Debugger

Presented by 李明璋

2012/05/08

The Definition of Bug

– Part of the code which would result in an error, fault or malfunctioning of the program.

Common Bugs

- Bugs with pointers and memory
  - Memory leaks
    - The allocated memory is not freed subsequently.
  - Free the already freed resource

```
int main(){
        char* str = ( char* ) malloc( sizeof(char) * 10 );
        if ( global == 0 ) free( str );
        /* Doing Something here … */
        free ( str );
        return 0;
}
```

Common Bugs

- Bugs with pointers and memory
  - Memory leaks
    - The allocated memory is not freed subsequently.
  - Free the already freed resource
  - NULL-pointer dereferencing
    - Improper initialization

```
int main(){
        char* str = NULL;
        strcpy( str, “def” );
        printf( “%s”, str );
        return 0;
}
```

```
int main(){
        char* str = “abc”;
        strcpy( str, “def” );
        printf( “%s”, str );
        return 0;
}
```

Common Bugs

- Error of scanf()

```
int main(){
        int num;
        char* str = (char*)malloc(sizeof(char) * SIZE);
        scanf("%d", &num);      // require to pass address to scanf()
        scanf("%s", &str);      // Not need & here, str points to variable itself
        printf("%d %s\n", num, str);
        return 0;
}
```

Common Bugs

- Using ‘=’ instead of ‘==’

```
int main(){
        int i;
        int a = 0;
        for(i = 0; i < 10; i++) a += i;
        if(a = 0) a = 1000;
        printf("%d", a);
        return 0;
}
```

Output:

0

Common Bugs

- Loop error

```
int x = 5;
while(x > 0);
    x--;
```

→ Infinite loop

Infinite loop

```
int main() {
        int a = 0;
        while(a < 10){
                printf("%d\n", a);
                if (a = 5) printf("a equals 5!\n");
                a++;
        }
        return 0;
}
```

Debugger

- A debugger is a computer program used to test and debug other programs.
- The code to be examined might alternatively be running on an instruction set simulator (ISS), a technique that allows great power in its ability to halt when specific conditions are encountered.

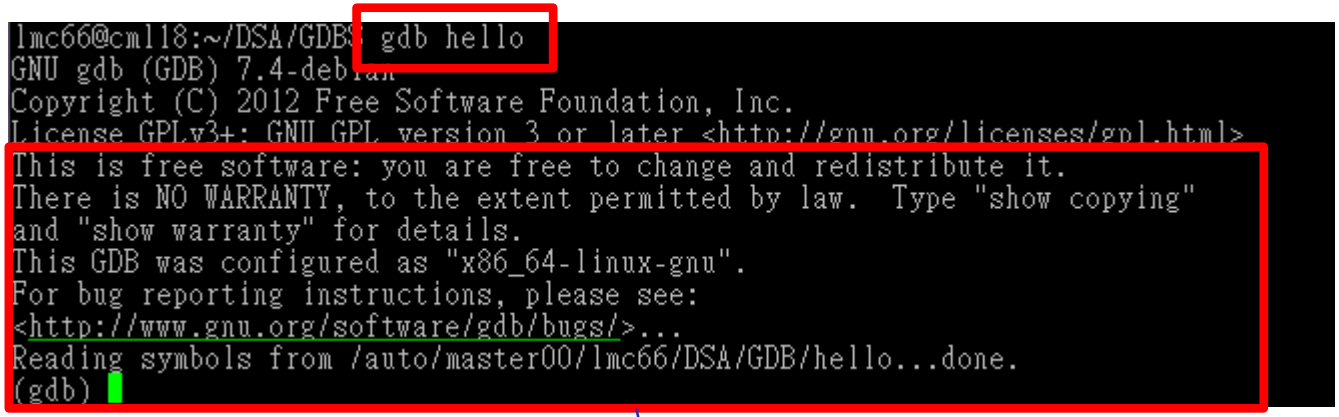
Debugger (GDB)

- GDB – GNU Debugger
- Compiler your program with ‘-g’ for debugging
  - gcc -g [your program] -o [executable file]

```
lmc66@cml18:~/DSA/GDB$ gcc -g hello.c -o hello
```

Debugger (GDB)

- Start GDB
  - gdb
  - gdb [executable file]



GDB window

Debugger (GDB)

- Load your program on GDB
  - file [executable file]
- Run your program
  - start (開始執行程式，並停留在main入口處)
  - run (開始執行程式，直到遭遇break point)

```
Reading symbols from /auto/master00/lmc66/DSA/GDB/hello...done.
(gdb) start
Temporary breakpoint 1 at 0x40067f: file hello.c, line 38.
Starting program: /auto/master00/lmc66/DSA/GDB/hello

Temporary breakpoint 1, main () at hello.c:38
38              struct Node* head = (struct Node*)malloc(sizeof(struct Node));
(gdb)
```

Stop at the beginning of 'main'

Debugger (GDB)

- Set breakpoints
  - break [location]
  - break [function]

The command "**list**" is used to list part of the code of your program.

```
(gdb) list
39              head = NULL;
40
41              int input;
42              while(scanf("%d", &input)!=EOF){
43                      struct Node* new = (struct Node*)malloc(sizeof(struct Node));
44                      new->next = NULL;
45                      new->data = input;
46                      head = InsertSorted(head, new);
47              }
48
(gdb) break 43
Breakpoint 1 at 0x400697: file hello.c, line 43.
(gdb) run
Starting program: /auto/master00/lmc66/DSA/GDB/hello
1

Breakpoint 1, main () at hello.c:43
43                      struct Node* new = (struct Node*)malloc(sizeof(struct Node));
(gdb)
```

Stop at the line 43

Debugger (GDB)

- Set breakpoints
  - break [function / location] if [condition]

```
(gdb) break InsertSorted if head->data < new->data
Breakpoint 3 at 0x4005b0: file hello.c, line 10.
```

Stop at the function ‘InsertSorted’ if (head->data < new->data)

Debugger (GDB)

- Print the value of some variables
  - print [variable]

Print the value of variable ‘new->data’, and the value is 10.

```
(gdb) break 50
Breakpoint 1 at 0x40069b: file InsertSort.c, line 50.
(gdb) run
Starting program: /auto/master00/lmc66/DSA/GDB/InsertSort
10

Breakpoint 1, main () at InsertSort.c:50
50                      head = InsertSorted(head, new);
(gdb) print new->data
$1 = 10
(gdb)
```

- Continue executing your program
  - continue (c)

Continue executing

```
(gdb) start
Temporary breakpoint 1 at 0x40067f: file hello.c, line 38.
Starting program: /auto/master00/lmc66/DSA/GDB/hello

Temporary breakpoint 1, main () at hello.c:38
38              struct Node* head = (struct Node*)malloc(sizeof(struct Node));
(gdb) c
Continuing.
```

Debugger (GDB)

- Set watchpoints
  - watch [variable]

```
Temporary breakpoint 1, main () at hello.c:38
38              struct Node* head = (struct Node*)malloc(sizeof(struct Node));
(gdb) watch head
Hardware watchpoint 2: head
(gdb) continue
Continuing.
Hardware watchpoint 2: head

Old value = (struct Node *) 0x0
New value = (struct Node *) 0x601010
main () at hello.c:39
39              head = NULL;
(gdb)
```

The value of variable ‘head’ has been changed.

Debugger (GDB)

- Set value of variable
  - set [variable] = [value]

```
(gdb) run
Starting program: /auto/master00/lmc66/DSA/GDB/hello
10

Breakpoint 1, InsertSorted (head=0x0, new=0x601030) at hello.c:10
10              struct Node* traverse = head;
(gdb) c
Continuing.
25

Breakpoint 1, InsertSorted (head=0x601030, new=0x601050) at hello.c:10
10              struct Node* traverse = head;
(gdb) set new->data = 1
(gdb) c
Continuing.
        10
        1
```

Set the value of new->data as 1.

Debugger (GDB)

- List breakpoints and watchpoints
  - list break

```
(gdb) info break
Num     Type           Disp Enb Address            What
2       breakpoint     keep y   0x0000000000400697 in main at hello.c:43
3       breakpoint     keep y   0x00000000004005b0 in InsertSorted at hello.c:10
4       hw watchpoint  keep y                      head
(gdb)
```

The list of all breakpoints and watchpoints.

