
chaste*codegenDocumentation*

Release 0.10.3

chaste*codegenauthors*

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chaste_codegen is hosted on [GitHub](#), where you can find the code and installation instructions.

UPDATING SYMPY OR OTHER PYTHON PACKAGES

Sympy or any other python package may need to be updated, especially as python versions evolve. To update the version:

- change the version listed in `setup.py`, e.g. for sympy it currently lists `'sympy>=1.9, <1.11'`, which means that the version is at least 1.9 and is less than 1.11.
- update `dev-requirements/dev.txt` if you want to also update your development pinned (fixed) versions
- create a new branch `git checkout -b <name_of_new_branch>`
- `git add`, `git commit` and `git push` the changes
- make a pull request. The tests may throw up some errors that may need fixing. The tests are in the `tests` folder and the reference data in `data/tests`. In `data/tests/chaste_reference_models` you'll see a few reference files ending in `.cpp_python36`, This is as due to sympy versions supported python 3.6 leads to an equivalent but subtly different generated model.
- Mention the changes made in the release notes `release.txt`
- To use the changes with `chaste`, do a new release of `chaste_codegen`.

UPDATING THE ONTOLOGY AND INCLUDING IT IN CHASTE_CODEGEN

- update the ontology according to the instructions in <https://github.com/ModellingWebLab/ontologies>
- the ontology is included in `chaste_codegen` via a submodule, update this with `git submodule update --remote chaste_codegen/ontologies`.
- *Please note* this same way can be used to update the `cellml` in `chaste_codegen/data/tests/cellml` submodule if required.
- create a new branch `git checkout -b <name_of_new_branch>`
- `git add`, `git commit` and `git push` the changes
- make a pull run the tests and fix any issues that arise
- update the release notes `release.txt` with information about the updated ontology.
- To use the changes with `chaste`, do a new release of `chaste_codegen`.

DOING A NEW CHASTE_CODEGEN RELEASE

- Update the release version number in `chaste_codegen/version.txt`.
- Update the release notes `release.txt` with the latest release number.
- For this version number: minor numbers will be picked up by chaste automatically, for major version numbers, `chaste_codegen.txt` will need updating in the chaste repository.
- Follow the following tutorial to publish the package: <https://packaging.python.org/en/latest/tutorials/packaging-projects/>
- You will need a login to pypi.org and the account you are using will need access to `chaste_codegen`.

API DOCUMENTATION

4.1 chaste_codegen Package

Main module for cardiac Chaste code generation

4.1.1 Functions

add_conversions(model[, use_modifiers, ...])

load_model_with_conversions(model_file[, ...])

<i>load_template</i> (*name)	Loads a template from the local template directory.
------------------------------	---

<i>subs_math_func_placeholders</i> (expr)	Substitutes the placeholder math functions in expr for their corresponding Sympy functions :param expr: sympy expression
---	--

<i>version</i> ([formatted])	Returns the version number, as a 3-part integer (major, minor, revision).
------------------------------	---

add_conversions

`chaste_codegen.add_conversions(model, use_modifiers=True, skip_chaste_stimulus_conversion=False)`

load_model_with_conversions

`chaste_codegen.load_model_with_conversions(model_file, use_modifiers=False, quiet=False, skip_singularity_fixes=False, skip_conversions=False)`

load_template

chaste_codegen.load_template(*name)

Loads a template from the local template directory.

Templates can be specified as a single filename, e.g. `load_template('temp.txt')`, or loaded from subdirectories using e.g. `load_template('subdir_1', 'subdir_2', 'file.txt')`.

subs_math_func_placeholders

chaste_codegen.subs_math_func_placeholders(expr)

Substitutes the placeholder math functions in `expr` for their corresponding Sympy functions :param expr: sympy expression

Example: `>> str(expr) '2.0 * exp(V)' >> subs_math_func_placeholders(expr) '2.0 * exp(V)'`

Returns

`expr` with all placeholder functions replaced by sympy functions.

version

chaste_codegen.version(formatted=False)

Returns the version number, as a 3-part integer (major, minor, revision). If `formatted=True`, it returns a string formatted version (e.g. "chaste_codegen 1.0.0").

