Gridify your Spring application with Grid Gain

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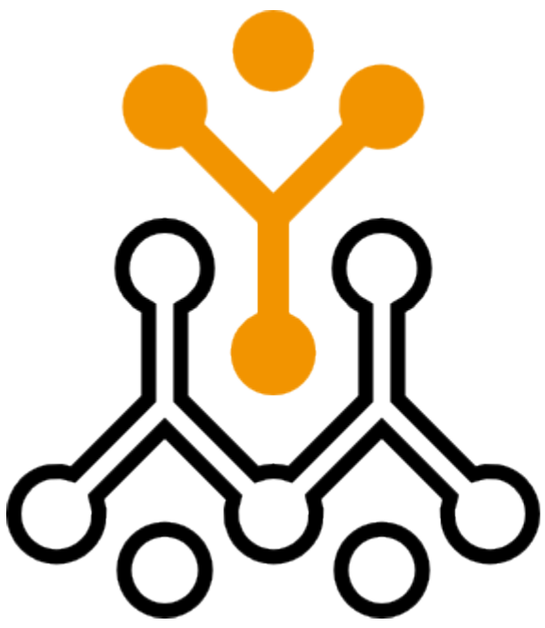

sourcesense

About me

- Software architect and engineer
  - Pro-Netics (http://www.pronetics.it)
  - Sourcesense (http://www.sourcesense.com)
- Blogger
  - http://sbtourist.blogspot.com
- Open Source Enthusiast
  - Lead at Scarlet - Clustering for Jira (http://scarlet.sf.net)
  - Committer at Spring Modules (http://springmodules.dev.java.net)
  - Committer at Taconite Ajax Framework (http://taconite.sourceforge.net/)

Agenda

- Common ground.
  - Why Grid?
  - Performance and Scalability.
  - Map / Reduce.
- Grid Gain and The Spring Framework.
  - Grid Gain concepts.
  - Grid Gain on Spring.
  - A practical example.

Why grid?
Social changes

- **Cheaper hardware**.
  - Computer as an off-the-shelf product.
- **Web explosion**.
  - Everything is on the web.
  - Everyone is on the web.
    - More and more users.
    - More and more transactions.

Why grid?
Technological changes

- **Cheaper hardware**.
  - We have more power.
    - We want more speed.

- **Moore's Law**: *the number of transistors that can be inexpensively placed on an integrated circuit is increasing exponentially*.
  - But we had to go from single-core processors to multi-core ones ...
  - So your for-loop will always run at the same speed.
    - **Forever**.

Why grid?

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Performance

It's all about doing one thing.
Faster.

Scalability

It's all about doing the same one thing.
In a bigger way.

Performance *vs* Scalability

- Performance is about *how fast*.
- Scalability is about *how much*.
- Nowadays, if you want to save your job and hears (remember that Boss screaming at your face) ...
  - **You have to scale.**

Scalability in two words

- **Vertical** scalability is about adding more and more power (CPU, RAM ...) to your single computer.
  - Also known as *scaling-in*.
  - Finite and costly.
- **Horizontal** scalability is about adding more and more computers.
  - Also known as *scaling-out*.
  - Infinite and cheaper, because using commodity hardware.
- Guess what, we want to **scale-out** ...

The scalability factor

- *Available resources while scaling out*.
  - Linear scalability.
  - Supra-linear scalability.
  - Sub-linear scalability.
  - Negative scalability.
- A scalable application should always strive for (almost) linear scalability.

The scalability problem

- **Amdahl's Law**: *performance decreases as number of processors increases once there is even a small percentage of non-parallelizable code*.
  - Most of the software is written in a non-parallelizable way.
  - Writing software that scales out is perceived as hard.

