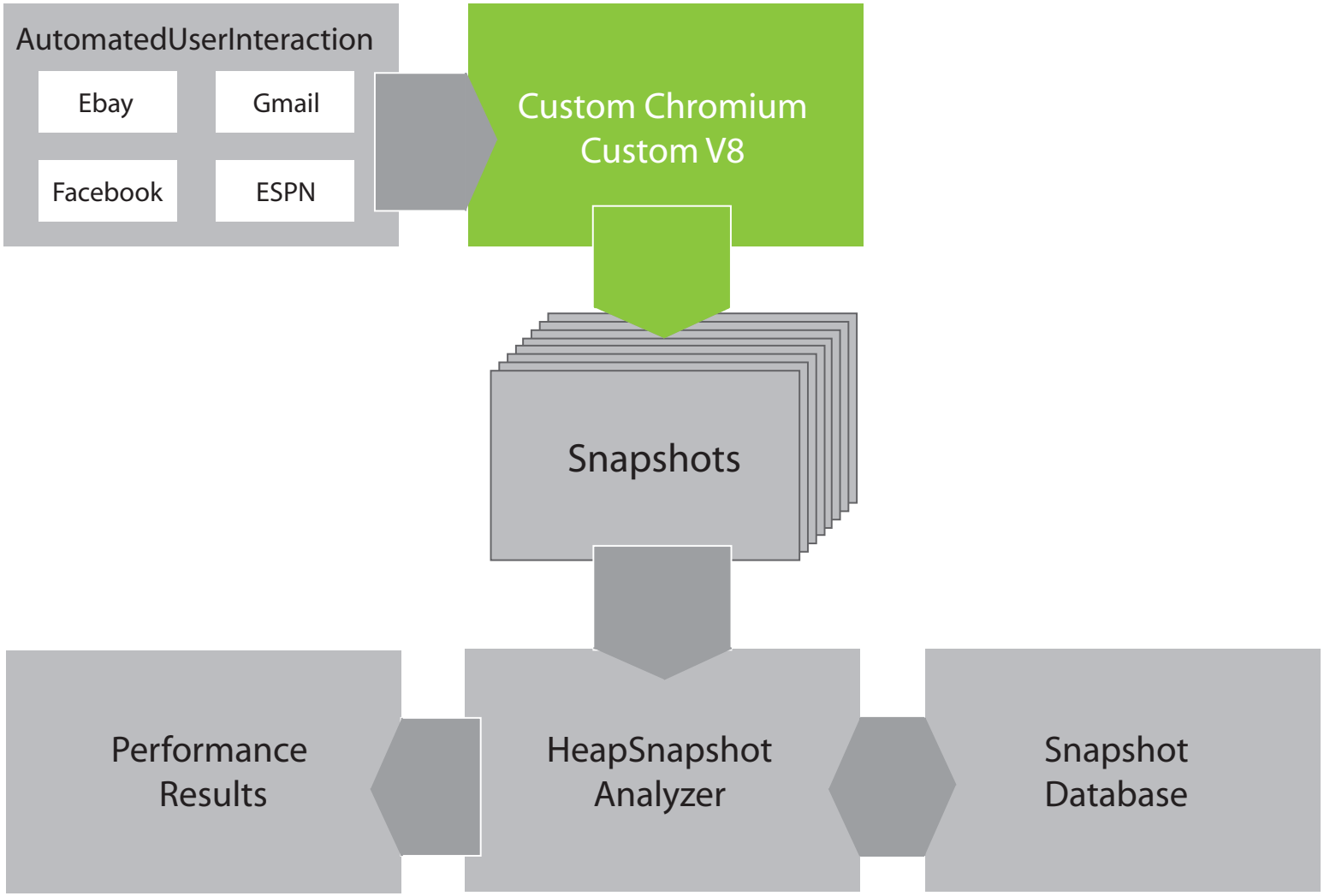
Step 2: Obtaining a realistic heap model



AUTOMATED USER INTERACTION

- Java application
- SeleniumHQ framework for automated user interaction
  - http://www.seleniumhq.org
- Web applications
  - **News:** CNN, ESPN, The Economist
  - **Email:** Gmail, Hotmail
  - **Shops:** Ebay, Amazon
  - **Maps:** Google, Bing
  - **Search:** Google, Bing
  - **Social:** Facebook, Google Plus

