

primesieve

5.7.2

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Chapter 1

Main Page

1.1 About

primesieve is a C/C++ library for fast prime number generation. It generates the primes below 10^9 in just 0.2 seconds on a single core of an Intel Core i7-6700 3.4GHz CPU. primesieve can generate primes and prime k-tuplets up to 2^{64} . primesieve's memory requirement is about $\pi(\sqrt{n}) * 8$ bytes per thread, its run-time complexity is $O(n \log \log n)$ operations. The recommended way to get started is to first have a look at a few C or C++ example programs. The most common use cases are storing primes in a vector (or array) and iterating over primes using `next_prime()` or `previous_prime()`.

For more information please visit <http://primesieve.org>.

1.2 C++ API

- [primesieve.hpp](#) - primesieve C++ header.
- [store_primes_in_vector.cpp](#) - Example that shows how to store primes in a `std::vector`.
- [primesieve_iterator.cpp](#) - Example that shows how to iterate over primes using `primesieve::iterator`.
- [count_primes.cpp](#) - Example that shows how to count primes.

1.3 C API

- [primesieve.h](#) - primesieve C header.
- [store_primes_in_array.c](#) - Example that shows how to store primes in an array.
- [primesieve_iterator.c](#) - Example that shows how to iterate over primes using `primesieve_iterator`.
- [count_primes.c](#) - Example that shows how to count primes.

Chapter 2

Namespace Index

2.1 Namespace List

Here is a list of all documented namespaces with brief descriptions:

primesieve	
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Chapter 3

Hierarchical Index

3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

primesieve::Callback< T >	17
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Chapter 4

Class Index

4.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

primesieve::Callback< T >	
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File Index

5.1 File List

Here is a list of all documented files with brief descriptions:

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primesieve.hpp		
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Chapter 6

Namespace Documentation

6.1 primesieve Namespace Reference

Contains primesieve's C++ functions and classes.

Classes

- class [Callback](#)
callback interface class.
- class [iterator](#)
[primesieve::iterator](#) allows to easily iterate over primes both forwards and backwards.
- class [primesieve_error](#)
primesieve throws a [primesieve_error](#) exception if an error occurs that cannot be handled e.g.

Functions

- `template<typename T >`
`void generate_primes (uint64_t stop, std::vector< T > *primes)`
Store the primes \leq stop in the primes vector.
- `template<typename T >`
`void generate_primes (uint64_t start, uint64_t stop, std::vector< T > *primes)`
Store the primes within the interval [start, stop] in the primes vector.
- `template<typename T >`
`void generate_n_primes (uint64_t n, std::vector< T > *primes)`
Store the first n primes in the primes vector.
- `template<typename T >`
`void generate_n_primes (uint64_t n, uint64_t start, std::vector< T > *primes)`
Store the first n primes \geq start in the primes vector.
- `uint64_t nth_prime (int64_t n, uint64_t start=0)`
Find the nth prime.
- `uint64_t parallel_nth_prime (int64_t n, uint64_t start=0)`
Find the nth prime in parallel.
- `uint64_t count_primes (uint64_t start, uint64_t stop)`
Count the primes within the interval [start, stop].
- `uint64_t count_twins (uint64_t start, uint64_t stop)`

- Count the twin primes within the interval [start, stop].*

 - uint64_t [count_triplets](#) (uint64_t start, uint64_t stop)
- Count the prime triplets within the interval [start, stop].*

 - uint64_t [count_quadruplets](#) (uint64_t start, uint64_t stop)
- Count the prime quadruplets within the interval [start, stop].*

 - uint64_t [count_quintuplets](#) (uint64_t start, uint64_t stop)
- Count the prime quintuplets within the interval [start, stop].*

 - uint64_t [count_sextuplets](#) (uint64_t start, uint64_t stop)
- Count the prime sextuplets within the interval [start, stop].*

 - uint64_t [parallel_count_primes](#) (uint64_t start, uint64_t stop)
- Count the primes within the interval [start, stop] in parallel.*

 - uint64_t [parallel_count_twins](#) (uint64_t start, uint64_t stop)
- Count the twin primes within the interval [start, stop] in parallel.*

 - uint64_t [parallel_count_triplets](#) (uint64_t start, uint64_t stop)
- Count the prime triplets within the interval [start, stop] in parallel.*

 - uint64_t [parallel_count_quadruplets](#) (uint64_t start, uint64_t stop)
- Count the prime quadruplets within the interval [start, stop] in parallel.*

 - uint64_t [parallel_count_quintuplets](#) (uint64_t start, uint64_t stop)
- Count the prime quintuplets within the interval [start, stop] in parallel.*

 - uint64_t [parallel_count_sextuplets](#) (uint64_t start, uint64_t stop)
- Count the prime sextuplets within the interval [start, stop] in parallel.*

 - void [print_primes](#) (uint64_t start, uint64_t stop)
- Print the primes within the interval [start, stop] to the standard output.*

 - void [print_twins](#) (uint64_t start, uint64_t stop)
- Print the twin primes within the interval [start, stop] to the standard output.*

 - void [print_triplets](#) (uint64_t start, uint64_t stop)
- Print the prime triplets within the interval [start, stop] to the standard output.*

 - void [print_quadruplets](#) (uint64_t start, uint64_t stop)
- Print the prime quadruplets within the interval [start, stop] to the standard output.*

 - void [print_quintuplets](#) (uint64_t start, uint64_t stop)
- Print the prime quintuplets within the interval [start, stop] to the standard output.*

 - void [print_sextuplets](#) (uint64_t start, uint64_t stop)
- Print the prime sextuplets within the interval [start, stop] to the standard output.*

 - void [callback_primes](#) (uint64_t start, uint64_t stop, void(*callback)(uint64_t prime))
- Call back the primes within the interval [start, stop].*

