primesieve

7.8

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Chapter 1

Main Page

1.1 About

primesieve is a C/C++ library for quickly generating prime numbers. 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 iterating over primes using next_prime() or prev_prime() and storing primes in a vector or an array.

For more information please visit `https://github.com/kimwalisch/primesieve`.

1.2 Installation

- **`Install libprimesieve using package manager.`**
- **`Build libprimesieve from source.`**

1.3 C API

- primesieve.h - primesieve C header.
- primesieve_iterator - Provides the primesieve_next_prime() and primesieve_prev_prime() functions.
- **`C examples`** - Example programs that show how to use libprimesieve.
- **`C error handling`** - How to detect and handle errors.
- **`Link against libprimesieve.`**

1.4 C++ API

- primesieve.hpp - primesieve C++ header.
- primesieve::iterator - Provides the next_prime() and prev_prime() methods.
- **`C++ examples`** - Example programs that show how to use libprimesieve.
- **`C++ error handling`** - How to detect and handle errors.
- **`Link against libprimesieve.`**

1.5 Performance tips

- `libprimesieve performance tips.`
- `libprimesieve multi-threading tips.`

Chapter 2

Namespace Index

2.1 Namespace List

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

Chapter 3

Hierarchical Index

3.1 Class Hierarchy

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

Chapter 4

Class Index

4.1 Class List

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

Chapter 5

File Index

5.1 File List

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

Chapter 6

Namespace Documentation

6.1 primesieve Namespace Reference

Contains primesieve's C++ functions and classes.

Classes

- 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 e.g.

Functions

- template<typename T >
  void generate_primes (uint64_t stop, std::vector< T > *primes)

  Store the primes <= 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 >= start in the primes vector.
- uint64_t nth_prime (int64_t n, uint64_t start=0)

  Find the nth prime.
- 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].
- 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.
- uint64_t get_max_stop ()

  Returns the largest valid stop number for primesieve.
- int get_sieve_size ()

  Get the current set sieve size in KiB.
- int get_num_threads ()

  Get the current set number of threads.
- void set_sieve_size (int sieve_size)

  Set the sieve size in KiB (kibibyte).
- void set_num_threads (int num_threads)

  Set the number of threads for use in primesieve::count_∗() and primesieve::nth_prime().
- std::string primesieve_version ()

  Get the primesieve version number, in the form "i.j".

6.1.1 Detailed Description

Contains primesieve's C++ functions and classes.

6.1.2 Function Documentation

6.1.2.1 count_primes()

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

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

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

Note that each call to count_primes() incurs an initialization overhead of O(sqrt(stop)) even if the interval [start, stop] is tiny. Hence if you have written an algorithm that makes many calls to count_primes() it may be preferable to use a primesieve::iterator which needs to be initialized only once.

Examples

count_primes.cpp.

6.1.2.2 count_quadruplets()

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

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

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

6.1.2.3 count_quintuplets()

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

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

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

6.1.2.4 count_sextuplets()

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

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

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

6.1.2.5 count_triplets()

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

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

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

6.1.2.6 count_twins()

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

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

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

6.1.2.7 get_max_stop()

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

Returns the largest valid stop number for primesieve.

Returns

2^64-1 (UINT64_MAX).

6.1.2.8 nth_prime()

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

Find the nth prime.

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

Note that each call to nth_prime(n, start) incurs an initialization overhead of O(sqrt(start)) even if n is tiny. Hence it is not a good idea to use nth_prime() repeatedly in a loop to get the next (or previous) prime. For this use case it is better to use a primesieve::iterator which needs to be initialized only once.

Parameters

n	if n = 0 finds the 1st prime >= start, if n > 0 finds the nth prime > start, if n < 0 finds the nth prime < start (backwards).

Examples

nth_prime.cpp.

6.1.2.9 set_num_threads()

```
void primesieve::set_num_threads (
            int num_threads )
```

Set the number of threads for use in primesieve::count_*() and primesieve::nth_prime().

By default all CPU cores are used.

6.1.2.10 set_sieve_size()

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

Set the sieve size in KiB (kibibyte).

The best sieving performance is achieved with a sieve size of your CPU's L1 or L2 cache size (per core).

Precondition

sieve_size >= 16 && <= 4096.

