diagram

March 21, 2021

1 Diagrams for cadCAD model structure through cadCAD_diagram

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This is a mini-demo showcasing the cadCAD_diagram plugin, which allows the user to create visualizations of the structure and flows for any cadCAD model! Just jump to the end so that you see the output of it.

In order to install the plugin, just install through pip by pasing `pip install cadCAD_diagram`. The most typical use-case is to visualize a given cadCAD configuration object through:

```
from cadCAD_diagram import diagram_from_config
from cadCAD import configs

# Generate visualization for the first config
diagram_from_config(configs[0])
```

1.1 Dependences

[1]:
```
%%capture
!pip install cadcad
```

[2]:
```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from cadCAD.configuration import Experiment
from cadCAD.configuration.utils import config_sim
from cadCAD.engine import ExecutionMode, ExecutionContext, Executor
```

1.2 Definitions

1.2.1 Initial conditions and parameters

[3]:
```
initial_conditions = {
    'prey_population': 100,
    'predator_population': 15
```

```
    }

params = {
    "prey_birth_rate": [1.0],
    "predator_birth_rate": [0.01],
    "predator_death_const": [1.0],
    "prey_death_const": [0.03],
    "dt": [0.1] # Precision of the simulation. Lower is more accurate / slower
}

simulation_parameters = {
    'N': 7,
    'T': range(200),
    'M': params
}
```

1.2.2 Policies

[4]:
```
def p_predator_births(params, step, sL, s):
  dt = params['dt']
  predator_population = s['predator_population']
  prey_population = s['prey_population']
  birth_fraction = params['predator_birth_rate'] + np.random.random() * 0.0002
  births =  birth_fraction * prey_population * predator_population * dt
  return {'add_to_predator_population': births}


def p_prey_births(params, step, sL, s):
  dt = params['dt']
  population = s['prey_population']
  birth_fraction = params['prey_birth_rate'] + np.random.random() * 0.1
  births =  birth_fraction * population * dt
  return {'add_to_prey_population': births}


def p_predator_deaths(params, step, sL, s):
  dt = params['dt']
  population = s['predator_population']
  death_rate = params['predator_death_const'] + np.random.random() * 0.005
  deaths = death_rate * population * dt
  return {'add_to_predator_population': -1.0 * deaths}


def p_prey_deaths(params, step, sL, s):
  dt = params['dt']
  death_rate = params['prey_death_const'] + np.random.random() * 0.1
  prey_population = s['prey_population']
```

```
    predator_population = s['predator_population']
    deaths = death_rate * prey_population * predator_population * dt
    return {'add_to_prey_population': -1.0 * deaths}
```

1.2.3 State update functions

[5]:
```
def s_prey_population(params, step, sL, s, _input):
    y = 'prey_population'
    x = s['prey_population'] + _input['add_to_prey_population']
    return (y, x)


def s_predator_population(params, step, sL, s, _input):
    y = 'predator_population'
    x = s['predator_population'] + _input['add_to_predator_population']
    return (y, x)
```

1.2.4 State update blocks

[6]:
```
partial_state_update_blocks = [
    {
        'label': 'Predator dynamics',
        'ignore': False,
        'debug': True,
        'policies': {
            'predator_births': p_predator_births,
            'predator_deaths': p_predator_deaths
        },
        'variables': {
            'predator_population': s_predator_population
        }
    },
    {
        'label': 'Prey dynamics',
        'ignore': False,
        'policies': {
            'prey_births': p_prey_births,
            'prey_deaths': p_prey_deaths
        },
        'variables': {
            'prey_population': s_prey_population
        }
    }
]
```

1.2.5 Configuration and Execution

[7]:
```
sim_config = config_sim(simulation_parameters)

exp = Experiment()
exp.append_configs(sim_configs=sim_config,
                   initial_state=initial_conditions,
                   partial_state_update_blocks=partial_state_update_blocks)


from cadCAD import configs
exec_mode = ExecutionMode()
exec_context = ExecutionContext(exec_mode.local_mode)
executor = Executor(exec_context=exec_context, configs=configs)
(records, tensor_field, _) = executor.execute()
```

```
                  ___________    ____
  ________ __ ___/ / ____/   |  / __ \
 / ___/ __` / __  / /   / /| | / / / /
/ /__/ /_/ / /_/ / /___/ ___ |/ /_/ /
\___/\__,_/\__,_/\____/_/  |_/_____/
by cadCAD

Execution Mode: local_proc
Configuration Count: 1
Dimensions of the first simulation: (Timesteps, Params, Runs, Vars) = (200, 5,
7, 2)
Execution Method: local_simulations
SimIDs   : [0, 0, 0, 0, 0, 0, 0]
SubsetIDs: [0, 0, 0, 0, 0, 0, 0]
Ns       : [0, 1, 2, 3, 4, 5, 6]
ExpIDs   : [0, 0, 0, 0, 0, 0, 0]
Execution Mode: parallelized
Total execution time: 0.20s
```

