

Secure Coding (CNT 4419) Assignment I

Objectives: To become acquainted with a C safe-string library and use it to implement basic string operations.

Due Date: Sunday, October 29, 2023 at 11:59pm. No late submissions will be accepted.

Assignment Description

Complete this assignment by yourself.

While doing this assignment you will need to run a C compiler. One option is to use an online C compiler such as <https://paiza.io/en/languages/online-c-compiler>. If you use Paiza, you may optionally create an account to save your code. Paiza has an Input tab for providing input to the program.

This assignment asks you to use the Better Strings Library. An example program (*Main.c*) using this library can be found at <https://paiza.io/projects/OwRf7NzAYfmP5VDfpcMr6A>. This example includes sample input in the Input tab. You may fork this code (that is, add a copy to your account) using the menu next to the Run button.

If you are not using Paiza, begin by downloading the *bstrlib.h* and *bstrlib.c* files from the repository at <https://github.com/websnarf/bstrlib>. Then copy-paste the code shown in *Main.c* at the Paiza link above into your own *Main.c* file.

As part of the Better Strings Library, you will be using the `bgets`, `bdestroy`, `bconcat`, and `binstr` functions, which are declared and implemented in the *bstrlib.h* and *bstrlib.c* files. These functions manipulate values of type `bstring`, a “better” string type (i.e., safer than the normal C-string type). Values of type `bstring` have two fields important for this assignment: `data` and `slen`. Field `data` refers to the underlying string (of type `unsigned char *`), and field `slen` refers to the string’s length (of type `int`). Your program can access these fields directly.

Below is documentation for the library functions you will need to use. This documentation appears in the *bstrlib.txt* file in the GitHub repository.

bgets

```
extern bstring bgets (bNgetc getcPtr, void * parm, char terminator);  
typedef int (* bNgetc) (void * parm);
```

Read a `bstring` from a stream. As many bytes as is necessary are read until the terminator is consumed or no more characters are available from the stream. If read from the stream, the terminator character will be appended to the end of the returned `bstring`. The `getcPtr` function must have the same semantics as the `fgetc` C library function (i.e., returning an integer whose value is negative when there are no more characters available, otherwise the value of the next available unsigned character from the stream.) The intention is that `parm` would contain the stream data context/state required (similar to the role of the `FILE*` I/O stream parameter of `fgets`.) If no characters are read, or there is some other detectable error, `NULL` is returned.

bgets will never call the `getcPtr` function more often than necessary to construct its output (including a single call, if required, to determine that the stream contains no more characters.)

Abstracting the character stream function and terminator character allows for different stream devices and string formats other than `\n` terminated lines in a file if desired (consider `\032` terminated email messages, in a UNIX mailbox for example.)

For files, this function can be used analogously as `fgets` as follows:

```
fp = fopen ( ... );  
if (fp) b = bgets ((bNgetc) fgetc, fp, '\n');
```

(Note that only one terminator character can be used, and that `\0` is not assumed to terminate the stream in addition to the terminator character. This is consistent with the semantics of `fgets`.)

[Hence,

```
    bstring b = bgets ((bNgetc) fgetc, stdin, '\n');
```

reads a “better string” from stdin.]

bdestroy

```
extern int bdestroy (bstring b);
```

Deallocate the `bstring` passed. Passing `NULL` in as a parameter will have no effect. Note that both the header and the data portion of the `bstring` will be freed. No other `bstring` function which modifies one of its parameters will free or reallocate the header. Because of this, in general, `bdestroy` cannot be called on any declared `struct tagbstring` even if it is not write protected. A `bstring` which is write protected cannot be destroyed via the `bdestroy` call. Any attempt to do so will result in no action taken, and `BSTR_ERR` will be returned.

bconcat

```
extern int bconcat (bstring b0, const_bstring b1);
```

Concatenate the `bstring` `b1` to the end of `bstring` `b0`. The value `BSTR_OK` is returned if the operation is successful, otherwise `BSTR_ERR` is returned.

binstr

```
extern int binstr (const_bstring s1, int pos, const_bstring s2);
```

Search for the `bstring` `s2` in `s1` starting at position `pos` and looking in a forward (increasing) direction. If it is found then it returns with the first position after `pos` where it is found, otherwise it returns `BSTR_ERR`. The algorithm used is brute force; $O(m*n)$.

Use the `bstring` library to implement the following 3 tasks.

1. Read a string `s`, print `s`, and print the length of `s`.
2. Read strings `s1` and `s2`, append `s2` to `s1`, and print the result.
3. Read strings `s1` and `s2` and print a message indicating whether `s2` is a substring of `s1`.

Most of Task 1 has already been implemented for you in the given `Main.c` file, but you still need to add a line of code to print the length of the input string. Note that the given code calls `rmNewLine` to remove any final newline character from the input string and calls `bdestroy` to deallocate `bstring` memory. Call `rmNewLine` and `bdestroy` as appropriate throughout this assignment.

Implement Task 2 using the `bconcat` function and Task 3 using the `binstr` function.

Submit to Canvas your completed `Main.c` file that performs the 3 required tasks.

Notes:

- For this assignment, only the `Main.c`, `bstringlib.h` and `bstringlib.c` files are needed. Your `Main.c` should include only the `bstringlib.h` and standard-I/O (`stdio.h`) header files.
- Only strings input by the user need to be handled by the Better Strings library. Static strings may be character arrays, as seen in the example `Main.c` you have been provided.

Sample Execution

Sample Input (note the space before Coding):

```
Input for Assignment 1
Secure
 Coding
Secure
cure
```

Sample Output:

```
The input string is: Input for Assignment 1
The length of this string is: 22
The concatenation of 'Secure' and ' Coding' is: Secure Coding
Finally, 'cure' is a substring of 'Secure'.
```

Changing the final line of input to `Z` would change the final line of output to:

Finally, 'Z' is not a substring of 'Secure'.

Optional Further Reading

The `bstring` library provides the following alternative means of accessing the `data` and `slen` fields.

`char * bdata (bstring b);`

Returns the `char *` data portion of the `bstring b`. If `b` is `NULL`, `NULL` is returned.

`int blength (const_bstring b);`

Returns the length of the `bstring`. If the `bstring` is `NULL`, the length returned is 0.

These accessors are documented in the `bstringlib.txt` file in the GitHub repository.

However, above this documentation, the following notice appears.

The macros described below are shown in a prototype form indicating their intended usage. Note that the parameters passed to these macros will be referenced multiple times. As with all macros, programmer care is required to guard against unintended side effects.

Macros are another source of security vulnerabilities in C. Details can be found in Chapter 2 of *The CERT C Secure Coding Standard* by Robert C. Seacord. (Reading from this book is entirely optional and not required for this course.)