Understanding the Java Virtual Machine: Memory Management

Introduction

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Why GC?

create and forget:
no need to remember
to delete

```
Account acc = new Account();
```

use and forget:
no need to ask
“Should I delete?”

```
Account acc = getAccount();
```

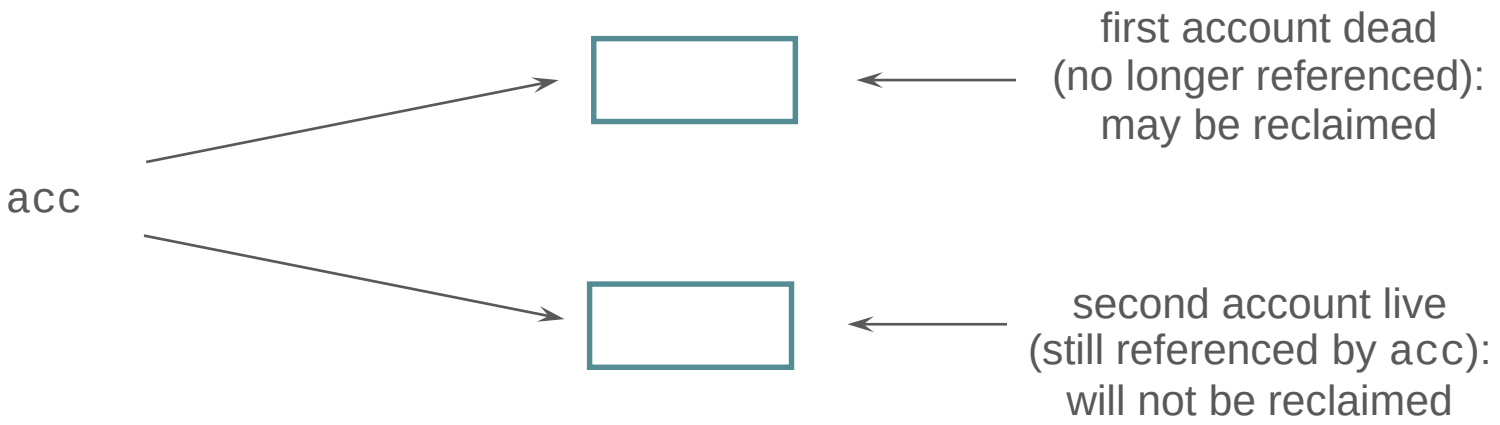
use with confidence:
objects will not
vanish or become corrupt
behind your back

```
acc.increment(amount);
```

The GC promise

- Claim no live objects
  - no promises about dead objects

```
Account acc = new Account();
acc = new Account();
```



