cryptopals_c

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Chapter 1

Cryptopals in C Code

Solve the **Cryptopals Crypto Challenges** using **pure C**.

- This repository contains my implementations, notes, and explanations for each challenge set, focused on clarity, correctness, and learning modern applied cryptography from first principles.

Basically a quiet Saturday and I am in need of a challenge, so I am speedrunning the Cryptopals challenges in C code, just for fun.

1.1 Overview

The **Cryptopals Challenges** are a well-known set of practical cryptography exercises covering topics like:

- Encoding and decoding
- XOR ciphers
- Block ciphers (AES)
- Padding oracles
- CBC, CTR, stream attacks
- Diffie–Hellman, RSA, and more

This repo is my attempt to solve them **from scratch in C**, without relying on high-level crypto libraries unless the challenge's intent allows it.
The goal is to deeply understand how the primitives work internally.

1.2 Documentation

There is a doxygen PDF in `./docs`

1.3 Requirements

- **C99 or newer**
- **Make**
- **doxygen and pdflatex/texlive environment for docs**

1.4 Building & Running

Common combinations of the below:

```
make clean
make
make test
make docs
```

1.5 Security Disclaimer

- This code is for my own amusement and educational purposes only.
- Do not use it in production, security-critical, or cryptographic applications.

1.6 References

Cryptopals Challenges

Chapter 2

File Index

2.1 File List

Here is a list of all files with brief descriptions:

Chapter 3

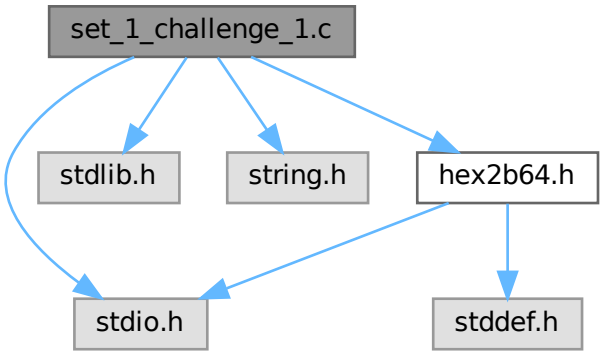
File Documentation

3.1 set_1_challenge_1.c File Reference

Cryptopals Set 1 Challenge 1 sample solution using hex2b64_buffer().

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "hex2b64.h"
```

Include dependency graph for set_1_challenge_1.c:



Functions

- int main (void)

  Convert the fixed challenge hex string and compare to expected Base64.

3.1.1 Detailed Description

Cryptopals Set 1 Challenge 1 sample solution using hex2b64_buffer().
Definition in file set_1_challenge_1.c.

3.1.2 Function Documentation

3.1.2.1 main()

```
int main (
```

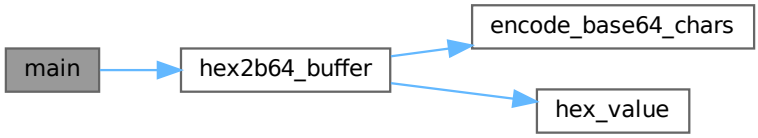
```
            void  )
```

Convert the fixed challenge hex string and compare to expected Base64.

Returns

EXIT_SUCCESS when the conversion matches the known answer.

Definition at line 17 of file set_1_challenge_1.c.
References hex2b64_buffer().
Here is the call graph for this function:



3.2 set_1_challenge_1.c

Go to the documentation of this file.

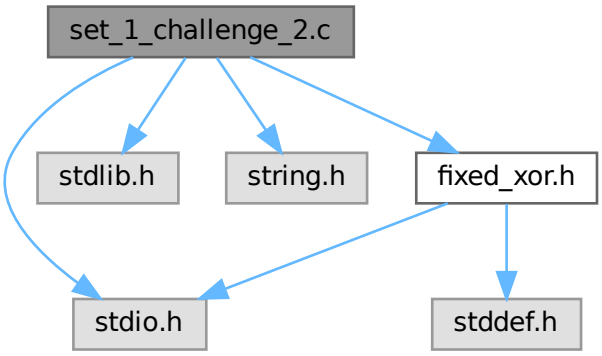
```
00001
00006 #include <stdio.h>
00007 #include <stdlib.h>
00008 #include <string.h>
00009
00010 #include "hex2b64.h"
00011
00017 int main(void) {
00018     const char *hex_input =
00019
      "49276d206b696c6c696e6720796f757220627261696e206c696b65206120706f69736f6e6f7573206d757368726f6f6d";
00020     const char *expected_b64 = "SSdtIGtpbGxpbmcgeW91ciBicmFpbiBsaWtlIGEgcG9pc29ub3VzIG11c2hyb29t\n";
00021
00022     unsigned char buffer[256];
00023     size_t out_len = 0;
00024     int rc = hex2b64_buffer((const unsigned char *)hex_input,
00025                             strlen(hex_input),
00026                             buffer,
00027                             sizeof(buffer),
00028                             &out_len);
00029     if (rc != 0) {
00030         fprintf(stderr, "hex2b64_buffer failed\n");
00031         return EXIT_FAILURE;
00032     }
00033     buffer[out_len] = '\0';
00034
00035     if (strcmp((const char *)buffer, expected_b64) == 0) {
00036         fprintf(stdout, "PASS: %s == %s\n", hex_input, expected_b64);
00037         return EXIT_SUCCESS;
00038     }
00039
00040     fprintf(stdout, "FAIL: %s != %s\n", hex_input, expected_b64);
00041     return EXIT_FAILURE;
00042 }
```

3.3 set_1_challenge_2.c File Reference

Cryptopals Set 1 Challenge 2: fixed XOR test harness.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "fixed_xor.h"
```

Include dependency graph for set_1_challenge_2.c:



Functions

- static int hex_digit_value (char c)
- static int hex_to_bytes (const char *hex, unsigned char *out, size_t out_cap)
- int main (void)

3.3.1 Detailed Description

Cryptopals Set 1 Challenge 2: fixed XOR test harness.
Definition in file set_1_challenge_2.c.

3.3.2 Function Documentation

3.3.2.1 hex_digit_value()

```
static int hex_digit_value (
            char c )  [static]
```

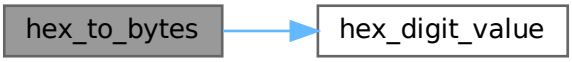
Definition at line 12 of file set_1_challenge_2.c.
Here is the caller graph for this function:

3.3.2.2 hex_to_bytes()

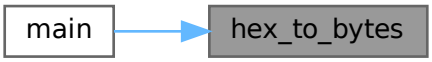
```
static int hex_to_bytes (
            const char * hex,
            unsigned char * out,
            size_t out_cap )  [static]
```

Definition at line 19 of file set_1_challenge_2.c.

References hex_digit_value().
Here is the call graph for this function:



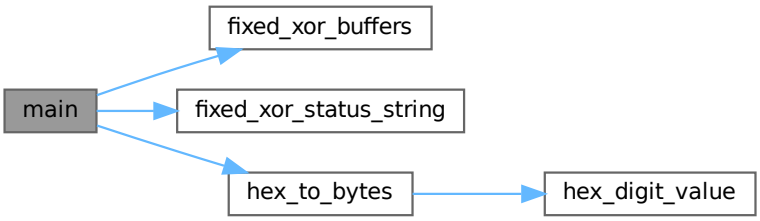
Here is the caller graph for this function:



3.3.2.3 main()

```
int main (
            void  )
```

Definition at line 40 of file set_1_challenge_2.c.
References fixed_xor_buffers(), FIXED_XOR_OK, fixed_xor_status_string(), and hex_to_bytes().
Here is the call graph for this function:



3.4 set_1_challenge_2.c

Go to the documentation of this file.

```
00001
00006 #include <stdio.h>
00007 #include <stdlib.h>
00008 #include <string.h>
00009
00010 #include "fixed_xor.h"
00011
00012 static int hex_digit_value(char c) {
00013     if (c >= '0' && c <= '9') return c - '0';
```

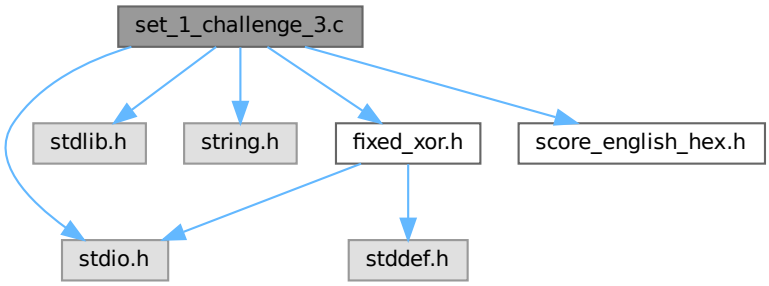
```
00014     if (c >= 'a' && c <= 'f') return 10 + (c - 'a');
00015     if (c >= 'A' && c <= 'F') return 10 + (c - 'A');
00016     return -1;
00017 }
00018
00019 static int hex_to_bytes(const char *hex, unsigned char *out, size_t out_cap) {
00020     size_t hex_len = strlen(hex);
00021     if (hex_len % 2 != 0) {
00022         return -1;
00023     }
00024     size_t byte_len = hex_len / 2;
00025     if (byte_len > out_cap) {
00026         return -1;
00027     }
00028
00029     for (size_t i = 0; i < byte_len; ++i) {
00030         int hi = hex_digit_value(hex[2 * i]);
00031         int lo = hex_digit_value(hex[2 * i + 1]);
00032         if (hi < 0 || lo < 0) {
00033             return -1;
00034         }
00035         out[i] = (unsigned char)((hi « 4) | lo);
00036     }
00037     return (int)byte_len;
00038 }
00039
00040 int main(void) {
00041     const char *lhs_hex = "1c0111001f010100061a024b53535009181c";
00042     const char *rhs_hex = "686974207468652062756c6c277320657965";
00043     const char *expected_hex = "746865206b696420646f6e277420706c6179";
00044
00045     unsigned char lhs[32];
00046     unsigned char rhs[32];
00047     unsigned char expected[32];
00048     unsigned char result[32];
00049
00050     int lhs_len = hex_to_bytes(lhs_hex, lhs, sizeof(lhs));
00051     int rhs_len = hex_to_bytes(rhs_hex, rhs, sizeof(rhs));
00052     int expected_len = hex_to_bytes(expected_hex, expected, sizeof(expected));
00053
00054     if (lhs_len < 0 || rhs_len < 0 || expected_len < 0 ||
00055         lhs_len != rhs_len || lhs_len != expected_len) {
00056         fprintf(stderr, "failed to decode hex inputs\n");
00057         return EXIT_FAILURE;
00058     }
00059
00060     fixed_xor_status status =
00061         fixed_xor_buffers(lhs, rhs, result, (size_t)lhs_len);
00062     if (status != FIXED_XOR_OK) {
00063         fprintf(stderr, "fixed_xor_buffers failed: %s\n",
00064                 fixed_xor_status_string(status));
00065         return EXIT_FAILURE;
00066     }
00067
00068     if (memcmp(result, expected, (size_t)expected_len) == 0) {
00069         printf("PASS: %s XOR %s == %s\n", lhs_hex, rhs_hex, expected_hex);
00070         return EXIT_SUCCESS;
00071     }
00072
00073     printf("FAIL: result does not match expected output\n");
00074     return EXIT_FAILURE;
00075 }
```

3.5 set_1_challenge_3.c File Reference

Cryptopals Set 1 Challenge 3: single-byte XOR cipher.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "fixed_xor.h"
#include "score_english_hex.h"
```

Include dependency graph for set_1_challenge_3.c:



Functions

- static int hex_digit_value (char c)
- static int hex_to_bytes (const char *hex, unsigned char *out, size_t out_cap)
- static void bytes_to_hex (const unsigned char *bytes, size_t len, char *out_hex)
- static void hex_to_ascii (const char *hex, char *ascii_out, size_t ascii_cap)
- int main (void)

3.5.1 Detailed Description

Cryptopals Set 1 Challenge 3: single-byte XOR cipher.
Definition in file set_1_challenge_3.c.

3.5.2 Function Documentation

3.5.2.1 bytes_to_hex()

```
static void bytes_to_hex (
            const unsigned char * bytes,
            size_t len,
            char * out_hex )  [static]
```

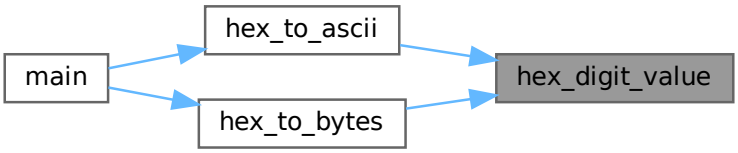
Definition at line 44 of file set_1_challenge_3.c.
Here is the caller graph for this function:

3.5.2.2 hex_digit_value()

```
static int hex_digit_value (
            char c )  [static]
```

Definition at line 13 of file set_1_challenge_3.c.

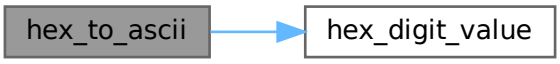
Here is the caller graph for this function:



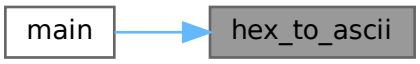
3.5.2.3 hex_to_ascii()

```
static void hex_to_ascii (
            const char * hex,
            char * ascii_out,
            size_t ascii_cap )  [static]
```

Definition at line 55 of file set_1_challenge_3.c.
References hex_digit_value().
Here is the call graph for this function:



Here is the caller graph for this function:

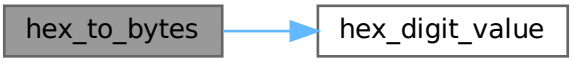


3.5.2.4 hex_to_bytes()

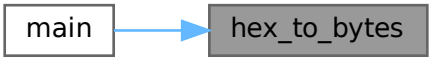
```
static int hex_to_bytes (
            const char * hex,
            unsigned char * out,
            size_t out_cap )  [static]
```

Definition at line 21 of file set_1_challenge_3.c.
References hex_digit_value().

Here is the call graph for this function:



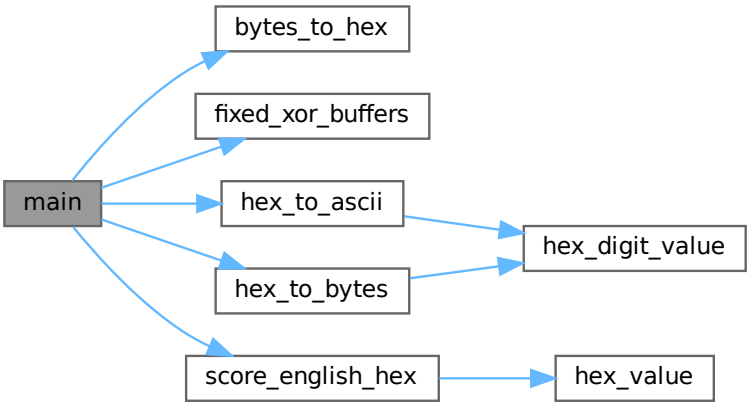
Here is the caller graph for this function:



3.5.2.5 main()

```
int main (
            void  )
```

Definition at line 74 of file set_1_challenge_3.c.
References bytes_to_hex(), fixed_xor_buffers(), FIXED_XOR_OK, hex_to_ascii(), hex_to_bytes(), and score_english_hex().
Here is the call graph for this function:



3.6 set_1_challenge_3.c

Go to the documentation of this file.

