A gentle introduction to

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$$\frac{j \in I \quad t_c = \mathsf{eval}(e,t) \quad M(t_c) = (o_j, t') :: \tilde{m}}{\sum_{i \in I} [o_i(x_i)\ \texttt{from}\ e]\{B_i\} \cdot t \cdot M \rightarrow B_j \cdot t \triangleleft (x_j, t') \cdot M[t_c \mapsto \tilde{m}]} \lfloor^{\mathsf{DCC}}|_{\mathsf{Choice}}\rceil$$

$$\frac{t' = \mathsf{eval}(x,t)}{x = e; B \cdot t \cdot M \rightarrow B \cdot t \triangleleft (x, t') \cdot M} \lfloor^{\mathsf{DCC}}|_{\mathsf{Assign}}\rceil$$

$$\frac{P \rightarrow P'}{P \mid P_1 \rightarrow P' \mid P_1} \lfloor^{\mathsf{DCC}}|_{\mathsf{PPar}}\rceil$$

$$\frac{P = \mathsf{cq}(x); B \cdot t \cdot M \quad t_c \notin \bigcup_i \mathsf{dom}(M_i) \cup \mathsf{dom}(M) \quad t' = t \triangleleft (x, t_c)}{\left\langle B_s,\ P \mid \prod_i B_i \cdot t_i \cdot M_i \right\rangle_l \rightarrow \left\langle B_s,\ B \cdot t' \cdot M[t_c \mapsto \varepsilon] \mid \prod_i B_i \cdot t_i \cdot M_i \right\rangle_l} \lfloor^{\mathsf{DCC}}|_{\mathsf{Cq}}\rceil$$

$$\frac{P \equiv P_1 \quad P_1 \rightarrow P_1' \quad P_1' \equiv P'}{\langle B_s, P\rangle_l \rightarrow \left\langle B_s, P'\right\rangle_l} \lfloor^{\mathsf{DCC}}|_{\mathsf{PEq}}\rceil$$

$$\frac{\begin{array}{c} P = o@e_1(e_2)\ \texttt{to}\ e_3; B \cdot t \cdot M \qquad \mathsf{eval}(e_1,t) = l \qquad \mathsf{eval}(e_3,t) = t_c \\ \mathsf{eval}(e_2,t) = t_m \qquad M'' = M'[t_c \mapsto M'(t_c) :: (o, t_m)] \end{array}}{\left\langle B_s,\ P \mid B' \cdot t' \cdot M' \mid P_1 \right\rangle_l \rightarrow \left\langle B_s,\ B \cdot t \cdot M \mid B' \cdot t' \cdot M'' \mid P_1 \right\rangle_l} \lfloor^{\mathsf{DCC}}|_{\mathsf{InSend}}\rceil$$

$$\frac{\begin{array}{c} P = o@e_1(e_2)\ \texttt{to}\ e_3; B \cdot t \cdot M \quad \mathsf{eval}(e_1,t) = l' \quad \mathsf{eval}(e_3,t) = t_c \\ \mathsf{eval}(e_2,t) = t_m \quad M'' = M'[t_c \mapsto M'(t_c) :: (o, t_m)] \end{array}}{\langle B_s, P \mid P_1\rangle_l \mid \left\langle B_s', B' \cdot t' \cdot M' \mid P_2 \right\rangle_{l'} \rightarrow \langle B_s, B \cdot t \cdot M \mid P_1\rangle_l \mid \left\langle B_s', B' \cdot t' \cdot M'' \mid P_2 \right\rangle_{l'}} \lfloor^{\mathsf{DCC}}|_{\mathsf{Send}}\rceil$$

$$\frac{P_1 = ?@e_1(e_2); B_1 \cdot t_1 \cdot M_1 \quad \mathsf{eval}(e_1,t_1) = l \quad Q = B \cdot t_\perp \triangleleft (x, \mathsf{eval}(e_2,t_1)) \cdot \emptyset}{\langle !(x); B,\ P\rangle_l \mid \left\langle B_s',\ P_1 \mid P_2 \right\rangle_{l'} \rightarrow \langle !(x); B,\ Q \mid P\rangle_l \mid \left\langle B_s',\ B_1 \cdot t_1 \cdot M_1 \mid P_2 \right\rangle_{l'}} \lfloor^{\mathsf{DCC}}|_{\mathsf{Start}}\rceil$$

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$$\frac{P = \mathsf{cq}(x); B \cdot t \cdot M \ \ldots}{\langle B_s,\ P \mid \prod \ldots} \ \lfloor^{\mathsf{DCC}}|_{\mathsf{Cq}}\rceil$$

$$\frac{P = \ldots \quad \ldots (o, t_m)]}{\langle B_s,\ P \ldots\ t \cdot M'' \mid P_1 \rangle_l} \ \lfloor^{\mathsf{DCC}}|_{\mathsf{InSend}}\rceil$$

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FORMAL CALCULUS
(like POCs and the pi-calculus)

What is Jolie?