4.1.2 Classes

<i>BackwardEulerModel</i> (model, file_name, **kwargs)	Holds template and information specific for the Backwards Euler model type
<i>BackwardEulerOptModel</i> (model, file_name, **kwargs)	Holds information specific for the Optimised Backward Euler model type.
<i>ChasteModel</i> (model, file_name, **kwargs)	Holds information about a cellml model for which chaste code is to be generated.
<i>ChastePrinter</i> ([symbol_function, ...])	Converts Sympy expressions to strings for use in Chaste code generation.
<i>CodegenError</i>	
<i>CvodeChasteModel</i> (model, file_name, **kwargs)	Holds template and information specific for the CVODE model type
<i>GeneralisedRushLarsenFirstOrderModel</i> (model, ...)	Holds template and information specific for the GeneralisedRushLarsen model type
<i>GeneralisedRushLarsenFirstOrderModelOpt</i> (...)	Holds template and information specific for the GeneralisedRushLarsenOpt model type
<i>GeneralisedRushLarsenSecondOrderModel</i> (model, ...)	Holds template and information specific for the GeneralisedRushLarsen model type
<i>GeneralisedRushLarsenSecondOrderModelOpt</i> (...)	Holds template and information specific for the GeneralisedRushLarsenOpt model type
<i>LabviewPrinter</i> ([symbol_function, ...])	Converts Sympy expressions to strings for use in Chaste code generation.
<i>NormalChasteModel</i> (model, file_name, **kwargs)	Holds template and information specific for the Normal model type
<i>OptChasteModel</i> (model, file_name, **kwargs)	Holds information specific for the Optimised model type.
<i>OptCvodeChasteModel</i> (model, file_name, **kwargs)	Holds information specific for the Cvode Optimised model type.
<i>RealFunction</i> (*args)	
<i>RushLarsenC</i> (model, file_name, **kwargs)	Holds template and information specific for the Rush-Larsen model type
<i>RushLarsenLabview</i> (model, file_name, **kwargs)	Holds template and information specific for the Rush-Larsen model type
<i>RushLarsenModel</i> (model, file_name, **kwargs)	Holds template and information specific for the Rush-Larsen model type
<i>RushLarsenOptModel</i> (model, file_name, **kwargs)	Holds template and information specific for the Rush-Larsen model type
<i>Transpiler</i> ([symbol_generator, number_generator]) <i>abs_</i> (*args)	Handles conversion of MathmL to Sympy exprerssions.
<i>acos_</i> (*args)	
<i>cos_</i> (*args)	
<i>exp_</i> (*args)	
<i>sin_</i> (*args)	
<i>sqrt_</i> (*args)	

BackwardEulerModel

class chaste_codegen.**BackwardEulerModel**(*model, file_name, **kwargs*)

Bases: [ChasteModel](#)

Holds template and information specific for the Backwards Euler model type

Methods Summary

<i>format_derivative_equation</i> (eq, ...)	Format an individual derivative equation specified so that other model types can specify more detailed printing
<i>format_jacobian</i> ()	Format the jacobian to allow opt model to update what belongs were
<i>format_linear_deriv_eqs</i> (linear_deriv_eqs)	Format linear derivative equations belonging, to update what belongs were
<i>format_nonlinear_state_vars</i> ()	
<i>format_residual_equations</i> ()	Update the state vars, savings residual and jacobian info for outputing

Methods Documentation

format_derivative_equation(*eq, modifiers_with_defining_eqs*)

Format an individual derivative equation specified so that other model types can specify more detailed printing

format_jacobian()

Format the jacobian to allow opt model to update what belongs were

format_linear_deriv_eqs(*linear_deriv_eqs*)

