
argon2*cf fi Documentation*

Release 15.0.1

Hynek Schlawack

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Release v15.0.1 (*What's new?*).

Argon2 won the [Password Hashing Competition](#) and `argon2_cffi` is the simplest way to use it in Python and PyPy:

```
>>> import argon2
>>> hash = argon2.hash_password(b"secret")
>>> hash
b'$argon2i$m=512,t=2,p=2$c29tZXNhbmHQ$2IdoNVglVTxb9w4YVJqW8w'
>>> argon2.verify_password(hash, b"secret")
True
>>> argon2.verify_password(hash, b"wrong")
Traceback (most recent call last):
...
argon2.exceptions.VerificationError: Decoding failed
```

`argon2_cffi`'s documentation lives at [Read the Docs](#), the code on [GitHub](#). It's rigorously tested on Python 2.6, 2.7, 3.3+, and PyPy.

1.1 Argon2

Note: **TL;DR:** Use **Argon2i** to securely hash your passwords.

You do **not** need to read or understand anything below this box.

Argon2 is a secure password hashing algorithm. It is designed to have both a configurable runtime as well as memory consumption.

This means that you can decide how long it takes to hash a password and how much memory is required.

Argon2 comes in two variants:

Argon2d is faster and uses data-dependent memory access, which makes it less suitable for hashing secrets and more suitable for cryptocurrencies and applications with no threats from side-channel timing attacks.

Argon2i uses data-independent memory access, which is preferred for password hashing and password-based key derivation. Argon2i is slower as it makes more passes over the memory to protect from tradeoff attacks.

1.1.1 Why “just use bcrypt” Is Not the Answer

There's an unfortunate meme to respond to questions of storage of secrets like passwords to “just use **bcrypt**”. The problem is, neither **bcrypt** nor its closest NIST-approved competitor **PBKDF2** are fit for hashing passwords in the days of **ASIC** password breakers. In a nutshell, password crackers are able to create highly parallelized hardware specifically tailored to crack computationally expensive password hashes.

An effective measure against extreme parallelism proved making computation of password hashes also *memory* hard. The best known implementation of that approach is to date **scrypt**. However according to the [Argon2 paper](#), page 2:

[...] the existence of a trivial time-memory tradeoff allows compact implementations with the same energy cost.

Therefore a new algorithm was needed.

1.1.2 Password Hashing Competition

The [Password Hashing Competition](#) took place between 2012 and 2015 to find a new, secure, and future-proof password hashing algorithm. Previously the NIST was in charge but after certain events and [revelations](#) their integrity has been put into question by the general public. So a group of independent cryptographers and security researchers came together.

In the end, Argon2 was [announced](#) as the winner.

1.2 Installation

Generally speaking,

```
pip install argon2_cffi
```

should be all it takes.

But since Argon2 (the C library) isn't packaged on any major distribution yet, `argon2_cffi` vendors its C code which depending on the platform can lead to complications.

The C code is known to compile and work on all common platforms (including x86, ARM, and PPC). On x86, an [SSE2-optimized](#) version is used.

If something goes wrong, please try to update your `cffi`, `pip` and `setuptools` first:

```
pip install -U cffi pip setuptools
```

1.2.1 OS X & Windows

Binary [wheels](#) are provided on [PyPI](#). With a recent-enough `pip` and `setuptools`, they should be used automatically.

1.2.2 Linux

A working C compiler and [CFFI environment](#) is required. If you've been able to compile Python CFFI extensions before, `argon2_cffi` should install without any problems.

1.3 API Reference

`argon2_cffi` comes with hopefully reasonable defaults for Argon2 parameters that result in a verification time of between 0.5ms and 1ms on recent-ish hardware.

So unless you have any special needs, all you need to know is:

```
>>> import argon2
>>> hash = argon2.hash_password(b"s3kr3tp4ssw0rd")
>>> hash
b'$argon2i$m=512,t=2,p=2$0FFfEeL6JmUnpxwgwcSC8g$98BmZUa5A/3t5wb3ZxFLBg'
>>> argon2.verify_password(hash, b"s3kr3tp4ssw0rd")
True
>>> argon2.verify_password(hash, b"t0t41lywr0ng")
Traceback (most recent call last):
```

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```
...
argon2.exceptions.VerificationError: Decoding failed
```

But of course, `argon2_cffi` gives you more control should you need it:

```
argon2.hash_password(password, salt=None, time_cost=2, memory_cost=512, parallelism=2,
                     hash_len=16, type=<Type.I: 1>)
Hash password and return an encoded hash.
```

An encoded hash can be directly passed into `verify_password()` as it contains all parameters and the salt.

Parameters

- **password** (*bytes*) – Password to hash.
- **salt** (*bytes*) – A **salt**. Should be random and different for each password. Will generate a random salt for you if left `None` (recommended).
- **time_cost** (*int*) – Defines the amount of computation realized and therefore the execution time, given in number of iterations.
- **memory_cost** (*int*) – Defines the memory usage, given in **kibibytes**.
- **parallelism** (*int*) – Defines the number of parallel threads (*changes* the resulting hash value).
- **hash_len** (*int*) – Length of the hash in bytes.
- **type** (*Type*) – Which Argon2 variant to use. In doubt use the default `Type.I` which is better suited for passwords.

Return type *bytes*

```
>>> argon2.hash_password(
...     b"secret", b"somesalt",
...     time_cost=1,          # number of iterations
...     memory_cost=8,        # used memory in KiB
...     parallelism=1,        # number of threads used; changes hash!
...     hash_len=64,          # length of resulting raw hash
...     type=argon2.Type.D,    # choose Argon2i or Argon2d
... )
b'$argon2d$m=8,t=1,p=1$c29tZXNhbHQ$H0oN1/
↪L3H8t8hcg47pAyJZ8toBh2UbgcMt0zRFRqt4mEJCeKSEWGxt+KpZrMwxvr7M5qktNcc/bk/hvbinueJA'
```

```
argon2.verify_password(hash, password, type=<Type.I: 1>)
```

Verify whether *password* is correct for *hash* of *type*.

Parameters

- **hash** (*bytes*) – An encoded Argon2 password hash as returned by `hash_password()`.
- **password** (*bytes*) – The password to verify whether it matches the one in *hash*.
- **type** (*Type*) – Type for *hash*.

Returns `True` on success, throw exception otherwise.

Return type *bool*

The raw hash can also be computed:

```
argon2.hash_password_raw(password, salt=None, time_cost=2, memory_cost=512, parallelism=2,
                        hash_len=16, type=<Type.I: 1>)
Hash password and return a raw hash.
```

This function takes the same parameters as `hash_password()`.

```
>>> argon2.hash_password_raw(b"secret", b"somesalt")
b'\xd8\x87h5X%U<[\xf7\x0e\x18T\x9a\x96\xf3'
```

class argon2.Type

Enum of Argon2 variants.

D = 0

Argon2d is faster and uses data-depending memory access, which makes it less suitable for hashing secrets and more suitable for cryptocurrencies and applications with no threats from side-channel timing attacks.

I = 1

Argon2i uses data-independent memory access, which is preferred for password hashing and password-based key derivation. Argon2i is slower as it makes more passes over the memory to protect from tradeoff attacks.

1.4 Choosing Parameters

Finding the right parameters for a password hashing algorithm is a daunting task. The authors of Argon2 specified a method in their [paper](#) but it should be noted that they also mention that no value for `time_cost` or `memory_cost` is actually insecure (cf. section 6.4).

1. Choose whether you want Argon2i or Argon2d (type). If you don't know what that means, choose Argon2i (`argon2.Type.I`).
2. Figure out how many threads can be used on each call to Argon2 (parallelism). They recommend twice as many as the number of cores dedicated to hashing passwords.
3. Figure out how much memory each call can afford (`memory_cost`).
4. Choose a salt length. 16 Bytes are fine.
5. Choose a hash length (`hash_len`). 16 Bytes are fine.
6. Figure out how long each call can take. One [recommendation](#) for concurrent user logins is to keep it under 0.5ms.
7. Measure the time for hashing using your chosen parameters. Find a `time_cost` that is within your accounted time. If `time_cost=1` takes too long, lower `memory_cost`.

`argon2_cffi`'s [CLI](#) will help you with this process.

1.5 CLI

To aid you with finding the parameters, `argon2_cffi` offers a CLI interface that can be accessed using `python -m argon2`. It will benchmark Argon2's password *verification* in the current environment. You can use command line arguments to set hashing parameters:

```
$ python -m argon2 -t 1 -m 512 -p 2
Running Argon2i 100 times with:
hash_len: 16
memory_cost: 512
parallelism: 2
time_cost: 1