 - void [callback_primes](#) (uint64_t start, uint64_t stop, [primesieve::Callback](#)< uint64_t > *callback)
- Call back the primes within the interval [start, stop].*

 - int [get_sieve_size](#) ()
- Get the current set sieve size in kilobytes.*

 - int [get_num_threads](#) ()
- Get the current set number of threads.*

 - uint64_t [get_max_stop](#) ()
- Returns the largest valid stop number for primesieve.*

 - void [set_sieve_size](#) (int sieve_size)
- Set the sieve size in kilobytes.*

 - void [set_num_threads](#) (int num_threads)
- Set the number of threads for use in subsequent primesieve::parallel_* function calls.*

 - bool [primesieve_test](#) ()
- Run extensive correctness tests.*

 - std::string [primesieve_version](#) ()
- Get the primesieve version number, in the form "i.j.k".*

6.1.1 Detailed Description

Contains primesieve's C++ functions and classes.

6.1.2 Function Documentation

6.1.2.1 `callback_primes()` [1/2]

```
void primesieve::callback_primes (
    uint64_t start,
    uint64_t stop,
    void(*) (uint64_t prime) callback )
```

Call back the primes within the interval [start, stop].

Parameters

<i>callback</i>	A callback function.
-----------------	----------------------

Examples:

[callback_primes.cpp](#).

6.1.2.2 `callback_primes()` [2/2]

```
void primesieve::callback_primes (
    uint64_t start,
    uint64_t stop,
    primesieve::Callback< uint64_t > * callback )
```

Call back the primes within the interval [start, stop].

Parameters

<i>callback</i>	An object derived from <code>primesieve::Callback<uint64_t></code> .
-----------------	----------------------------------------------------------------------------

6.1.2.3 `get_max_stop()`

```
uint64_t primesieve::get_max_stop ( )
```

Returns the largest valid stop number for primesieve.

Returns

$2^{64}-1$ (UINT64_MAX).

6.1.2.4 nth_prime()

```
uint64_t primesieve::nth_prime (
    int64_t n,
    uint64_t start = 0 )
```

Find the nth prime.

Parameters

<i>n</i>	if $n = 0$ finds the 1st prime \geq start, if $n > 0$ finds the nth prime $>$ start, if $n < 0$ finds the nth prime $<$ start (backwards).
----------	----------------------------------------------------------------------------------------------------------------------------------------------------

Examples:

[nth_prime.cpp](#).

6.1.2.5 parallel_count_primes()

```
uint64_t primesieve::parallel_count_primes (
    uint64_t start,
    uint64_t stop )
```

Count the primes within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve::set_num_threads\(int\)](#) to change the number of threads.

Examples:

[count_primes.cpp](#).

6.1.2.6 parallel_count_quadruplets()

```
uint64_t primesieve::parallel_count_quadruplets (
    uint64_t start,
    uint64_t stop )
```

Count the prime quadruplets within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve::set_num_threads\(int\)](#) to change the number of threads.

6.1.2.7 parallel_count_quintuplets()

```
uint64_t primesieve::parallel_count_quintuplets (
    uint64_t start,
    uint64_t stop )
```

Count the prime quintuplets within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve::set_num_threads\(int\)](#) to change the number of threads.

6.1.2.8 parallel_count_sextuplets()

```
uint64_t primesieve::parallel_count_sextuplets (
    uint64_t start,
    uint64_t stop )
```

Count the prime sextuplets within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve::set_num_threads\(int\)](#) to change the number of threads.

6.1.2.9 parallel_count_triplets()

```
uint64_t primesieve::parallel_count_triplets (
    uint64_t start,
    uint64_t stop )
```

Count the prime triplets within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve::set_num_threads\(int\)](#) to change the number of threads.

6.1.2.10 parallel_count_twins()

```
uint64_t primesieve::parallel_count_twins (
    uint64_t start,
    uint64_t stop )
```

Count the twin primes within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve::set_num_threads\(int\)](#) to change the number of threads.

6.1.2.11 parallel_nth_prime()

```
uint64_t primesieve::parallel_nth_prime (
    int64_t n,
    uint64_t start = 0 )
```

Find the nth prime in parallel.

By default all CPU cores are used, use [primesieve::set_num_threads\(int\)](#) to change the number of threads.

Parameters

<i>n</i>	if $n = 0$ finds the 1st prime \geq start, if $n > 0$ finds the n th prime $>$ start, if $n < 0$ finds the n th prime $<$ start (backwards).
----------	----------------------------------------------------------------------------------------------------------------------------------------------------------

6.1.2.12 primesieve_test()

```
bool primesieve::primesieve_test ( )
```

Run extensive correctness tests.

The tests last about one minute on a quad core CPU from 2013 and use up to 1 gigabyte of memory.

Returns

true if success else false.

6.1.2.13 set_sieve_size()

```
void primesieve::set_sieve_size (
    int sieve_size )
```

Set the sieve size in kilobytes.

The best sieving performance is achieved with a sieve size of your CPU's L1 data cache size (per core). For sieving $\geq 10^{17}$ a sieve size of your CPU's L2 cache size sometimes performs better.

Parameters

<i>sieve_size</i>	Sieve size in kilobytes.
-------------------	--------------------------

Precondition

$\text{sieve_size} \geq 1 \ \&\& \ \text{sieve_size} \leq 2048$.

Chapter 7

Class Documentation

7.1 primesieve::Callback< T > Class Template Reference

callback interface class.

```
#include <Callback.hpp>
```

Public Member Functions

- virtual void **callback** (T prime)=0

7.1.1 Detailed Description

```
template<typename T>
class primesieve::Callback< T >
```

callback interface class.

Objects derived from this class can be passed to the [primesieve::generate_primes\(\)](#) functions.