Forms of Garbage Collection

Do Nothing

Reference Counting

Mark and Sweep

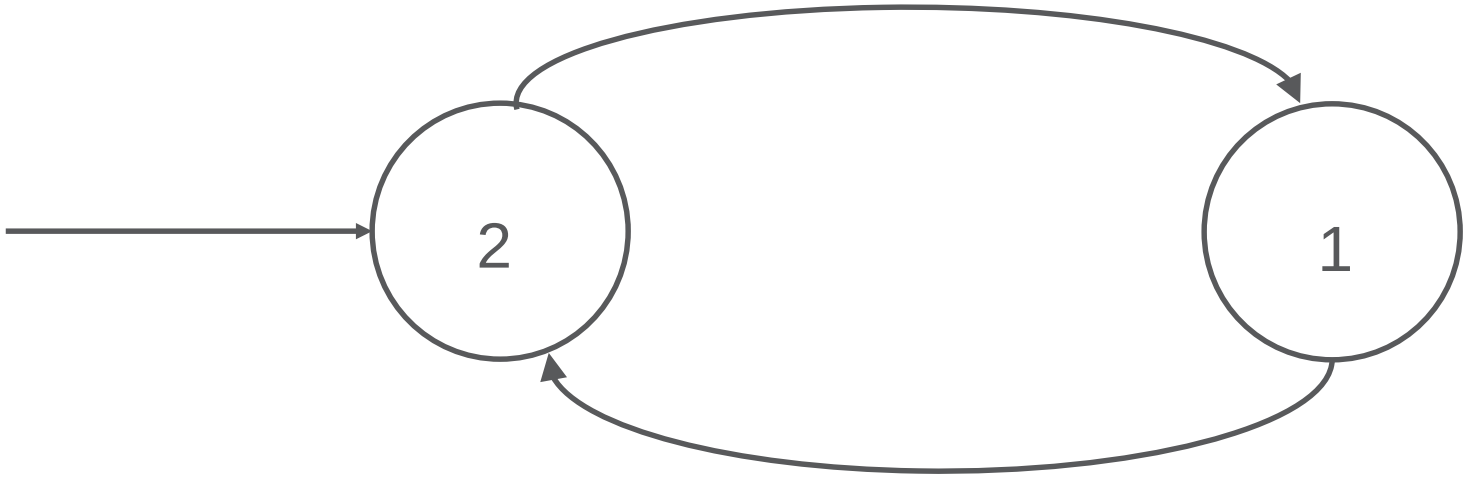
Copying

Generational

Incremental

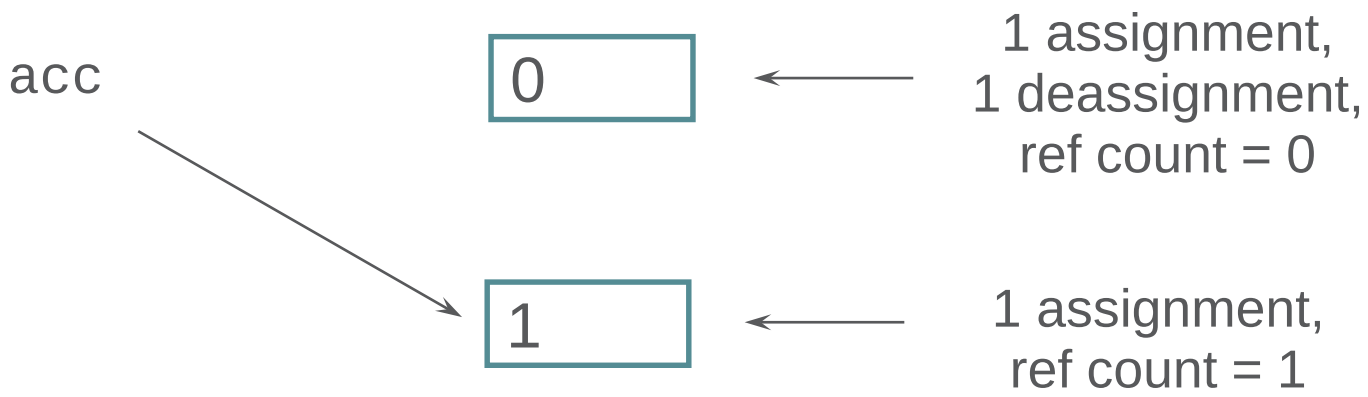
Reference Counting

- Onus on client to call methods when allocating/freeing memory
  - COM for example had AddRef and Release calls for objects
  - When count hits zero object can be freed
  - Problems with circular references



Reference Counting

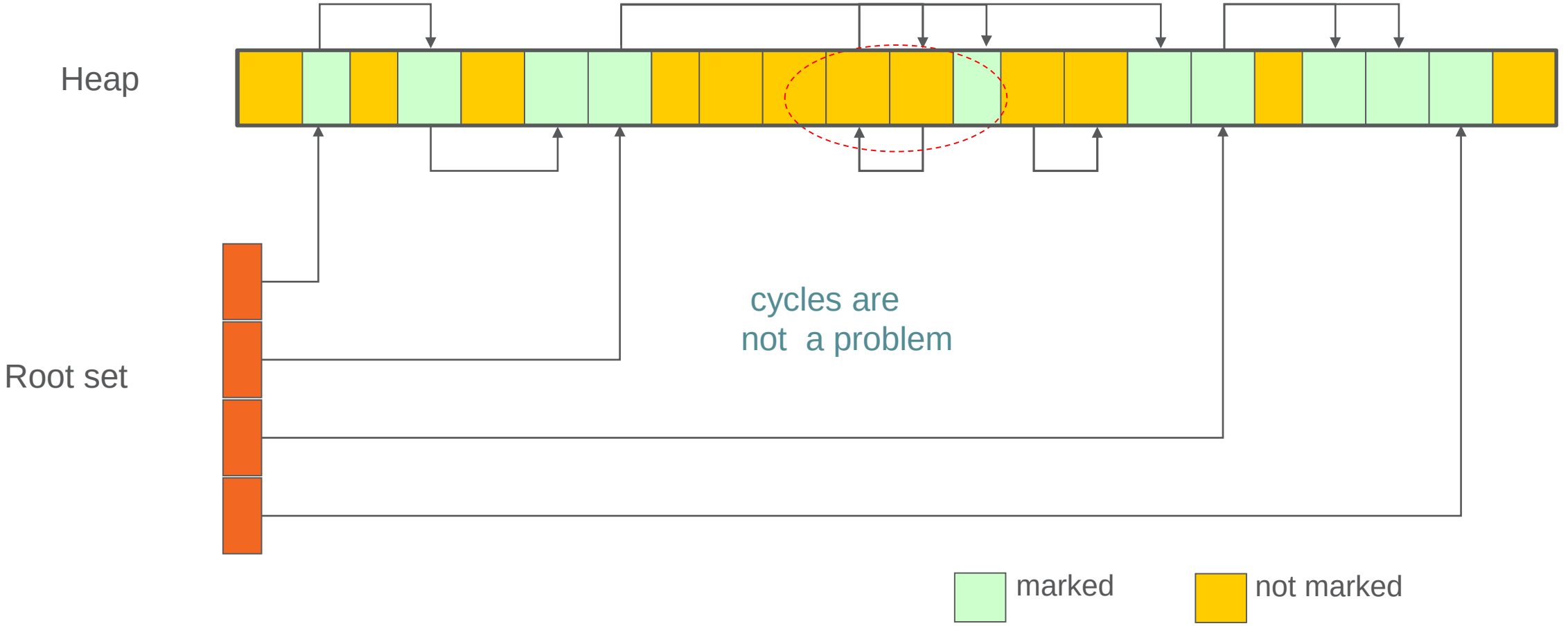
```
Account acc = new Account();
acc = new Account();
```



