

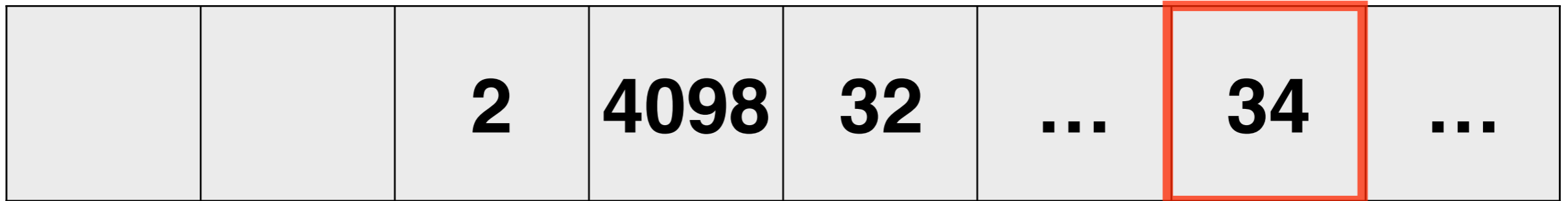
The CWI logo consists of the letters 'CWI' in white, bold, sans-serif font, set against a red trapezoidal background that tapers to the right.The JKU logo features the letters 'JKU' in a large, bold, black sans-serif font. Below it, the text 'JOHANNES KEPLER UNIVERSITY LINZ' is written in a smaller, black, all-caps sans-serif font.

Fast and Lean Immutable Data Structures

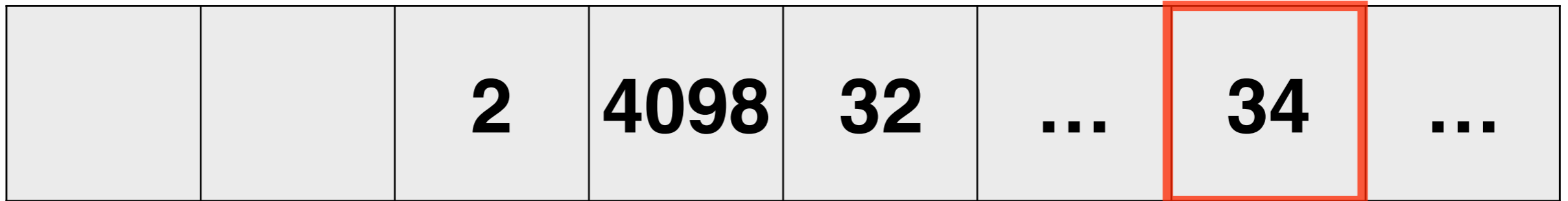
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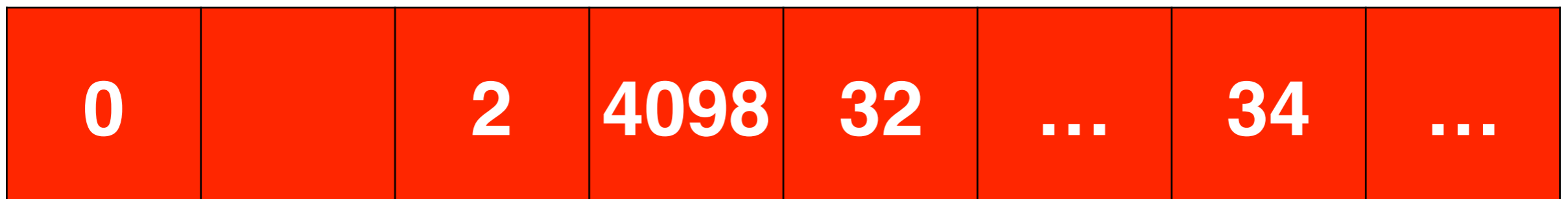
```
set.add(34);
```



```
set.add(34);
```

```
newSet = set.clone();  
newSet.add(0);
```