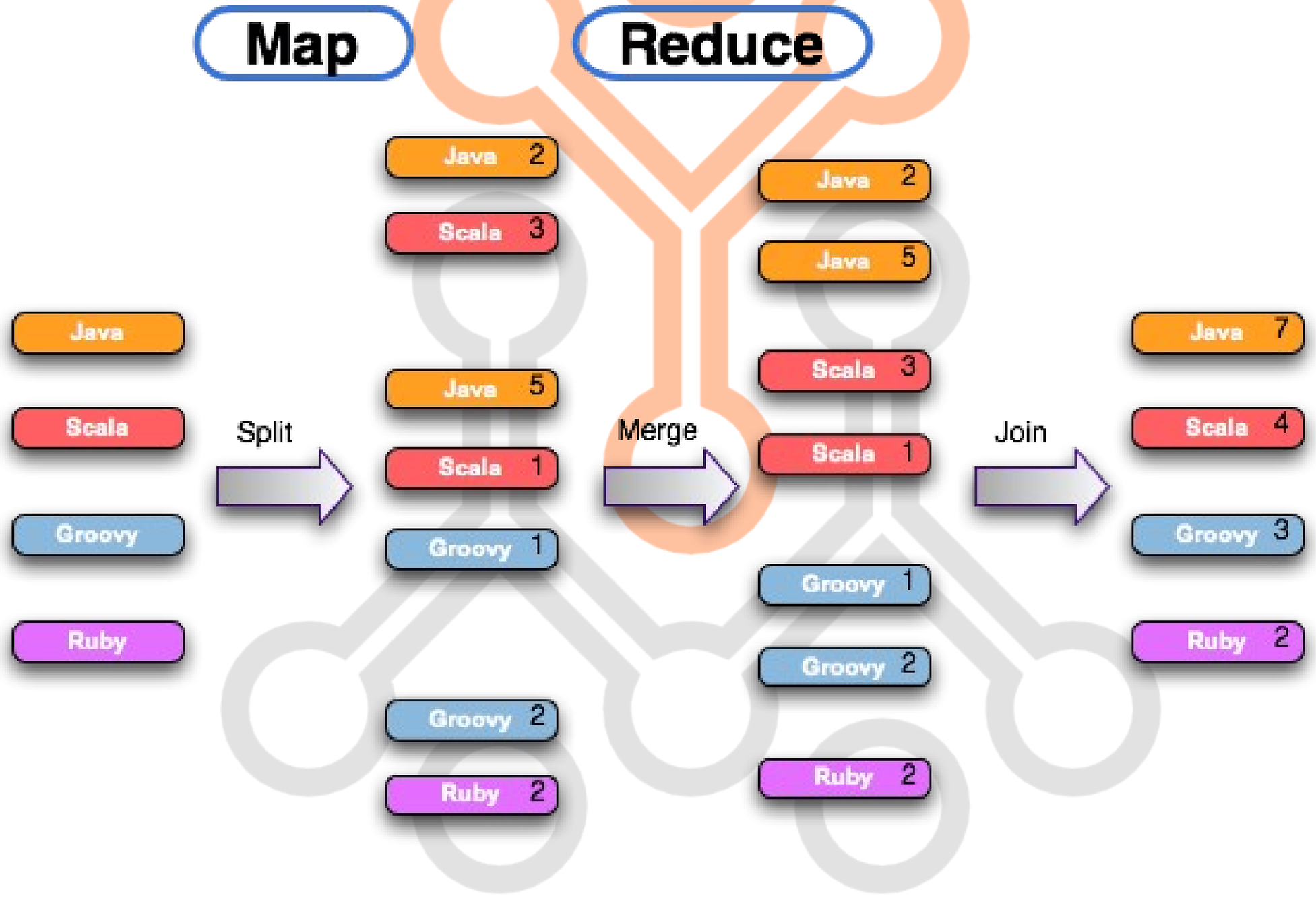
Entering Map / Reduce

- From Google Labs.
  - Is it enough?

Map / Reduce explained

- Programming model for linearly scaling out.
- De-facto standard for parallelizing intensive processing tasks.
- Based on:
  - Splitting tasks into several parallelizable jobs grouped by key.
  - Mapping jobs to processing units, optionally taking into account the job key.
  - Merging jobs results, joining them into a global task result.

