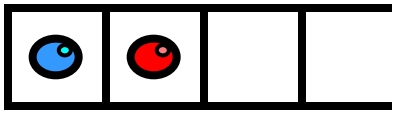
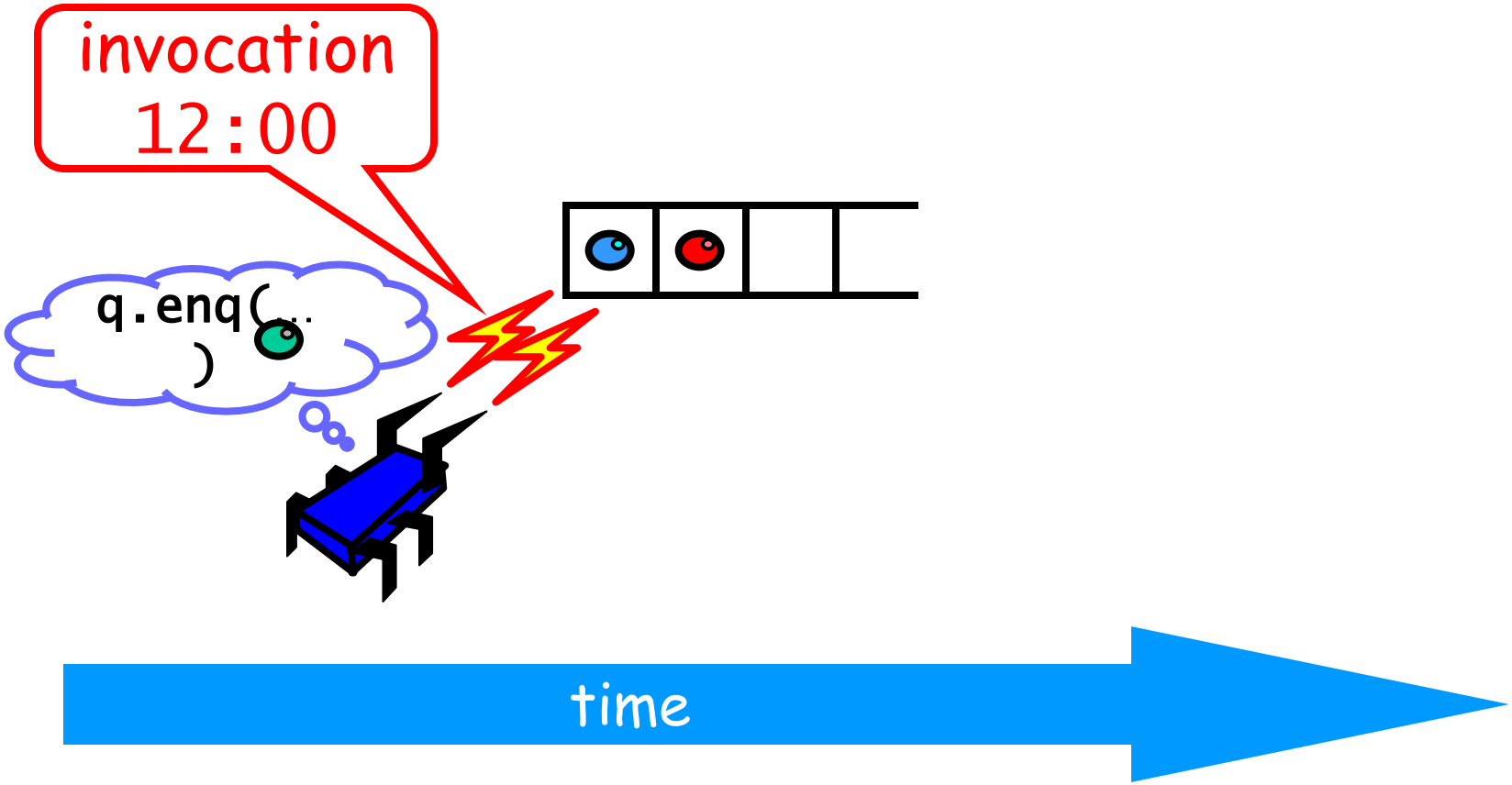
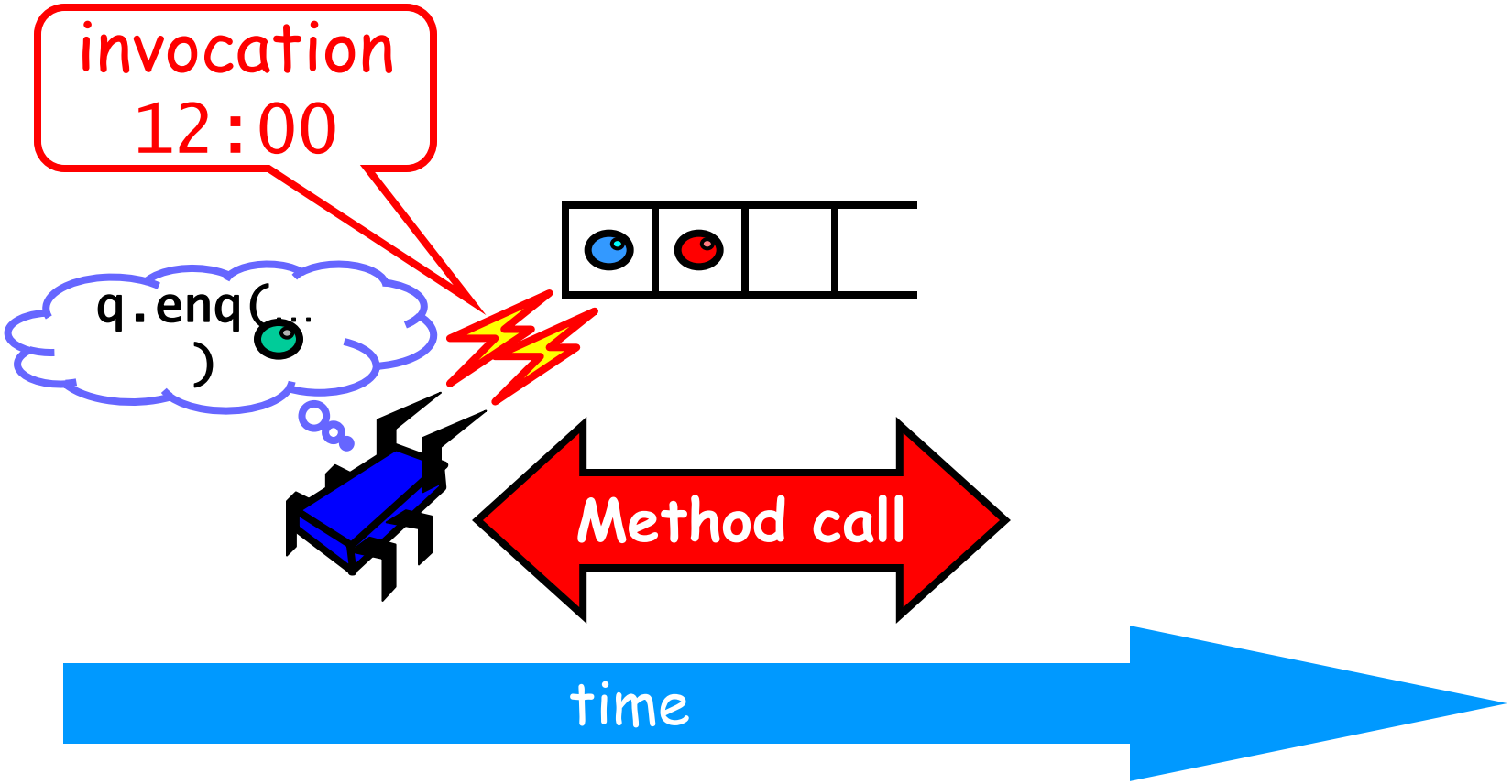
Methods Take Time



Methods Take Time



Methods Take Time



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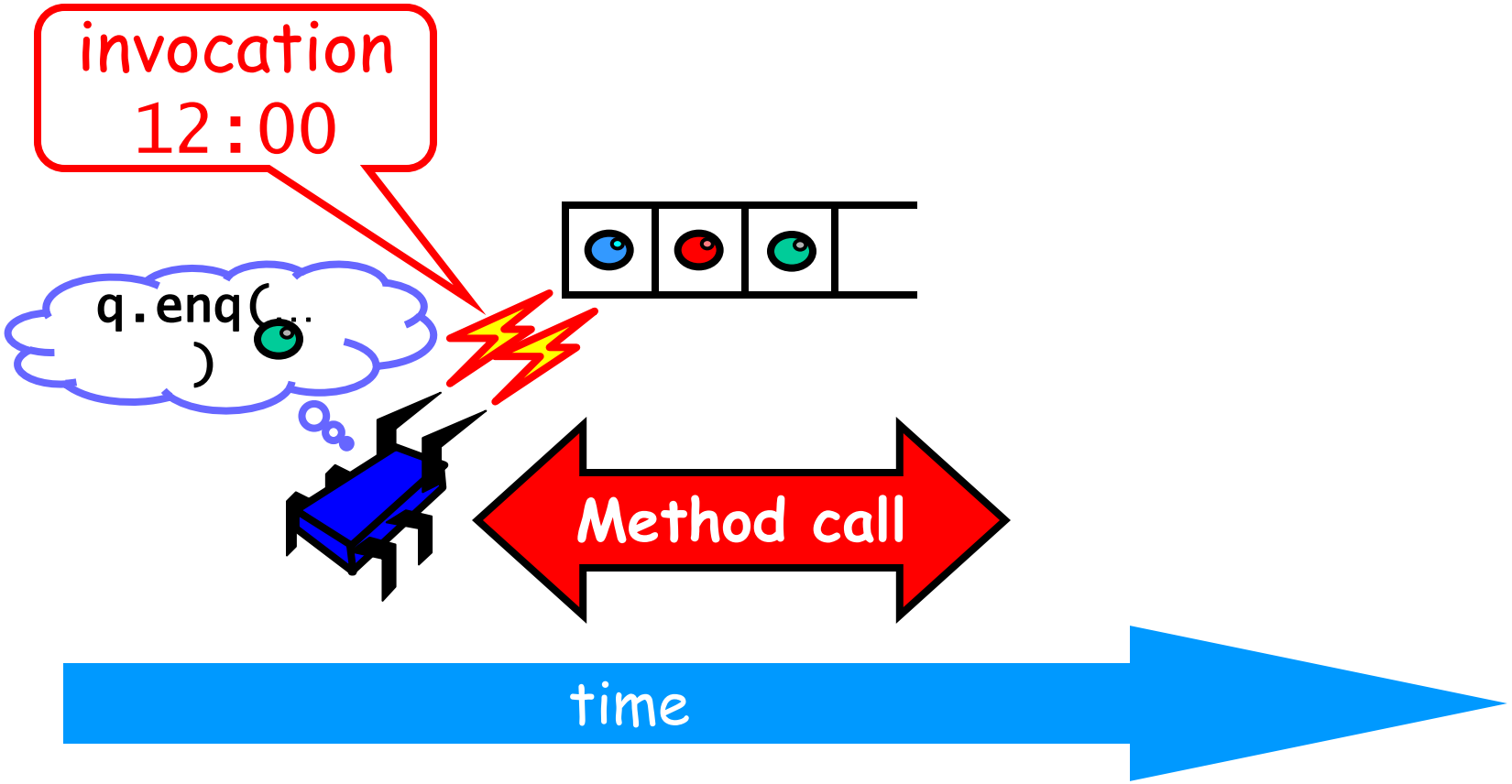

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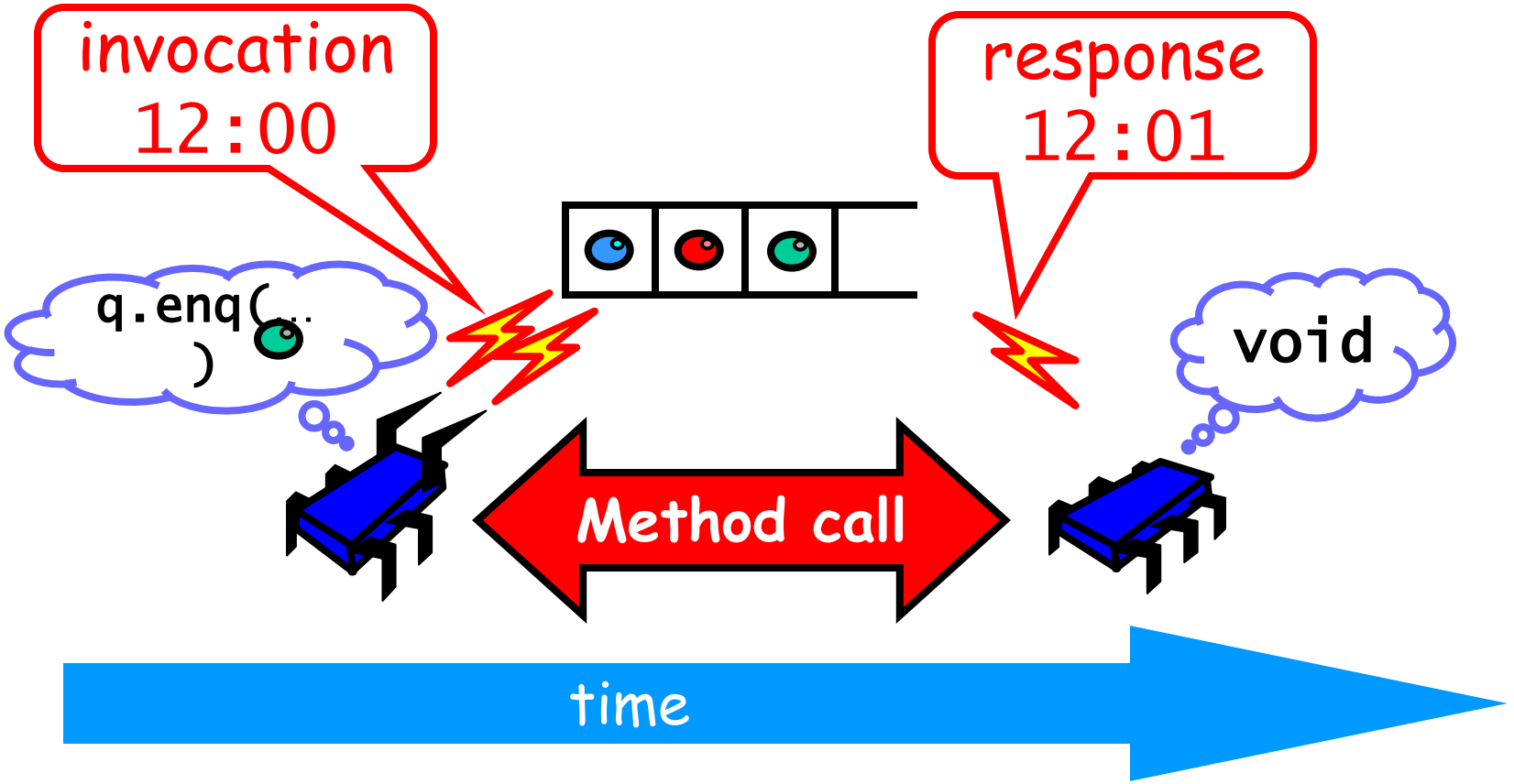
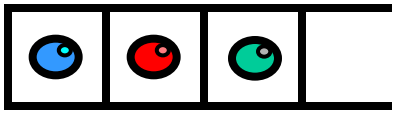


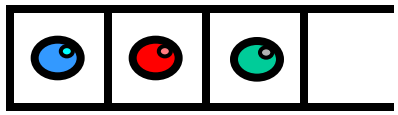
Sequential vs Concurrent

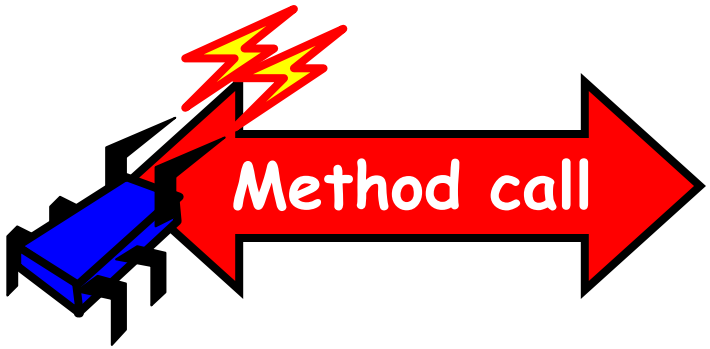
- Sequential
  - Methods take time? Who knew?
- Concurrent
  - Method call is not an event
  - Method call is an interval.

Concurrent Methods Take Overlapping Time

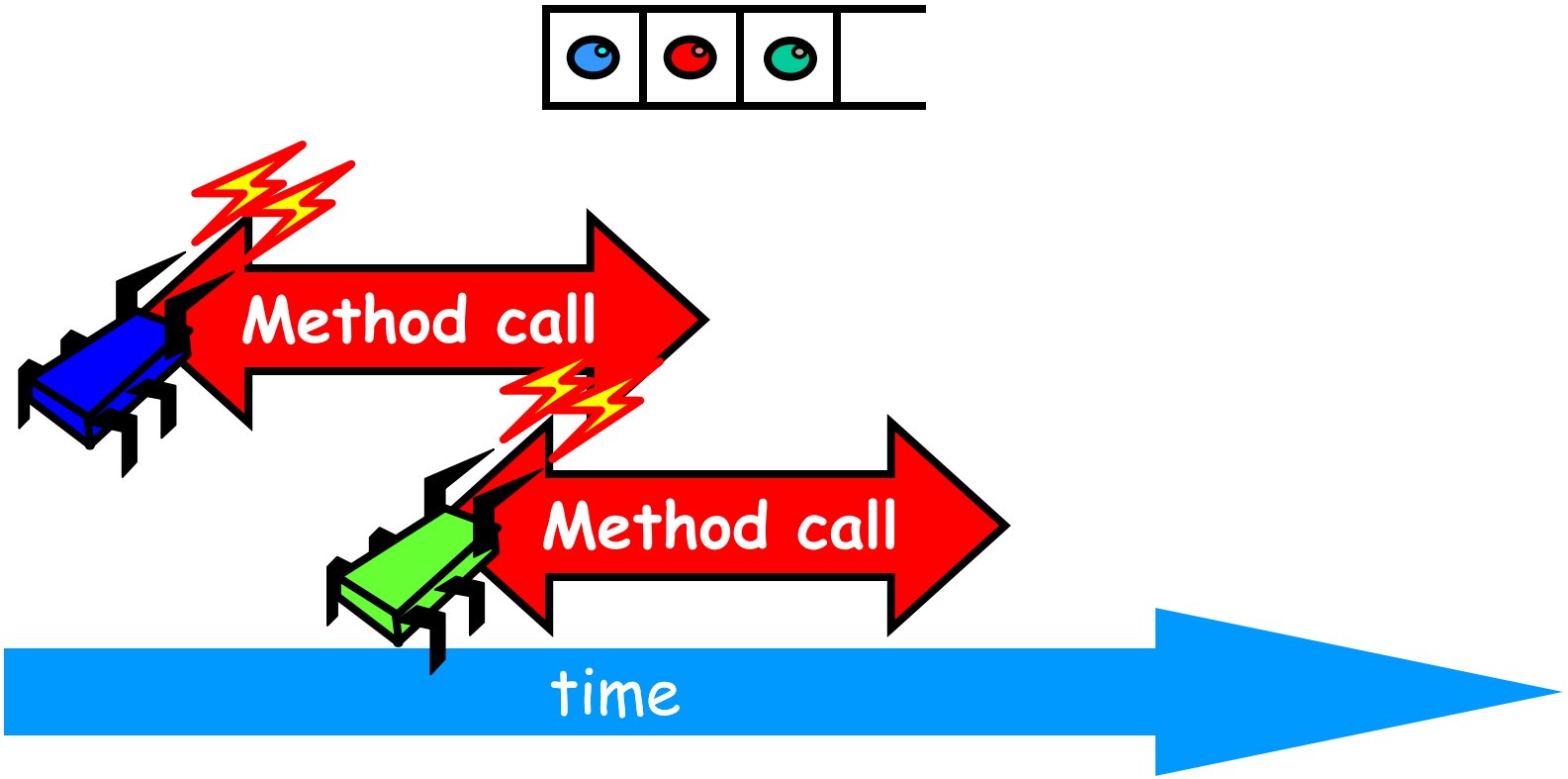


Concurrent Methods Take Overlapping Time

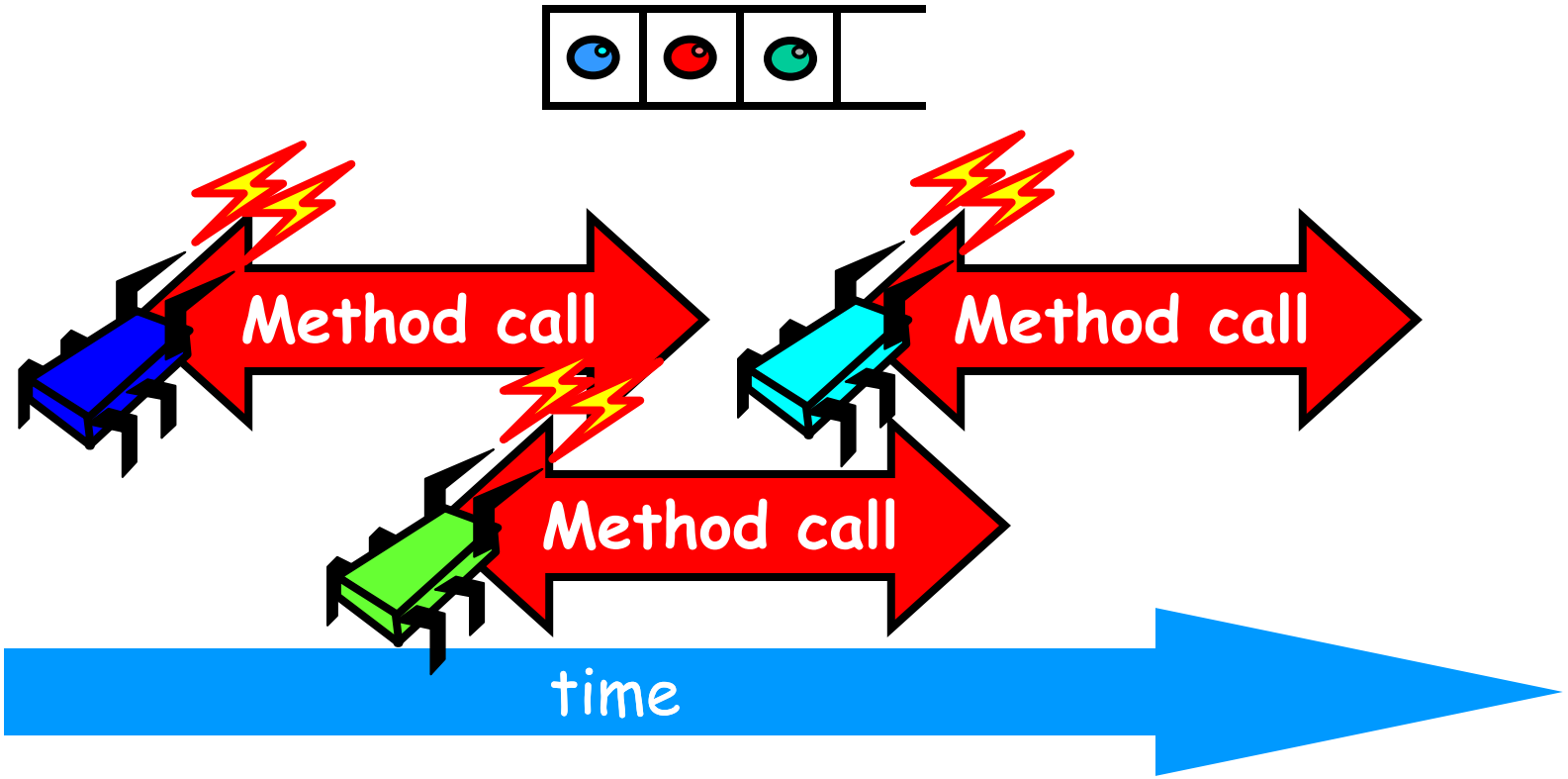




Concurrent Methods Take Overlapping Time



Concurrent Methods Take Overlapping Time



The Big Question

- What does it mean for a *concurrent* object to be correct?
  - What *is* a concurrent FIFO queue?
  - FIFO means strict temporal order
  - Concurrent means ambiguous temporal order

Intuitively…

```
public T deq() throws EmptyException {
  lock.lock();
  try {
    if (tail == head)
       throw new EmptyException();
    T x = items[head % items.length];
    head++;
    return x;
  } finally {
    lock.unlock();
  }
}
```

Intuitively…

```
public T deq() throws EmptyException {
  lock.lock();
  try {
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}
```
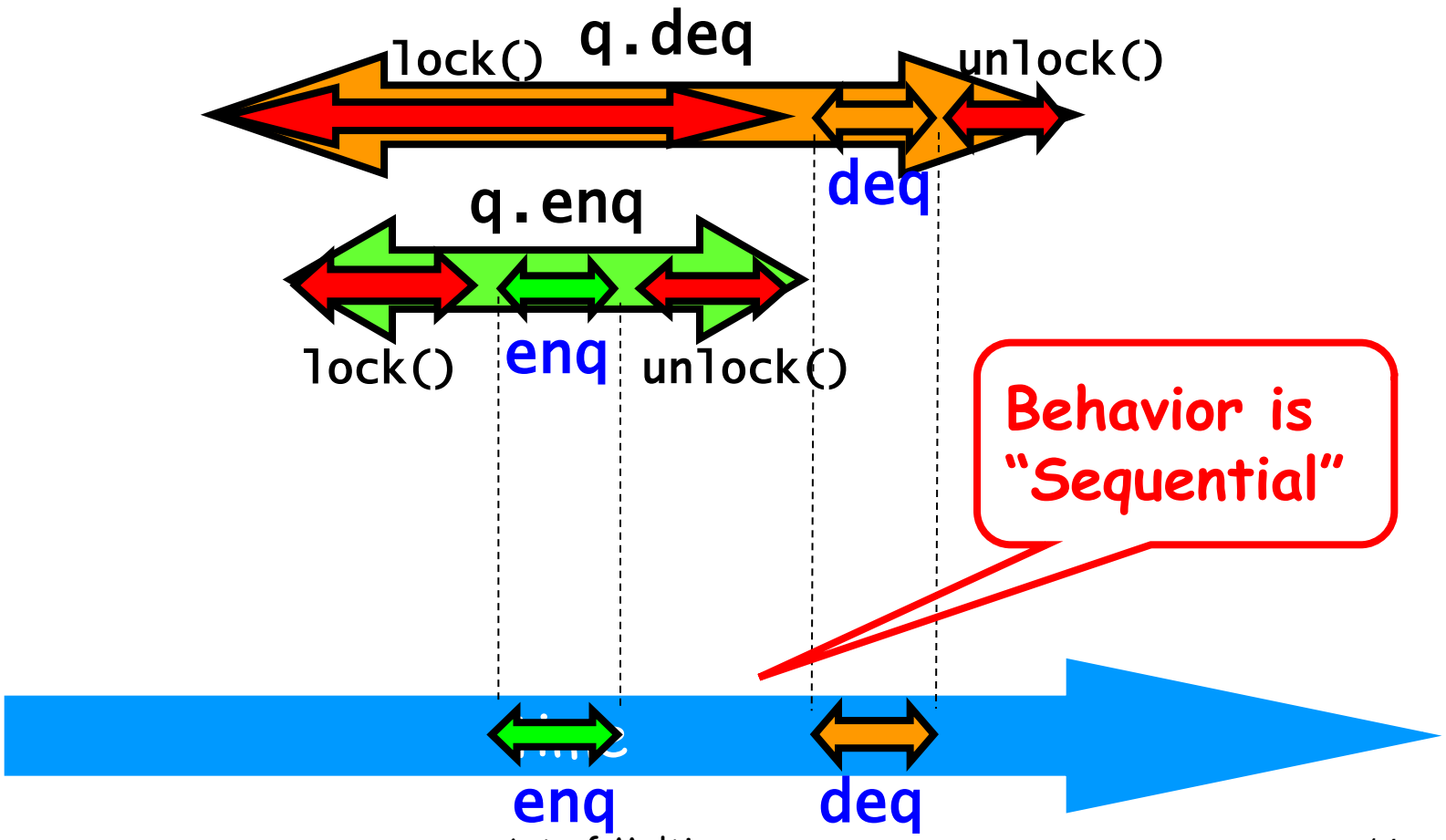

All modifications of queue are done mutually exclusive

Intuitively

Lets capture the idea of describing the concurrent via the sequential



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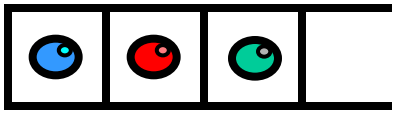

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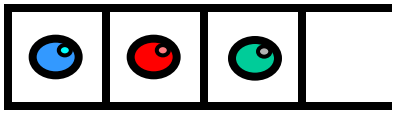

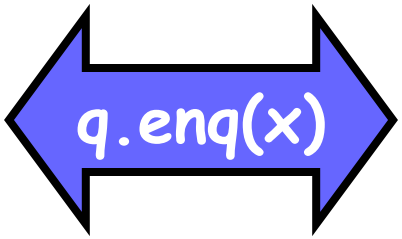

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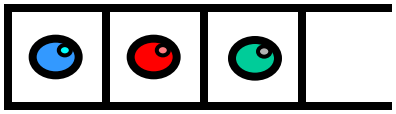

