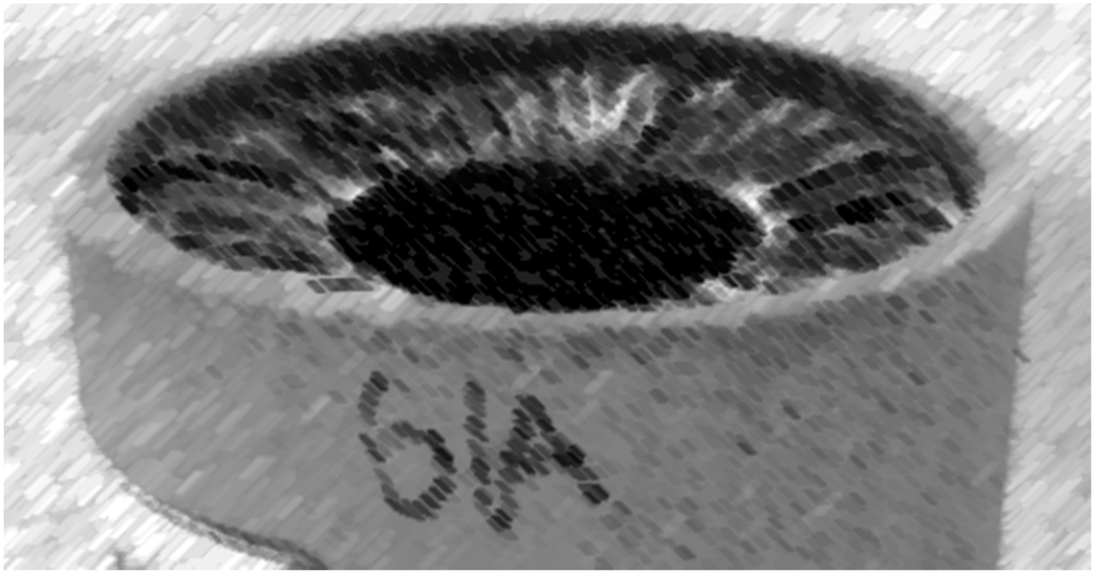

CS61A Lecture 43

Amir Kamil

UC Berkeley

May 1, 2013

Announcements

- HW13 due tonight
- Scheme contest due Friday
- Special guest lecture by Brian Harvey on Friday at 2pm
  - Attendance is mandatory!!!

The Problem with Shared State

```
def increment():
    count = counter[0]
    sleep(0)
    counter[0] = count + 1
```

May cause the interpreter to switch threads

Given a switch at the **`sleep`** call, here is a possible sequence of operations on each thread:

```
Thread 0                          Thread 1
read counter[0]: 0
                                  read counter[0]: 0
calculate 0 + 1: 1
write 1 -> counter[0]
                                  calculate 0 + 1: 1
                                  write 1 -> counter[0]
```

The counter ends up with a value of 1, even though it was incremented twice!

Synchronized Data Structures

Some data structures guarantee synchronization, so that their operations are atomic

```
from queue import Queue
queue = Queue()
def increment():
    count = queue.get()
    sleep(0)
    queue.put(count + 1)
other = Thread(target=increment, args=())
other.start()
queue.put(0)
increment()
other.join()
print('count is now', queue.get())
```

Synchronized FIFO queue

Waits until an item is available

Add initial value of 0

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There is no synchronized set in the Python library, so we must provide our own synchronization using a lock

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    """Queue the given URL."""
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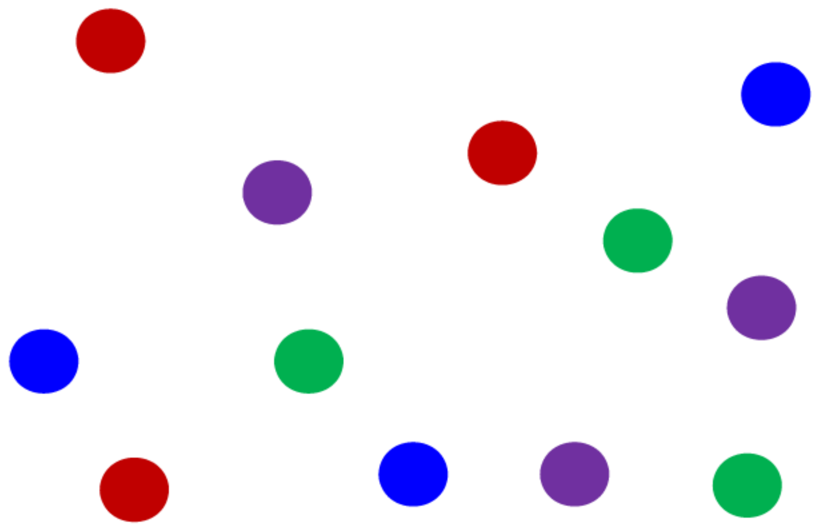
def get_url():
    """Retrieve a URL."""
    return queue.get()