```
00001
00006 #include <stdio.h>
00007 #include <stdlib.h>
00008 #include <string.h>
00009
00010 #include "fixed_xor.h"
00011 #include "score_english_hex.h"
00012
00013 static int hex_digit_value(char c) {
00014     if (c >= '0' && c <= '9') return c - '0';
00015     if (c >= 'a' && c <= 'f') return 10 + (c - 'a');
00016     if (c >= 'A' && c <= 'F') return 10 + (c - 'A');
00017     return -1;
00018 }
00019
00020 /* Decode hex string into bytes; returns length or -1 on error. */
00021 static int hex_to_bytes(const char *hex, unsigned char *out, size_t out_cap) {
00022     size_t hex_len = strlen(hex);
00023     if (hex_len % 2 != 0) {
00024         return -1;
00025     }
00026
00027     size_t byte_len = hex_len / 2;
00028     if (byte_len > out_cap) {
00029         return -1;
00030     }
00031
00032     for (size_t i = 0; i < byte_len; ++i) {
00033         int hi = hex_digit_value(hex[2 * i]);
00034         int lo = hex_digit_value(hex[2 * i + 1]);
00035         if (hi < 0 || lo < 0) {
00036             return -1;
00037         }
00038         out[i] = (unsigned char)((hi « 4) | lo);
00039     }
00040     return (int)byte_len;
00041 }
00042
00043 /* Encode bytes into hex string. */
00044 static void bytes_to_hex(const unsigned char *bytes,
00045                          size_t len,
00046                          char *out_hex) {
00047     static const char digits[] = "0123456789abcdef";
00048     for (size_t i = 0; i < len; ++i) {
00049         out_hex[2 * i]     = digits[(bytes[i] » 4) & 0xF];
00050         out_hex[2 * i + 1] = digits[bytes[i] & 0xF];
00051     }
00052     out_hex[2 * len] = '\0';
00053 }
00054
00055 static void hex_to_ascii(const char *hex, char *ascii_out, size_t ascii_cap) {
00056     size_t hex_len = strlen(hex);
00057     size_t ascii_len = hex_len / 2;
00058     if (ascii_len >= ascii_cap) {
00059         ascii_len = ascii_cap - 1;
00060     }
00061
00062     for (size_t i = 0; i < ascii_len; ++i) {
00063         int hi = hex_digit_value(hex[2 * i]);
00064         int lo = hex_digit_value(hex[2 * i + 1]);
00065         if (hi < 0 || lo < 0) {
00066             ascii_out[i] = '?';
00067         } else {
00068             ascii_out[i] = (char)((hi « 4) | lo);
00069         }
00070     }
00071     ascii_out[ascii_len] = '\0';
00072 }
00073
00074 int main(void) {
00075     const char *hex_input =
00076         "1b37373331363f78151b7f2b783431333d78397828372d363c78373e783a393b3736";
00077
00078     unsigned char ciphertext[128];
00079     int cipher_len = hex_to_bytes(hex_input, ciphertext, sizeof(ciphertext));
00080     if (cipher_len < 0) {
00081         fprintf(stderr, "Failed to decode ciphertext hex\n");
00082         return EXIT_FAILURE;
00083     }
00084
00085     double best_score = -1e12;
00086     unsigned char best_plain[128];
00087     unsigned char best_key = 0;
00088
00089     unsigned char key_stream[128];
00090     unsigned char candidate[128];
00091
```

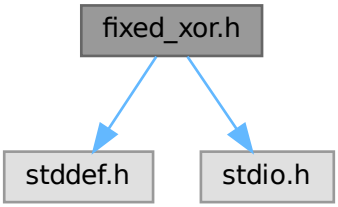
```
00092     for (int key = 0; key <= 0xFF; ++key) {
00093         for (int i = 0; i < cipher_len; ++i) {
00094             key_stream[i] = (unsigned char)key;
00095         }
00096
00097         fixed_xor_status status =
00098             fixed_xor_buffers(ciphertext, key_stream, candidate,
00099                               (size_t)cipher_len);
00100         if (status != FIXED_XOR_OK) {
00101             fprintf(stderr, "fixed_xor_buffers failed for key %02x\n", key);
00102             return EXIT_FAILURE;
00103         }
00104
00105         char candidate_hex[256];
00106         bytes_to_hex(candidate, (size_t)cipher_len, candidate_hex);
00107         double score = score_english_hex(candidate_hex);
00108         if (score > best_score) {
00109             best_score = score;
00110             memcpy(best_plain, candidate, (size_t)cipher_len);
00111             best_key = (unsigned char)key;
00112         }
00113     }
00114
00115     char best_hex[256];
00116     bytes_to_hex(best_plain, (size_t)cipher_len, best_hex);
00117
00118     char best_ascii[128];
00119     hex_to_ascii(best_hex, best_ascii, sizeof(best_ascii));
00120
00121     printf("Best key: 0x%02x\n", best_key);
00122     printf("Best plaintext (hex): %s\n", best_hex);
00123     printf("Best plaintext (ascii): %s\n", best_ascii);
00124
00125     return EXIT_SUCCESS;
00126 }
```

3.7 fixed_xor.h File Reference

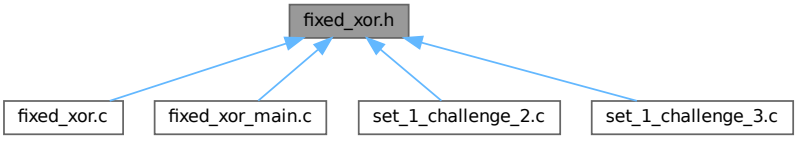
Public interface for XORing two equally sized buffers.

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

Include dependency graph for fixed_xor.h:



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



Enumerations

- enum fixed_xor_status {
  FIXED_XOR_OK = 0 , FIXED_XOR_ERR_ARGS = -1 , FIXED_XOR_ERR_IO = -2 , FIXED_XOR_ERR_ODD_INPUT = -3 ,
  FIXED_XOR_ERR_OOM = -4 }

  Status codes describing the outcome of fixed XOR operations.

Functions

- fixed_xor_status fixed_xor_buffers (const unsigned char *lhs, const unsigned char *rhs, unsigned char *out, size_t len)

  XOR two buffers of equal length into an output buffer.
- fixed_xor_status fixed_xor_stream (FILE *in, FILE *out)

  XOR two half-length buffers read sequentially from a stream.
- const char * fixed_xor_status_string (fixed_xor_status status)

  Convert a fixed_xor_status value into a human-readable string.

3.7.1 Detailed Description

Public interface for XORing two equally sized buffers.
Definition in file fixed_xor.h.

3.7.2 Enumeration Type Documentation

3.7.2.1 fixed_xor_status

```
enum fixed_xor_status
```

Status codes describing the outcome of fixed XOR operations.

Enumerator

FIXED_XOR_OK	Operation completed successfully.
FIXED_XOR_ERR_ARGS	Invalid arguments were supplied.
FIXED_XOR_ERR_IO	I/O failure while reading or writing.
FIXED_XOR_ERR_ODD_INPUT	Stream input contained an odd byte count.
FIXED_XOR_ERR_OOM	Memory allocation failed.

Definition at line 15 of file fixed_xor.h.

3.7.3 Function Documentation

3.7.3.1 fixed_xor_buffers()

```
fixed_xor_status fixed_xor_buffers (
            const unsigned char * lhs,
            const unsigned char * rhs,
            unsigned char * out,
            size_t len )
```

XOR two buffers of equal length into an output buffer.

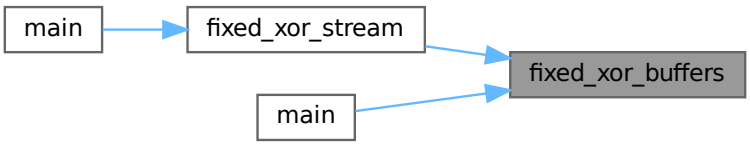
Parameters

lhs	Pointer to the left-hand buffer.
rhs	Pointer to the right-hand buffer.
out	Destination buffer that receives lhs ^ rhs.
len	Number of bytes to process.

Returns

FIXED_XOR_OK on success or an error status on failure.

XOR two buffers of equal length into an output buffer.
Definition at line 18 of file fixed_xor.c.
References FIXED_XOR_ERR_ARGS, and FIXED_XOR_OK.
Here is the caller graph for this function:



3.7.3.2 fixed_xor_status_string()

```
const char * fixed_xor_status_string (
            fixed_xor_status status )
```

Convert a fixed_xor_status value into a human-readable string.

Parameters

status	Status code to describe.

Returns

Pointer to a static string literal.

Convert a fixed_xor_status value into a human-readable string.
Definition at line 125 of file fixed_xor.c.
References FIXED_XOR_ERR_ARGS, FIXED_XOR_ERR_IO, FIXED_XOR_ERR_ODD_INPUT, FIXED_XOR_ERR_OOM, and FIXED_XOR_OK.
Here is the caller graph for this function:

3.7.3.3 fixed_xor_stream()

```
fixed_xor_status fixed_xor_stream (
            FILE * in,
            FILE * out )
```

XOR two half-length buffers read sequentially from a stream.
The input stream is expected to contain two equally sized buffers back to back. The result is written to `out`.

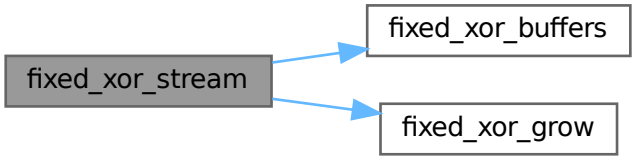
Parameters

in	Stream containing the concatenated buffers.
out	Stream that receives XOR output.

Returns

FIXED_XOR_OK on success or an error status on failure.

XOR two half-length buffers read sequentially from a stream.
Definition at line 68 of file fixed_xor.c.
References fixed_xor_buffers(), FIXED_XOR_CHUNK, FIXED_XOR_ERR_ARGS, FIXED_XOR_ERR_IO, FIXED_XOR_ERR_ODD_INPUT, FIXED_XOR_ERR_OOM, fixed_xor_grow(), and FIXED_XOR_OK.
Here is the call graph for this function:



Here is the caller graph for this function:

3.8 fixed_xor.h

Go to the documentation of this file.