Step 2: Obtaining a realistic heap model

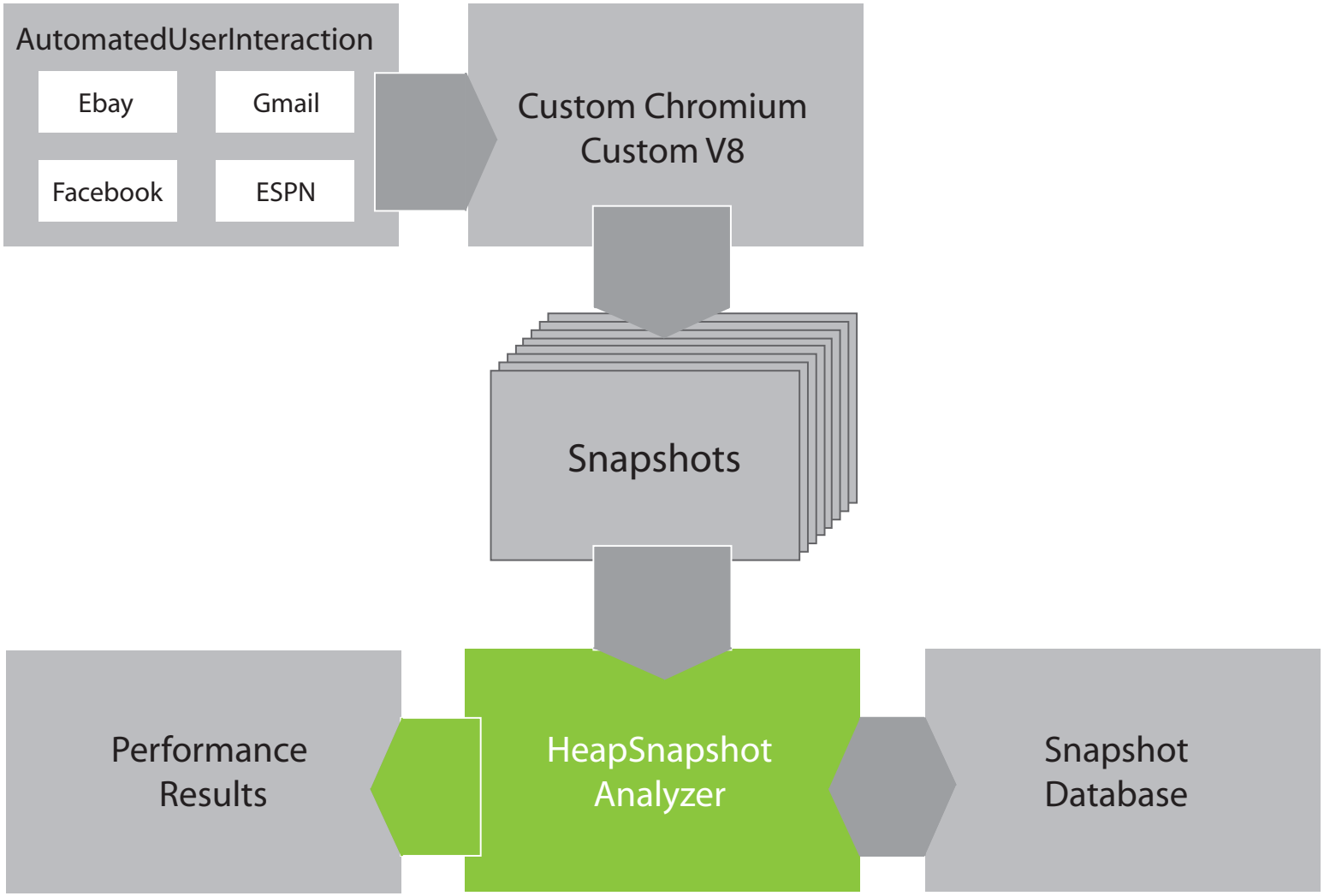


CUSTOMIZATIONS

Custom V8 binary

- New flags
  - `automatic_heap_snapshots`
  - `heap_snapshot_interval`
  - `heap_snapshot_prefix`
- Used flags
  - `gc_interval`