Chapter 7

Class Documentation

7.1 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.
- iterator (const iterator &)=delete

  primesieve::iterator objects cannot be copied.
- iterator & **operator=** (const iterator &)=delete
- iterator (iterator &&) noexcept

  primesieve::iterator objects support move semantics.
- iterator & **operator=** (iterator &&) noexcept
- void skipto (uint64_t start, uint64_t stop_hint=get_max_stop())

  Reset the primesieve iterator to start.
- uint64_t next_prime ()

  Get the next prime.
- uint64_t prev_prime ()

  Get the previous prime.

7.1.1 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 PrimePi(n^0.5) ∗ 8 bytes.

Examples

prev_prime.cpp, and primesieve_iterator.cpp.

7.1.2 Constructor & Destructor Documentation

7.1.2.1 iterator()

```
primesieve::iterator::iterator (
            uint64_t start = 0,
            uint64_t stop_hint = get_max_stop() )
```

Create a new iterator object.

Parameters

start	Generate primes > start (or < start).
stop_hint	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.

7.1.3 Member Function Documentation

7.1.3.1 next_prime()

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

Get the next prime.

Returns UINT64_MAX if next prime > 2^64.

Examples

primesieve_iterator.cpp.

7.1.3.2 prev_prime()

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

Get the previous prime.

prev_prime(n) returns 0 for n <= 2. Note that next_prime() runs up to 2x faster than prev_prime(). Hence if the same algorithm can be written using either prev_prime() or next_prime() it is preferable to use next_prime().

Examples

prev_prime.cpp.

7.1.3.3 skipto()

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

Reset the primesieve iterator to start.

Parameters

start	Generate primes > start (or < start).
stop_hint	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.

Examples

prev_prime.cpp.

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

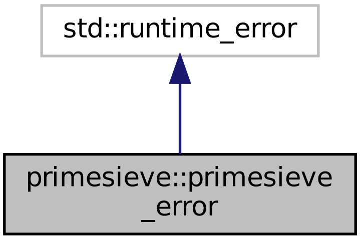
- iterator.hpp

7.2 primesieve::primesieve_error Class Reference

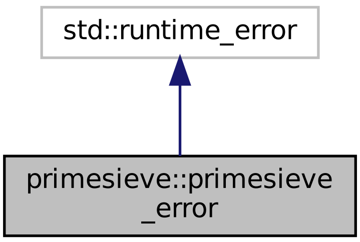
primesieve throws a primesieve_error exception if an error occurs e.g.

`#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)

7.2.1 Detailed Description

primesieve throws a primesieve_error exception if an error occurs e.g.

prime > 2^64.

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

- primesieve_error.hpp

7.3 primesieve_iterator Struct Reference

C prime iterator, please refer to iterator.h for more information.

```
#include <iterator.h>
```

Public Attributes

- size_t **i**
- size_t **last_idx**
- uint64_t **start**
- uint64_t **stop**
- uint64_t **stop_hint**
- uint64_t **dist**
- uint64_t * **primes**
- void * **vector**
- void * **primeGenerator**
- int **is_error**

7.3.1 Detailed Description

C prime iterator, please refer to iterator.h for more information.

Examples

prev_prime.c, and primesieve_iterator.c.

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

- iterator.h

Chapter 8

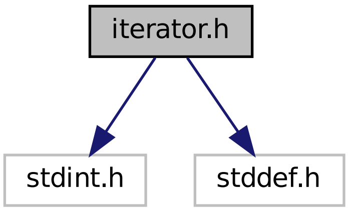
File Documentation

8.1 iterator.h File Reference

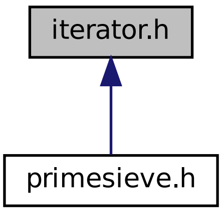
primesieve_iterator allows to easily iterate over primes both forwards and backwards.

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

Include dependency graph for iterator.h:



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



Classes

- struct primesieve_iterator

    C prime iterator, please refer to iterator.h for more information.

Functions

- void primesieve_init (primesieve_iterator ∗it)

    Initialize the primesieve iterator before first using it.
- void primesieve_free_iterator (primesieve_iterator ∗it)

    Free all memory.
- void primesieve_skipto (primesieve_iterator ∗it, uint64_t start, uint64_t stop_hint)

    Reset the primesieve iterator to start.
- static uint64_t primesieve_next_prime (primesieve_iterator ∗it)

    Get the next prime.
- static uint64_t primesieve_prev_prime (primesieve_iterator ∗it)

    Get the previous prime.

8.1.1 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 PrimePi(n^0.5) ∗ 8 bytes.

The primesieve_iterator.c example shows how to use primesieve_iterator. If any error occurs primesieve_next_prime() and primesieve_prev_prime() return PRIMESIEVE_ERROR. Furthermore primesieve_iterator.is_error is initialized to 0 and set to 1 if any error occurs.