```
00001 #ifndef FIXED_XOR_H
00002 #define FIXED_XOR_H
00003
00009 #include <stddef.h>
00010 #include <stdio.h>
00011
00015 typedef enum {
00016     FIXED_XOR_OK = 0,
00017     FIXED_XOR_ERR_ARGS = -1,
00018     FIXED_XOR_ERR_IO = -2,
00019     FIXED_XOR_ERR_ODD_INPUT = -3,
00020     FIXED_XOR_ERR_OOM = -4
00021 } fixed_xor_status;
00022
00032 fixed_xor_status fixed_xor_buffers(const unsigned char *lhs,
00033                                    const unsigned char *rhs,
00034                                    unsigned char *out,
00035                                    size_t len);
00036
00047 fixed_xor_status fixed_xor_stream(FILE *in, FILE *out);
00048
```

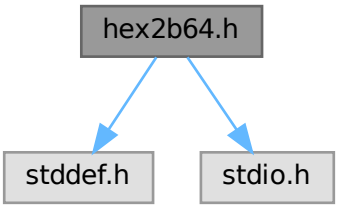
```
00055 const char *fixed_xor_status_string(fixed_xor_status status);
00056
00057 #endif /* FIXED_XOR_H */
```

3.9 hex2b64.h File Reference

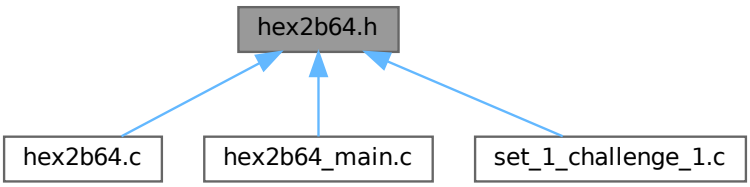
Public interface for converting hexadecimal data to Base64.

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

Include dependency graph for hex2b64.h:



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



Functions

- int hex2b64_stream (FILE *in, FILE *out)

  Convert hexadecimal text read from a stream into Base64.
- int hex2b64_buffer (const unsigned char *hex, size_t hex_len, unsigned char *out, size_t out_cap, size_t *out_len)

  Convert a memory buffer of hexadecimal characters into Base64.

3.9.1 Detailed Description

Public interface for converting hexadecimal data to Base64.
Definition in file hex2b64.h.

3.9.2 Function Documentation

3.9.2.1 hex2b64_buffer()

```
int hex2b64_buffer (
```

```
const unsigned char * hex,
size_t hex_len,
unsigned char * out,
size_t out_cap,
size_t * out_len )
```

Convert a memory buffer of hexadecimal characters into Base64.
The input buffer may contain ASCII whitespace, which is skipped. The output buffer receives the Base64 encoding followed by a newline. The caller must supply sufficient capacity (including room for the newline). When `out_len` is non-NULL it receives the number of bytes written.

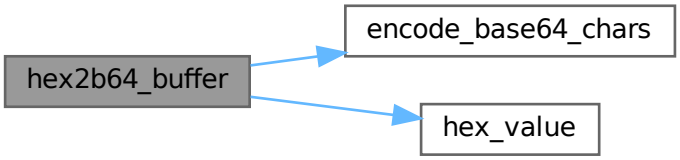
Parameters

hex	Pointer to the hex buffer (may be NULL when `hex_len` is 0).
hex_len	Number of bytes in `hex`.
out	Destination buffer for Base64 characters.
out_cap	Capacity of `out` in bytes.
out_len	Optional pointer that receives the bytes produced.

Returns

0 on success, non-zero on invalid hex, odd digit count, or overflow.

Convert a memory buffer of hexadecimal characters into Base64.
Definition at line 123 of file hex2b64.c.
References encode_base64_chars(), and hex_value().
Here is the call graph for this function:



Here is the caller graph for this function:

3.9.2.2 hex2b64_stream()

```
int hex2b64_stream (
            FILE * in,
            FILE * out )
```

Convert hexadecimal text read from a stream into Base64.
Whitespace characters in the input stream are ignored. The output stream receives the Base64 encoding plus a trailing newline. Errors are reported via the return code and (for malformed hex) an explanatory message on stderr.

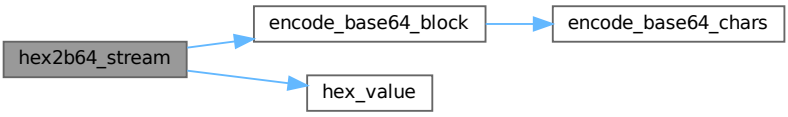
Parameters

in	Input stream providing ASCII hex characters.
out	Output stream that receives Base64 data.

Returns

0 on success, non-zero on invalid input or I/O failure.

Convert hexadecimal text read from a stream into Base64.
Definition at line 70 of file hex2b64.c.
References encode_base64_block(), and hex_value().
Here is the call graph for this function:



Here is the caller graph for this function:

3.10 hex2b64.h

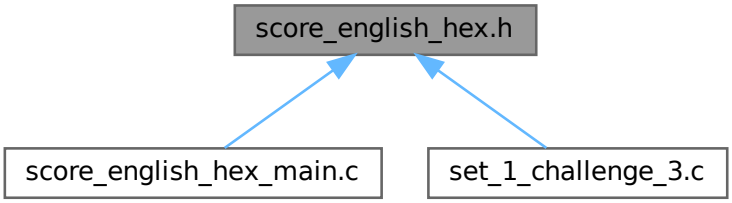
Go to the documentation of this file.

```
00001 #ifndef HEX2B64_H
00002 #define HEX2B64_H
00003
00009 #include <stddef.h>
00010 #include <stdio.h>
00011
00023 int hex2b64_stream(FILE *in, FILE *out);
00024
00040 int hex2b64_buffer(const unsigned char *hex,
00041                    size_t hex_len,
00042                    unsigned char *out,
00043                    size_t out_cap,
00044                    size_t *out_len);
00045
00046 #endif /* HEX2B64_H */
```

3.11 score_english_hex.h File Reference

Estimate how closely hex-encoded data resembles English text.

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



Functions

- double score_english_hex (const char *hex)

  Score a hex string based on English letter frequency heuristics.

3.11.1 Detailed Description

Estimate how closely hex-encoded data resembles English text.
Definition in file score_english_hex.h.

3.11.2 Function Documentation

3.11.2.1 score_english_hex()

```
double score_english_hex (
            const char * hex )
```

Score a hex string based on English letter frequency heuristics.

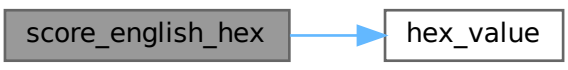
Parameters

hex	Null-terminated ASCII hex string.

Returns

Higher values indicate closer resemblance to English text.

Score a hex string based on English letter frequency heuristics.
Definition at line 59 of file score_english_hex.c.
References english_freq, and hex_value().
Here is the call graph for this function:



Here is the caller graph for this function:

3.12 score_english_hex.h

Go to the documentation of this file.

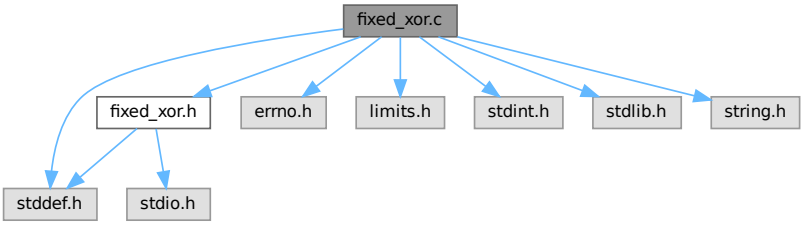
```
00001 #ifndef SCORE_ENGLISH_HEX_H
00002 #define SCORE_ENGLISH_HEX_H
00003
00015 double score_english_hex(const char *hex);
00016
00017 #endif /* SCORE_ENGLISH_HEX_H */
```

3.13 fixed_xor.c File Reference

Implementation of fixed-length buffer XOR helpers.