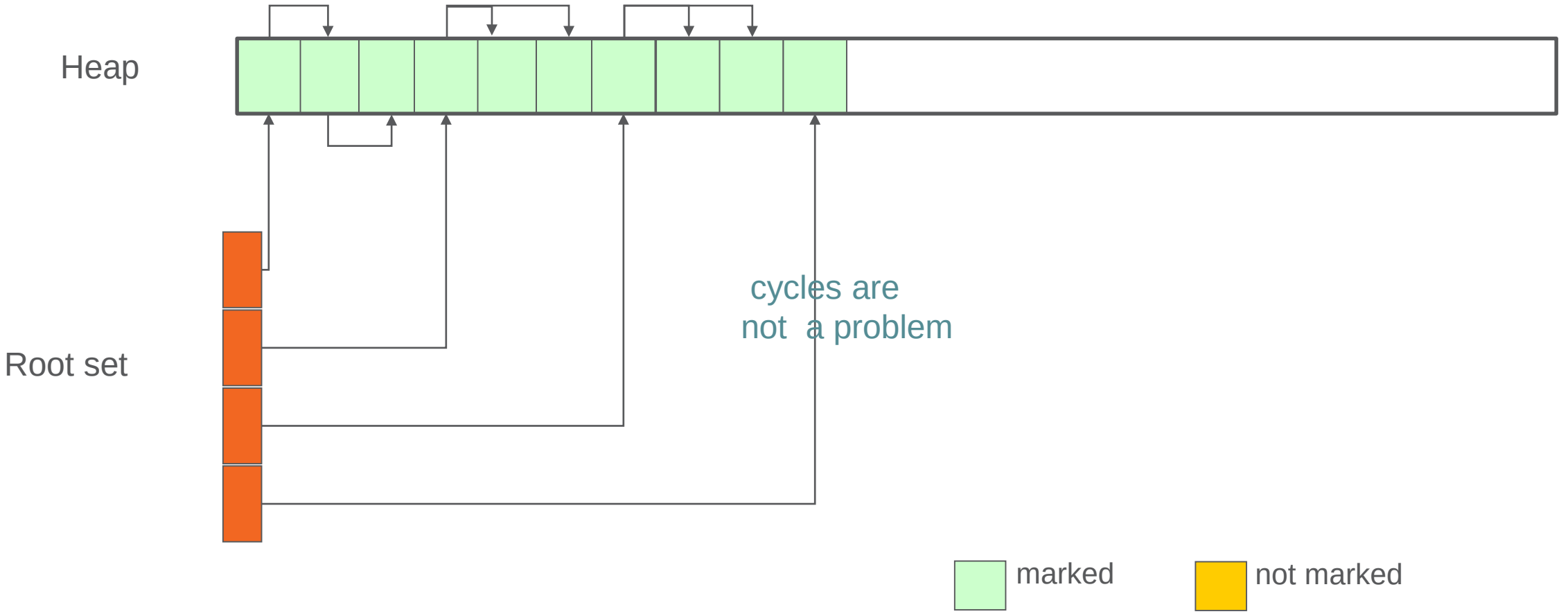
Mark and Sweep

- ‘mark’ phase that identifies the objects that are still in use
- ‘sweep’ phase to remove unused objects
- ‘compact’ phase to compact the memory

