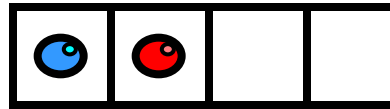
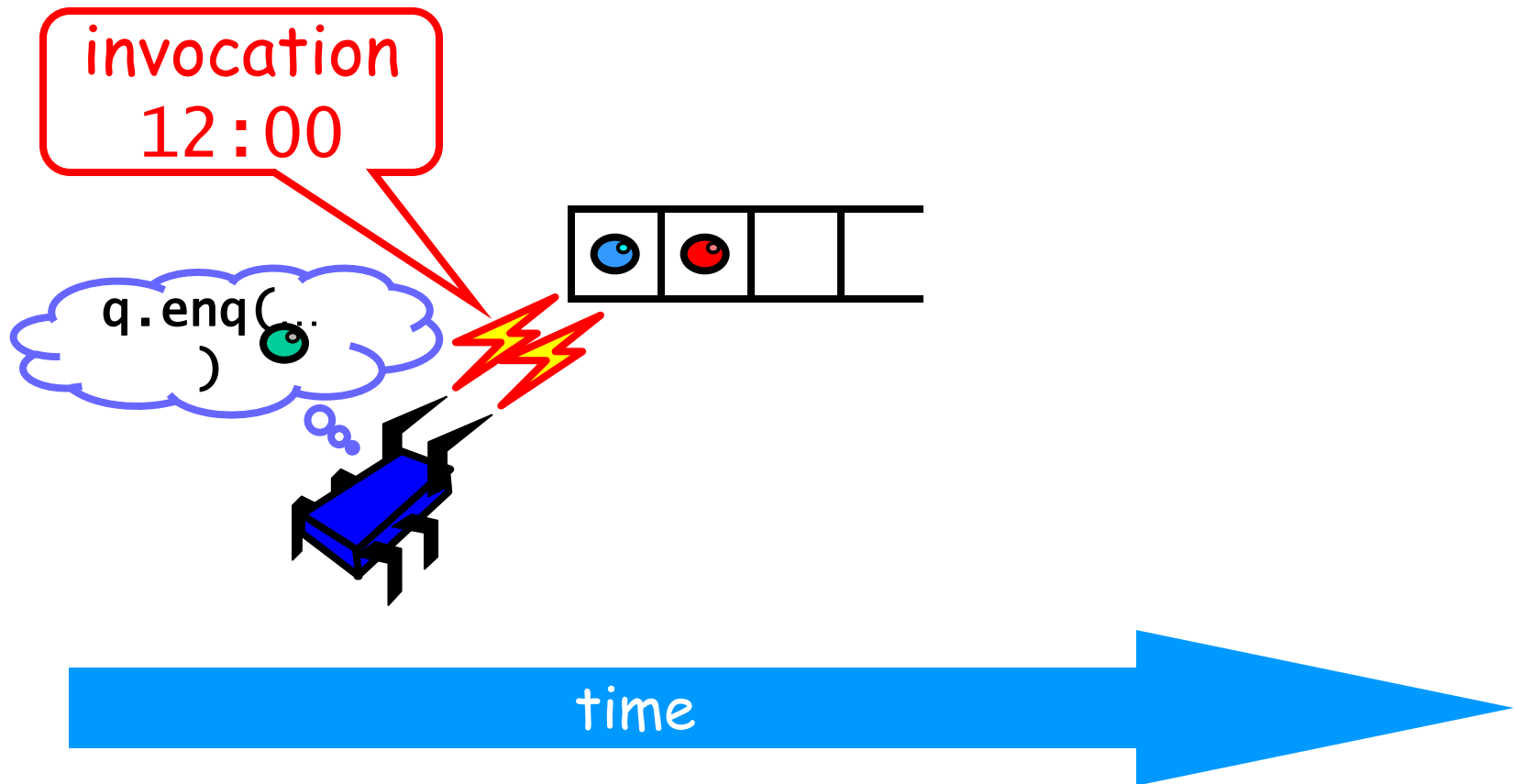


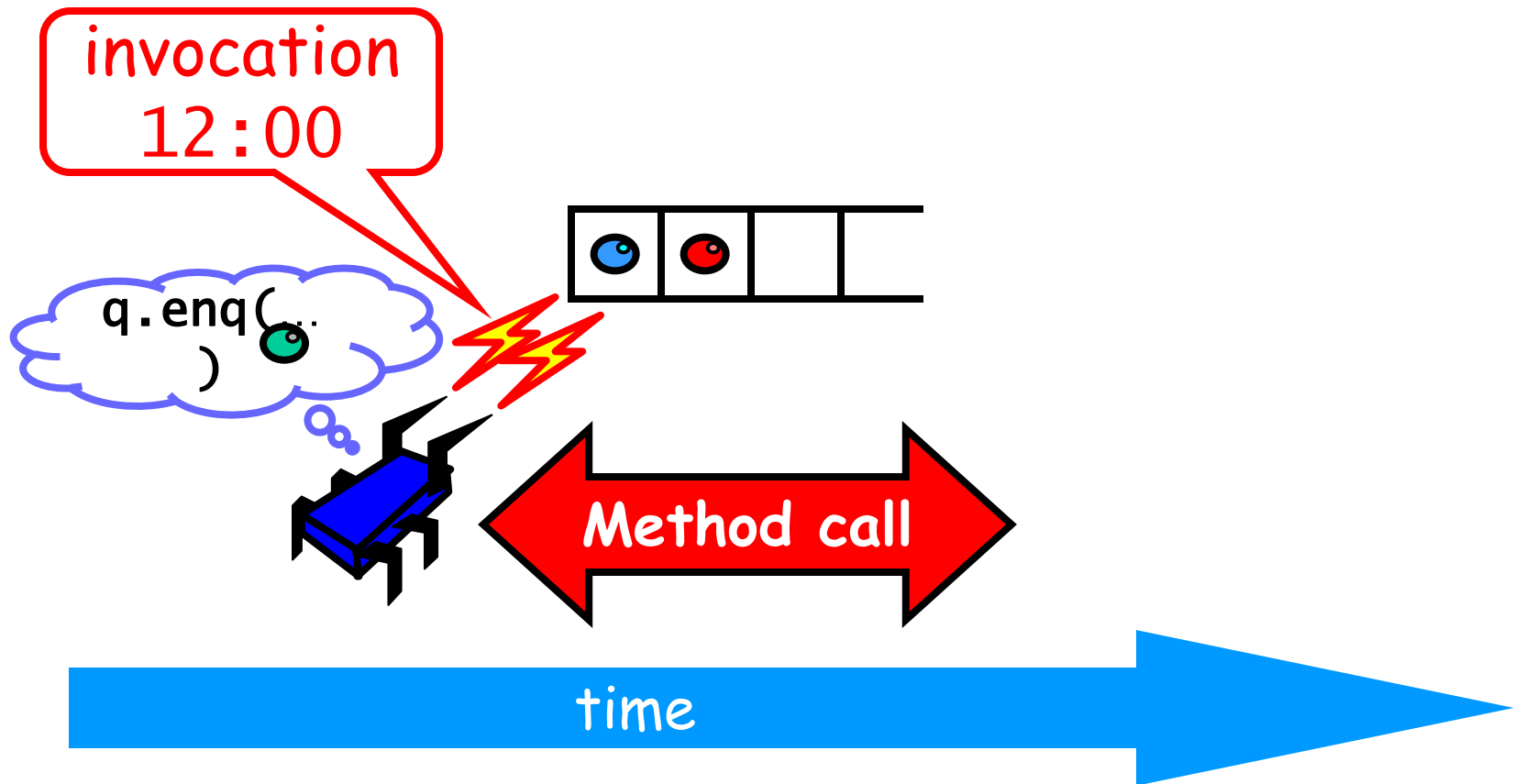
Methods Take Time



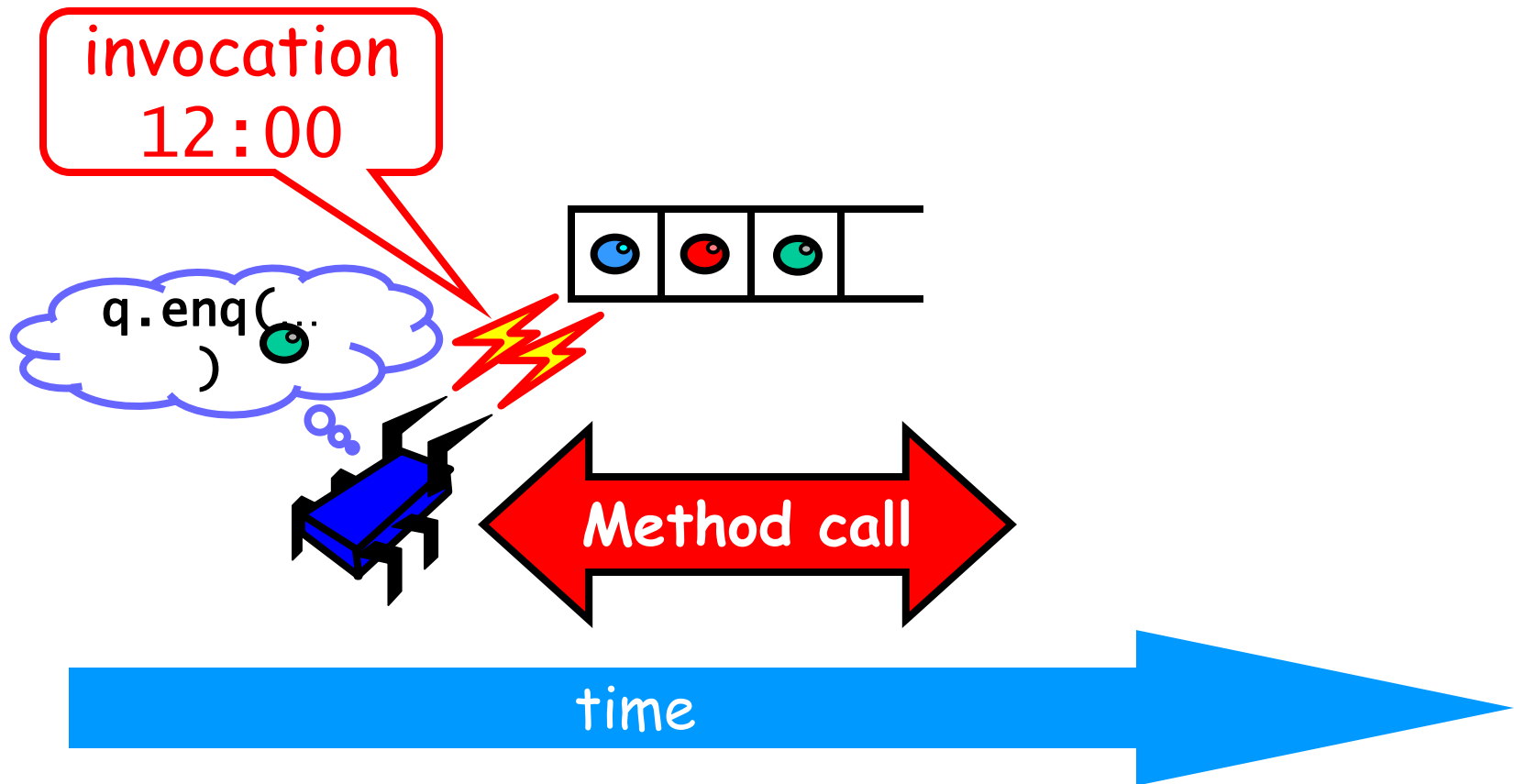
Methods Take Time



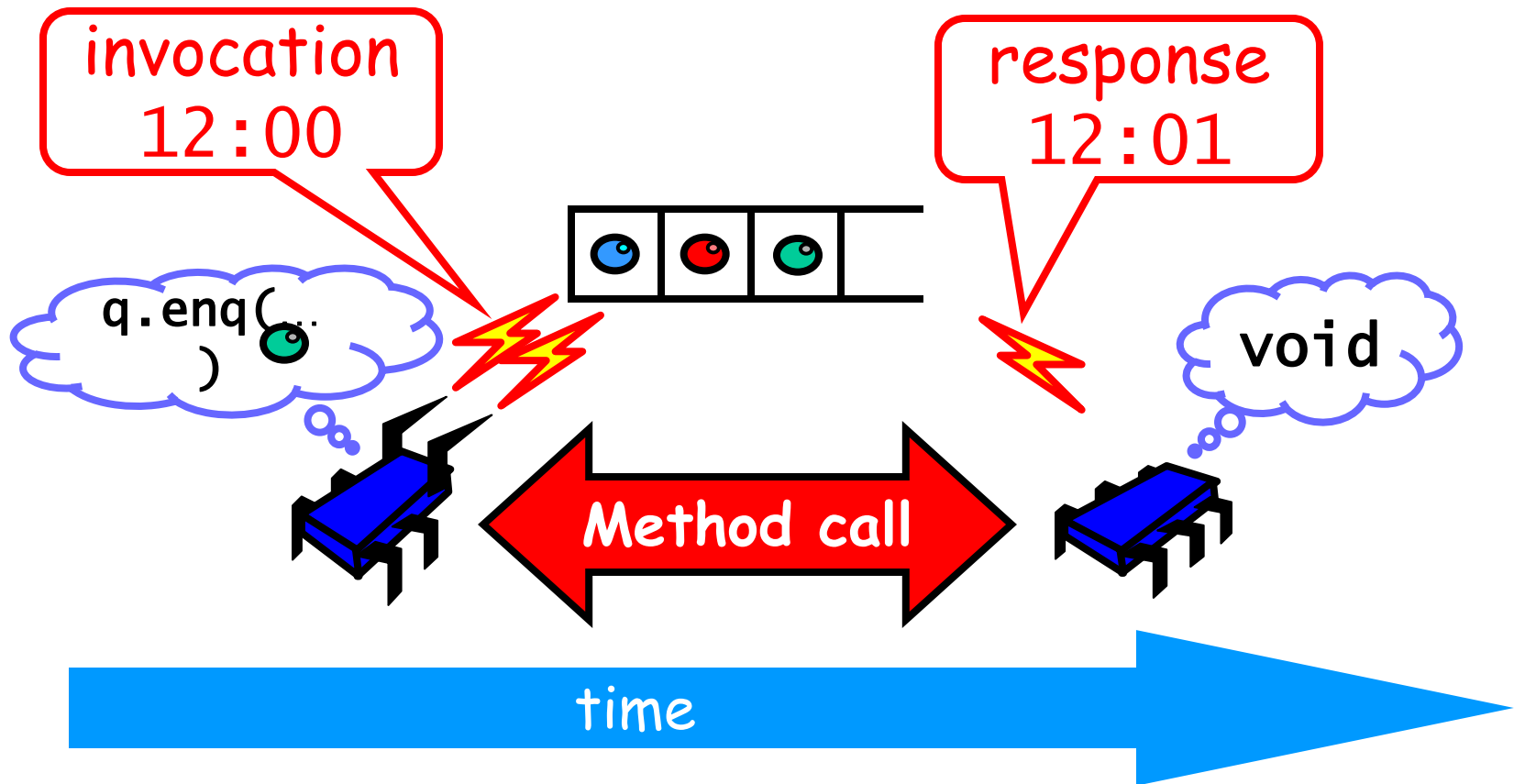
Methods Take Time



Methods Take Time



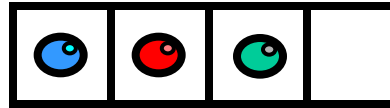
Methods Take Time



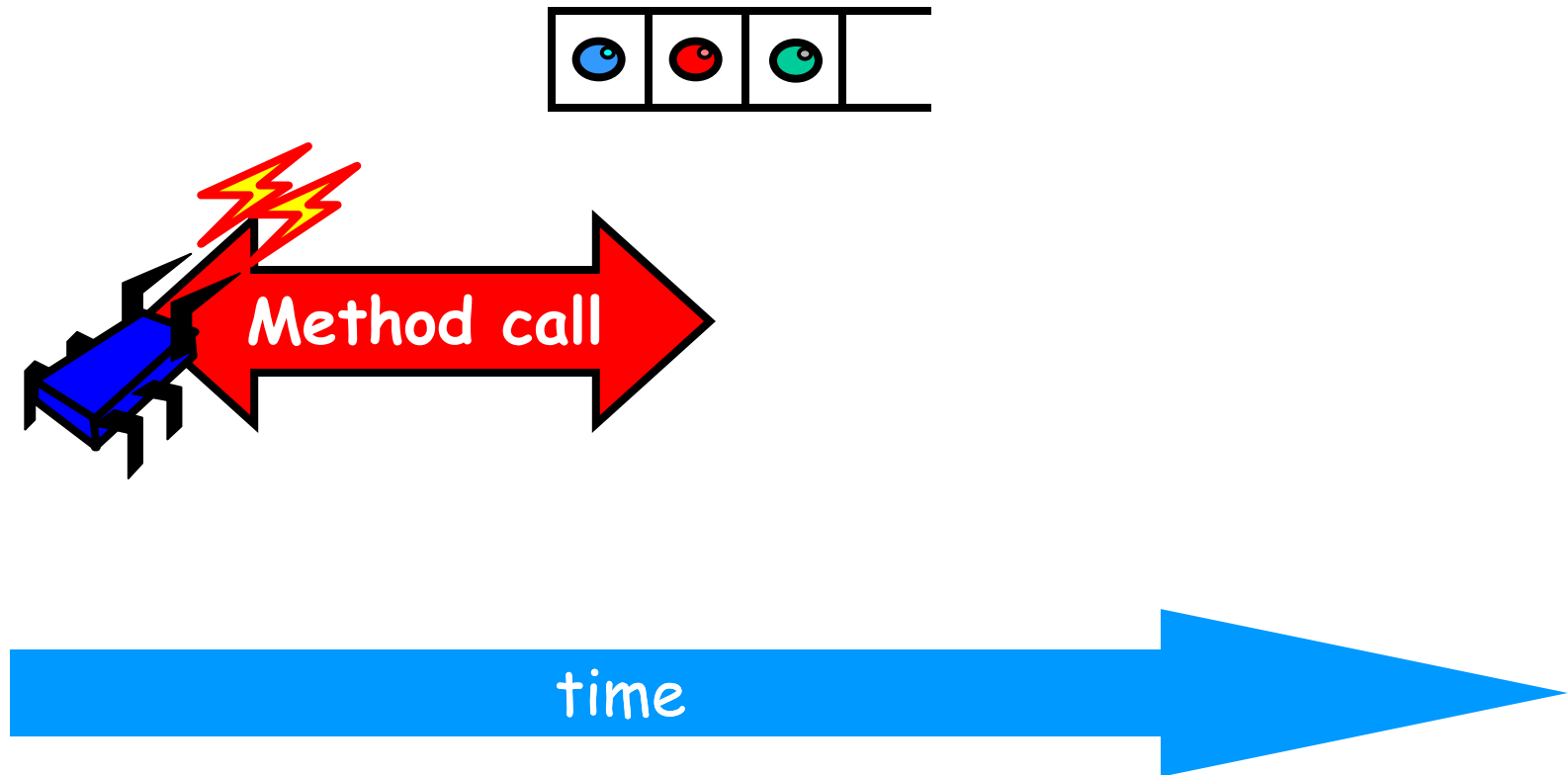
Sequential vs Concurrent

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

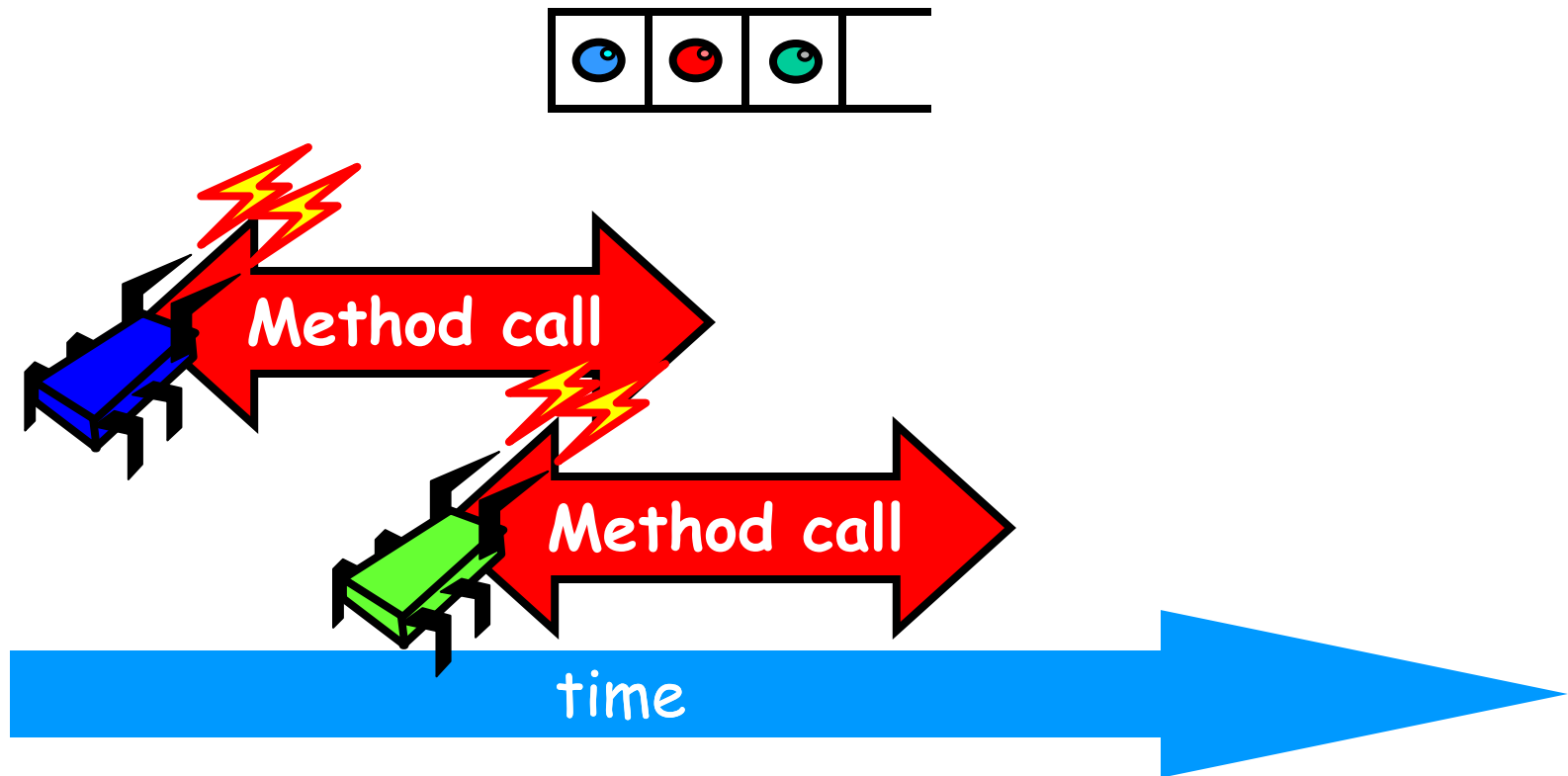
Concurrent Methods Take Overlapping Time



