Debug Mode

CS 211

Debugging

- Debugging is the process of identifying and removing errors from your program.
- You need to debug your program when it doesn't do what it is supposed to do.
- You need to fix it.

- Ask this question:

  "What should I do to try and fix my program?"

Debugging a Program

- Many different approaches:
  - Adding lots of print statements
  - Rubber duck debugging
    - https://rubberduckdebugging.com/
  - Using debuggers like gdb
  - Code Review

Debugging a Program

- One common approach: adding lots of printf statements

```
int binarySearch(int arr[], int l, int r, int x, int* numComps) {
    if (r >= l) {
        int mid = l + (r - l)/2;
        *numComps++;
        if (arr[mid] == x) return mid;
        if (arr[mid] > x) return binarySearch(arr, l, mid-1, x, numComps);
        return binarySearch(arr, mid+1, r, x, numComps);
    }
return -1;
}
```

Debugging a Program: Step 1 – Wrong Result

- Called from main()

```
int main() {
        int arr[10] = { 1, 3, 5, 7, 9, 11, 13, 15, 17, 19};
        int numComps = 0; int pos = 0;

        pos = binarySearch ( arr, 0, 9, 11, &numComps);
        printf ("Result: %d, numComps: %d\n", pos, numComps);
        return 1;
         }
```

Produces the Following Result:

Result: 5, numComps: 0

Debugging a Program: Step 2 – Add printf()s

```
int binarySearch(int arr[], int l, int r, int x, int* numComps) {
    if (r >= l) {
        int mid = l + (r - l)/2;
        *numComps++;
         printf ("mid val: %d, mid pos: %d, numComp: %d\n", arr[mid],
                    mid, *numComps);
        if (arr[mid] == x) return mid;
        if (arr[mid] > x) return binarySearch(arr, l, mid-1, x, numComps);
        return binarySearch(arr, mid+1, r, x, numComps);
    }
return -1;
}
```

Debugging a Program: Step 3 – Finding Error

Now Produces the Following Result:

mid val: 9, mid pos: 4, numComp: 1
mid val: 15, mid pos: 7, numComp: 3
mid val: 11, mid pos: 5, numComp: 5
Result: 5, numComps: 0

Binary Search values looks good

Pos:	0	1	2	3	4	5	6	7	8	9
Values:	1	3	5	7	9	11	13	15	17	19

numComps values are not right!

May need to add more printf() statements!

Debugging a Program: Step 4 – Fix Code

```
int binarySearch(int arr[], int l, int r, int x, int* numComps) {
    if (r >= l) {
        int mid = l + (r - l)/2;
        (*numComps)++;
         printf ("mid val: %d, mid pos: %d, numComp: %d\n", arr[mid],
                    mid, *numComps);
        if (arr[mid] == x) return mid;
        if (arr[mid] > x) return binarySearch(arr, l, mid-1, x, numComps);
        return binarySearch(arr, mid+1, r, x, numComps);
    }
return -1;
}
```

Debugging a Program: Step 5 – Verify the Fix

Now Produces the Following Result:

mid val: 9, mid pos: 4, numComp: 1
mid val: 15, mid pos: 7, numComp: 2
mid val: 11, mid pos: 5, numComp: 3
Result: 5, numComps: 3

Pos:	0	1	2	3	4	5	6	7	8	9
Values:	1	3	5	7	9	11	13	15	17	19

Test your function with few more target values!

Debugging a Program: Step 6 – Remove Code

Remove added printf() statement
Hopefully you don't remove something needed by mistake

```
int binarySearch(int arr[], int l, int r, int x, int* numComps) {
    if (r >= l) {
        int mid = l + (r - l)/2;
        (*numComps)++;
        if (arr[mid] == x) return mid;
        if (arr[mid] > x) return binarySearch(arr, l, mid-1, x, numComps);
        return binarySearch(arr, mid+1, r, x, numComps);
    }
return -1;
}
```

Debugging a Program: Step 7 – Re-Verify

Still Produces the Following Result:

mid val: 9, mid pos: 4, numComp: 1
mid val: 15, mid pos: 7, numComp: 2
mid val: 11, mid pos: 5, numComp: 3
Result: 5, numComps: 3

Pos:	0	1	2	3	4	5	6	7	8	9
Values:	1	3	5	7	9	11	13	15	17	19

Create a Debug Mode for your program

- Remove the final 2 steps from the Debugging Process
- Add code that will cause Debugging Printf() Statements to execute only when command line flag is given
- If flag is never given in “production mode”, Debugging Printf() Statements don’t execute
- “production staff” never knows it exists