A **Service-Oriented** Programming Language

Service-Oriented	**Object-Oriented**
Service Instances	**Objects**
Operations	**Methods**

Why SOC and Jolie?

Jolie is perfect for fast prototyping. In little time a small team of developers can build up a full-fledged distributed system.

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But I already know Java!
Why shall I use Jolie?

Why SOC and Jolie?

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```
SocketChannel socketChannel = SocketChannel.open();
  socketChannel.connect(
new InetSocketAddress("http://someurl.com", 80));
  Buffer buffer = . . .; // byte buffer
  while( buffer.hasRemaining() ) {
     channel.write( buffer );
}
```

Happy?

Why SOC and Jolie?

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Happy?

Ok, but you did not even close the channel or handled exceptions

Why SOC and Jolie?

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```
SocketChannel socketChannel = SocketChannel.open();
try {
  socketChannel.connect(new InetSocketAddress("http://someurl.com",
80));
  Buffer buffer = . . .; // byte buffer
  while( buffer.hasRemaining() ) {
    channel.write( buffer );
} }
catch( UnresolvedAddressException e ) { . . . }
catch( SecurityException e ) { . . . }
/* . . . many catches later . . . */
catch( IOException e ) { . . . }
finally { channel.close(); }
```

Happier now?

Why SOC and Jolie?

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```

Happier now?

Yes, but what about the **server**?

Why SOC and Jolie?

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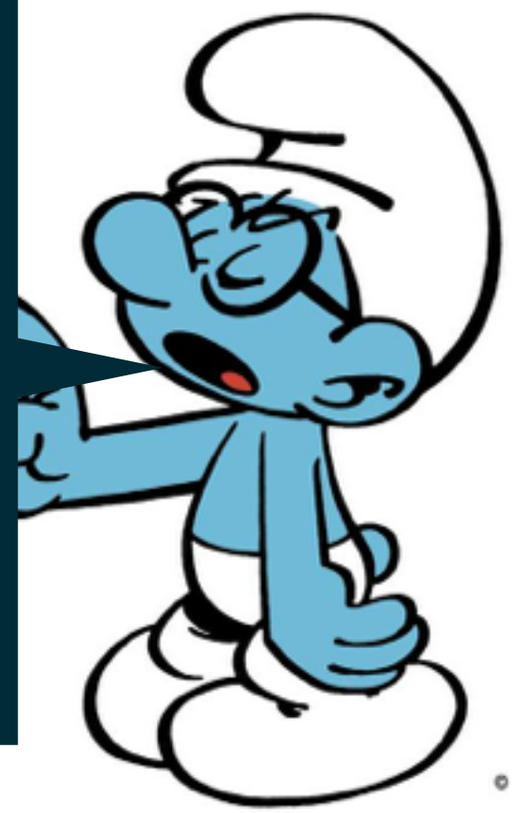
```
Selector selector = Selector.open();
channel.configureBlocking(false);
SelectionKey key = channel.register(selector, SelectionKey.OP_READ);
while(true) {
  int readyChannels = selector.select();
  if(readyChannels == 0) continue;
  Set<SelectionKey> selectedKeys = selector.selectedKeys();
  Iterator<SelectionKey> keyIterator = selectedKeys.iterator();
  while(keyIterator.hasNext()) {
    SelectionKey key = keyIterator.next();
    if(key.isAcceptable()) {
        // a connection was accepted by a ServerSocketChannel.
    } else if (key.isConnectable()) {
        // a connection was established with a remote server.
    } else if (key.isReadable()) {
        // a channel is ready for reading
    } else if (key.isWritable()) {
        // a channel is ready for writing
    }
    keyIterator.remove();
  }
}
```

Here you are



Why SOC and Jolie?