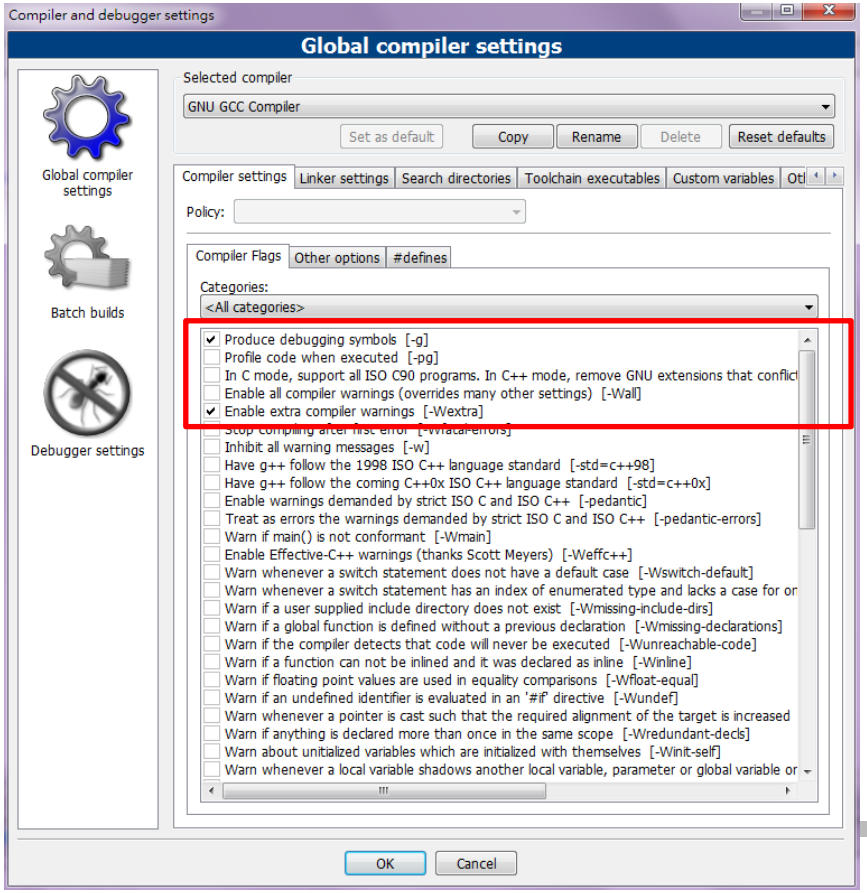
- Delete breakpoint or watchpoint
  - delete [point number]

Delete the watchpoint which Num is 4.

```
(gdb) delete 4
(gdb) info break
Num     Type           Disp Enb Address            What
2       breakpoint     keep y   0x0000000000400697 in main at hello.c:43
3       breakpoint     keep y   0x00000000004005b0 in InsertSorted at hello.c:10
(gdb)
```

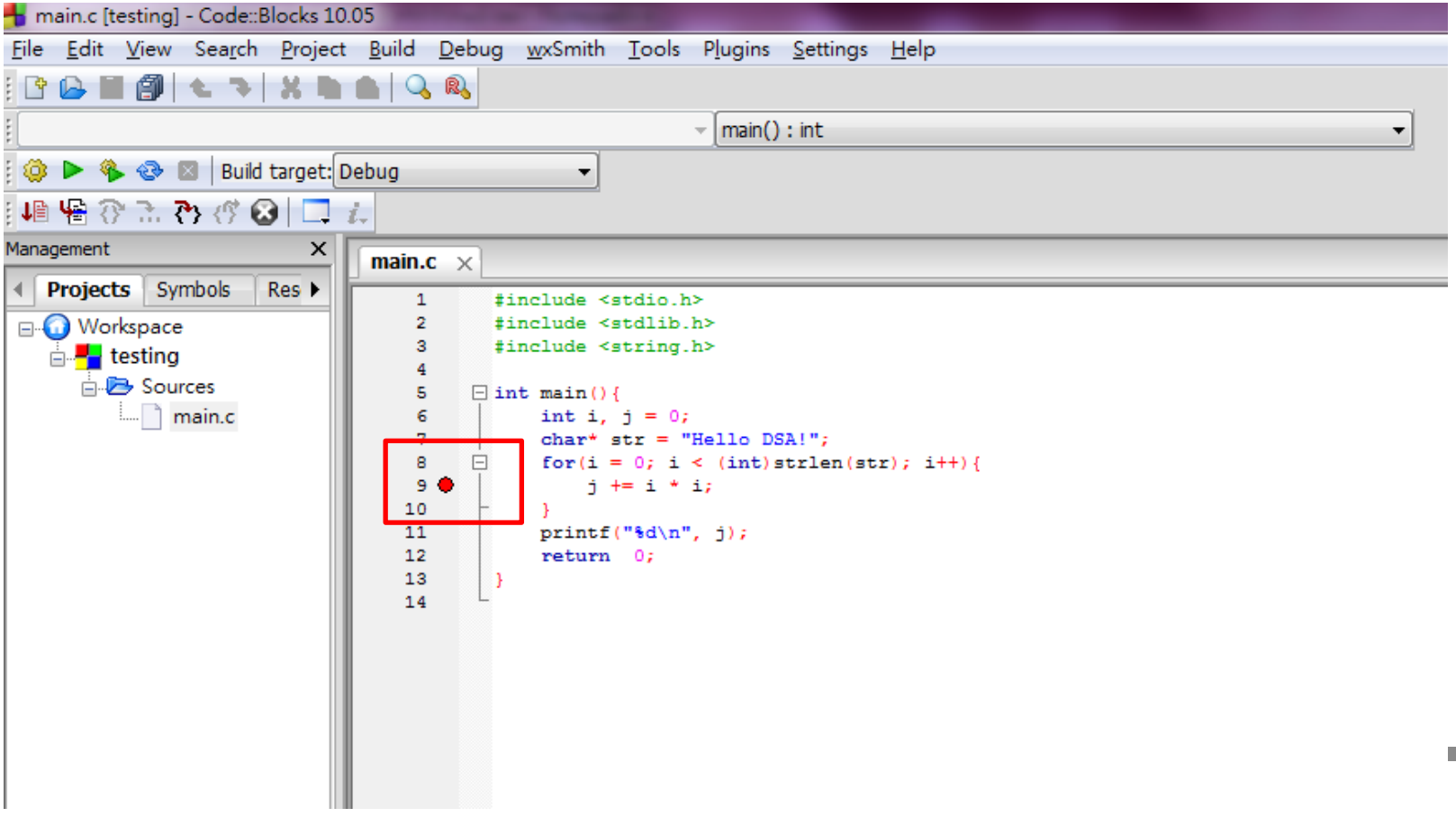
Debugger (Code Blocks)