```
#include "fixed_xor.h"
#include <errno.h>
#include <limits.h>
#include <stddef.h>
#include <stdint.h>
#include <stdlib.h>
#include <string.h>
```

Include dependency graph for fixed_xor.c:



Macros

- #define FIXED_XOR_CHUNK 4096

Functions

- fixed_xor_status fixed_xor_buffers (const unsigned char *lhs, const unsigned char *rhs, unsigned char *out, size_t len)

  Implementation of fixed_xor_buffers().
- static fixed_xor_status fixed_xor_grow (unsigned char **buffer, size_t *capacity, size_t required)

  Ensure that `buffer` has capacity for `required` bytes.

- fixed_xor_status fixed_xor_stream (FILE *in, FILE *out)

  Implementation of fixed_xor_stream().
- const char * fixed_xor_status_string (fixed_xor_status status)

  Implementation of fixed_xor_status_string().

3.13.1 Detailed Description

Implementation of fixed-length buffer XOR helpers.
Definition in file fixed_xor.c.

3.13.2 Macro Definition Documentation

3.13.2.1 FIXED_XOR_CHUNK

```
#define FIXED_XOR_CHUNK 4096
```

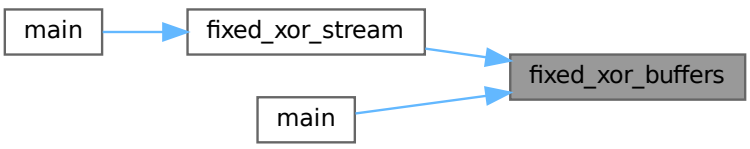
Definition at line 15 of file fixed_xor.c.

3.13.3 Function Documentation

3.13.3.1 fixed_xor_buffers()

```
fixed_xor_status fixed_xor_buffers (
            const unsigned char * lhs,
            const unsigned char * rhs,
            unsigned char * out,
            size_t len )
```

Implementation of fixed_xor_buffers().
XOR two buffers of equal length into an output buffer.
Definition at line 18 of file fixed_xor.c.
References FIXED_XOR_ERR_ARGS, and FIXED_XOR_OK.
Here is the caller graph for this function:



3.13.3.2 fixed_xor_grow()

```
static fixed_xor_status fixed_xor_grow (
            unsigned char ** buffer,
            size_t * capacity,
            size_t required )  [static]
```

Ensure that `buffer` has capacity for `required` bytes.

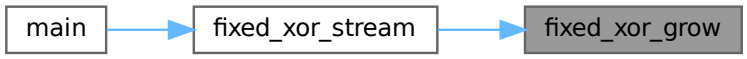
Parameters

buffer	Pointer to heap storage pointer to grow.
capacity	Current capacity in bytes (updated on success).
required	Target capacity required by the caller.

Returns

FIXED_XOR_OK on success or FIXED_XOR_ERR_OOM on allocation failure.

Definition at line 42 of file fixed_xor.c.
References FIXED_XOR_ERR_OOM, and FIXED_XOR_OK.
Here is the caller graph for this function:



3.13.3.3 fixed_xor_status_string()

```
const char * fixed_xor_status_string (
            fixed_xor_status status )
```

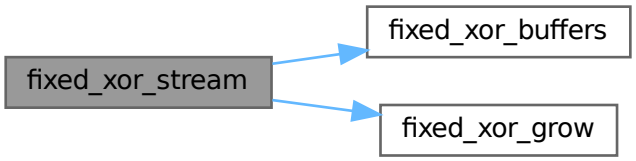
Implementation of fixed_xor_status_string().
Convert a fixed_xor_status value into a human-readable string.
Definition at line 125 of file fixed_xor.c.
References FIXED_XOR_ERR_ARGS, FIXED_XOR_ERR_IO, FIXED_XOR_ERR_ODD_INPUT, FIXED_XOR_ERR_OOM, and FIXED_XOR_OK.
Here is the caller graph for this function:

3.13.3.4 fixed_xor_stream()

```
fixed_xor_status fixed_xor_stream (
            FILE * in,
            FILE * out )
```

Implementation of fixed_xor_stream().
XOR two half-length buffers read sequentially from a stream.
Definition at line 68 of file fixed_xor.c.
References fixed_xor_buffers(), FIXED_XOR_CHUNK, FIXED_XOR_ERR_ARGS, FIXED_XOR_ERR_IO, FIXED_XOR_ERR_ODD_INPUT, FIXED_XOR_ERR_OOM, fixed_xor_grow(), and FIXED_XOR_OK.

Here is the call graph for this function:



Here is the caller graph for this function:

3.14 fixed_xor.c

Go to the documentation of this file.

```
00001
00006 #include "fixed_xor.h"
00007
00008 #include <errno.h>
00009 #include <limits.h>
00010 #include <stddef.h>
00011 #include <stdint.h>
00012 #include <stdlib.h>
00013 #include <string.h>
00014
00015 #define FIXED_XOR_CHUNK 4096
00016
00018 fixed_xor_status fixed_xor_buffers(const unsigned char *lhs,
00019                                    const unsigned char *rhs,
00020                                    unsigned char *out,
00021                                    size_t len) {
00022     if (!lhs || !rhs || !out) {
00023         errno = EINVAL;
00024         return FIXED_XOR_ERR_ARGS;
00025     }
00026
00027     for (size_t i = 0; i < len; ++i) {
00028         out[i] = lhs[i] ^ rhs[i];
00029     }
00030
00031     return FIXED_XOR_OK;
00032 }
00033
00042 static fixed_xor_status fixed_xor_grow(unsigned char **buffer,
00043                                        size_t *capacity,
00044                                        size_t required) {
00045     size_t new_capacity = *capacity;
00046     while (required > new_capacity) {
00047         if (new_capacity > (SIZE_MAX / 2)) {
00048             return FIXED_XOR_ERR_OOM;
00049         }
00050         new_capacity *= 2;
00051     }
00052
00053     if (new_capacity == *capacity) {
00054         return FIXED_XOR_OK;
```

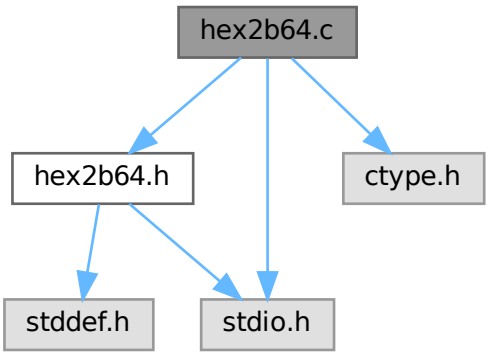
```
00055     }
00056
00057     unsigned char *new_data = realloc(*buffer, new_capacity);
00058     if (!new_data) {
00059         return FIXED_XOR_ERR_OOM;
00060     }
00061
00062     *buffer = new_data;
00063     *capacity = new_capacity;
00064     return FIXED_XOR_OK;
00065 }
00066
00068 fixed_xor_status fixed_xor_stream(FILE *in, FILE *out) {
00069     if (!in || !out) {
00070         errno = EINVAL;
00071         return FIXED_XOR_ERR_ARGS;
00072     }
00073
00074     size_t capacity = FIXED_XOR_CHUNK;
00075     unsigned char *data = malloc(capacity);
00076     if (!data) {
00077         return FIXED_XOR_ERR_OOM;
00078     }
00079
00080     size_t length = 0;
00081     unsigned char chunk[FIXED_XOR_CHUNK];
00082     size_t nread;
00083
00084     while ((nread = fread(chunk, 1, sizeof(chunk), in)) > 0) {
00085         if (length + nread > capacity) {
00086             fixed_xor_status grow_status =
00087                 fixed_xor_grow(&data, &capacity, length + nread);
00088             if (grow_status != FIXED_XOR_OK) {
00089                 free(data);
00090                 return grow_status;
00091             }
00092         }
00093         memcpy(data + length, chunk, nread);
00094         length += nread;
00095     }
00096
00097     if (ferror(in)) {
00098         free(data);
00099         return FIXED_XOR_ERR_IO;
00100     }
00101
00102     if (length % 2 != 0) {
00103         free(data);
00104         return FIXED_XOR_ERR_ODD_INPUT;
00105     }
00106
00107     size_t half = length / 2;
00108     fixed_xor_status status = fixed_xor_buffers(data, data + half, data, half);
00109     if (status != FIXED_XOR_OK) {
00110         free(data);
00111         return status;
00112     }
00113
00114     size_t nwritten = fwrite(data, 1, half, out);
00115     if (nwritten != half) {
00116         free(data);
00117         return FIXED_XOR_ERR_IO;
00118     }
00119
00120     free(data);
00121     return FIXED_XOR_OK;
00122 }
00123
00125 const char *fixed_xor_status_string(fixed_xor_status status) {
00126     switch (status) {
00127         case FIXED_XOR_OK:
00128             return "success";
00129         case FIXED_XOR_ERR_ARGS:
00130             return "invalid arguments";
00131         case FIXED_XOR_ERR_IO:
00132             return "I/O failure";
00133         case FIXED_XOR_ERR_ODD_INPUT:
00134             return "input length must be even (two equal buffers)";
00135         case FIXED_XOR_ERR_OOM:
00136             return "out of memory";
00137         default:
00138             return "unknown error";
00139     }
00140 }
```

3.15 hex2b64.c File Reference

Implementation of hex-to-Base64 conversion helpers.

