Concurrency

Unleash your processor(s)

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About me

Passionate programmer
Concurrency enthusiast

GPars @ Codehaus lead
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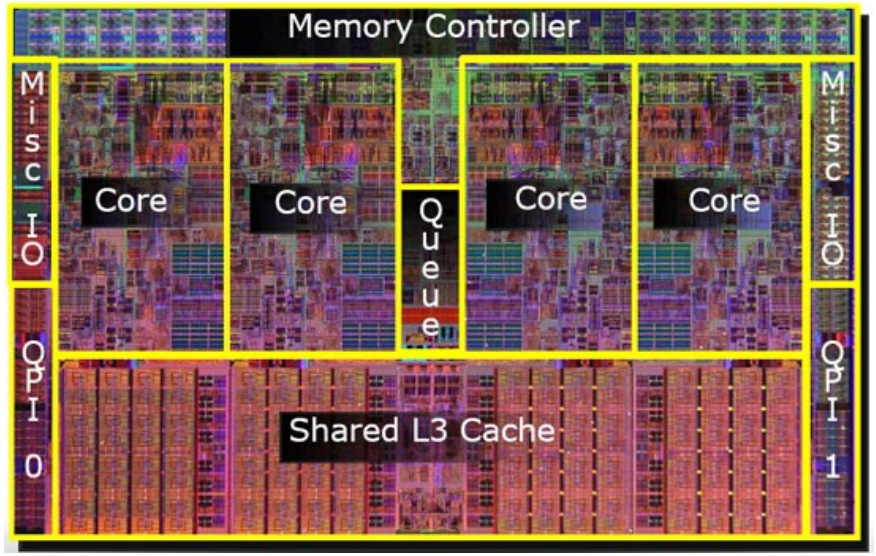

We’re all in the parallel computing business!


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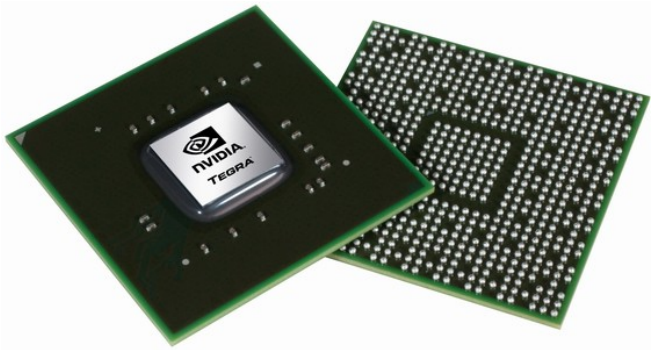
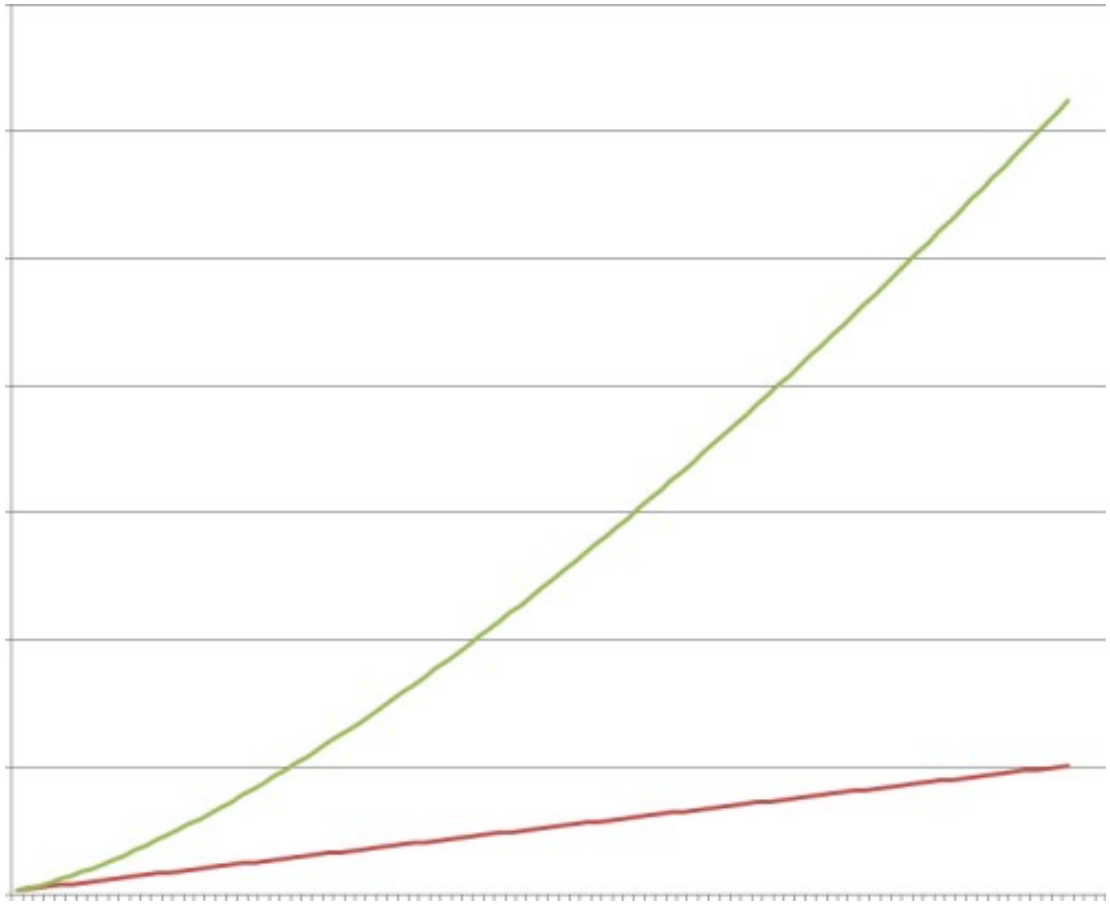
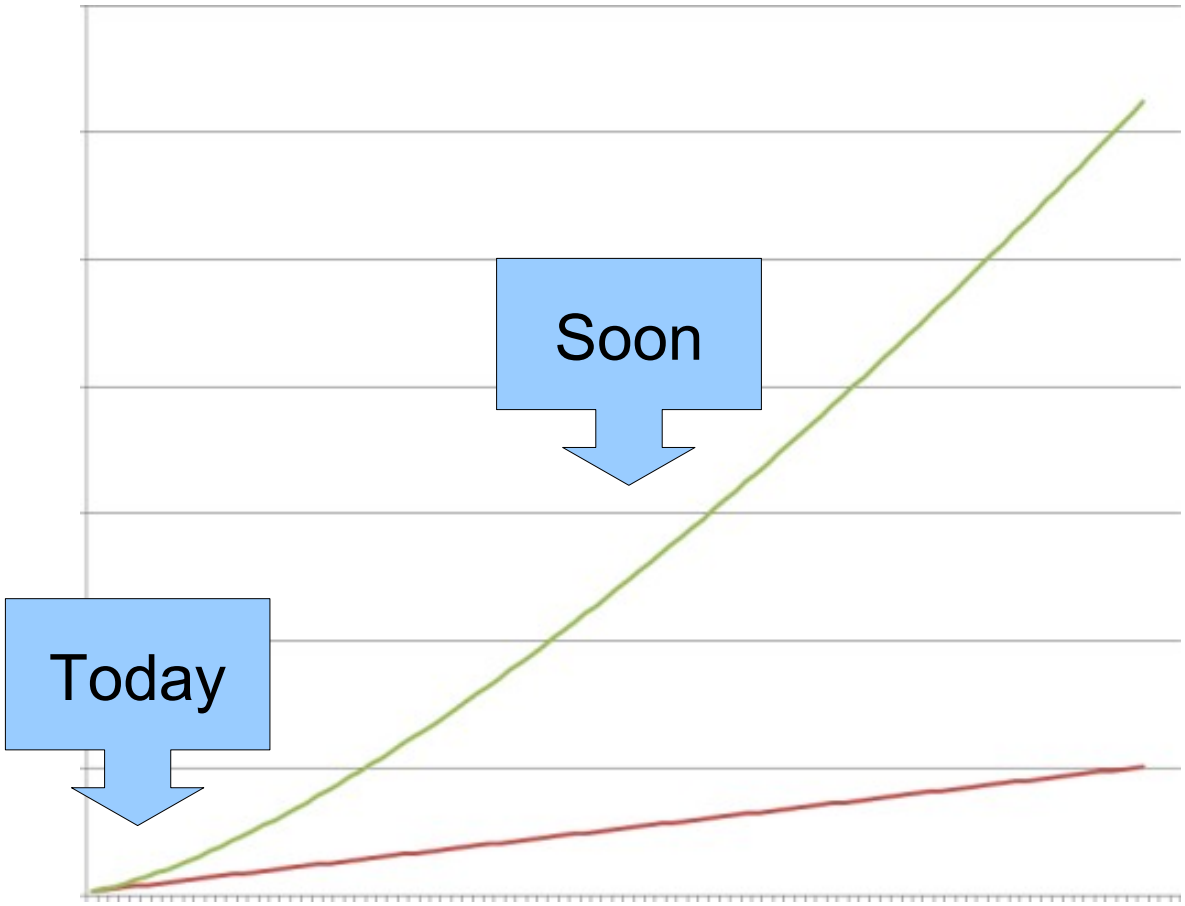