- Settings → Compiler and debugger…



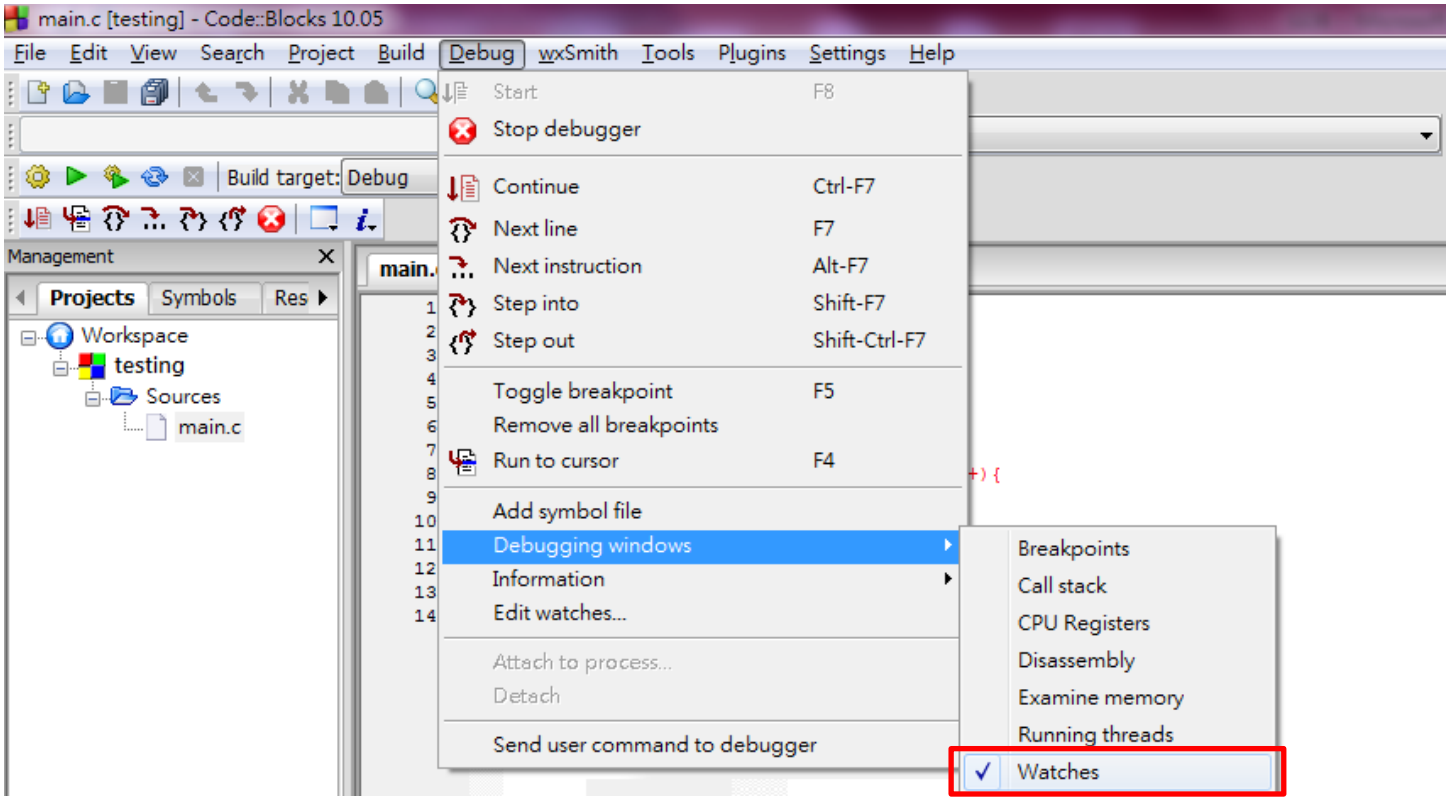
Debugger (Code Blocks)