Create a Debug Mode for your program

- Add code that will cause Debugging Printf() Statements to execute only when command line flag is given
  - ./a.out -d
- If flag is never given, Debugging Printf() Statements don't execute
  - ./a.out

Command Line Arguments

- **Command line arguments** are given after the executable name on the command line

- Allows user to change parameters at run time without recompiling or needing access to code

  - ./a.out 25

Handling Command Line Arguments

- handled as parameters to main() function

```
int main ( int argc,  char **argv )
```

- **int argc** – number of arguments – including name of executable

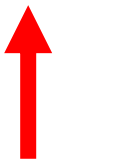
- **char **argv** – array of argument strings
  - Also written as char *argv[ ]
  - An array of strings

Command Line Arguments

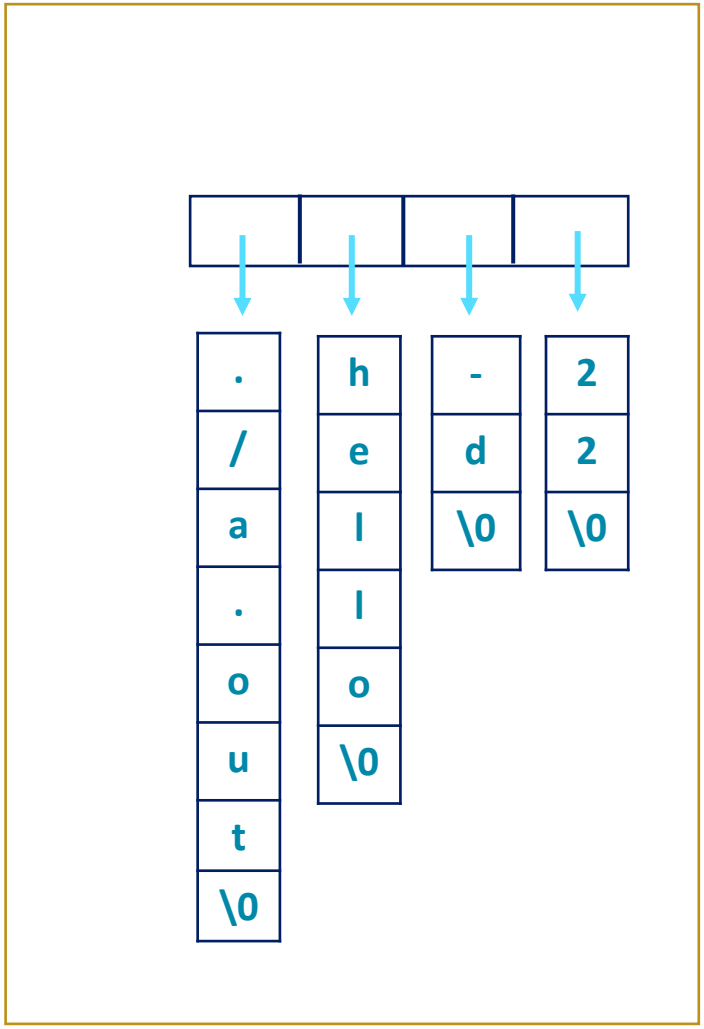
```
./a.out hello -d 22
```

argc = 4

argv = {“./a.out” , “hello” , “-d”, “22”}



“22” is a string



Code to be added in “Global Code Space”

```
#include <stdio.h>


#define  TRUE   1
#define  FALSE  0


int DebugMode;
```

- Allows DebugMode variable to be used throughout the program

Code to be added in main()

```
int main( int argc, char** argv)
{
        DebugMode = FALSE;
        int i;
        for ( i = 0 ; i < argc ; i++ )
                if ( strcmp (argv[i], "-d") == 0 )
                        DebugMode = TRUE;
```

Code to be added in for each debug printf()

```
if ( DebugMode == TRUE )
        printf ("mid val: %d, mid pos: %d, numComp: %d\n",
                arr[mid], mid, *numComps);
```

This code can be added into any function without changing any parameters since DebugMode is globally defined.

Using a Global Variable?

- Wait a minute?? Aren't Global Variables BAD???
  - Yes, they are. Use of Global Variables in an APP should be avoided.

- The DebugMode variable is not an "application variable"
- The DebugMode variable is a "development variable"
  - It is being used to help the development process

- This technicality gives us enough reason to "violate" the principle that wants us to always avoid Global Variables
  - Don't have the "clutter" functions with an extra parameter
  - Save the parameters for the "application variables"