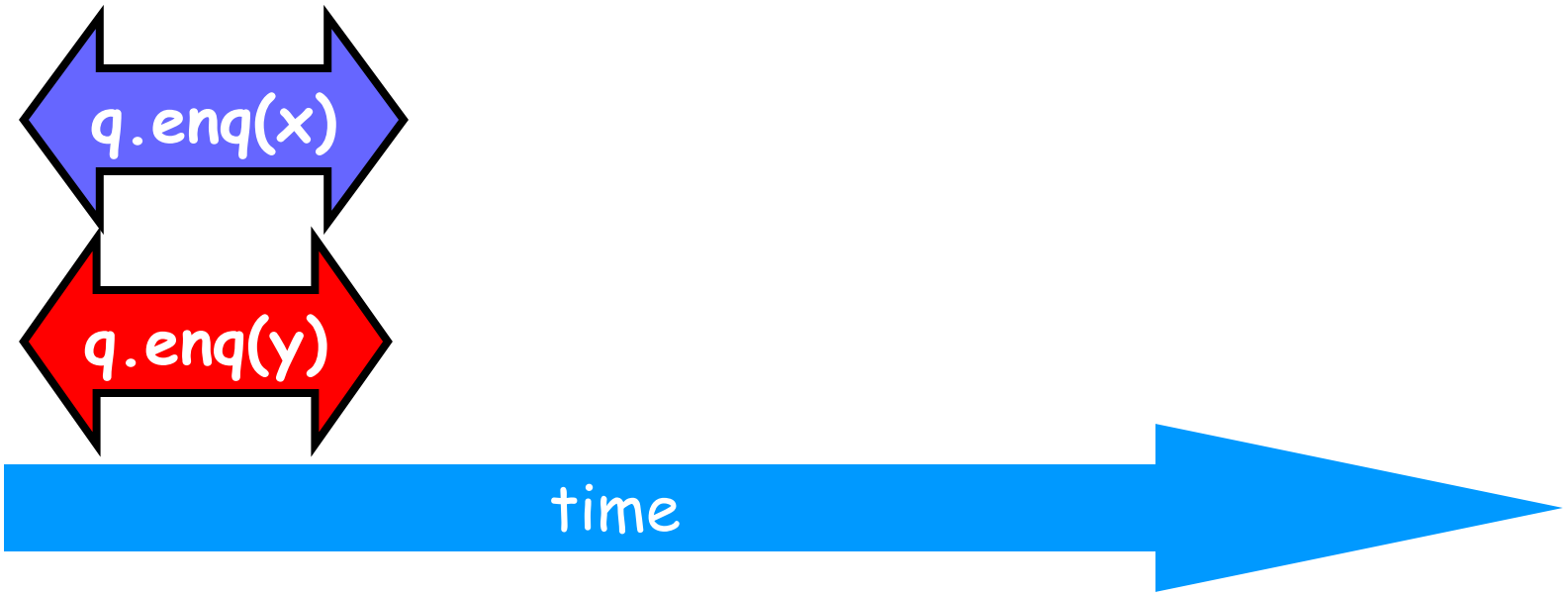

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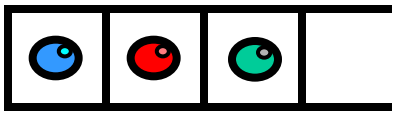

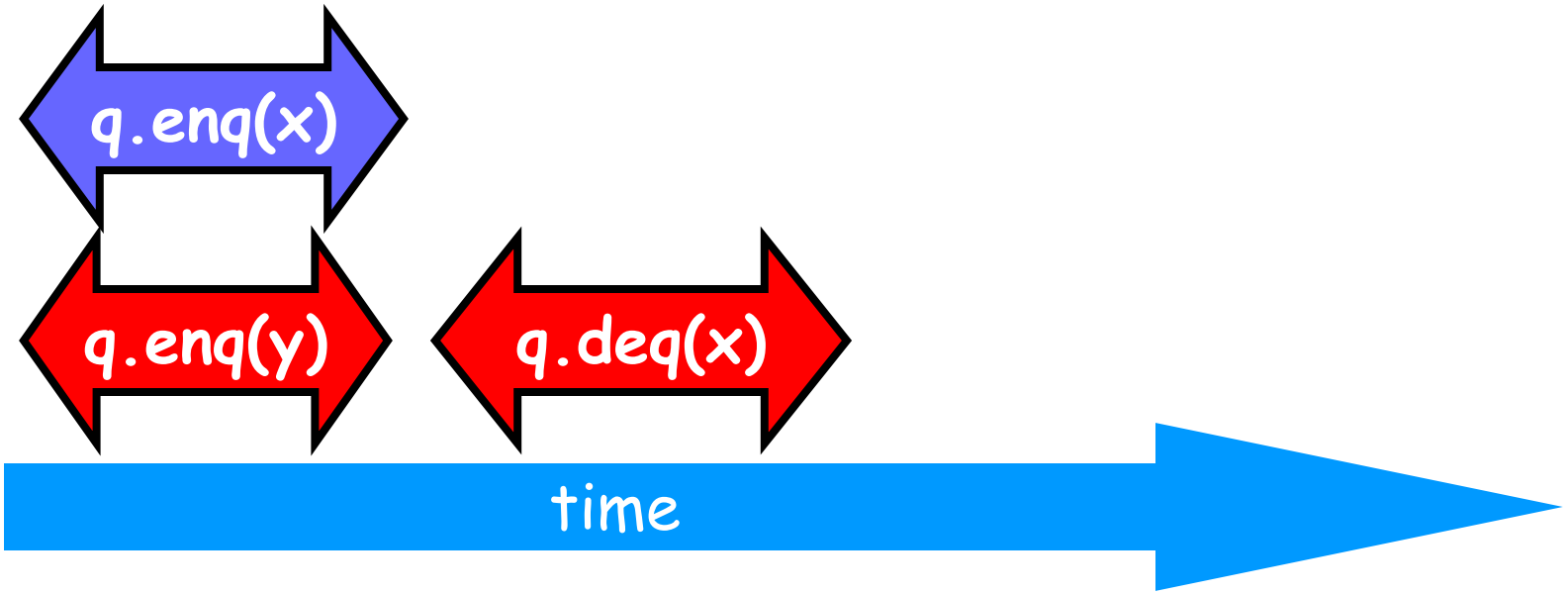

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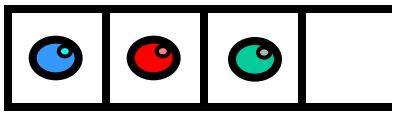

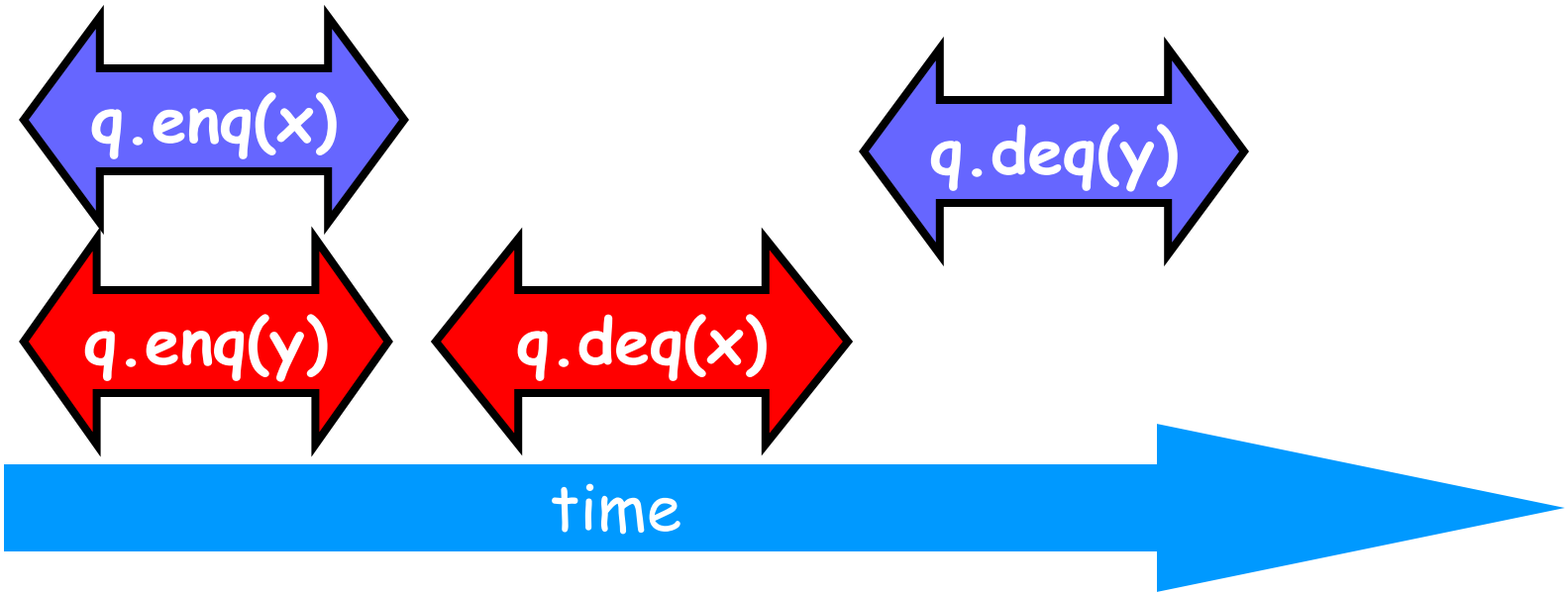

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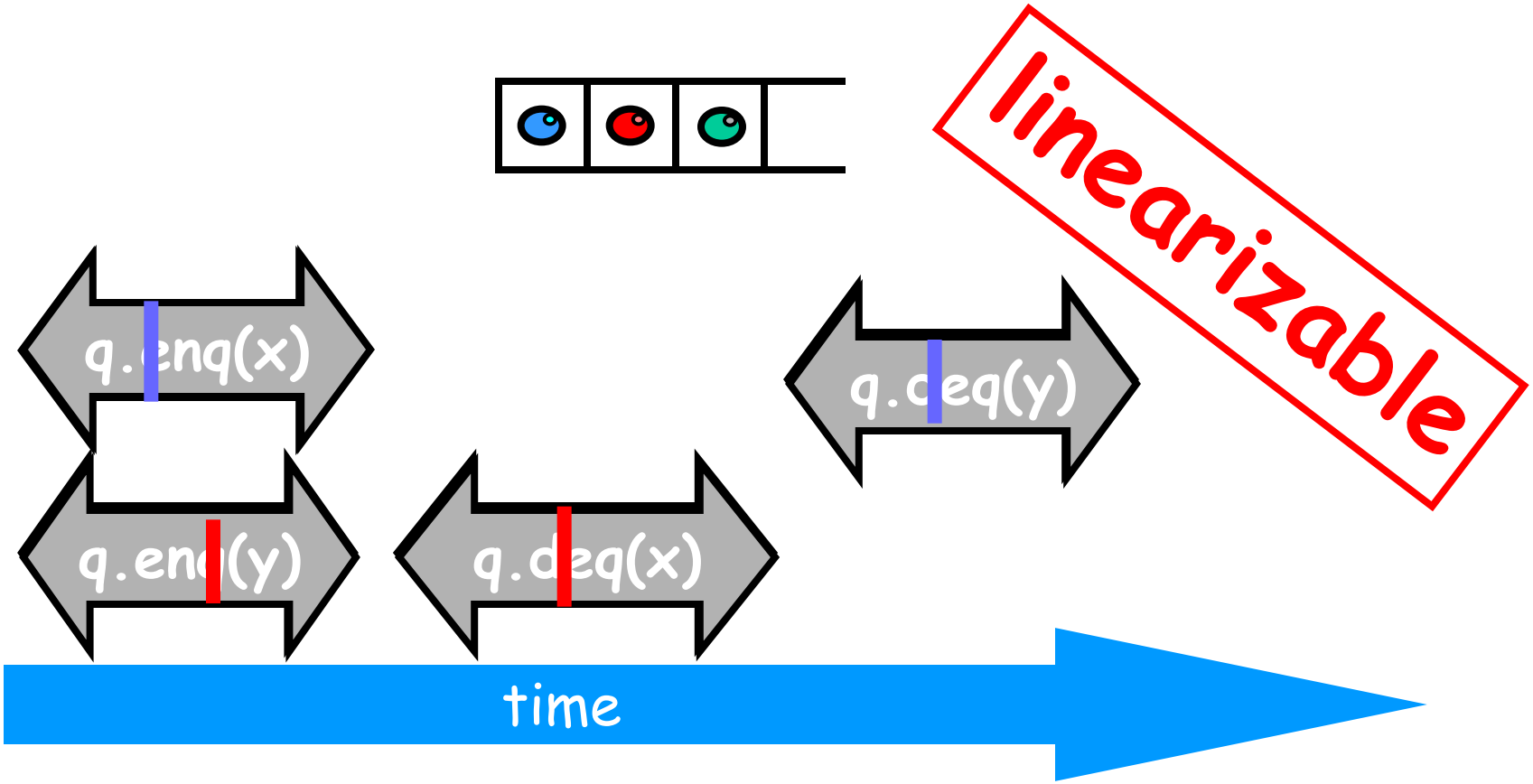

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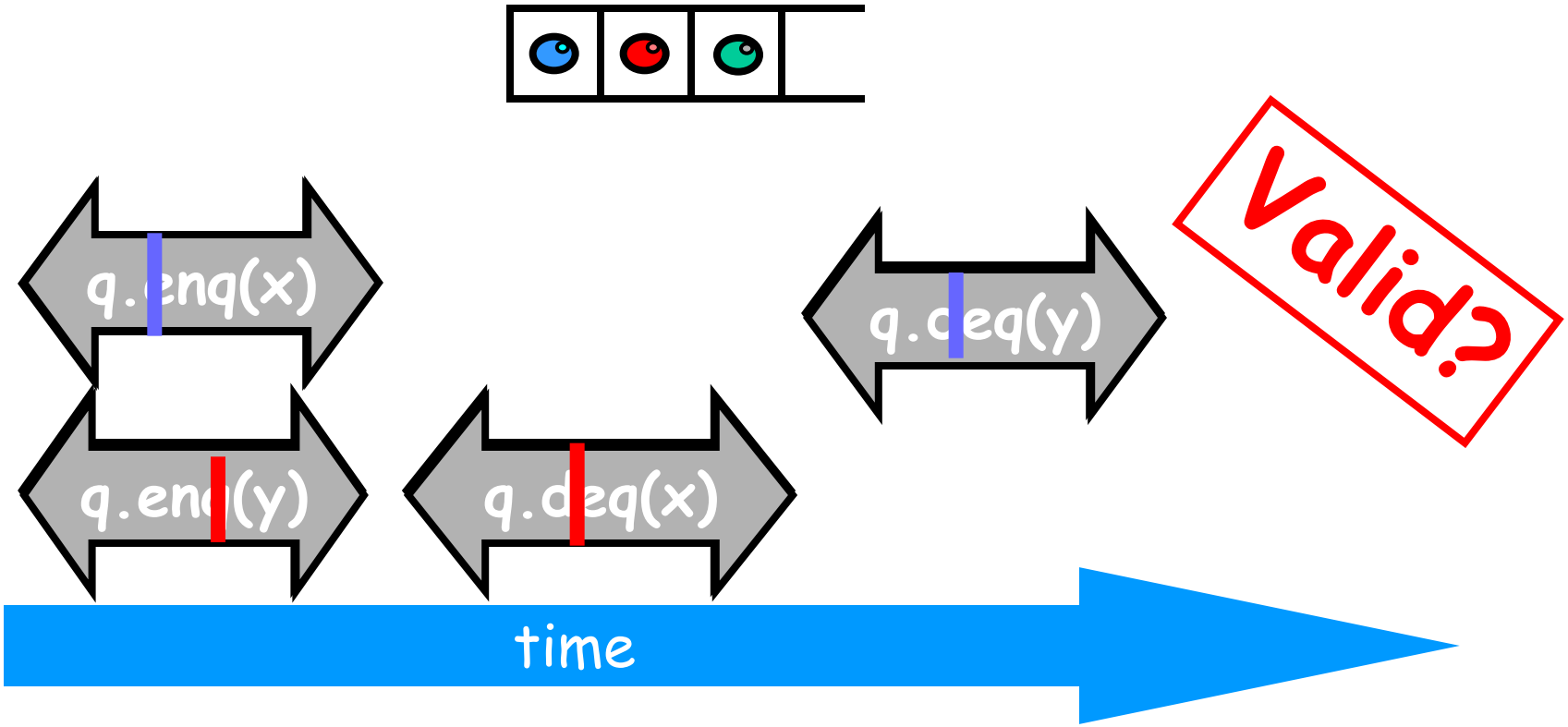

