

CSC 209 Review 6 Solution

August 26, 2020

1 Exercises

1. I need to write which of the supplied function calls don't work and explain why.

- b) String format in `printf` expects character constant, but string literal is used
- c) String format in `printf` expects string but character constant is used
- e) The first argument in `printf` expects pointer but character constant (an integer) is used instead
- h) The first argument in `putchar` expects a character, but string literal (a pointer to character) is used
- i) The first argument in `puts` expects a pointer to character, but character constant (an integer) is used

Notes

- **putchar**
 - **Syntax:** `int putchar(int char)`
 - Writes a character (an unsigned char) specified by the argument `char` to stdout.
 - Does not append a new line to the output
 - Is similar to `printf` but for character
- **puts**
 - **Syntax:** `int puts(const char *str)`
 - Writes a string to stdout up to but not including the null character
 - Appends a newline character to the output.
 - Is similar to `printf` but for string
- **Character Constant**
 - **Syntax:** `' ... '`

- Is represented by an integer

- **String Literal**

- **Syntax:** " . . . "
- Has a sequence of characters inside
- Ends with `\0`
- Is represented by a pointer

Example

"When you come to a fork in the road, take it"

- **Escape Sequences in String Literal**

- A common example is `'\n'`
 - * causes the cursor to advance to the next line

2. First, I need to write which of the provided function calls are legal, and write the output produced

The solution to the first part is:

- b) [output: a]
- c) [output: abc]

Second, I need to write which of the following function calls are illegal, and explain why.

The solution to the second part is:

- a) `purchar` expects a character constant (an integer) but a value of type pointer to `char` is used
- d) `puts` expects a variable of type pointer to `char`, but a variable of type pointer to `char` is used

3. I need to write the values of `i`, `j`, `k` in the function

```
scanf("%d%s%d", &i, s, &j)
```

if the user enters `12abc34 56def78`.

The solution to this problem is:

- `i` - 12
- `j` - abc34

- k - 56

4. I need to modify the following `read_line` function in the following ways:

```
int read_line(char str[], int n)
{
    int ch, i = 0;

    while ((ch = getchar()) != '\n')
        if (i < n)
            str[i++] = ch;
    str[i] = '\0';
    return i;
}
```

- Have it skip white space before beginning to store input characters
- Have it stop reading at the first white-space character
- Have it stop reading at the first new-line character, then store the new-line character in the string
- Have it leave behind characters that it doesn't have room to store

The solution to this problem is:

```
a) #include <ctype.h>
2  #include <stdbool.h>
3
4  ...
5
6  int read_line(char str[], int n)
7  {
8      int ch, i = 0;
9      bool non_space_char_exists = false;
10
11     while ((ch = getchar()) != '\n')
12         if (isspace(ch) && non_space_char_exists){
13             continue;
14         }
15
16         if (i < n)
17             str[i++] = ch;
18             non_space_char_exists = true;
19     str[i] = '\0';
20     return i;
21 }
```

```
b) #include <ctype.h>
2
3   ...
4
5   int read_line(char str[], int n)
6   {
7       int ch, i = 0;
8
9       while ((ch = getchar()) != '\n')
10          if (isspace(ch)){
11              break;
12          }
13
14          if (i < n)
15              str[i++] = ch;
16      str[i] = '\0';
17      return i;
18  }
```

```
c) #include <ctype.h>
2
3   ...
4
5   int read_line(char str[], int n)
6   {
7       int ch, i = 0;
8
9       while ((ch = getchar()) != '\n')
10          if (ch == '\n'){
11              break;
12          }
13
14          if (i < n)
15              str[i++] = ch;
16
17      str[i] = '\n';
18      str[i+1] = '\0';
19      return i;
20  }
```

```
d) #include <ctype.h>
2
3   ...
4
5   int read_line(char str[], int n)
6   {
7       int ch, i = 0;
8       int n = strlen(str) + 1;
9
10      do {
11          ch = getchar();
12
13          if (!ch) {
14              break;
```

```
15         }
16
17         str[i++] = ch;
18
19     } while (i < (n - 1));
20
21     str[i] = '\0';
22     return i;
23 }
```

Correct Solution

- c)

```
1  #include <ctype.h>
2
3  ...
4
5  int read_line(char str[], int n)
6  {
7      int ch, i = 0;
8
9      do {
10         ch = getchar()
11
12         if (ch == '\n'){
13             break;
14         }
15
16         if (i < n)
17             str[i++] = ch;
18
19     } while (ch != '\n');
20
21     str[i] = '\0';
22     return i;
23 }
```

