

Assignment 2 – Hangman

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Purpose

This program implements the classic hangman game. This game consists of a player guessing letters in order to figure out a secret word. For each wrong guess, a body part of a person is drawn hanging from a gallows. The person's body consists of a head, two arms, two legs, and a spine; a total of six incorrect guesses. The program draws ASCII art to represent the man and the gallows.

How to Use the Program

With the files `hangman_helpers.h`, `hangman_helpers.c`, `hangman.c`, and `Makefile` in the same directory, use command `make` to compile the program. After doing this, use command `./hangman word` to run the program. This will run the game with the secret word as "word". To change the secret word replace "word" in the command with your desired word. If you wish to have more than one word or wish to include apostrophes, spaces, or hyphens in the secret word, then wrap your secret word with double quotes ("").

Program Design

This program will first check for the correct number of arguments: making sure it is two. It then passes the second argument to a function which validates the argument as a correct phrase to be used for the game. It then creates an array equal to the length of the string of the second argument (the secret phrase) with each values set to 0. A mistakes counter is initialized and set to 0. An array is created with a length of 26 vaules with every value initialized to 0. This array represents whether each letter of the alphabet has been guessed incorrectly. A integer variable is initialized and set to 0 to be used later as an index value for the previous array. A character variable is set to the value ' ' to represent the user's guess and an integer variable is set to 0 to represent if the guess was valid. The program then begins a while loop that continues until the mistakes counter is more than or equal to the constant value `LOSING_MISTAKE` or a function that checks whether all the letters have been guessed returns true. A function is called to print the game to the screen. Then, a do while loop begins. Within this loop is another do while loop that prompts, and retrieves a character from the user and continues until a function that checks whether the user's input was a lowercase letter returns true. After exiting that loop, the program checks whether the guess is within the secret phrase using a function. If it is not, the program checks whether it has been guessed already according to the array initialized earlier. If it has been guessed already, the program loops again. If it has not been guessed then it is added to the array of eliminated letters and a mistake is added to the counter. If the guess is within the secret phrase and has not been guessed already, its guessed value in the array is set to 1. Once the program exits the game loop, it checks whether mistakes is equal to or greater than `LOSING_MISTAKES`. If it is, it prints the losing prompt, if it is not it prints the winning prompt. The program then returns 0 to signify proper completion of the program.

Data Structures

This program contains two integer arrays, an unsigned long value, three integer values, and one character value. It also contains two constant integer values, a constant character string value, a constant character

string pointer, and a constant character array pointer given in the starter files for this assignment.[1]

- **guessed**: This array is of size equal to the length of the secret phrase. It holds either a 1 or 0 (true or false) at each index to represent whether the corresponding letter in the phrase at the matching index has been guessed. This array is used to check if the user has made a repeat guess and if the game has been won.
- **eliminated**: This array is of size 26. Each index corresponds to a letter in the alphabet with index 0 being 'a' and index 25 being 'z'. The array holds either a 1 or 0 (true or false) at each index to represent whether that letter has been incorrectly guessed. This array is used to print out which letters have been eliminated in alphabetical order. It is also used to check whether a repeat guess has been made. I chose to keep track of the eliminated letters in this way because it allowed me to easily print them out in alphabetical order.
- **len**: This is a variable of type unsigned long. It holds the length of the secret phrase. I chose to use a variable of type unsigned long because the command `strlen()` returns an unsigned long and changing this to an int value would lose precision. I use this value to iterate over the list of guessed letters and iterate over the phrase itself.
- **mistake**: This integer variable keeps count of the number of mistakes the user has made. It is used to check if the user has lost the game and it is used to determine which game art to print to the screen.
- **elim_index**: This integer variable is used as the index value for the **eliminated** array. When a player makes a guess, this variable receives the player's guess - 97 in order to get the corresponding index value for the letter the player guessed in the **eliminated** array.
- **valid_guess**: This integer variable represents whether the user made a valid guess or not. It stores either a 0 or 1 (true or false). It is used to determine whether or not to continue prompting for input.
- **guess**: This variable of type character is used to store the user's guess. The user's guess is vital to the program and is used repeatedly.
- **MAX_LENGTH**: This constant integer is equal to 256 and represents the max length the secret phrase can be. It is used to validate the phrase.
- **LOSING_MISTAKE**: This constant integer is equal to 6 and represents the amount of mistakes a user needs to lose. It is used to check whether the user has lost.
- **CLEAR_SCREEN**: This constant character string is used to clear the screen before printing the game screen.
- ***punctuation**: This pointer points to a character string of accepted punctuation in the secret phrase. It is used to validate the secret phrase.
- ***arts**: This pointer points to an array of character strings. These strings are the ASCII art for the different stages of the game. They are accessed by passing **mistake** as the index and printed to the screen.