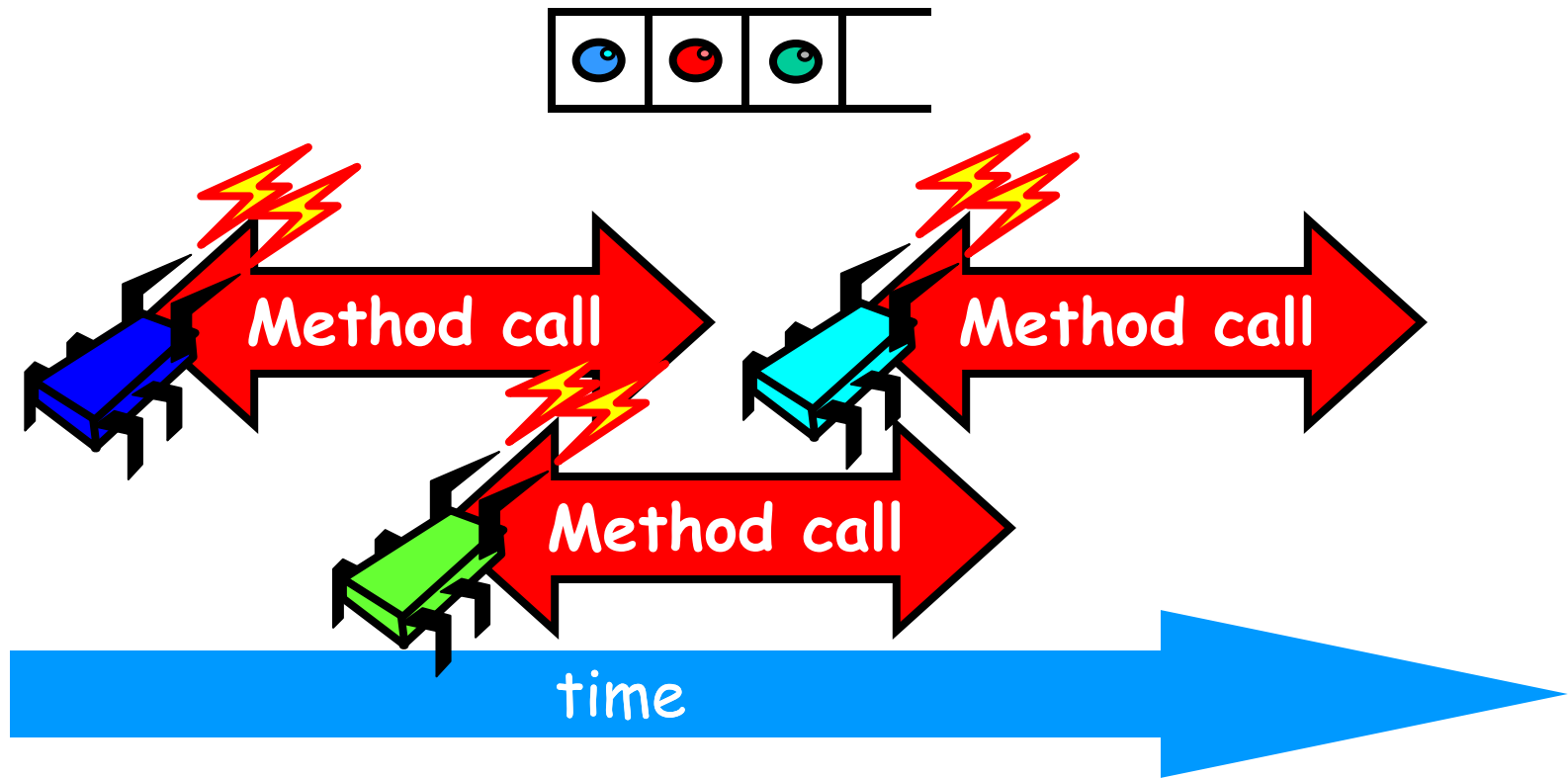
Concurrent Methods Take Overlapping Time



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();  
    }  
}
```

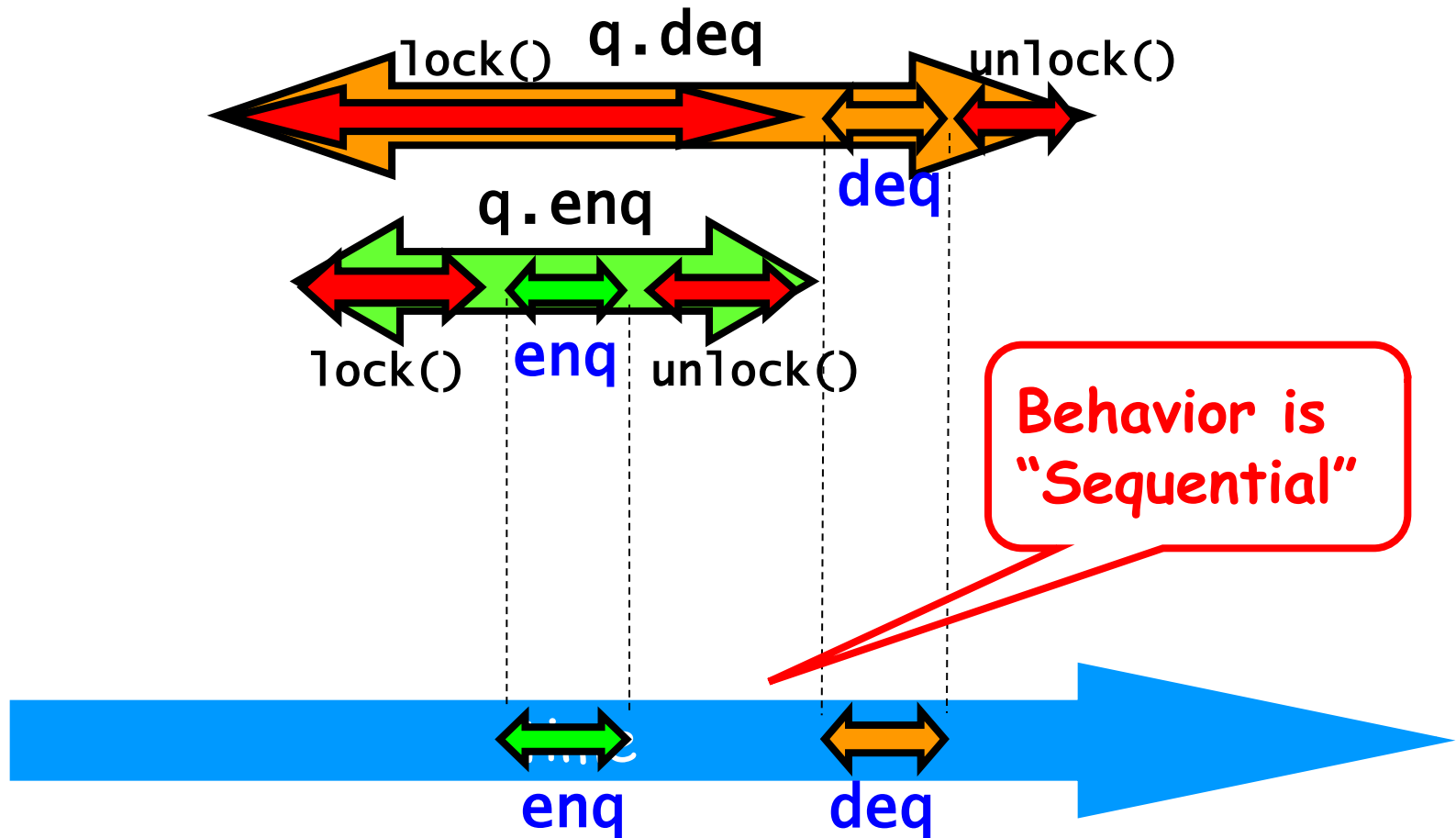
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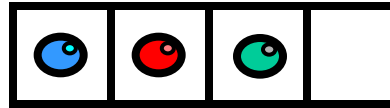
All modifications
of queue are done
mutually exclusive

Testability

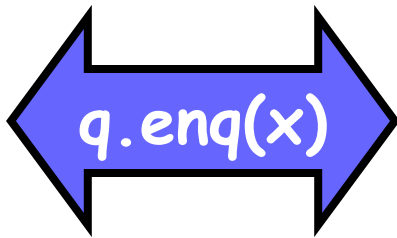
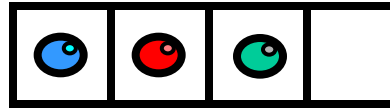
Lets capture the idea of describing the concurrent via the sequential



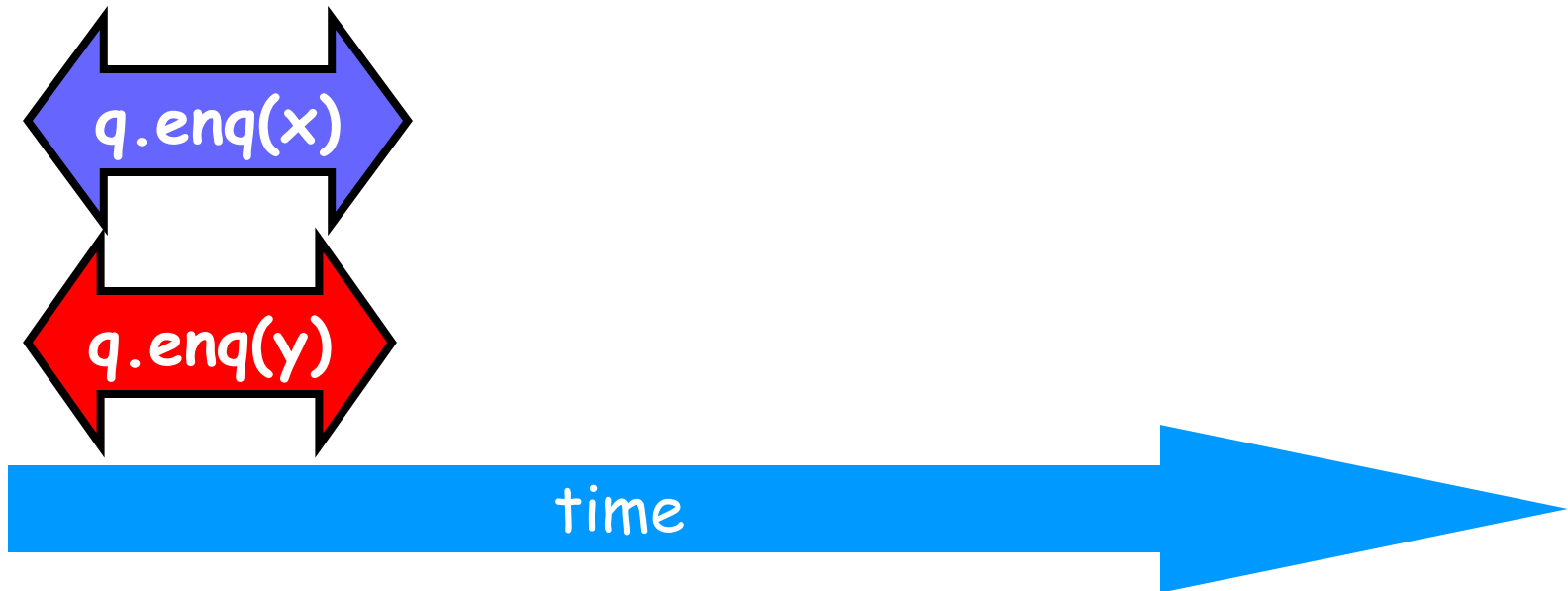
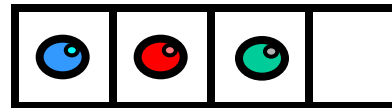