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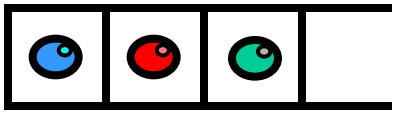

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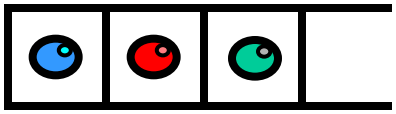

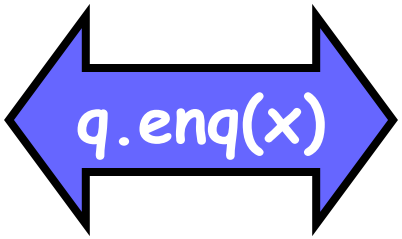

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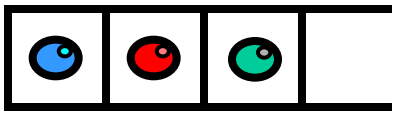

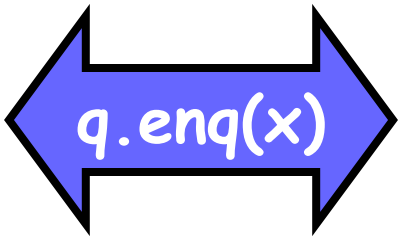

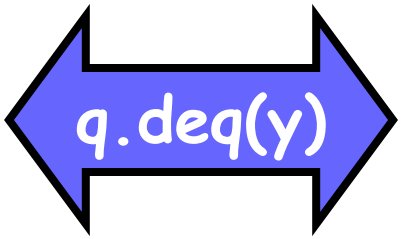

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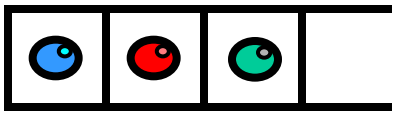

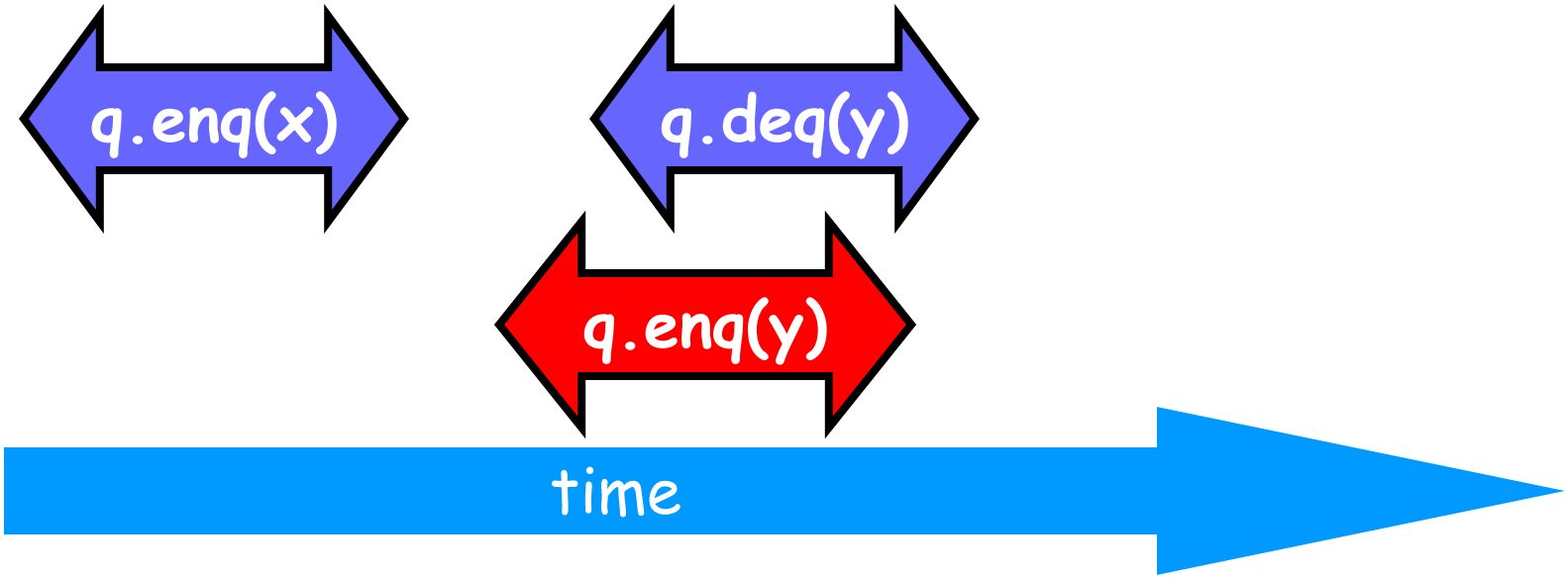

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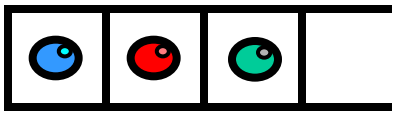

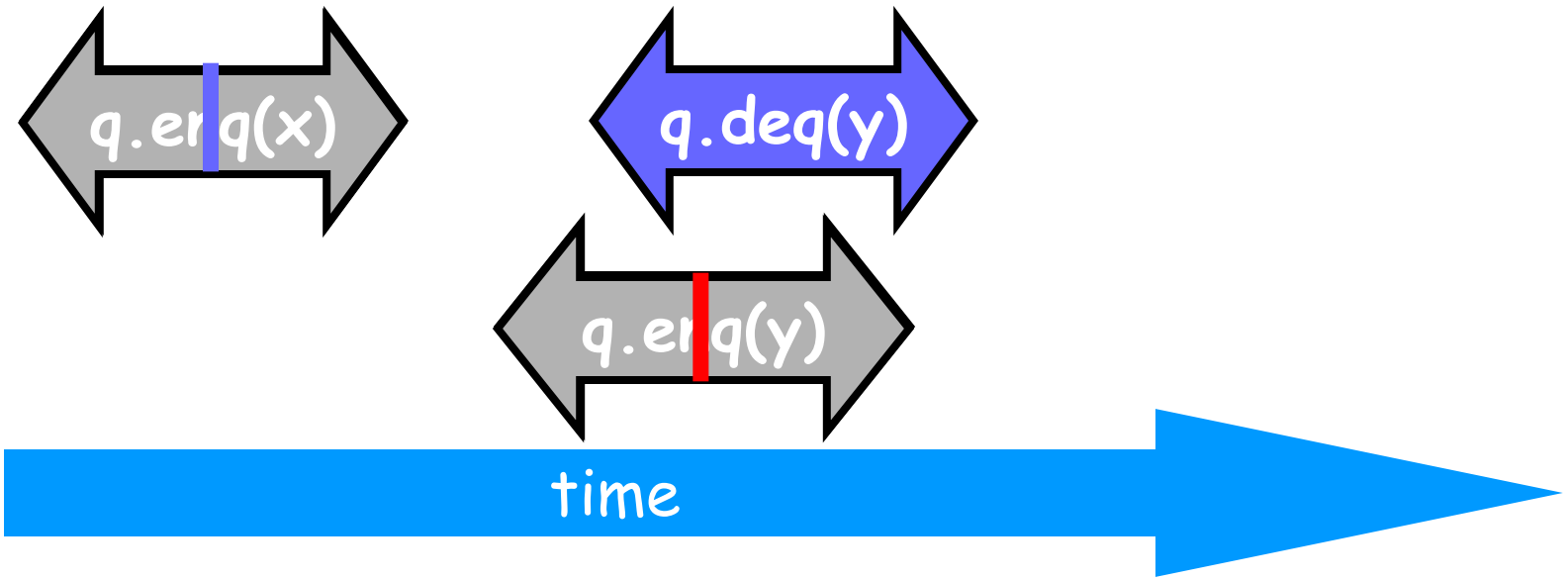

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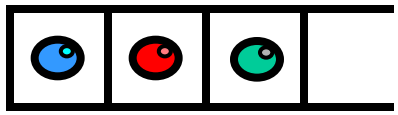

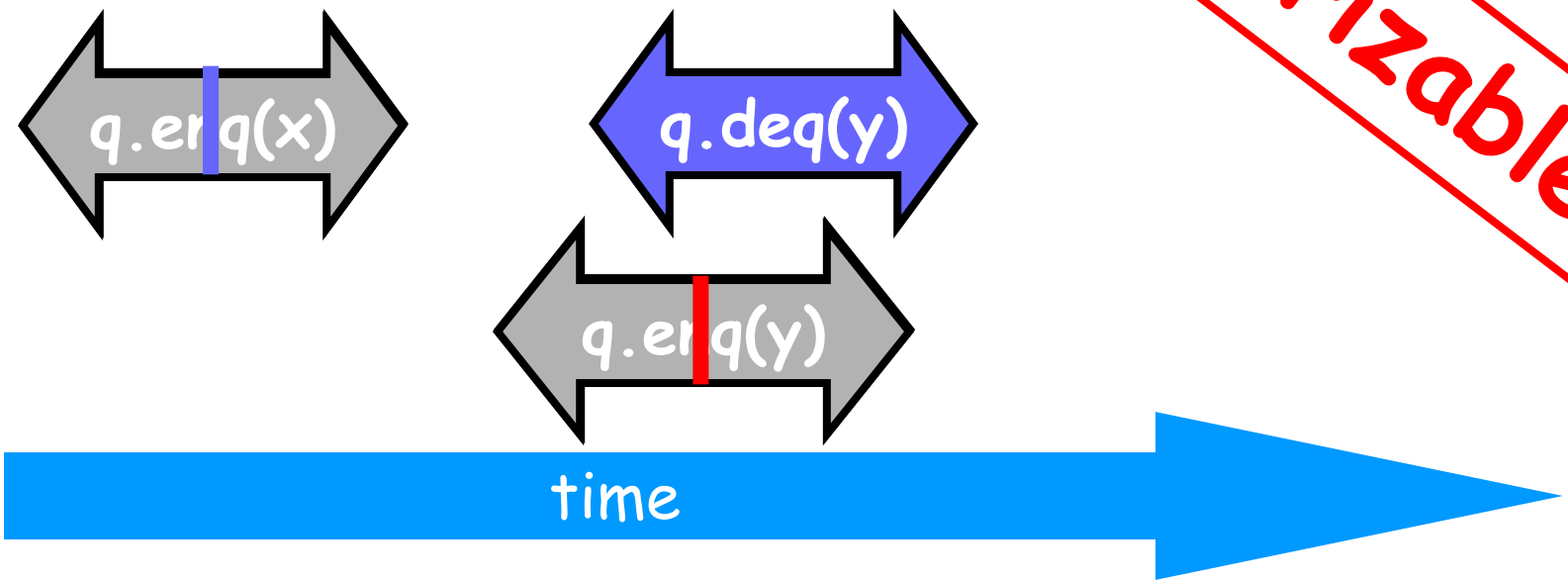

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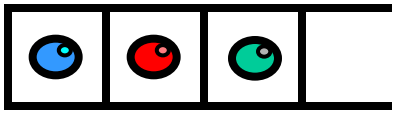

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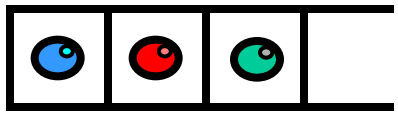

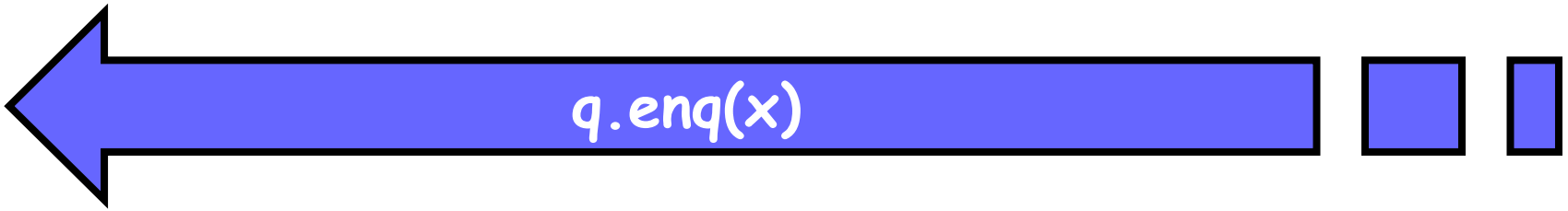

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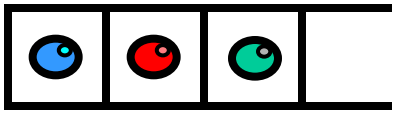

