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Boogle

```c
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>
#include <string.h>
#include <ctype.h>
```

The libraries above are used for these functions:

1. stdio.h – standard input output
2. stdlib.h – malloc(), system(), exit()
3. stdbool.h – boolean variable support
4. string.h – strlen(), strcpy(), strchr(), strtok()
5. ctype.h – tolower()

```c
struct trie{
    struct trie* child[26];
    bool end;
    char description[256];
}   *root = NULL;
```

To make a trie we use a struct that contains a pointer to struct array, boolean variable, and a character array. The struct trie array *child* are used with 26 indexes to represent each character in the alphabet (0 for a, 1 for b, 2 for c, …). This way, the struct are the character. The booleand *end* are used to determine if the word inserted has reached its end. The character array *descripion* are used to store a description for slang word as explained in the case study. Lastly, we initialize a *root* node as NULL to tell that there is no trie created for the current session.

```
char menu(){
    char choice[101];
    printf("\nWELCOME TO BOOGLE\n\n");
    printf("1. Release a new slang word\n");
    printf("2. Search a slang word\n");
    printf("3. View all slang word starting with a specific pre
           fix\n");
    printf("4. View all slang words\n");
    printf("5. Exit\n");
    do{
        printf("Choice: ");
        scanf("%[^\n]", choice);
        getchar();
    }while((choice[0] < '1' || choice[0] > '5') || strlen(choice) >
           1);
    return choice[0];
}
```

The *menu()* function is used to display a menu for the user to choose from as explained in the case study. To store an input we first declare a variable, in this function as character variable *choice*. The decision to use a character is based of ASCII table and input validation. To make sure the user inputs 1 to 5 (number of options), we need a character variable to keep asking for input as long as the input character ASCII is higher that '5' or lower than '1' or if the inputted value is longer than 1 character. In addition to that, we use *[^\n]* to get the inputted value until *enter* key is pressed (if we use *c* than it would yield an error wher the user inputs more than one character or use spaces in between. Lastly we return those that passed the validation (1 to 5 as character).

```
struct trie* createNode(){
    struct trie* node = (struct trie*)malloc(sizeof(struct trie));
    node->end = false;
    for (int i = 0; i < 26; i++) {
        node->child[i] = NULL;
    }
    return node;
}
```

The *createNode()* function is used to create a node for trie with *malloc()*, assign the node's *end* as false as it is unknown whether this node is the end of word, loops 26 times (for each alphabet or index) to set each *child* struct to NULL to tell that the trie has

not yet created for this session. Lastly we return the created trie node to really create it.

```
bool alphabetValid(char word[]){
    bool alphabet = true;
    for(int i = 0; word[i] != '\0'; i++){
        if(!(word[i] >= ‘A’ && word[i] <= ‘Z’) && !(word[i] >= ‘a’&&
           word[i] <= ‘z’)){
            alphabet = false;
            break;
        }
    }
    return alphabet;
}
```

The *alphabetValid()* function is used to check if every character in the inputted word is an alphabet to validate if it’s an valid word. This function asks for 1 parameter, an array of characters to be checked *word[]*. First initialize the *alphabet* to true assuming *word[]* consists of alphabets only. The function loops until the last character in *word[]* to check the ASCII values of each alphabet and checks if that character is not placed between a to z (lower that ‘a’ or higher than ‘z’) and A to Z (lower than ‘A’ or higher than ‘Z’). if the character satisfies those constraints then we interrupt the loop and set *alphabet* to false (not all alphabet. After the loop is finished or interrupted, return the *alphabet* value.

```
void escape(){
    printf("\n");
    char enter[101];
    printf("Press enter to continue...");
    scanf("[^\n]", enter);
    getchar();
}
```

