

---

# Python support for the Linux perf profiler

Wydanie 3.14.0a0

Guido van Rossum and the Python development team

września 18, 2024

Python Software Foundation  
Email: docs@python.org

## Spis treści

1	How to enable <code>perf</code> profiling support	4
2	How to obtain the best results	4
3	How to work without frame pointers	5
	Indeks	6

---

### autor

Pablo Galindo

The Linux `perf` profiler is a very powerful tool that allows you to profile and obtain information about the performance of your application. `perf` also has a very vibrant ecosystem of tools that aid with the analysis of the data that it produces.

The main problem with using the `perf` profiler with Python applications is that `perf` only gets information about native symbols, that is, the names of functions and procedures written in C. This means that the names and file names of Python functions in your code will not appear in the output of `perf`.

Since Python 3.12, the interpreter can run in a special mode that allows Python functions to appear in the output of the `perf` profiler. When this mode is enabled, the interpreter will interpose a small piece of code compiled on the fly before the execution of every Python function and it will teach `perf` the relationship between this piece of code and the associated Python function using `perf` map files.

### Informacja

Support for the `perf` profiler is currently only available for Linux on select architectures. Check the output of the `configure` build step or check the output of `python -m sysconfig | grep HAVE_PERF_TRAMPOLINE` to see if your system is supported.

For example, consider the following script:

```
def foo(n):  
    result = 0
```

(ciąg dalszy na następnej stronie)

(kontynuacja poprzedniej strony)

```
for _ in range(n):
    result += 1
return result

def bar(n):
    foo(n)

def baz(n):
    bar(n)

if __name__ == "__main__":
    baz(1000000)
```

We can run perf to sample CPU stack traces at 9999 hertz:

```
$ perf record -F 9999 -g -o perf.data python my_script.py
```

Then we can use perf report to analyze the data:

```
$ perf report --stdio -n -g
```

#	Children	Self	Samples	Command	Shared Object	Symbol		
#	.....	.....	.....	.....	.....	.....		
↪	.....	.....	.....	.....	.....	.....		
#	91.08%	0.00%	0	python.exe	python.exe	[.] _start		
						---		
						__start		
		--90.71%		--__libc_start_main				
				Py_BytesMain				
				--56.88%	--pymain_run_python.constprop.0			
					--56.13%	--_PyRun_AnyFileObject		
						_PyRun_SimpleFileObject		
						--55.02%	--run_mod	
						--54.65%	--PyEval_EvalCode	
						_PyEval_		
↪EvalFrameDefault								
↪Vectorcall						PyObject_		
						_PyEval_Vector		
↪EvalFrameDefault						_PyEval_		
↪Vectorcall						PyObject_		
						_PyEval_Vector		
						_PyEval_		
↪EvalFrameDefault						PyObject_		
↪Vectorcall						_PyEval_Vector		
							--51.67%	--_
↪PyEval_EvalFrameDefault								
↪11.52%	--_PyLong_Add							--

(ciąg dalszy na następnej stronie)



(kontynuacja poprzedniej strony)

→13.77%--_PyLong_Add						--
→						└
→						└
→	--3.26%--_PyObject_Malloc					└

## 1 How to enable perf profiling support

perf profiling support can be enabled either from the start using the environment variable `PYTHONPERFSUPPORT` or the `-X perf` option, or dynamically using `sys.activate_stack_trampoline()` and `sys.deactivate_stack_trampoline()`.

The `sys` functions take precedence over the `-X` option, the `-X` option takes precedence over the environment variable.

Example, using the environment variable:

```
$ PYTHONPERFSUPPORT=1 perf record -F 9999 -g -o perf.data python script.py
$ perf report -g -i perf.data
```

Example, using the `-X` option:

```
$ perf record -F 9999 -g -o perf.data python -X perf script.py
$ perf report -g -i perf.data
```

Example, using the `sys` APIs in file `example.py`:

```
import sys

sys.activate_stack_trampoline("perf")
do_profiled_stuff()
sys.deactivate_stack_trampoline()

non_profiled_stuff()
```

...then:

```
$ perf record -F 9999 -g -o perf.data python ./example.py
$ perf report -g -i perf.data
```

## 2 How to obtain the best results

For best results, Python should be compiled with `CFLAGS="-fno-omit-frame-pointer -mno-omit-leaf-frame-pointer"` as this allows profilers to unwind using only the frame pointer and not on DWARF debug information. This is because as the code that is interposed to allow perf support is dynamically generated it doesn't have any DWARF debugging information available.

You can check if your system has been compiled with this flag by running:

```
$ python -m sysconfig | grep 'no-omit-frame-pointer'
```

If you don't see any output it means that your interpreter has not been compiled with frame pointers and therefore it may not be able to show Python functions in the output of `perf`.

### 3 How to work without frame pointers

If you are working with a Python interpreter that has been compiled without frame pointers, you can still use the `perf` profiler, but the overhead will be a bit higher because Python needs to generate unwinding information for every Python function call on the fly. Additionally, `perf` will take more time to process the data because it will need to use the DWARF debugging information to unwind the stack and this is a slow process.

To enable this mode, you can use the environment variable `PYTHON_PERF_JIT_SUPPORT` or the `-Xperf_jit` option, which will enable the JIT mode for the `perf` profiler.

#### Informacja

Due to a bug in the `perf` tool, only `perf` versions higher than v6.8 will work with the JIT mode. The fix was also backported to the v6.7.2 version of the tool.

Note that when checking the version of the `perf` tool (which can be done by running `perf version`) you must take into account that some distros add some custom version numbers including a `-` character. This means that `perf 6.7-3` is not necessarily `perf 6.7.3`.

When using the `perf` JIT mode, you need an extra step before you can run `perf report`. You need to call the `perf inject` command to inject the JIT information into the `perf.data` file.:

```
$ perf record -F 9999 -g --call-graph dwarf -o perf.data python -Xperf_jit my_
↳script.py
$ perf inject -i perf.data --jit --output perf.jit.data
$ perf report -g -i perf.jit.data
```

or using the environment variable:

```
$ PYTHON_PERF_JIT_SUPPORT=1 perf record -F 9999 -g --call-graph dwarf -o perf.data
↳python my_script.py
$ perf inject -i perf.data --jit --output perf.jit.data
$ perf report -g -i perf.jit.data
```

`perf inject --jit` command will read `perf.data`, automatically pick up the `perf` dump file that Python creates (in `/tmp/perf-$PID.dump`), and then create `perf.jit.data` which merges all the JIT information together. It should also create a lot of `jitted-XXXX-N.so` files in the current directory which are ELF images for all the JIT trampolines that were created by Python.

#### Ostrzeżenie

Notice that when using `--call-graph dwarf` the `perf` tool will take snapshots of the stack of the process being profiled and save the information in the `perf.data` file. By default the size of the stack dump is 8192 bytes but the user can change the size by passing the size after comma like `--call-graph dwarf,4096`. The size of the stack dump is important because if the size is too small `perf` will not be able to unwind the stack and the output will be incomplete. On the other hand, if the size is too big, then `perf` won't be able to sample the process as frequently as it would like as the overhead will be higher.

## Indeks

### P

`PYTHON_PERF_JIT_SUPPORT`, 5

`PYTHONPERFSUPPORT`, 4

### Z

zmienna środowiskowa

`PYTHON_PERF_JIT_SUPPORT`, 5

`PYTHONPERFSUPPORT`, 4