Example



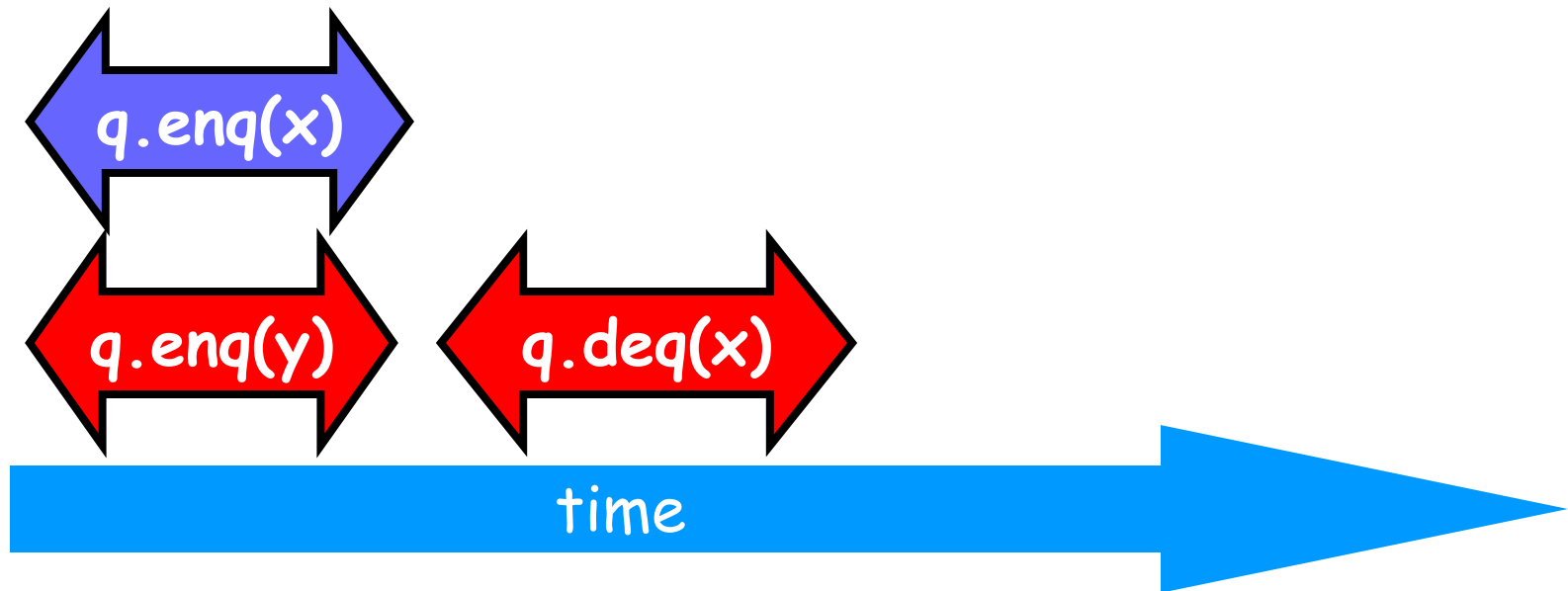
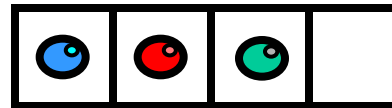
Example



Example

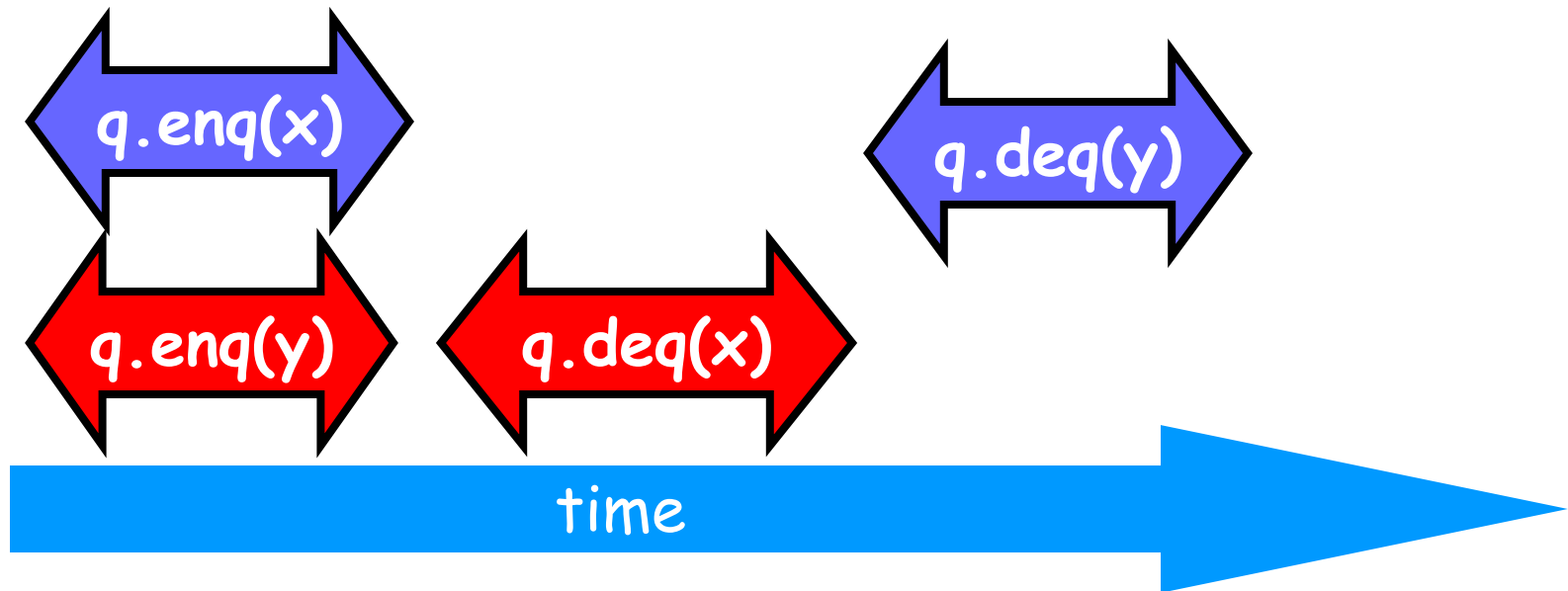
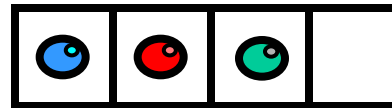


Example

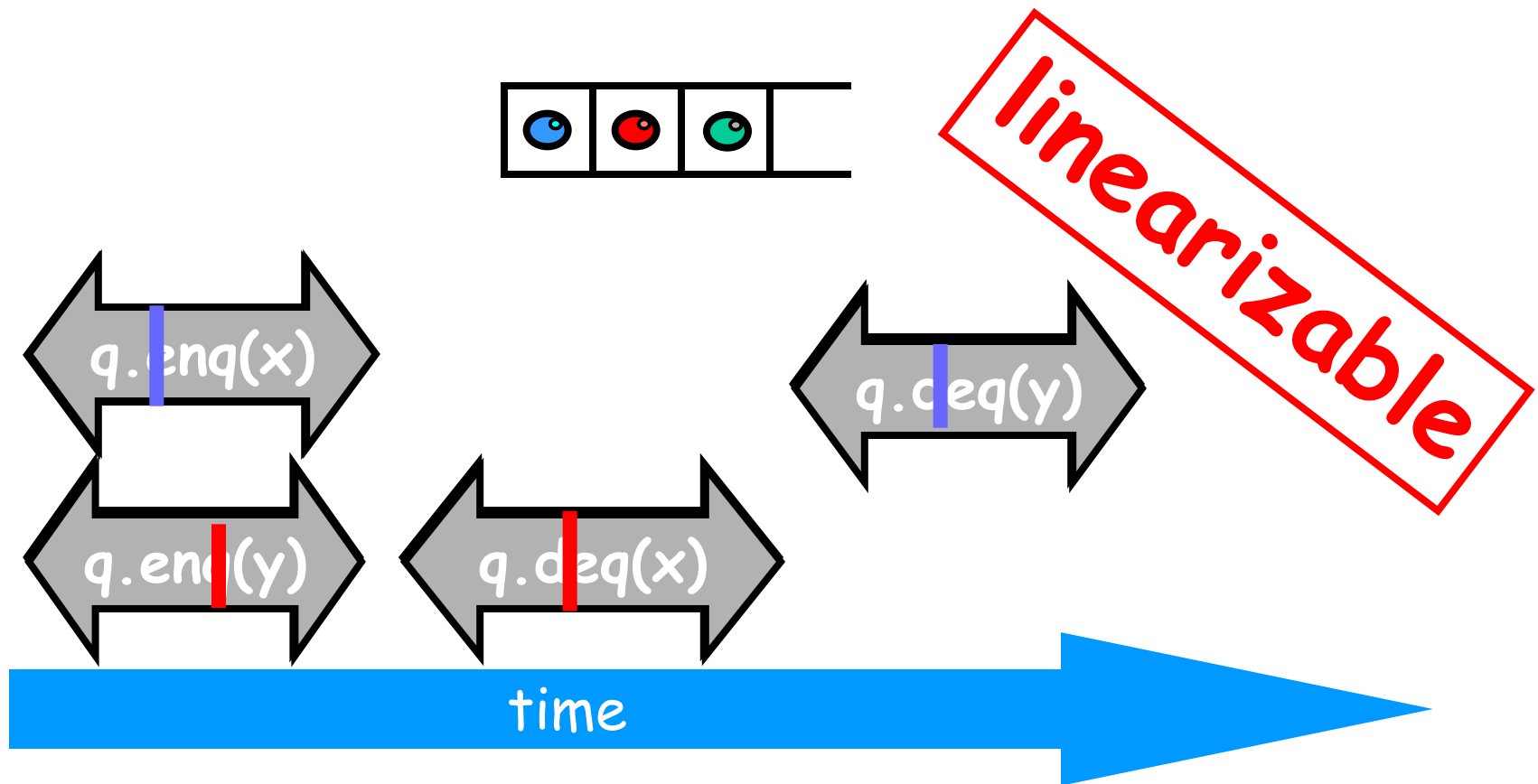




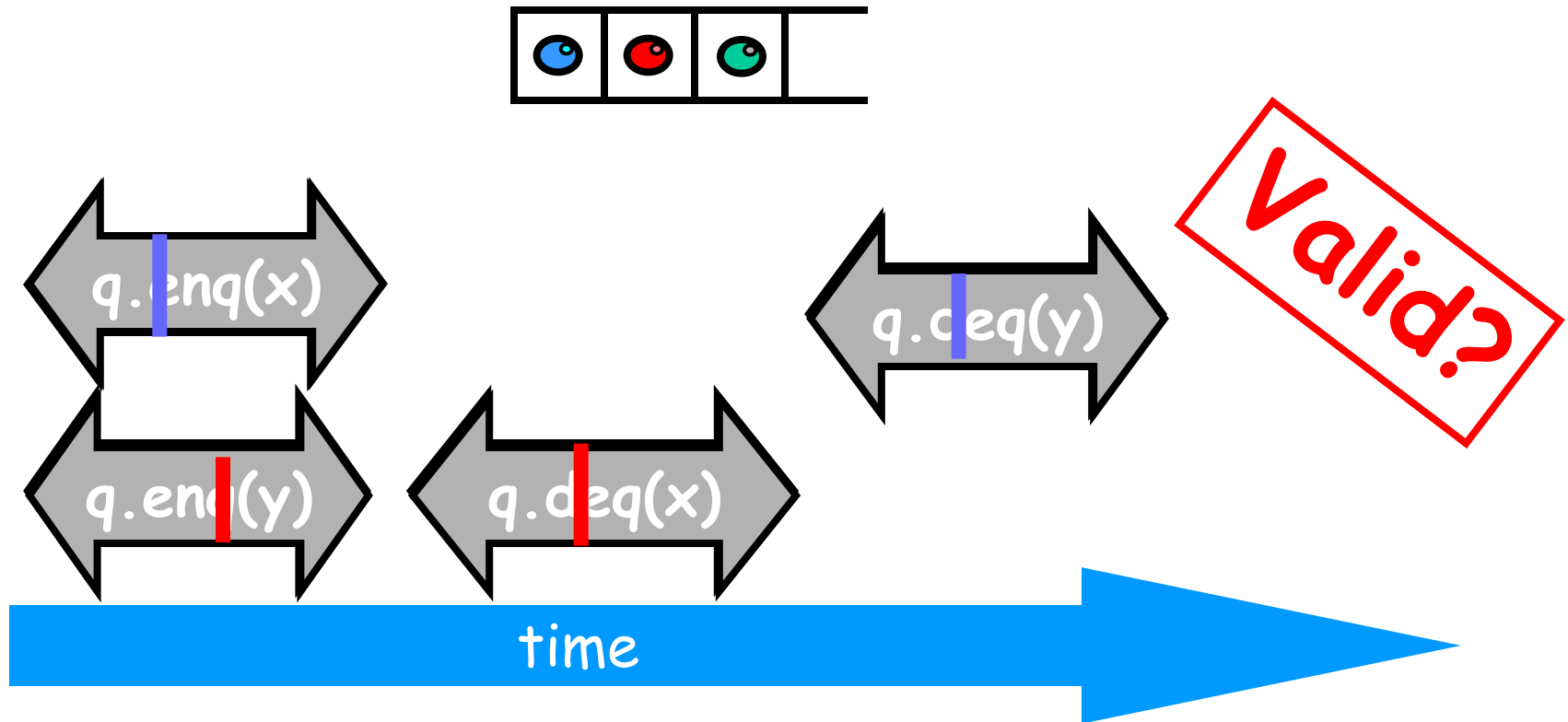
Example



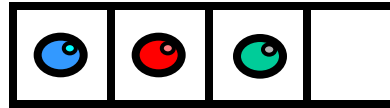
Example



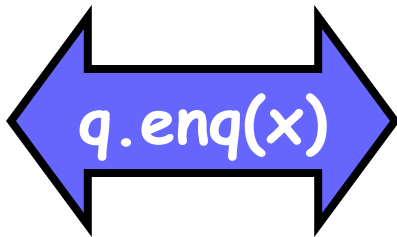
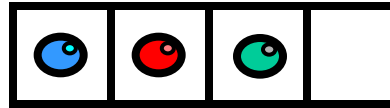
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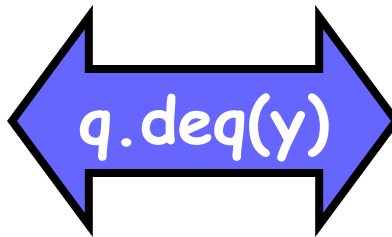
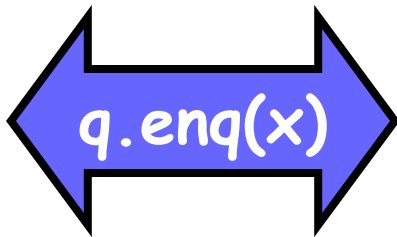