The *escape()* function is used for asking the user to continue with another operation. The *\n* output is just for decoration. Similarly with *menu()* function, we need a character array variable *enter* to store the inputted characters. What the user inputs does not matter as in the end, the enter key is pressed which completes the requirements stated in the second output. The *getchar()* function is used to catch unwanted ‘\n’ from pressing the *enter* key.

```
void inputSlang(struct trie* root, char word[], char desc[]){
    int length = strlen(word);
    struct trie* current = root;
    for(int i = 0; i < length; i++){
        int index = word[i] - 'a';
        if(current->child[index] == NULL){
            current->child[index] = createNode();
        }
        current = current->child[index];
    }
    current->end = true;
    strcpy(current->description, desc);
}
```

The *inputSlang()* function is used to insert the word into the created trie. This function asks for 3 parameters, a pointer for root trie node *root*, an array of characters to be inputted *word[]*, and the description of that character array *desc[]*. The first step is to know what is the length of *word[]* using *strlen()* and stores the value to an integer variable *length*. The next step is to use *root* to assign it to another trie struct variable *current* that represents what the current node is. Then loop *length* times and check for each loop if the node for each character in *word[]* has been created before or not. If not, then create the node by using *createNode()* function above (the index in *child* node corresponds with the current *word[]* character – ‘a’ (‘a’-‘a’ equals 0, ‘b’-‘a’ equals 1, …)). After each check, move *current* to the node of that character as the new *current*. This way, a specific string of trie can be traversed and checked. When the loop ends, all characters from *word[]* has been created of traversed. As the last character node is the current node, we update the *end* to true to mark the end of that word and assign the description with *desc[]* with *strcpy()* because a character array can’t be simply assigned to another variable.

```
void releaseSlang(struct trie* root){
    char newSlang[101];
    char description[101];
    int parts;
    printf("\n");
    do{
        printf("Input a new slang word [must be more than 1 alphabetic
                character and contains no space]: ");
        scanf("%[^\n]", newSlang);
        getchar();
    }while(!(strlen(newSlang) > 1 && strchr(newSlang, ' ') == NULL) ||
           alphabetValid(newSlang) == false);
    for(int i = 0; i < strlen(newSlang); i++){
        newSlang[i] = tolower(newSlang[i]);
    }
```

The function *releaseSlang()* is used to store data that needs to be inputted using *inputSlang()* function. This function asks for a parameter, a pointer for root trie node *root*. First we need to declare some character array variables and an integer. Then we need to ask the user for to input one of those character array, *newSlang[]* and validate until the input is longer than one word using *strlen()*, no occurrence of space (‘ ‘) using *strchr()*, and all character in input are alphabets using *alphabetValid()* function above. After all of those requirements are satisfied, the loop will be exited. The next step would be changing all occurrences of uppercase character with its lowercase counterparts to make it simpler by regarding uppercase and lowercase as the same thing.

```
    bool found = true;
    struct trie* current = root;
    for(int i = 0; i < strlen(newSlang); i++){
        int index = newSlang[i] - 'a';
        if(current->child[index] == NULL){
            found = false;
            break;
        }
        current = current->child[index];
    }
```

As the case study includes a scenario where the user inputted the same word and the system updates the new description, this function needs to know whether the current inputted word is in the trie yet by using a similar method with *inputSlang()*. So, assume the word is in the trie by assigning *found* to true. What differs from that

function's method is when a node for the next character is not found (it points to NULL), set *found* to false (for the case where the new word branches from the existing word or continues from it) and exit the validation loop. Otherwise continue traversing until the end of *newSlang[]* (*length* times). The logic for this case is that when the system checks for the first extension character, the node for that character has not been created yet as the existing word does not reach that side of extension (new word "abcd", existing word "ab", "abc", "abce").

```
    do{
        parts = 0;
        printf("Input a new slang word description [must be more than
           2 words]: ");
        scanf("%[^\n]", description);
        getchar();
        char descriptionCopy[101];
        strcpy(descriptionCopy, description);
        char* token = strtok(descriptionCopy, " ");
        while(token != NULL){
            parts += 1;
            token = strtok(NULL, " ");
        }
    }while(!(parts > 2));
    if(found == false || (found == true && current->end == false))
      printf("\nSuccessfully released new slang word.\n");
    else if(found == true && current->end == true) printf("\nSuccess
      fully updated a slang word.\n");
    inputSlang(root, newSlang, description);
    escape();
}
```