```
#include "hex2b64.h"
#include <ctype.h>
#include <stdio.h>
```

Include dependency graph for hex2b64.c:



Functions

- static int hex_value (int c)

  Convert a single hexadecimal character into its integer value.
- static void encode_base64_chars (const unsigned char ∗in, size_t len, char encoded[4])

  Produce four Base64 characters from up to three bytes.
- static void encode_base64_block (const unsigned char ∗in, size_t len, FILE ∗out)

  Write a Base64 block derived from up to three input bytes.
- int hex2b64_stream (FILE ∗in, FILE ∗out)

  Implementation of hex2b64_stream().
- int hex2b64_buffer (const unsigned char ∗hex, size_t hex_len, unsigned char ∗out, size_t out_cap, size_t ∗out_len)

  Implementation of hex2b64_buffer().

Variables

- static const char b64_table [ ]

3.15.1 Detailed Description

Implementation of hex-to-Base64 conversion helpers.
Definition in file hex2b64.c.

3.15.2 Function Documentation

3.15.2.1 encode_base64_block()

```
static void encode_base64_block (
            const unsigned char * in,
```

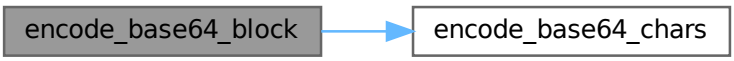
```
            size_t len,
            FILE * out )  [static]
```

Write a Base64 block derived from up to three input bytes.

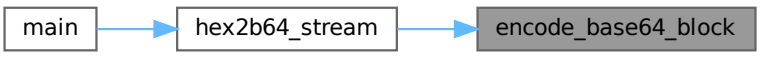
Parameters

in	Source bytes.
len	Number of source bytes.
out	Output stream that receives four Base64 characters.

Definition at line 59 of file hex2b64.c.
References encode_base64_chars().
Here is the call graph for this function:



Here is the caller graph for this function:



3.15.2.2 encode_base64_chars()

```
static void encode_base64_chars (
            const unsigned char * in,
            size_t len,
            char encoded[4] )  [static]
```

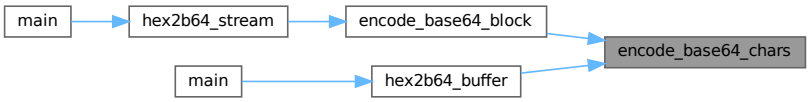
Produce four Base64 characters from up to three bytes.

Parameters

in	Input bytes (padded implicitly with zeros).
len	Number of valid bytes (1-3).
encoded	Destination for the four encoded characters.

Definition at line 36 of file hex2b64.c.
References b64_table.

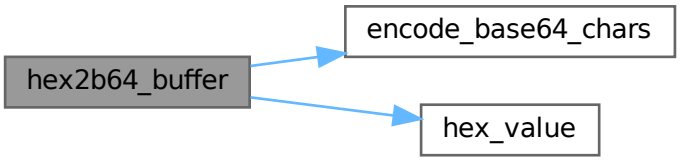
Here is the caller graph for this function:



3.15.2.3 hex2b64_buffer()

```
int hex2b64_buffer (
            const unsigned char * hex,
            size_t hex_len,
            unsigned char * out,
            size_t out_cap,
            size_t * out_len )
```

Implementation of hex2b64_buffer().
Convert a memory buffer of hexadecimal characters into Base64.
Definition at line 123 of file hex2b64.c.
References encode_base64_chars(), and hex_value().
Here is the call graph for this function:



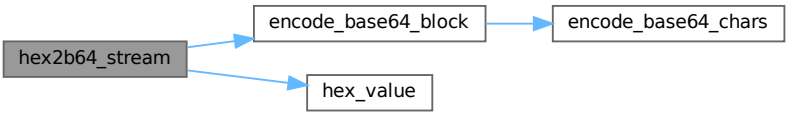
Here is the caller graph for this function:

3.15.2.4 hex2b64_stream()

```
int hex2b64_stream (
            FILE * in,
            FILE * out )
```

Implementation of hex2b64_stream().

Convert hexadecimal text read from a stream into Base64.
Definition at line 70 of file hex2b64.c.
References encode_base64_block(), and hex_value().
Here is the call graph for this function:



Here is the caller graph for this function:

3.15.2.5 hex_value()

```
static int hex_value (
            int c )  [static]
```

Convert a single hexadecimal character into its integer value.

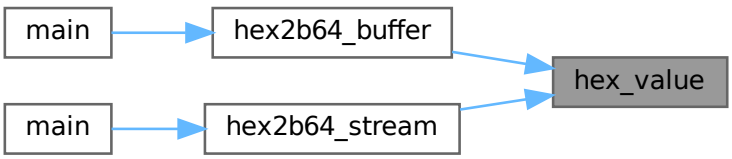
Parameters

c	Character to convert.

Returns

0-15 for valid hex digits, or -1 when `c` is not hexadecimal.

Definition at line 22 of file hex2b64.c.
Here is the caller graph for this function:



3.15.3 Variable Documentation

3.15.3.1 b64_table

```
const char b64_table[]  [static]
```

Initial value:

```
=
    "ABCDEFGHIJKLMNOPQRSTUVWXYZ"
    "abcdefghijklmnopqrstuvwxyz"
    "0123456789+/"
```

Definition at line 11 of file hex2b64.c.

3.16 hex2b64.c

Go to the documentation of this file.

```
00001
00006 #include "hex2b64.h"
00007
00008 #include <ctype.h>
00009 #include <stdio.h>
00010
00011 static const char b64_table[] =
00012     "ABCDEFGHIJKLMNOPQRSTUVWXYZ"
00013     "abcdefghijklmnopqrstuvwxyz"
00014     "0123456789+/";
00015
00022 static int hex_value(int c) {
00023     if (c >= '0' && c <= '9') return c - '0';
00024     if (c >= 'a' && c <= 'f') return 10 + (c - 'a');
00025     if (c >= 'A' && c <= 'F') return 10 + (c - 'A');
00026     return -1;
00027 }
00028
00036 static void encode_base64_chars(const unsigned char *in,
00037                                 size_t len,
00038                                 char encoded[4]) {
00039     unsigned int triple = 0;
00040
00041     /* Pack bytes into 24 bits: [b0 b1 b2] -> 0x00b0b1b2 */
00042     triple |= (unsigned int)in[0] << 16;
00043     if (len > 1) triple |= (unsigned int)in[1] << 8;
00044     if (len > 2) triple |= (unsigned int)in[2];
00045
00046     encoded[0] = b64_table[(triple >> 18) & 0x3F];
00047     encoded[1] = b64_table[(triple >> 12) & 0x3F];
00048     encoded[2] = (len > 1) ? b64_table[(triple >> 6) & 0x3F] : '=';
00049     encoded[3] = (len > 2) ? b64_table[triple & 0x3F]        : '=';
00050 }
00051
00059 static void encode_base64_block(const unsigned char *in, size_t len, FILE *out) {
00060     char encoded[4];
00061     encode_base64_chars(in, len, encoded);
00062
00063     fputc(encoded[0], out);
00064     fputc(encoded[1], out);
00065     fputc(encoded[2], out);
00066     fputc(encoded[3], out);
00067 }
00068
00070 int hex2b64_stream(FILE *in, FILE *out) {
00071     int ch;
00072     int high_nibble = -1;          /* -1 means "no pending half-byte" */
00073     unsigned char buffer[3];       /* group bytes into blocks of 3 for Base64 */
00074     size_t buf_len = 0;
00075
00076     while ((ch = fgetc(in)) != EOF) {
00077         if (isspace((unsigned char)ch)) {
00078             /* Ignore whitespace entirely */
00079             continue;
00080         }
00081
00082         int v = hex_value(ch);
00083         if (v < 0) {
00084             fprintf(stderr, "Error: invalid hex character '%c'\n", ch);
00085             return 1;
00086         }
00087
00088         if (high_nibble < 0) {
00089             /* First half of the byte */
00090             high_nibble = v;
00091         } else {
00092             /* Second half: form full byte */
```