Sweep Phase



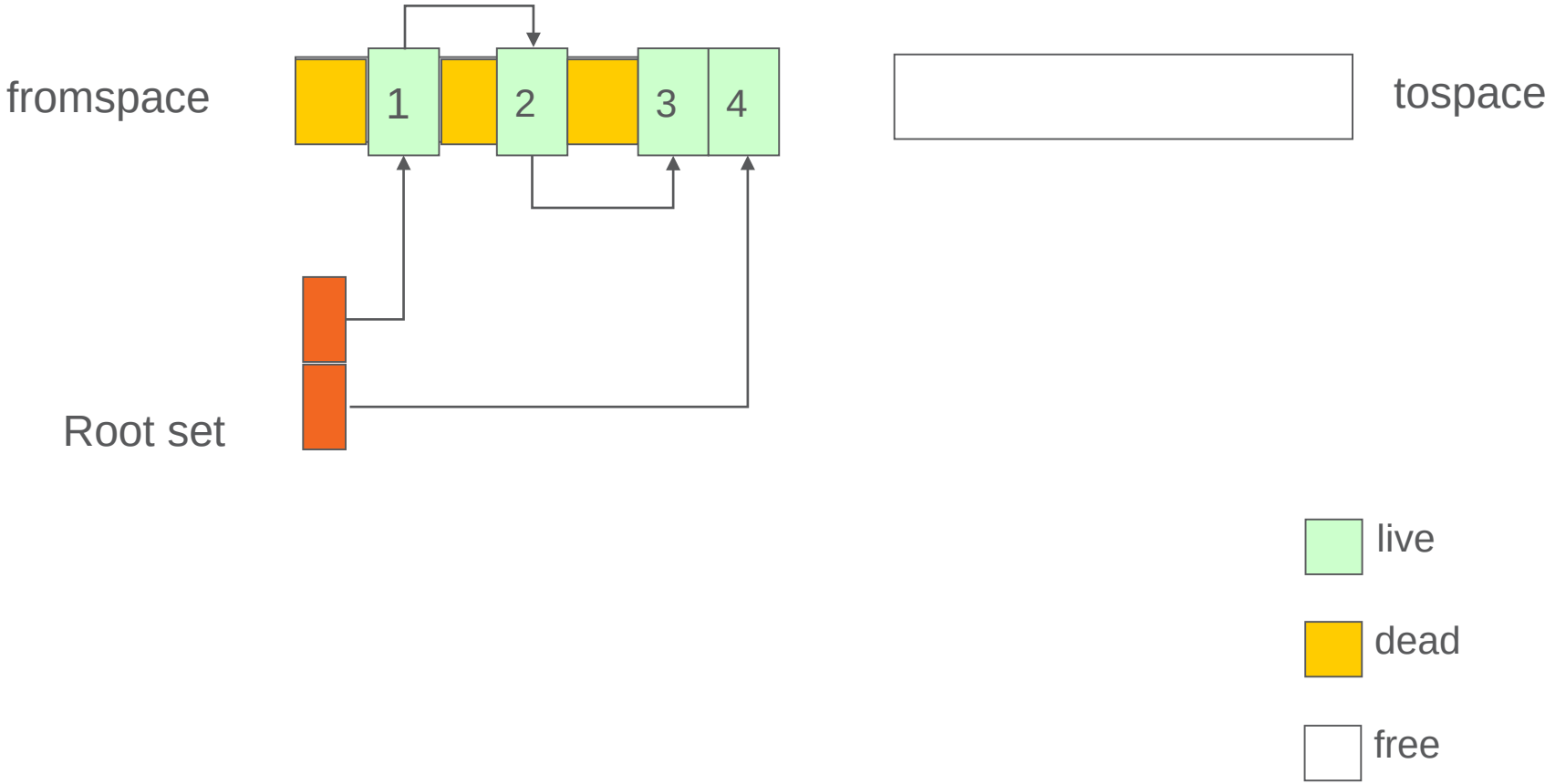
Compact Phase



Copying

- Uses different ‘spaces’ to manage memory

Copying Fromspace to Tospace



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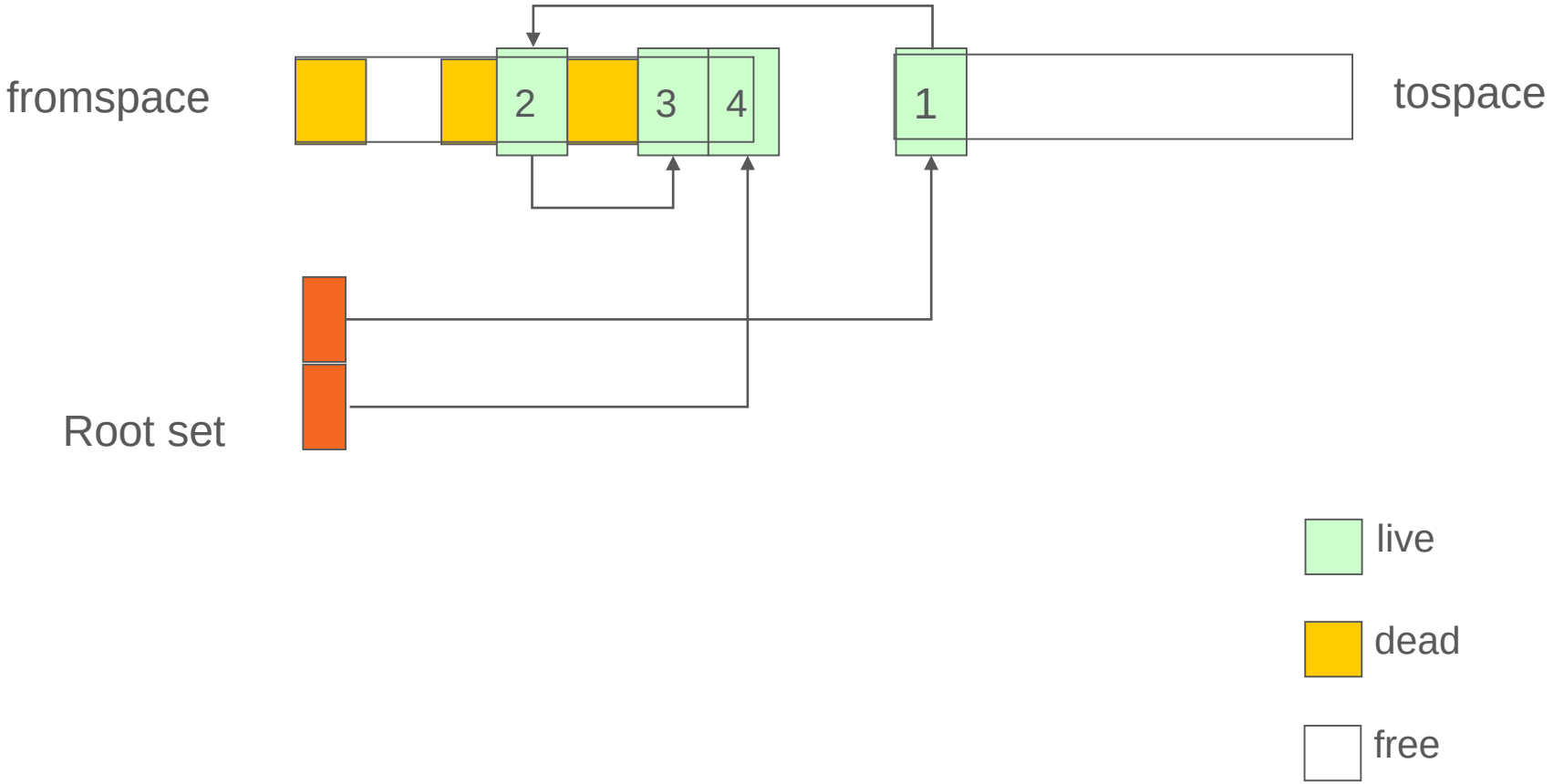