Well, ok, but again, you are not **handling exceptions**.
And what about if **different operations** use the **same channel**?
And if we wanted to use **RMIs** instead of **Sockets**?
In what **format** are you transmitting data? And if we need to **change** the **format** after we wrote the application? Do you **check** the **type of data** you receive/send?

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Why SOC and Jolie?

Programming distributed systems is usually harder than programming non distributed ones.

Concerns of **concurrent** programming.

Plus (not exhaustive):

- handling **communications**;
- handling **heterogeneity**;
- handling **faults**;
- handling the **evolution** of systems.

Hello World! in Jolie

Let us get our hands dirty.

"Hello World!" is enough to let you see some of the main features of Jolie and Service-Oriented Programming.

```
include "console.iol"

main
{
  println@Console( "Hello, world!" )()
}
```

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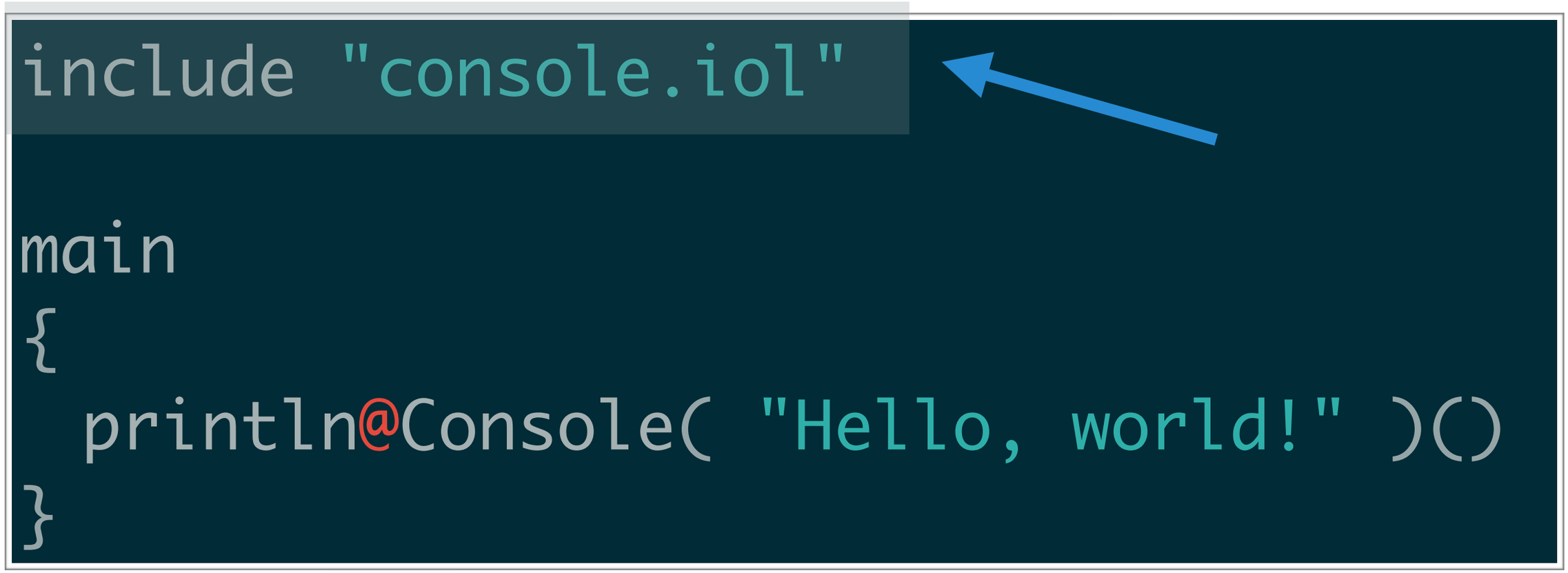