- d)

```
1  #include <ctype.h>
2
3  ...
4
5  int read_line(char str[], int n)
6  {
7      int ch, i = 0;
8      int n = strlen(str) + 1;
9
10     do {
11         ch = getchar();
```

```
12
13         if (ch == '\n') {
14             break;
15         }
16
17         str[i++] = ch;
18
19     } while (i < (n - 1));
20
21     str[i] = '\0';
22     return i;
23 }
```

Notes

- Learned that `getchar()` always ends with `\n`

5. a) I need to write a function named `capitalize` that capitalizes all letters in its argument.

The requirement for this function is:

- Array subscripting must be used to access each character in string

The solution to this problem is:

```
1  #include <ctype.h> // toupper
2
3  void capitalize(char *s)
4  {
5
6      for (int i = 0; s[i] != '\0'; i++) {
7          s[i] = toupper(s[i]);
8      }
9  }
```

Notes

- Accessing the Characters in a String
 1. Using array subscripting

Example

```
int count_spaces(const char s[])
{
    int count = 0, i;

    for (i = 0; s[i] != '\0'; i++)
        if (s[i] == ' ')
            count++;
    return count;
}
```

2. Using pointer

Example

```
int count_spaces(const char *s)
{
    int count = 0;

    for (; *s != '\0'; s++)
        if (*s == ' ')
            count++;
    return count;
}
```

- b) I need to write a function named `capitalize` that capitalizes all letters in its argument.

The requirement for this function is:

- pointer must be used to access each character in string

The solution to this problem is:

```
1  #include <ctype.h> // toupper
2
3  void capitalize(char *s)
4  {
5      char *p = s;
6      while (*p != '\0') {
7          *p = toupper(*p);
8          p++;
9      }
10 }
```

6. I need to write a function `sensor` that modifies a string by replacing every occurrence of `foo` with `***`.

The additional requirement of this function are:

- I need to make the function as short as possible without sacrificing clarity.

The solution to this problem is:

```
1 #include <string.h> \\ strlen
2
3 void sensor(char s[]) {
4     char *p;
5
6     if (strlen(s) < 3) {
7         return;
8     }
9
10    for (p = &s[2]; p < s + strlen(s); p++) {
11        if (tolower(*p) == 'o' &&
12            tolower(*(p-1)) == 'o' &&
13            tolower(*(p-2)) == 'f') {
14
15            *p = '*';
16            *(p-1) = '*';
17            *(p-2) = '*';
18        }
19    }
20 }
21 }
```

Correct Solution

```
1 #include <string.h> \\ strlen
2
3 void sensor(char s[]) {
4     if (strlen(s) < 3) {
5         return;
6     }
7
8     for (char *p = &s[2]; *p != '\\0'; p++) {
9         if (tolower(*p) == 'o' &&
10             tolower(*(p-1)) == 'o' &&
11             tolower(*(p-2)) == 'f') {
12
13             *p = *(p-1) = *(p-2) = '*';
14         }
15     }
16 }
17 }
```


18

7. I need to identify from the provided statements that which is not equivalent to others.

The solution to this problem is:

- d) All of the other statements are about making `str` null or empty.

Notes

- `*str = 0` makes pointer NULL
- `strcpy`
 - **Syntax:** `char *strcpy (char *s1, const char *s2)`
 - Copies string `s2` to the string `s1`
- `strcat`
 - **Syntax:** `char *strcat(char *s1, const char *s2)`
 - appends the contents of the string `s2` to the end of the string `s1`

Example

```
strcpy(str1, "abc");  
strcat(str1, "def"); /* str1 now contains "abcdef" */
```

8. I need to write the value of the string `str` after the following execution of statements

```
strcpy(str, "tire-bouchon");  
strcpy(&str[4], "d-or-wi");  
strcat(str, "red?");
```

The solution to this problem is: `tired-or-winred?`

Correct Solution

The solution to this problem is: `tired-or-wired?`

Notes

- `strcpy` always copies upto the first null character.
 - The pointer stops and points at the first null character after `strcpy`

9. I need to write the value of the string `s1` after the executing the provided statements:

The solution to this problem is: `computers`

Correct Solution

The solution to this problem is: `computers\0`

Notes

- `strcmp`
 - **Syntax:** `int strcmp(const char *s1, const char *s2)`
 - * Compares string `s1` and `s2`
 - * Returns
 - 0 - if `s1` and `s2` are identical
 - >0 - if ASCII value of first unmatched character in `s1` is greater than `s2`
 - <0 - if ASCII value of first unmatched character in `s1` is less than `s2`

10. I need to write what's wrong with the provided function.

The solution to this problem is that the pointer `*q` hasn't allocated memory, and because of that, the function call `strcpy(q,p)` would result in segmentation fault.