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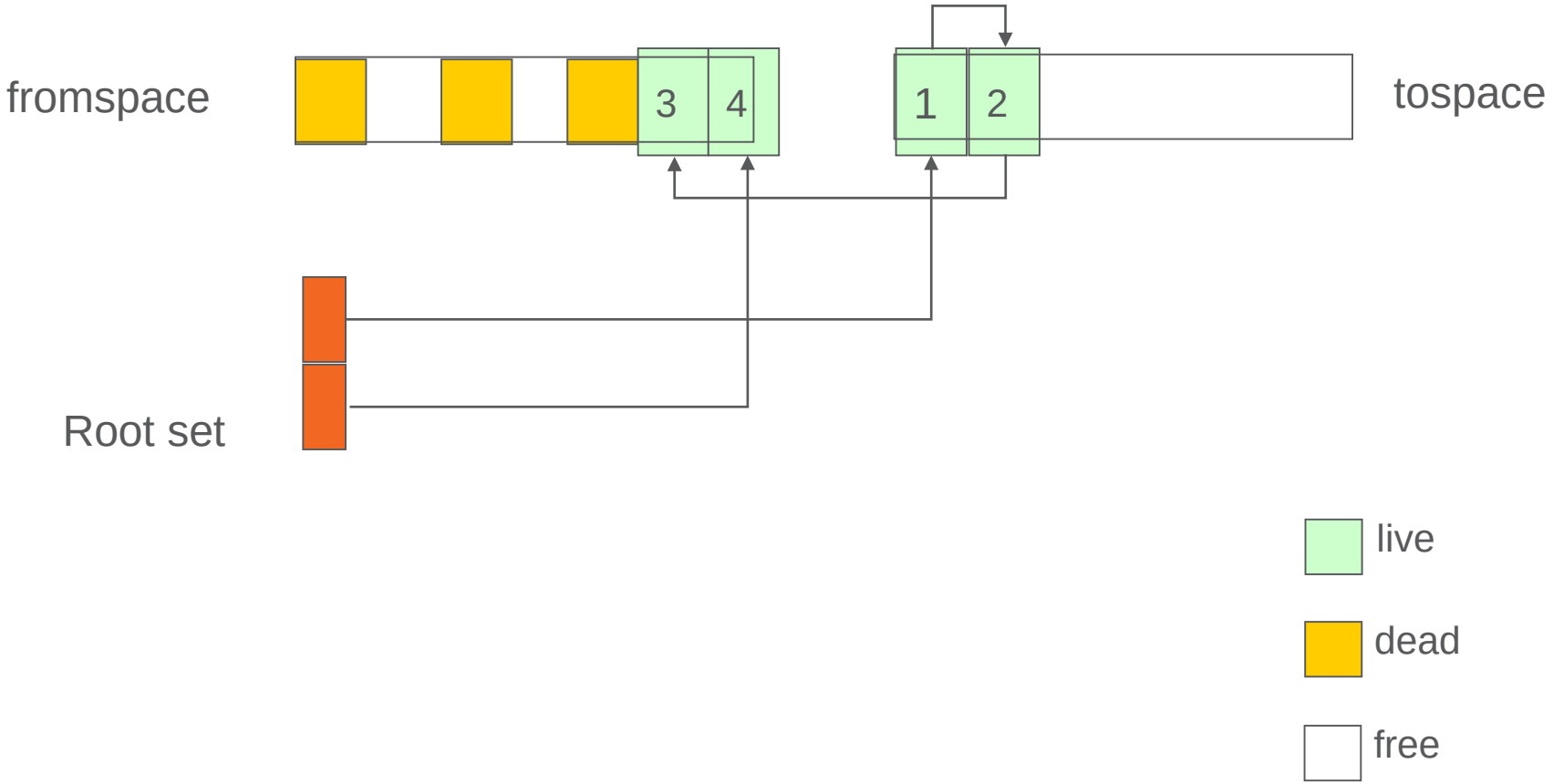

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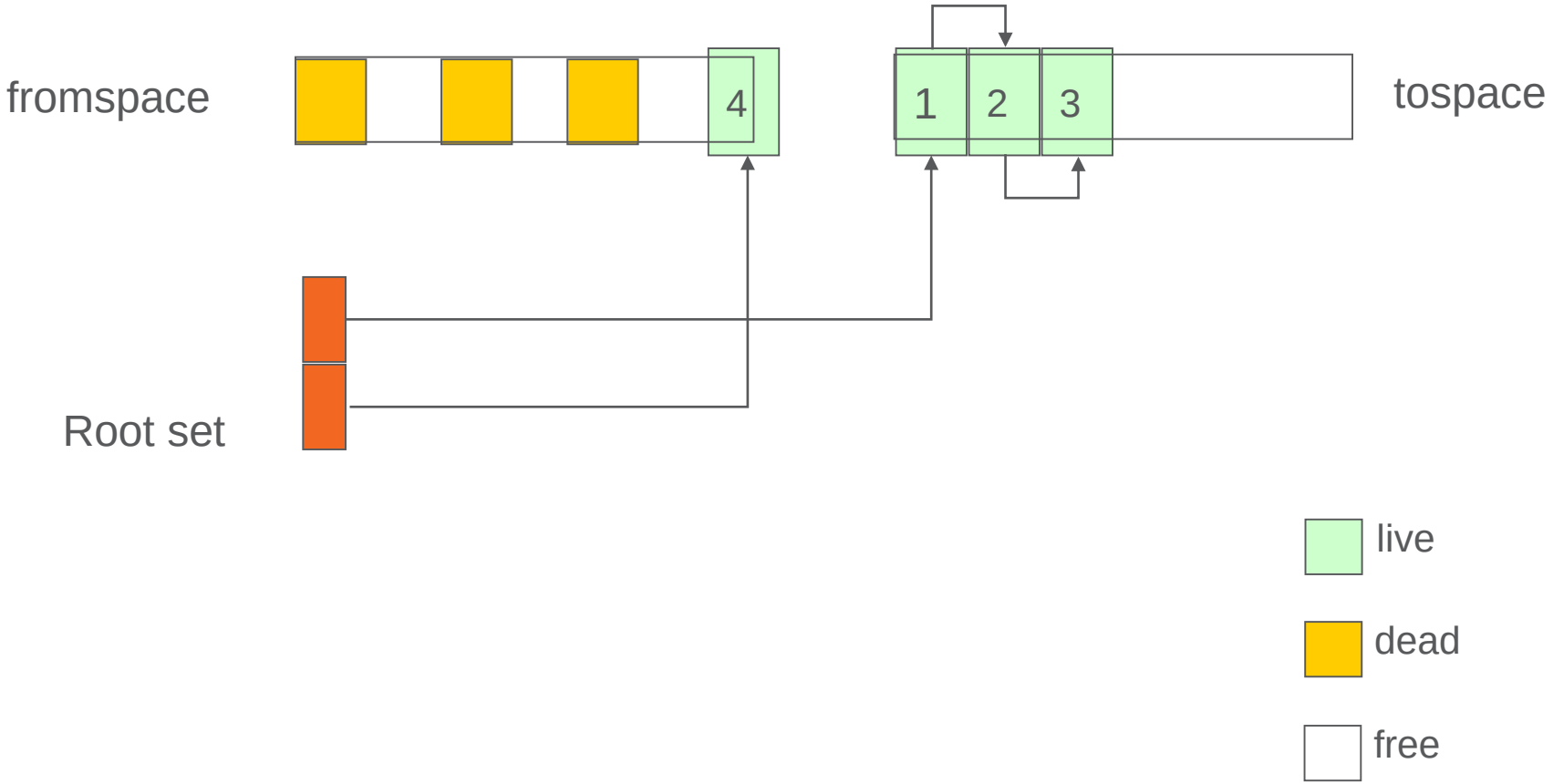