Map / Reduce illustrated
Counting words



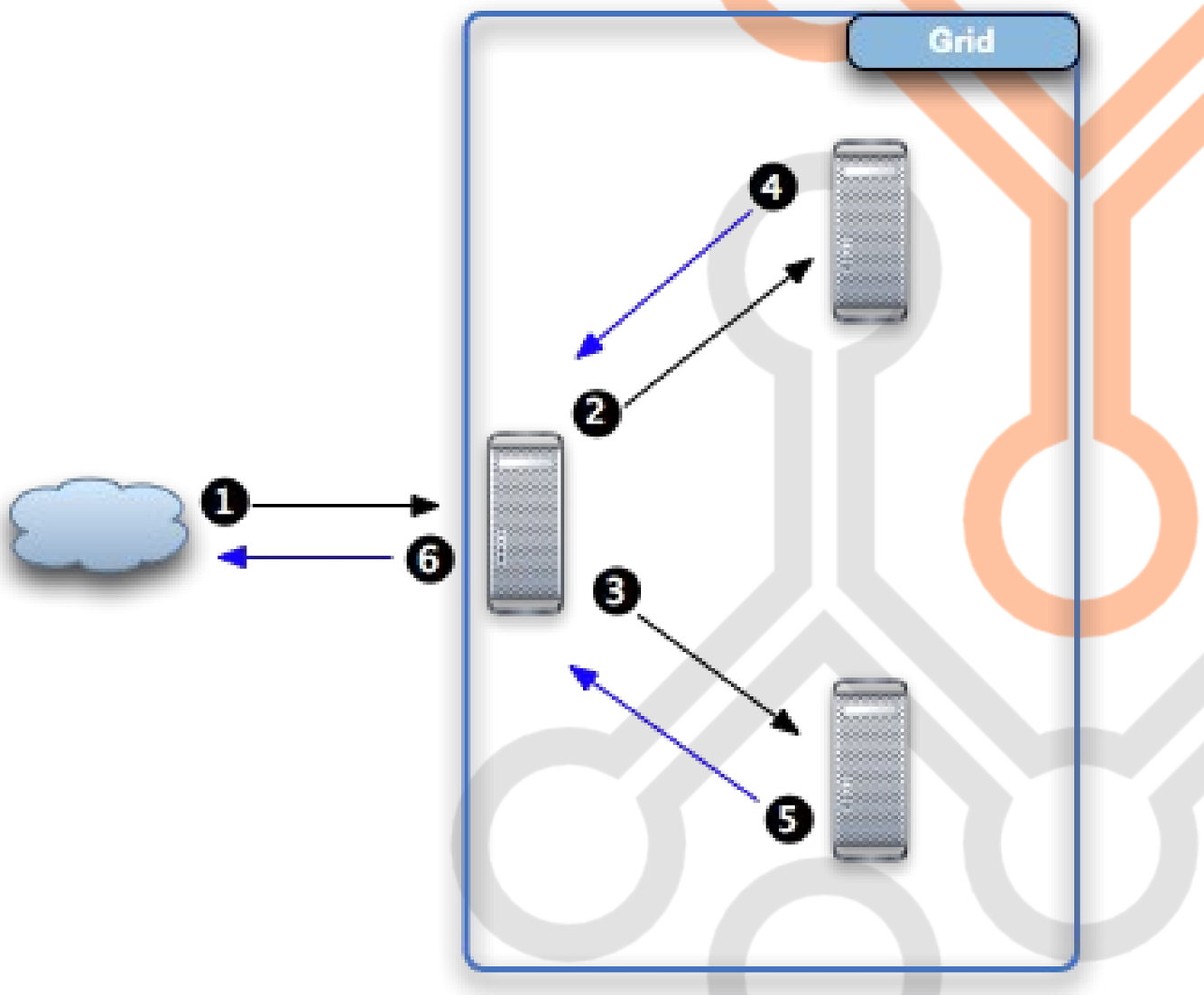
Grid computing with Map / Reduce

- Grid computing.
  - Basically, a way to exploit multi-core / multi-processors / multi-computer environments for achieving horizontal scalability.
- Map / Reduce.
  - Common paradigm in grid computing for implementing scalable applications.

Entering Grid Gain

- Open Source Grid Computing Framework.
  - Web : http://www.gridgain.com
  - Created and supported by Grid Gain Systems.
    - Community support.
    - Professional support.
- Powerful, yet simple, yet fun, Map / Reduce implementation.
- Integrated with major servlet containers and application servers.
- Integrated with major data grid solutions.
- Integrated with the Spring Framework.

Map / Reduce in Grid Gain



- 1 -
Task arrives to the first grid node, where is split into three jobs.
First job is self-assigned and processed.
- 2 -
Second job is sent to the second grid node, where is processed.
- 3 -
Third job is sent to a the third grid node, where is processed.
- 4 -
Result from the second job is collected by the task on the first node.
- 5 -
Result from the third job is collected by the task on the first node.
- 6 -
Collected job results, together with the result from the first job, are reduced by the task and returned as a global result.

Grid Gain Quick Start

- `GridTask`.
  - → Implements the Map / Reduce logic.
- `GridJob`.
  - → Implements the processing logic.
- `GridFactory`.
  - → Provides access to the grid for executing tasks.
- Automatic deployment.
  - → Tasks are automatically deployed to the grid.
- Peer class loading.
  - → Needed classes are automatically loaded from peers.

Grid Gain Advanced

- SPI (Service Provider Interface) based configuration.
  - Discovery SPI.
  - Topology SPI.
  - Checkpoint SPI.
  - Load Balancing SPI.
  - Collision SPI.
  - Failover SPI.
  - Metrics SPI.
  - ...

Entering Spring Framework

The leading full-stack Java/JEE application framework.

Grid Gain on Spring

- POJO configuration.
- AOP grid execution.
- Resource Look-up.