def already_seen(url):
    """Check if a URL has already been seen."""
    with seen_lock:
        if url in seen:
            return True
        seen.add(url)
        return False
```

Example: Particle Simulation



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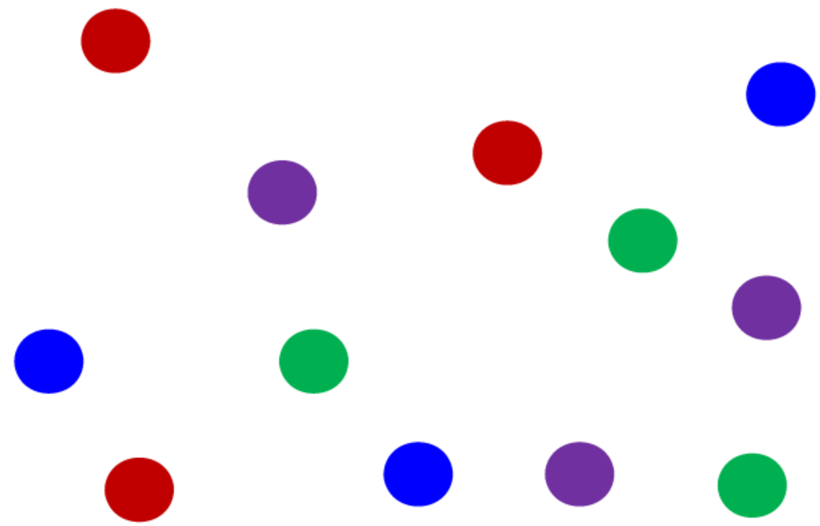

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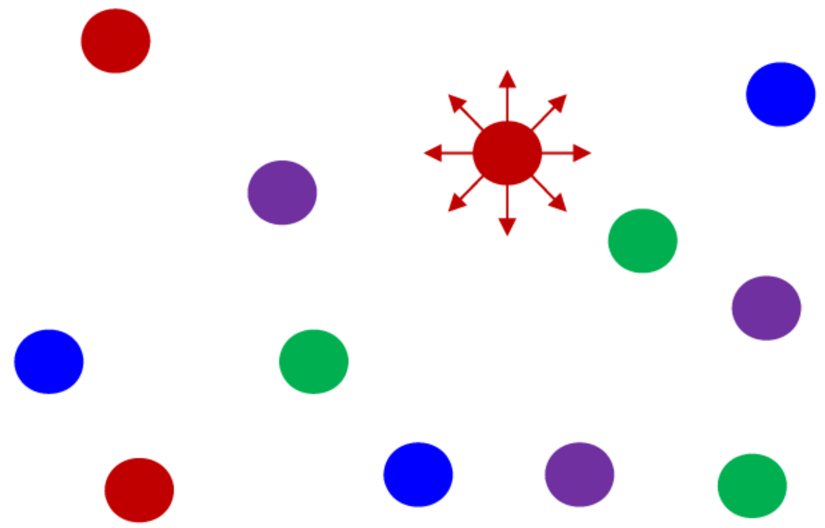

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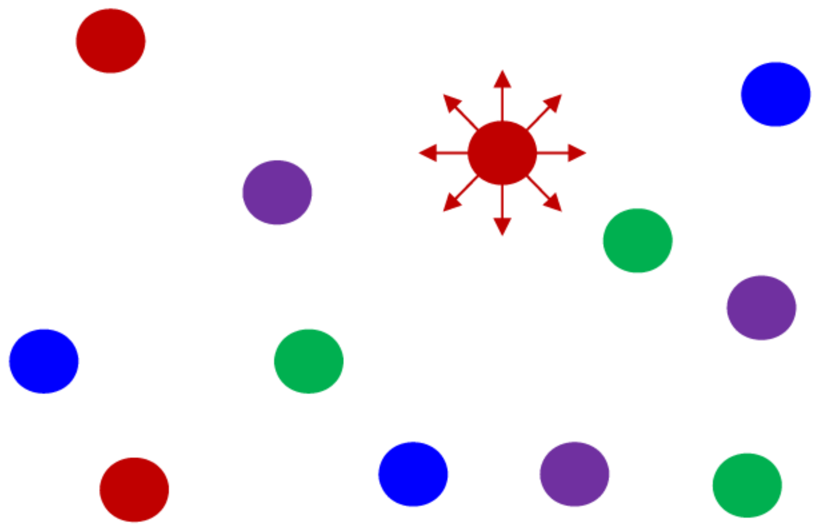

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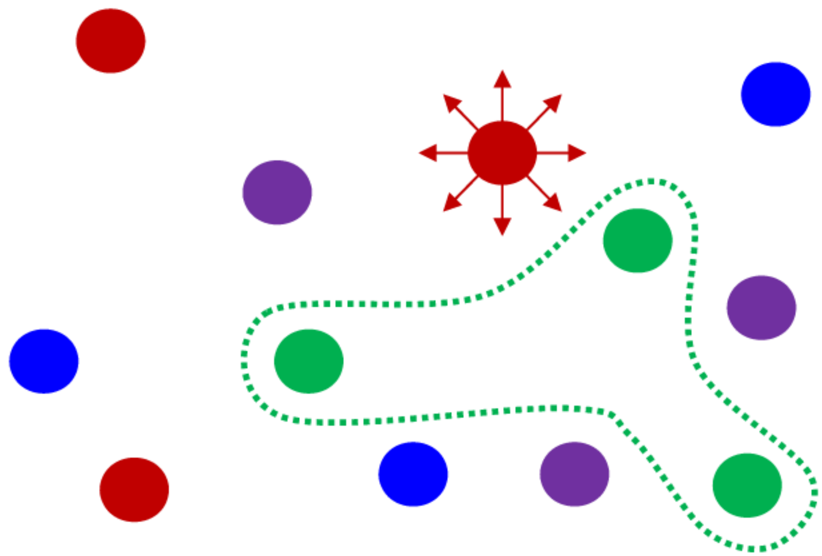

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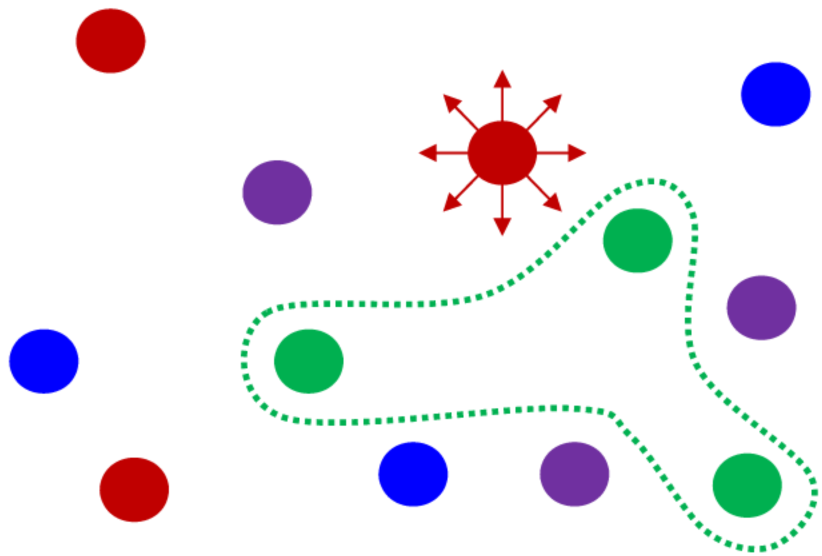