Parameters

<i>T</i>	must be uint64_t.
----------	----------------------

The documentation for this class was generated from the following file:

- [Callback.hpp](#)

7.2 primesieve::iterator Class Reference

[primesieve::iterator](#) allows to easily iterate over primes both forwards and backwards.

```
#include <iterator.hpp>
```

Public Member Functions

- [iterator](#) (uint64_t start=0, uint64_t stop_hint=[get_max_stop](#)())
Create a new iterator object.
- void [skipto](#) (uint64_t start, uint64_t stop_hint=[get_max_stop](#)())
Reinitialize this iterator object to start.
- uint64_t [next_prime](#) ()
Advance the iterator by one position.
- uint64_t [previous_prime](#) ()
Get the previous prime, or 0 if input ≤ 2 e.g.

7.2.1 Detailed Description

[primesieve::iterator](#) allows to easily iterate over primes both forwards and backwards.

Generating the first prime has a complexity of $O(r \log \log r)$ operations with $r = n^{0.5}$, after that any additional prime is generated in amortized $O(\log n \log \log n)$ operations. The memory usage is about $\pi(n^{0.5}) * 16$ bytes. [primesieve::iterator](#) objects are very convenient to use at the cost of being slightly slower than the [callback_primes\(\)](#) functions.

Examples:

[previous_prime.cpp](#), and [primesieve_iterator.cpp](#).

7.2.2 Constructor & Destructor Documentation

7.2.2.1 iterator()

```
primesieve::iterator::iterator (
    uint64_t start = 0,
    uint64_t stop_hint = get\_max\_stop() )
```

Create a new iterator object.

Parameters

<i>start</i>	Generate primes $>$ start (or $<$ start).
<i>stop_hint</i>	Stop number optimization hint, gives significant speed up if few primes are generated. E.g. if you want to generate the primes below 1000 use stop_hint = 1000.

7.2.3 Member Function Documentation

7.2.3.1 next_prime()

```
uint64_t primesieve::iterator::next_prime ( ) [inline]
```

Advance the iterator by one position.

Returns

The next prime.

Examples:

[primesieve_iterator.cpp](#).

7.2.3.2 previous_prime()

```
uint64_t primesieve::iterator::previous_prime ( ) [inline]
```

Get the previous prime, or 0 if input ≤ 2 e.g.

`previous_prime(2) = 0`.

Examples:

[previous_prime.cpp](#).

7.2.3.3 skipto()

```
void primesieve::iterator::skipto (
    uint64_t start,
    uint64_t stop_hint = get_max_stop() )
```

Reinitialize this iterator object to start.

Parameters

<i>start</i>	Generate primes $>$ start (or $<$ start).
<i>stop_hint</i>	Stop number optimization hint, gives significant speed up if few primes are generated. E.g. if you want to generate the primes below 1000 use <code>stop_hint = 1000</code> .

Examples:

[previous_prime.cpp](#).

The documentation for this class was generated from the following file:

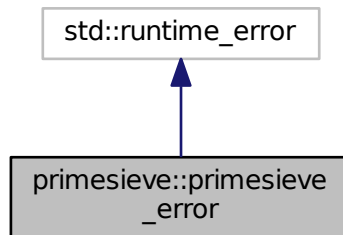
- [iterator.hpp](#)

7.3 primesieve::primesieve_error Class Reference

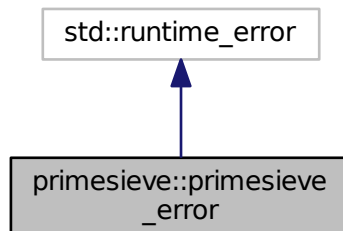
primesieve throws a [primesieve_error](#) exception if an error occurs that cannot be handled e.g.

```
#include <primesieve_error.hpp>
```

Inheritance diagram for primesieve::primesieve_error:



Collaboration diagram for primesieve::primesieve_error:



Public Member Functions

- **primesieve_error** (const std::string &msg)

7.3.1 Detailed Description

primesieve throws a [primesieve_error](#) exception if an error occurs that cannot be handled e.g.

stop > primesieve::max_stop().

The documentation for this class was generated from the following file:

- [primesieve_error.hpp](#)

7.4 primesieve_iterator Struct Reference

C prime iterator, please refer to [primesieve_iterator.h](#) for more information.

```
#include <primesieve_iterator.h>
```

Public Attributes

- `size_t i_`
- `size_t last_idx_`
- `uint64_t * primes_`
- `uint64_t * primes_pimpl_`
- `uint64_t start_`
- `uint64_t stop_`
- `uint64_t stop_hint_`
- `uint64_t tiny_cache_size_`
- `int is_error_`

7.4.1 Detailed Description

C prime iterator, please refer to [primesieve_iterator.h](#) for more information.

Examples:

[previous_prime.c](#), and [primesieve_iterator.c](#).

The documentation for this struct was generated from the following file:

- [primesieve_iterator.h](#)

Chapter 8

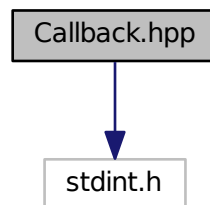
File Documentation

8.1 Callback.hpp File Reference

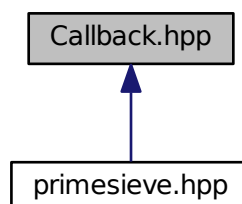
Callback interface classes.

```
#include <stdint.h>
```

Include dependency graph for Callback.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class `primesieve::Callback< T >`
callback interface class.

Namespaces

- `primesieve`
Contains primesieve's C++ functions and classes.

8.1.1 Detailed Description

Callback interface classes.

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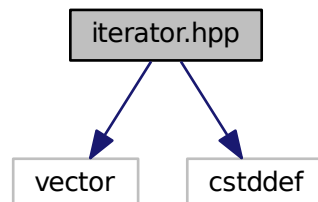
8.2 iterator.hpp File Reference

The iterator class allows to easily iterate (forward and backward) over prime numbers.

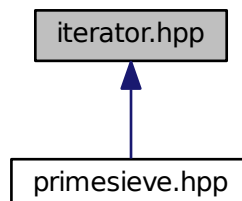
```
#include <vector>
```

```
#include <cstdint>
```

Include dependency graph for `iterator.hpp`:



This graph shows which files directly or indirectly include this file:



Classes

- class [primesieve::iterator](#)
[primesieve::iterator](#) allows to easily iterate over primes both forwards and backwards.

Namespaces

- [primesieve](#)
Contains primesieve's C++ functions and classes.

Functions

- uint64_t [primesieve::get_max_stop\(\)](#)
Returns the largest valid stop number for primesieve.

8.2.1 Detailed Description

The iterator class allows to easily iterate (forward and backward) over prime numbers.

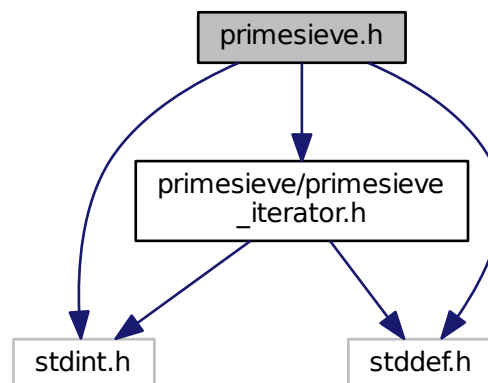
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8.3 primesieve.h File Reference

primesieve C API.

```
#include <primesieve/primesieve_iterator.h>
#include <stdint.h>
#include <stddef.h>
Include dependency graph for primesieve.h:
```



Macros

- `#define PRIMESIEVE_VERSION "5.7.2"`
- `#define PRIMESIEVE_VERSION_MAJOR 5`
- `#define PRIMESIEVE_VERSION_MINOR 7`
- `#define PRIMESIEVE_VERSION_PATCH 2`
- `#define PRIMESIEVE_ERROR ((uint64_t) ~((uint64_t) 0))`
primesieve functions return PRIMESIEVE_ERROR (UINT64_MAX) if any error occurs.

Enumerations

- `enum {`
`SHORT_PRIMES, USHORT_PRIMES, INT_PRIMES, UINT_PRIMES,`
`LONG_PRIMES, ULONG_PRIMES, LONGLONG_PRIMES, ULLONGLONG_PRIMES,`
`INT16_PRIMES, UINT16_PRIMES, INT32_PRIMES, UINT32_PRIMES,`
`INT64_PRIMES, UINT64_PRIMES }`

Functions

- `void * primesieve_generate_primes (uint64_t start, uint64_t stop, size_t *size, int type)`
Get an array with the primes inside the interval [start, stop].
- `void * primesieve_generate_n_primes (uint64_t n, uint64_t start, int type)`
Get an array with the first n primes >= start.
- `uint64_t primesieve_nth_prime (int64_t n, uint64_t start)`
Find the nth prime.
- `uint64_t primesieve_parallel_nth_prime (int64_t n, uint64_t start)`
Find the nth prime in parallel.
- `uint64_t primesieve_count_primes (uint64_t start, uint64_t stop)`
Count the primes within the interval [start, stop].
- `uint64_t primesieve_count_twins (uint64_t start, uint64_t stop)`
Count the twin primes within the interval [start, stop].
- `uint64_t primesieve_count_triplets (uint64_t start, uint64_t stop)`
Count the prime triplets within the interval [start, stop].
- `uint64_t primesieve_count_quadruplets (uint64_t start, uint64_t stop)`
Count the prime quadruplets within the interval [start, stop].
- `uint64_t primesieve_count_quintuplets (uint64_t start, uint64_t stop)`
Count the prime quintuplets within the interval [start, stop].
- `uint64_t primesieve_count_sextuplets (uint64_t start, uint64_t stop)`
Count the prime sextuplets within the interval [start, stop].
- `uint64_t primesieve_parallel_count_primes (uint64_t start, uint64_t stop)`
Count the primes within the interval [start, stop] in parallel.
- `uint64_t primesieve_parallel_count_twins (uint64_t start, uint64_t stop)`
Count the twin primes within the interval [start, stop] in parallel.
- `uint64_t primesieve_parallel_count_triplets (uint64_t start, uint64_t stop)`
Count the prime triplets within the interval [start, stop] in parallel.
- `uint64_t primesieve_parallel_count_quadruplets (uint64_t start, uint64_t stop)`
Count the prime quadruplets within the interval [start, stop] in parallel.
- `uint64_t primesieve_parallel_count_quintuplets (uint64_t start, uint64_t stop)`
Count the prime quintuplets within the interval [start, stop] in parallel.
- `uint64_t primesieve_parallel_count_sextuplets (uint64_t start, uint64_t stop)`

- Count the prime sextuplets within the interval *[start, stop]* in parallel.
- void [primesieve_print_primes](#) (uint64_t start, uint64_t stop)
Print the primes within the interval *[start, stop]* to the standard output.
- void [primesieve_print_twins](#) (uint64_t start, uint64_t stop)
Print the twin primes within the interval *[start, stop]* to the standard output.
- void [primesieve_print_triplets](#) (uint64_t start, uint64_t stop)
Print the prime triplets within the interval *[start, stop]* to the standard output.
- void [primesieve_print_quadruplets](#) (uint64_t start, uint64_t stop)
Print the prime quadruplets within the interval *[start, stop]* to the standard output.
- void [primesieve_print_quintuplets](#) (uint64_t start, uint64_t stop)
Print the prime quintuplets within the interval *[start, stop]* to the standard output.
- void [primesieve_print_sextuplets](#) (uint64_t start, uint64_t stop)
Print the prime sextuplets within the interval *[start, stop]* to the standard output.
- void [primesieve_callback_primes](#) (uint64_t start, uint64_t stop, void(*callback)(uint64_t prime))
Call back the primes within the interval *[start, stop]*.
- int [primesieve_get_sieve_size](#) ()
Get the current set sieve size in kilobytes.
- int [primesieve_get_num_threads](#) ()
Get the current set number of threads.
- uint64_t [primesieve_get_max_stop](#) ()
Returns the largest valid stop number for primesieve.
- void [primesieve_set_sieve_size](#) (int sieve_size)
Set the sieve size in kilobytes.
- void [primesieve_set_num_threads](#) (int num_threads)
Set the number of threads for use in subsequent `primesieve_parallel_*` function calls.
- void [primesieve_free](#) (void *primes)
Deallocate a primes array created using the [primesieve_generate_primes\(\)](#) or [primesieve_generate_n_primes\(\)](#) functions.
- int [primesieve_test](#) ()
Run extensive correctness tests.
- const char * [primesieve_version](#) ()
Get the primesieve version number, in the form "i.j.k"

8.3.1 Detailed Description

primesieve C API.

primesieve is a library for fast prime number generation. In case an error occurs `errno` is set to `EDOM` and `PRIMESIEVE_ERROR` is returned.

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8.3.2 Enumeration Type Documentation

8.3.2.1 anonymous enum

anonymous enum

Enumerator

SHORT_PRIMES	Generate primes of short type.
USHORT_PRIMES	Generate primes of unsigned short type.
INT_PRIMES	Generate primes of int type.
UINT_PRIMES	Generate primes of unsigned int type.
LONG_PRIMES	Generate primes of long type.
ULONG_PRIMES	Generate primes of unsigned long type.
LONGLONG_PRIMES	Generate primes of long long type.
ULONGLONG_PRIMES	Generate primes of unsigned long long type.
INT16_PRIMES	Generate primes of int16_t type.
UINT16_PRIMES	Generate primes of uint16_t type.
INT32_PRIMES	Generate primes of int32_t type.
UINT32_PRIMES	Generate primes of uint32_t type.
INT64_PRIMES	Generate primes of int64_t type.
UINT64_PRIMES	Generate primes of uint64_t type.

8.3.3 Function Documentation

8.3.3.1 primesieve_callback_primes()

```
void primesieve_callback_primes (
    uint64_t start,
    uint64_t stop,
    void(*) (uint64_t prime) callback )
```

Call back the primes within the interval [start, stop].

Parameters

<i>callback</i>	A callback function.
-----------------	----------------------

8.3.3.2 primesieve_generate_n_primes()

```
void* primesieve_generate_n_primes (
    uint64_t n,
    uint64_t start,
    int type )
```

Get an array with the first n primes \geq start.

Parameters

<i>type</i>	The type of the primes to generate, e.g. INT_PRIMES.
-------------	------------------------------------------------------

Examples:

[store_primes_in_array.c](#).

8.3.3.3 primesieve_generate_primes()

```
void* primesieve_generate_primes (
    uint64_t start,
    uint64_t stop,
    size_t * size,
    int type )
```

Get an array with the primes inside the interval [start, stop].

Parameters

<i>size</i>	The size of the returned primes array.
<i>type</i>	The type of the primes to generate, e.g. INT_PRIMES.

Examples:

[store_primes_in_array.c](#).

8.3.3.4 primesieve_get_max_stop()

```
uint64_t primesieve_get_max_stop ( )
```

Returns the largest valid stop number for primesieve.

Returns

2⁶⁴-1 (UINT64_MAX).

8.3.3.5 primesieve_nth_prime()

```
uint64_t primesieve_nth_prime (
    int64_t n,
    uint64_t start )
```

Find the nth prime.

Parameters

<i>n</i>	if <i>n</i> = 0 finds the 1st prime \geq start, if <i>n</i> > 0 finds the <i>n</i> th prime > start, if <i>n</i> < 0 finds the <i>n</i> th prime < start (backwards).
----------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Examples:

[nth_prime.c](#).

8.3.3.6 primesieve_parallel_count_primes()

```
uint64_t primesieve_parallel_count_primes (
    uint64_t start,
    uint64_t stop )
```

Count the primes within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve_set_num_threads\(int\)](#) to change the number of threads.

Examples:

[count_primes.c](#).

8.3.3.7 primesieve_parallel_count_quadruplets()

```
uint64_t primesieve_parallel_count_quadruplets (
    uint64_t start,
    uint64_t stop )
```

Count the prime quadruplets within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve_set_num_threads\(int\)](#) to change the number of threads.

8.3.3.8 primesieve_parallel_count_quintuplets()

```
uint64_t primesieve_parallel_count_quintuplets (
    uint64_t start,
    uint64_t stop )
```

Count the prime quintuplets within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve_set_num_threads\(int\)](#) to change the number of threads.

8.3.3.9 primesieve_parallel_count_sextuplets()

```
uint64_t primesieve_parallel_count_sextuplets (
    uint64_t start,
    uint64_t stop )
```

Count the prime sextuplets within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve_set_num_threads\(int\)](#) to change the number of threads.

8.3.3.10 primesieve_parallel_count_triplets()

```
uint64_t primesieve_parallel_count_triplets (
    uint64_t start,
    uint64_t stop )
```

Count the prime triplets within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve_set_num_threads\(int\)](#) to change the number of threads.

8.3.3.11 primesieve_parallel_count_twins()

```
uint64_t primesieve_parallel_count_twins (
    uint64_t start,
    uint64_t stop )
```

Count the twin primes within the interval [start, stop] in parallel.

By default all CPU cores are used, use [primesieve_set_num_threads\(int\)](#) to change the number of threads.

8.3.3.12 primesieve_parallel_nth_prime()

```
uint64_t primesieve_parallel_nth_prime (
    int64_t n,
    uint64_t start )
```

Find the nth prime in parallel.