NVIDIA
TEGRA

of cores



of cores



Dealing with threads sucks!

```
public class Counter {
    private static long count = 0;

    public Counter() {

        count++;

    }
}
```

Dealing with threads sucks!

```
public class Counter {
    private static long count = 0;

    public Counter() {
        synchronized (this) {
            count++;
        }
    }
}
```

Dealing with threads sucks!

```
public class Counter {
    private static long count = 0;

    public Counter() {
        synchronized (this.getClass()) {
            count++;
        }
    }
}
```

Dealing with threads sucks!

```
public class ClickCounter implements ActionListener {
    public ClickCounter(JButton button) {
        button.addActionListener(this);
    }

    public void actionPerformed(final ActionEvent e) {
        ...
    }
}
```

Stone age of parallel SW

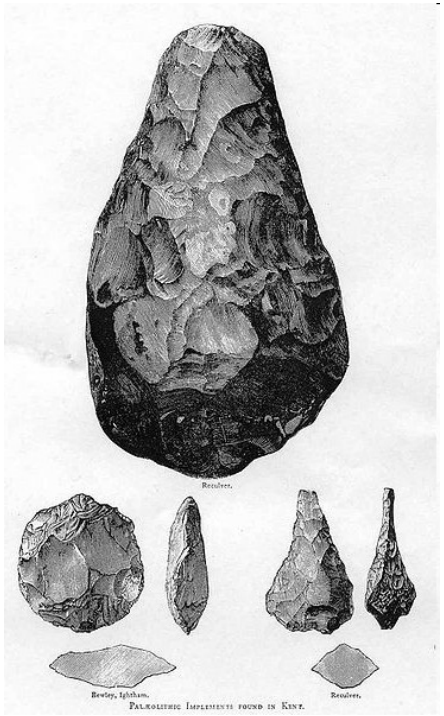
Dead-locks

Live-locks

Race conditions

Starvation

Shared Mutable State



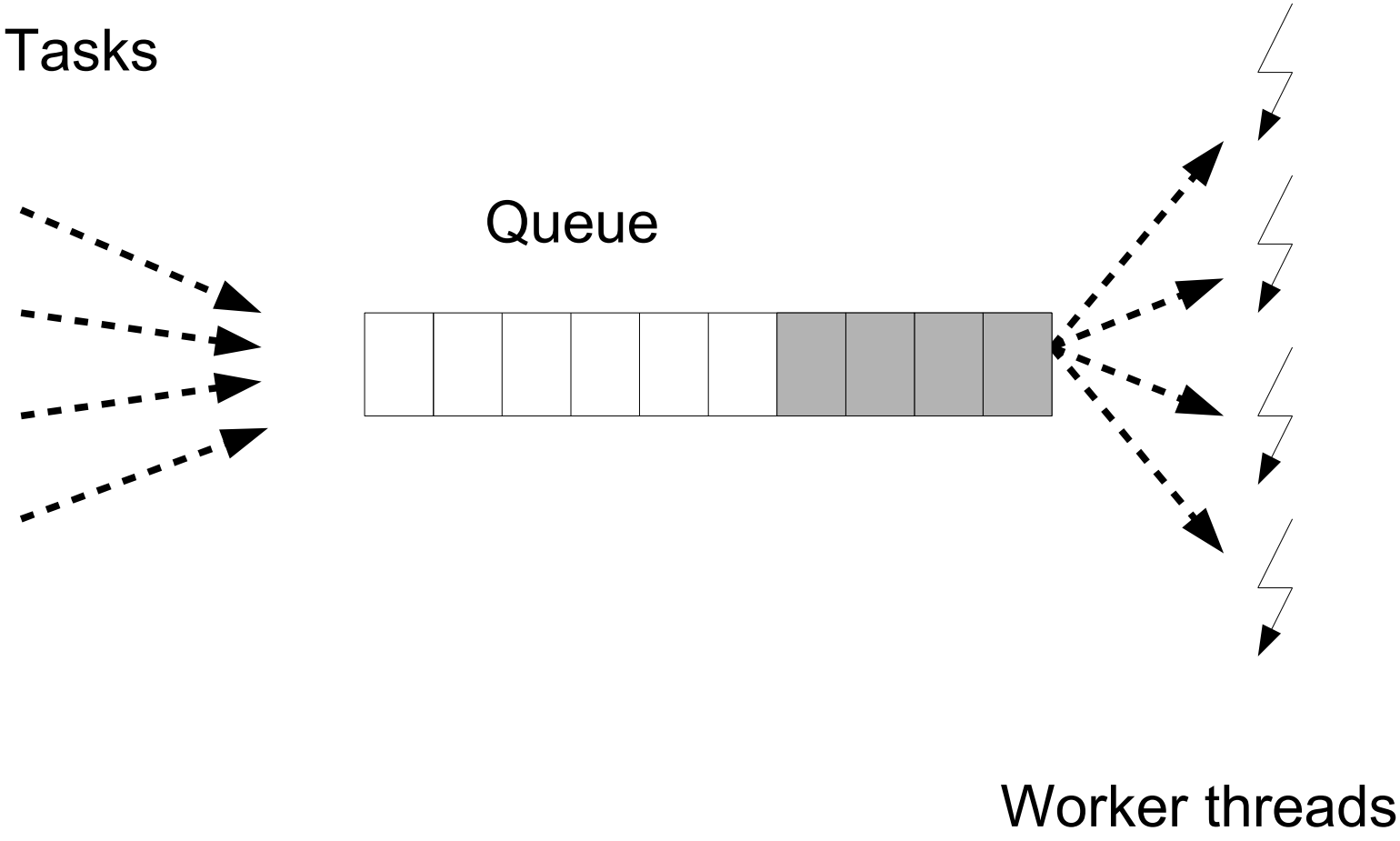
Multithreaded programs today work mostly by accident!

Can we do better?

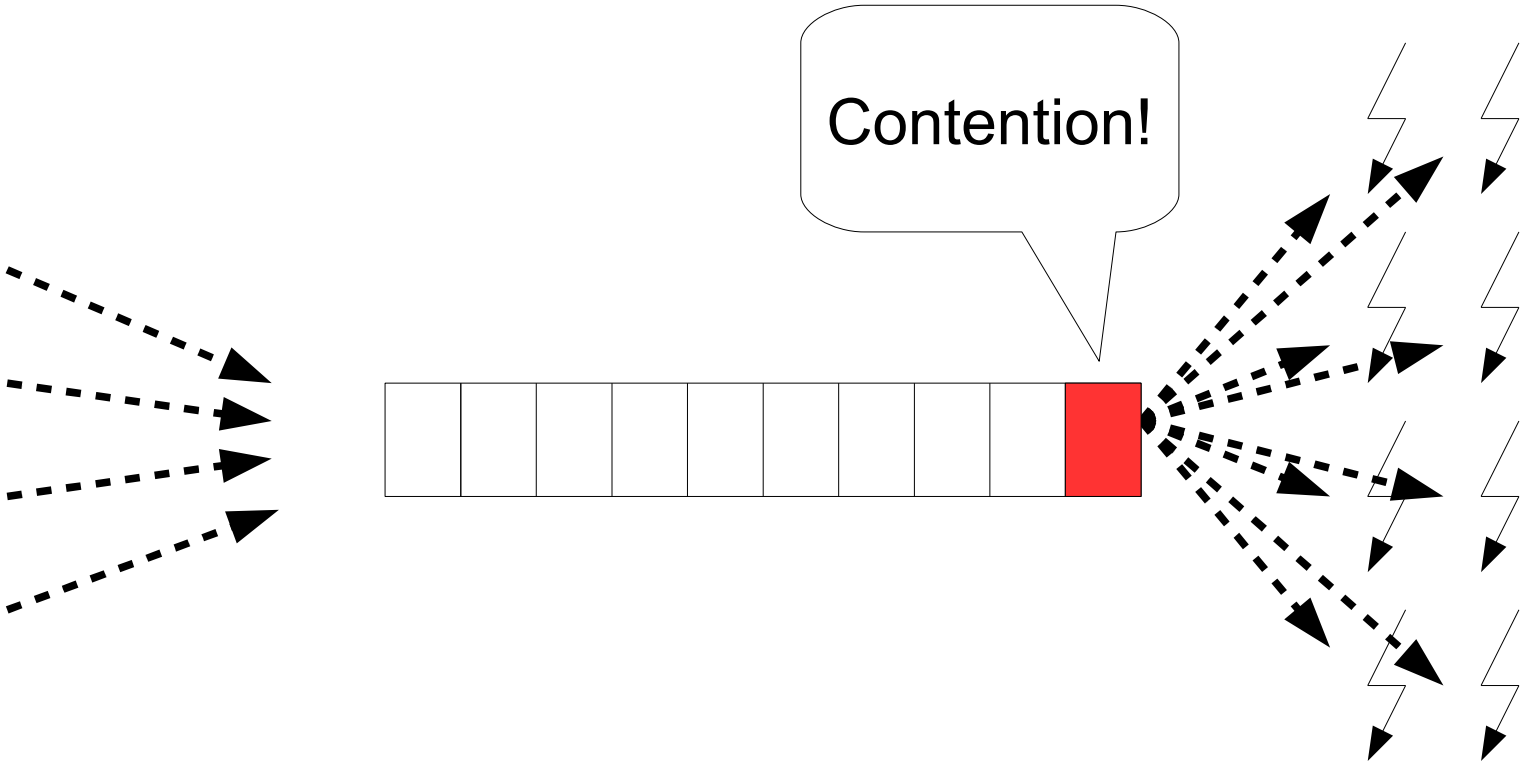
Asynchronous invocation

```
Future f = threadPool.submit(calculation);
…
System.out.println(“Result: “ + f.get());
```