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hello_world.ol

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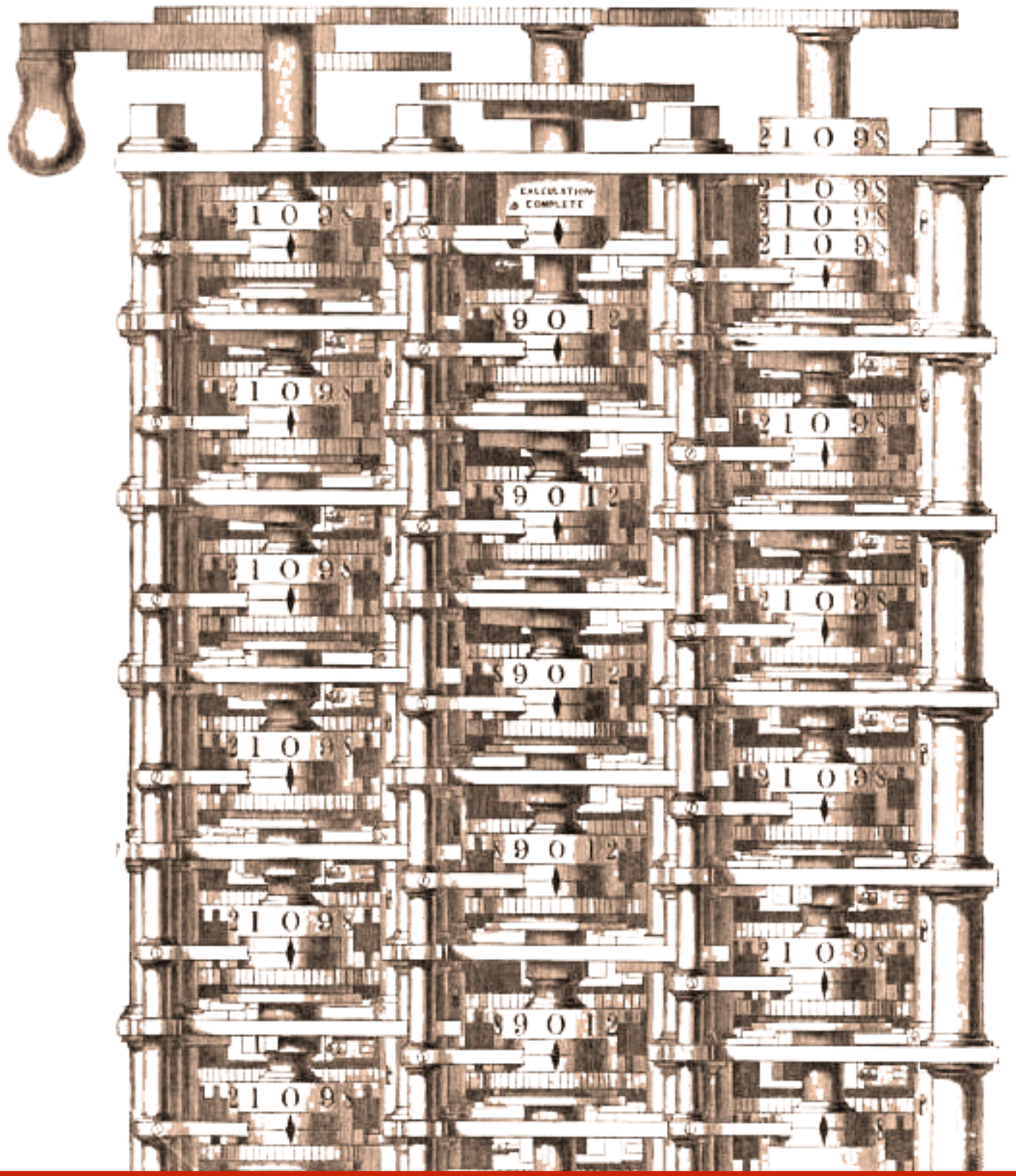
hello_world.ol

```
$ jolie hello_world.ol
```

Let us see some **Jolie in Action**

Everything starts with a **calculator**...



Behaviours and Deployments

```
interface MyInterface {
  OneWay: sendNumber( int )
}
```

```
include "MyInterface.iol"
outputPort  B  {
Location:
   "socket://localhost:8000"
Protocol: sodep
Interfaces: MyInterface
}

main
{
   sendNumber @ B ( 5 )
}
```