Spring-based configuration

- POJO-based.
- Spring-based.
- `GridConfiguration`
  - Configure grid parameters.
  - Configure actual SPI implementations.
  - Declared as a Spring bean.
- `GridFactory`
  - `GridFactory.start(GridConfiguration cfg)`
  - `GridFactory.start(String springCfg)`

AOP-based grid execution

- Parallelization on grid as a cross-cutting concern.
- Transparent task deployment and execution.
- `Gridify`
  - Annotation to identify methods that must be executed on grid.
- `GridifySpringEnhancer`
  - Proxy-based enhancer for executing annotated object methods on grid **as an aspect**.

Container-based resource look-up.

- Spring application context as a source for resources needed by tasks and jobs.
- `GridSpringApplicationContextResource`
  - → Annotation for injecting the Spring application context into tasks and jobs.
- `GridFactory.start(GridConfiguration cfg, ApplicationContext springCtx)`
  - → Starts grid with a specific context to use for looking-up resources.

An Example
The Business Problem

```
public class WordCounter {

    @Gridify(taskClass = WordCounterGridTask.class, gridName = GridStarter.GRID_NAME)
    public Map<String, Integer> count(Set<String> fileNames, Set<String> words) {
        Map<String, Integer> result = new HashMap<String, Integer>();
        for (String fileName : fileNames) {
            String fileContent = this.readFile(fileName);
            StringTokenizer fileTokenizer = new StringTokenizer(fileContent, " ,.;:\n\r\t");
            while (fileTokenizer.hasMoreTokens()) {
                String token = fileTokenizer.nextToken();
                if (words.contains(token)) {
                    Integer wordOccurrency = result.get(token);
                    if (wordOccurrency == null) {
                        result.put(token, 1);
                    } else {
                        result.put(token, ++wordOccurrency);
                    }
                }
            }
        }
        return result;
    }

    // ...
}
```

An Example
The Grid Task

```
public class WordCounterGridTask implements GridTask<GridifyArgument, Map<String, Integer>> {

    @GridLoadBalancerResource private GridLoadBalancer balancer;
    @GridLoggerResource private GridLogger logger;

    public Map<? extends GridJob, GridNode> map(List<GridNode> nodes, GridifyArgument args) throws GridException {
        Map<GridJob, GridNode> mapping = new HashMap<GridJob, GridNode>(nodes.size());
        Set<String> fileNames = (Set<String>) args.getMethodParameters()[0];
        Set<String> words = (Set<String>) args.getMethodParameters()[1];
        for (String fileName : fileNames) {
            WordCounterGridJob job = new WordCounterGridJob(fileName, words);
            mapping.put(job, this.balancer.getBalancedNode(job));
        }
        return mapping;
    }

    public GridJobResultPolicy result(GridJobResult currentResult, List<GridJobResult> processedResults) throws GridException {
        if (currentResult.getException() == null) {
            return GridJobResultPolicy.WAIT;
        } else {
            this.logger.error(currentResult.getException().getMessage(), currentResult.getException());
            throw new IllegalStateException(currentResult.getException());
        }
    }

    public Map<String, Integer> reduce(List<GridJobResult> jobResults) throws GridException {
        Map<String, Integer> globalResult = new HashMap<String, Integer>();
        for (GridJobResult jobResult : jobResults) {
            Map<String, Integer> perJobOccurrencies = jobResult.getData();
            for (String word : perJobOccurrencies.keySet()) {
                Integer globalOccurrency = globalResult.get(word);
                if (globalOccurrency == null) {
                    globalResult.put(word, perJobOccurrencies.get(word));
                } else {
                    globalResult.put(word, globalOccurrency + perJobOccurrencies.get(word));
                }
            }
        }
        return globalResult;
    }
}
```

An Example
The Grid Job

```
public class WordCounterGridJob extends GridJobAdapter {

    @GridSpringApplicationContextResource private ApplicationContext springContext;
    @GridLoggerResource private GridLogger logger;
    private WordCounter counter;
    private String fileName;
    private Set<String> words;

    public WordCounterGridJob(String fileName, Set<String> words) {
        this.fileName = fileName;
        this.words = words;
    }

    public Serializable execute() throws GridException {
        this.counter = (WordCounter) this.springContext.getBean("counter");
        Map<String, Integer> result = this.counter.count(new HashSet<String>(Arrays.asList(this.fileName)), this.words);
        this.logger.info("Occurrencies found for " + this.fileName + " : " + result);
        return (Serializable) result;
    }
}
```