- Add breakpoint



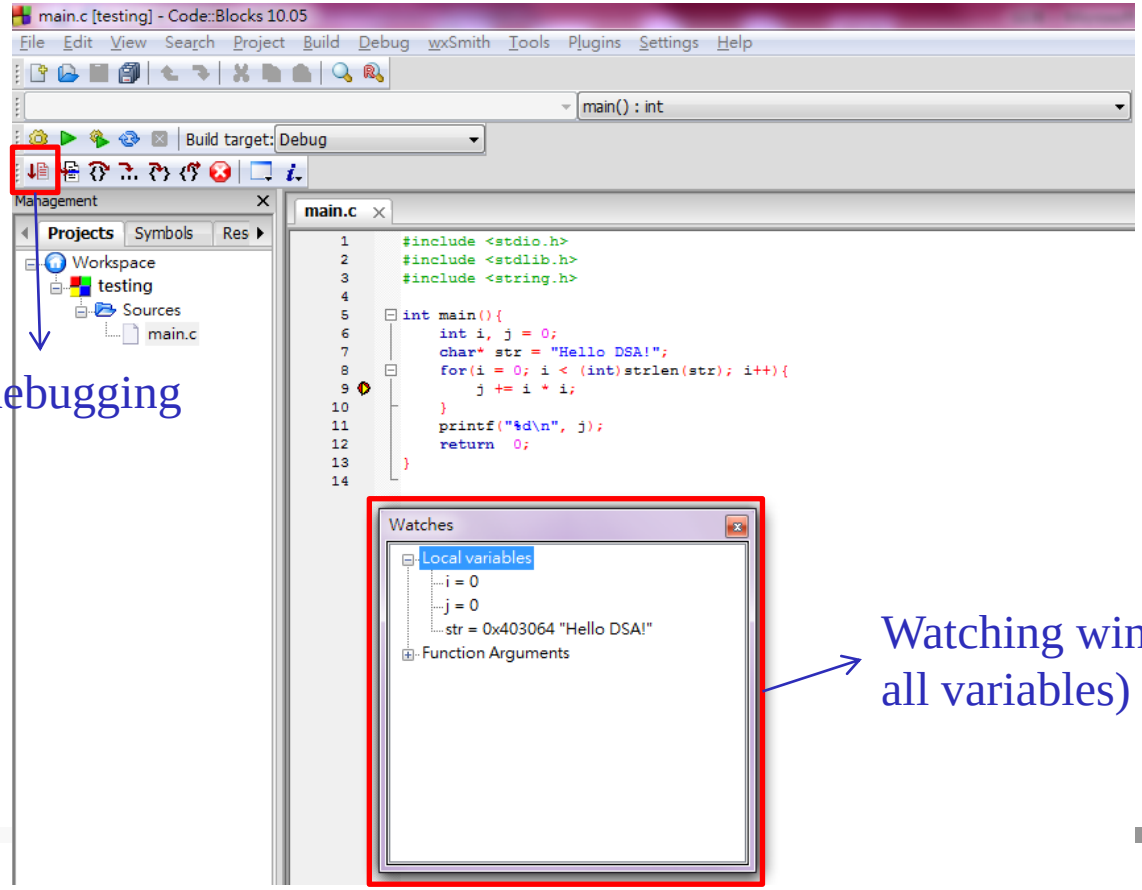
Debugger (Code Blocks)

- Open debugging window



Debugger (Code Blocks)

- Start debugging



Press to start debugging

Watching window (the state of all variables)

References

- GDB manual
  - http://sourceware.org/gdb/current/onlinedocs/gdb
- Code::Blocks Debugger manual
  - http://ez2learn.com/index.php/c-tutorials/codeblocks-tutorials/206-codeblocks-debugger
- Dev C++ Debugger manual
  - http://ez2learn.com/index.php/c-tutorials/dev-c-/203-dev-cdebugger