By default all CPU cores are used, use [primesieve_set_num_threads\(int\)](#) to change the number of threads.

Parameters

<i>n</i>	if <i>n</i> = 0 finds the 1st prime \geq start, if <i>n</i> > 0 finds the nth prime $>$ start, if <i>n</i> < 0 finds the nth prime $<$ start (backwards).
----------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------

8.3.3.13 primesieve_set_sieve_size()

```
void primesieve_set_sieve_size (
    int sieve_size )
```

Set the sieve size in kilobytes.

The best sieving performance is achieved with a sieve size of your CPU's L1 data cache size (per core). For sieving $\geq 10^{17}$ a sieve size of your CPU's L2 cache size sometimes performs better.

Parameters

<i>sieve_size</i>	Sieve size in kilobytes.
-------------------	--------------------------

Precondition

`sieve_size >= 1 && <= 2048.`

8.3.3.14 primesieve_test()

```
int primesieve_test ( )
```

Run extensive correctness tests.

The tests last about one minute on a quad core CPU from 2013 and use up to 1 gigabyte of memory.

Returns

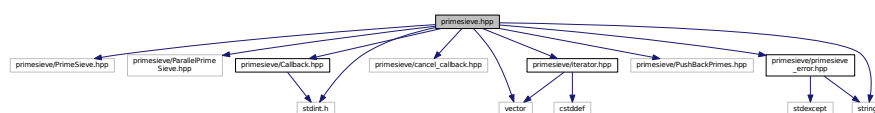
1 if success, 0 if error.

8.4 primesieve.hpp File Reference

primesieve C++ API.

```
#include <primesieve/PrimeSieve.hpp>
#include <primesieve/ParallelPrimeSieve.hpp>
#include <primesieve/Callback.hpp>
#include <primesieve/cancel_callback.hpp>
#include <primesieve/iterator.hpp>
#include <primesieve/PushBackPrimes.hpp>
#include <primesieve/primesieve_error.hpp>
#include <stdint.h>
#include <vector>
#include <string>
```

Include dependency graph for primesieve.hpp:



Namespaces

- [primesieve](#)

Contains primesieve's C++ functions and classes.

Macros

- #define **PRIMESIEVE_VERSION** "5.7.2"
- #define **PRIMESIEVE_VERSION_MAJOR** 5
- #define **PRIMESIEVE_VERSION_MINOR** 7
- #define **PRIMESIEVE_VERSION_PATCH** 2

Functions

- template<typename T >
void [primesieve::generate_primes](#) (uint64_t stop, std::vector< T > *primes)
Store the primes <= stop in the primes vector.
- template<typename T >
void [primesieve::generate_primes](#) (uint64_t start, uint64_t stop, std::vector< T > *primes)
Store the primes within the interval [start, stop] in the primes vector.
- template<typename T >
void [primesieve::generate_n_primes](#) (uint64_t n, std::vector< T > *primes)
Store the first n primes in the primes vector.
- template<typename T >
void [primesieve::generate_n_primes](#) (uint64_t n, uint64_t start, std::vector< T > *primes)
Store the first n primes >= start in the primes vector.
- uint64_t [primesieve::nth_prime](#) (int64_t n, uint64_t start=0)
Find the nth prime.
- uint64_t [primesieve::parallel_nth_prime](#) (int64_t n, uint64_t start=0)
Find the nth prime in parallel.
- uint64_t [primesieve::count_primes](#) (uint64_t start, uint64_t stop)
Count the primes within the interval [start, stop].
- uint64_t [primesieve::count_twins](#) (uint64_t start, uint64_t stop)
Count the twin primes within the interval [start, stop].
- uint64_t [primesieve::count_triplets](#) (uint64_t start, uint64_t stop)
Count the prime triplets within the interval [start, stop].
- uint64_t [primesieve::count_quadruplets](#) (uint64_t start, uint64_t stop)
Count the prime quadruplets within the interval [start, stop].
- uint64_t [primesieve::count_quintuplets](#) (uint64_t start, uint64_t stop)
Count the prime quintuplets within the interval [start, stop].
- uint64_t [primesieve::count_sextuplets](#) (uint64_t start, uint64_t stop)
Count the prime sextuplets within the interval [start, stop].
- uint64_t [primesieve::parallel_count_primes](#) (uint64_t start, uint64_t stop)
Count the primes within the interval [start, stop] in parallel.
- uint64_t [primesieve::parallel_count_twins](#) (uint64_t start, uint64_t stop)
Count the twin primes within the interval [start, stop] in parallel.
- uint64_t [primesieve::parallel_count_triplets](#) (uint64_t start, uint64_t stop)
Count the prime triplets within the interval [start, stop] in parallel.
- uint64_t [primesieve::parallel_count_quadruplets](#) (uint64_t start, uint64_t stop)
Count the prime quadruplets within the interval [start, stop] in parallel.

