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# **pystencils***autodiff Documentation*

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This is the documentation of **pystencils-autodiff**.

This document assumes that you are already familiar with [pystencils](#). If not, here is a good [tutorial](#) to start.



# CHAPTER 1

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## Installation of this Auto-Diff Extension

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Install via pip :

```
pip install pystencils-autodiff
```

or if you downloaded this [repository](#) using:

```
pip install -e .
```

Then, you can access the submodule *pystencils.autodiff*.

```
import pystencils.autodiff
```



# CHAPTER 2

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## Usage

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Create a `pystencils.AssignmentCollection` with `pystencils`:

```
import sympy
import pystencils

z, y, x = pystencils.fields("z, y, x: [20,30]")

forward_assignments = pystencils.AssignmentCollection({
    z[0, 0]: x[0, 0] * sympy.log(x[0, 0] * y[0, 0])
})

print(forward_assignments)
```

```
Subexpressions:
Main Assignments:
z[0,0] ← x_C*log(x_C*y_C)
```

You can then obtain the corresponding backward assignments:

```
from pystencils.autodiff import AutoDiffOp, create_backward_assignments
backward_assignments = create_backward_assignments(forward_assignments)

# Sorting for reproducible outputs
backward_assignments.main_assignments = sorted(backward_assignments.main_assignments, ↵
    key=lambda a: str(a))

print(backward_assignments)
```

You can see the derivatives with respect to the two inputs multiplied by the gradient  $diffz\_C$  of the output  $z\_C$ .

```
Subexpressions:
Main Assignments:
```

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```
\hat{x}[0,0] ← diffz_C*(log(x_C*y_C) + 1)  
\hat{y}[0,0] ← diffz_C*x_C/y_C
```

You can also use the class `pystencils_autodiff.AutoDiffOp` to obtain both the assignments (if you are curious) and auto-differentiable operations for Tensorflow...

```
op = AutoDiffOp(forward_assignments)  
backward_assignments = op.backward_assignments  
  
tensorflow_op = op.create_tensorflow_op(backend='tensorflow_native', use_cuda=False)
```

... or Torch:

```
torch_op = op.create_tensorflow_op(backend='torch_native', use_cuda=False)
```

## 2.1 Contents

### 2.1.1 License

`pystencils_autodiff` – Adds automatic differentiation and generation of Tensorflow/PyTorch operations to `pystencils`  
Copyright © 2019 Stephan Seitz

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### 2.1.2 Contributors

- Stephan Seitz <[stephan.seitz@fau.de](mailto:stephan.seitz@fau.de)>

### 2.1.3 Changelog

#### 2.1.3.1 0.2.2

- Add possibility to overwrite nvcc arch for Tensorflow compilation: PYSTEN-CILS\_TENSORFLOW\_NVCC\_ARCH
- Add possibility to compile Tensorflow module without loading

#### 2.1.3.2 0.2.1

- Bugfix: tensorflow\_jit had erroneous code for writing to pystencils' config file

### 2.1.3.3 0.2.0

- Compilation of Torch/Tensorflow/pybind11 modules with an AST (instead of pure jinja as before)



## 2.1.4 **pystencils\_autodiff**

### 2.1.4.1 **pystencils\_autodiff** package

#### 2.1.4.1.1 Subpackages

##### 2.1.4.1.1.1 **pystencils\_autodiff.backends** package

#### 2.1.4.1.1.2 Submodules

##### 2.1.4.1.1.3 **pystencils\_autodiff.backends.astnodes** module

##### 2.1.4.1.1.4 **pystencils\_autodiff.backends.python\_bindings** module

#### 2.1.4.1.1.5 Module contents

##### 2.1.4.1.1.6 **pystencils\_autodiff.framework\_integration** package

#### 2.1.4.1.1.7 Submodules

##### 2.1.4.1.1.8 **pystencils\_autodiff.framework\_integration.astnodes** module

##### 2.1.4.1.1.9 **pystencils\_autodiff.framework\_integration.datahandling** module

##### 2.1.4.1.1.10 **pystencils\_autodiff.framework\_integration.printer** module

##### 2.1.4.1.1.11 **pystencils\_autodiff.framework\_integration.texture\_astnodes** module

#### 2.1.4.1.1.12 Module contents

##### 2.1.4.1.1.13 **pystencils\_autodiff.lbmc** package

#### 2.1.4.1.1.14 Submodules

##### 2.1.4.1.1.15 **pystencils\_autodiff.lbmc.adjoint\_boundaryconditions** module

#### 2.1.4.1.1.16 Module contents

#### 2.1.4.1.2 Submodules

##### 2.1.4.1.3 **pystencils\_autodiff.field\_tensor\_conversion** module

##### 2.1.4.1.4 **pystencils\_autodiff.kernel\_wrapper** module

##### 2.1.4.1.5 **pystencils\_autodiff.tensorflow\_jit** module

##### 2.1.4.1.6 **pystencils\_autodiff.transformations** module

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#### 2.1.4.1.7 Module contents

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- search