After that, we ask the user for the second character array *description[]* and validate it. This method of validation uses *strtok()* to divide *description[]* to count how many words inputted using spaces (1 space means 2 words, 2 spaces means 3 words, …). Variable *descriptionCopy[]* is used as a substitute to *description[]* to prevent it get divided from *strtok()* and causing only 1 word left. To store the count, we use the declared integer *parts* that is set back to 0 to refresh the counter every failed validation loop (parts still less or equal to 2). Then place *root* from parameter, *newSlang[]*, and *description[]* into *inputSlang()* function's call. In the selection between new release and update, current->end == false serves as the case where the new word is in an existing word (new

word is “ab”, existing word is “abc”). The logic is based on when the new word reaches the end of loop, the found would be true as that node has been created before, but because it is the end of word, *end* would be false as the new word has not been inserted and triggers new release output. In the case when the user inputter an existing word, the loop would not set found to false and the *end* would be true so output update message. Lastly *escape()* function is used as shown in case study document.

```
void searchSlang(struct trie* root){
    bool data = false;
    for(int i = 0; i < 26; i++){
        if(root->child[i] != NULL){
            data = true;
            break;
        }
    }
    if(data == false){
        printf("\nThere is no slang word yet in the dictionary.\n");
    }
```

The function *searchSlang()* is used to search a word from created trie. This function asks for a parameter, a pointer for struct trie *root*. The function starts with validating if the current session’s trie holds any data by looping the *child* indexes until there is one that does not point to NULL (a trie connected *root* exists) therefore there is at least one data inserted in trie. If there is no data then output no data message.

```
    else{
        char search[101];
        printf("\n");
        do{
            printf("Input a slang word to be searched [Must be more
            than 1 alphabetic characters and contains no space]: ");
            scanf("%[^\n]", search);
            getchar();
        }while(!(strlen(search) > 1 && strchr(search, ' ') == NULL) ||
            alphabetValid(search) == false);
```

If a data exists then the system asks the user for a word that needs to be searched and validates in the same way as *releaseSlang()* above when inputting a word to be inserted into trie.

```
        bool found = true;
        struct trie* current = root;
        for(int i = 0; i < strlen(search); i++){
            int index = search[i] - 'a';
            if(current->child[index] == NULL){
                found = false;
                break;
            }
            current = current->child[index];
        }
        if(found == false || (found == true && current->end ==
           false)){
            printf("\nThere is no word \"%s\" in the dictionary..\n",
                search);
        }
        else if(found == true && current->end == true){
            printf("\nSlang word  : %s\n", search);
            printf("Description : %s\n", current->description);
        }
    }
    escape();
}
```

The next step would be using the same method again in *releaseSlang()* when validating whether inputted word exists in the trie or not. This method is used because if inputted word doesn't exist, then that word is a new word that can be inserted using *releaseSlang()* so we show no word message. Similarly, if that word already existed, that word's description can be updated in *releaseSlang()* so we show the word and its description. Lastly, *escape()* function is used again for the same reason as before.

```
void printSlang(struct trie* current, char word[], int index, int*
     count){
    if(current->end == true){
        word[index] = '\0';
        printf("%d. %s\n", *count, word);
        (*count) += 1;
    }
    for(int i = 0; i < 26; i++){
        if(current->child[i] != NULL){
            word[index] = 'a' + i;
            printSlang(current->child[i], word, index+1, count);
        }
    }
}
```