```
00093             unsigned char byte = (unsigned char)((high_nibble « 4) | v);
00094             high_nibble = -1;
00095
00096             buffer[buf_len++] = byte;
00097
00098             if (buf_len == 3) {
00099                 encode_base64_block(buffer, buf_len, out);
00100                 buf_len = 0;
00101             }
00102         }
00103     }
00104
00105     if (high_nibble >= 0) {
00106         /* Odd number of hex digits: cannot form a full byte */
00107         fprintf(stderr, "Error: odd number of hex digits (incomplete byte)\n");
00108         return 1;
00109     }
00110
00111     /* Flush remaining bytes (if 1 or 2 bytes) with padding */
00112     if (buf_len > 0) {
00113         encode_base64_block(buffer, buf_len, out);
00114     }
00115
00116     /* Optional trailing newline */
00117     fputc('\n', out);
00118
00119     return 0;
00120 }
00121
00123 int hex2b64_buffer(const unsigned char *hex,
00124                    size_t hex_len,
00125                    unsigned char *out,
00126                    size_t out_cap,
00127                    size_t *out_len) {
00128     if (!out || (hex_len > 0 && !hex)) {
00129         return 1;
00130     }
00131
00132     unsigned char buffer[3];
00133     size_t buf_len = 0;
00134     int high_nibble = -1;
00135     size_t produced = 0;
00136
00137     for (size_t i = 0; i < hex_len; ++i) {
00138         unsigned char ch = hex[i];
00139         if (isspace((unsigned char)ch)) {
00140             continue;
00141         }
00142
00143         int v = hex_value(ch);
00144         if (v < 0) {
00145             return 1;
00146         }
00147
00148         if (high_nibble < 0) {
00149             high_nibble = v;
00150         } else {
00151             unsigned char byte = (unsigned char)((high_nibble « 4) | v);
00152             high_nibble = -1;
00153             buffer[buf_len++] = byte;
00154
00155             if (buf_len == 3) {
00156                 if (produced + 4 > out_cap) {
00157                     return 1;
00158                 }
00159                 char encoded[4];
00160                 encode_base64_chars(buffer, buf_len, encoded);
00161                 out[produced++] = (unsigned char)encoded[0];
00162                 out[produced++] = (unsigned char)encoded[1];
00163                 out[produced++] = (unsigned char)encoded[2];
00164                 out[produced++] = (unsigned char)encoded[3];
00165                 buf_len = 0;
00166             }
00167         }
00168     }
00169
00170     if (high_nibble >= 0) {
00171         return 1;
00172     }
00173
00174     if (buf_len > 0) {
00175         if (produced + 4 > out_cap) {
00176             return 1;
00177         }
00178         char encoded[4];
00179         encode_base64_chars(buffer, buf_len, encoded);
00180         out[produced++] = (unsigned char)encoded[0];
```

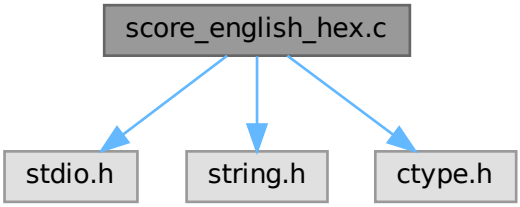
```
00181         out[produced++] = (unsigned char)encoded[1];
00182         out[produced++] = (unsigned char)encoded[2];
00183         out[produced++] = (unsigned char)encoded[3];
00184     }
00185
00186     if (produced + 1 > out_cap) {
00187         return 1;
00188     }
00189     out[produced++] = '\n';
00190
00191     if (out_len) {
00192         *out_len = produced;
00193     }
00194
00195     return 0;
00196 }
```

3.17 score_english_hex.c File Reference

Implementation of English scoring for hex-encoded strings.

```
#include <stdio.h>
#include <string.h>
#include <ctype.h>
```

Include dependency graph for score_english_hex.c:



Functions

- static int hex_value (char c)

  Convert a single hex character to its integer value.
- double score_english_hex (const char *hex)

  Implementation of score_english_hex().

Variables

- static const double english_freq [27]

  English letter frequency proportions for a-z plus space.

3.17.1 Detailed Description

Implementation of English scoring for hex-encoded strings.
Definition in file score_english_hex.c.

3.17.2 Function Documentation

3.17.2.1 hex_value()

```
static int hex_value (
            char c )  [static]
```

Convert a single hex character to its integer value.

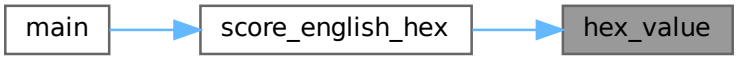
Parameters

c	Hex digit to convert.

Returns

0-15 on success or -1 on invalid characters.

Definition at line 51 of file score_english_hex.c.
Here is the caller graph for this function:



3.17.2.2 score_english_hex()

```
double score_english_hex (
            const char * hex )
```

Implementation of score_english_hex().
Score a hex string based on English letter frequency heuristics.
Definition at line 59 of file score_english_hex.c.
References english_freq, and hex_value().
Here is the call graph for this function:

Here is the caller graph for this function:

3.17.3 Variable Documentation

3.17.3.1 english_freq

```
const double english_freq[27]  [static]
```

Initial value:

```
= {
    0.0817,
    0.0150,
    0.0278,
    0.0425,
    0.1270,
    0.0223,
    0.0202,
    0.0609,
    0.0697,
    0.0015,
    0.0077,
    0.0403,
    0.0241,
    0.0675,
    0.0751,
    0.0193,
    0.0010,
    0.0599,
    0.0633,
    0.0906,
    0.0276,
    0.0098,
    0.0236,
    0.0015,
    0.0197,
    0.0007,
    0.1300
}
```

English letter frequency proportions for a-z plus space.
Index 0-25 correspond to 'a'-'z' and index 26 represents space.
Definition at line 15 of file score_english_hex.c.

3.18 score_english_hex.c

Go to the documentation of this file.

```
00001
00006 #include <stdio.h>
00007 #include <string.h>
00008 #include <ctype.h>
00009
00015 static const double english_freq[27] = {
00016     0.0817, // a
00017     0.0150, // b
00018     0.0278, // c
00019     0.0425, // d
00020     0.1270, // e
00021     0.0223, // f
00022     0.0202, // g
00023     0.0609, // h
00024     0.0697, // i
00025     0.0015, // j
00026     0.0077, // k
00027     0.0403, // l
00028     0.0241, // m
00029     0.0675, // n
00030     0.0751, // o
00031     0.0193, // p
00032     0.0010, // q
00033     0.0599, // r
00034     0.0633, // s
00035     0.0906, // t
00036     0.0276, // u
00037     0.0098, // v
00038     0.0236, // w
00039     0.0015, // x
00040     0.0197, // y
00041     0.0007, // z
00042     0.1300  // space (very common in normal English text)
00043 };
00044
00051 static int hex_value(char c) {
00052     if (c >= '0' && c <= '9') return c - '0';
00053     if (c >= 'a' && c <= 'f') return 10 + (c - 'a');
00054     if (c >= 'A' && c <= 'F') return 10 + (c - 'A');
```

```
00055     return -1;
00056 }
00057
00059 double score_english_hex(const char *hex) {
00060     size_t hex_len = strlen(hex);
00061     if (hex_len == 0 || (hex_len & 1)) {
00062         // empty or odd-length hex is invalid
00063         return -1e9;
00064     }
00065
00066     int counts[27] = {0};  // letter+space counts
00067     size_t total_letters = 0;
00068     size_t total_bytes = 0;
00069     double penalty = 0.0;
00070
00071     // Decode hex on the fly; no need to allocate a separate buffer.
00072     for (size_t i = 0; i < hex_len; i += 2) {
00073         int hi = hex_value(hex[i]);
00074         int lo = hex_value(hex[i + 1]);
00075         if (hi < 0 || lo < 0) {
00076             // invalid hex character
00077             return -1e9;
00078         }
00079
00080         unsigned char c = (unsigned char)((hi << 4) | lo);
00081         total_bytes++;
00082
00083         if (isalpha(c)) {
00084             c = (unsigned char)tolower(c);
00085             counts[c - 'a']++;
00086             total_letters++;
00087         } else if (c == ' ') {
00088             counts[26]++;
00089             total_letters++;
00090         } else if (c == '\n' || c == '\r' || c == '\t' ||
00091                    c == ',' || c == '.' || c == '\'' || c == '"') {
00092             // Neutral punctuation/whitespace: allowed but not counted as letters.
00093         } else if (c < 32 || c > 126) {
00094             // Non-printable or non-ASCII characters: penalize heavily but keep scoring.
00095             penalty += 50.0;
00096             continue;
00097         } else {
00098             // Other printable symbols like ! ? ; : etc. are allowed but not counted as letters.
00099         }
00100     }
00101
00102     if (total_bytes == 0) {
00103         return -1e9;
00104     }
00105     if (total_letters == 0) {
00106         return -1000.0 - penalty;
00107     }
00108
00109     // Compute a chi-squared style statistic over letters+space.
00110     // Lower chi2 means closer to English; we will invert it into a score.
00111     double chi2 = 0.0;
00112     for (int i = 0; i < 27; i++) {
00113         double expected = english_freq[i] * (double)total_letters;
00114         double observed = (double)counts[i];
00115         double diff = observed - expected;
00116         // Add a tiny constant to avoid division by zero.
00117         chi2 += (diff * diff) / (expected + 1e-9);
00118     }
00119
00120     // Convert chi-squared to a score.
00121     // Smaller chi2 -> higher score. Add bonus for high proportion of letters/spaces.
00122     double letter_ratio = (double)total_letters / (double)total_bytes;
00123     double score = -chi2 + letter_ratio * 50.0 - penalty;
00124
00125     return score;
00126 }
```

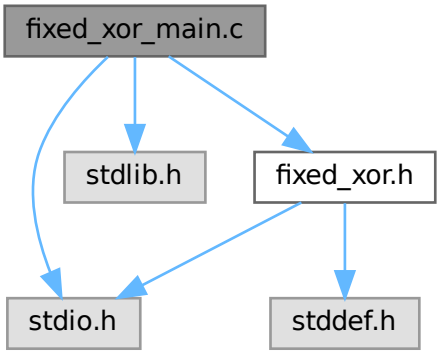
3.19 README.md File Reference

3.20 fixed_xor_main.c File Reference

Command-line wrapper for XORing two equal-length buffers.