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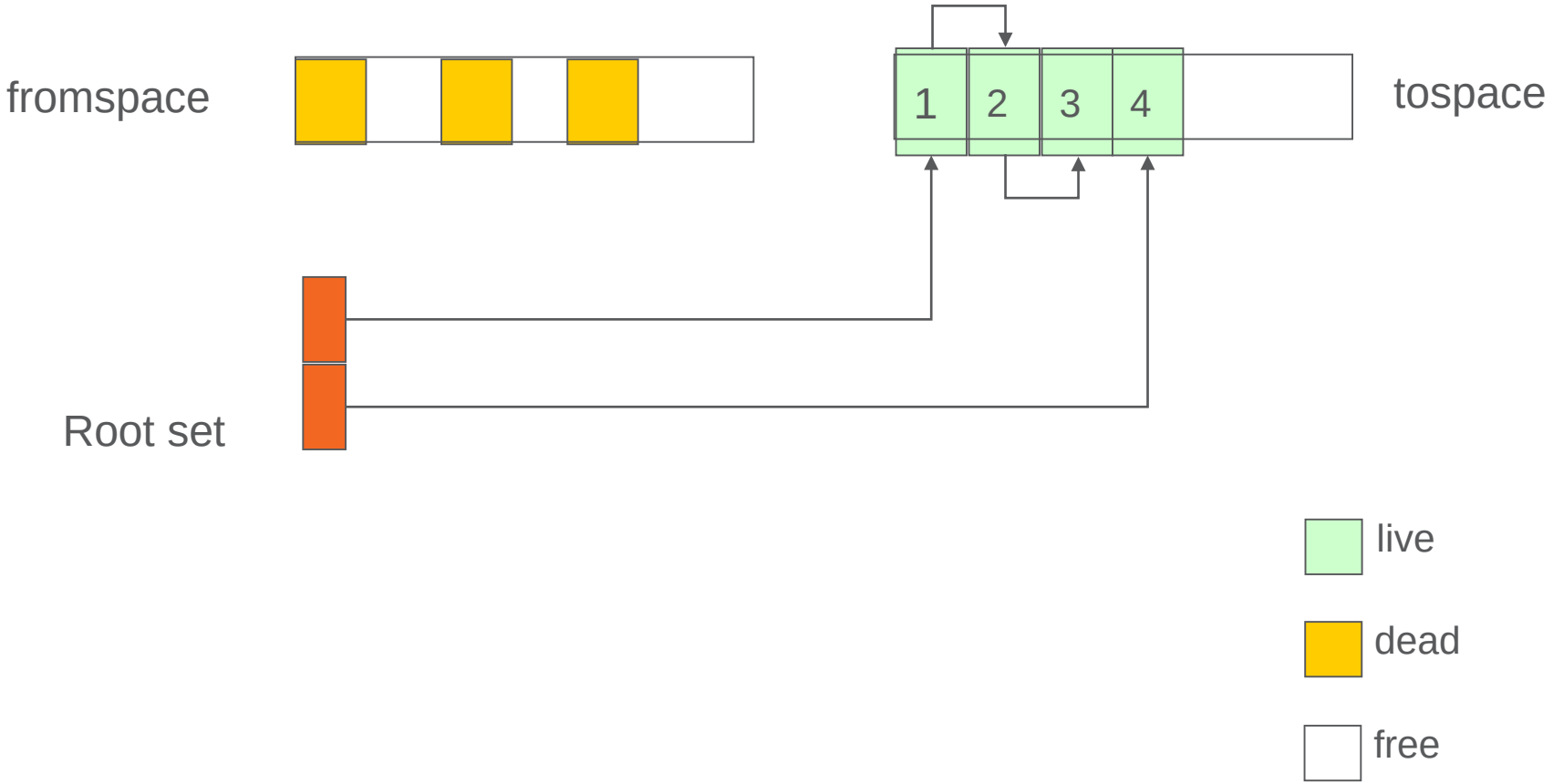