Client

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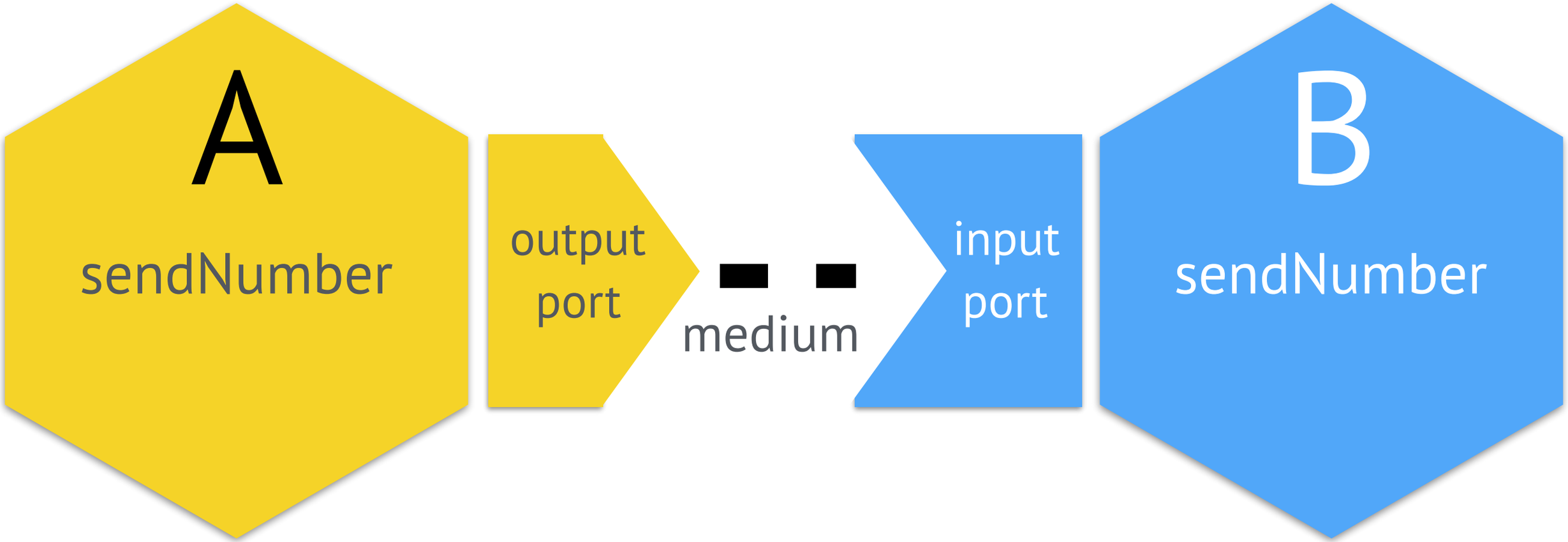
Deployments

Enabling Communication

Behaviours and Deployments



- Services communicate through **ports**.
- **Ports** give access to an **interface**.
- An interface is a set of **operations**.
- An **output port** is used to invoke interfaces exposed by other services.
- An **input port** is used to expose an interface.

A closer look on ports - Locations

A location describes:

- the **communication medium**;
- the **parameters** to set the communication up.

In Jolie a **location** is a **Uniform Resource Identifier** (URI)
with form: **medium[:parameters]**

	Medium	Parameters
TCP/IP	**socket://**	**www.google.it:80**
Bluetooth	**btl2cap://**	`localhost: 3B9FA89520078C303355AAA694238F07;name=Vision;encrypt= false;authenticate=false`
Local	**localsocket:**	**/tmp/mysocket.socket**
Java RMI	**rmi://**	**myRmiUrl.com/MyService**
In-Memory	**local**	

A closer look on ports - Protocols

A protocol defines the format the data is sent (**encoded**) and received (**encoded**)

In Jolie protocols are names and possibly additional parameters:

```
json/rpc
```

```
sodep
```

```
https
```

```
soap
```

```
http { .debug = true }
```

Behaviours

Composing Interactions

Interactions via Operations

Input Operations	`oneWay( req )`
	
	`reqRes( req )( res ){`
	`  // code block`
	`}`

Output Operations	`oneWay@Port( req )`
	
	`reqRes@Port( req )( res )`

Behaviour Composition

The sequence operator **;** denotes that the **left operand** of the statement is executed **before** the one on the right.

```
println@Console( "A" )();
println@Console( "B" )()
```

Prints

```
A
B
```

Behaviour Composition

The parallel operator | states that both left and right operands execute concurrently

```
println@Console( "A" )() |
println@Console( "B" )()
```

can print

```
A
B
```

but also

```
B
A
```

Behaviour Composition

The input choice implements **input-guarded non-deterministic choice**.

```
[ oneWayOperation() ] { branch_code }
[ oneWayOperation2() ] {branch_code2}


[ requestResponseOperation()(){
  rr_code }
 ] { branch_code }
```