The *printSlang()* function is used to show every word in trie by doiing it recursively. This function asks for 4 parameters, a pointer for the current trie node *current*, an array of characters to store the word to be showed *word[]*, an integer that represents the current depth of specific trie branch (for the system to know where to put the new character inside the array that forms a word) *index*, and an integer pointer so the word's number can be updated when one word is completed. This function outputs the word lexicographically as it iterates from left to right ("abcd" would be iterated first than "abda") because of how it is created and iterated. First the function loops for 26 times (26 alphabets) then it checks if the current node is the end of word. If it is, then we assign the last index of the word as a NULL terminator so the system knows it is a string and can be outputted without error. After it increase the number by one using the pointer. Whether or not that *if* operation is executed, the program would run a loop to find another character and adds that character to *word[]* whose placing controlled by *index*. After it, the program calls this function again with some modifications notably, passing the node where that character is found as *current* to traverse down the trie. When the new character is found, the program does not stop and keeps looping until it cant't to find every single instance of word.

```
void printPrefix(struct trie* current, char word[], char prefix[]){
    int skipIndex = strlen(prefix);
    for(int i = 0; i < skipIndex; i++){
        if(current->child[prefix[i]-'a'] != NULL){
            word[i] = prefix[i];
            current = current->child[prefix[i]-'a'];
        }
        else{
            printf("\nThere is no prefix \"%s\" in the dictionary.\n",
                prefix);
            return;
        }
    }
    int count = 1;
    printSlang(current, word, skipIndex, &count);
}
```

The *printPrefix()* function is used to show all words that starts with a specific word (prefix). This function asks for 3 parameters, a pointer for the current trie node *current*, an array of characters to store the word to be passed *word[]*, and an array of characters *prefix[]*. First we create an integer *skipIndex* to know when the loop would stop. In the loop we first check if there is a node with the characters in *prefix[]*. If there is not, output no prefix message and exit the function. If there is, copy each character in *prefix[]* to *word[]* while traversing down the trie. After the loop ends, we declare counter variable *count* to 1 to be used in *printSlang()* that we call next using the current node as root, *word[]* that contains *prefix[]*, index from *skipIndex*, and pass count. This logic can be explained using subtree. When showing all words that starts with a prefix, we just have to ignore anything that's not rooted from the last character of the prefix while still starting traversing from the first character. By this, we can start the traversal from the last character as *root* and by passing *word[]* and *skipIndex[]* we can continue all the words from *word[skipIndex]*.

```
void viewPrefix(struct trie* root){
    bool data = false;
    for(int i = 0; i < 26; i++){
        if(root->child[i] != NULL){
            data = true;
            break;
        }
    }
    if(data == false){
        printf("\nThere is no slang word yet in the dictionary.\n");
    }
    else{
        char prefix[101];
        printf("\n");
            do{
            printf("Input an alphabetic prefix to be searched: ");
            scanf("%[^\n]", prefix);
            getchar();
        }while(strchr(prefix, ' ') != NULL || alphabetValid(prefix) ==
           false);
        char word[101];
        printPrefix(root,word, prefix);
    }
    escape();
}
```

the *viewPrefix()* function is used to store data that need to be passed to *printPrefix()* function. This function asks for a parameter, root trie node root. First we do data validation just like *searchSlang()*. Then validate inputted prefix if that prefix consists by just alphabet and no spaces. After that declare a character array *word[]* to be used to call *printPrefix()*. Lastly call *escape()* like before.

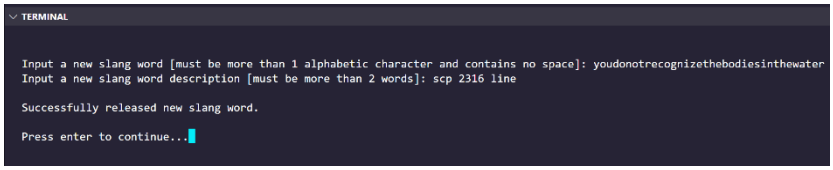
```
void viewSlang(struct trie* root){
    bool data = false;
    for(int i = 0; i < 26; i++){
        if(root->child[i] != NULL){
            data = true;
            break;
        }
    }
    if(data == false){
        printf("\nThere is no slang word yet in the dictionary.\n");
    }
    else{
        printf("\nList of all slang words in the dictionary:\n");
        char word[101];
        int count = 1;
        printSlang(root, word, 0, &count);
    }
    escape();
}
```