8.1.2 Function Documentation

8.1.2.1 primesieve_next_prime()

```
static uint64_t primesieve_next_prime (
            primesieve_iterator * it )  [inline], [static]
```

Get the next prime.

Returns UINT64_MAX if next prime > 2^64.

Examples

primesieve_iterator.c.

8.1.2.2 primesieve_prev_prime()

```
static uint64_t primesieve_prev_prime (
            primesieve_iterator * it )  [inline], [static]
```

Get the previous prime.

primesieve_prev_prime(n) returns 0 for n <= 2. Note that primesieve_next_prime() runs up to 2x faster than primesieve_prev_prime(). Hence if the same algorithm can be written using either primesieve_prev_prime() or primesieve_next_prime() it is preferable to use primesieve_next_prime().

Examples

prev_prime.c.

8.1.2.3 primesieve_skipto()

```
void primesieve_skipto (
            primesieve_iterator * it,
            uint64_t start,
            uint64_t stop_hint )
```

Reset the primesieve iterator to start.

Parameters

start	Generate primes > start (or < start).
stop_hint	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

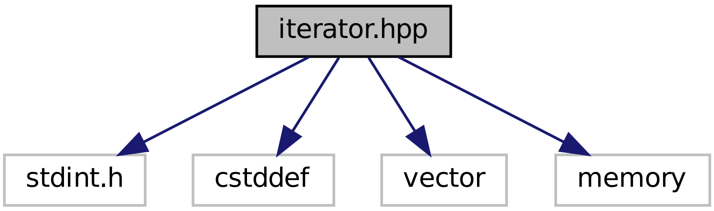
prev_prime.c, and primesieve_iterator.c.

8.2 iterator.hpp File Reference

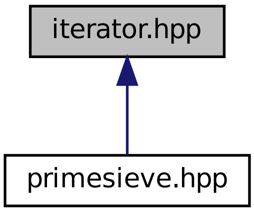
The iterator class allows to easily iterate (forwards and backwards) over prime numbers.

```
#include <stdint.h>
#include <cstddef>
#include <vector>
#include <memory>
```

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

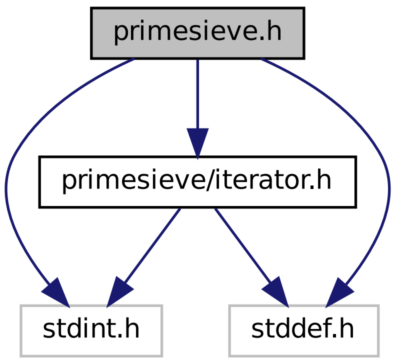
The iterator class allows to easily iterate (forwards and backwards) over prime numbers.

8.3 primesieve.h File Reference

primesieve C API.

```
#include <primesieve/iterator.h>
#include <stdint.h>
#include <stddef.h>
```

Include dependency graph for primesieve.h:



Macros

- #define **PRIMESIEVE_VERSION** "7.8"
- #define **PRIMESIEVE_VERSION_MAJOR** 7
- #define **PRIMESIEVE_VERSION_MINOR** 8
- #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 , ULONGLONG_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_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].
- 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.
- uint64_t primesieve_get_max_stop ()

  Returns the largest valid stop number for primesieve.
- int primesieve_get_sieve_size ()

  Get the current set sieve size in KiB.
- int primesieve_get_num_threads ()

  Get the current set number of threads.
- void primesieve_set_sieve_size (int sieve_size)

  Set the sieve size in KiB (kibibyte).
- void primesieve_set_num_threads (int num_threads)

  Set the number of threads for use in primesieve_count_∗() and primesieve_nth_prime().
- void primesieve_free (void ∗primes)

  Deallocate a primes array created using the primesieve_generate_primes() or primesieve_generate_n_primes() functions.
- const char ∗ primesieve_version ()

  Get the primesieve version number, in the form "i.j"

8.3.1 Detailed Description

primesieve C API.

primesieve is a library for quickly generating prime numbers. If an error occurs, primesieve functions with a uint64_t return type return PRIMESIEVE_ERROR and the corresponding error message is printed to the standard error stream. libprimesieve also sets the C errno variable to EDOM if an error occurs.

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_count_primes()

```
uint64_t primesieve_count_primes (
            uint64_t start,
            uint64_t stop )
```

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

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

Note that each call to primesieve_count_primes() incurs an initialization overhead of O(sqrt(stop)) even if the interval [start, stop] is tiny. Hence if you have written an algorithm that makes many calls to primesieve_count_primes() it may be preferable to use a primesieve::iterator which needs to be initialized only once.