Full Copy on Write



Goal

Mimimize Performance Gap

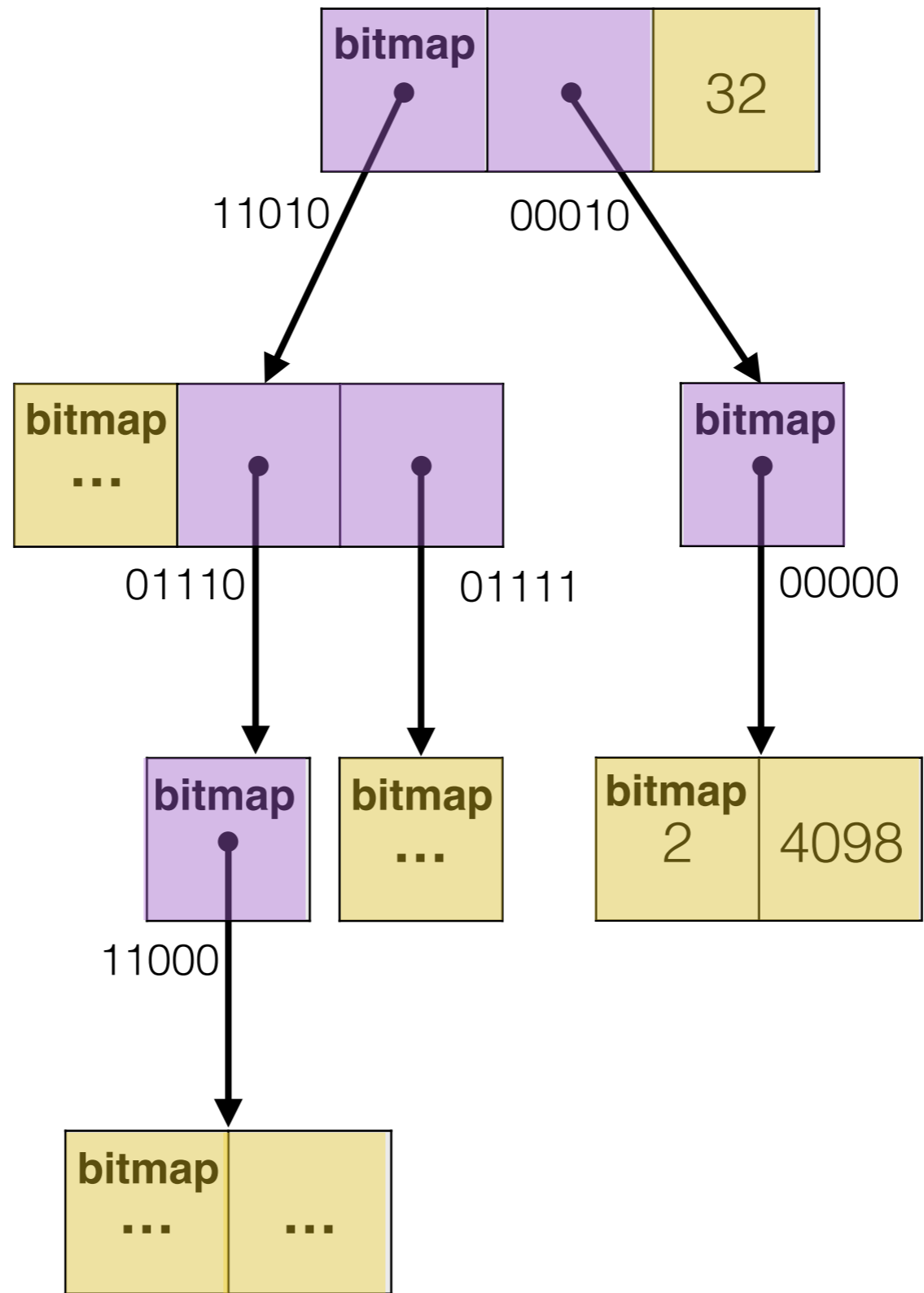
Focus On

**Scalable and Efficient Immutable
General Purpose Data Structures (on the JVM)**

Data Driven & Experimental

Hash Array Mapped Trie (HAMT)