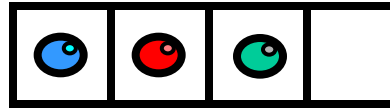
Example



Example

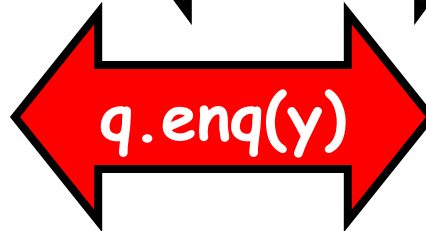
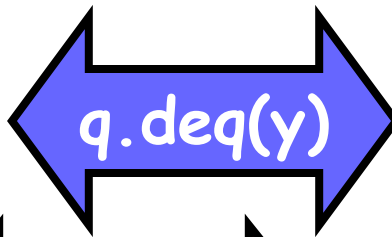
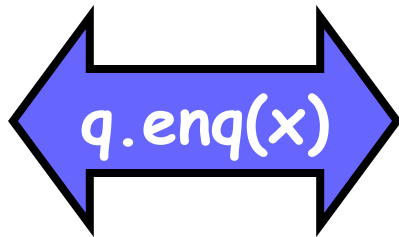
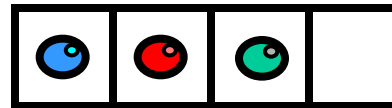


Example



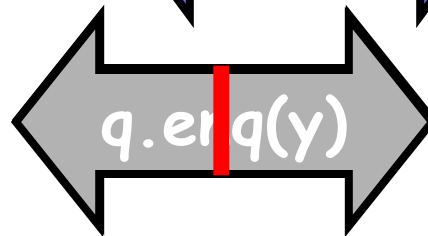
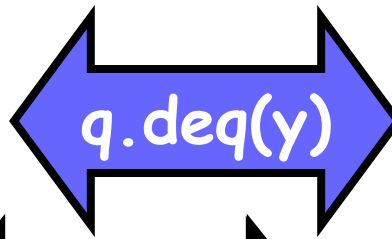
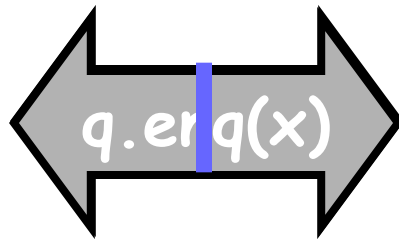
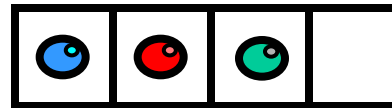


Example





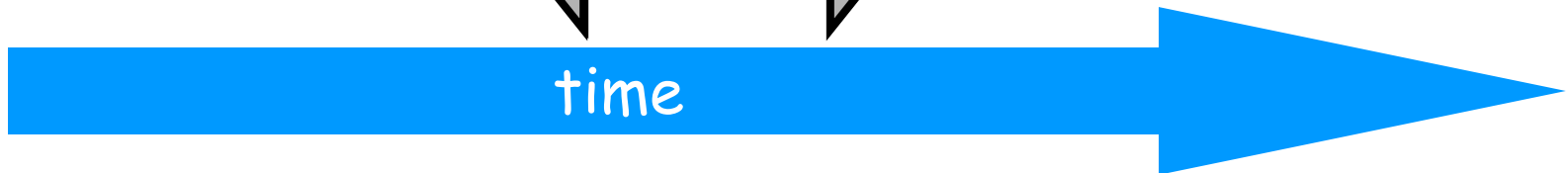
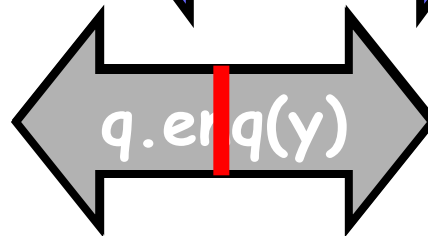
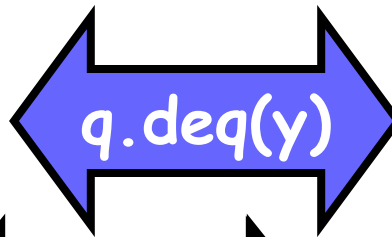
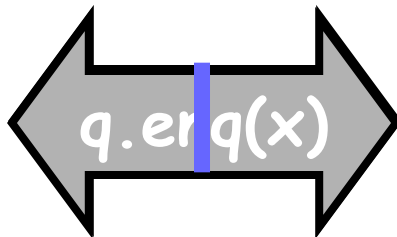
