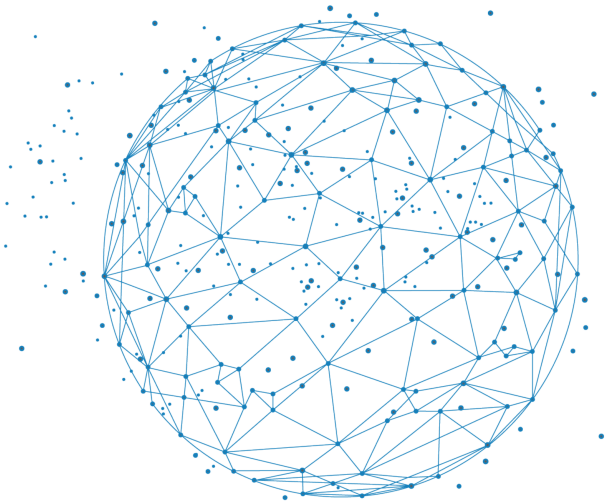

nextflow

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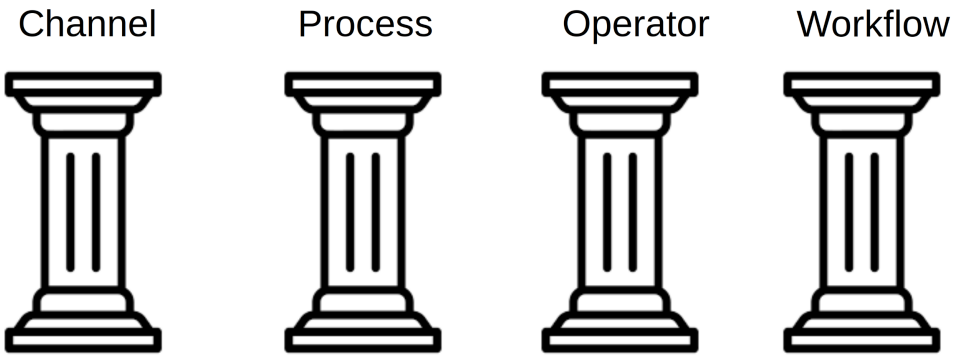
INVESTIR L'AVENIR

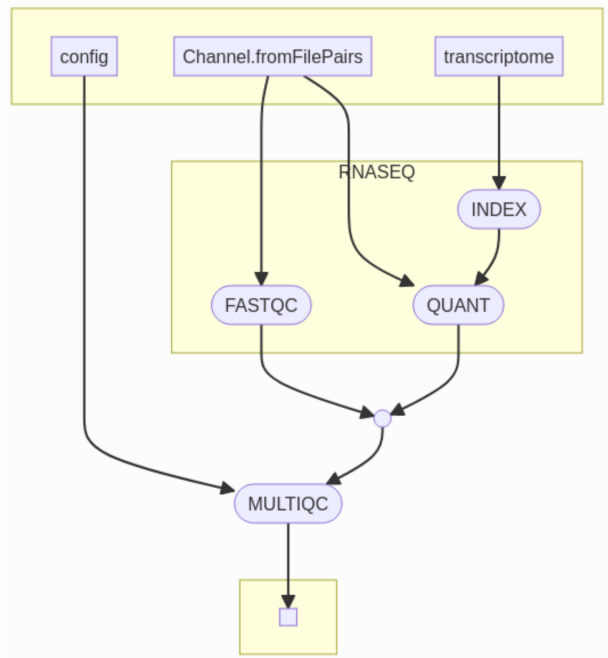
- Introduction
- Channels
- Operators
- Processes
- Configuration
- Profile
- Error Management
- Debugging
- Metrics

Introduction

- Nextflow is Data Flow Model programming language that helps for building complex worflows
- The idea is to chain multiple simple tasks like in *nix system with piping command
- Nextflow runs upon Java and extensively uses Groovy
- The elementary bricks of Nextflow are processes, channels, operators and workflows (since DSL2)

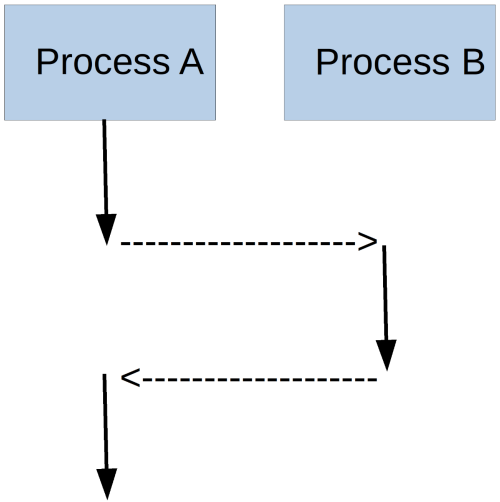
Introduction



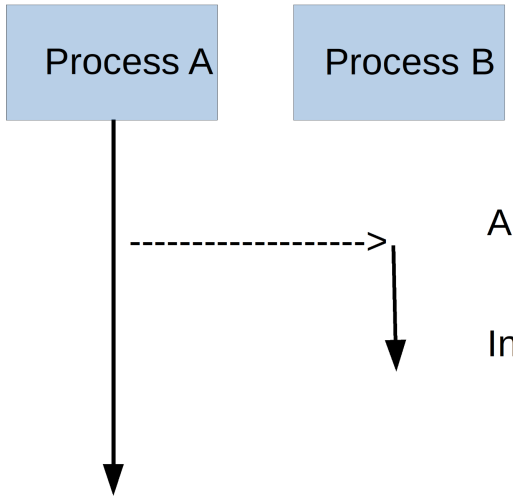


Channels

synchronous => blocking



asynchronous => non blocking



Advantage:

masking computing and communication

Inconvenient:

difficult to debug

difficult to develop

Channels

- Channels are 2 types:

  Queue channels:
  - queue channels are FIFO queues and block other input queue channels

  Value channels:
  - only one value and consumed repeatedly and don't block other input queue channels

- Channels Factory:

```
Channel.value("toto")                    Channel.of(1,2,3)

Channel.value([1,2,3])                   Channel.of([1,2,3])

Channel.fromList([1,2,3])                Channel.fromPath("/input/*.gz")

Channel.fromFilePairs('input/**.R{1,2}.fastq.gz')
```

Value Channel

```
process foo {

    input:
    val x

    output:
    path 'x.txt'

    """
    echo $x > x.txt
    """
}

workflow {
    result = foo(1)
    result.view()
}
```

Channel Factory

```
ch1 = Channel.of( 1, 3, 5, 7, 9 )
ch2 = Channel.of( [1, 3, 5, 7, 9] )
ch3 = Channel.of( [1, 2], [5,6], [7,9] )

Channel.fromList( ['a', 'b', 'c', 'd'] )
       .view()
```

```
files       = Channel.fromPath( 'data/**.fa' )
moreFiles   = Channel.fromPath( 'data/**/*.fa' )
pairFiles   = Channel.fromPath( 'data/file_{1,2}.fq' )
```

** for directory recursion

example1.nf
example2.nf

Operators

- Operators manipulate channels.

- operators return queue channels or value channels

- With channels you can:
  - Filter (filter, first, unique)
  - combine (map, groupTuple, collect, flatten)
  - process text (splitCSV, splitFasta)
  - fork (multiMap, branch)
  - Math (count, min, max)

Operators

Branch

```
result = Channel.of(1, 2, 3, 40, 50)
    .branch {
        small: it < 10
        large: it > 10
}

result.small.view()
result.large.view()
```

Text

```
Channel.of( '10,20,30\n70,80,90' )
       .splitCsv()
       .view()
```

```
Channel.fromPath('misc/sample.fa')
       .splitFasta( by: 10 )
       .view()
```

example3.nf

Reduce

```
Channel.of( [1, 'A'], [1, 'B'], [2, 'C'], [1, 'C'], [2, 'A'] )
       .groupTuple()
       .view()
```

Math

```
Channel.of( 8, 6, 2, 5 )
       .min()
       .view()
```

example4.nf

Operators - closures

- Closures a block of code that can be passed as argument of an operator
- Closures are written between brackets: { put the code here }
- By default only 1 argument : it
- Multiple arguments can be passed

```
Channel.of(1,2,3,4,5)
       .map{it * it}
```

```
Channel.of(1,2,3,4,5)
       .map{ a -> a * a}
```

example4.nf

Skeleton

```
process name  {

  [directives]

  input:
    < process inputs >

  output:
    < process outputs >

  when:
    < condition >

  [script|shell|exec]:
  """
  < user script to be executed>
  """
}
```

Only one script
Script executed as a Bash
Script runs in the host environment
Prefer script
Prefer """ over '''

```
process doOtherThings  {

  script:
  """
    blast -db \${DB} -query.fa -outfmt 6 > blast_result
    cat blast_result | head -n ${MAX} | cut -f2 > top_hits
    blastdbcmd -db \${DB} -entry_batch top_hits > sequences
  """
}
```

\${DB} is a bash variable
${MAX} is a nextflow variable

exec is for groovy commands

Processes

- Processes contain the commands to execute.

Input can be:
- val
- file
- path
- env
- stdin
- tuple

Output can be:
- val
- path
- env
- stdout
- tuple

Files use separator (:), path don't

Tuple gather multiple values in a single channel

If inputs of different sizes the first empty stops the process

Chose your environment

```
process perlTask {
    script:
    """
    #!/usr/bin/perl
    print 'Hi there!' . '\n';
    """
}
```

```
process pythonTask {

    script:
    """
    #!/usr/bin/python
    X = 'Hello'
    Y = 'world'
    print("%s - %s", X,Y)
    """
}
```

example5.nf

Processes – Dry run

Prototype your process without real data

nextflow --stub-run

```
process Index {

  input:
    path transcriptome

  output:
    path 'index'

  script:
    """
    salmon index --thread $task.cpus -t $transcriptome -i index
    """

  stub:
    """
    mkdir index
    touch index/seq.bin
    touch index/info.json
    touch index/refseq.bin
    """
}
```