Prefix Trees Encoding Hash Codes

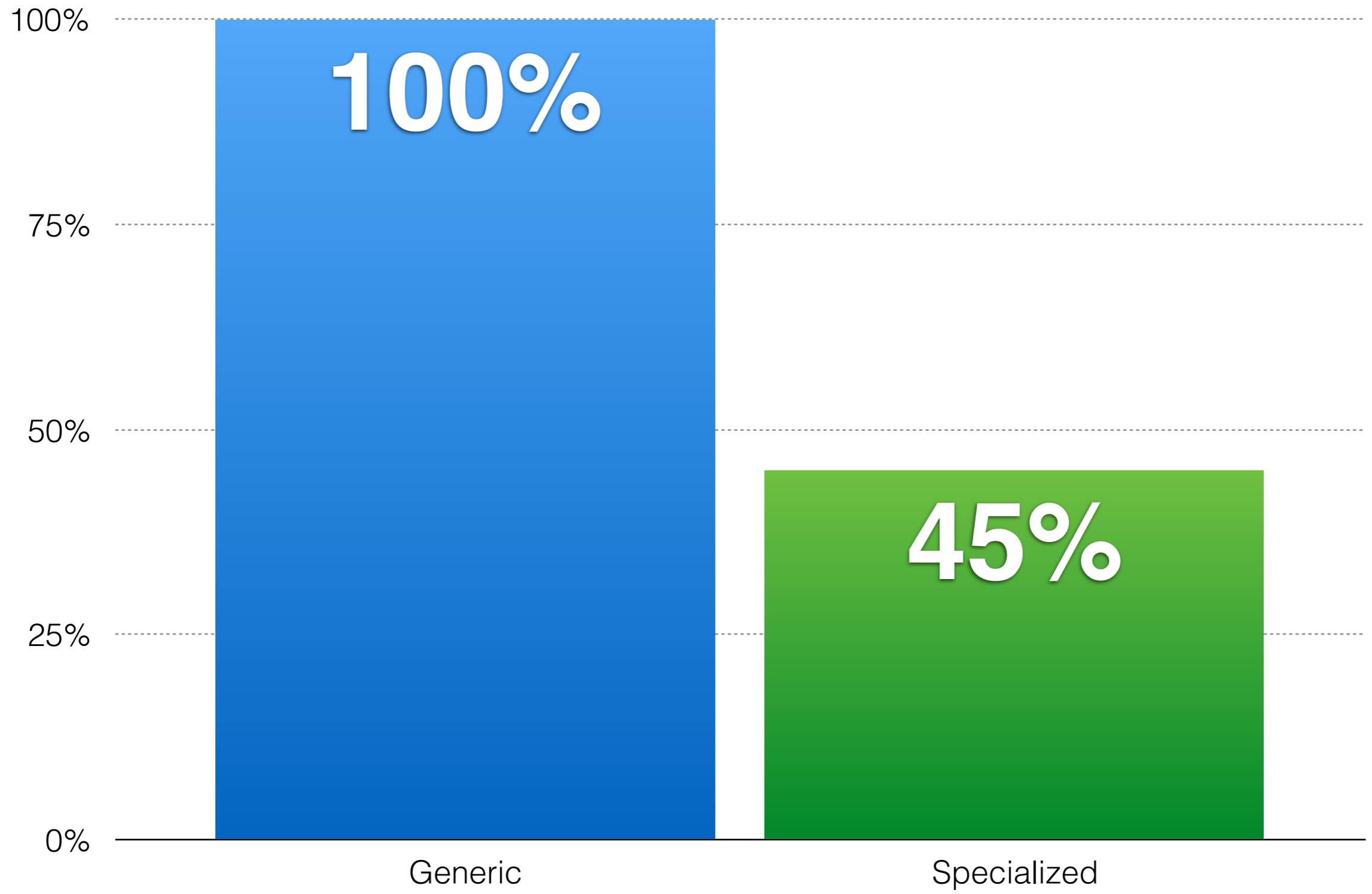


Result #1

Cache Conscious, Canonical, and