Format linear derivative equations belonging, to update what belongs were

format_nonlinear_state_vars()

format_residual_equations()

Update the state vars, savings residual and jacobian info for outputing

format_derivative_equation(*eq, modifiers_with_defining_eqs*)

Format an individual derivative equation specified so that other model types can specify more detailed printing

format_linear_deriv_eqs(*linear_deriv_eqs*)

Format linear derivative equations belonging, to update what belongs were

format_residual_equations()

Update the state vars, savings residual and jacobian info for outputing

format_jacobian()

Format the jacobian to allow opt model to update what belongs were

BackwardEulerOptModel

class chaste_codegen.**BackwardEulerOptModel**(*model*, *file_name*, ***kwargs*)

Bases: *BackwardEulerModel*

Holds information specific for the Optimised Backward Euler model type.

Methods Summary

<i>format_jacobian()</i>	Format the jacobian to update what belongs were
<i>format_linear_deriv_eqs</i> (<i>linear_deriv_eqs</i>)	Format linear derivative equations belonging, to update what belongs were

Methods Documentation

format_jacobian()

Format the jacobian to update what belongs were

format_linear_deriv_eqs(*linear_deriv_eqs*)

Format linear derivative equations belonging, to update what belongs were

format_linear_deriv_eqs(*linear_deriv_eqs*)

Format linear derivative equations belonging, to update what belongs were

format_jacobian()

Format the jacobian to update what belongs were

ChasteModel

class chaste_codegen.**ChasteModel**(*model*, *file_name*, ***kwargs*)

Bases: *object*

Holds information about a cellml model for which chaste code is to be generated.

It also holds relevant formatted equations and derivatives. Please Note: this calass cannot generate chaste code directly, instead use a subclass of the model type

Attributes Summary

<i>DEFAULT_EXTENSIONS</i>

Methods Summary

<code>format_derivative_equation(eq, ...)</code>	Format an individual derivative equation specified so that other model types can specify more detailed printing
<code>generate_chaste_code()</code>	Generates and stores chaste code

Attributes Documentation

`DEFAULT_EXTENSIONS = ('.hpp', '.cpp')`

Methods Documentation

format_derivative_equation(*eq*, *modifiers_with_defining_eqs*)

Format an individual derivative equation specified so that other model types can specify more detailed printing

generate_chaste_code()

Generates and stores chaste code

format_derivative_equation(*eq*, *modifiers_with_defining_eqs*)

Format an individual derivative equation specified so that other model types can specify more detailed printing

generate_chaste_code()

Generates and stores chaste code

ChastePrinter

class chaste_codegen.**ChastePrinter**(*symbol_function=None*, *derivative_function=None*,
lookup_table_function=<function ChastePrinter.<lambda>>>)

Bases: [Printer](#)

Converts Sympy expressions to strings for use in Chaste code generation.

To use, create a [ChastePrinter](#) instance, and call its method `doprint()` with a Sympy expression argument.

Arguments:

symbol_function

A function that converts symbols to strings (variable names).

derivative_function

A function that converts derivatives to strings.

lookup_table_function

A function that prints lookup table expressions or returns None if the expression is not in the lookup table.

CodegenError

exception chaste_codegen.CodegenError

Bases: [Exception](#)

CvodeChasteModel

class chaste_codegen.CvodeChasteModel(model, file_name, **kwargs)

Bases: [ChasteModel](#)

Holds template and information specific for the CVODE model type

GeneralisedRushLarsenFirstOrderModel

class chaste_codegen.GeneralisedRushLarsenFirstOrderModel(model, file_name, **kwargs)

Bases: [ChasteModel](#)

Holds template and information specific for the GeneralisedRushLarsen model type

Methods Summary

eq_in_evaluate_partial_derivative (eq, ...)	Indicate if the lhs of equation eq appears in used_jacobian_vars specified here so derived model types can specify in detail what happens here
eq_in_evaluate_y_derivative (eq, used_equations)	Indicate if the lhs of equation eq appears in used_equations specified here so derived model types can specify in detail what happens here