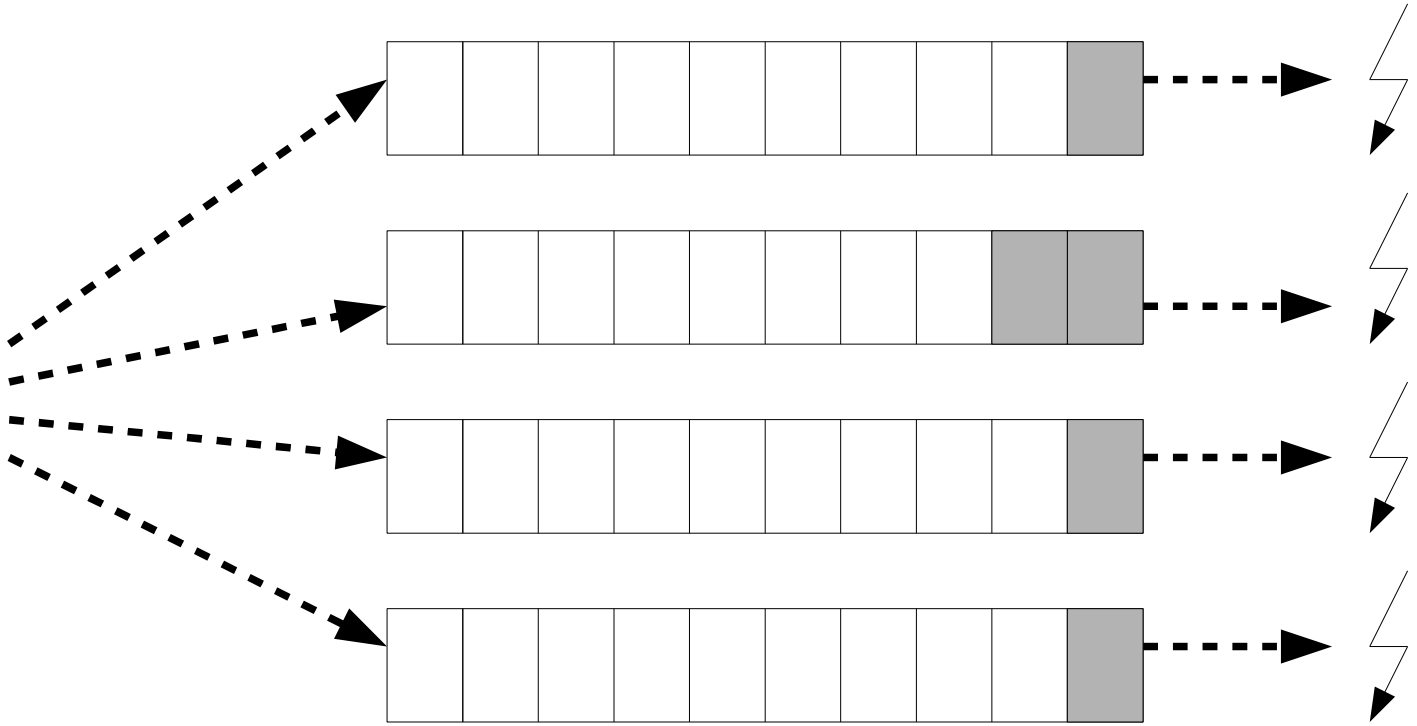
Thread Pool



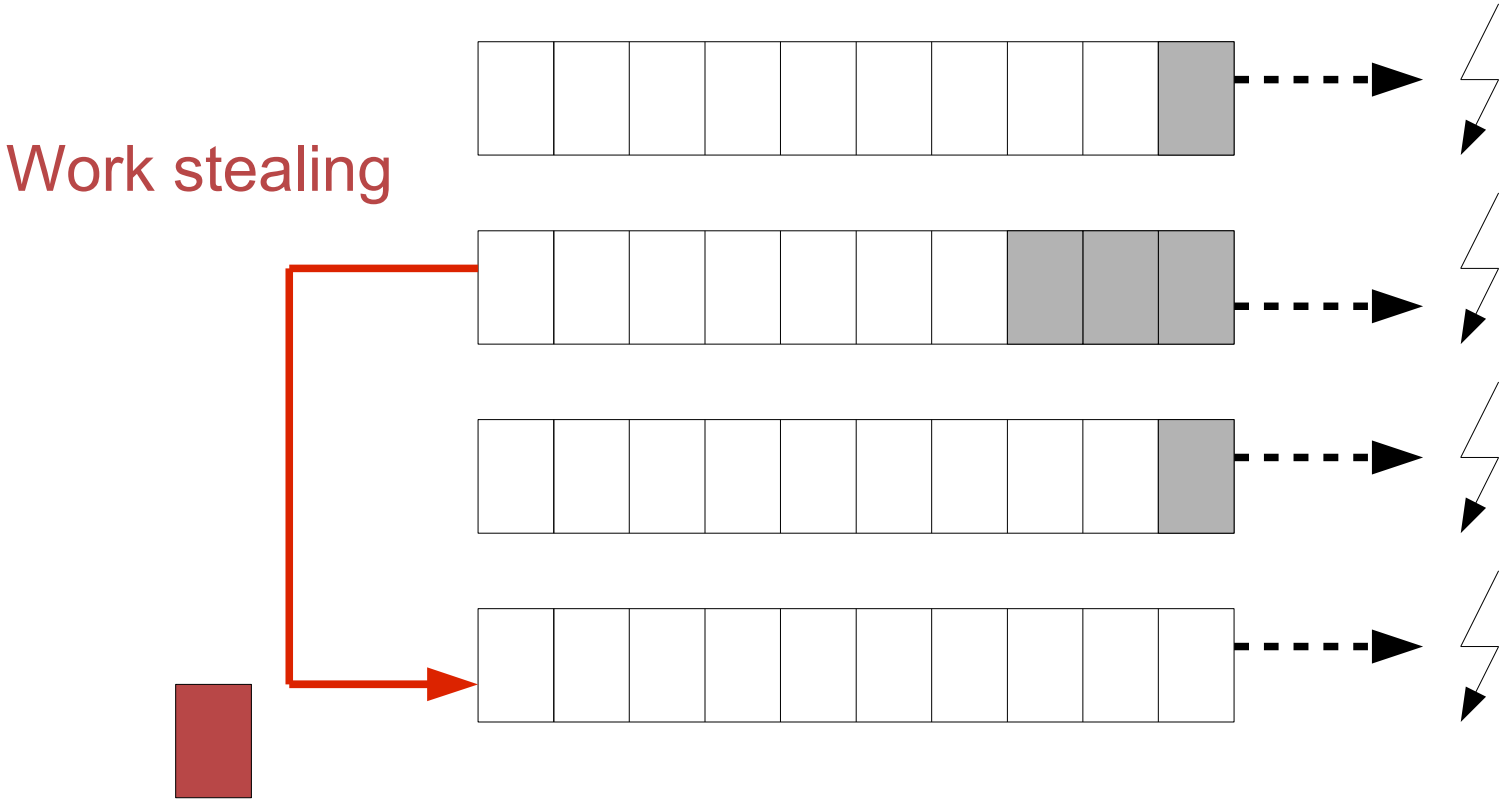
Thread Pool



Fork/Join Thread Pool

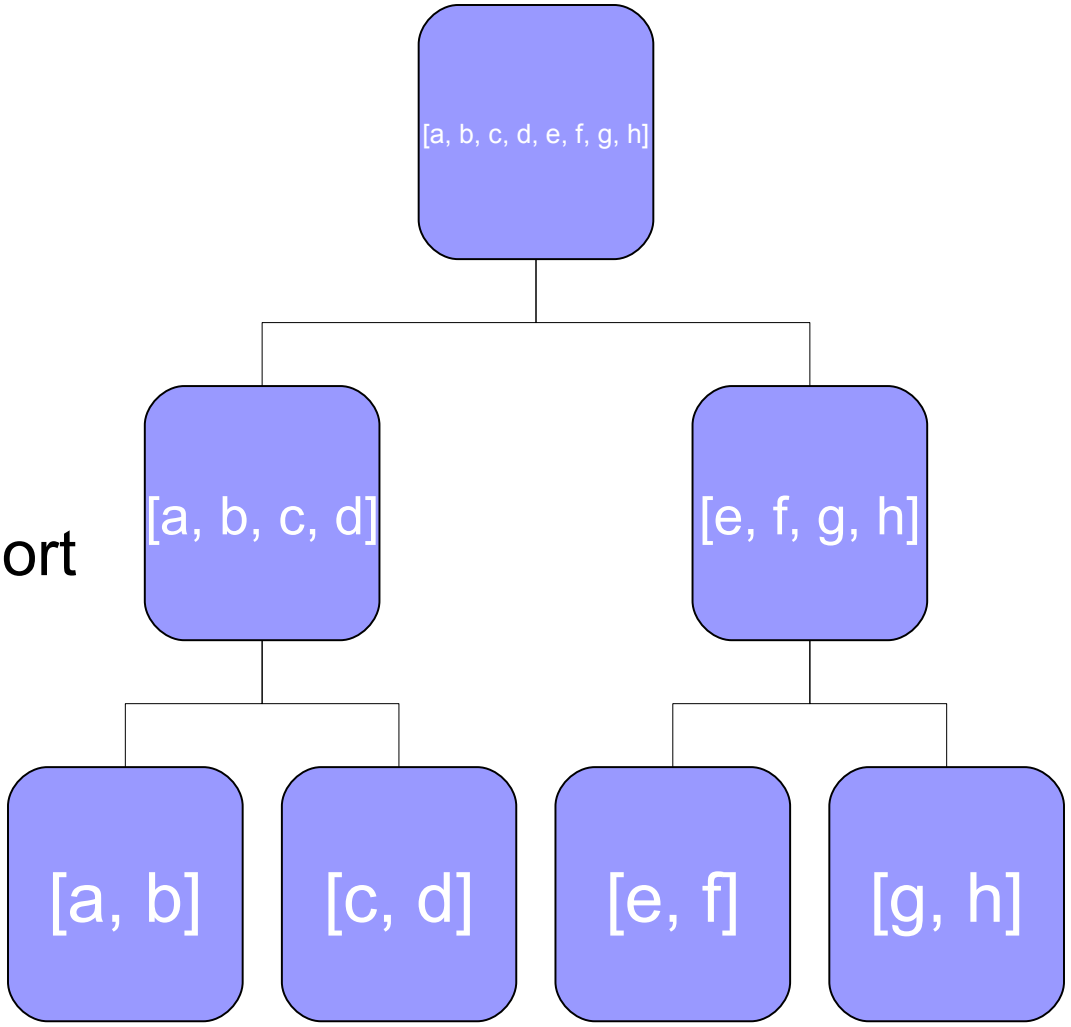


Fork/Join Thread Pool



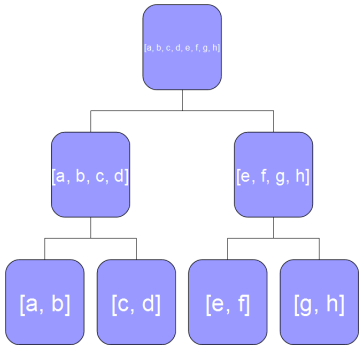
Fork/Join

- Solve hierarchical problems
  - Divide and conquer
  - Merge sort, Quick sort
  - Tree traversal
  - File scan / search
  - …



Fork/Join (GPars)

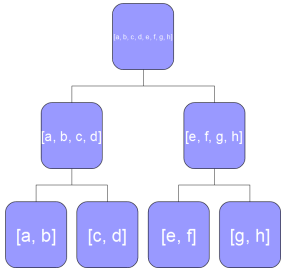
```
runForkJoin(new File("./src")) {currentDir ->
    long count = 0;
    currentDir.eachFile {
        if (it.isDirectory()) {
            forkOffChild it
        } else {
            count++
        }
    }
    return count + childrenResults.sum(0)
}
```



Waits for children without blocking the thread!