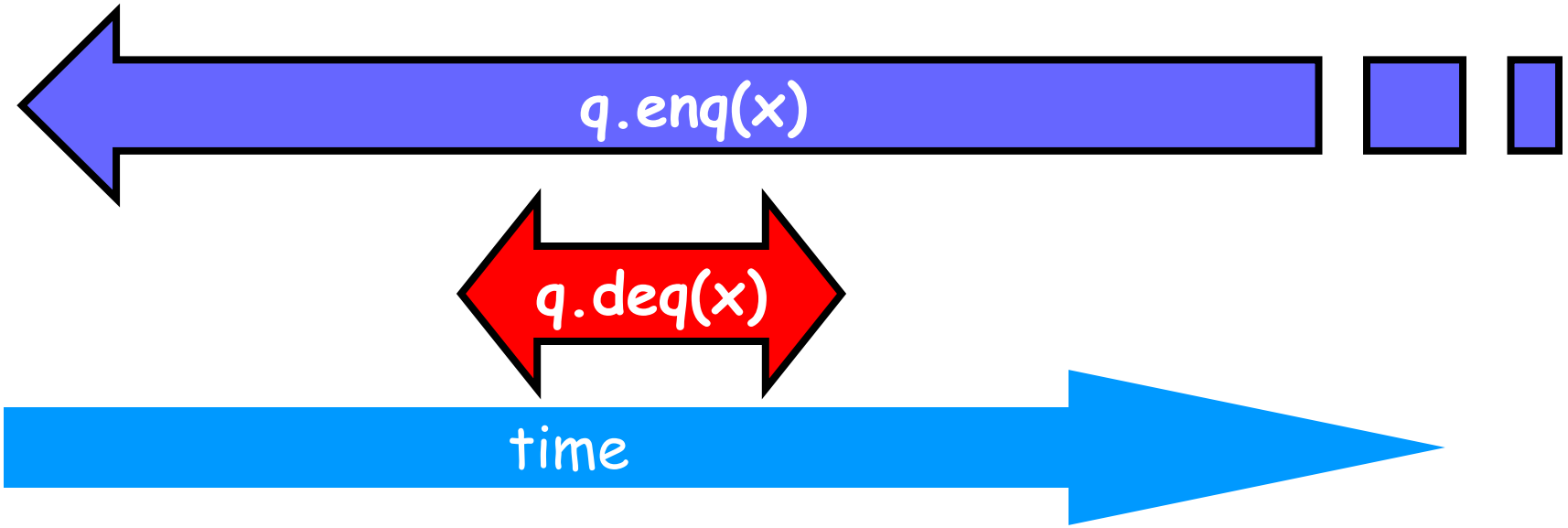

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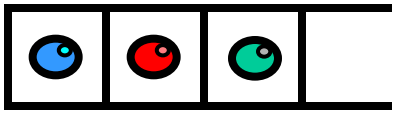

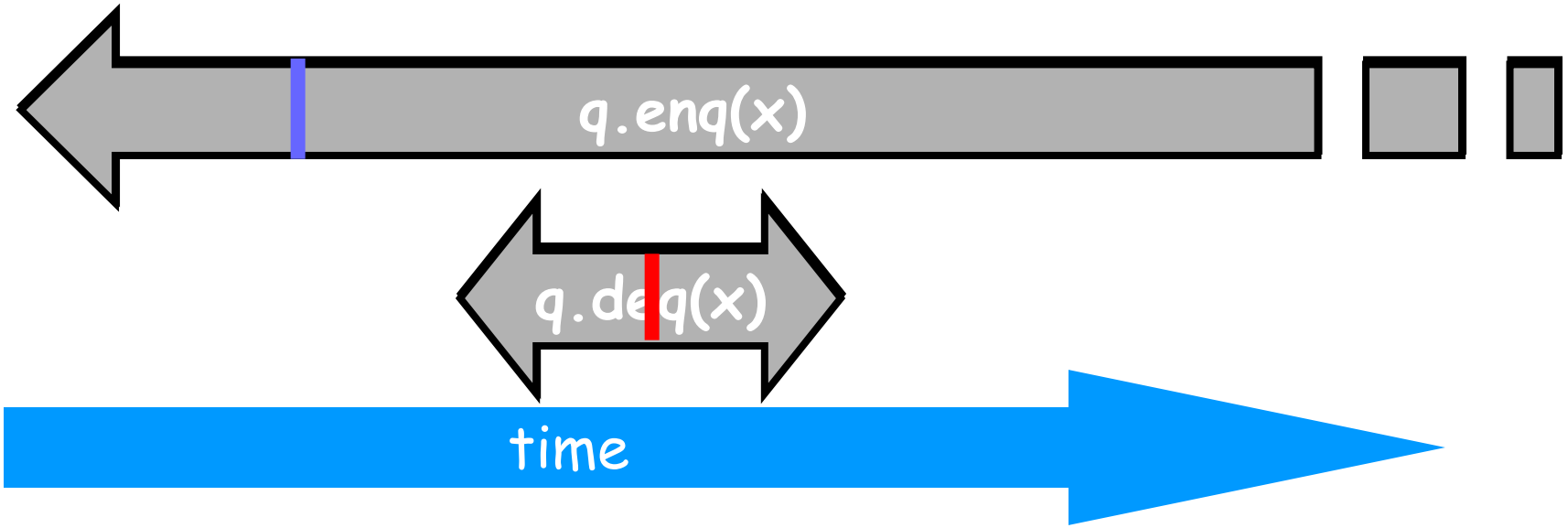

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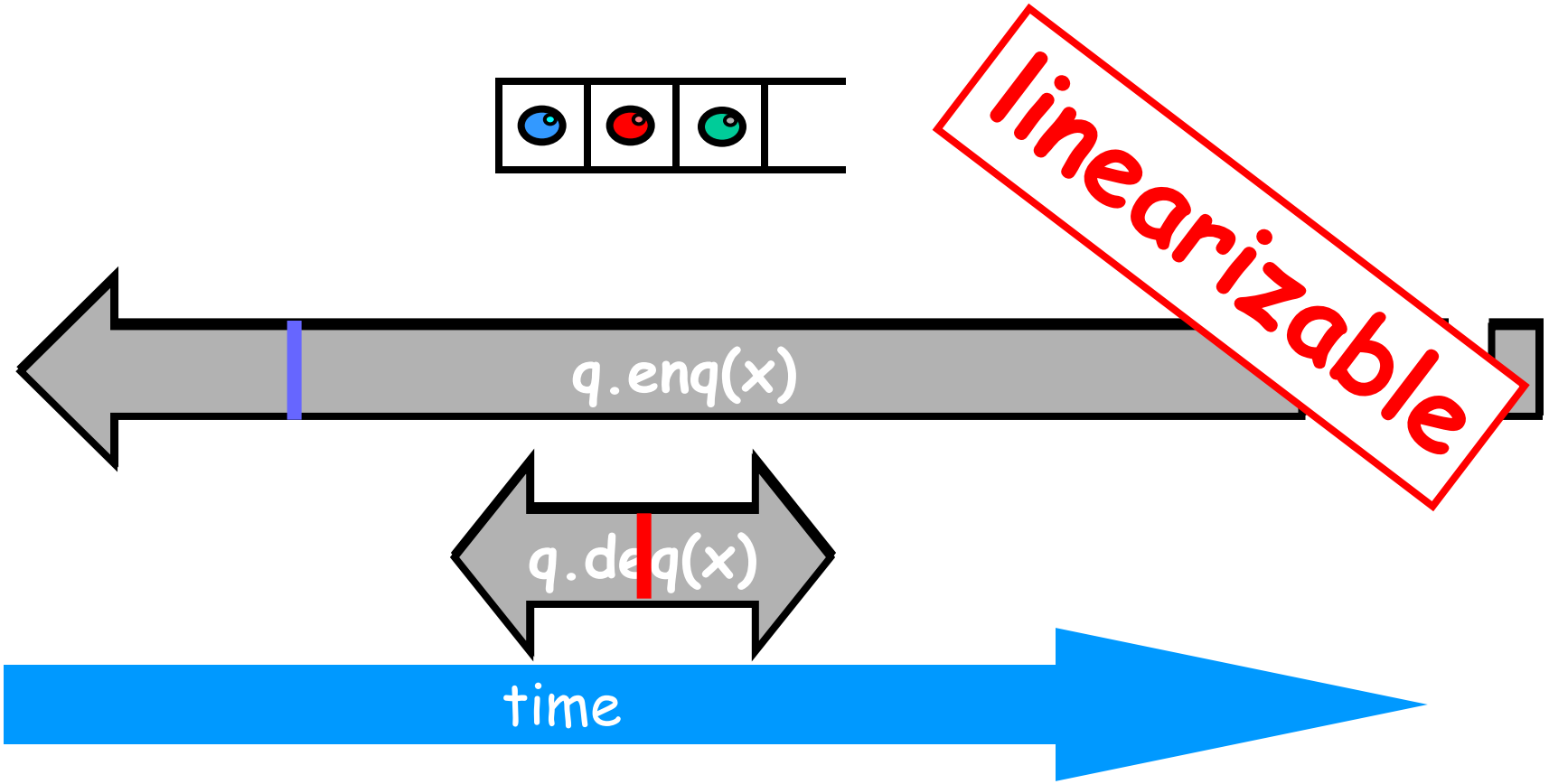

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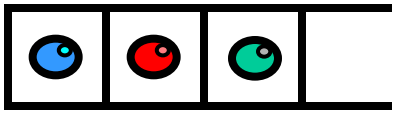

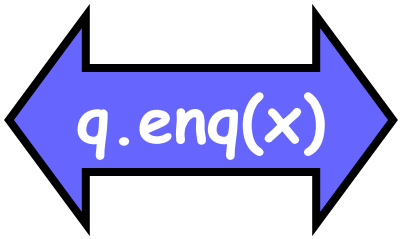

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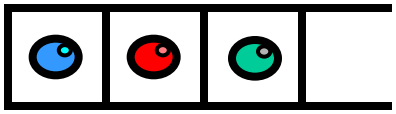

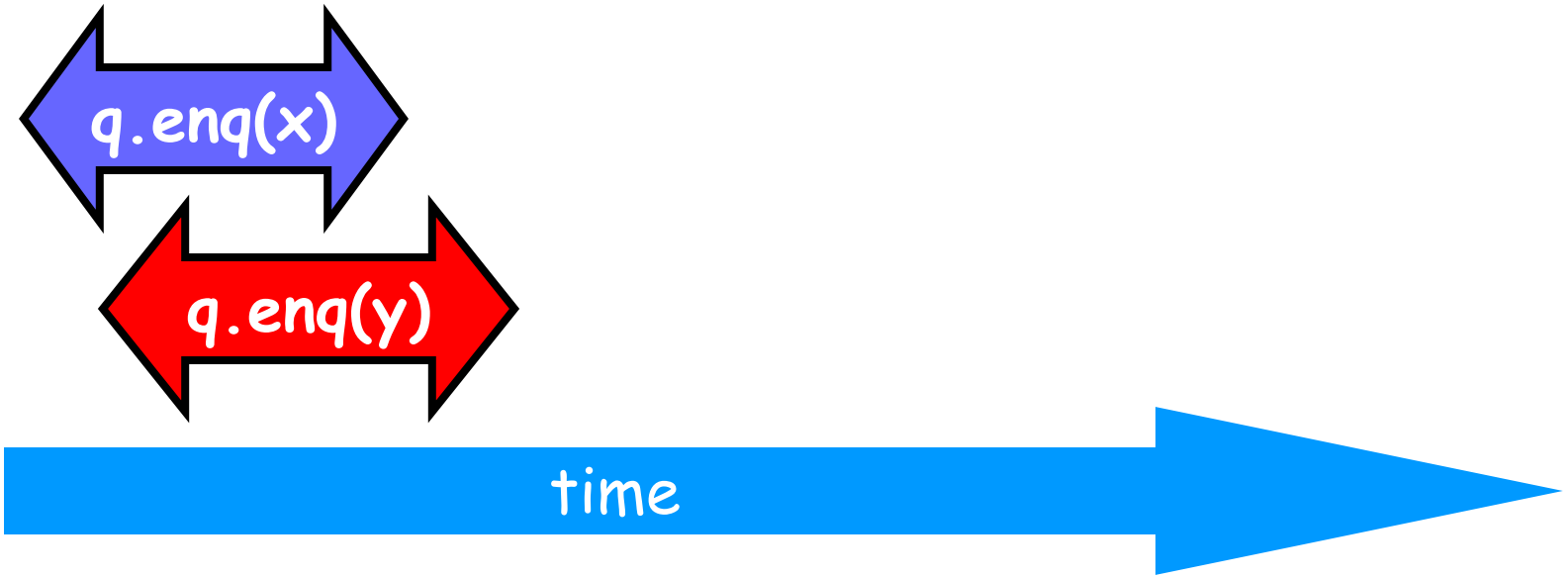

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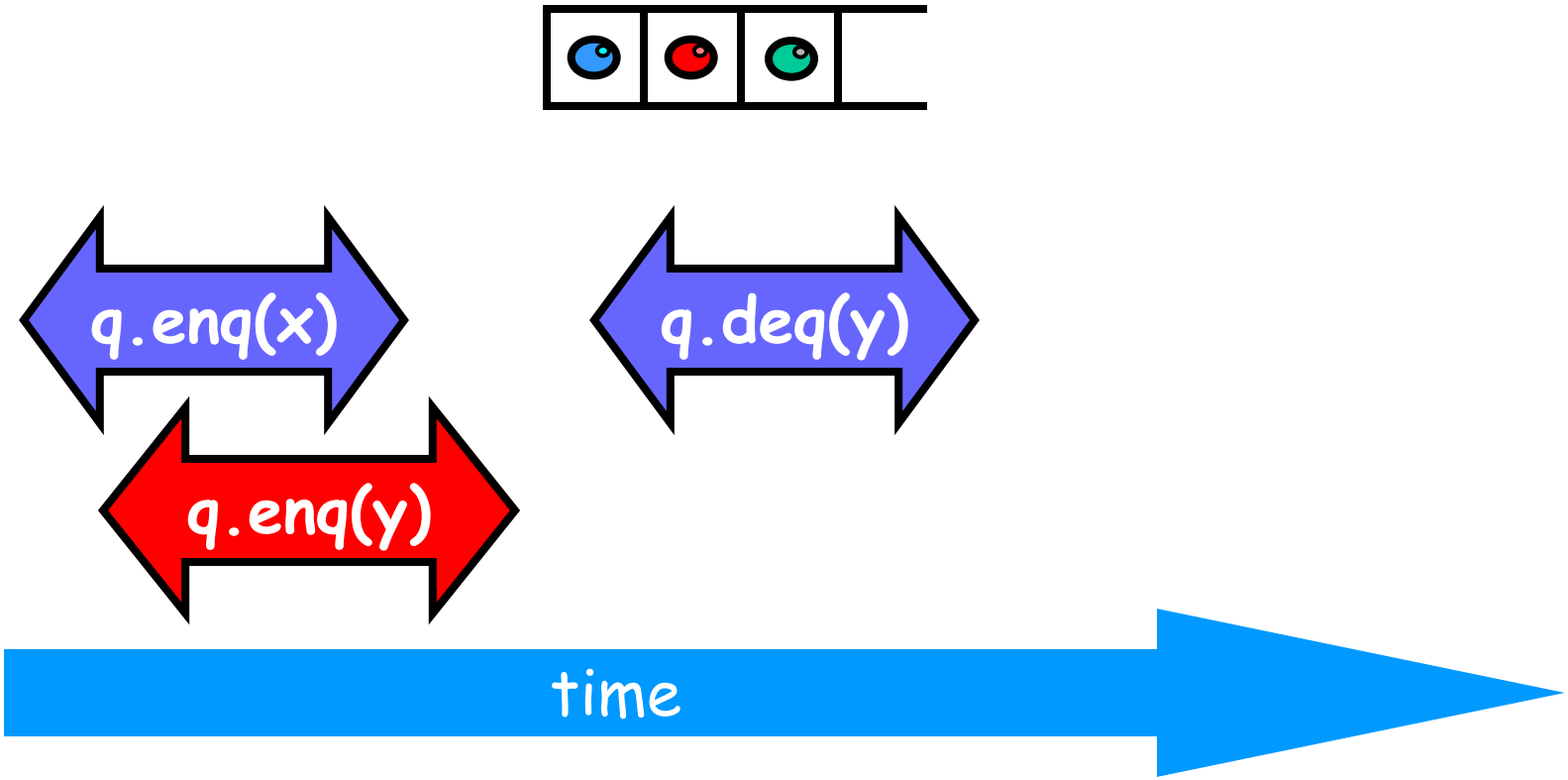