Methods Documentation

eq_in_evaluate_partial_derivative(eq, used_jacobian_vars)

Indicate if the lhs of equation eq appears in used_jacobian_vars specified here so derived model types can specify in detail what happens here

eq_in_evaluate_y_derivative(eq, used_equations)

Indicate if the lhs of equation eq appears in used_equations specified here so derived model types can specify in detail what happens here

eq_in_evaluate_y_derivative(eq, used_equations)

Indicate if the lhs of equation eq appears in used_equations specified here so derived model types can specify in detail what happens here

eq_in_evaluate_partial_derivative(eq, used_jacobian_vars)

Indicate if the lhs of equation eq appears in used_jacobian_vars specified here so derived model types can specify in detail what happens here

GeneralisedRushLarsenFirstOrderModelOpt

class chaste_codegen.GeneralisedRushLarsenFirstOrderModelOpt(model, file_name, **kwargs)

Bases: [GeneralisedRushLarsenFirstOrderModel](#)

Holds template and information specific for the GeneralisedRushLarsenOpt model type

Methods Summary

eq_in_evaluate_partial_derivative (eq, ...)	Indicate if the lhs of equation eq appears in used_jacobian_vars
eq_in_evaluate_y_derivative (eq, used_equations)	Indicate if the lhs of equation eq appears in used_equations
format_derivative_equation (eq, ...)	Format an individual derivative equation

Methods Documentation

eq_in_evaluate_partial_derivative(eq, used_jacobian_vars)

Indicate if the lhs of equation eq appears in used_jacobian_vars

eq_in_evaluate_y_derivative(eq, used_equations)

Indicate if the lhs of equation eq appears in used_equations

format_derivative_equation(eq, modifiers_with_defining_eqs)

Format an individual derivative equation

format_derivative_equation(eq, modifiers_with_defining_eqs)

Format an individual derivative equation

eq_in_evaluate_y_derivative(eq, used_equations)

Indicate if the lhs of equation eq appears in used_equations

eq_in_evaluate_partial_derivative(eq, used_jacobian_vars)

Indicate if the lhs of equation eq appears in used_jacobian_vars

GeneralisedRushLarsenSecondOrderModel

class chaste_codegen.GeneralisedRushLarsenSecondOrderModel(model, file_name, **kwargs)

Bases: [GeneralisedRushLarsenFirstOrderModel](#)

Holds template and information specific for the GeneralisedRushLarsen model type

GeneralisedRushLarsenSecondOrderModelOpt

class chaste_codegen.GeneralisedRushLarsenSecondOrderModelOpt(model, file_name, **kwargs)

Bases: [GeneralisedRushLarsenFirstOrderModelOpt](#)

Holds template and information specific for the GeneralisedRushLarsenOpt model type

LabviewPrinter

```
class chaste_codegen.LabviewPrinter(symbol_function=None, derivative_function=None,  
                                   lookup_table_function=<function ChastePrinter.<lambda>>)
```

Bases: [ChastePrinter](#)

Converts Sympy expressions to strings for use in Chaste code generation.

To use, create a [ChastePrinter](#) instance, and call its method `doprint()` with a Sympy expression argument.

Arguments:

symbol_function

A function that converts symbols to strings (variable names).

derivative_function

A function that converts derivatives to strings.

lookup_table_function

A function that prints lookup table expressions or returns None if the expression is not in the lookup table.