An Example Grid Configuration

```
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:util="http://www.springframework.org/schema/util"
       xsi:schemaLocation="
       http://www.springframework.org/schema/beans http://www.springframework.org/schema/beans/spring-beans-2.0.xsd
       http://www.springframework.org/schema/util http://www.springframework.org/schema/util/spring-util-2.0.xsd">

    <bean id="gridCfg" class="org.gridgain.grid.GridConfigurationAdapter">
        <property name="gridName">
            <util:constant static-field="com.sourcesense.gridgain.wordcounter.grid.starter.GridStarter.GRID_NAME"/>
        </property>
        <property name="gridGainHome" value="/opt/gridgain-2.0.2"/>
        <property name="checkpointSpi">
            <bean class="org.gridgain.grid.spi.checkpoint.sharedfs.GridSharedFsCheckpointSpi">
                <property name="directoryPath" value="/tmp/gridgain"/>
            </bean>
        </property>
    </bean>

    <bean id="gridifiedCounter" class="org.gridgain.grid.gridify.aop.spring.GridifySpringEnhancer" factory-method="enhance">
        <constructor-arg ref="counter"/>
    </bean>

    <bean id="counter" class="com.sourcesense.gridgain.wordcounter.WordCounter"/>

</beans>
```

An Example Grid Starter

```
public class GridStarter {

    public final static String GRID_NAME = "WordCounterGrid";

    public static void main(String[] args) throws GridException, InterruptedException {
        ApplicationContext gridContext = new ClassPathXmlApplicationContext("classpath:grid-context.xml");
        try {
            GridFactory.start((GridConfiguration) gridContext.getBean("gridCfg"), gridContext);
            Thread.sleep(180000);
        } finally {
            GridFactory.stop(GRID_NAME, false);
        }
    }
}
```

An Example Grid Tester (...)

```
public class WordCounterGridTest extends AbstractDependencyInjectionSpringContextTests {

    private final static String FILE_1 = "/tmp/test1";
    private final static String FILE_2 = "/tmp/test2";
    private WordCounter gridifiedCounter;
    private GridConfiguration gridCfg;

    public WordCounterGridTest(String testName) {
        super(testName);
        this.setAutowireMode(AUTOWIRE_BY_NAME);
    }

    public void setGridifiedCounter(WordCounter gridifiedCounter) {
        this.gridifiedCounter = gridifiedCounter;
    }

    public void setGridCfg(GridConfiguration gridCfg) {
        this.gridCfg = gridCfg;
    }
```

An Example
Grid Tester (... continued)

```
public void testGridifiedWordCounter() {
    try {
        Map<String, Integer> result = this.gridifiedCounter.count(
                new HashSet<String>(Arrays.asList(FILE_1, FILE_2)),
                new HashSet<String>(Arrays.asList("java", "scala", "groovy")));
        assertEquals(3, result.size());
        assertEquals(new Integer(3), result.get("java"));
        assertEquals(new Integer(3), result.get("scala"));
        assertEquals(new Integer(1), result.get("groovy"));
    } catch (Throwable ex) {
        ex.printStackTrace();
        fail(ex.getMessage());
    }
}

protected void onSetUp() throws Exception {
    if (GridFactory.getState(GridStarter.GRID_NAME).equals(GridFactoryState.STOPPED)) {
        GridFactory.start(this.gridCfg, this.applicationContext);
    }
}

protected String[] getConfigLocations() {
    return new String[]{"classpath:grid-context.xml"};
}
}
```

Q&A

Thank you

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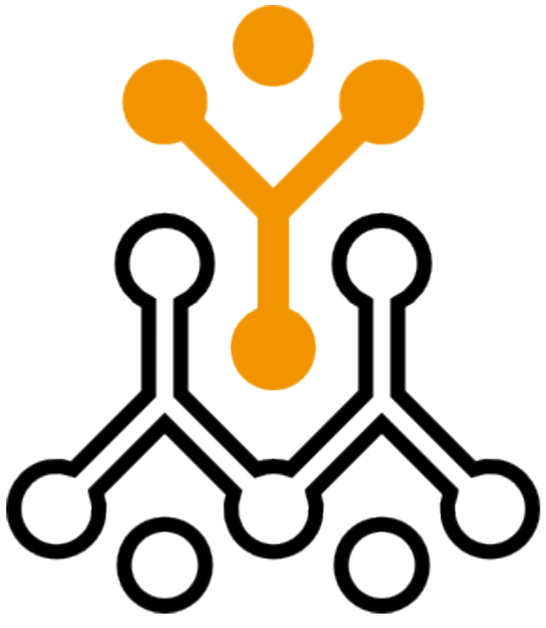

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