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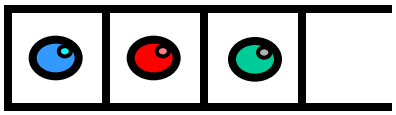
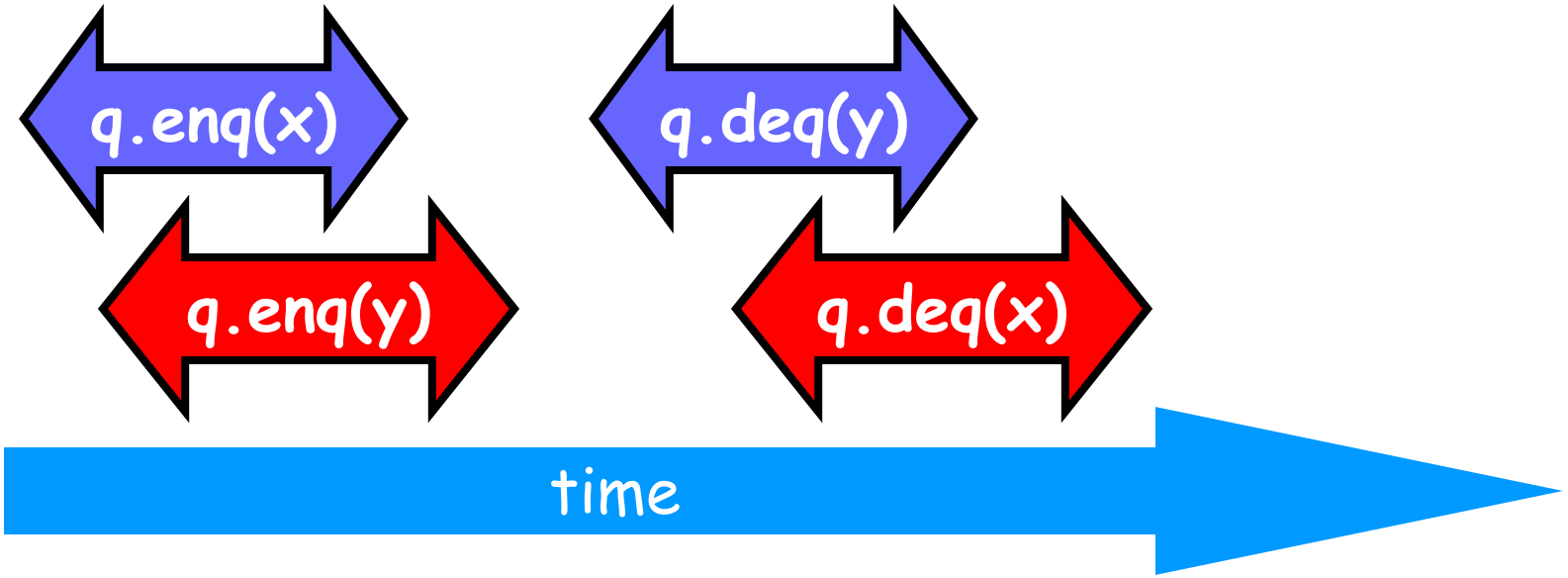
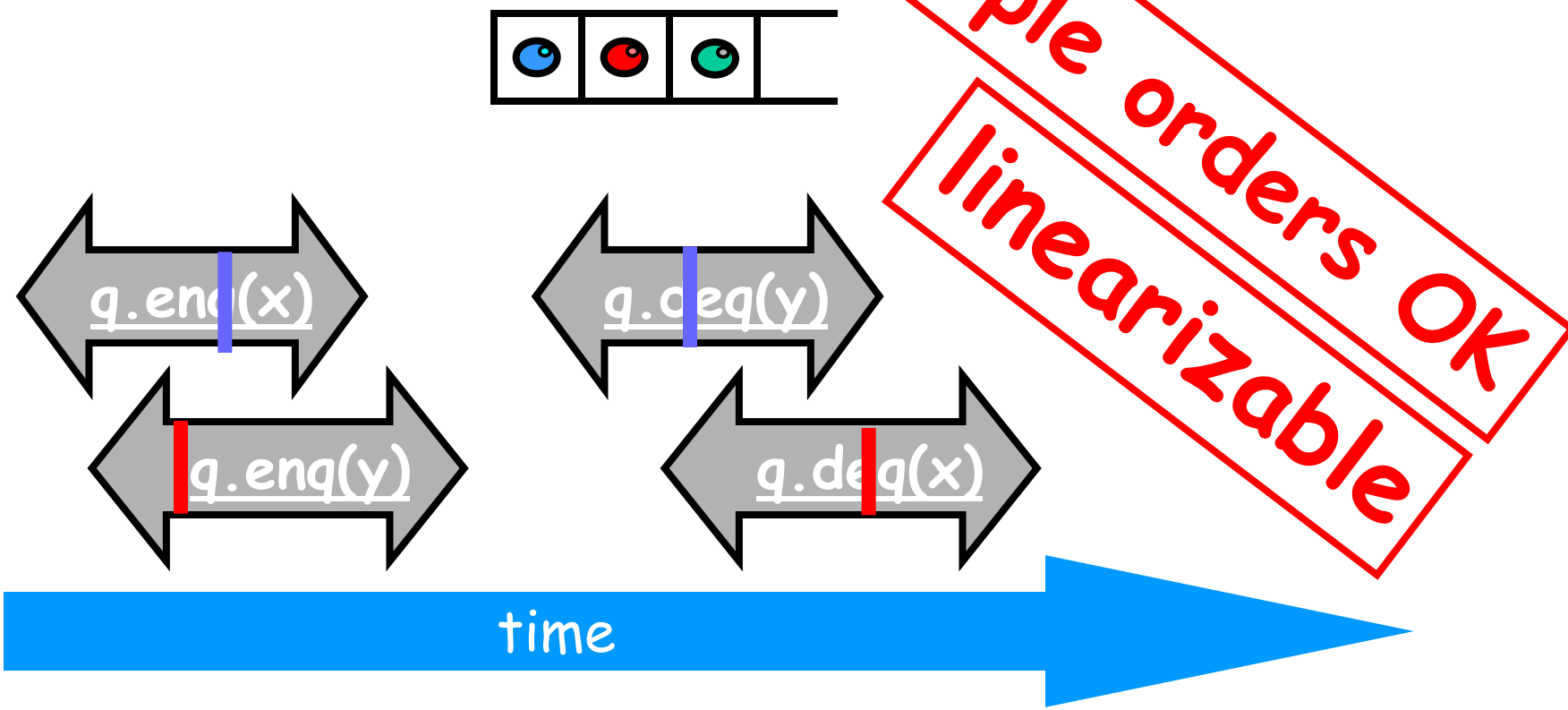




Comme ci Comme ça

Example



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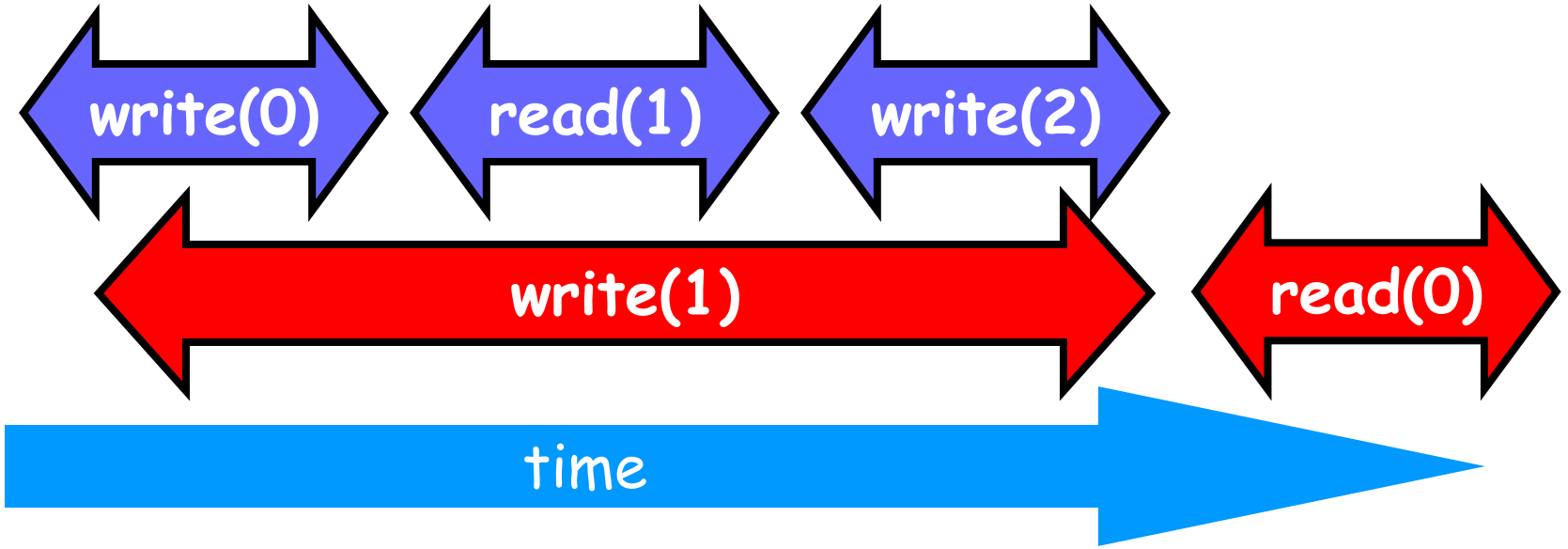

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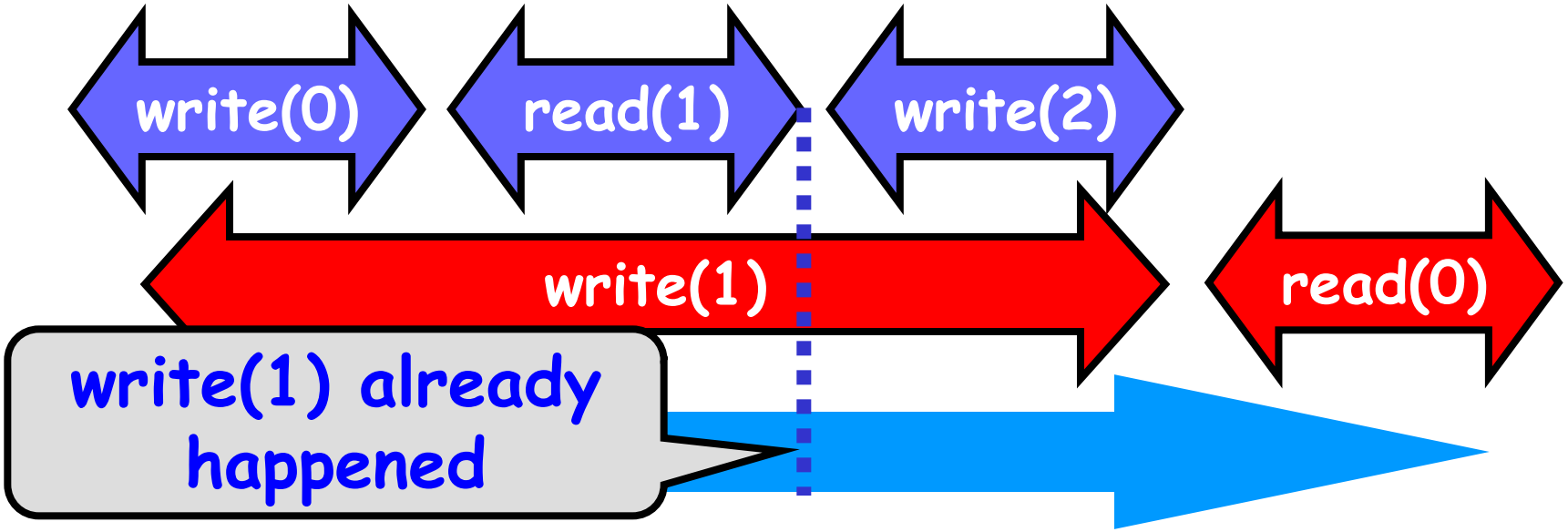

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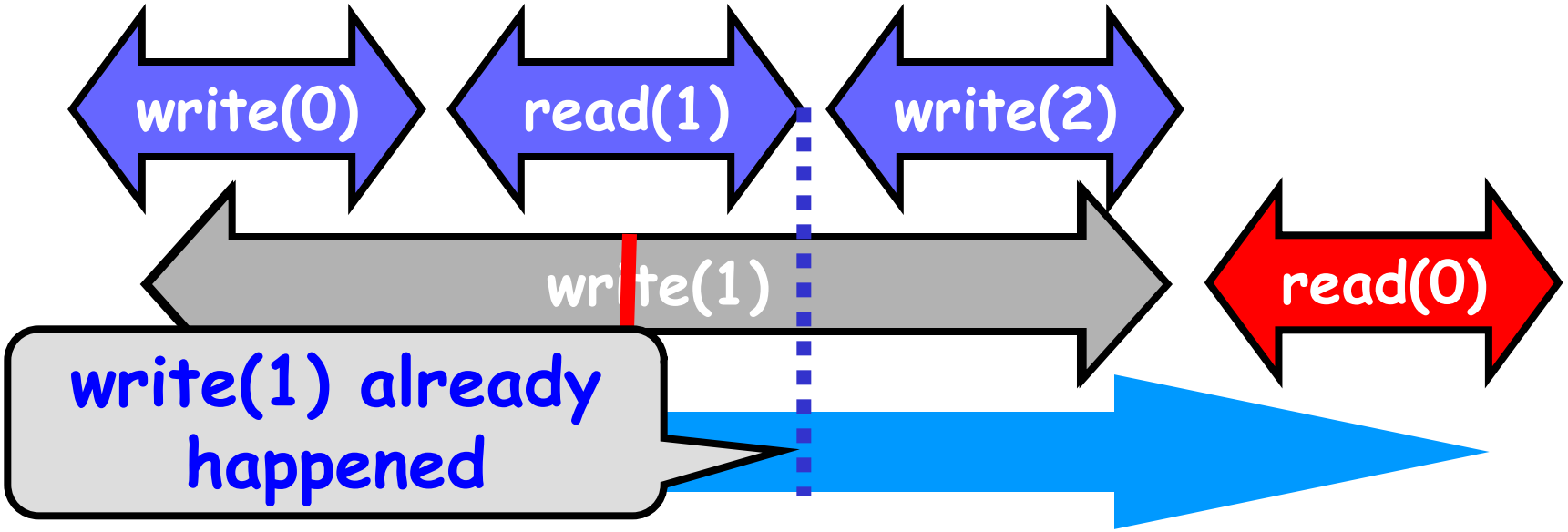