- `uint64_t primesieve::parallel_count_quintuplets` (`uint64_t start`, `uint64_t stop`)
Count the prime quintuplets within the interval [start, stop] in parallel.
- `uint64_t primesieve::parallel_count_sextuplets` (`uint64_t start`, `uint64_t stop`)
Count the prime sextuplets within the interval [start, stop] in parallel.
- `void primesieve::print_primes` (`uint64_t start`, `uint64_t stop`)
Print the primes within the interval [start, stop] to the standard output.
- `void primesieve::print_twins` (`uint64_t start`, `uint64_t stop`)
Print the twin primes within the interval [start, stop] to the standard output.
- `void primesieve::print_triplets` (`uint64_t start`, `uint64_t stop`)
Print the prime triplets within the interval [start, stop] to the standard output.
- `void primesieve::print_quadruplets` (`uint64_t start`, `uint64_t stop`)
Print the prime quadruplets within the interval [start, stop] to the standard output.
- `void primesieve::print_quintuplets` (`uint64_t start`, `uint64_t stop`)
Print the prime quintuplets within the interval [start, stop] to the standard output.
- `void primesieve::print_sextuplets` (`uint64_t start`, `uint64_t stop`)
Print the prime sextuplets within the interval [start, stop] to the standard output.
- `void primesieve::callback_primes` (`uint64_t start`, `uint64_t stop`, `void(*callback)(uint64_t prime)`)
Call back the primes within the interval [start, stop].
- `void primesieve::callback_primes` (`uint64_t start`, `uint64_t stop`, `primesieve::Callback< uint64_t > *callback`)
Call back the primes within the interval [start, stop].
- `int primesieve::get_sieve_size` ()
Get the current set sieve size in kilobytes.
- `int primesieve::get_num_threads` ()
Get the current set number of threads.
- `uint64_t primesieve::get_max_stop` ()
Returns the largest valid stop number for primesieve.
- `void primesieve::set_sieve_size` (`int sieve_size`)
Set the sieve size in kilobytes.
- `void primesieve::set_num_threads` (`int num_threads`)
Set the number of threads for use in subsequent primesieve::parallel_ function calls.*
- `bool primesieve::primesieve_test` ()
Run extensive correctness tests.
- `std::string primesieve::primesieve_version` ()
Get the primesieve version number, in the form "i.j.k".

8.4.1 Detailed Description

primesieve C++ API.

primesieve is a library for fast prime number generation, in case an error occurs a `primesieve::primesieve_error` exception (derived from `std::runtime_error`) will be thrown.

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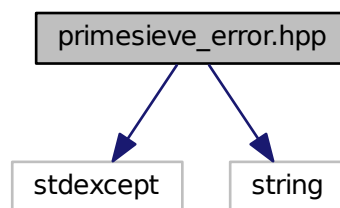
8.5 primesieve_error.hpp File Reference

The `primesieve_error` class is used for all exceptions within `primesieve`.

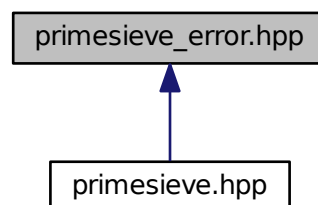
```
#include <stdexcept>
```

```
#include <string>
```

Include dependency graph for `primesieve_error.hpp`:



This graph shows which files directly or indirectly include this file:



Classes

- class `primesieve::primesieve_error`
primesieve throws a `primesieve_error` exception if an error occurs that cannot be handled e.g.

Namespaces

- `primesieve`
Contains primesieve's C++ functions and classes.

8.5.1 Detailed Description

The `primesieve_error` class is used for all exceptions within `primesieve`.

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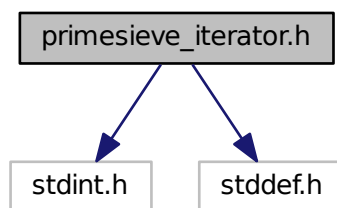
8.6 `primesieve_iterator.h` File Reference

[primesieve_iterator](#) allows to easily iterate over primes both forwards and backwards.

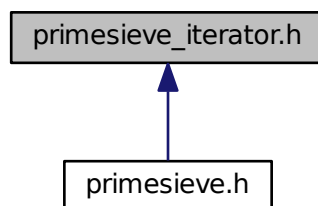
```
#include <stdint.h>
```

```
#include <stddef.h>
```

Include dependency graph for `primesieve_iterator.h`:



This graph shows which files directly or indirectly include this file:



Classes

- struct [primesieve_iterator](#)

C prime iterator, please refer to [primesieve_iterator.h](#) for more information.

Functions

- void [primesieve_init](#) ([primesieve_iterator](#) *pi)
Initialize the primesieve iterator before first using it.
- void [primesieve_free_iterator](#) ([primesieve_iterator](#) *pi)
Free all memory.
- void [primesieve_skipto](#) ([primesieve_iterator](#) *pi, uint64_t start, uint64_t stop_hint)
Set the primesieve iterator to start.
- static uint64_t [primesieve_next_prime](#) ([primesieve_iterator](#) *pi)
Get the next prime.
- static uint64_t [primesieve_previous_prime](#) ([primesieve_iterator](#) *pi)
Get the previous prime, or 0 if input ≤ 2 e.g.

8.6.1 Detailed Description

[primesieve_iterator](#) allows to easily iterate over primes both forwards and backwards.

Generating the first prime has a complexity of $O(r \log \log r)$ operations with $r = n^{0.5}$, after that any additional prime is generated in amortized $O(\log n \log \log n)$ operations. The memory usage is about $\pi(n^{0.5}) * 16$ bytes. [primesieve_iterator](#) objects are very convenient to use at the cost of being slightly slower than the [primesieve_↔callback_primes\(\)](#) functions.

The [primesieve_iterator.c](#) example shows how to use [primesieve_iterator](#). If any error occurs `errno` is set to `EDOM` and [primesieve_next_prime\(\)](#) and [primesieve_previous_prime\(\)](#) return `PRIMESIEVE_ERROR`.

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8.6.2 Function Documentation

8.6.2.1 [primesieve_previous_prime\(\)](#)

```
static uint64_t primesieve_previous_prime (
    primesieve\_iterator * pi ) [inline], [static]
```

Get the previous prime, or 0 if input ≤ 2 e.g.

`previous_prime(2) = 0.`

Examples:

[previous_prime.c](#).

8.6.2.2 [primesieve_skipto\(\)](#)

```
void primesieve_skipto (
    primesieve\_iterator * pi,
    uint64_t start,
    uint64_t stop_hint )
```

Set the primesieve iterator to start.