Collections (Groovy/GPars)

images.eachParallel {it.process()}



documents.sumParallel()

candidates.maxParallel {it.salary}.marry()

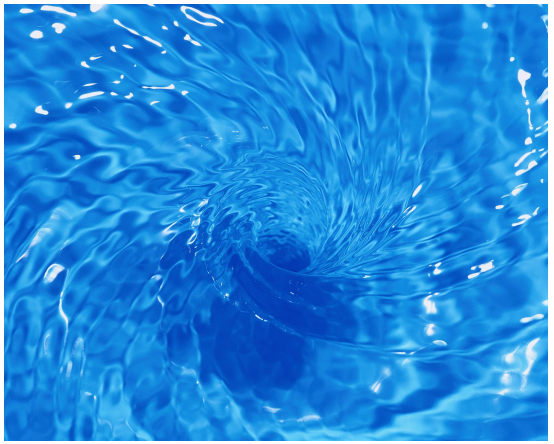
Parallel Arrays (jsr-166y)

```
ParallelArray namesOfWomen =
    people.withFilter(aWoman).withMapping(retrieveName).all();
```

```
Ops.Predicate aWoman = new Ops.Predicate() {
  public boolean op(Person friend) {return !friend.isMale();}
};

Ops.Op retrieveName = new Ops.Op() {
  public Object op(Person friend) {return friend.getName();}
};
```

Dataflow Concurrency



- No race-conditions
- No live-locks
- Deterministic deadlocks

  Completely deterministic programs

BEAUTIFUL code

(Jonas Bonér)

Milestone

Asynchronous calculations

Fork/Join

Parallel collection processing

Dataflow variables/streams

Message Passing

Actors

Processes with mailboxes

Communicating Sequential Processes (CSP)

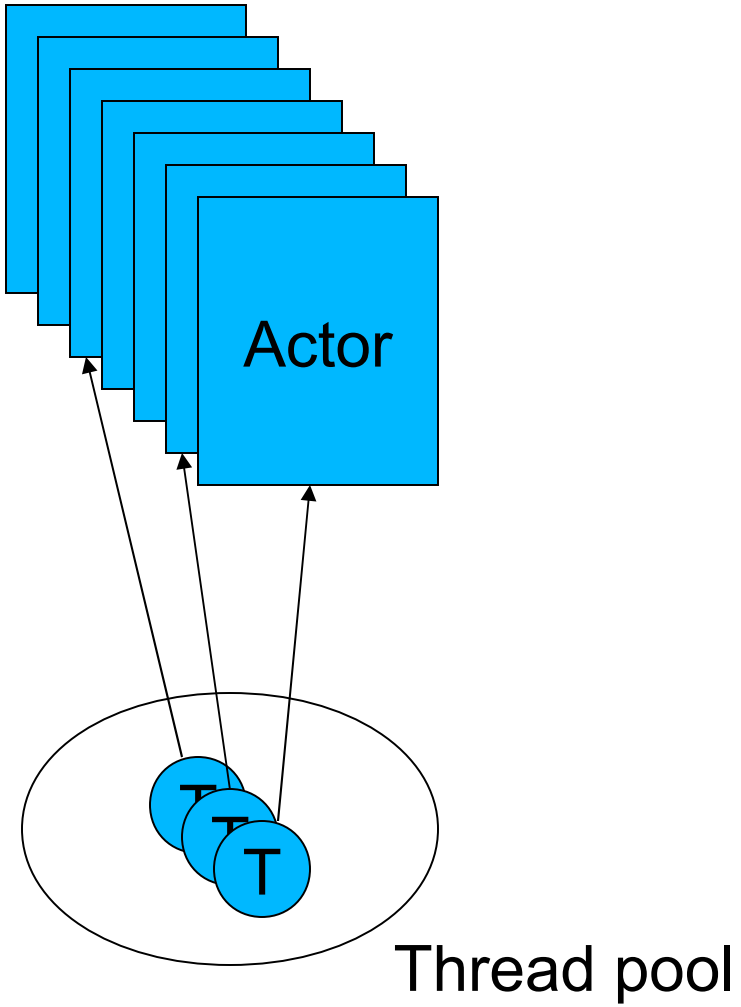
Sequential processes synchronously talking through channels