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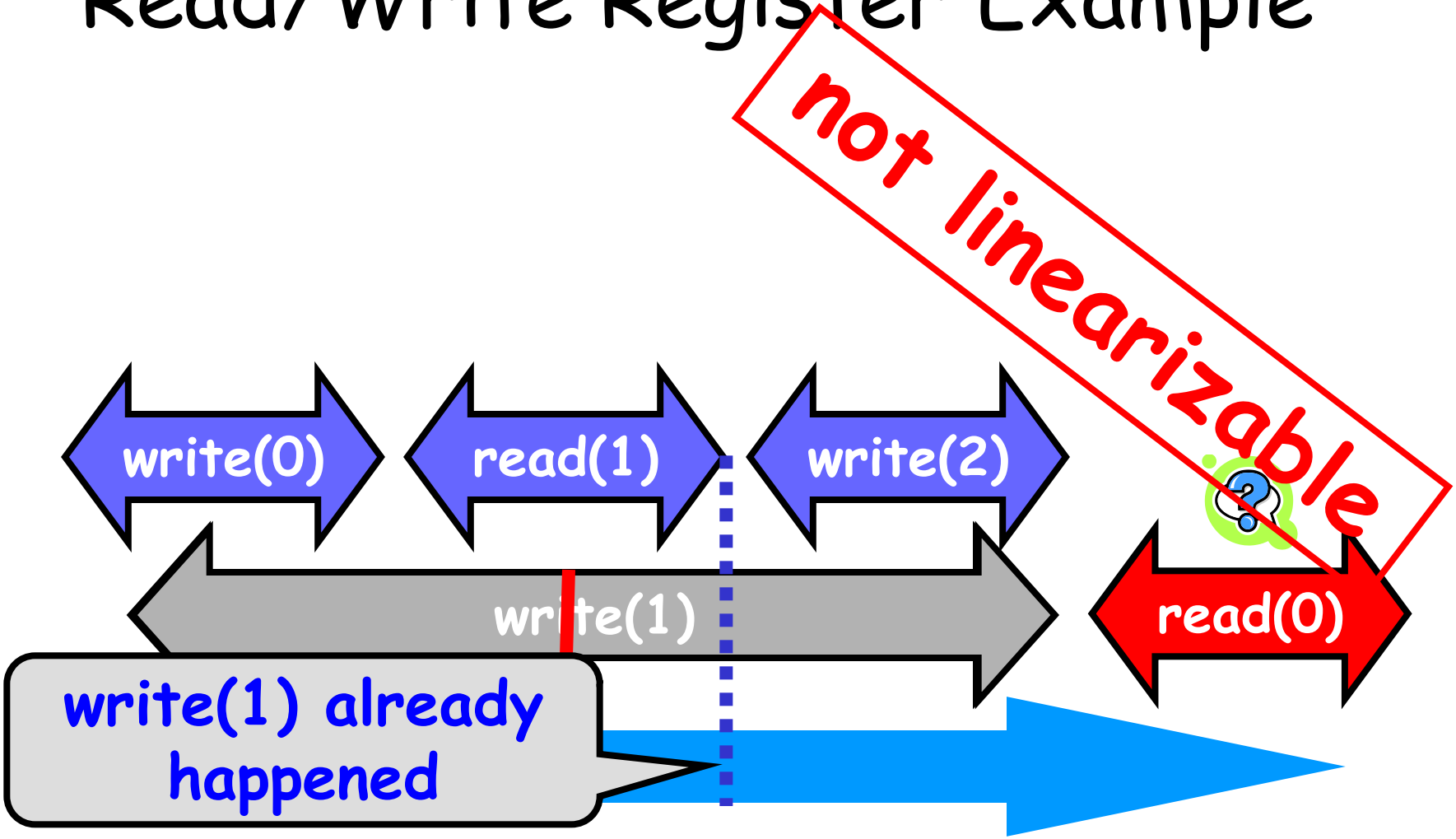

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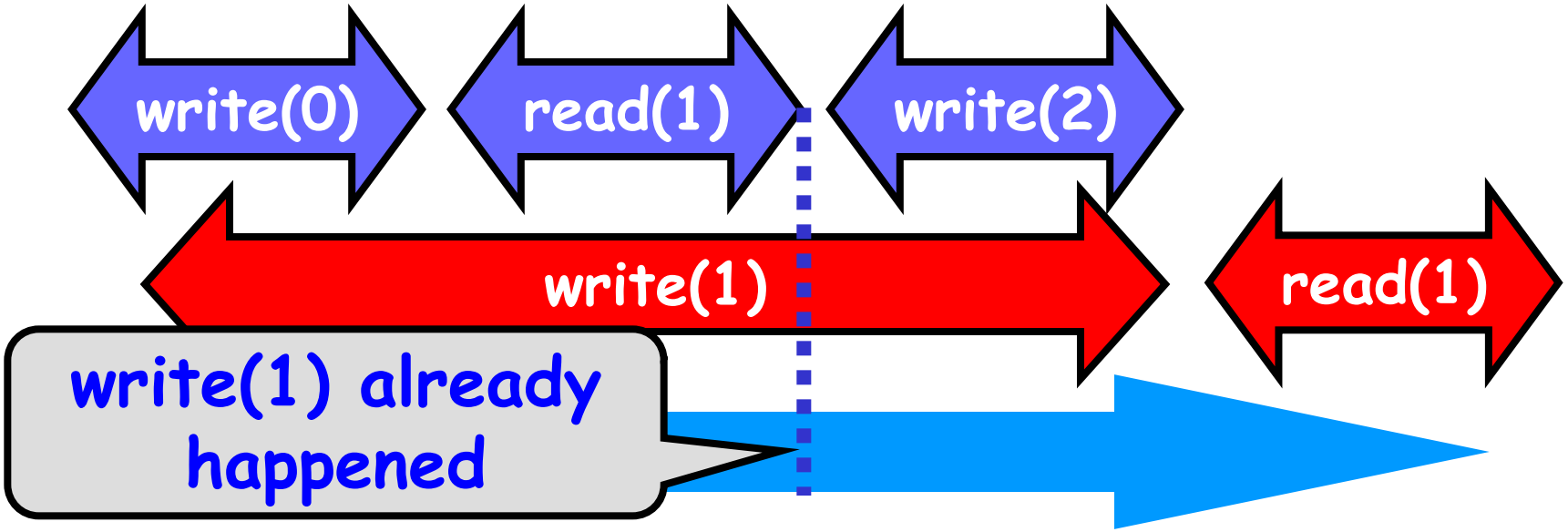

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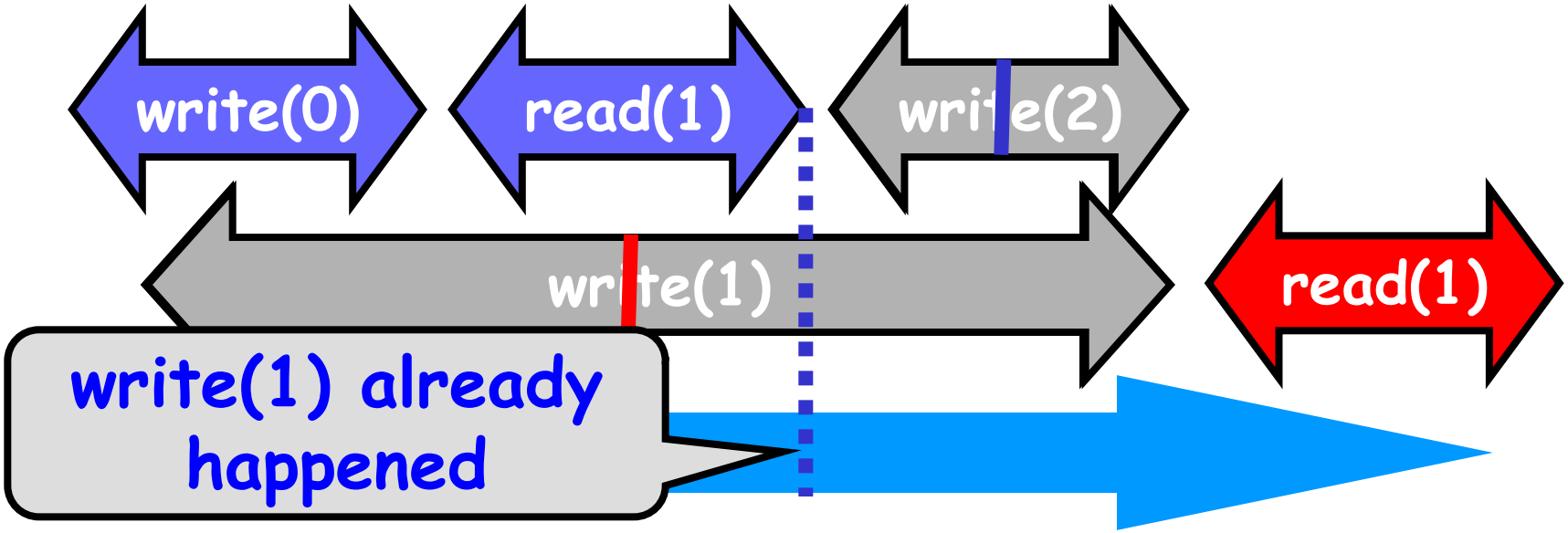
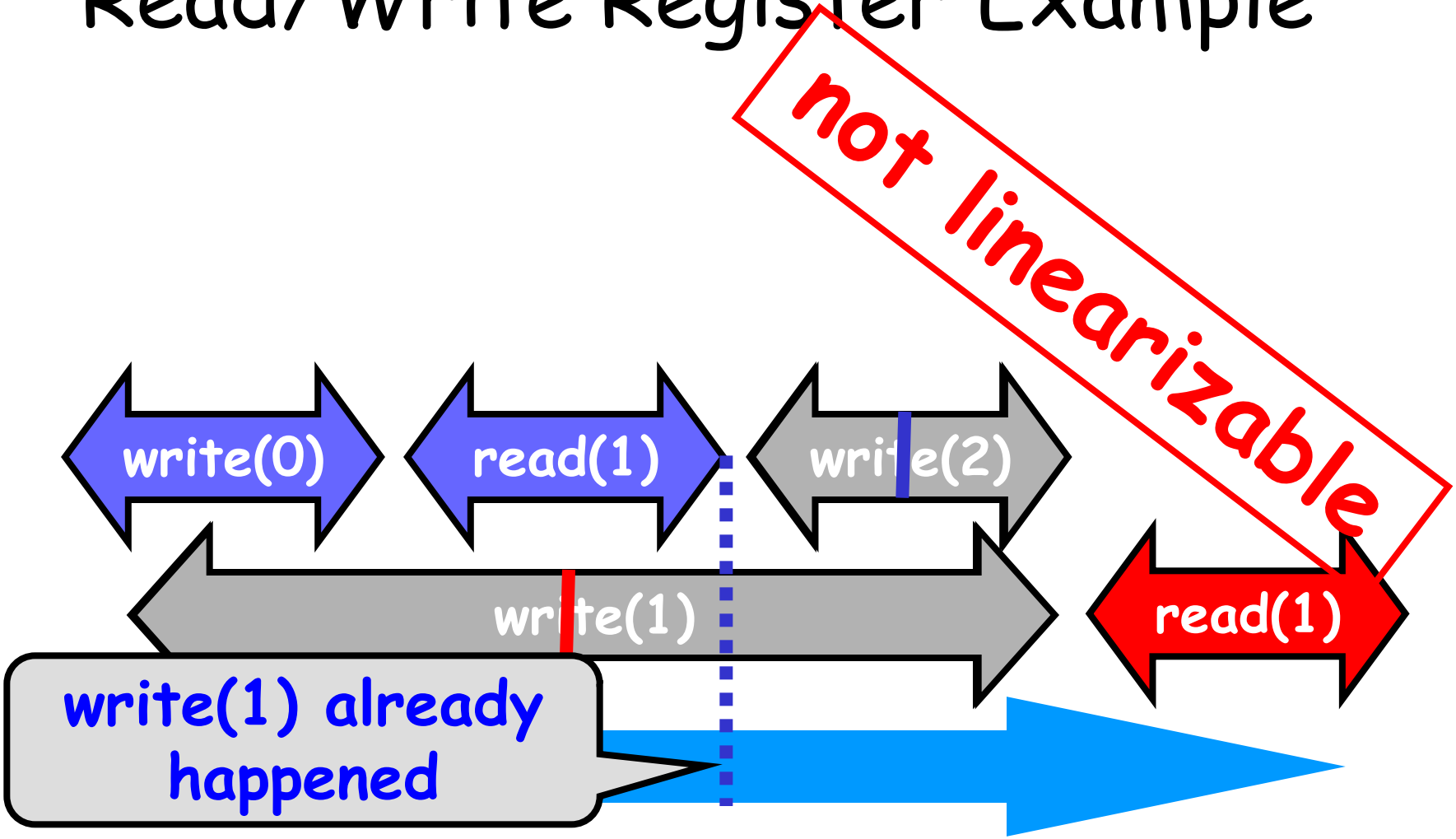


Read/Write Register Example



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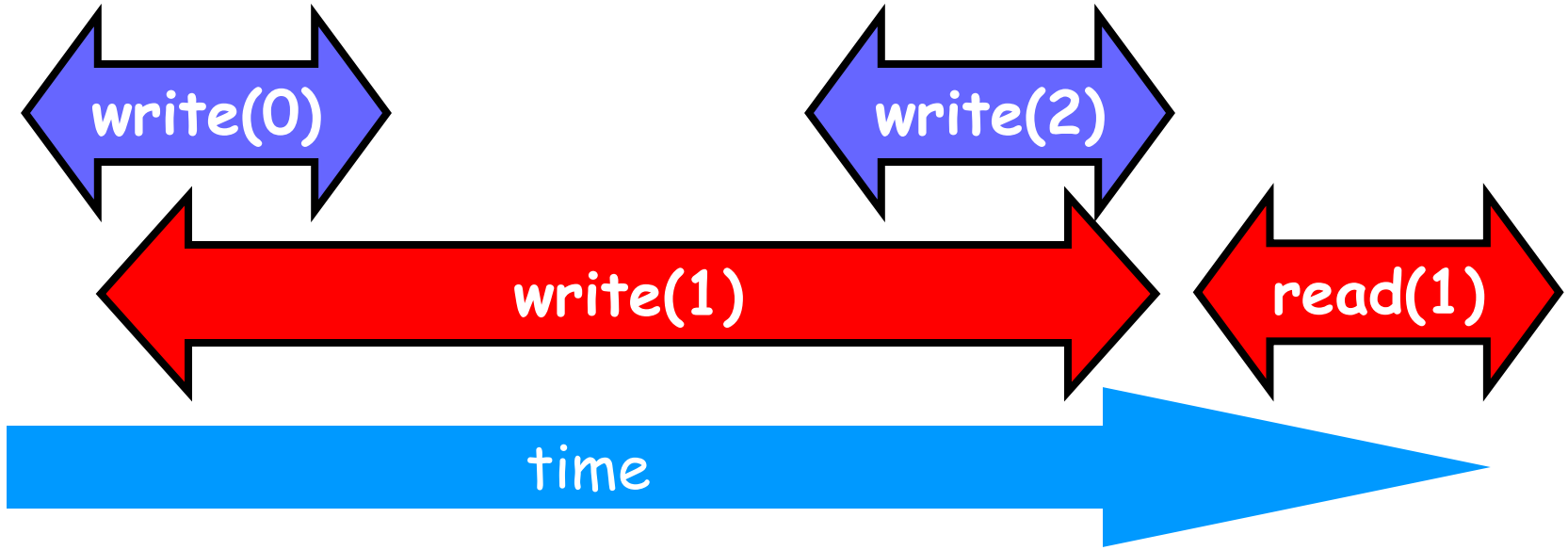