11. Here I need to modify `strcmp` function to use pointer arithmetic.

The solution to this problem is:

```
1  int strcmp (char *s, char *t) {
2      char *p = s, *q = t;
3
4      while (*p == *q) {
5          if (*p == '\0') {
6              return 0;
7          }
8          p++;
9          q++;
10     }
11
12     return *p - *q;
13 }
```

12. I need to write the following function

```
void get_extension(const char *file_name, char *extension)
```

satisfying the following requirements:

- If the file name doesn't have an extension, empty string should be stored instead
- `get_extension` should be kept as simple as possible by using `strlen` and `strcpy`

The solution to this problem is:

```
1  void get_extension(const char *file_name, char *extension) {
2      int i = strlen(file_name) - 1;
3
4      for (; i >= 0; i--) {
5          if (*(file_name+i) == '.') {
6              break;
7          }
8      }
9      strcpy(extension, file_name + (i+1));
10 }
```

13. I need to write the following function

```
void build_index_url (const char *domain, char *index_url);
```

satisfying the following requirements:

- `build_index_url` should add "http://www." to the beginning of the string
- `build_index_url` should add "/index.html" to the end of the string
- `build_index_url` should store the result in `index_url`

- `build_index_url` should be kept as simple as possible by using `strcat` and `strcpy`

The solution to this problem is:

```

1 void build_index_url (const char *domain, char *index_url) {
2     strcat(index_url, "http://www.");
3     strcat(index_url, domain);
4     strcat(index_url, "/index.html");
5 }

```

14. I need to write the output of the provided function.

The solution to this problem is: Grinch

Notes

- `--*p` means decrement `*p` first; the value of expression is `*p` after decrement
- Idioms are good to know. It's used by a lot of C programmers.
- **String Idioms - Searching for the end of string**
 - The following function `strlen` are equal

<pre> size_t strlen(const char *s) { size_t n; for (n = 0; *s != '\0'; s++) n++; return n; } </pre>	=	<pre> size_t strlen(const char *s) { size_t n = 0; while (*s++) n++; return n; } </pre>
--	---	--

It takes advantage of the fact that the end of string is `*s = '\0' = 0`

- **String Idioms - Copying string**
 - The following function `strlen` are equal

<pre> char *strcat(char *s1, const char *s2) { char *p = s1; while (*p != '\0') p++; while (*s2 != '\0') { *p = *s2; p++; s2++; } *p = '\0'; return s1; } </pre>	=	<pre> char *strcat(char *s1, const char *s2) { char *p = s1; while (*p) p++; while (*p++ = *s2++) ; return s1; } </pre>
---	---	--

15. a) I need to find the value of `f("abcd", "babcd")` given the provided function `f`.

The solution to this problem is: 3

- b) I need to find the value of `f("abcd", "bcd")` given the provided function `f`.

The solution to this problem is: 0

- c) I need to write what value `f` returns when two strings `s` and `t` are passed.

The answer to this problem is: it returns the number of consecutive characters in `s` that's also in `t`.

16. I need to use the techniques of section 13.6 to condense the function `count_spaces` in section 13.4

The solution to this problem is:

```
1 int count_spaces(const char s[])
2 {
3     int count = 0;
4
5     do {
6         if (*s == ' ') {
7             count++;
8         }
9     } while (*s++);
10
11     return count;
12 }
```

17. I need to write the following function

```
bool test_extension (const char *file_name, const char *extension)
```

satisfying the following requirements

- `test_extension` should return `true` if the file's extension matches the string pointed to by `extension`.
- `test_extension` should ignore the case of letters
- `test_extension` should use "search for the end of a string" idiom
- `test_extension` should use `toupper` to make the process case-insensitive

The solution to this problem is:

```
1  bool test_extension (const char *file_name, const char *extension)
2  {
3      while (*file_name++ != '.')
4          ;
5
6
7      while (toupper(*file_name++) == toupper(*extension++)) {
8          if (*file_name == '\0' && *extension == '\0') {
9              return true;
10         }
11     }
12
13     return false;
14 }
```

