Running Ensemble Simulations with CODES/Swift/CoRtEx

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How to setup a large number of runs?

- Study of various networks
  - Many topologies: Dragonfly, Slimfly, Torus, Fat Tree, etc.
  - Many parameters: link bandwidth, buffer size, etc.
  - Many variants of collective algorithms
  - Many job placement strategies
  - Many routing strategies
- Typically, we want to run MANY experiments varying such parameters
- This is a difficult task
  - Hand-written scripts to submit hundreds of thousands of jobs?
  - How to know which jobs will require more resources?
  - How to keep track of the jobs that completed?
  - How to make the whole campaign reproducible?

Outline

- Two tools helping CODES ensemble simulations
  - The CoRtEx library
  - The CODES-ESW framework

CoRtEx: Collective Runtime Extension

- **Goal:** translate MPI collective calls into a series of point-to-point calls
- **Features:**
  - Reads DUMPI trace files
  - Translates any event into a series of other events using C functions or Python scripts
  - Can generate events without a DUMPI trace using Python scripts
  - Provides a set of collective to p2p translation as implemented in Mpich
- https://xgitlab.cels.anl.gov/mdorier/dumpi-cortex
- Now integrated into CODES!

CoRtEx: example Python translation

```
1  import cortex
2
3  class MyTranslator():
4
5      def MPI_Bcast(self, thread, **args):
6
7          dtype = args['datatype']
8          root  = args['root']
9          comm  = args['comm']
10         count = args['count']
11
12         print "MPI_Bcast called in Python, root = ", root
13
14         if not (cortex.MPI_COMM_WORLD == comm):
15           print "Communicator is not MPI_COMM_WORLD, not translating"
16           return
17
18         if thread != root :
19           s = cortex.MPI_Status()
20           cortex.MPI_Recv(thread,count=count,datatype=dtype,source=root,tag=1234,comm=comm,status=s)
21         else :
22           size = cortex.comm_world_size()
23           for i in range(size):
24             if i != thread:
25               cortex.MPI_Send(thread,count=count,datatype=dtype,dest=i,tag=1234,comm=comm)
```

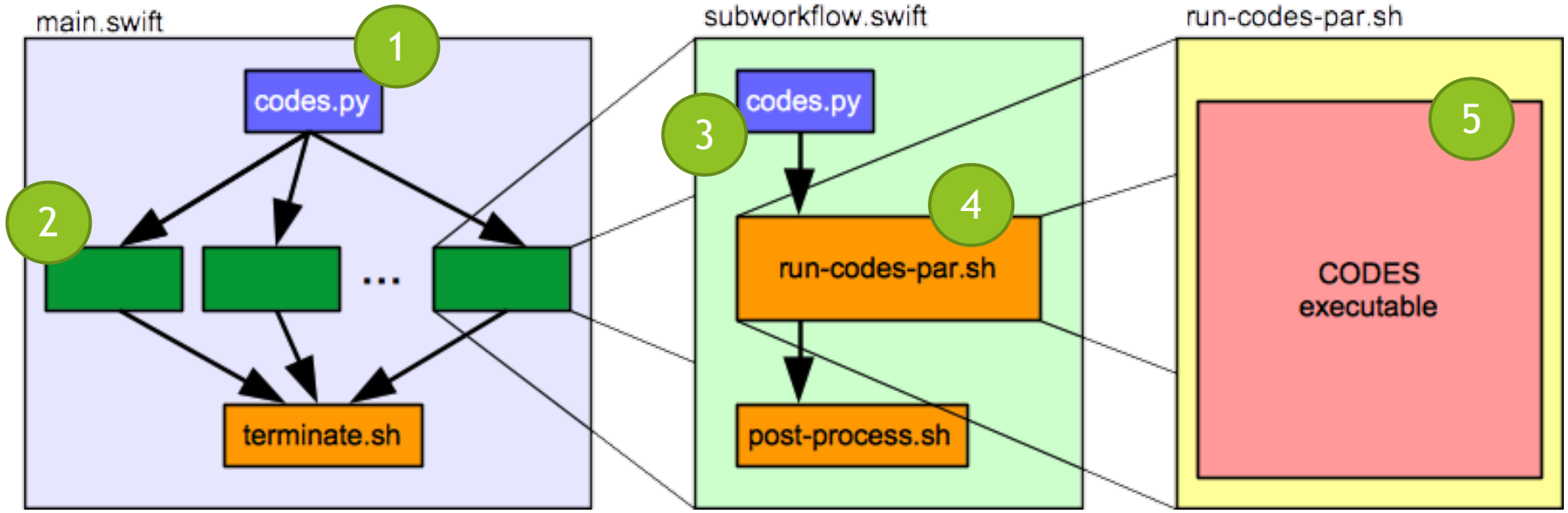
CoRtEx: example Python generator

```
1  import cortex
2
3  def GenerateThings(thread):
4
5      print "In the generator"
6      if thread == 0:
7         cortex.MPI_Send(thread,count=1,datatype=cortex.MPI_INT,dest=1,tag=1234,comm=cortex.MPI_COMM_WORLD)
8      elif thread == 1:
9         s = cortex.MPI_Status()
10        s.nbytes = 4
11        s.source = 0
12        s.tag = 1234
13        s.cancelled = False
14        s.error = 0
15        cortex.MPI_Recv(thread,count=1,datatype=cortex.MPI_INT,source=0,tag=1234,comm=cortex.MPI_COMM_WORLD,status=s)
```