Compact HAMT

Result #2

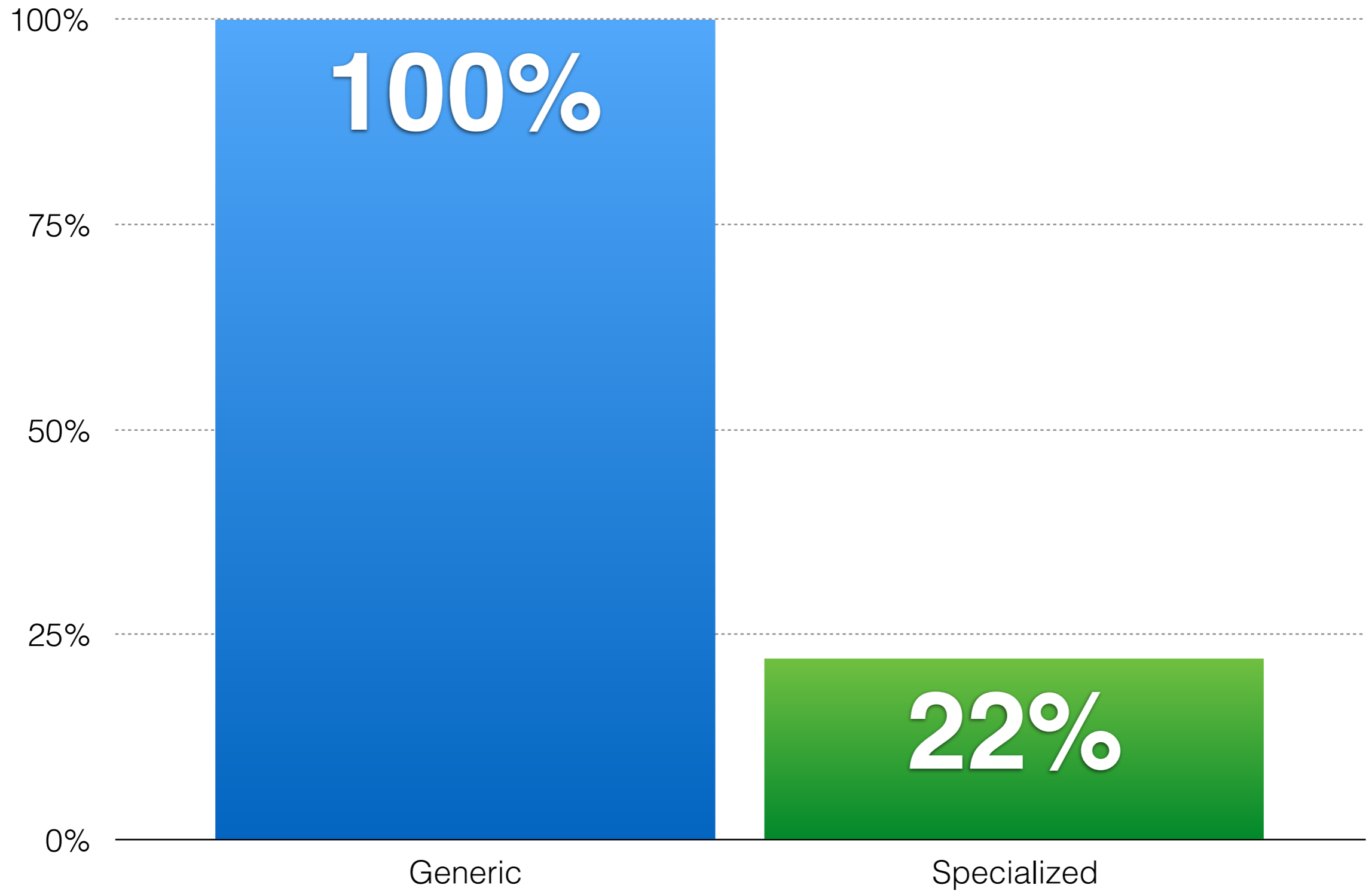
Code Specialization for Memory Efficiency