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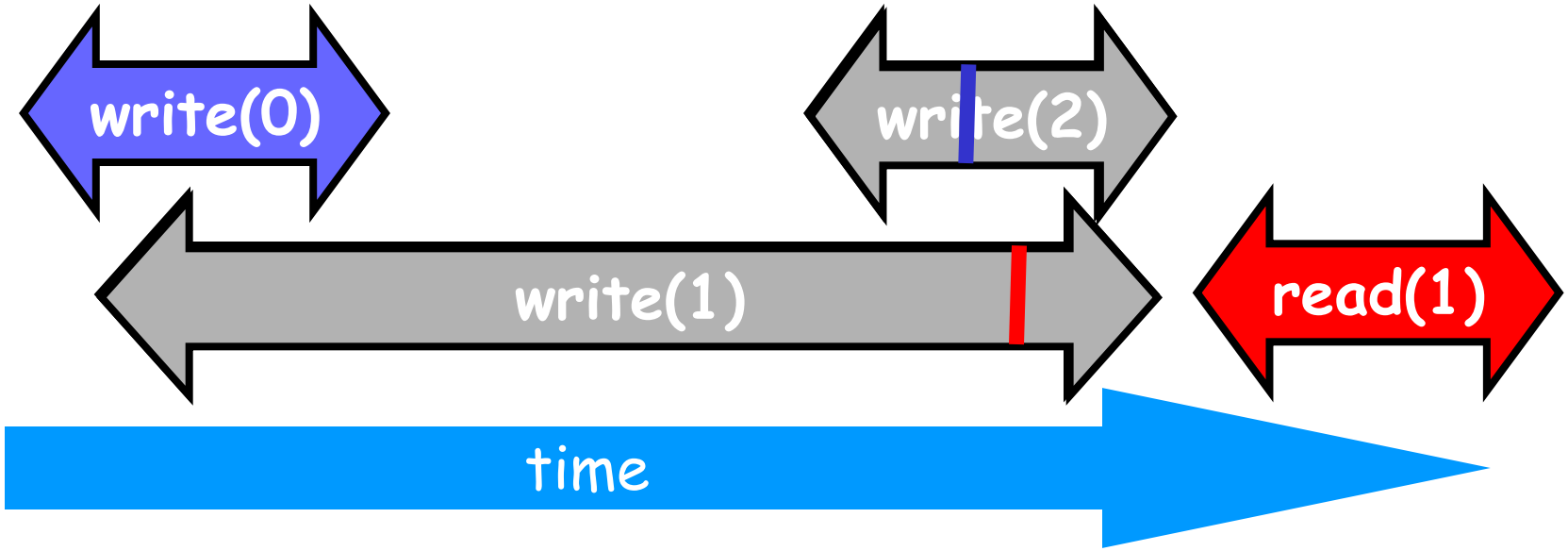

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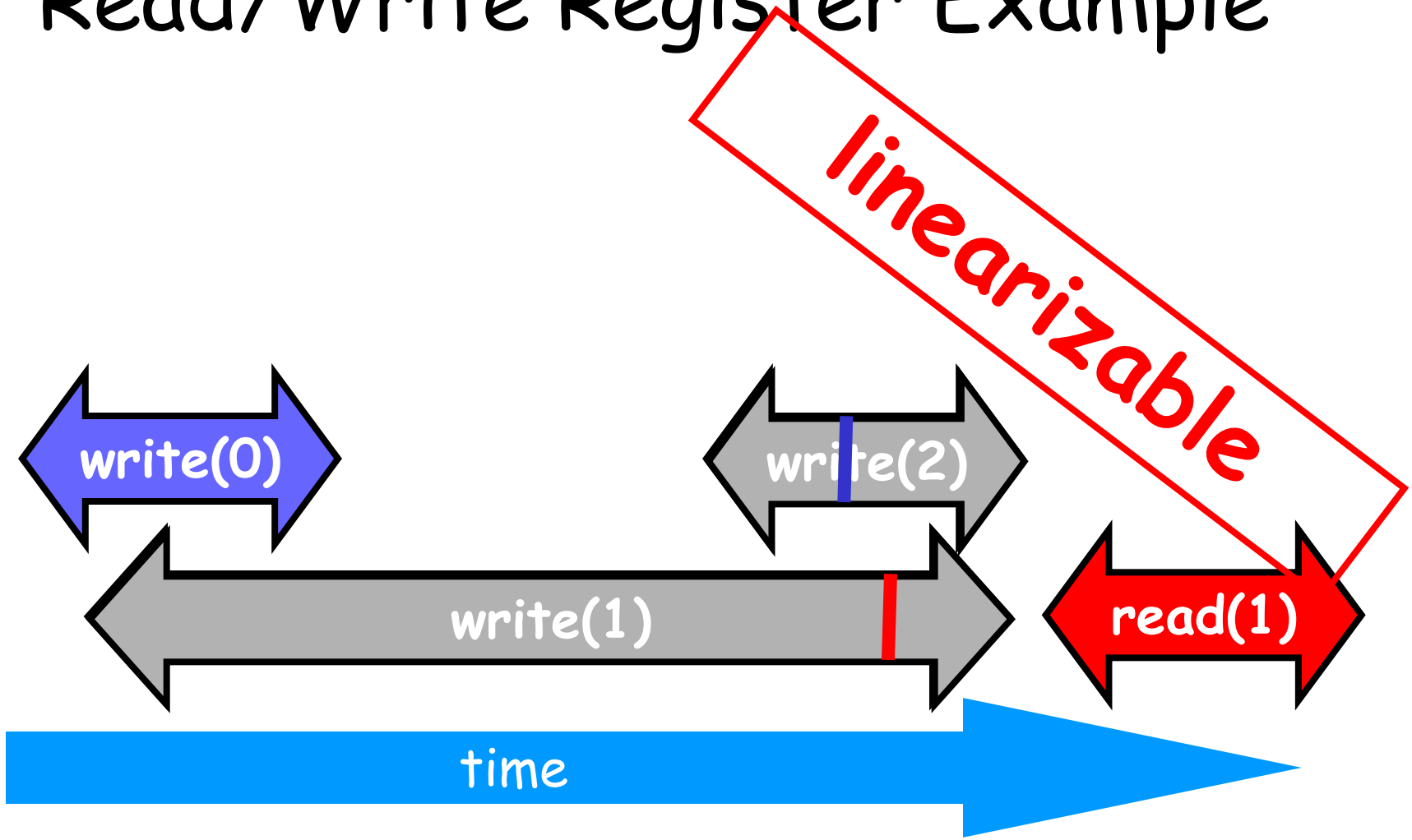

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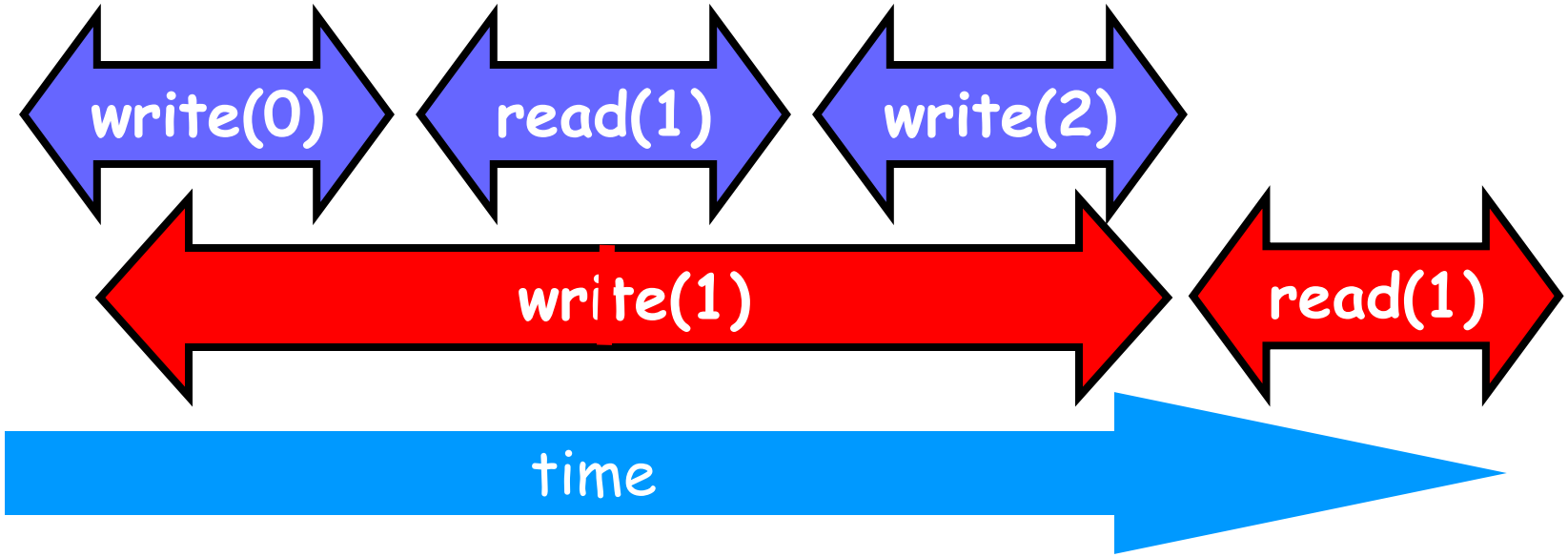

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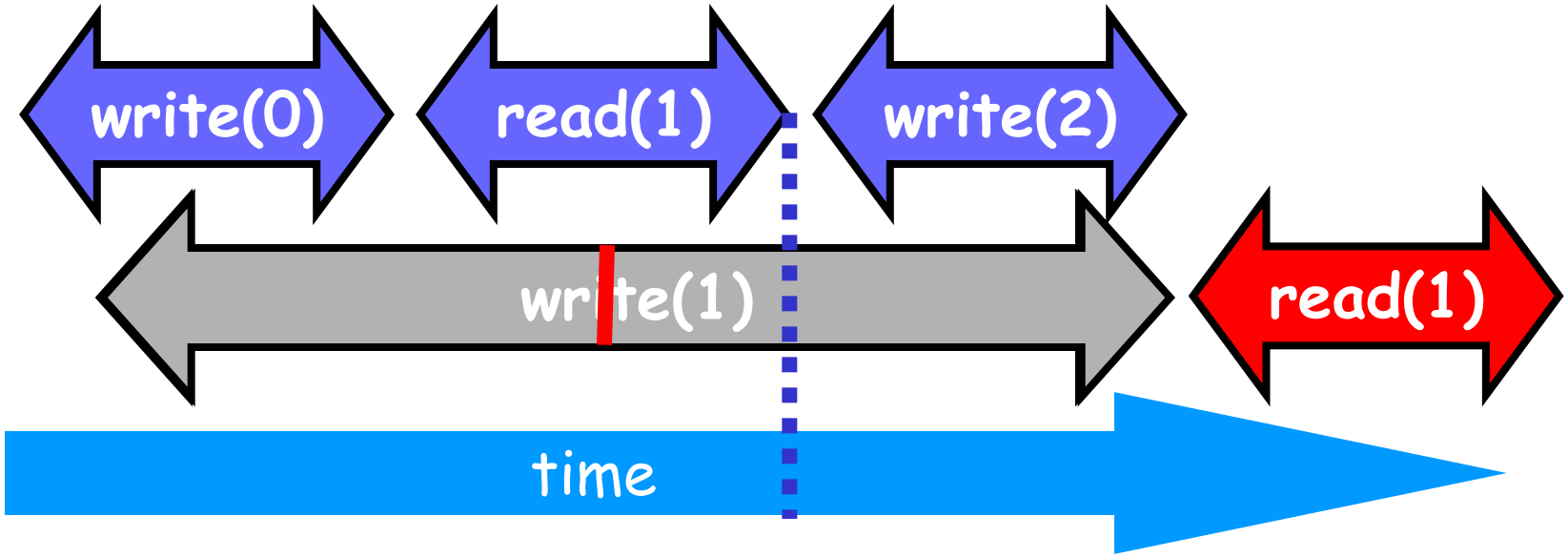

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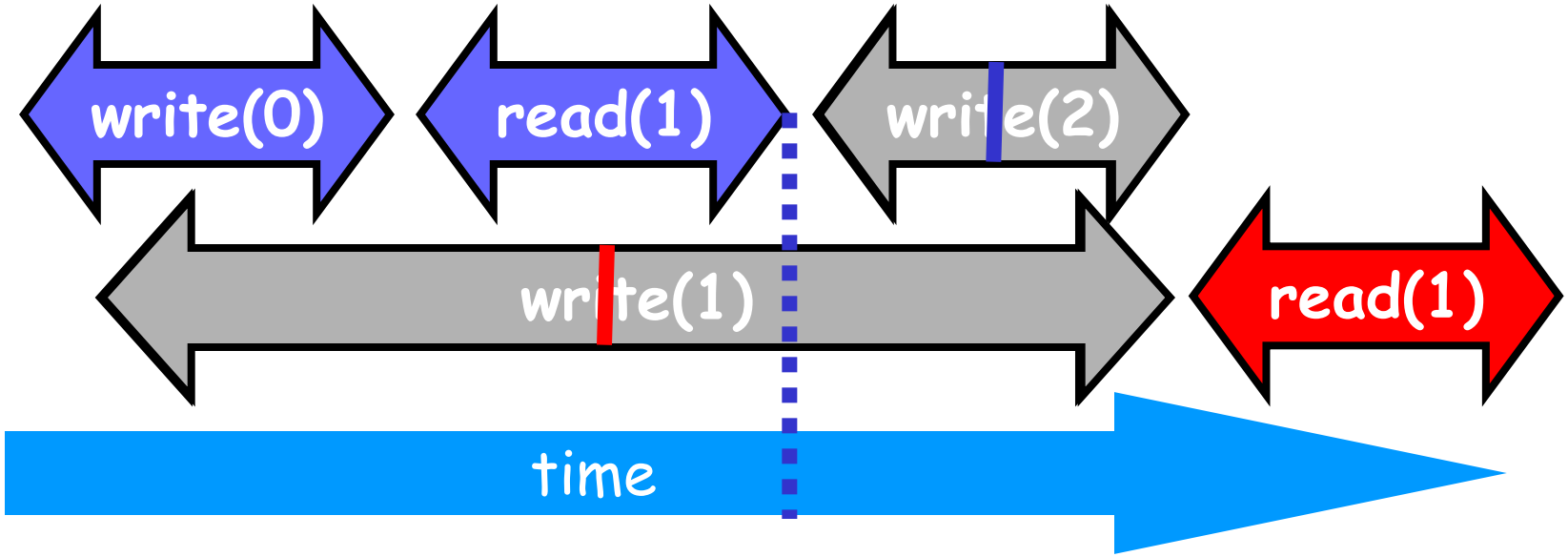

Read/Write Register Example