The CODES-ESW framework

Running many instances of CODES/CoRtEx using Swift/T

Overview of the CODES-ESW workflow



1. codes.py computes the tasks to spawn and the required parallelism
2. Tasks are spawned using launch_turbine (subworkflow)
3. codes.py generates the input files for the given tasks
4. run-codes-par.sh is called on multiple swift workers and setup env
5. CODES is executed

https://bitbucket.org/mdorier/codes-esw

Example configuration file (YAML)

```yaml
- codes:
    binary: /home/mdorier/codes-work/install/bin/model-net-mpi-replay
    timeout: 1200
    network: dragonfly
    parameters:
      packet_size: [ 512, 1024, 2048, 4096 ]
      routing: prog-adaptive
      seed: 0
      local_vc_size: [ 8192, 16384, 32768, 65536 ]
      local_bandwidth: [ 2.0, 4.0, 8.0, 10.0, 16.0 ]
      alloc_size: [ 128, 512, 1024, 2048, 3096 ]
      cortex_file: ../scripts/BinomialBcast.py
      cortex_gen: GenerateEvents
      workload_file: none
      bcast_num_iter: [ 2, 4, 8, 16, 20 ]
      bcast_msg_size: [ 1024, 4096, 8192 ]
    tasks: 1
    template: ../templates/dragonfly.conf.tpl
```