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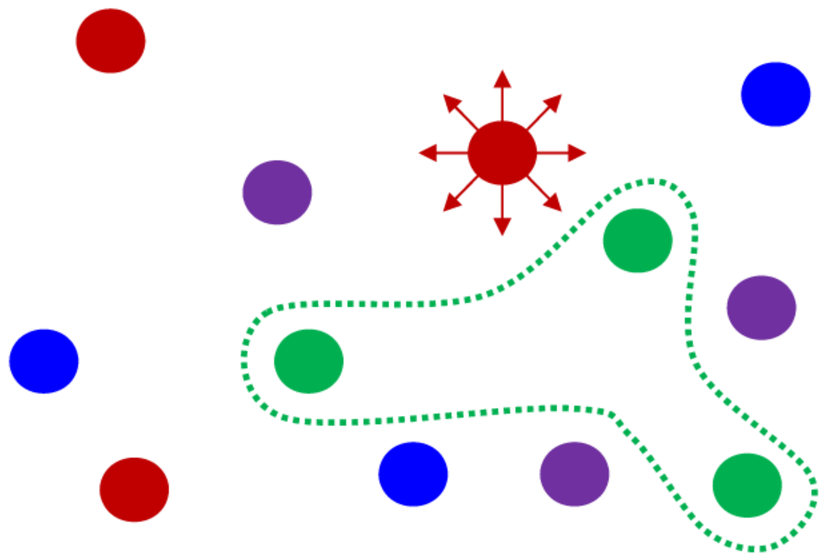

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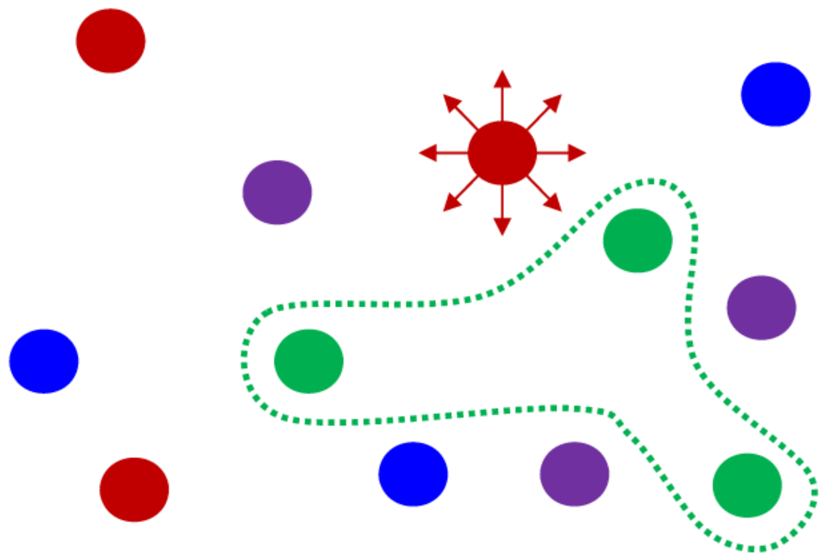

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The simulation is discretized into timesteps

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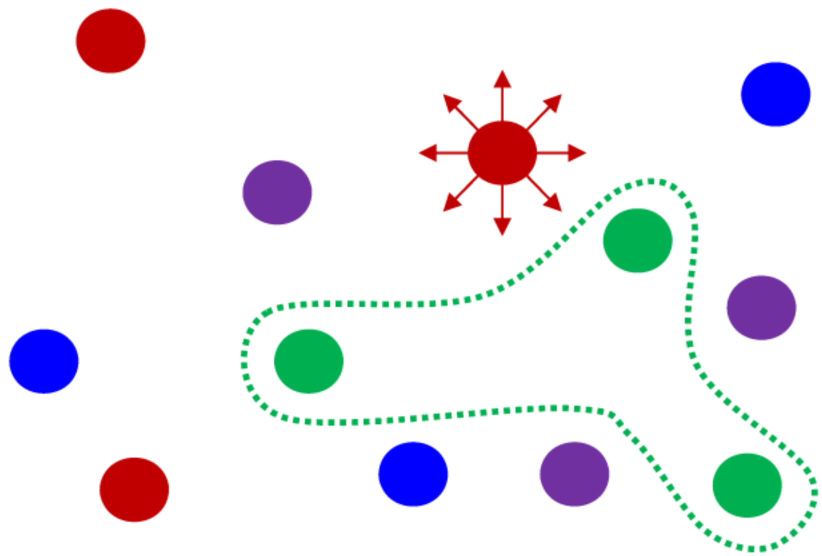

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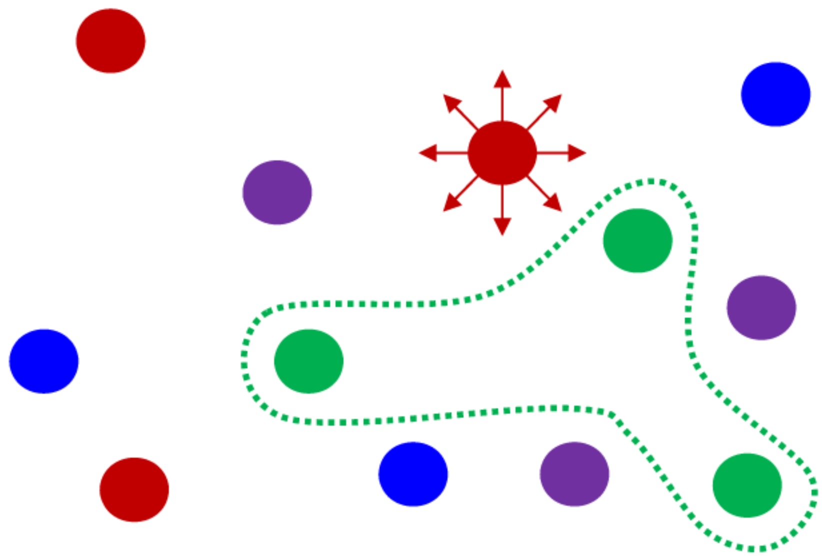

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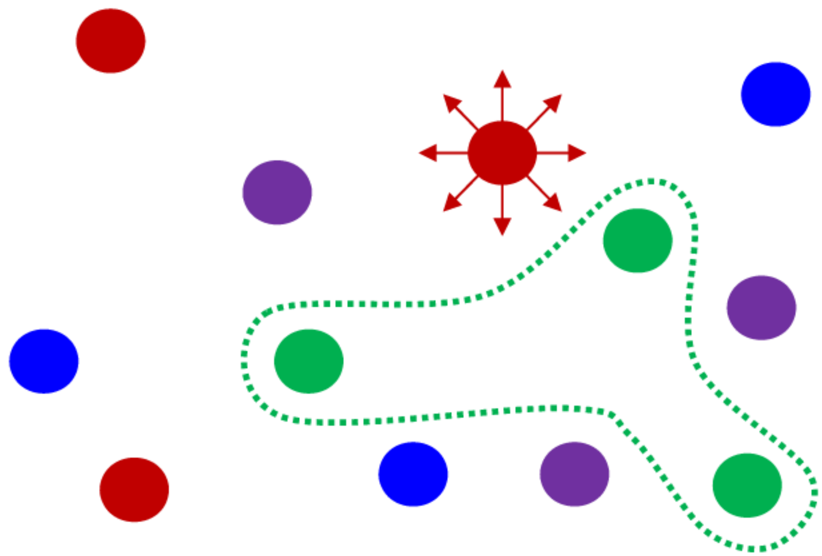

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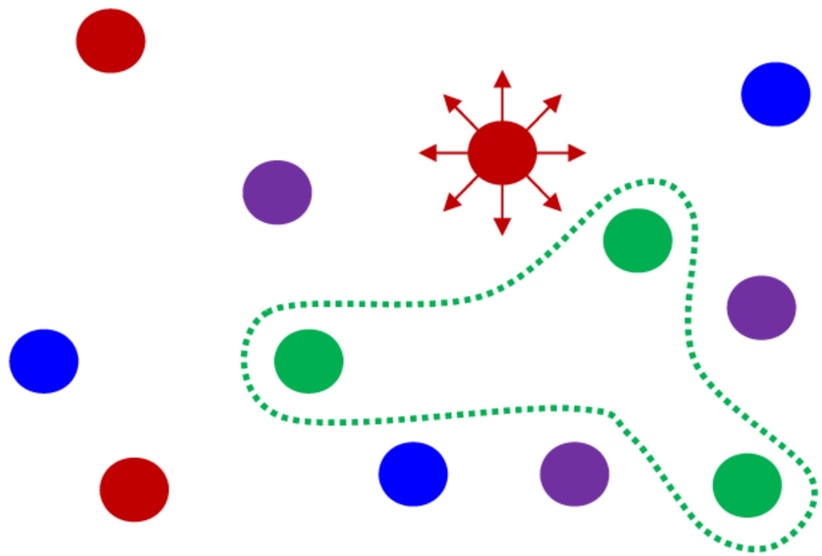