Step 2: Obtaining a realistic heap model



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- PostgreSQL 9.3
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  - Number of leafs
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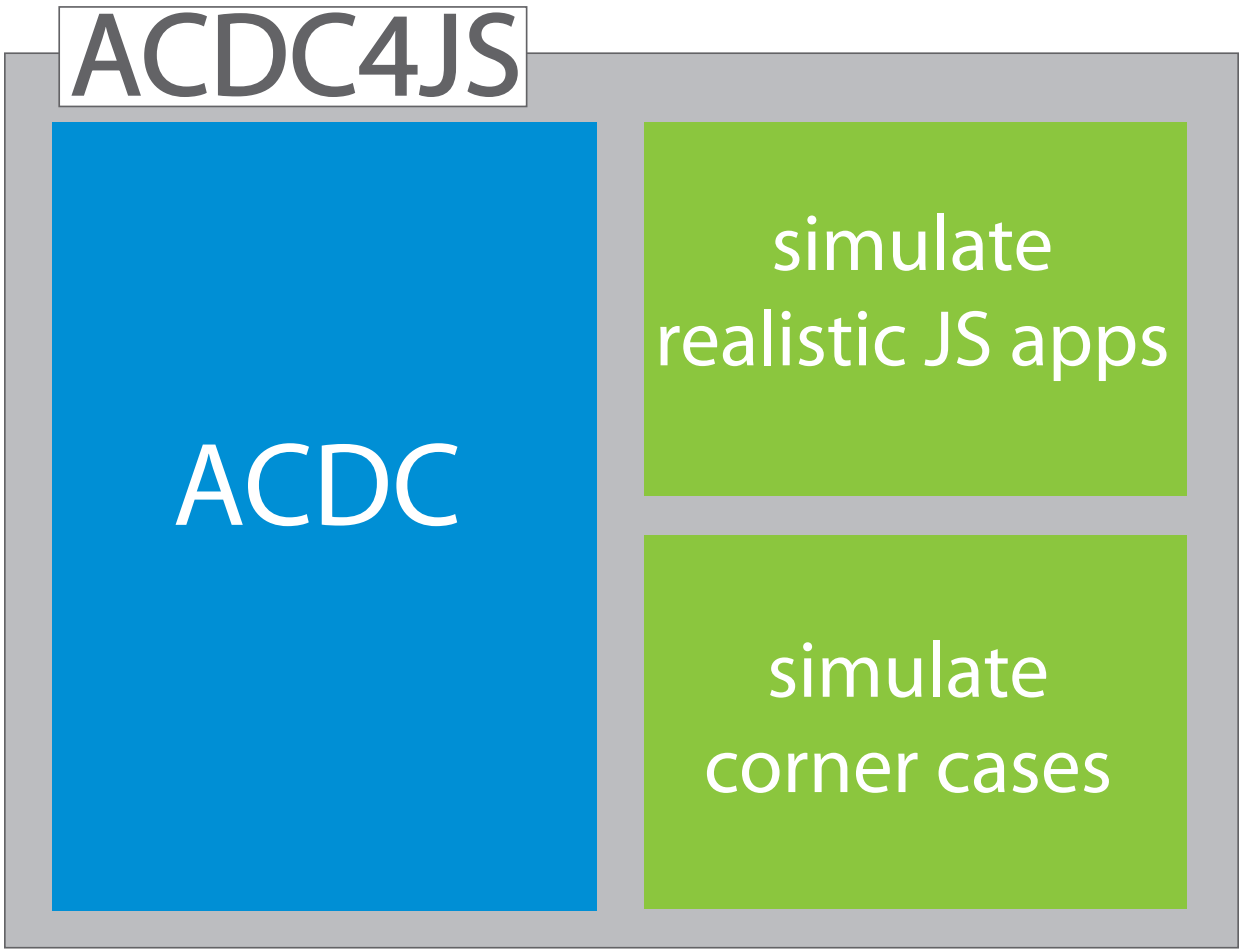
- Node characteristics
  - In-degree
  - Out-degree
  - Root distance
  - Node size

Step 3: Developing a realistic JavaScript mutator (TODO)



Thank you for your attention!

Questions?