Measuring...
```

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0.418ms per password verification

This should make it much easier to determine the right parameters for your use case and your environment.

2.1 Backward Compatibility

`argon2_cffi` has a very strong backward compatibility policy. Generally speaking, you shouldn't ever be afraid of updating.

If breaking changes are needed to be done, they are:

1. ...announced in the [changelog](#).
2. ...the old behavior raises a `DeprecationWarning` for a year.
3. ...are done with another announcement in the [changelog](#).

What explicitly *may* change over time are the default hashing parameters.

2.2 How To Contribute

Every open source project lives from the generous help by contributors that sacrifice their time and `argon2_cffi` is no different.

Here are a few guidelines to get you started:

- Try to limit each pull request to one change only.
- To run the test suite, all you need is a recent `tox`. It will ensure the test suite runs with all dependencies against all Python versions just as it will on [Travis CI](#). If you lack some Python version, you can always limit the environments like `tox -e py27,py35` (in that case you may want to look into [pyenv](#) that makes it very easy to install many different Python versions in parallel).
- Make sure your changes pass our CI. You won't get any feedback until it's green unless you ask for it.
- If you address review feedback, make sure to bump the pull request. Maintainers don't receive notifications if you push new commits.

- If your change is noteworthy, add an entry to the [changelog](#). Use present tense, semantic newlines, and add link to your pull request.
- No contribution is too small; please submit as many fixes for typos and grammar bloopers as you can!
- Don't break backward compatibility.
- *Always* add tests and docs for your code. This is a hard rule; patches with missing tests or documentation won't be merged.
- Write [good test docstrings](#).
- Obey [PEP 8](#) and [PEP 257](#).

Please note that this project is released with a Contributor [Code of Conduct](#). By participating in this project you agree to abide by its terms. Please report any harm to [Hynek Schlawack](#) in any way you find appropriate.

Thank you for considering to contribute!

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- Trolling or insulting/derogatory comments
- Public or private harassment
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- Other unethical or unprofessional conduct

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This Code of Conduct is adapted from the [Contributor Covenant](#), version 1.3.0, available at <http://contributor-covenant.org/version/1/3/0/>.

2.4 Changelog

Versions are year-based with a strict backward compatibility policy. The third digit is only for regressions.

2.4.1 15.0.1 (2015-12-18)

Vendoring argon2 @ 4fe0d8cda37691228dd5a96a310be57369403a4b.

Changes:

- Fix `long_description` on PyPI.

2.4.2 15.0.0 (2015-12-18)

Vendoring argon2 @ 4fe0d8cda37691228dd5a96a310be57369403a4b.

Changes:

- `verify_password()` doesn't guess the hash type if passed `None` anymore. Supporting this resulted in measurable overhead (~ 0.6ms vs 0.8ms on my notebook) since it had to happen in Python. That means that naïve usage of the API would give attackers an edge. The new behavior is that it has the same default value as `hash_password()` such that `verify_password(hash_password(b"password"), b"password")` still works.
- Conditionally use the [SSE2](#)-optimized version of `argon2` on x86 architectures.
- More packaging fixes. Most notably compilation on Visual Studio 2010 for Python 3.3 and 3.4.
- Tweaked default parameters to more reasonable values. Verification should take between 0.5ms and 1ms on recent-ish hardware.

2.4.3 15.0.0b5 (2015-12-10)

Vendoring argon2 @ 4fe0d8cda37691228dd5a96a310be57369403a4b.

Initial work. Previous betas were only for fixing Windows packaging. The authors of `argon2` were kind enough to [help me](#) to get it building under Visual Studio 2008 that we're forced to use for Python 2.7 on Windows.

2.5 Credits & License

`argon2_cffi` is maintained by Hynek Schlawack and released under the [MIT license](#).

The development is kindly supported by [Variomedia AG](#).

A full list of contributors can be found in GitHub's [overview](#).

2.5.1 Vended Code

Argon2

The original Argon2 repo can be found at <https://github.com/P-H-C/phc-winner-argon2/>.

Except for the components listed below, the Argon2 code in this repository is copyright (c) 2015 Daniel Dinu, Dmitry Khovratovich (main authors), Jean-Philippe Aumasson and Samuel Neves, and under CC0 license.

The string encoding routines in `src/encoding.c` are copyright (c) 2015 Thomas Pornin, and under CC0 license.

The BLAKE2 code in `src/blake2/` is copyright (c) Samuel Neves, 2013-2015, and under CC0 license.

The authors of Argon2 also were very helpful to get the library to compile on ancient versions of Visual Studio for ancient versions of Python.

The documentation also quotes frequently from the Argon2 [paper](#) to avoid mistakes by rephrasing.

msinttypes

In order to be able to compile on Visual Studio 2008 and Visual Studio 2010 which are required for Python 2.6/2.7 and 3.3/3.4 respectively, we also ship two C headers with integer types. They are from the [msinttypes project \(auto-import on GitHub\)](#) and licensed under New BSD:

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CHAPTER 3

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