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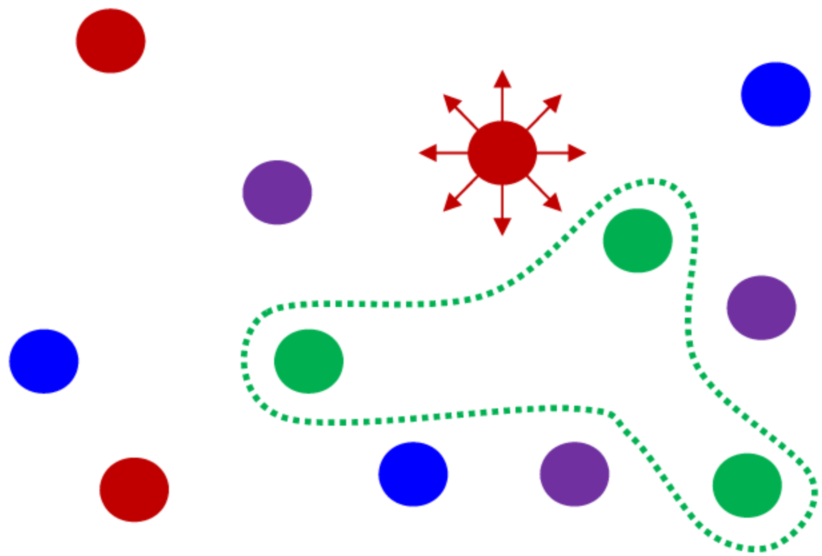

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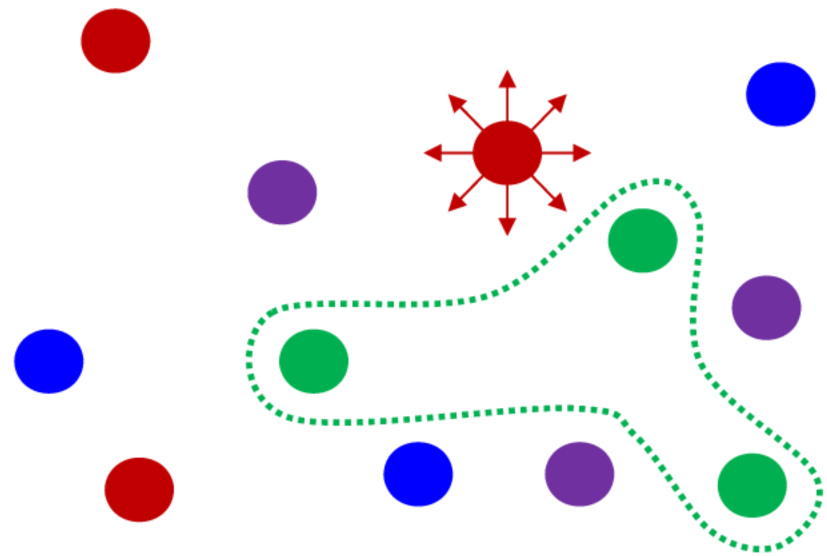

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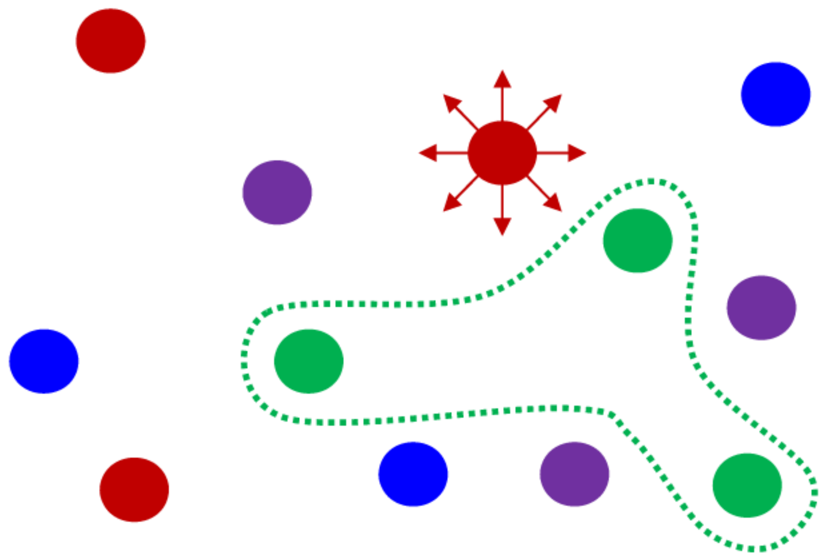

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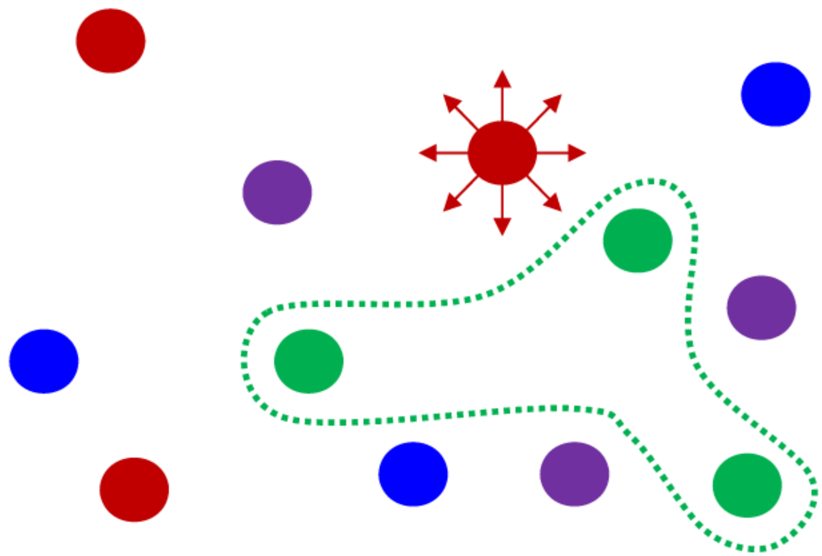

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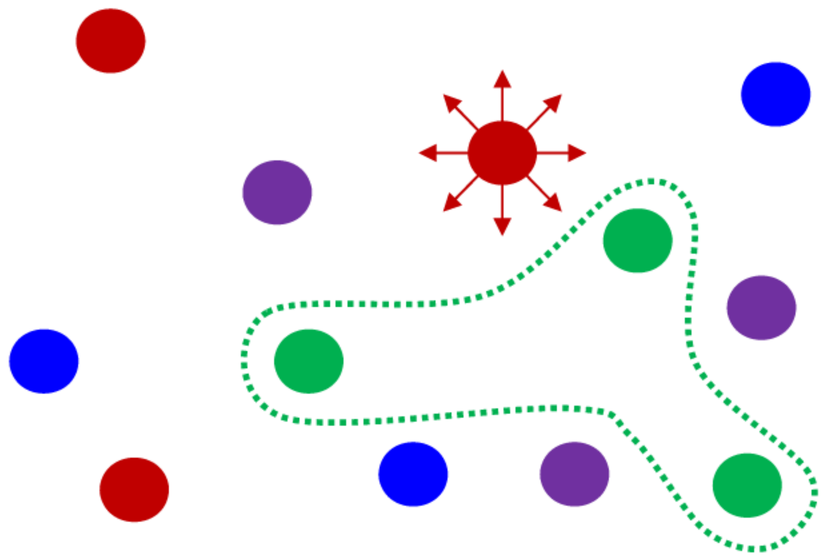

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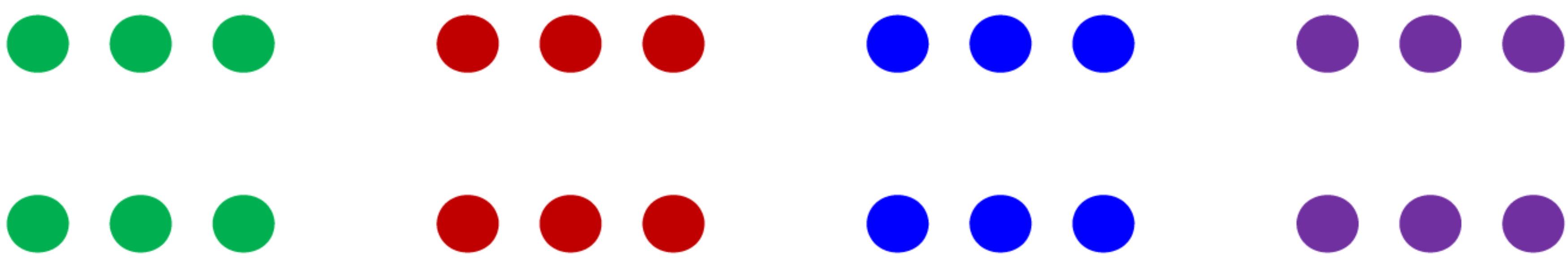

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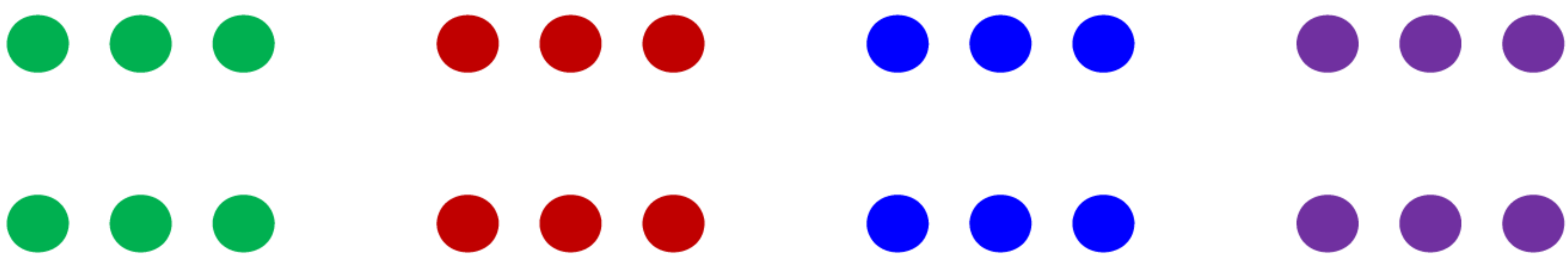