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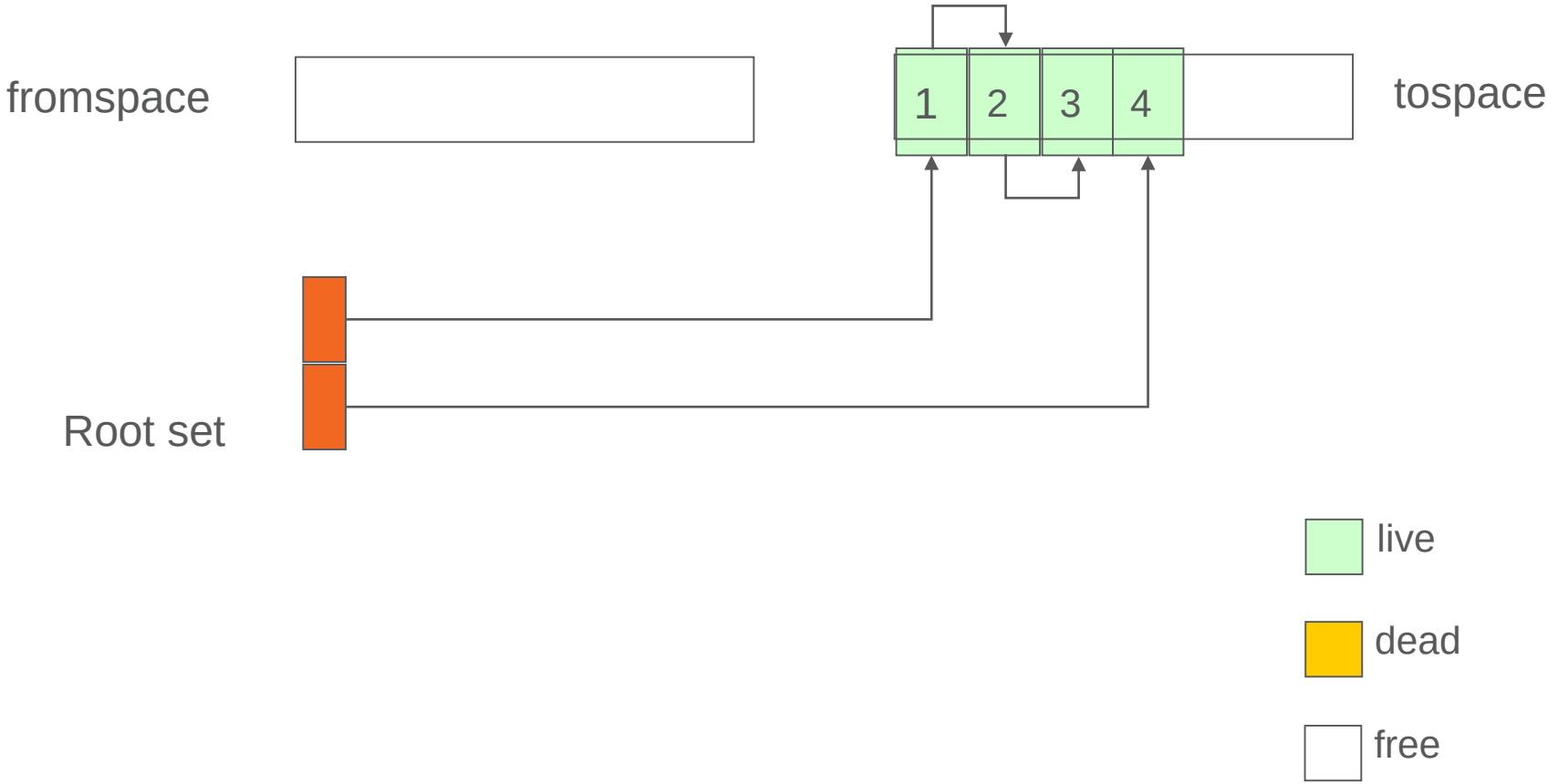
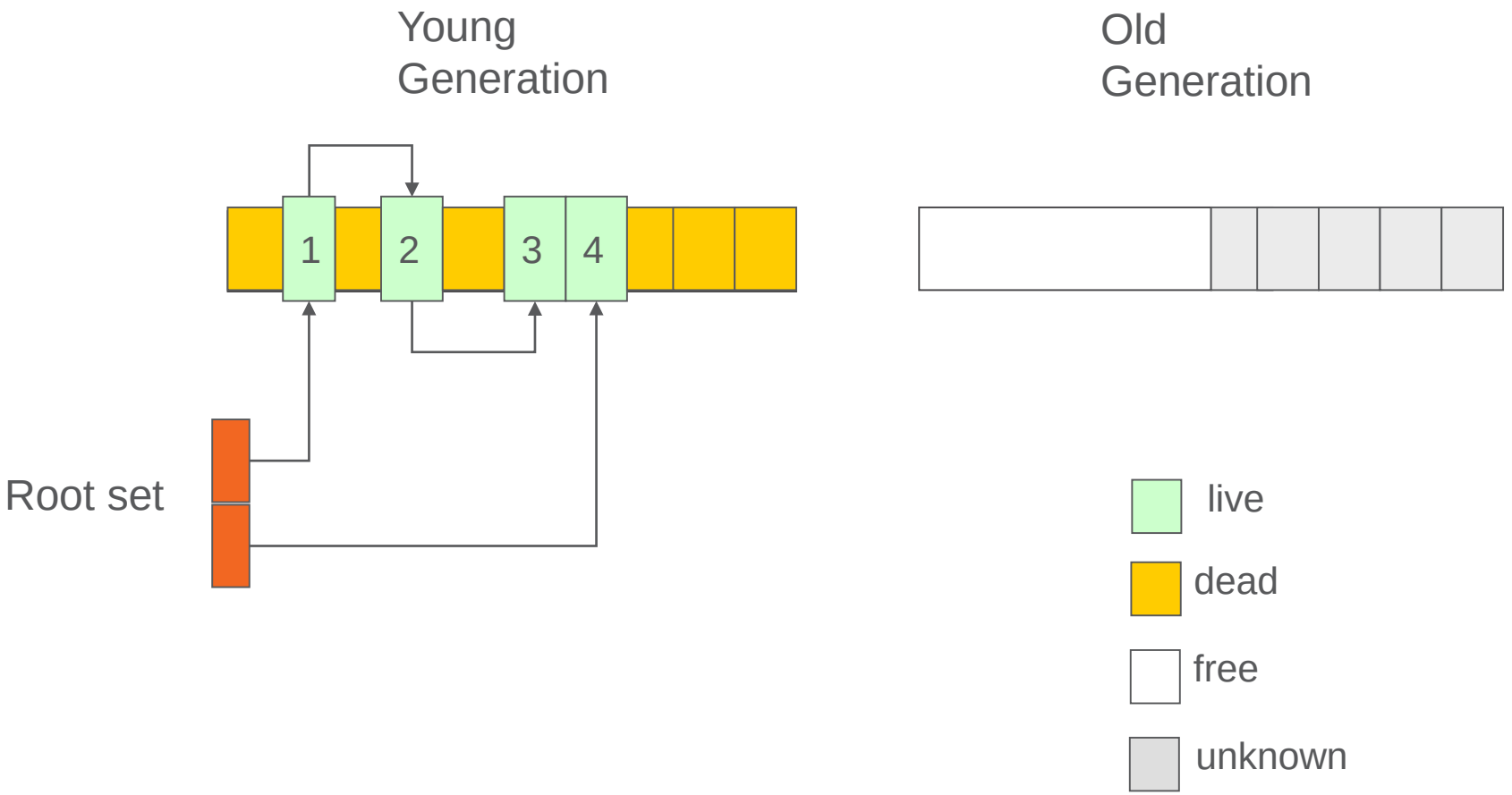