Behaviour Composition

The input choice implements **input-guarded non-deterministic choice**.

```
main {
 [ buy( stock )( response ) {
  buy@Exchange( stock )( response )
 } ] { println@Console( "Buy order forwarded" )() }

 [ sell( stock )( response ) {
  sell@Exchange( stock )( response )
 }] { println@Console( "Sell order forwarded" )() }
}
```

Last stand - that ORC example

```
include "net.inc"
val BingSpell =
    BingSpellFactoryPropertyFile
    ("orc/orchard/orchard.properties")
Println(y)
< y <
  ( Prompt("Input a string: ") > x >
    ( BingSpell(x) | (Rwait(250) >> x) ) )
```

Last stand - that ORC example

```
include "console.iol"
include "time.iol"

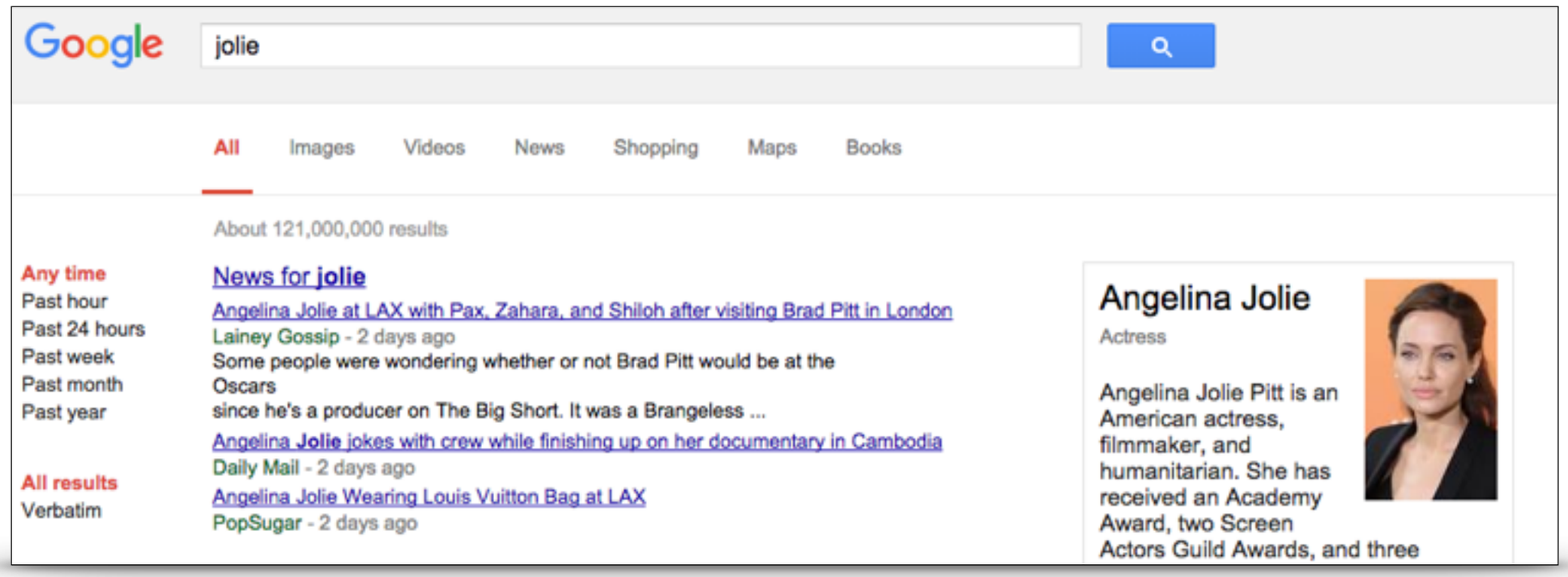
timeout = 250;
timeout.operation = "timeout";
txt = "Beutiful";
{
 spellCheck@BingSpell({ .text = txt, .location = myLoc })
 |
 setNextTimeout@Time( timeout )
};
[ spellCheckResponse( text )]{ println@Console( text )() }
[ timeout() ]{ throw( TimeoutException ) }
```

Before you take off

Jolie Website

http://www.jolie-lang.org

still working out the SEO…



The Jolie Interpreter

Last release

http://www.jolie-lang.org/downloads.html

- Requires JRE 1.6+
- Download jolie-installer.jar
- open a console and run

```
java -jar jolie-installer.jar
```