./run.sh 32 hosts.txt config/bcast.yml

Default value if none provided

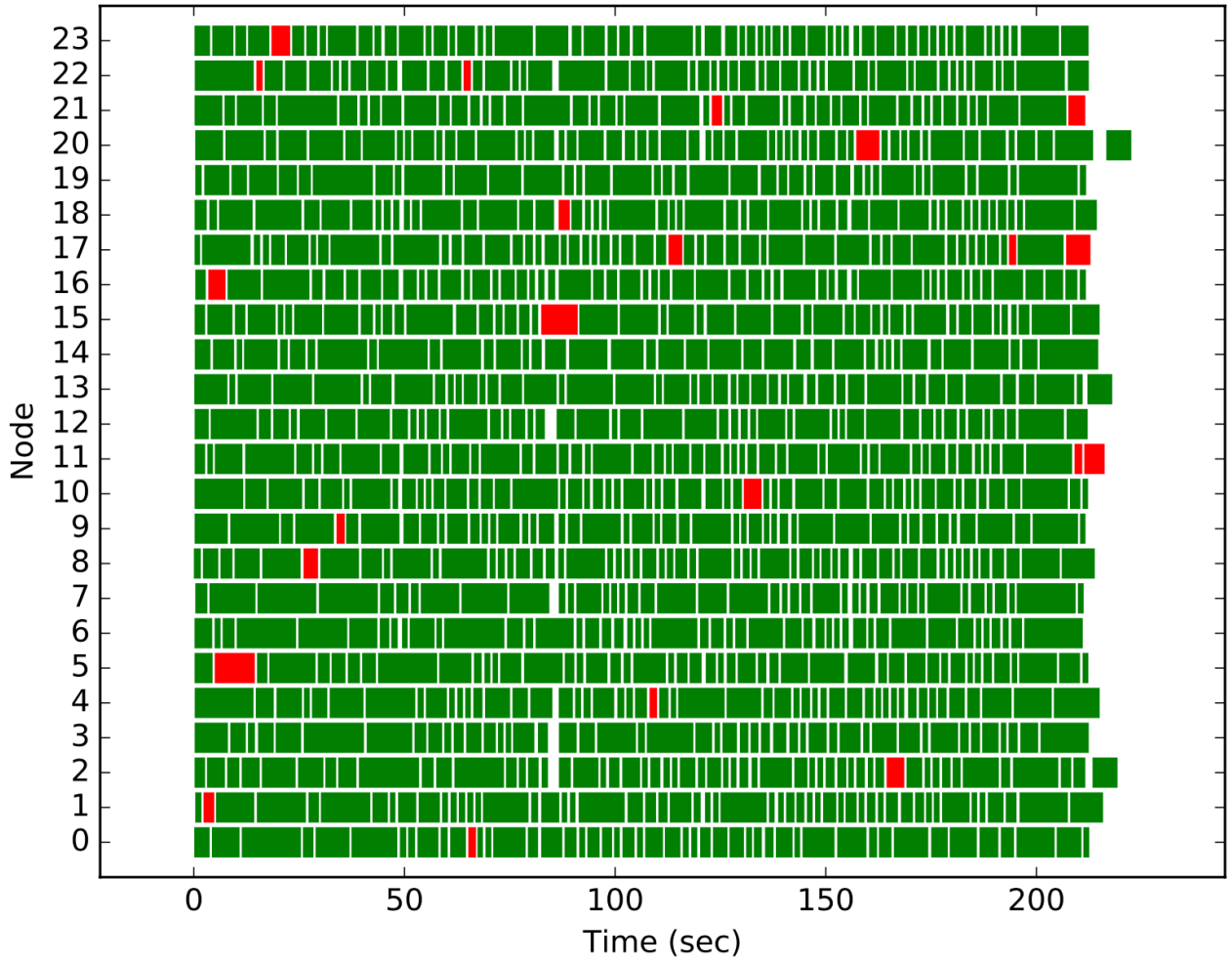
Default values can be computed based on other parameters

```
    num_groups="<<num_groups:9>>";
# buffer size in bytes for local virtual channels
    local_vc_size="<<local_vc_size:8192>>";
#buffer size in bytes for global virtual channels
    global_vc_size="<<global_vc_size:2*local_vc_size>>";
#buffer size in bytes for compute node virtual channels
    cn_vc_size="<<cn_vc_size:local_vc_size>>";
#bandwidth in GiB/s for local channels
    local_bandwidth="<<local_bandwidth:5.25>>";
# bandwidth in GiB/s for global channels
    global_bandwidth="<<global_bandwidth:3.5*local_bandwidth>>";
```

CODES-ESW output

- A set of directory names with a number (e.g. "00001234"), containing
  - the configuration files used as CODES input
  - a YAML file summarizing all the input parameters
  - the resulting CODES and ROSS output files/directories

Result: a framework to run many CODES instances (and supporting fault-tolerance)



Conclusion

- CoRtEx: a library for translating MPI collective events into point-to-point events
  - Supporting Python scripts
  - and DUMPI traces
- CODES-ESW: a framework based on Swift/T for running ensemble simulations using CODES
  - Supporting fault-tolerance
  - Easy description of a design-space using a YAML file and template configurations
- Publication (on a new MPI feature, MPI_Comm_launch, used by CODES-ESW)
  - EuroMPI 2017, Launching MPI applications inside MPI applications (Matthieu Dorier, Justin Wozniak, Rob Ross) – submitted