Algorithms

```
game loop
loop while mistakes < LOSING_MISTAKE and not all_letters_guessed(guessed, length of phrase)
print_screen(mistakes, guessed, len, argv[1], eliminated)
do
do
    print "Guess a letter: "
    guess = read_letter
    while guess is not a lowercase letter
    if string argv[1] does not contain character user guessed then
```

```

        set elim_index to users guess - 97
        if eliminated[elim_index] true then
            valid_guess = false
            loop again
        else
            eliminated[elim_index] = true
            add a mistake
            valid_guess = true
    else
        valid_guess = true
        for i, 0 to < len
            if guess == argv[1][i] then
                if guessed[i] true
                    valid_guess = false
                    loop again
                else
                    guessed[i] = true
            while valid guess false

```

Function Descriptions

bool string_contains_character(const char *s, char *c)

This function takes two parameters: a constant character string pointer s and a character c. It returns either a 1 or 0 (true or false). Its purpose is to determine whether the character c is in the character string s.

```

bool string_contains_character(const char *s, char *c)
    while (s does not point to end of string)
        if c equal to s then
            return true
        move s to next character
    return false

```

bool is_lowercase_letter(char c)

This function takes one parameter: a character c. It returns either true (1) or false (0). Its purpose is to determine whether c is a lowercase letter or not.

```

bool is_lowercase_letter(char c)
    if ASCII value of a <= c or c <= ASCII value of z then
        return true
    return false

```

bool validate_secret(const char *secret)

This function takes one parameter: a constant charace pointer secret. It returns either true (1) or false (0). Its purpose is to check whether the secret phrase entered by the user meets the required guidelines.

```

bool validate_secret(const char *secret)
    if length of secret > max length of secret phrase then
        print "the secret phrase is over 256 characters"
        return false
    while secret does not point to end of string
        if secret not lowercase letter and secret not a space, hyphen, or apostrophe then
            print "invalid character: {secret}"

```

```
        print "he secret phrase must contain only lowercase letters, spaces, hyphens, and
            apostrophes"
        return false
    move secret pointer to next position
    return true
```

char read_letter(void)

This function takes no parameters and returns a character. Its purpose is to read a character from standard input and return it. The function checks whether the character input is the new line character because when a user submits an entry the program receives the user's entry followed by a newline character. This means that if the program looks for input again it will receive a newline character rather than waiting for the user's entry.

```
char read_letter(void)
    initialize variable c to space character
    do
        set c to user's input
        if c == new line character then
            loop again
        else
            return c
    while true
```

bool all_letters_guessed(int guessed[], unsigned long len)

This function takes two parameters: an integer array guessed and an unsigned long len. Guessed is an array of size equal to the length of the secret phrase. It stores either a 0 or 1 for each index to represent whether that index in the secret phrase has been guessed (1) or not (0). Len is the length of the secret phrase. The purpose of this function is to check whether each value in the array guessed is true.

```
bool all_letters_guessed(int guessed[ ], unsigned long len)
    for i, 0 to < len
        if not guessed then
            return false
    return true
```

void print_screen(int mistakes, int guessed[], unsigned long len, const char *secret, int eliminated[])