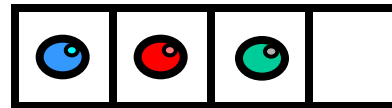
Example



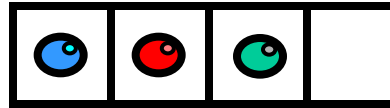


Example

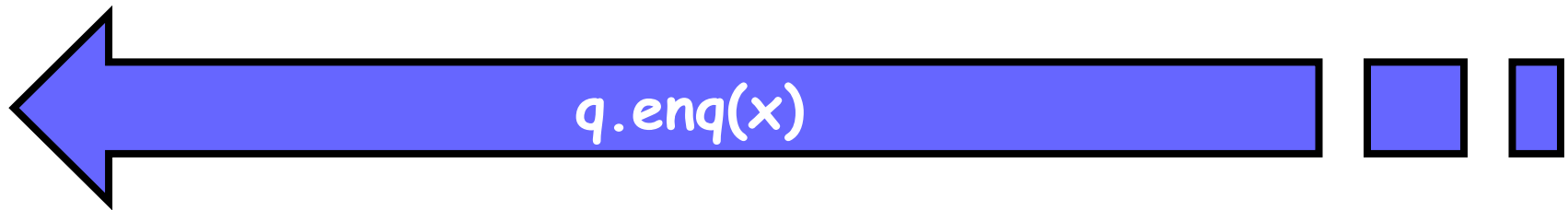
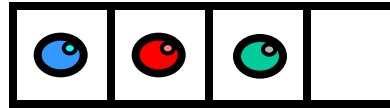
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Example

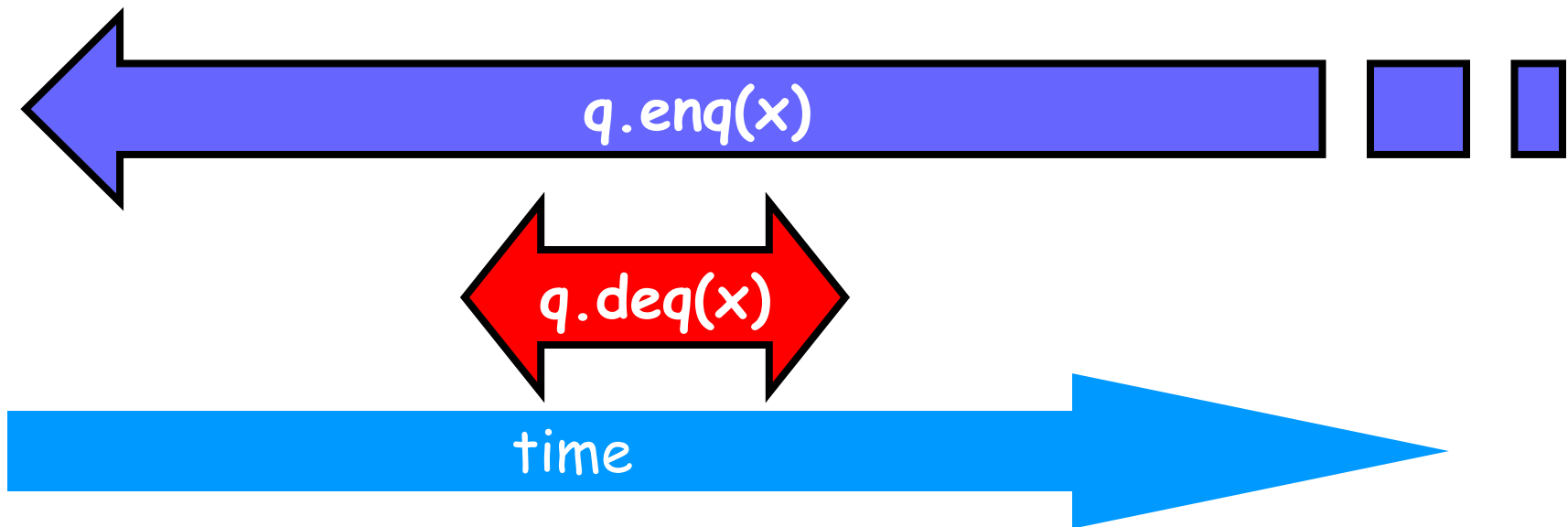
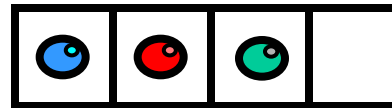


Example



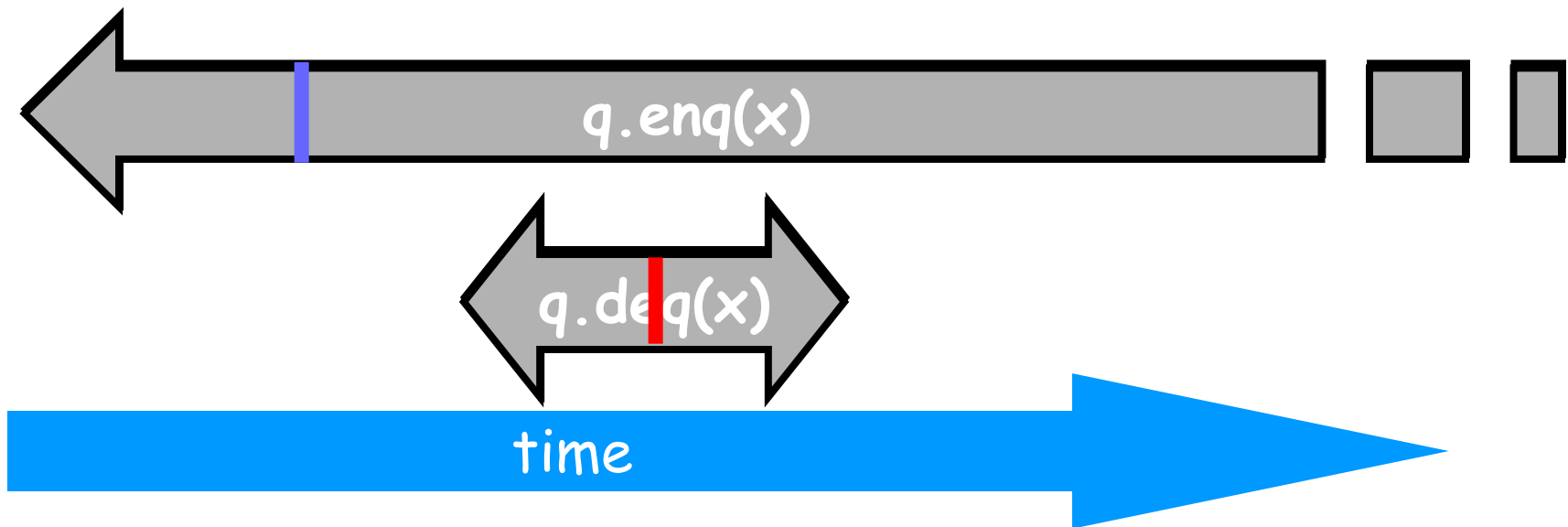
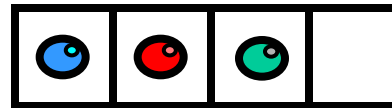


Example



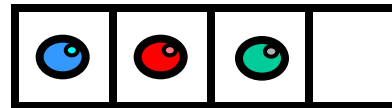


Example

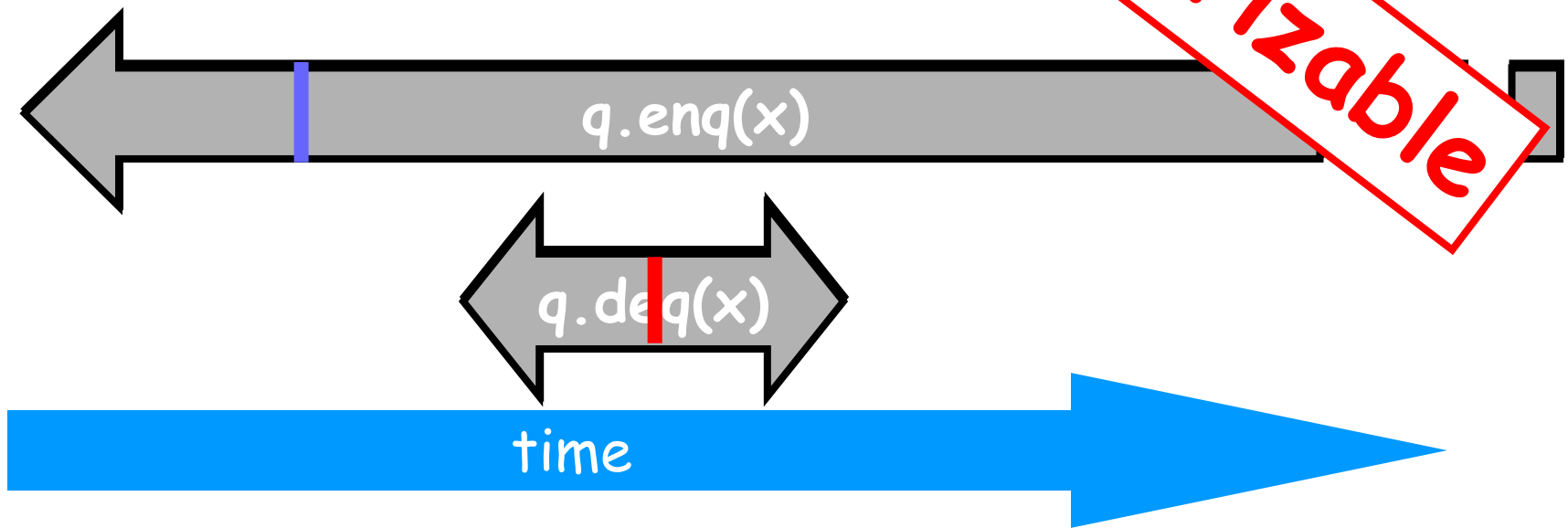




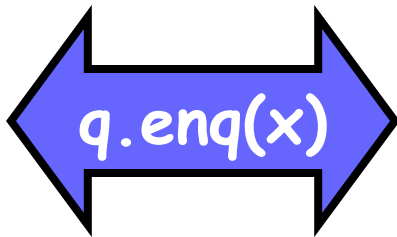