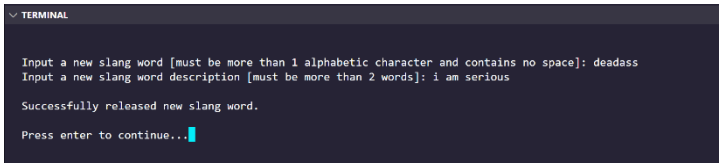
The *viewSlang()* function is used for data validation and storing variables that are passed to *printSlang()* function. This function asks for a parameter, root trie node *root*. First we do data validation just like *searchSlang()*. Then we output decorative message and pass character array *word[]* and counter *count* to *printSlang()* with index value of 0 as the *word[]* is still empty so it needs to start from the first index 0. Lastly we call *escape()* like before.

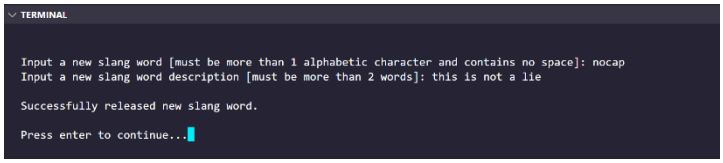
```
int main(){
    struct trie* root = createNode();
    int choice;
    do{
        choice = menu() - 48;
        system("cls");
        switch(choice){
            case 1:
                releaseSlang(root);
                break;
            case 2:
                searchSlang(root);
                break;
            case 3:
                viewPrefix(root);
                break;
            case 4:
                viewSlang(root);
                break;
            case 5:
                printf("\nThank you... have a nice day! :)\n");
                exit(0);
                break;
        }
        system("cls");
    }while(choice != 5);
    return 0;
}
```

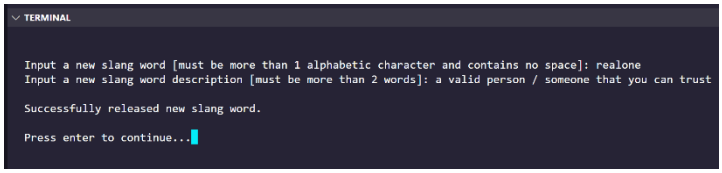
The *main()* function is used as a driver for the whole program. First we initialize root node to be used for all functions above. Then we create a do-while loop to constantly do operations with the trie. After that call *menu()* and reduce its output by the ASCII value of 0 to convert from character to integer that can be used to pick the operations. Before picking we clear the console with *system("cls")* for decorative purposes. We do this again after finishing an operation. If the user picks 5, we display a closing message and exits the program using *exit(0)*.

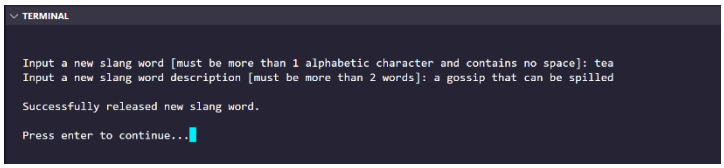
INPUT WORD

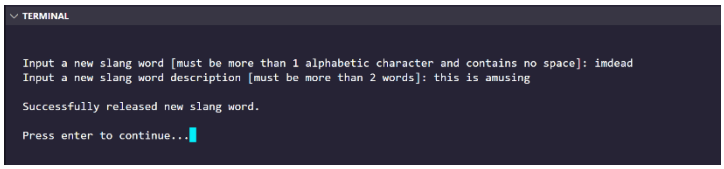

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: youdonotrecognizethebodiesinthewater
Input a new slang word description [must be more than 2 words]: scp 2316 line
Successfully released new slang word.
Press enter to continue...

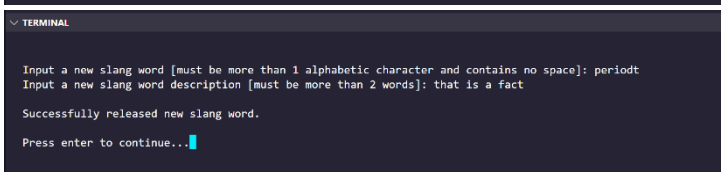

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: deadass
Input a new slang word description [must be more than 2 words]: i am serious
Successfully released new slang word.
Press enter to continue...

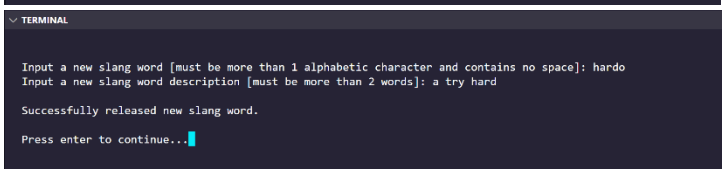

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: nocap
Input a new slang word description [must be more than 2 words]: this is not a lie
Successfully released new slang word.
Press enter to continue...

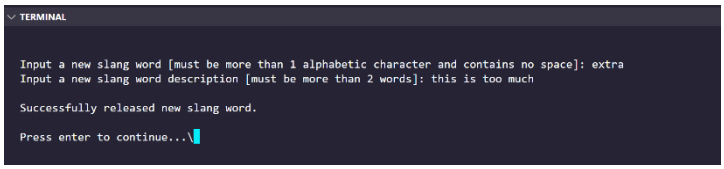

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: realone
Input a new slang word description [must be more than 2 words]: a valid person / someone that you can trust
Successfully released new slang word.
Press enter to continue...

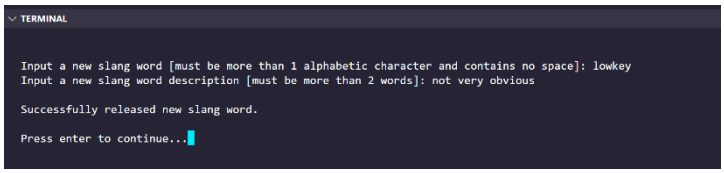

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: tea
Input a new slang word description [must be more than 2 words]: a gossip that can be spilled
Successfully released new slang word.
Press enter to continue...

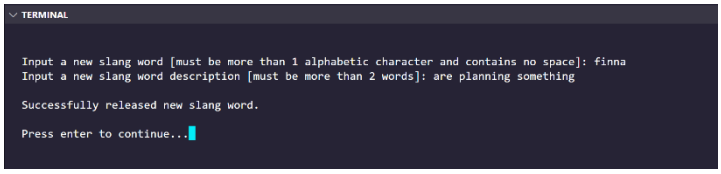

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: imdead
Input a new slang word description [must be more than 2 words]: this is amusing
Successfully released new slang word.
Press enter to continue...

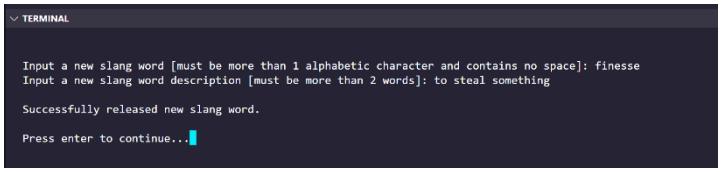

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: periodt
Input a new slang word description [must be more than 2 words]: that is a fact
Successfully released new slang word.
Press enter to continue...