18. I need to write the function

```
void remove_filename(char *url)
```

satisfying the following requirements

- `remove_filename` should modify the string in `url` by removing the file name and the preceding slash

`http://www.knking.com/index.html` → `http://www.knking.com/`

- `remove_filename` should use "search for the end of a string" idiom

The solution to this problem is:

```
1  void remove_filename(char *url)
2  {
3      char *p = url;
4
5      while (*p++)
6          ;
7
8      while (p-- > url) {
9          if (*p == '/') {
10             *p = '\0';
11             return;
12         }
13     }
14 }
```

2 Programming Exercise

1. I need to write a program that finds the "smallest" and "largest" in a series of words.

The requirement for this program are:

- The program should ask the user to enter the words
- The program should determine which words comes first and last as if the words are listed in dictionary order
- The program must stop accepting input when the user enters a four-letter word
- Assume program has no word more than 20 letters long
- The program should use `smallest_word` and `largest_word` to keep trak of the "smallest" and "largest" words so far.
- The program should use `strcmp` to compare with `smallest_word`
- The program should also use `strcmp` to comapre with `largest_word`
- The program should use `strlen` to determine when the user entered a four-letter word

The solution to this problem is included in file `question_19.c`.

2. a) I need to improve the `remind.c` satisfying the following requirements:

- The program should print an error message and ignore a reminder if the corresponding day is negative or larger than 31 using `continue` statement

The solution to this problem is included in file `question_20_a.c`.

- b) I need to improve the `remind.c` satisfying the following requirements:

- The user should enter a day, a 24-hour time, and a reminder.
- The program should sort the printed reminder list first by day and then by time

The solution to this problem is included in file `question_20_b.c`.

Notes

- Learned the unread characters in `scanf` are yielded

```

printf("Enter day and reminder: ");
scanf("%2d", &day);
if (day == 0)
    break;
sprintf(day_str, "%2d", day);
read_line(msg_str, MSG_LEN);

for (i = 0; i < num_remind; i++)
    if (strcmp(day_str, reminders[i]) < 0)
        break;
for (j = num_remind; j > i; j--)
    strcpy(reminders[j], reminders[j-1]);

strcpy(reminders[i], day_str);
strcat(reminders[i], msg_str);

num_remind++;
}

printf("\nDay Reminder\n");
for (i = 0; i < num_remind; i++)
    printf(" %s\n", reminders[i]);

return 0;
}

int read_line(char str[], int n)
{
    int ch, i = 0;

    while ((ch = getchar()) != '\n')
        if (i < n)
            str[i++] = ch;
    str[i] = '\0';
    return i;
}

```

enter '31 Exercise at night'

31 is stored in 'day'

'Exercise at night' is read here

c) I need to improve the `remind.c` satisfying the following requirements:

- The program should print one-year reminder list.
- The program should require user to enter days in the form *month/day*

The solution to this problem is included in file `question_20_c.c`.

3. I need to modify `deal.c` program so that it prints the full names of the cards it deals.

The solution to this problem is included in file `question_21_c.c`.

Notes

• Ragged Array

- Is a two dimensional array whose rows can have different lengths
- Can be simulated by C language

Example

```

char *planets[] = {"Mercury", "Venus", "Earth",
                  "Mars", "Jupiter", "Saturn",
                  "Uranus", "Neptune", "Pluto"};

```


4. I need to write a program that satisfies the following requirements:

- The program should echoe its command-line arguments in reverse

The solution to this problem is included in file `./question_22.c`.

Notes

- **Command Line Arguments**

- **Syntax**

```
int main(int argc, char *argv[])
{
    ...
}
```

- * `argc` Means ‘argument count’
- * `argv` Means ‘argument vector’ or an array of pointers to the command-line arguments

Example

```
ls -l remind.c
```

Here,

- * `argc` is 3
- * `argv[0]` is `ls`
- * `argv[1]` is `-l`
- * `argv[2]` is `remind.c`

5. I need to write a program that adds up its command-line arguments, which are assumed to be integers.

The solution to this problem is included in file `question_23.c`.

Notes

- **atoi**

- **Syntax:** `int atoi(const char *str)`
- Converts the string argument `str` to an integer

6. I need to improve `planet.c` program of section 13.7 satisfying the following requirements:

- The program should ignore case when comparing command-line arguments with string in `planets` array

The solution to this problem is included in file `question_24.c`.