Parameters

<i>start</i>	Generate primes $>$ start (or $<$ start).
<i>stop_hint</i>	Stop number optimization hint. E.g. if you want to generate the primes below 1000 use stop_hint = 1000, if you don't know use primesieve_get_max_stop() .

Examples:

[previous_prime.c](#).

Chapter 9

Example Documentation

9.1 callback_primes.cpp

This example shows how to use callback functions.

```
#include <primesieve.hpp>
#include <stdint.h>
#include <iostream>

void callback(uint64_t prime)
{
    std::cout << prime << std::endl;
}

int main()
{
    primesieve::callback_primes(2, 1000, callback);
    return 0;
}
```

9.2 count_primes.c

C program that shows how to count primes.

```
#include <primesieve.h>
#include <inttypes.h>
#include <stdio.h>

int main()
{
    uint64_t count = primesieve_count_primes(0, 1000);
    printf("Primes below 1000 = %" PRIu64 "\n", count);

    /* use multi-threading for large intervals */
    count = primesieve_parallel_count_primes(0, 1000000000);
    printf("Primes below 10^9 = %" PRIu64 "\n", count);

    return 0;
}
```

9.3 count_primes.cpp

This example shows how to count primes.

```
#include <primesieve.hpp>
#include <stdint.h>
#include <iostream>

int main()
{
    uint64_t count = primesieve::count_primes(0, 1000);
    std::cout << "Primes below 1000 = " << count << std::endl;

    uint64_t stop = 1000000000;

    // use multi-threading for large intervals
    count = primesieve::parallel_count_primes(0, stop);
    std::cout << "Primes below 10^9 = " << count << std::endl;

    return 0;
}
```

9.4 nth_prime.c

C program that finds the nth prime.

```
#include <primesieve.h>
#include <stdlib.h>
#include <inttypes.h>
#include <stdio.h>

int main(int argc, char** argv)
{
    uint64_t n = 1000;
    if (argv[1])
        n = atol(argv[1]);

    uint64_t prime = primesieve_nth_prime(n, 0);
    printf("%" PRIu64 "th prime = %" PRIu64 "\n", n, prime);

    return 0;
}
```

9.5 nth_prime.cpp

Find the nth prime.

```
#include <primesieve.hpp>
#include <stdint.h>
#include <iostream>
#include <cstdlib>

int main(int, char** argv)
{
    uint64_t n = 1000;
    if (argv[1])
        n = std::atol(argv[1]);

    uint64_t nth_prime = primesieve::nth_prime(n);
    std::cout << n << "th prime = " << nth_prime << std::endl;

    return 0;
}
```

9.6 previous_prime.c

Iterate backwards over primes using `primesieve_iterator`.

```
#include <primesieve.h>
#include <inttypes.h>
#include <stdio.h>

int main()
{
    primesieve_iterator it;
    primesieve_init(&it);

    /* primesieve_skipto(&it, start_number, stop_hint) */
    primesieve_skipto(&it, 2000, 1000);
    uint64_t prime;

    /* iterate over the primes from 2000 to 1000 */
    while ((prime = primesieve_previous_prime(&it)) >= 1000)
        printf("%" PRIu64 "\n", prime);

    primesieve_free_iterator(&it);
    return 0;
}
```

9.7 previous_prime.cpp

Iterate backwards over primes using `primesieve::iterator`.

```
#include <primesieve.hpp>
#include <iostream>

int main()
{
    primesieve::iterator it;
    it.skipto(2000);
    uint64_t prime = it.previous_prime();

    // iterate over the primes from 2000 to 1000
    for (; prime >= 1000; prime = it.previous_prime())
        std::cout << prime << std::endl;

    return 0;
}
```

9.8 primesieve_iterator.c

Iterate over primes using C `primesieve_iterator`.

```
#include <primesieve.h>
#include <inttypes.h>
#include <stdio.h>

int main()
{
    primesieve_iterator it;
    primesieve_init(&it);

    uint64_t sum = 0;
    uint64_t prime = 0;

    /* iterate over the primes below 10^10 */
    while ((prime = primesieve_next_prime(&it)) < 10000000000ull)
        sum += prime;

    primesieve_free_iterator(&it);
    printf("Sum of the primes below 10^10 = %" PRIu64 "\n", sum);
    return 0;
}
```

9.9 primesieve_iterator.cpp

Iterate over primes using `primesieve::iterator`.

```
#include <primesieve.hpp>
#include <iostream>

int main()
{
    primesieve::iterator it;
    uint64_t prime = it.next_prime();
    uint64_t sum = 0;

    // iterate over the primes below 10^10
    for (; prime < 10000000000ull; prime = it.next_prime())
        sum += prime;

    std::cout << "Sum of the primes below 10^10 = " << sum << std::endl;
    return 0;
}
```

9.10 store_primes_in_array.c

Store primes in a C array.

```
#include <primesieve.h>
#include <stdio.h>

int main()
{
    uint64_t start = 0;
    uint64_t stop = 1000;
    size_t i;
    size_t size;

    /* store the primes below 1000 */
    int* primes = (int*) primesieve_generate_primes(start, stop, &size,
        INT_PRIMES);

    for (i = 0; i < size; i++)
        printf("%i\n", primes[i]);

    primesieve_free(primes);
    uint64_t n = 1000;

    /* store the first 1000 primes */
    primes = (int*) primesieve_generate_n_primes(n, start,
        INT_PRIMES);

    for (i = 0; i < n; i++)
        printf("%i\n", primes[i]);

    primesieve_free(primes);
    return 0;
}
```

9.11 store_primes_in_vector.cpp

Store primes in a `std::vector` using `primesieve`.


```
#include <primesieve.hpp>
#include <vector>

int main()
{
    std::vector<int> primes;

    // Store the primes <= 1000
    primesieve::generate_primes(1000, &primes);

    primes.clear();

    // Store the first 1000 primes
    primesieve::generate_n_primes(1000, &primes);

    return 0;
}
```


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