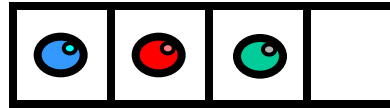
Example



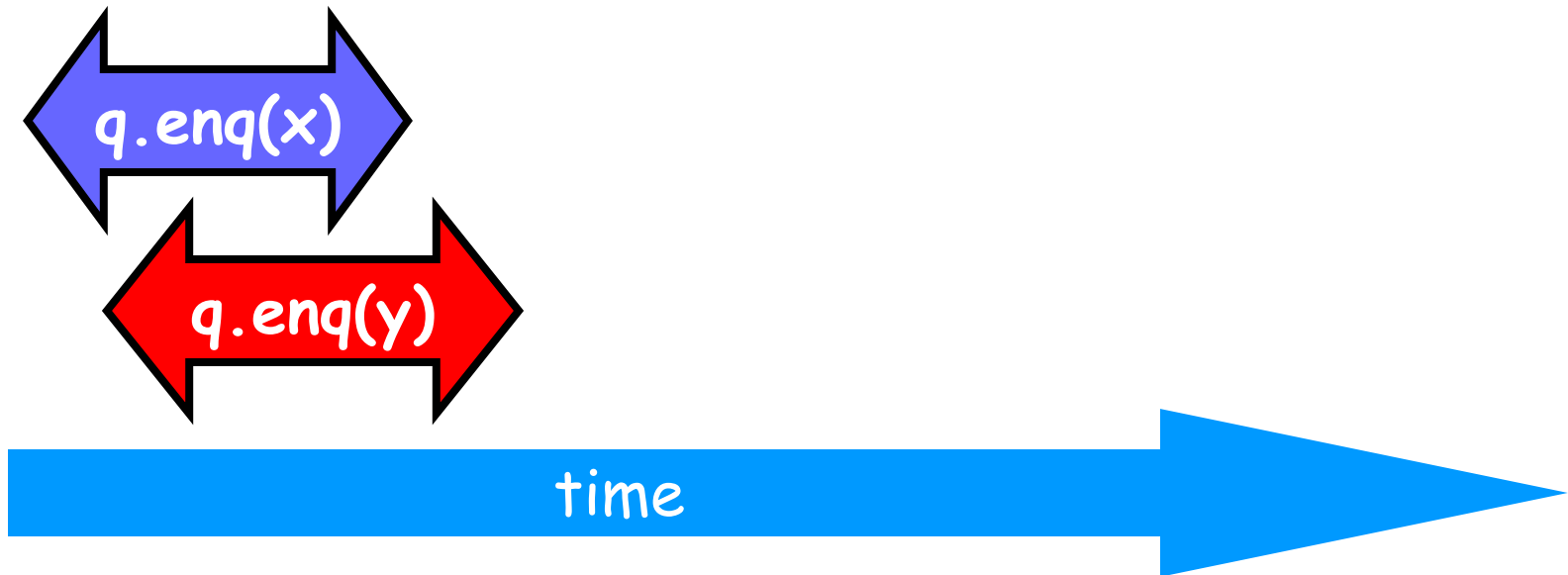
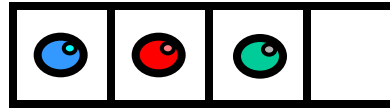
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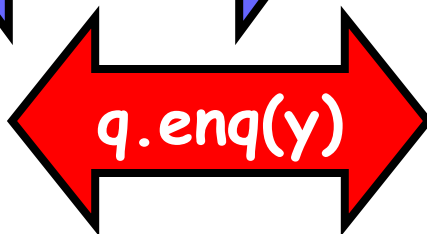
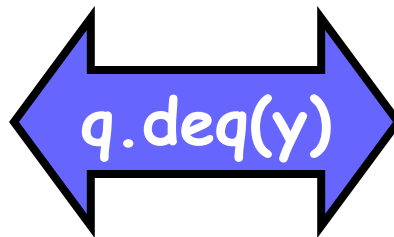
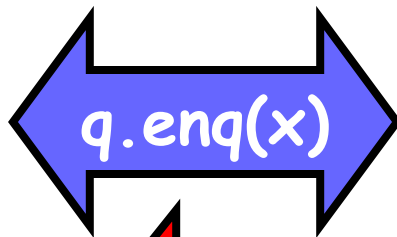
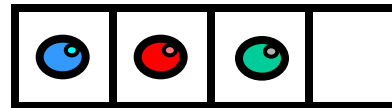
Example



Example

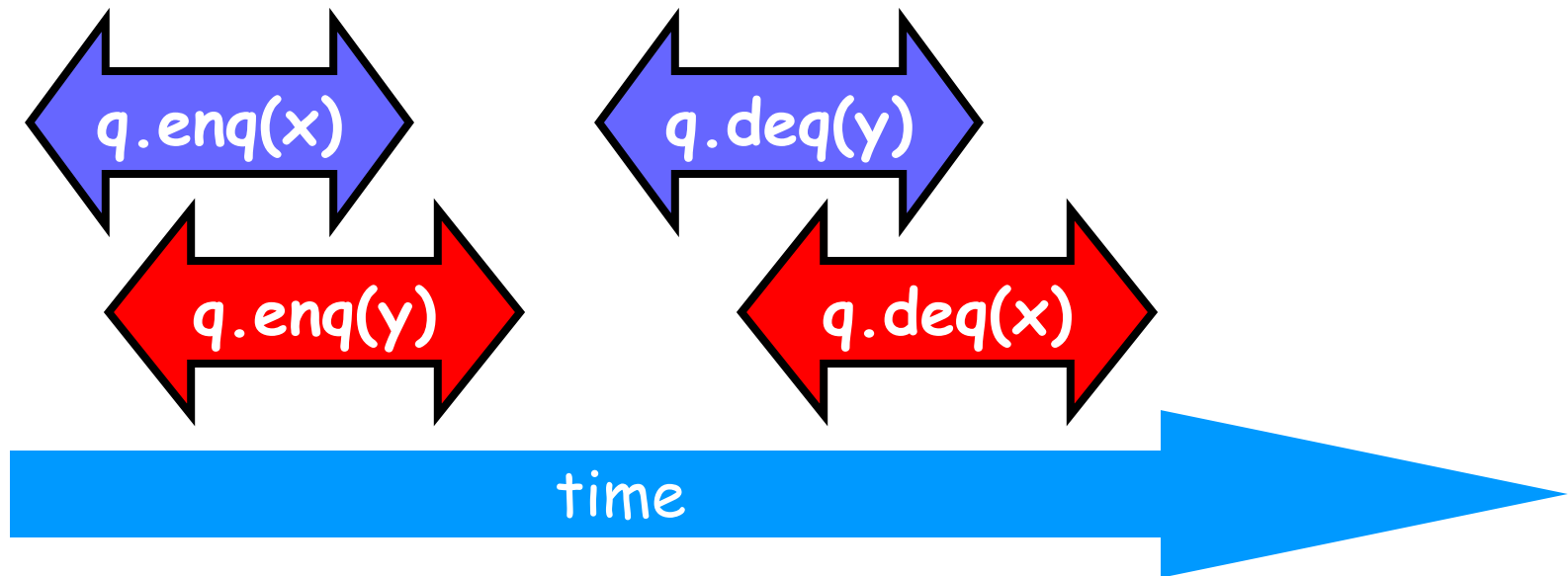
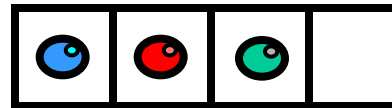


Example



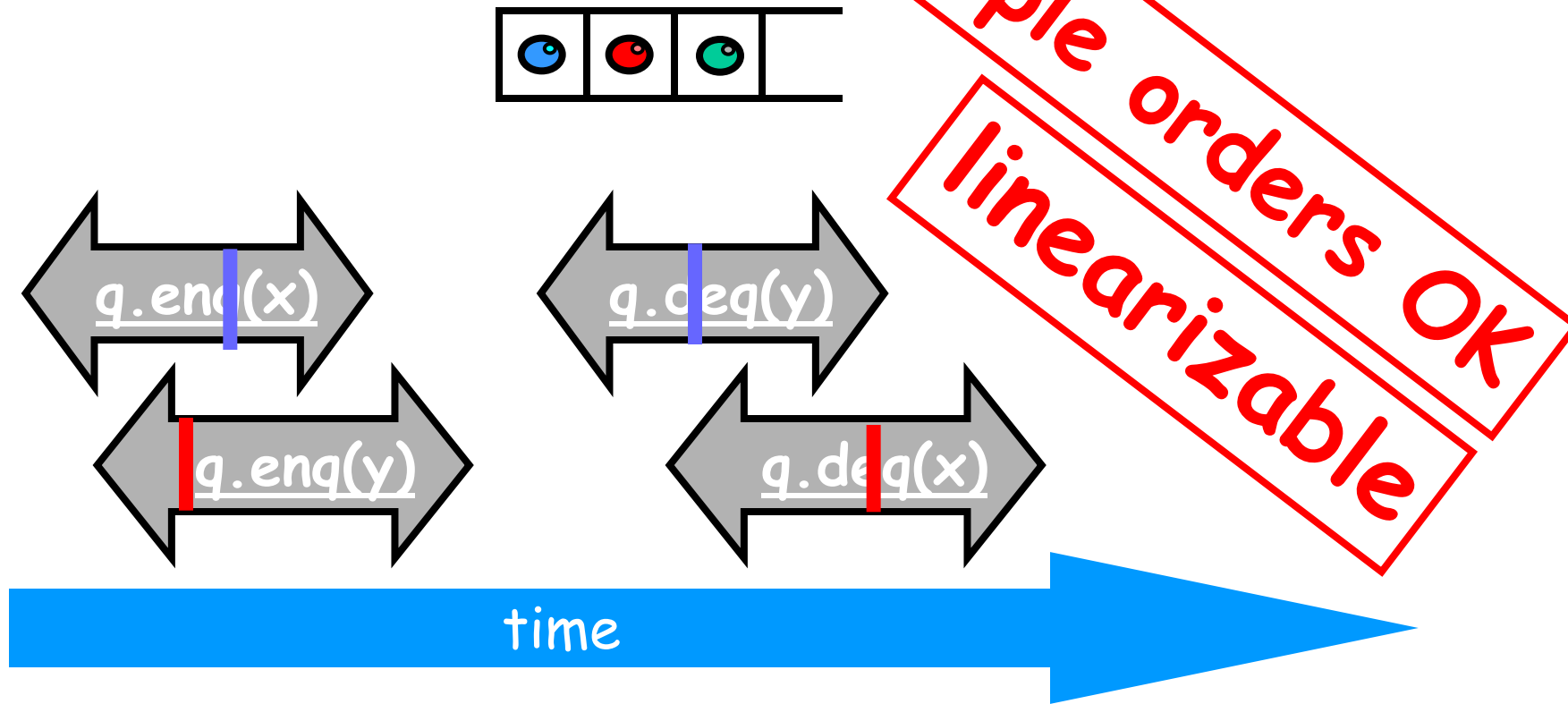


Example

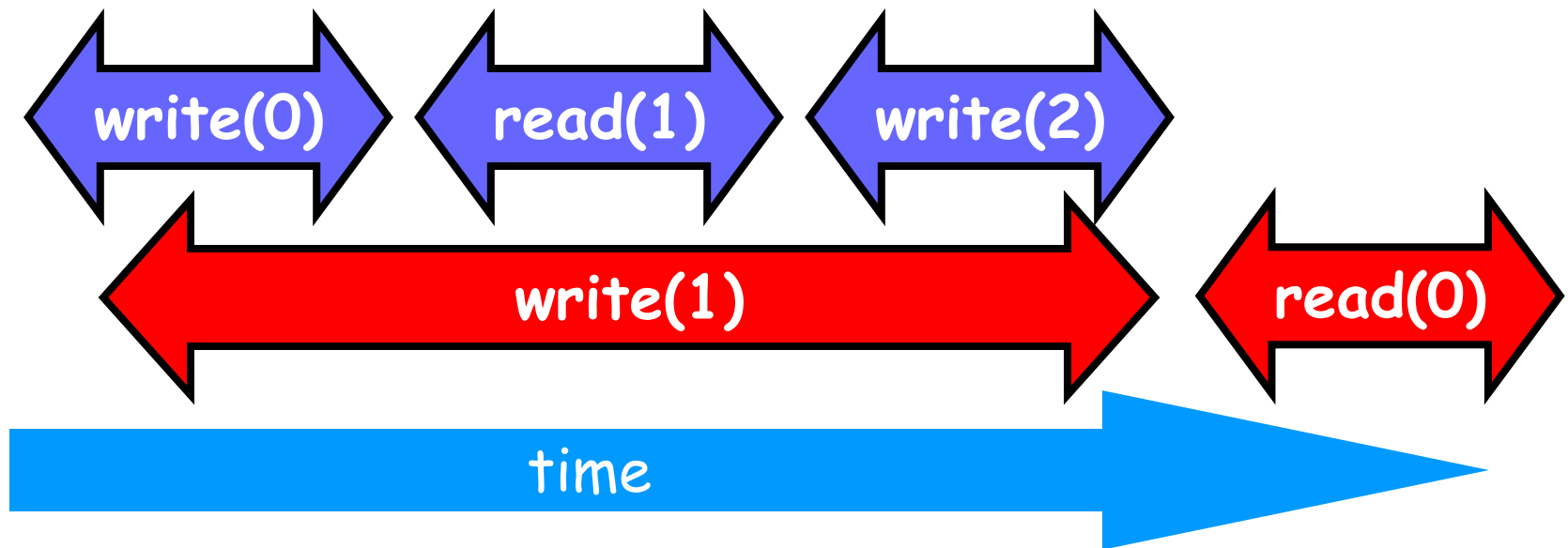