7. I need to modify programming project 11 from chapter 5 satisfying the following requirements:
- The program uses array containing pointers to strings instead of `switch` statements

The solution to this problem is included in file `Question_25.c`.

References

- 1) Github (William Gherman), c-solutions (Chapter 5 Project 11), link
8. I need to modify project 5 from chapter 7 to satisfy the following requirements:
- The program includes the function `int compute_scrabble_value (const char *word)` that returns the SCRABBLE value pointed by `word`

The solution to this problem is included in file `question_26.c`

References

- 1) Github (William Gherman), c-solutions (Chapter 7 Project 5), link
9. I need to modify programming project from chapter 7 project 10 to satisfy the following requirements
- The program includes `int compute_vowel_count(const char *sentence)`
 - The function `int compute_vowel_count(const char *sentence)` returns the number of vowels in the string pointed to by the `sentence` parameter

The solution is included in file `question_27.c`.

Notes

- `scanf` scans `"%s"` upto white-space (i.e `\n`, `\0`)

References

- 1) Github (William Gherman), c-solutions (Chapter 7 Project 10), link

10. I need to modify programming project chapter 7 project 11 to satisfy the following:

- The program includes the function `void reverse_name(char *name)`
- The original string may contain extra spaces between the first and last name, and after the last name
- The function `reverse_name` should point to a string containing a first name followed by a last name
- The function `reverse_name` should modify the string so the last name comes first, followed by a comma, a space, the first initial, and a period

The solution to this problem is included in file `question_28.c`.

References

1) Github (William Gherman), c-solutions (Chapter 7 Project 11), link

11. I need to modify programming project chapter 7 project 13 to satisfy the following:

- The program includes the function `double compute_average_word_length(const char *sentence)`
- The function `compute_average_word_length` returns the average length of the words pointed to by sentence

The solution to this problem is included in file `question_29.c`.

References

1) Github (William Gherman), c-solutions (Chapter 7 Project 13), link

12. I need to modify programming project chapter 8 project 14 to satisfy the following requirements:

- The program stores words in a two dimensional `char` array as it reads the sentence, with each row storing a single word
- Assume sentence contains no more than 30 words
- Assume no word is more than 20 characters long

The solution to this problem is included in file `question_30.c`.

References

1) Github (William Gherman), c-solutions (Chapter 8 Project 14), link

13. I need to modify programming project chapter 8 project 15 to satisfy the following requirements

- The program should include function `void encrypt (char *message, int shift)`
- The parameter `message` of function `encrypt` should point to a string to be encrypted
- The parameter `shift` of function `encrypt` should represent the amount which each letter to be shifted

The solution to this problem is included in file `question_31.c`.

References

1) Github (William Gherman), c-solutions (Chapter 8 Project 15), link

14. I need to modify the programming project chapter 8 project 16 to satisfy the following requirements:

- The program should include the function `bool are_anagrams(const char *word1, const char *word2)`
- The function `are_anagrams` should return `true` if the string pointed to by `word1` and `word2` are anagrams

The solution to this problem is included in file `question_32.c`.

Notes

- **anagram** is a word or phrase formed by rearranging the letters of a different word or phrase ^[1]

References

1) Github (William Gherman), c-solutions (Chapter 8 Project 16), link

2) Wikipedia, Anagram, link

15. I need to modify programming project chapter 10 project 6 to satisfy the following requirements

- The program should include the function `evaluate_RPN_expression(const char *expression)`
- The function `evaluate_RPN_expression` returns the value of the RPN expression pointed to by `expression`

The solution to this problem is included in `question_33.c`.

References

1) Github (William Gherman), c-solutions (Chapter 10 Project 6), link

16. I need to modify programming project chapter 12 project 1 to satisfy the following requirements:

- The program should include the function `void reverse(char *message)`
- The function `reverse` should use two pointers
- The first pointer in function `reverse` should start in the beginning
- The second pointer in function `reverse` should start at the end
- The function `reverse` should use the pointers to reverse characters until the two meet at the middle

The solution to this problem is included in file `question_34.c`.

17. I need to modify programming project chapter 12 project 2 to satisfy the following requirements

- The program should include the function `bool is_palindrome(const char *message)`
- The function `(is_palindrome)` should return `true` if string pointed to by `message` is a palindrome

The solution to this problem is included in file `question_35.c`.