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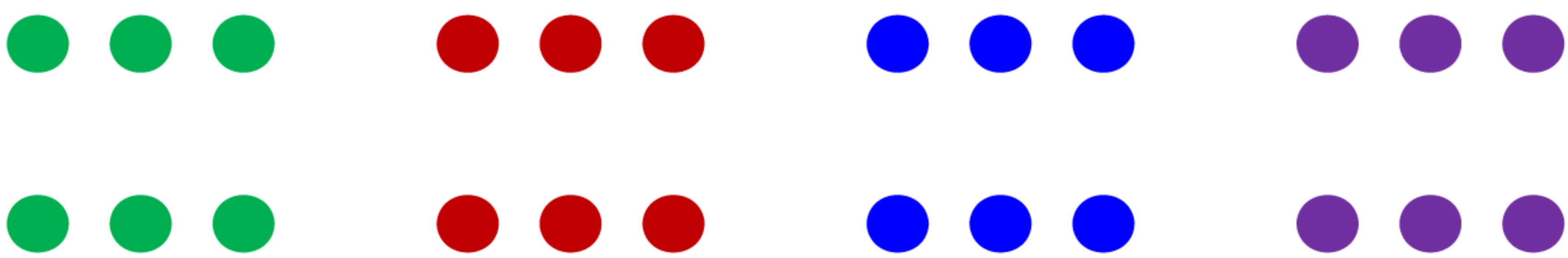

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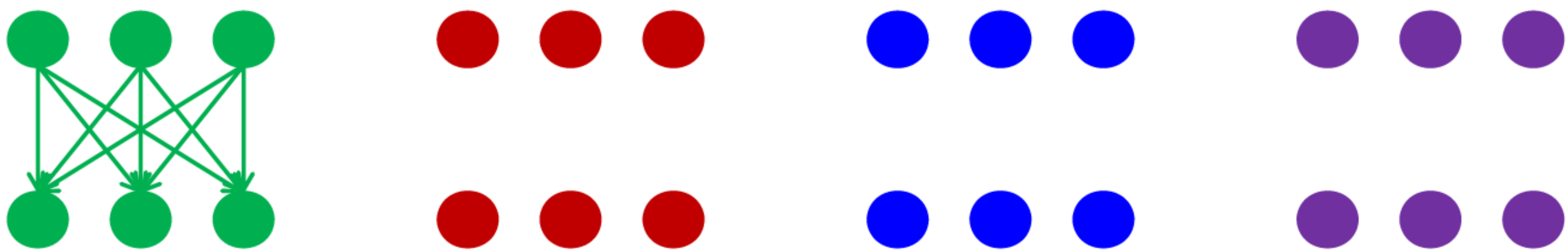

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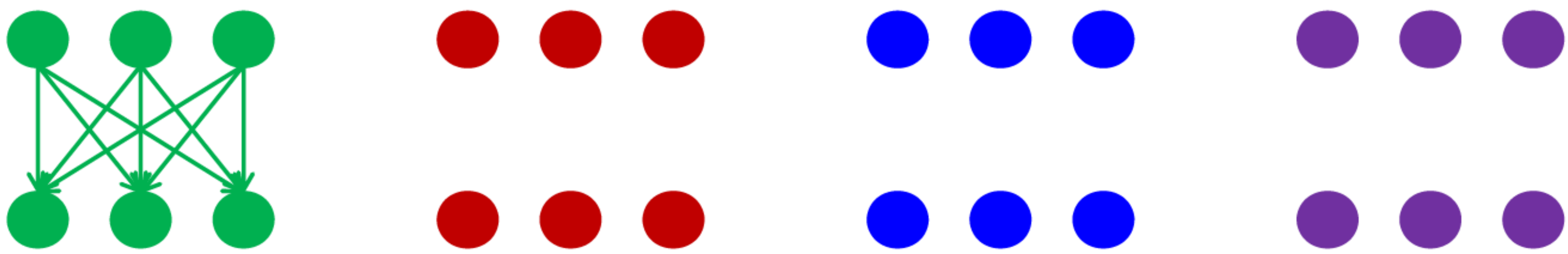

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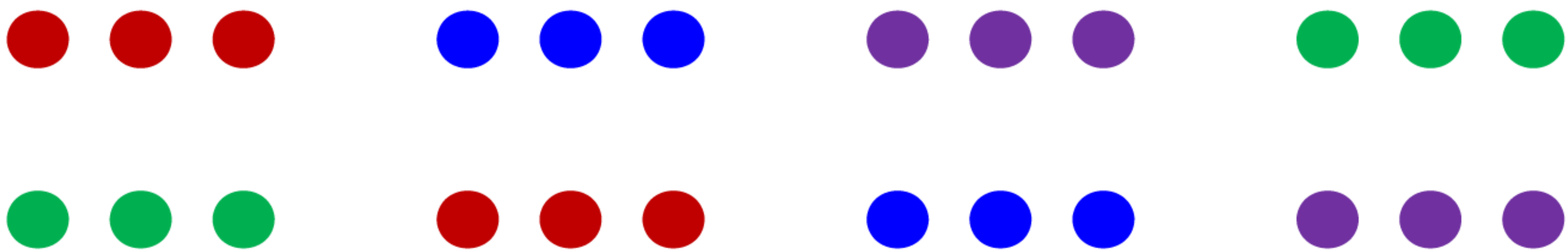

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Alternatively, we can explicitly pass state from the thread/process that owns it to those that need to use it

In each timestep, every process makes a copy of its own particles

Then, they do the following `num_processes-1` times:

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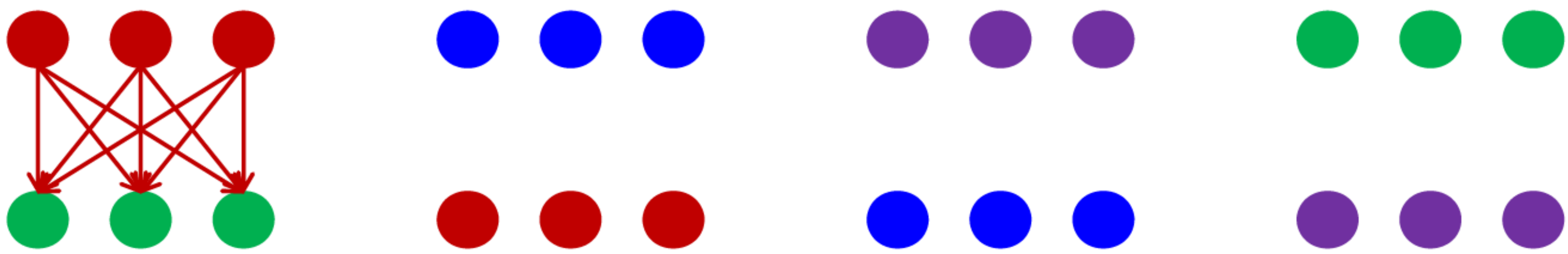

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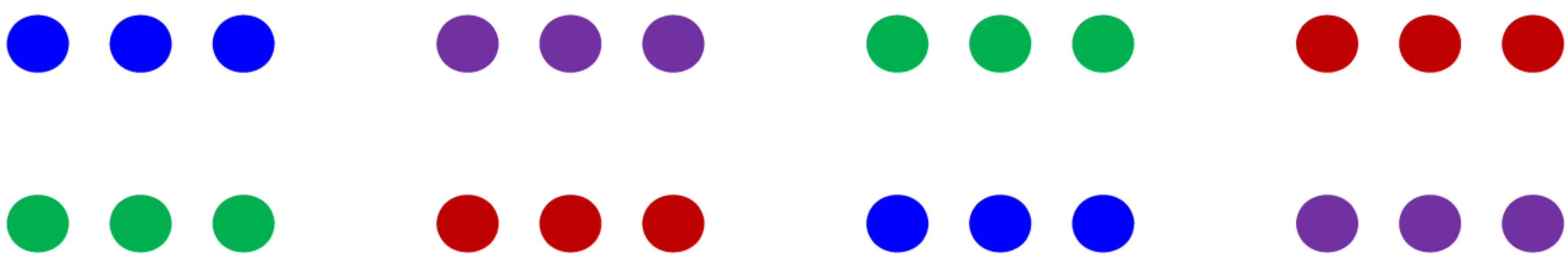

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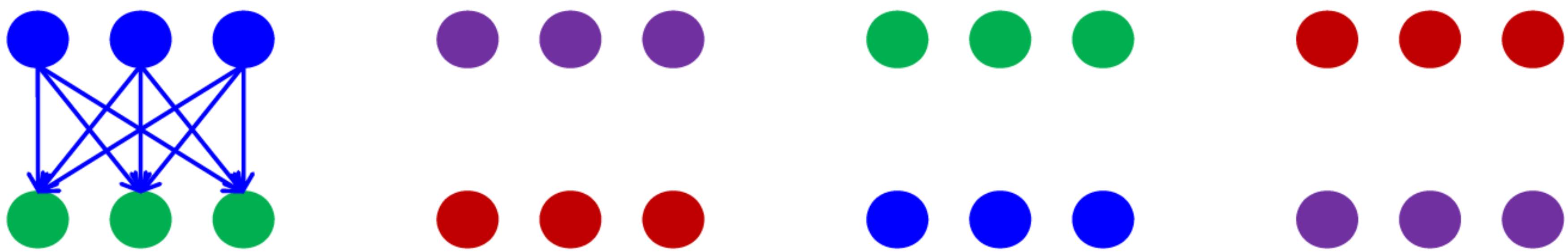

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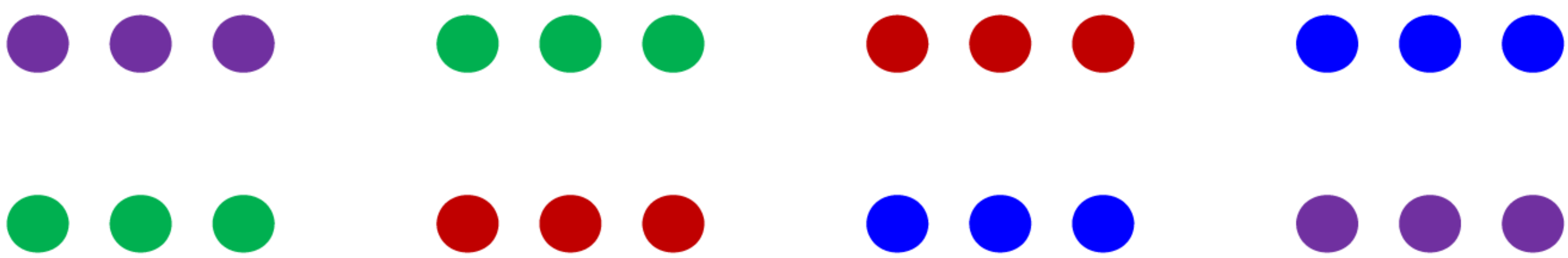

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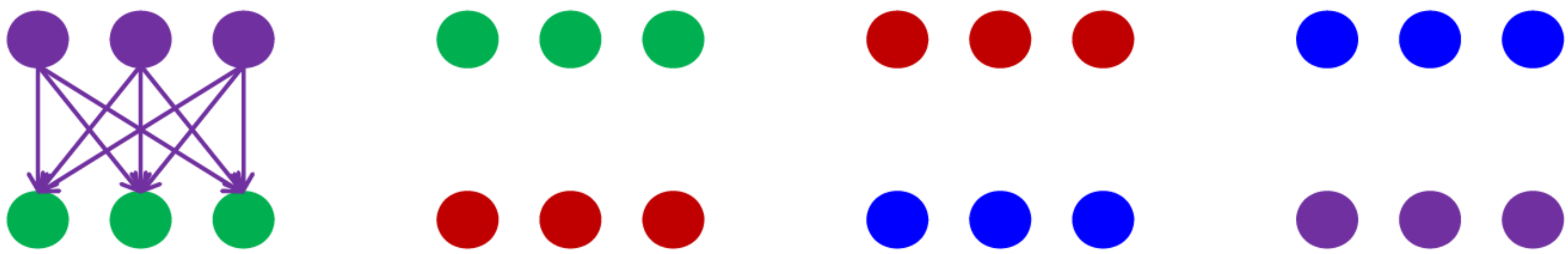

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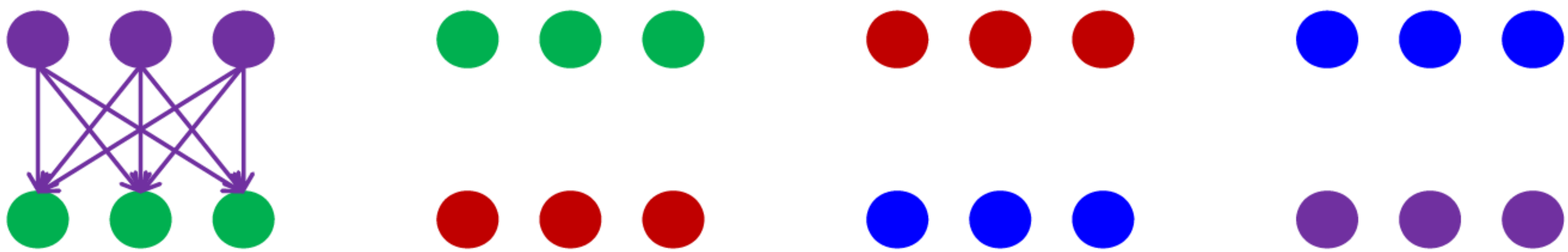
Thus, reads are on copies, so they don't conflict with writes



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Making parallel programming easier is one of the central challenges that Computer Science faces today

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- Simple and compact implementations provide very powerful abstractions

61A Topics in Future Courses

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You will see the topics you learned here many times over your academic career and beyond

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Of course, you will see abstraction everywhere!

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You can apply to be a reader or TA here: https://willow.coe.berkeley.edu/PHP/gsiapp/menu.php

The 61A Staff

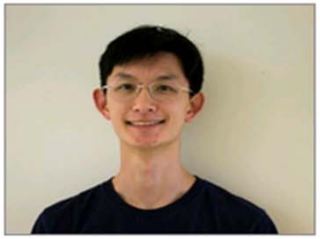
Teaching Assistants


Hamilton Nguyen


Joy Jeng


Keegan Mann


Stephen Martinis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Julia Oh

Robert Huang


Mark Miyashita


Sharad Vikram


Soumya Basu

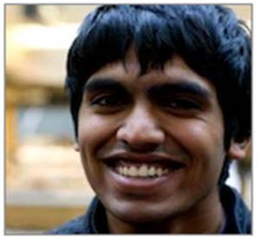

Richard Hwang

Readers


Michelle Hwang

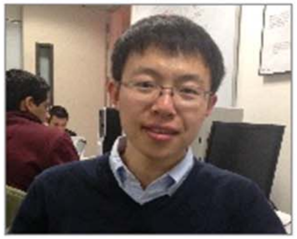

Alvin Wong


Yan Zhao


Vaishaal Shankar

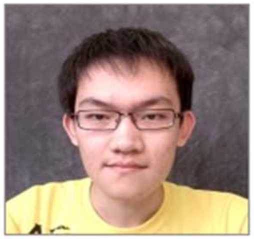

Lori Krakirian


James Sha


Siyuan (Jack) He


Jian Qiao


Iris Wang


Chenyang Yuan

From all of us:

Thank you for a wonderful semester!

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