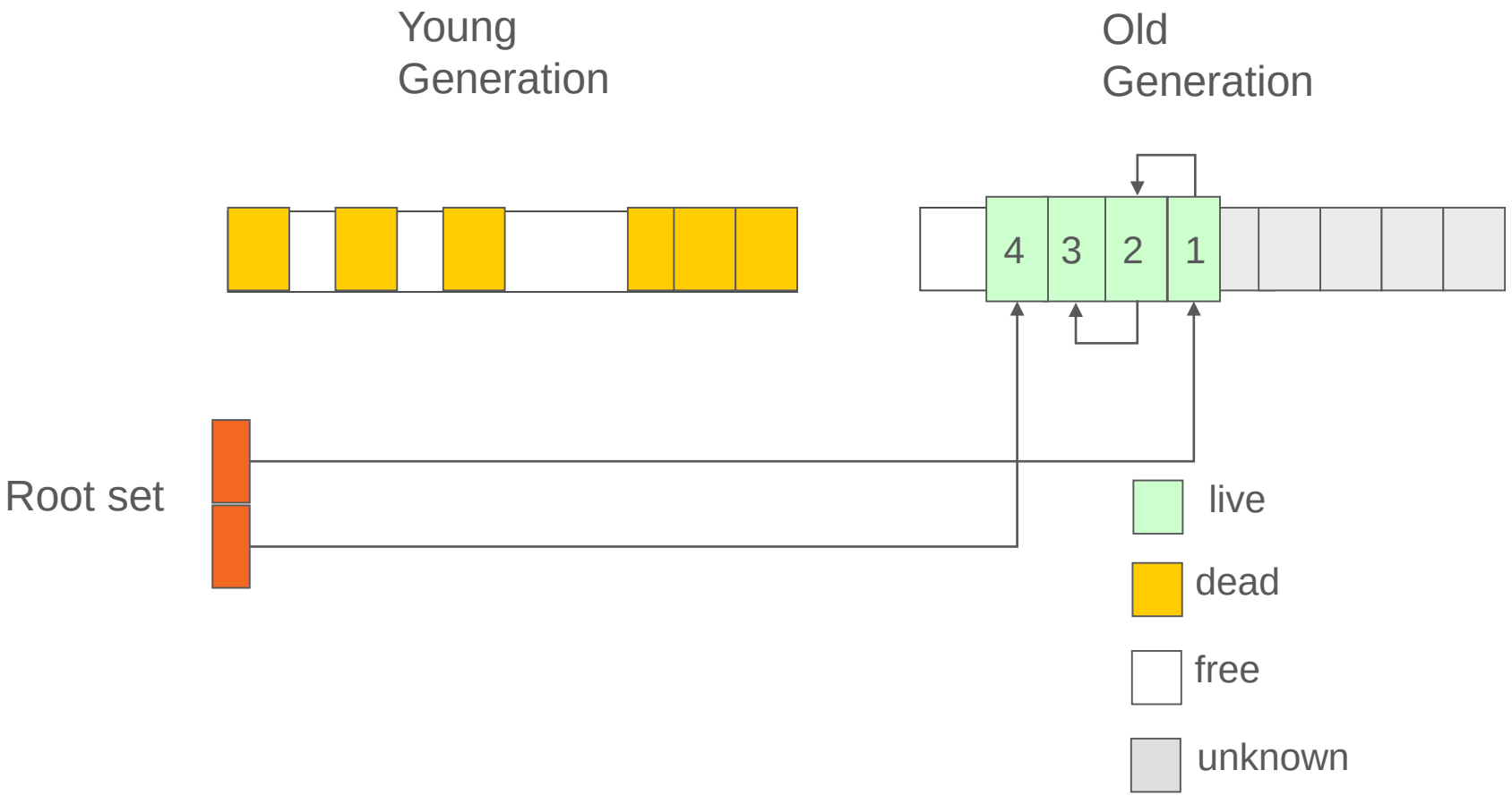
Generational Collectors

- Maintain different generations for memory
  - Long living objects 'promoted' to a different generation
  - For a given definition of 'long'

Before a Generational Minor Collection



After a Generational Minor Collection



Demonstration