Sources

Jolie is an **open source** project with continuous updates and a well documented codebase

https://github.com/jolie/jolie

"This *is* the programming language you are looking for"

Documentation

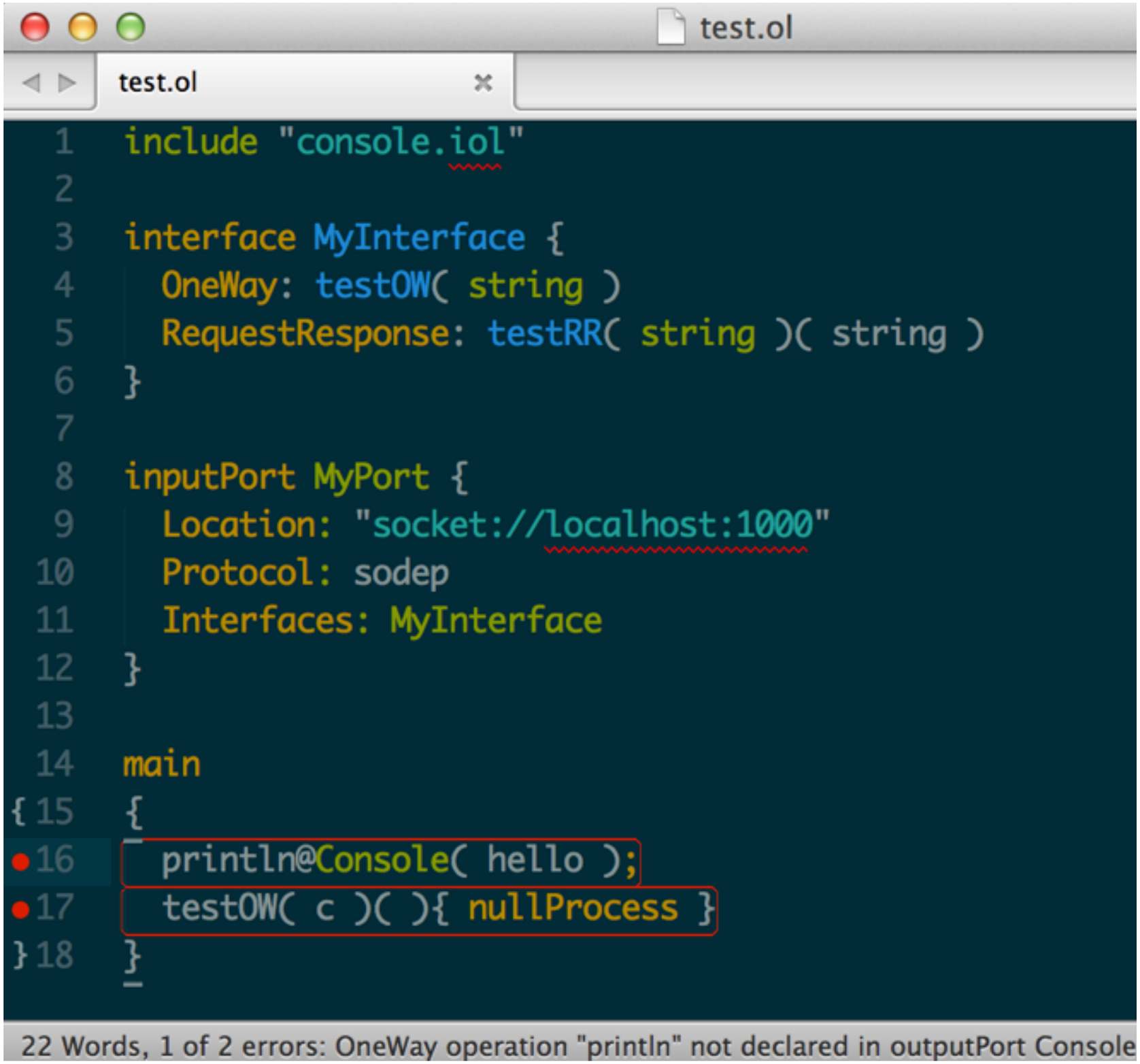
Comprehensive and ever-growing
documentation and **Standard Library**.

http://docs.jolie-lang.org

Editors

Sublime Text but also Atom

Syntax highlight, online checking, etc.



Thanks for your time!