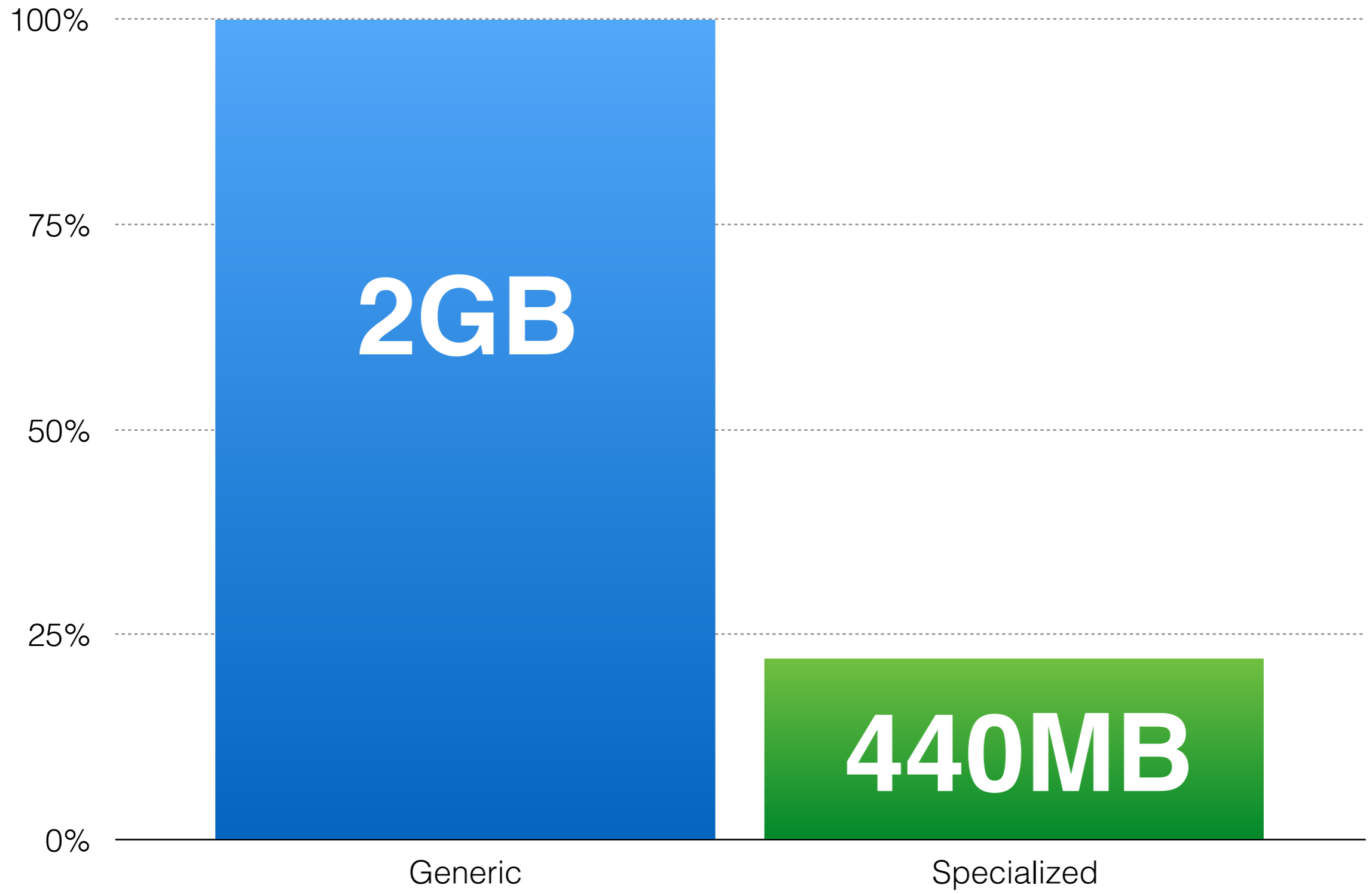


Generic

Specialized

Map





Result #3

Heterogeneous Optimizations

Result #4

Performance Modeling of Complex, Cross-Cutting Optimization Strategies

$x.equals(y) \leftrightarrow x === y$

Maximal Sharing a.k.a. Hash-Consing

Ongoing Research

A Product Family of Collection Data Structures

Future Work

Dynamic Adaptability of Collection Data Structures