This function takes 5 parameters: an integer mistakes, an integer array guessed, an unsigned long len, a constant character pointer secret, and an integer array eliminated. It returns nothing. The integer mistakes represents how many mistakes the player has made. Guessed is an array of size equal to the length of the secret phrase. It stores either a 0 or 1 for each index to represent whether that index in the secret phrase has been guessed (1) or not (0). Len is the length of the secret phrase. Secret is a pointer to the secret phrase. It is constant so it can't be changed accidentally. Eliminated is an array equal to the length of the alphabet with index 0 being a and index 25 being z. It holds either a 0 or 1 at each index to represent whether this letter has been guessed incorrectly.

```
void print_screen(int mistakes, int guessed[ ], unsigned long len, const char *secret, int
    eliminated[ ])
    clear the screen
    print game art according to number of mistakes
    print "Phrase: "
    for i, 0 to < len
        if guessed[i] = true then
```

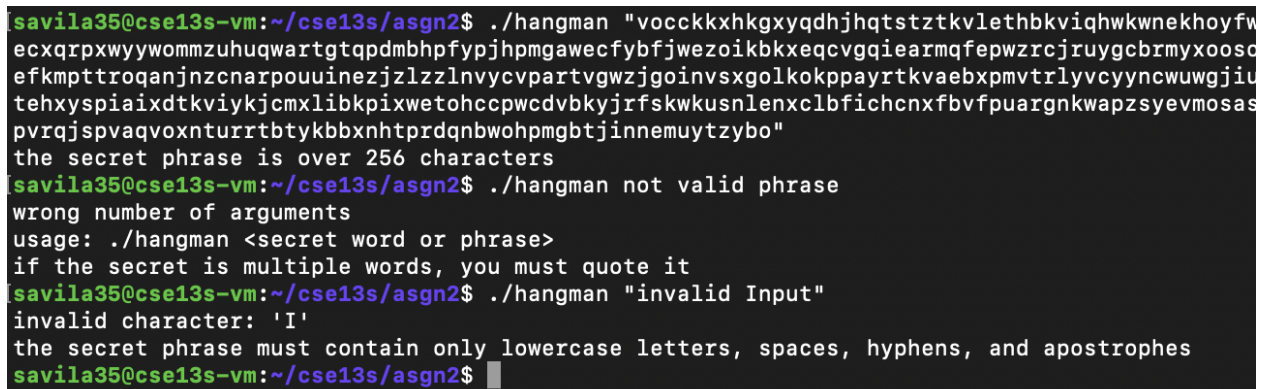
```

        print character secrets pointing at
    else
        print "_"
    move secret pointer to next character
    print new line
    print "Eliminated: "
    for i, 0 to 25
        if eliminated[i] = true
            print character of ascii value i + 97
    print two new line

```

Results

This program works as intended. It runs the hangman game perfectly and catches input errors in the way that it is supposed to. For example, when the secret phrase is missing or invalid, the program outputs the correct error message. This is shown in Fig. 1. When repeating a guess or making an invalid guess, the program re-prompts the user in the way its intended to as shown in Fig. 2. The program also prints the correct winning screen (Fig. 3) and losing screen (Fig. 4). One thing I would change is that an array is initialized with a size dependent on a variable rather than a size that exists at compile time. This is shown in Fig. 5. Variable sized arrays can cause errors, but my program works as intended every time I have tested it and when it has been tested with the pipeline. This being said, I have chosen to leave this variable sized array because I would have to restructure my program without it. In the future, I will stay away from using run time sized arrays.



```

savila35@cse13s-vm:~/cse13s/asn2$ ./hangman "vocckkxhkgxyqdhjhtstztkvlethbkviqhwkwnekhoyfw
ecxqrpwxwywommzuhuqwartgtqpdmbhpfypjhpmgawecfybfjwezoikbkxeqcvqgiearmqfepwzrcjruggcbrmyxoosc
efkmppttroqanjzcnarpouuinezjzllzlnvyevpartvgwzjgoinvxgolkokppayrtkvaebxpmvtrlyvcyyncwuwgjiu
tehxyspiaixdtkvijkcmxlibkpixwetohccpwcdbvbjrfskwwkusnlencblfichcnxfbvfpuargnkwapszyevmosas
pvrqjspaavoxnturrtbtykbbxnhtprdqnbwohpmgbtjinnemuytzybo"
the secret phrase is over 256 characters
savila35@cse13s-vm:~/cse13s/asn2$ ./hangman not valid phrase
wrong number of arguments
usage: ./hangman <secret word or phrase>
if the secret is multiple words, you must quote it
savila35@cse13s-vm:~/cse13s/asn2$ ./hangman "invalid Input"
invalid character: 'I'
the secret phrase must contain only lowercase letters, spaces, hyphens, and apostrophes
savila35@cse13s-vm:~/cse13s/asn2$

```

Figure 1: Screenshot of error messages for invalid phrase.