1.2.6 Results

[8]:
```
import plotly.express as px
```

[9]:
```
df = pd.DataFrame(records)

fig = px.line(df,
              x=df.prey_population,
              y=df.predator_population,
              color=df.run.astype(str))

fig.show()
```

1.3 Diagram

[10]:
```
%%capture
!pip install cadCAD_diagram==0.0.1.2
```

[11]:
```
from cadCAD_diagram import diagram_from_config
from cadCAD import configs
diagram_from_config(configs[0])
```

```
---------------------------------------------------------------------------
FileNotFoundError                         Traceback (most recent call last)
~/.local/lib/python3.9/site-packages/graphviz/backend.py in run(cmd, input,␣
↪capture_output, check, encoding, quiet, **kwargs)
    163     try:
--> 164         proc = subprocess.Popen(cmd, startupinfo=get_startupinfo(),␣
↪**kwargs)
    165     except OSError as e:

/usr/local/lib/python3.9/subprocess.py in __init__(self, args, bufsize,␣
↪executable, stdin, stdout, stderr, preexec_fn, close_fds, shell, cwd, env,␣
↪universal_newlines, startupinfo, creationflags, restore_signals,␣
↪start_new_session, pass_fds, user, group, extra_groups, encoding, errors,␣
↪text, umask)
    950
--> 951             self._execute_child(args, executable, preexec_fn, close_fds
    952                                 pass_fds, cwd, env,

/usr/local/lib/python3.9/subprocess.py in _execute_child(self, args, executable␣
↪preexec_fn, close_fds, pass_fds, cwd, env, startupinfo, creationflags, shell,␣
↪p2cread, p2cwrite, c2pread, c2pwrite, errread, errwrite, restore_signals, gid␣
↪gids, uid, umask, start_new_session)
   1822                         err_msg = os.strerror(errno_num)
-> 1823                     raise child_exception_type(errno_num, err_msg,␣
↪err_filename)
   1824                 raise child_exception_type(err_msg)

FileNotFoundError: [Errno 2] No such file or directory: 'dot'

During handling of the above exception, another exception occurred:

ExecutableNotFound                        Traceback (most recent call last)
~/.local/lib/python3.9/site-packages/IPython/core/formatters.py in␣
↪__call__(self, obj)
    343             method = get_real_method(obj, self.print_method)
    344             if method is not None:
--> 345                 return method()
    346             return None
    347         else:
```

```
~/.local/lib/python3.9/site-packages/graphviz/files.py in _repr_svg_(self)
    142
    143     def _repr_svg_(self):
--> 144         return self.pipe(format='svg').decode(self._encoding)
    145
    146     def pipe(self, format=None, renderer=None, formatter=None,␣
 ↪quiet=False):

~/.local/lib/python3.9/site-packages/graphviz/files.py in pipe(self, format,␣
 ↪renderer, formatter, quiet)
    167         data = text_type(self.source).encode(self._encoding)
    168
--> 169         out = backend.pipe(self._engine, format, data,
    170                            renderer=renderer, formatter=formatter,
    171                            quiet=quiet)

~/.local/lib/python3.9/site-packages/graphviz/backend.py in pipe(engine, format␣
 ↪data, renderer, formatter, quiet)
    246     """
    247     cmd, _ = command(engine, format, None, renderer, formatter)
--> 248     out, _ = run(cmd, input=data, capture_output=True, check=True,␣
 ↪quiet=quiet)
    249     return out
    250

~/.local/lib/python3.9/site-packages/graphviz/backend.py in run(cmd, input,␣
 ↪capture_output, check, encoding, quiet, **kwargs)
    165     except OSError as e:
    166         if e.errno == errno.ENOENT:
--> 167             raise ExecutableNotFound(cmd)
    168         else:
    169             raise

ExecutableNotFound: failed to execute ['dot', '-Kdot', '-Tsvg'], make sure the␣
 ↪Graphviz executables are on your systems' PATH
```

[11]: <graphviz.dot.Digraph at 0x7fb6136ff850>

[ ]: