PyNuSMV: NuSMV as a Python Library

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5th NASA Formal Methods Symposium (NFM 2013)
Moffett Field, CA, USA
May 14–16, 2013

Objectives

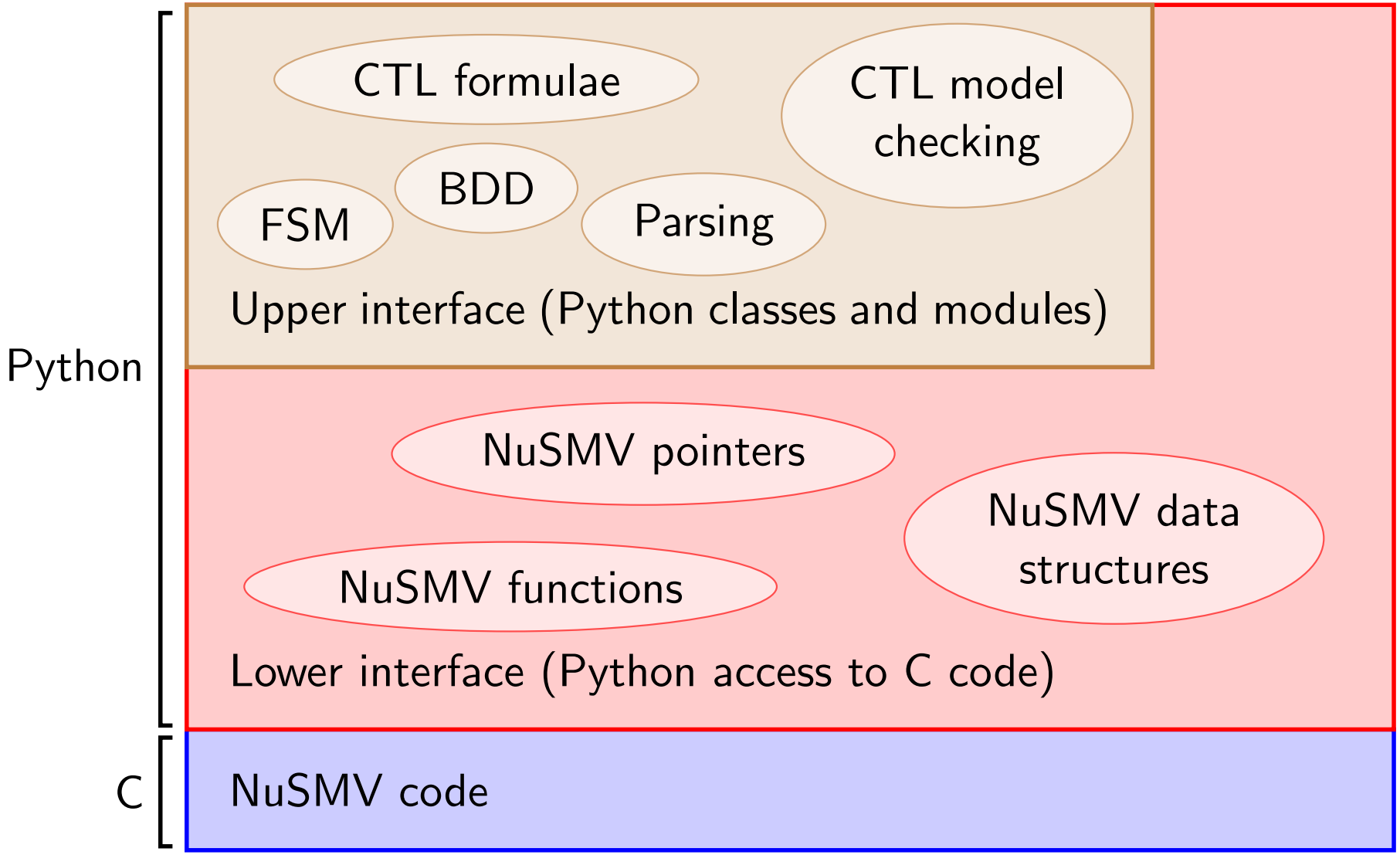
PyNuSMV = a **Python platform** to implement **new logics** and experiment with custom **model-checking algorithms** based on **NuSMV**

- BDD-based model-checking algorithms
- Access to NuSMV features
- High-level language

Already used for prototyping ARCTL, CTLK, ATL model checking and rich counter-examples.

Available at `http://lvl.info.ucl.ac.be/Tools/PyNuSMV/`

Structure of the library



Example: CTL model checking

```
def fixpoint(funct, start):
    old = start
    new = funct(start)
    while old != new:
        old = new
        new = funct(old)
    return old

def eg(fsm, phi):
    return fixpoint(lambda Z: phi & fsm.pre(Z),
                    BDD.true(fsm.bddEnc.DDmanager))
```

$EG\phi = \nu Z.\phi \wedge Pre(Z)$

Advantages and drawbacks

+ Access to all NuSMV functionalities
+ Access to NuSMV modeling language and existing models
+ High-level language with garbage collection

− Stick to NuSMV architecture
− No unified error management

Future work

- Supporting more NuSMV features:
  - SAT-based model checking
  - LTL model checking
  - model simulation
- A homogeneous error management (Python exceptions)

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Appendix

Example: ATL model checking

```
def ceu(fsm, agents, phi, psi):
    return fp(lambda Y : psi |
                  (phi & fsm.pre_strat(Y, agents)),
                BDD.false(fsm.bddEnc.DDmanager))
```

$\langle\Gamma\rangle\phi U\psi = \mu Z.\psi \vee (\phi \wedge Pre_{\langle\Gamma\rangle}(Z))$

```
def pre_strat(self, stts, agents):
  gamma_cube = self.inputs_cube_for_agents(agents)
  ng_cube = self.bddEnc.inputsCube - gamma_cube
  return (~(self.weak_pre(~stts).forsome(ng_cube))
          & self.weak_pre(stts)
         ).forsome(gamma_cube)
```

$Pre_{\langle\Gamma\rangle}(Z) = \exists a_\Gamma \overline{\exists a_{\overline{\Gamma}} Pre_{SI}(\overline{Z})}$