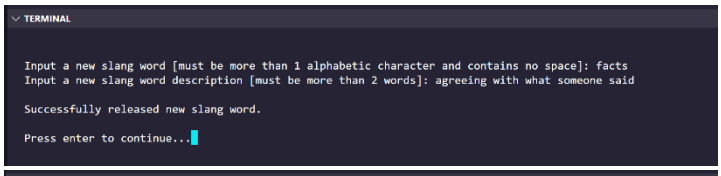

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: hardo
Input a new slang word description [must be more than 2 words]: a try hard
Successfully released new slang word.
Press enter to continue...

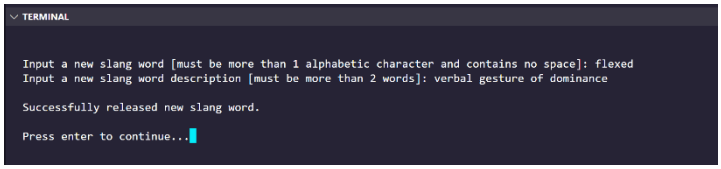

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: extra
Input a new slang word description [must be more than 2 words]: this is too much
Successfully released new slang word.
Press enter to continue...

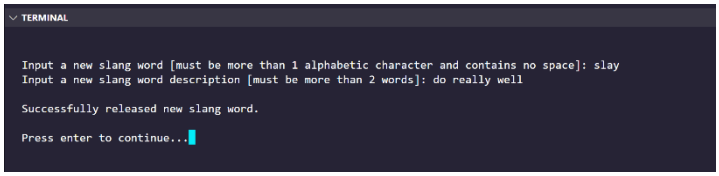

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: lowkey
Input a new slang word description [must be more than 2 words]: not very obvious
Successfully released new slang word.
Press enter to continue...


TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: finna
Input a new slang word description [must be more than 2 words]: are planning something
Successfully released new slang word.
Press enter to continue...

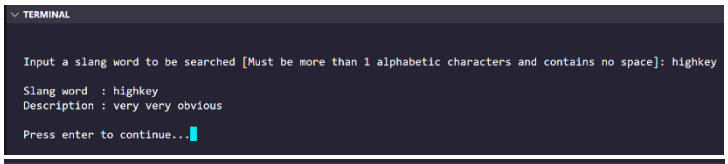

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: finesse
Input a new slang word description [must be more than 2 words]: to steal something
Successfully released new slang word.
Press enter to continue...

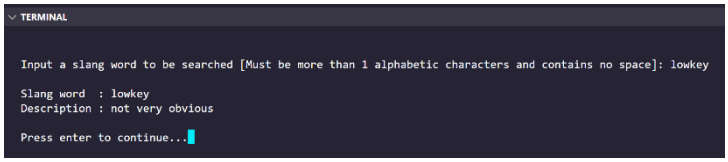

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: facts
Input a new slang word description [must be more than 2 words]: agreeing with what someone said
Successfully released new slang word.
Press enter to continue...

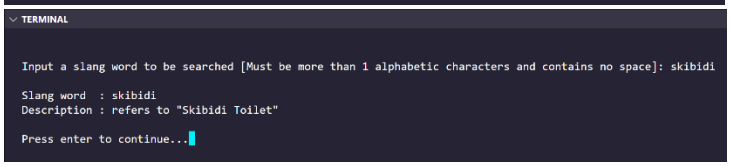

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: flexed
Input a new slang word description [must be more than 2 words]: verbal gesture of dominance
Successfully released new slang word.
Press enter to continue...

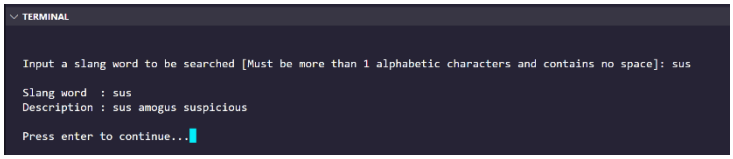

TERMINAL
Input a new slang word [must be more than 1 alphabetic character and contains no space]: slay
Input a new slang word description [must be more than 2 words]: do really well
Successfully released new slang word.
Press enter to continue...