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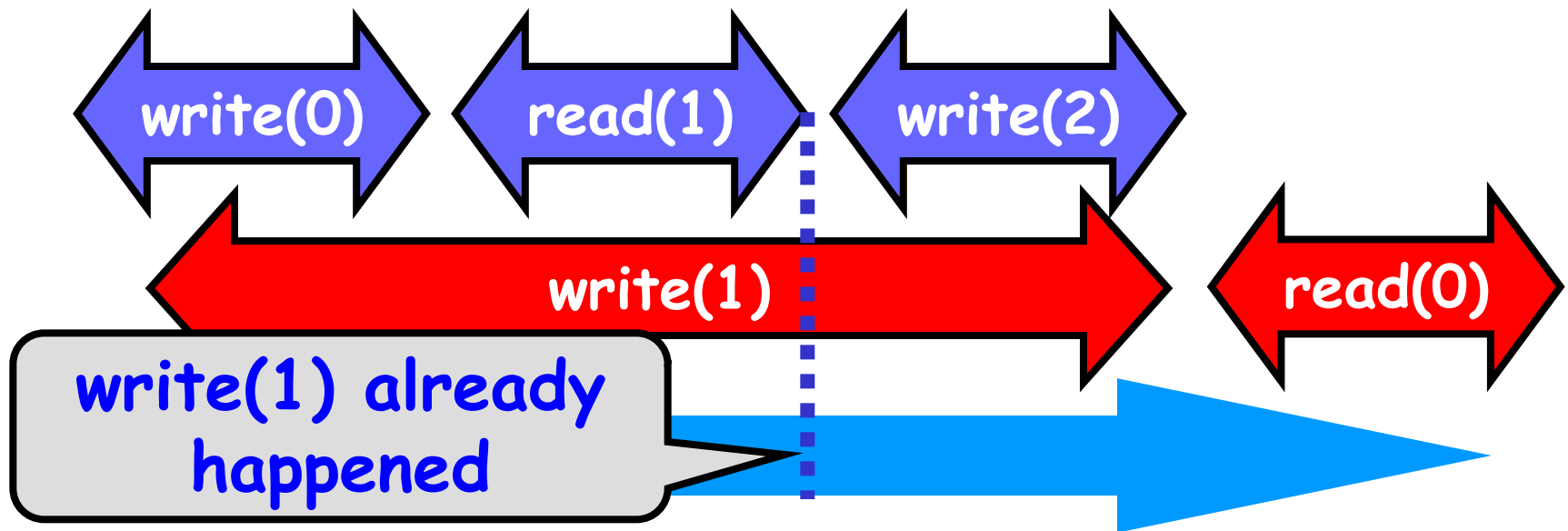
Example



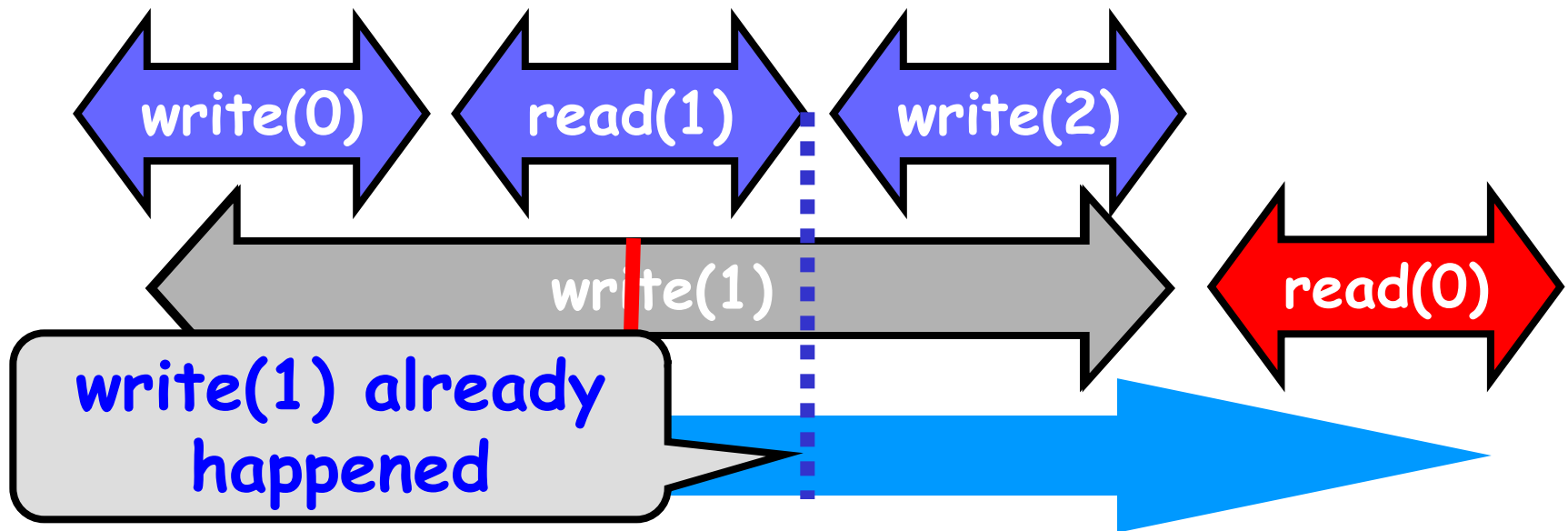
Read/Write Register Example



Read/Write Register Example

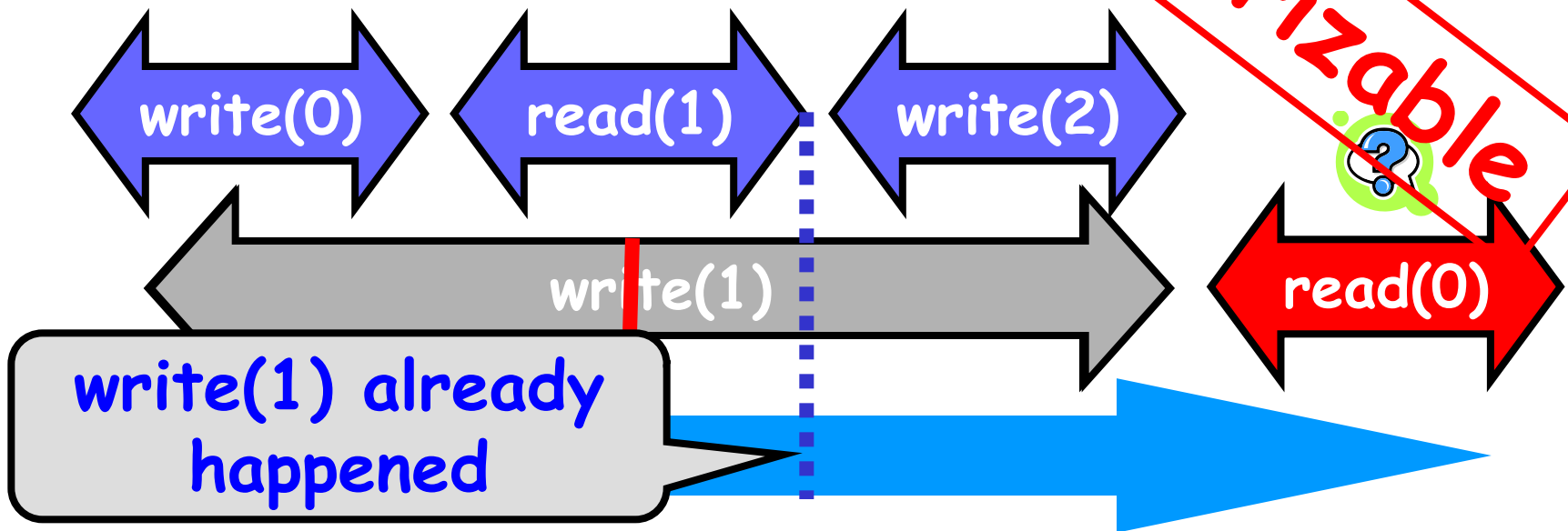


Read/Write Register Example

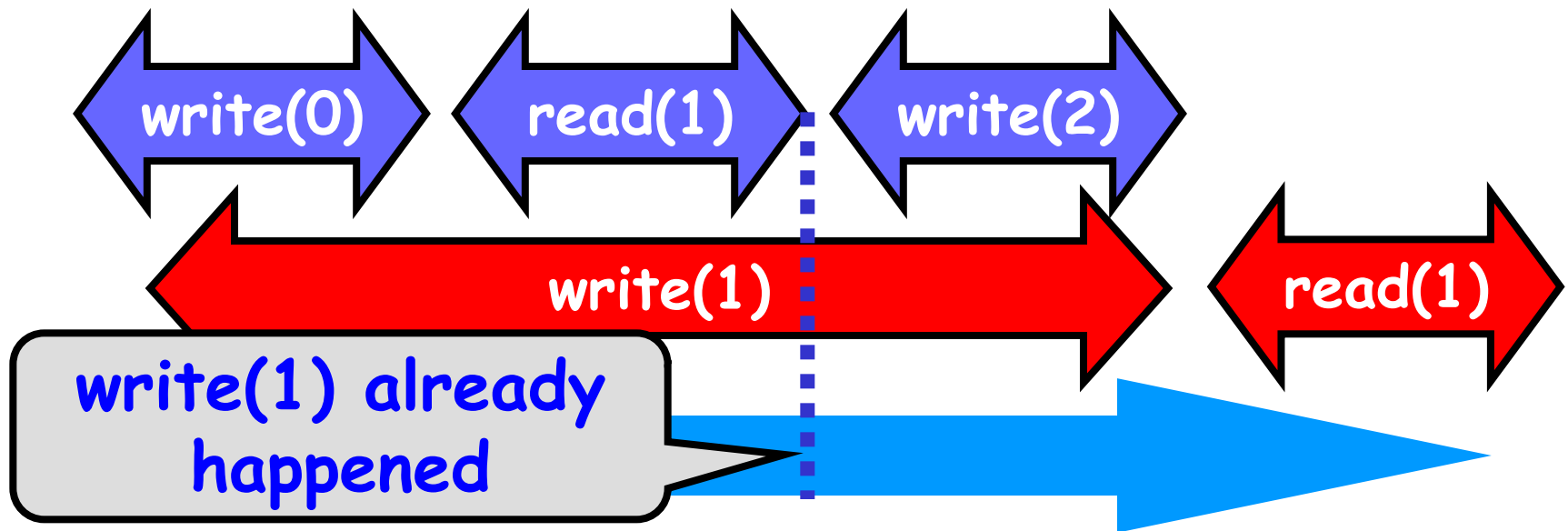


Read/Write Register Example

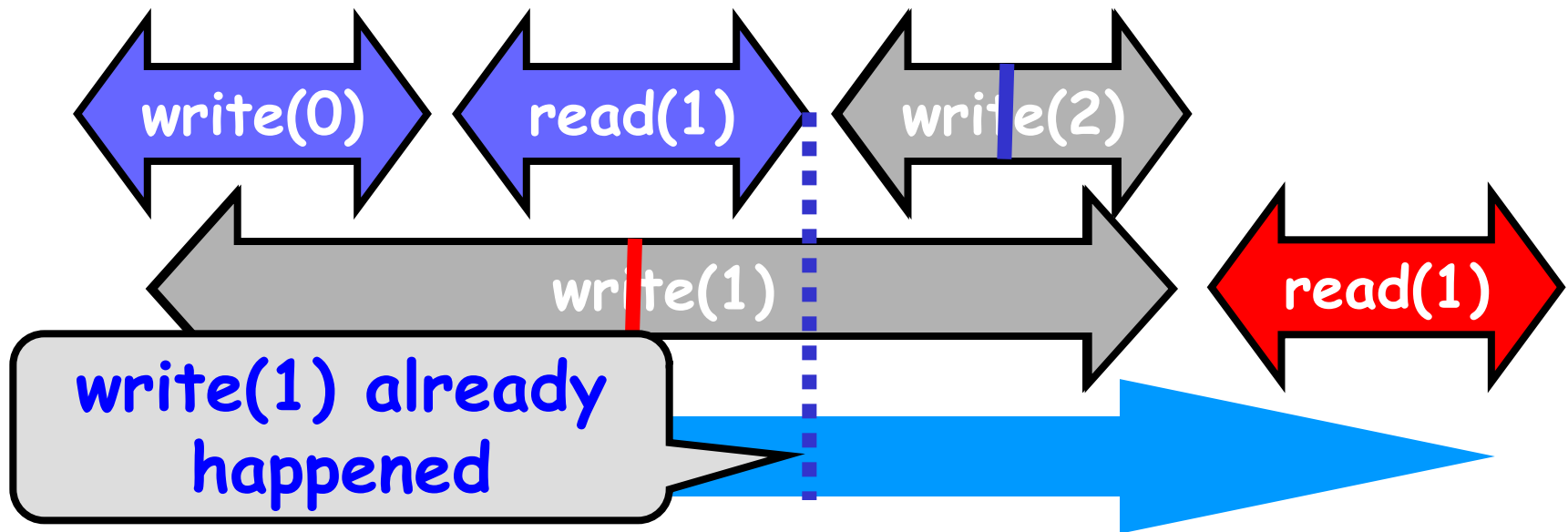
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Read/Write Register Example

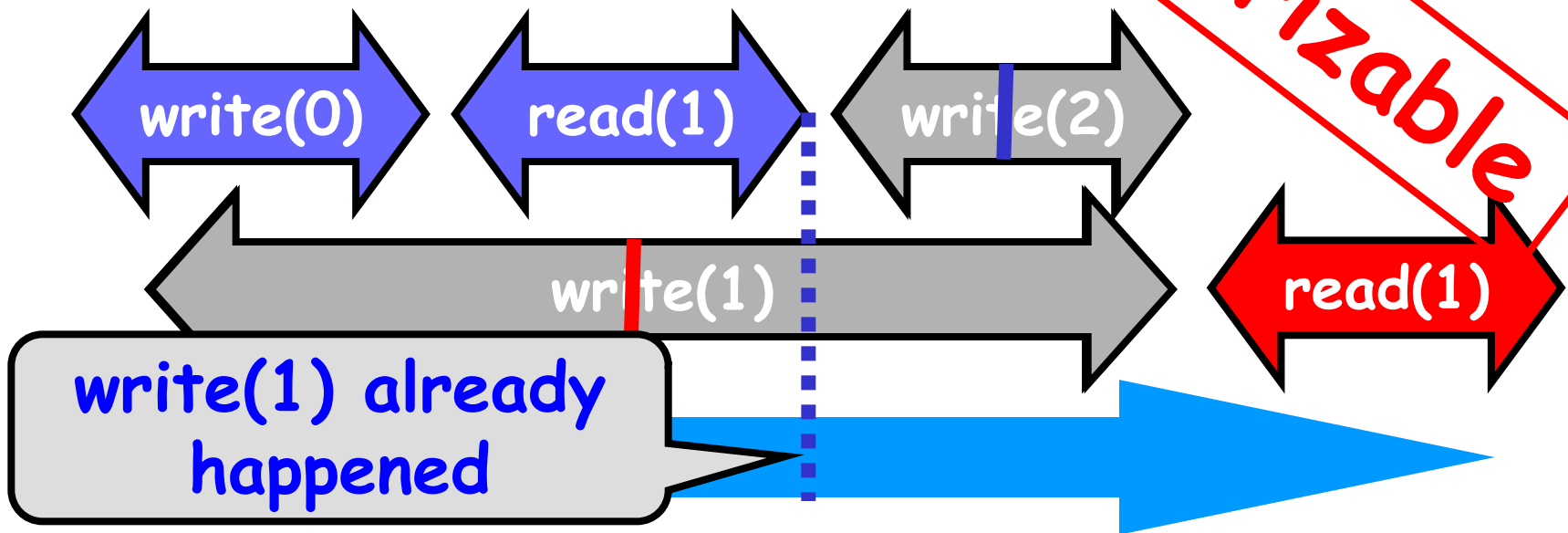


Read/Write Register Example

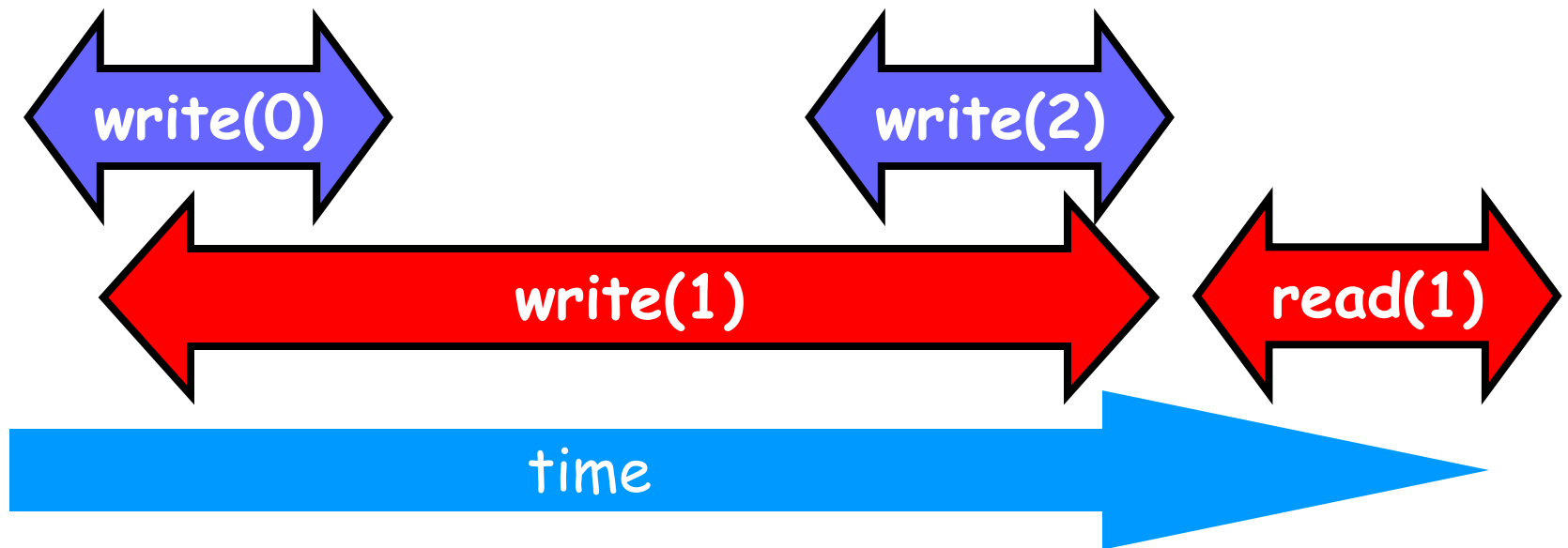


Read/Write Register Example

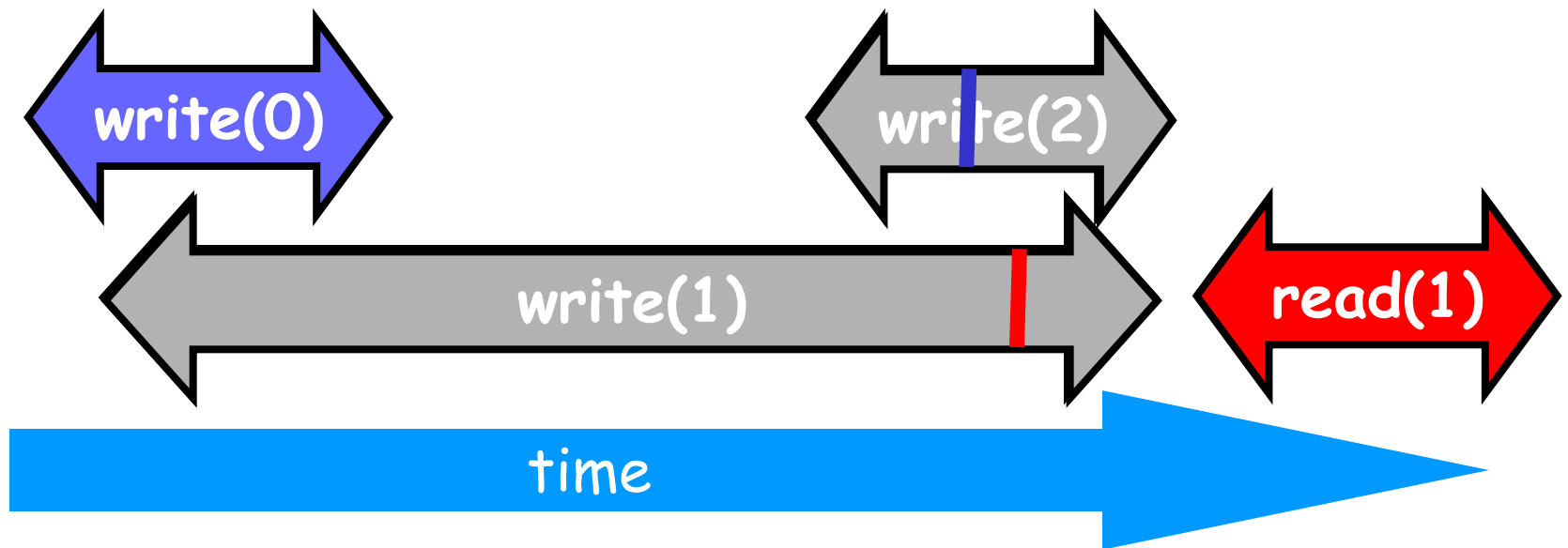
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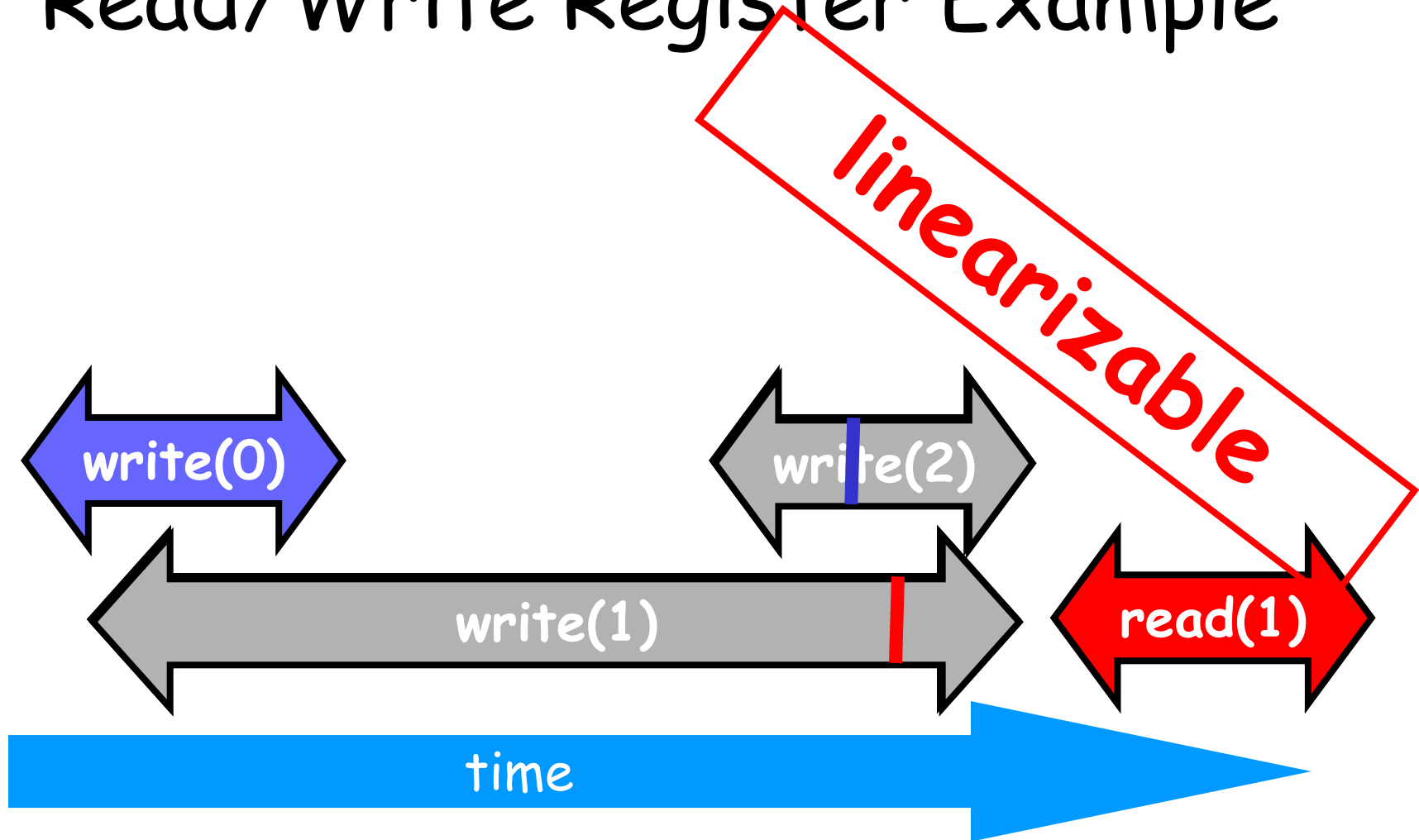
Read/Write Register Example



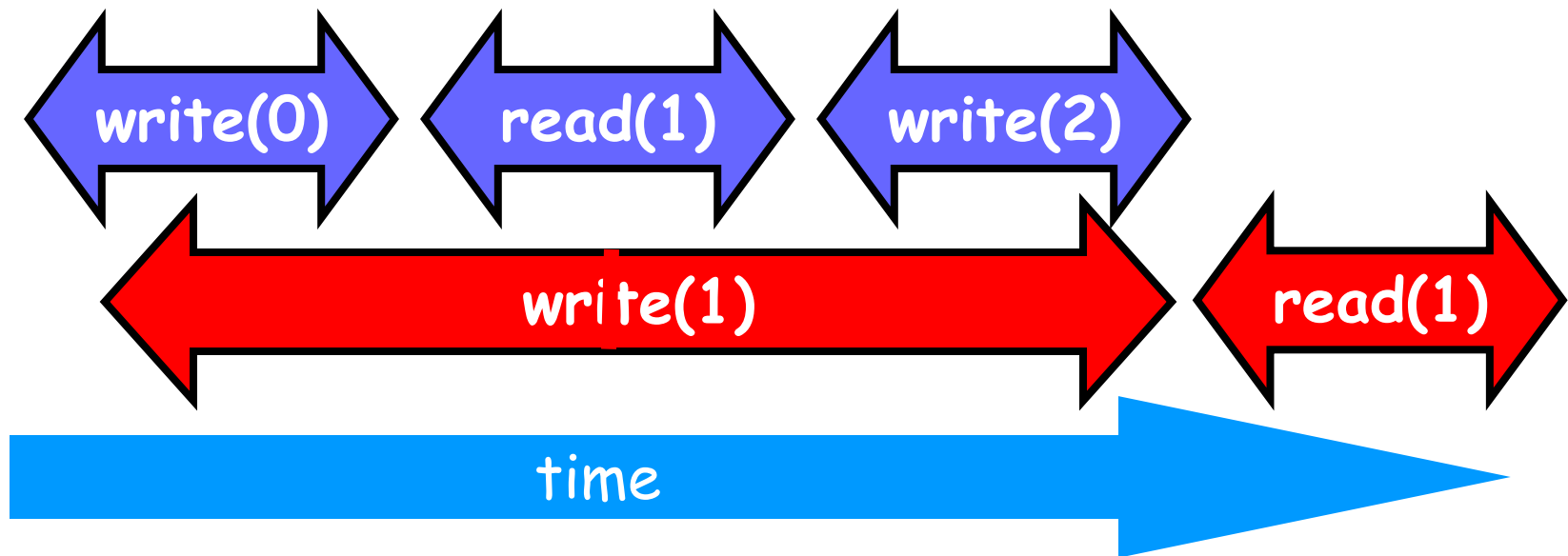
Read/Write Register Example



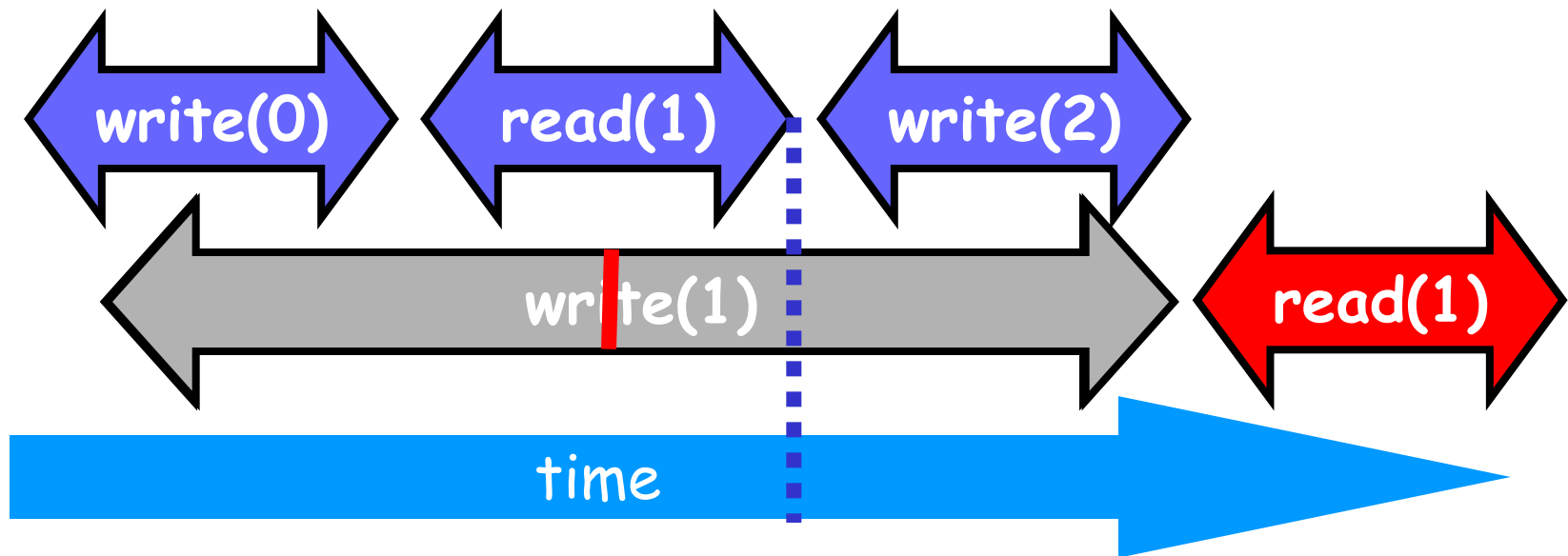
Read/Write Register Example



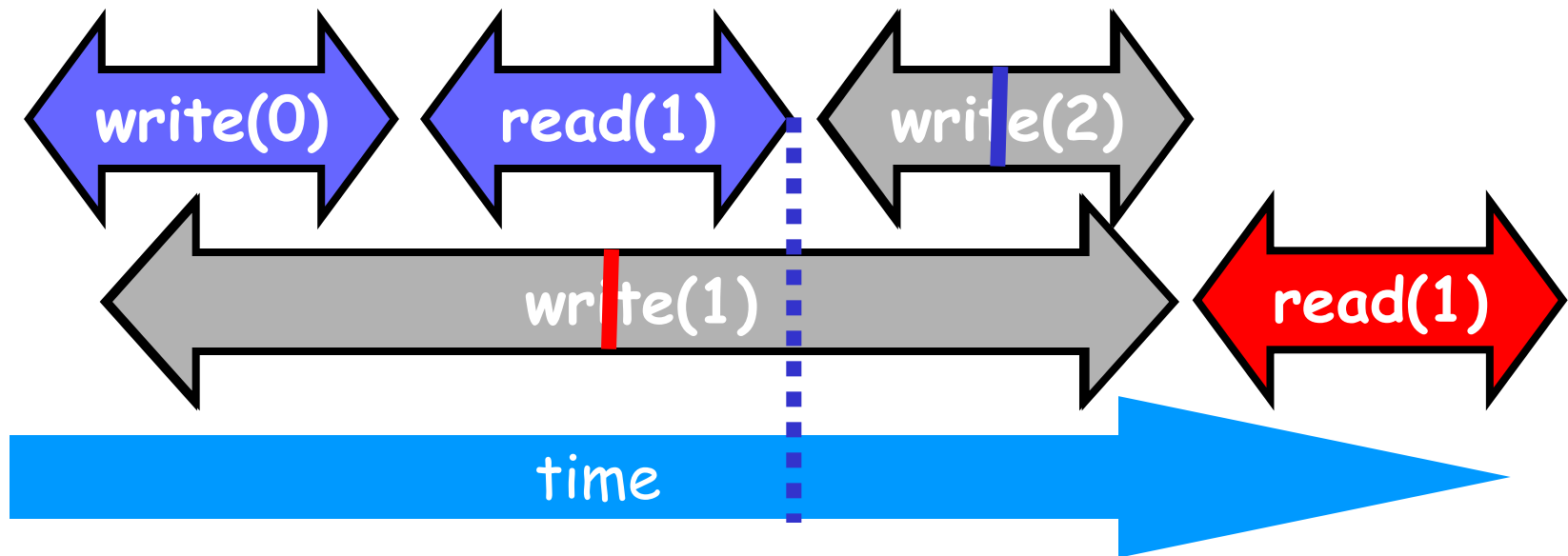
Read/Write Register Example



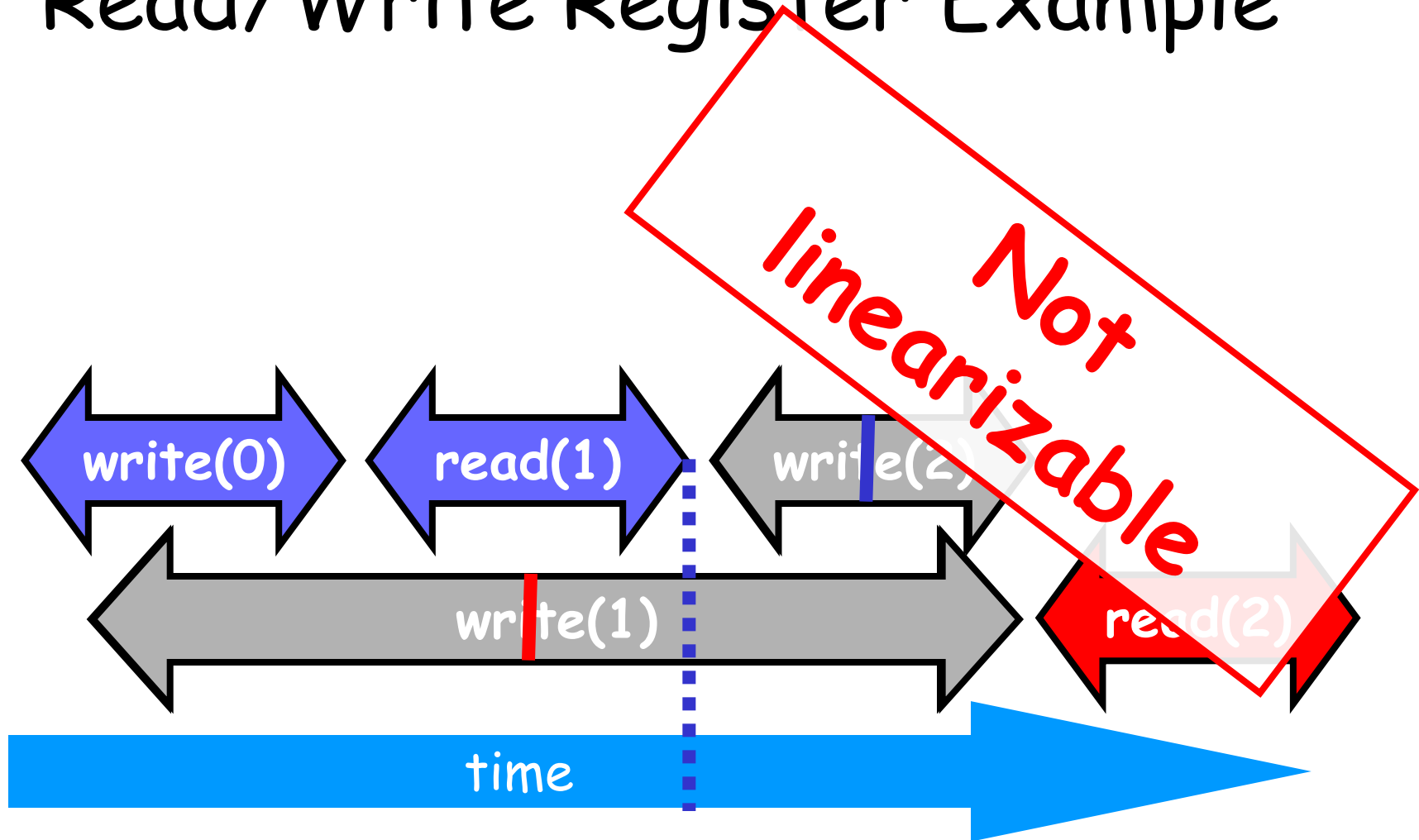
Read/Write Register Example



Read/Write Register Example



Read/Write Register Example



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