```
pip install symforce
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Collecting symforce
  Downloading symforce-0.7.0-cp38-cp38-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (4.4 MB)
     |████████████████████████████████| 4.4 MB 5.4 MB/s
Requirement already satisfied: numpy in /usr/local/lib/python3.8/dist-packages (from symforce) (1.21.6)
Collecting skymarshal==0.7.0
  Downloading skymarshal-0.7.0-py3-none-any.whl (82 kB)
     |████████████████████████████████| 82 kB 312 kB/s
Collecting sympy~=1.11.1
  Downloading sympy-1.11.1-py3-none-any.whl (6.5 MB)
     |████████████████████████████████| 6.5 MB 42.5 MB/s
Requirement already satisfied: scipy in /usr/local/lib/python3.8/dist-packages (from symforce) (1.7.3)
Collecting clang-format
  Downloading clang_format-15.0.4-py2.py3-none-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (1.5 MB)
     |████████████████████████████████| 1.5 MB 23.6 MB/s
Collecting black
  Downloading black-22.10.0-cp38-cp38-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (1.5 MB)
     |████████████████████████████████| 1.5 MB 50.7 MB/s
Requirement already satisfied: jinja2 in /usr/local/lib/python3.8/dist-packages (from symforce) (2.11.3)
Collecting symforce-sym==0.7.0
  Downloading symforce_sym-0.7.0-py3-none-any.whl (70 kB)
     |████████████████████████████████| 70 kB 4.6 MB/s
Requirement already satisfied: graphviz in /usr/local/lib/python3.8/dist-packages (from symforce) (0.10.1)
Requirement already satisfied: six in /usr/local/lib/python3.8/dist-packages (from skymarshal==0.7.0->symforce) (1.15.0)
Collecting ply
  Downloading ply-3.11-py2.py3-none-any.whl (49 kB)
     |████████████████████████████████| 49 kB 3.9 MB/s
Collecting argh
  Downloading argh-0.26.2-py2.py3-none-any.whl (30 kB)
Requirement already satisfied: mpmath>=0.19 in /usr/local/lib/python3.8/dist-packages (from sympy~=1.11.1->symforce) (1.2.1)
Requirement already satisfied: typing-extensions>=3.10.0.0 in /usr/local/lib/python3.8/dist-packages (from black->symforce) (4.1.1)
Requirement already satisfied: tomli>=1.1.0 in /usr/local/lib/python3.8/dist-packages (from black->symforce) (2.0.1)
Collecting platformdirs>=2
  Downloading platformdirs-2.5.4-py3-none-any.whl (14 kB)
Collecting pathspec>=0.9.0
  Downloading pathspec-0.10.2-py3-none-any.whl (28 kB)
Collecting click>=8.0.0
  Downloading click-8.1.3-py3-none-any.whl (96 kB)
     |████████████████████████████████| 96 kB 3.9 MB/s
Collecting mypy-extensions>=0.4.3
  Downloading mypy_extensions-0.4.3-py2.py3-none-any.whl (4.5 kB)
Requirement already satisfied: MarkupSafe>=0.23 in /usr/local/lib/python3.8/dist-packages (from jinja2->symforce) (2.0.1)
Installing collected packages: ply, platformdirs, pathspec, mypy-extensions, click, argh, sympy, symforce-sym, skymarshal, clang-format,
  Attempting uninstall: click
    Found existing installation: click 7.1.2
    Uninstalling click-7.1.2:
      Successfully uninstalled click-7.1.2
  Attempting uninstall: sympy
    Found existing installation: sympy 1.7.1
    Uninstalling sympy-1.7.1:
      Successfully uninstalled sympy-1.7.1
ERROR: pip's dependency resolver does not currently take into account all the packages that are installed. This behaviour is the source
flask 1.1.4 requires click<8.0,>=5.1, but you have click 8.1.3 which is incompatible.
Successfully installed argh-0.26.2 black-22.10.0 clang-format-15.0.4 click-8.1.3 mypy-extensions-0.4.3 pathspec-0.10.2 platformdirs-2.5
```

```
import numpy as np
import os
import symforce

symforce.set_symbolic_api("symengine")
symforce.set_log_level("warning")

# https://symforce.org/tutorials/epsilon_tutorial.html
symforce.set_epsilon_to_symbol()

from symforce import codegen
from symforce.codegen import codegen_util
from symforce import ops
import symforce.symbolic as sf
```

```python
from symforce.values import Values
from symforce.notebook_util import display, display_code, display_code_file


def az_el_from_point(
    nav_T_cam: sf.Pose3, nav_t_point: sf.Vector3, epsilon: sf.Scalar = 0
) -> sf.Vector2:
    """
    Transform a nav point into azimuth / elevation angles in the
    camera frame.

    Args:
        nav_T_cam (sf.Pose3): camera pose in the world
        nav_t_point (sf.Matrix): nav point
        epsilon (Scalar): small number to avoid singularities

    Returns:
        sf.Matrix: (azimuth, elevation)
    """
    cam_t_point = nav_T_cam.inverse() * nav_t_point
    x, y, z = cam_t_point
    theta = sf.atan2(y, x + epsilon)
    phi = sf.pi / 2 - sf.acos(z / (cam_t_point.norm() + epsilon))
    return sf.V2(theta, phi)


az_el_codegen = codegen.Codegen.function(
    func=az_el_from_point,
    config=codegen.CppConfig(),
)
az_el_codegen_data = az_el_codegen.generate_function()

print("Files generated in {}:\n".format(az_el_codegen_data.output_dir))
for f in az_el_codegen_data.generated_files:
    print("  |- {}".format(os.path.relpath(f, az_el_codegen_data.output_dir)))

display_code_file(az_el_codegen_data.generated_files[0], "C++")
```

```cpp
 /
 template <typename Scalar>
 Eigen::Matrix<Scalar, 2, 1> AzElFromPoint(const sym::Pose3<Scalar>& nav_T_cam,
                                           const Eigen::Matrix<Scalar, 3, 1>& nav_t_point,
                                           const Scalar epsilon) {
   // Total ops: 78

   // Input arrays
   const Eigen::Matrix<Scalar, 7, 1>& _nav_T_cam = nav_T_cam.Data();

   // Intermediate terms (24)
   const Scalar _tmp0 = 2 * _nav_T_cam[0];
   const Scalar _tmp1 = _nav_T_cam[3] * _tmp0;
   const Scalar _tmp2 = 2 * _nav_T_cam[1];
```

```python
codegen_with_jacobians = az_el_codegen.with_jacobians(
    which_args=["nav_T_cam", "nav_t_point"],
    include_results=True,
)

data = codegen_with_jacobians.generate_function()
from symforce.notebook_util import display_code_file

display_code_file(data.generated_files[0], "C++")
```