```
#include <stdio.h>
#include <stdlib.h>
#include "fixed_xor.h"
```

Include dependency graph for fixed_xor_main.c:



Functions

- int main (void)

  Entry point that streams stdin through fixed_xor_stream().

3.20.1 Detailed Description

Command-line wrapper for XORing two equal-length buffers.
Definition in file fixed_xor_main.c.

3.20.2 Function Documentation

3.20.2.1 main()

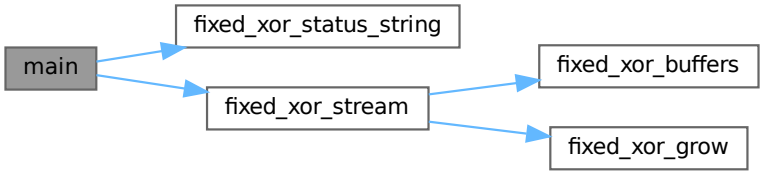
```
int main (
            void  )
```

Entry point that streams stdin through fixed_xor_stream().

Returns

EXIT_SUCCESS on success, EXIT_FAILURE otherwise.

Definition at line 16 of file fixed_xor_main.c.
References FIXED_XOR_OK, fixed_xor_status_string(), and fixed_xor_stream().
Here is the call graph for this function:



3.21 fixed_xor_main.c

Go to the documentation of this file.

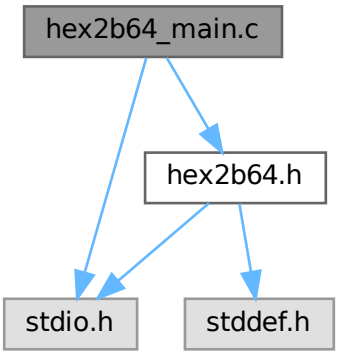
```
00001
00006 #include <stdio.h>
00007 #include <stdlib.h>
00008
00009 #include "fixed_xor.h"
00010
00016 int main(void) {
00017     fixed_xor_status status = fixed_xor_stream(stdin, stdout);
00018     if (status != FIXED_XOR_OK) {
00019         fprintf(stderr, "fixed_xor: %s\n", fixed_xor_status_string(status));
00020         return EXIT_FAILURE;
00021     }
00022
00023     return EXIT_SUCCESS;
00024 }
```

3.22 hex2b64_main.c File Reference

Command-line tool that converts hex input to Base64.

```
#include <stdio.h>
#include "hex2b64.h"
```

Include dependency graph for hex2b64_main.c:



Functions

- int main (void)

  Entry point that wires stdin/stdout through hex2b64_stream().

3.22.1 Detailed Description

Command-line tool that converts hex input to Base64.
Definition in file hex2b64_main.c.

3.22.2 Function Documentation

3.22.2.1 main()

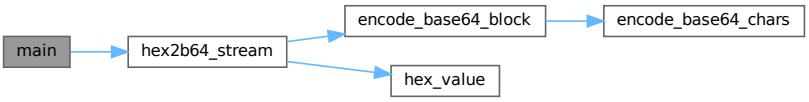
```
int main (
            void  )
```

Entry point that wires stdin/stdout through hex2b64_stream().

Returns

0 on success, non-zero if conversion fails.

Definition at line 14 of file hex2b64_main.c.
References hex2b64_stream().
Here is the call graph for this function:



3.23 hex2b64_main.c

Go to the documentation of this file.

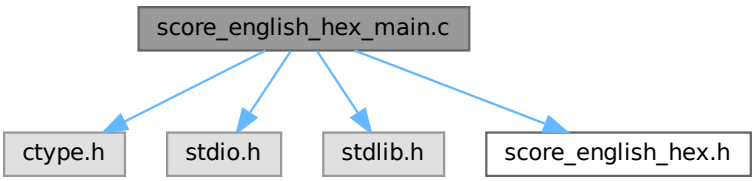
```
00001
00006 #include <stdio.h>
00007 #include "hex2b64.h"
00008
00014 int main(void) {
00015     return hex2b64_stream(stdin, stdout);
00016 }
```

3.24 score_english_hex_main.c File Reference

CLI utility that scores hex data for English-likeness.

```
#include <ctype.h>
#include <stdio.h>
#include <stdlib.h>
#include "score_english_hex.h"
```

Include dependency graph for score_english_hex_main.c:



Functions

- static double score_to_percentage (double raw)

  Map a raw English score to a 0-100 percentage.
- int main (void)

  Read hex from stdin, score it, and print a percentage.

3.24.1 Detailed Description

CLI utility that scores hex data for English-likeness.
Definition in file score_english_hex_main.c.

3.24.2 Function Documentation

3.24.2.1 main()

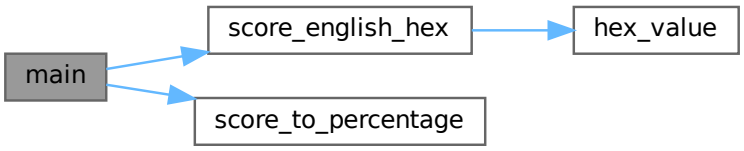
```
int main (
            void  )
```

Read hex from stdin, score it, and print a percentage.

Returns

EXIT_SUCCESS on valid input, EXIT_FAILURE otherwise.

Definition at line 38 of file score_english_hex_main.c.
References score_english_hex(), and score_to_percentage().
Here is the call graph for this function:



3.24.2.2 score_to_percentage()

```
static double score_to_percentage (
            double raw )  [static]
```

Map a raw English score to a 0-100 percentage.

Parameters

raw	Score returned by score_english_hex().

Returns

Normalized percentage.

Definition at line 18 of file score_english_hex_main.c.
Here is the caller graph for this function:

3.25 score_english_hex_main.c

Go to the documentation of this file.

```
00001
00006 #include <ctype.h>
00007 #include <stdio.h>
00008 #include <stdlib.h>
00009
00010 #include "score_english_hex.h"
00011
00018 static double score_to_percentage(double raw) {
00019     if (raw < -1e8) {
00020         return 0.0;
00021     }
00022
00023     double normalized = raw + 50.0;
00024     if (normalized < 0.0) {
00025         normalized = 0.0;
00026     }
00027     if (normalized > 100.0) {
00028         normalized = 100.0;
00029     }
00030     return normalized;
00031 }
00032
00038 int main(void) {
00039     size_t capacity = 1024;
00040     size_t len = 0;
00041     char *hex = malloc(capacity);
00042     if (!hex) {
00043         fprintf(stderr, "score_english_hex: failed to allocate input buffer\n");
00044         return EXIT_FAILURE;
00045     }
00046
00047     int ch;
00048     while ((ch = fgetc(stdin)) != EOF) {
00049         if (isspace((unsigned char)ch)) {
00050             continue;
00051         }
00052
00053         if (len + 1 >= capacity) {
00054             size_t new_capacity = capacity * 2;
00055             char *tmp = realloc(hex, new_capacity);
00056             if (!tmp) {
00057                 free(hex);
00058                 fprintf(stderr, "score_english_hex: failed to grow input buffer\n");
00059                 return EXIT_FAILURE;
00060             }
00061             hex = tmp;
00062             capacity = new_capacity;
00063         }
00064
00065         hex[len++] = (char)ch;
00066     }
00067     hex[len] = '\0';
00068
00069     if (len == 0) {
00070         free(hex);
00071         fprintf(stderr, "score_english_hex: no hex data provided\n");
00072         return EXIT_FAILURE;
00073     }
00074
00075     double raw_score = score_english_hex(hex);
00076     free(hex);
00077
00078     if (raw_score < -1e8) {
00079         fprintf(stderr, "score_english_hex: invalid hex input\n");
00080         return EXIT_FAILURE;
00081     }
00082
00083     double percentage = score_to_percentage(raw_score);
00084     printf("%.2f\n", percentage);
00085
00086     return EXIT_SUCCESS;
00087 }
```

Index