Examples

count_primes.c.

8.3.3.2 primesieve_count_quadruplets()

```
uint64_t primesieve_count_quadruplets (
            uint64_t start,
            uint64_t stop )
```

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

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

8.3.3.3 primesieve_count_quintuplets()

```
uint64_t primesieve_count_quintuplets (
            uint64_t start,
            uint64_t stop )
```

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

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

8.3.3.4 primesieve_count_sextuplets()

```
uint64_t primesieve_count_sextuplets (
            uint64_t start,
            uint64_t stop )
```

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

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

8.3.3.5 primesieve_count_triplets()

```
uint64_t primesieve_count_triplets (
            uint64_t start,
            uint64_t stop )
```

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

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

8.3.3.6 primesieve_count_twins()

```
uint64_t primesieve_count_twins (
            uint64_t start,
            uint64_t stop )
```

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

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

8.3.3.7 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 >= start.

Parameters

type	The type of the primes to generate, e.g. INT_PRIMES.

Examples

store_primes_in_array.c.

8.3.3.8 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

size	The size of the returned primes array.
type	The type of the primes to generate, e.g. INT_PRIMES.

Examples

store_primes_in_array.c.

8.3.3.9 primesieve_get_max_stop()

```
uint64_t primesieve_get_max_stop ( )
```

Returns the largest valid stop number for primesieve.

Returns

2^64-1 (UINT64_MAX).

8.3.3.10 primesieve_nth_prime()

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

Find the nth prime.

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

Note that each call to primesieve_nth_prime(n, start) incurs an initialization overhead of O(sqrt(start)) even if n is tiny. Hence it is not a good idea to use primesieve_nth_prime() repeatedly in a loop to get the next (or previous) prime. For this use case it is better to use a primesieve::iterator which needs to be initialized only once.

Parameters

n	if n = 0 finds the 1st prime >= start, if n > 0 finds the nth prime > start, if n < 0 finds the nth prime < start (backwards).

Examples

nth_prime.c.

8.3.3.11 primesieve_set_num_threads()

```
void primesieve_set_num_threads (
            int num_threads )
```

Set the number of threads for use in primesieve_count_∗() and primesieve_nth_prime().

By default all CPU cores are used.

8.3.3.12 primesieve_set_sieve_size()

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

Set the sieve size in KiB (kibibyte).

The best sieving performance is achieved with a sieve size of your CPU's L1 or L2 cache size (per core).

Precondition

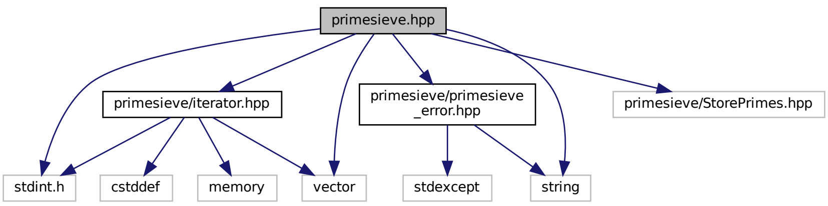
sieve_size >= 16 && <= 4096.

8.4 primesieve.hpp File Reference

primesieve C++ API.

```
#include <primesieve/iterator.hpp>
#include <primesieve/primesieve_error.hpp>
#include <primesieve/StorePrimes.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** "7.8"
- #define **PRIMESIEVE_VERSION_MAJOR** 7
- #define **PRIMESIEVE_VERSION_MINOR** 8

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::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].
- 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.
- uint64_t primesieve::get_max_stop ()

  Returns the largest valid stop number for primesieve.
- int primesieve::get_sieve_size ()

  Get the current set sieve size in KiB.
- int primesieve::get_num_threads ()

Get the current set number of threads.

- void primesieve::set_sieve_size (int sieve_size)

  Set the sieve size in KiB (kibibyte).

- void primesieve::set_num_threads (int num_threads)

  Set the number of threads for use in primesieve::count_*() and primesieve::nth_prime().

- std::string primesieve::primesieve_version ()

  Get the primesieve version number, in the form "i.j".

8.4.1 Detailed Description

primesieve C++ API.

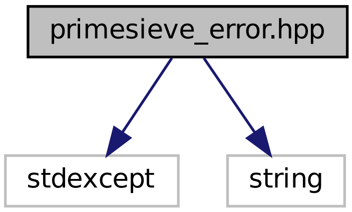
primesieve is a library for fast prime number generation, in case an error occurs a primesieve::primesieve_error exception (derived form std::runtime_error) is thrown.

8.5 primesieve_error.hpp File Reference

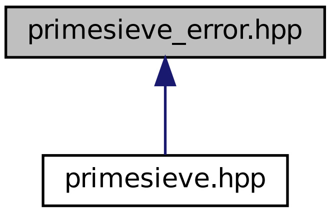
The primesieve_error class is used for all exceptions within primesieve.