Dataflow Operators

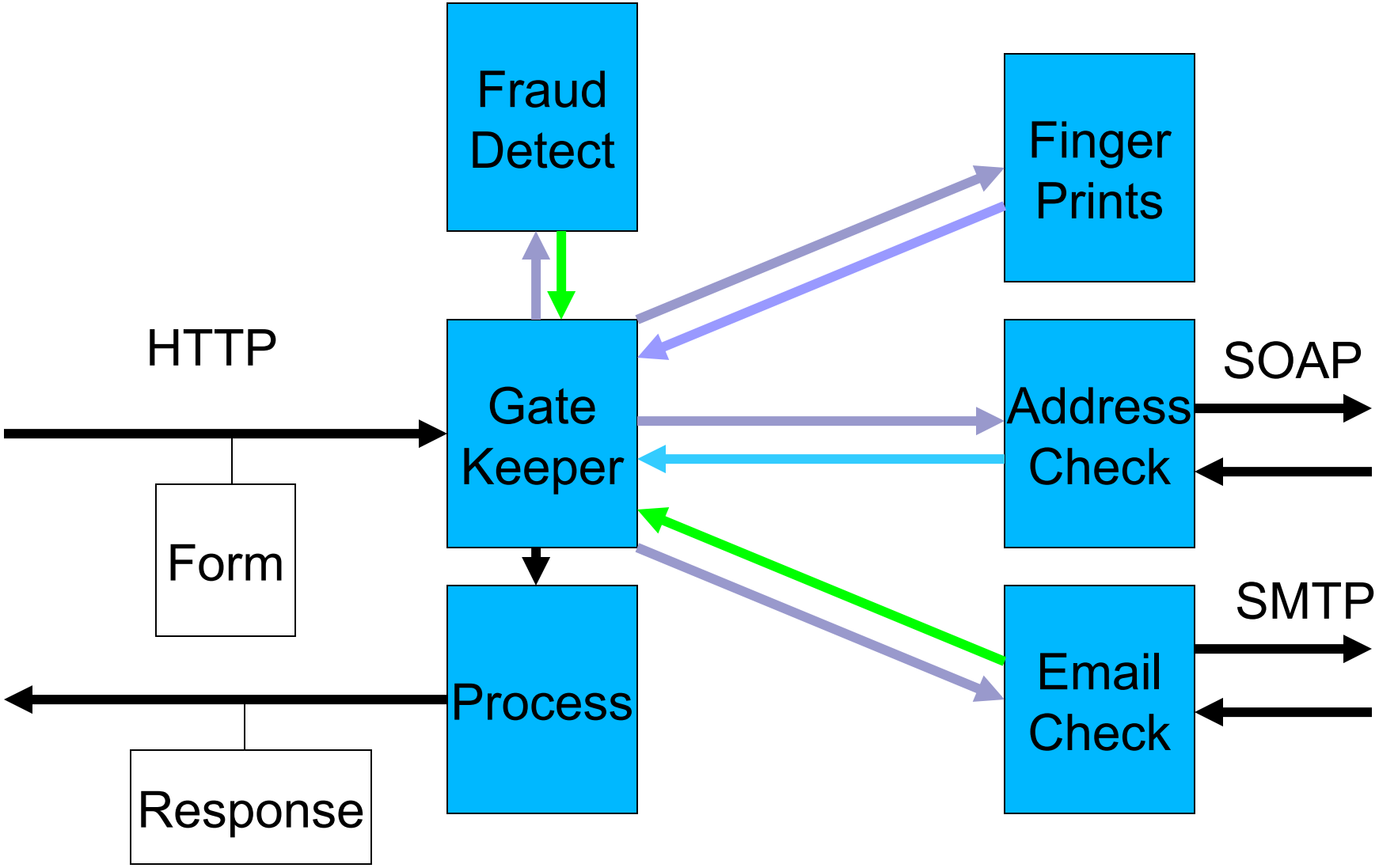
Event-triggered computations connected by channels into a graph

Actors

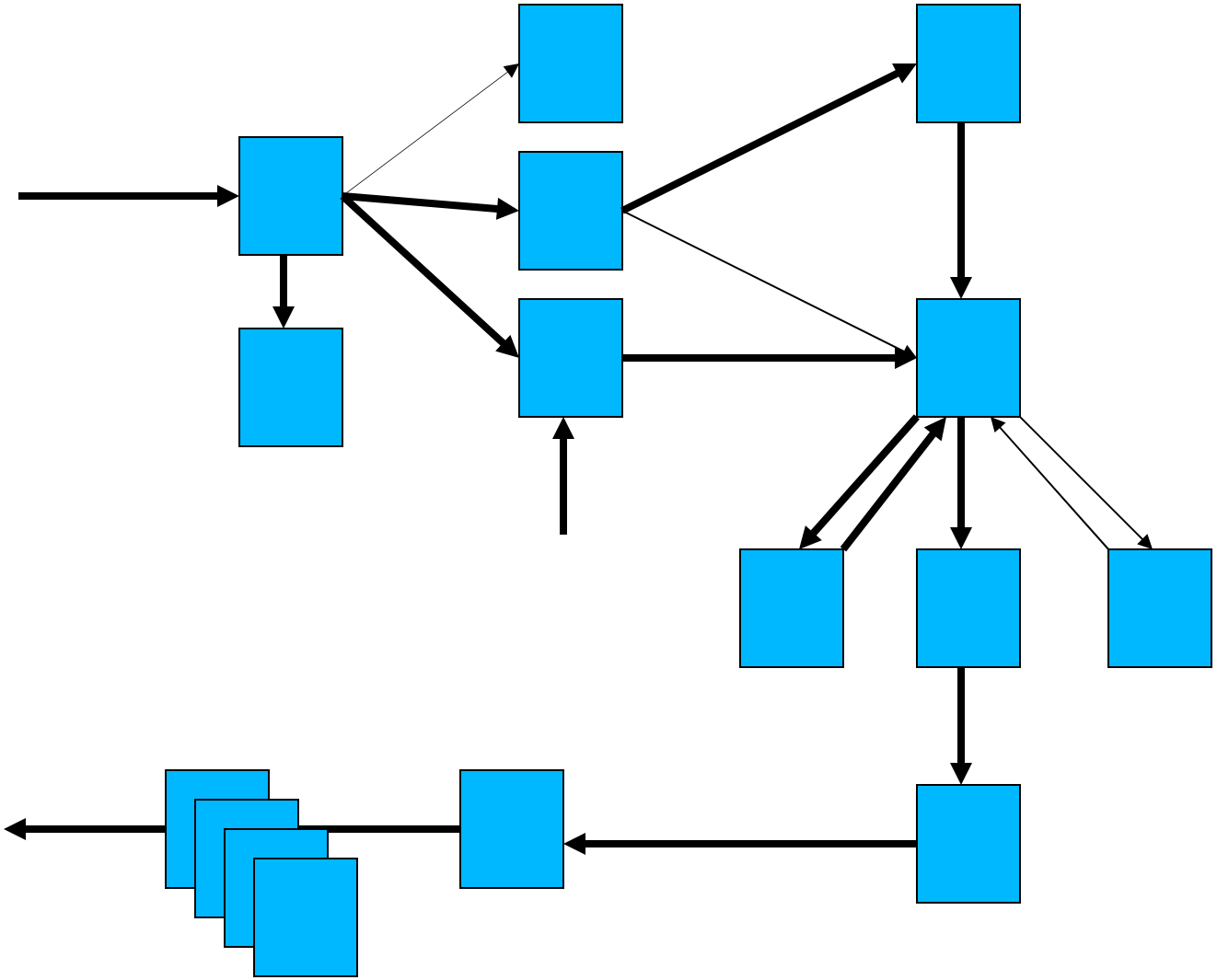
- Isolated
- Communicating
  - Immutable messages
- Active
  - Pooled shared threads
- Activities
  - Create a new actor
  - Send a message
  - Receive a message



