A framework for development of concurrency and I/O in servers
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Development of concurrency and I/O in servers and middlewares becomes more and more complex:

- minimization of latency;
- maximization of bandwidth;
- no consensus on the best concurrency model;
- select the model best adapted to the hardware.

Applications are modeled by a directed graph, in which each stage (or vertex) corresponds to an atomic unit of treatment and edges correspond to channels (method calls, local queues or sockets) between them.

We describe here the implementation of a simple “Echo” server which uses three stages. The directed graph models the interconnection of its stages:

Reading the context is the way to reach successor(s) in the graph.

Example:
```java
public class AcceptStage {
    public void handleStageContext(ctx, InputAcceptEvent in) {
        SaburoSocket client = server.accept();
        out.setAcceptSaburoSocket(client);
        ctx.dispatchNextSuccessor(out);
    }
}
```

The implementation is based on the Java NIO API which provides blocking and non-blocking I/O. To avoid the complexity of this API, we provide encapsulation classes which simplify implementation.

Example: Iterative architecture
```java
public class IterativeModel {
    public void service() throws Exception {
        new Thread(new Runnable() {
            public void run() {
                while (true) {
                    client.write(in.getReadByteBuffer());
                }
            }
        }).start();
    }
}
```

The bytecode is generated automatically using ASM and all the code generators can be used at runtime, even if they are usually used at compile time.

Example: Staged Event-Driven Architecture
```java
public class SedaModel {
    public void service() throws Exception {
        new Thread(new Runnable() {
            public void run() {
                while (true) {
                    writeSelector.doSelect();
                }
            }
        }).start();
    }
}
```

The model is automatically generated according to the concurrency model.”

The last step consists of the automatic generation of the concurrency model. The developer should implement the `handle(...)` method which corresponds to the instructions carried out by a stage. Its parameters are the input and/or output events and the context.

The context is the way to reach successor(s) in the graph.

Example:
```java
public class AcceptStage {
    public void handleStageContext(ctx, InputAcceptEvent in) {
        SaburoSocket client = server.accept();
        out.setAcceptSaburoSocket(client);
        ctx.dispatchNextSuccessor(out);
    }
}
```

The developer has to define the interface for input and/or output events for each stage. These events allow the communication between stages.

Example: For the initial stage, only an output interface is defined:
```java
public interface OutputAcceptEvent {
    public void setAcceptSaburoSocket(SaburoSocket s);
}
```

For a final stage only an input interface is defined:
```java
public interface InputWriteEvent {
    public void writeToFile(SaburoSocket client);
    public byte[] getReadByteBuffer();
}
```

For any other stage input and output interfaces should be defined:
```java
public interface InputReadEvent {
    public SaburoSocket getAcceptSaburoSocket();
    public void setReadByteBuffer(ByteBuffer b);
}
```

The context is the way to reach successor(s) in the graph.

Example: Iterative architecture
```java
public class IterativeModel {
    public void service() throws Exception {
        new Thread(new Runnable() {
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            }
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}
```

The bytecode is generated automatically using ASM and all the code generators can be used at run-time, even if they are usually used at compile time.