```
#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 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.

Chapter 9

Example Documentation

9.1 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;
  return 0;
}
```

9.2 primesieve_iterator.cpp

Iterate over primes using primesieve::iterator.

```
#include <primesieve.hpp>
#include <cstdlib>
#include <iostream>
int main(int argc, char** argv)
{
  primesieve::iterator it;
  uint64_t limit = 10000000000ull;
  uint64_t prime = it.next_prime();
  uint64_t sum = 0;
  if (argc > 1)
    limit = std::atol(argv[1]);
  // iterate over the primes below 10^9
  for (; prime < limit; prime = it.next_prime())
    sum += prime;
  std::cout « "Sum of primes < " « limit « " = " « sum « std::endl;
  // Note that since sum is a 64-bit variable the result
  // will be incorrect (due to integer overflow) if
  // limit > 10^10. However we do allow limits > 10^10
  // since this is useful for benchmarking.
  if (limit > 10000000000ull)
    std::cerr « "Warning: sum is likely incorrect due to 64-bit integer overflow!" « std::endl;
  return 0;
}
```

9.3 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;
}
```

9.4 prev_prime.cpp

Iterate backwards over primes using primesieve::iterator.

```
#include <primesieve.hpp>
#include <cstdlib>
#include <iostream>
int main(int argc, char** argv)
{
  uint64_t limit = 10000000000ull;
  if (argc > 1)
    limit = std::atol(argv[1]);
  primesieve::iterator it;
  it.skipto(limit);
  uint64_t prime = it.prev_prime();
  uint64_t sum = 0;
  // iterate over the primes below 10^9
  for (; prime > 0; prime = it.prev_prime())
    sum += prime;
  std::cout « "Sum of primes < " « limit « " = " « sum « std::endl;
  // Note that since sum is a 64-bit variable the result
  // will be incorrect (due to integer overflow) if
  // limit > 10^10. However we do allow limits > 10^10
  // since this is useful for benchmarking.
  if (limit > 10000000000ull)
    std::cerr « "Warning: sum is likely incorrect due to 64-bit integer overflow!" « std::endl;
  return 0;
}
```

9.5 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 primes <= 1000
  primesieve::generate_primes(1000, &primes);
  primes.clear();
  // Store primes inside [1000, 2000]
  primesieve::generate_primes(1000, 2000, &primes);
  primes.clear();
  // Store first 1000 primes
  primesieve::generate_n_primes(1000, &primes);
  primes.clear();
  // Store first 10 primes >= 1000
  primesieve::generate_n_primes(10, 1000, &primes);
  return 0;
}
```

9.6 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);
  return 0;
}
```

9.7 prev_prime.c

Iterate backwards over primes using primesieve_iterator.Note that primesieve_next_prime() runs up to 2x faster and uses only half as much memory as primesieve_prev_prime(). Hence if it is possible to write the same algorithm using either primesieve_prev_prime() or primesieve_next_prime() then it is preferable to use primesieve_next_prime().

```
#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 primes from 2000 to 1000 */
  while ((prime = primesieve_prev_prime(&it)) >= 1000)
    printf("%" PRIu64 "\n", prime);
  primesieve_free_iterator(&it);
  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 10^9 */
  while ((prime = primesieve_next_prime(&it)) < 1000000000ull)
    sum += prime;
  printf("Sum of the primes below 10^9 = %" PRIu64 "\n", sum);
  /* generate primes > 1000 */
  primesieve_skipto(&it, 1000, 1100);
  while ((prime = primesieve_next_prime(&it)) < 1100)
    printf("%" PRIu64 "\n", prime);
  primesieve_free_iterator(&it);
  return 0;
}
```

9.9 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 (argc > 1 && argv[1])
    n = atol(argv[1]);
  uint64_t prime = primesieve_nth_prime(n, 0);
  printf("%" PRIu64 "th prime = %" PRIu64 "\n", n, prime);
  return 0;
}
```

9.10 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;
}
```

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