NormalChasteModel

```
class chaste_codegen.NormalChasteModel(model, file_name, **kwargs)
```

Bases: [ChasteModel](#)

Holds template and information specific for the Normal model type

OptChasteModel

```
class chaste_codegen.OptChasteModel(model, file_name, **kwargs)
```

Bases: [NormalChasteModel](#)

Holds information specific for the Optimised model type. Builds on Normal model type

OptCvodeChasteModel

```
class chaste_codegen.OptCvodeChasteModel(model, file_name, **kwargs)
```

Bases: [CvodeChasteModel](#)

Holds information specific for the Cvode Optimised model type. Builds on Cvode model type

RealFunction

```
class chaste_codegen.RealFunction(*args)
```

Bases: `Function`

RushLarsenC

class chaste_codegen.**RushLarsenC**(*model*, *file_name*, ***kwargs*)

Bases: *RushLarsenModel*

Holds template and information specific for the RushLarsen model type

Attributes Summary

DEFAULT_EXTENSIONS

Methods Summary

<i>format_derivative_equation</i> (<i>eq</i> , ...)	Format an individual derivative equation specified so that other model types can specify more detailed printing
--	---

Attributes Documentation

DEFAULT_EXTENSIONS = ('.h', '.c')

Methods Documentation

format_derivative_equation(*eq*, *modifiers_with_defining_eqs*)

Format an individual derivative equation specified so that other model types can specify more detailed printing

format_derivative_equation(*eq*, *modifiers_with_defining_eqs*)

Format an individual derivative equation specified so that other model types can specify more detailed printing

RushLarsenLabview

class chaste_codegen.**RushLarsenLabview**(*model*, *file_name*, ***kwargs*)

Bases: *RushLarsenC*

Holds template and information specific for the RushLarsen model type

Attributes Summary

DEFAULT_EXTENSIONS

Attributes Documentation

DEFAULT_EXTENSIONS = (None, '.txt')

RushLarsenModel

class chaste_codegen.**RushLarsenModel**(*model, file_name, **kwargs*)

Bases: *ChasteModel*

Holds template and information specific for the RushLarsen model type

Methods Summary

<i>format_deriv_eqs_EvaluateEquations(...)</i>	Format derivative equations belonging to EvaluateEquations, to allow opt model to update what belongs were
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Methods Documentation

format_deriv_eqs_EvaluateEquations(*deriv_eqs_EvaluateEquations*)

Format derivative equations belonging to EvaluateEquations, to allow opt model to update what belongs were

format_deriv_eqs_EvaluateEquations(*deriv_eqs_EvaluateEquations*)

Format derivative equations belonging to EvaluateEquations, to allow opt model to update what belongs were

RushLarsenOptModel

class chaste_codegen.**RushLarsenOptModel**(*model, file_name, **kwargs*)

Bases: *RushLarsenModel*

Holds template and information specific for the RushLarsen model type

Methods Summary

<i>format_deriv_eqs_EvaluateEquations(...)</i>	Format derivative equations belonging to EvaluateEquations, to update what equation belongs were
--	--

Methods Documentation

format_deriv_eqs_EvaluateEquations(*deriv_eqs_EvaluateEquations*)

Format derivative equations belonging to EvaluateEquations, to update what equation belongs were

format_deriv_eqs_EvaluateEquations(*deriv_eqs_EvaluateEquations*)

Format derivative equations belonging to EvaluateEquations, to update what equation belongs were

abs

class chaste_codegen.**abs_**(*args)

Bases: *RealFunction*

fdiff(*argindex=1*)

Returns the first derivative of this function.

acos

class chaste_codegen.**acos_**(*args)

Bases: *RealFunction*

fdiff(*argindex=1*)

Returns the first derivative of this function.

cos

class chaste_codegen.**cos_**(*args)

Bases: *RealFunction*

fdiff(*argindex=1*)

Returns the first derivative of this function.

exp

class chaste_codegen.**exp_**(*args)

Bases: *RealFunction*

fdiff(*argindex=1*)

Returns the first derivative of this function.

sin

class chaste_codegen.**sin_**(*args)

Bases: *RealFunction*

fdiff(argindex=1)

Returns the first derivative of this function.

sqrt

class chaste_codegen.**sqrt_**(*args)

Bases: *RealFunction*

fdiff(argindex=1)

Returns the first derivative of this function.

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