Actors use


Fraud Detect
Finger Prints
HTTP
Gate Keeper
SOAP
Address Check
Form
Process
SMTP
Email Check
Response

Actors patterns



Enricher

Router

Translator

Endpoint

Splitter

Aggregator

Filter

Resequencer

Checker

Sending messages

```
buddy.send 10.eur

buddy << new Book(title:'Groovy Recipes',
                  author:'Scott Davis')

def canChat = buddy.sendAndWait 'Got time?'

buddy.sendAndContinue 'Need money!', {cash->
    pocket.add cash
}
```

Stateless Actors (pure Java)

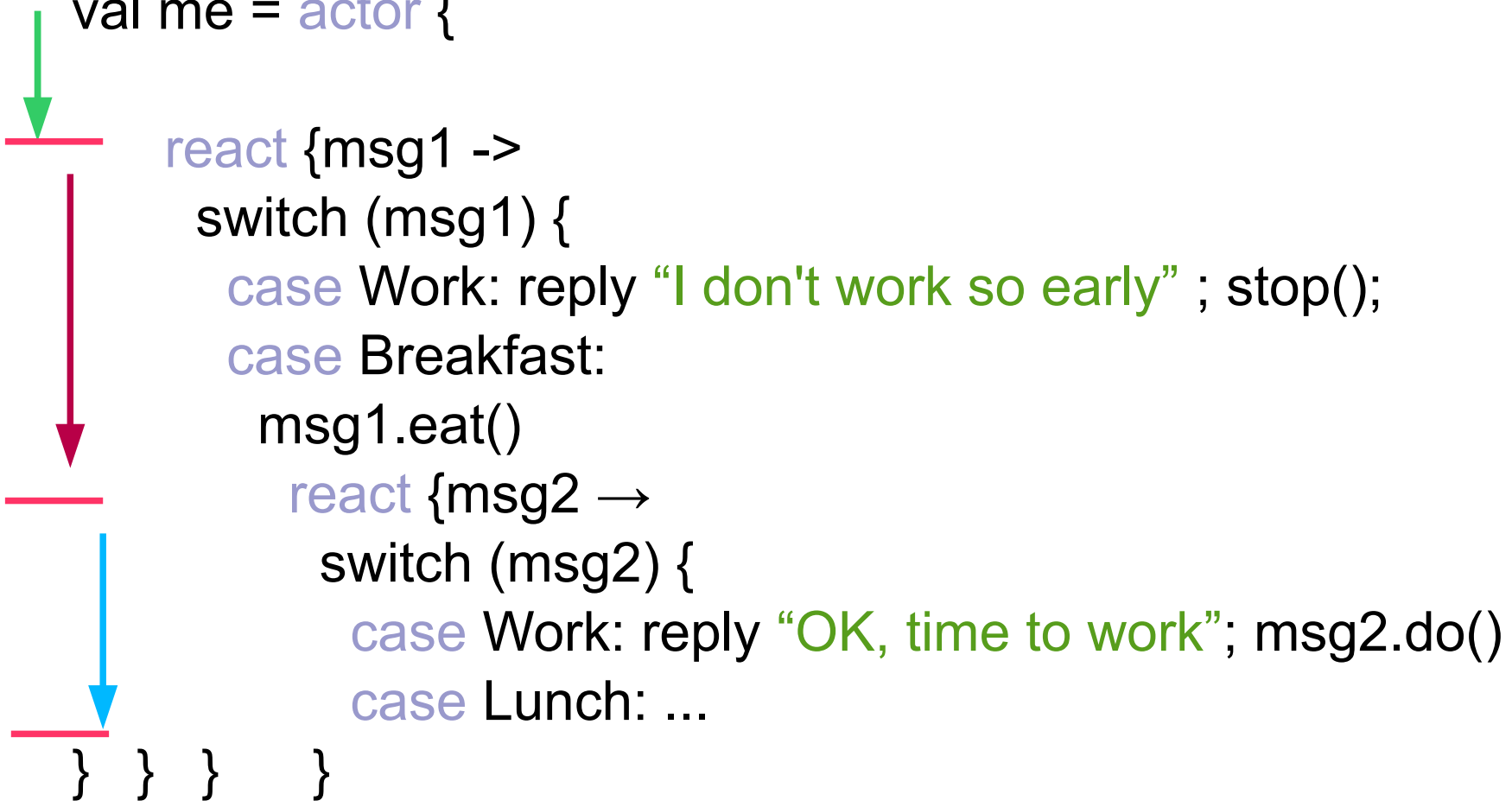
```
class MyActor extends DynamicDispatchActor {
    private Account account = ...
    public void onMessage(String msg) {
        String encripted = encrypt(msg);
        reply(encripted);
    }
    public void onMessage(Integer number) {
        reply(2 * number);
    }

    public void onMessage(Money cash) {
        System.out.println("Received a donation " + cash);
        account.deposit(cash);
    }
}
```

Stateful Actors

```
class MyActor extends DefaultActor {
    void act() {
        def buddy = new YourActor()
        buddy << ‘Hi man, how\’re things?’
        def response = receive()
    }
}
```

Implicit State in Actors



Continuation Style

```
loop {
    …
    react {
        …
        react {/* schedule the block and exit */
            …
        }
        //Never reached
    }
    //Never reached
}
//Never reached
```

Java actor frameworks

Jetlang
Kilim
ActorFoundry
Actorom
Akka
GPars (Yes!)
…

Shared Mutable State

Misused most of the time

When really needed, use

- Agents
- Software Transactional Memory
- Locks

No more threads and locks

```
images.eachParallel {
    //concurrency agnostic code here
}

def myActor = actor {
    //concurrency agnostic code here
}

atomic { /*concurrency agnostic code here*/ }
…
```

Summary

Parallelism is not hard, multi-threading is

Jon Kerridge, Napier University

Questions?

Find more at:

http://gpars.codehaus.org

http://www.jroller.com/vaclav

http://twitter.com/vaclav_pech