Figure 2: Screenshot of invalid guesses.

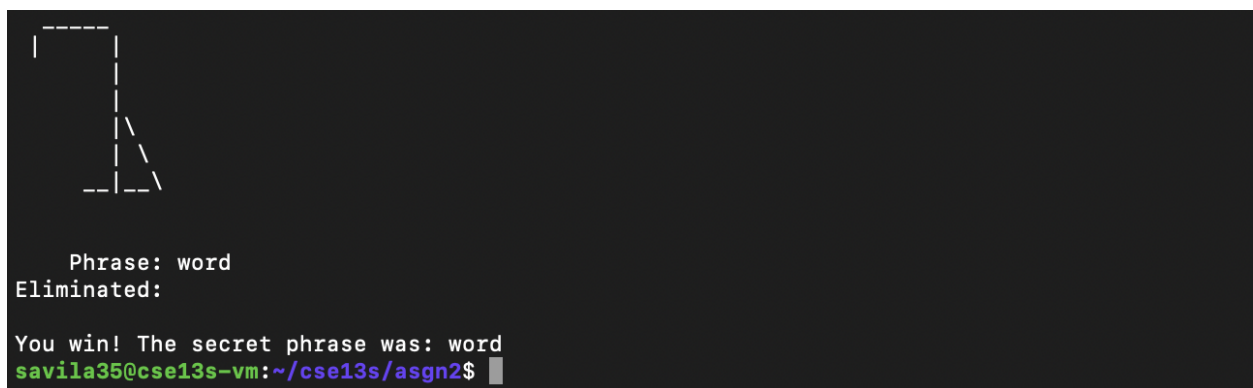


Figure 3: Screenshot of win output.

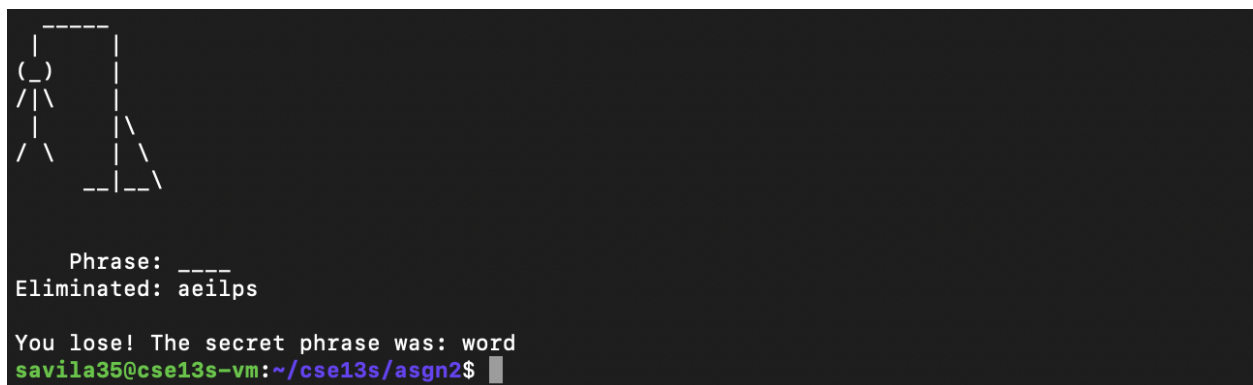


Figure 4: Screenshot of lose output.

```
unsigned long len = strlen(argv[1]); // length of secret phrase

int guessed[len]; // list of bools: true if letter at index guessed
for (unsigned long i = 0; i < len; i++) {
    if (string_contains_character(punctuation, argv[1][i])) {
        guessed[i] = 1;
    } else {
        guessed[i] = 0;
    }
}
```

Figure 5: Screenshot of variable dependent array.

References

- [1] Dr. Keery Veenestra and TAs. Assignment 2: Hangman starter files. <https://git.ucsc.edu/cse13s/fall-2023-section-01/resources>, Fall 2023.