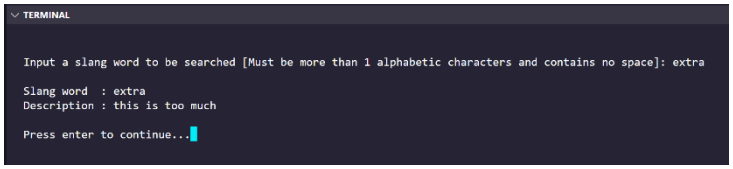
SEARCH WORD


TERMINAL
Input a slang word to be searched [Must be more than 1 alphabetic characters and contains no space]: highkey
Slang word : highkey
Description : very very obvious
Press enter to continue...

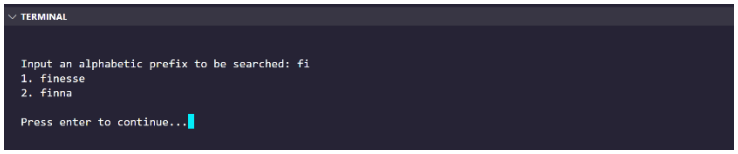

TERMINAL
Input a slang word to be searched [Must be more than 1 alphabetic characters and contains no space]: lowkey
Slang word : lowkey
Description : not very obvious
Press enter to continue...

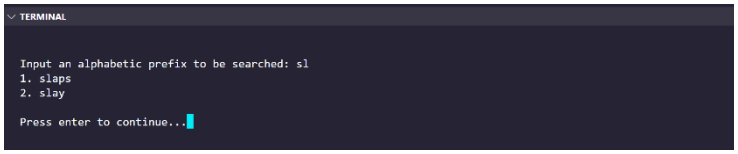

TERMINAL
Input a slang word to be searched [Must be more than 1 alphabetic characters and contains no space]: skibidi
Slang word : skibidi
Description : refers to "Skibidi Toilet"
Press enter to continue...

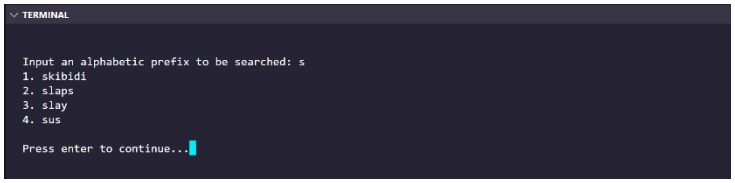

TERMINAL
Input a slang word to be searched [Must be more than 1 alphabetic characters and contains no space]: sus
Slang word : sus
Description : sus amogus suspicious
Press enter to continue...

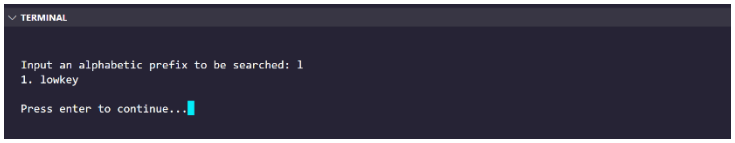

TERMINAL
Input a slang word to be searched [Must be more than 1 alphabetic characters and contains no space]: extra
Slang word : extra
Description : this is too much
Press enter to continue...

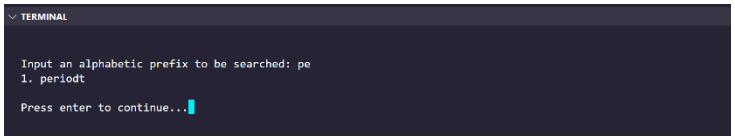
SEARCH PREFIX



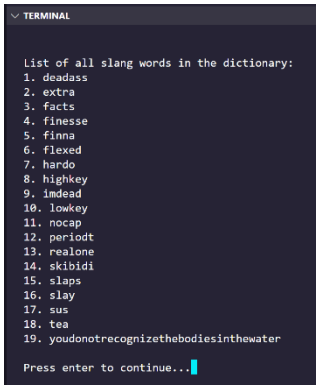








VIEW WORD



EXIT