

```
1:  /*****
2:  * binary.c
3:  *
4:  * Computer Science 50
5:  * David J. Malan
6:  *
7:  * Displays a number in binary.
8:  *
9:  * Demonstrates bitwise operators.
10:  *****/
11:
12: #include <cs50.h>
13: #include <stdio.h>
14:
15:
16: int
17: main(int argc, char * argv[])
18: {
19:     // prompt user for number
20:     int n;
21:     do
22:     {
23:         printf("Non-negative integer please: ");
24:         n = GetInt();
25:     }
26:     while (n < 0);
27:
28:     // print number in binary
29:     for (int i = sizeof(int) * 8 - 1; i >= 0; i--)
30:     {
31:         int mask = 1 << i;
32:         if (n & mask)
33:             printf("1");
34:         else
35:             printf("0");
36:     }
37:     printf("\n");
38:
39:     // that's all folks
40:     return 0;
41: }
42:
```

```
1: /*****
2:  * hello.c
3:  *
4:  * Computer Science 50
5:  * David J. Malan
6:  *
7:  * Says hello to the world.
8:  *****/
9:
10: #include <stdio.h>
11:
12: int
13: main(int argc, char * argv[])
14: {
15:     printf("hello, world\n");
16: }
```

```

1: GAS LISTING /tmp/cc65bAnI.s                                page 1
2:
3:
4:     1                                .file    "hello.c"
5:     9                                .Ltext0:
6:    10                                .section      .rodata
7:    11                                .LC0:
8:    12 0000 68656C6C                                .string "hello, world"
9:    12                                6F2C2077
10:   12                                6F726C64
11:   12                                00
12:   13                                .text
13:   14                                .globl main
14:   16                                main:
15:   17                                .LFB2:
16:   18                                .file 1 "hello.c"
17:   1:hello.c      **** /*****
*****
18:   2:hello.c      **** * hello.c
19:   3:hello.c      **** *
20:   4:hello.c      **** * Computer Science 50
21:   5:hello.c      **** * David J. Malan
22:   6:hello.c      **** *
23:   7:hello.c      **** * Says hello to the world.
24:   8:hello.c      **** ****
*****/
25:   9:hello.c      ****
26:  10:hello.c      **** #include <stdio.h>
27:  11:hello.c      ****
28:  12:hello.c      **** int
29:  13:hello.c      **** main(int argc, char * argv[])
30:  14:hello.c      **** {
31:  19                                .loc 1 14 0
32:  20 0000 8D4C2404                                leal    4(%esp), %ecx
33:  21                                .LCFI0:
34:  22 0004 83E4F0                                andl    $-16, %esp
35:  23 0007 FF71FC                                pushl   -4(%ecx)
36:  24                                .LCFI1:
37:  25 000a 55                                pushl   %ebp
38:  26                                .LCFI2:
39:  27 000b 89E5                                movl    %esp, %ebp
40:  28                                .LCFI3:
41:  29 000d 51                                pushl   %ecx
42:  30                                .LCFI4:
43:  31 000e 83EC04                                subl    $4, %esp
44:  32                                .LCFI5:
45:  15:hello.c      ****     printf("hello, world\n");
46:  33                                .loc 1 15 0
47:  34 0011 C7042400                                movl    $.LC0, (%esp)
48:  34                                000000
49:  35 0018 E8FCFFFF                                call    puts
50:  35                                FF
51:  16:hello.c      **** }
52:  36                                .loc 1 16 0
53:  37 001d 83C404                                addl    $4, %esp
54:  38 0020 59                                popl    %ecx
55:  39 0021 5D                                popl    %ebp
56:  40 0022 8D61FC                                leal    -4(%ecx), %esp
57:  41 0025 C3                                ret
58:  42                                .LFE2:
59:  97                                .Ltext0:

```

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61:

62:

63: DEFINED SYMBOLS

64: *ABS*:00000000 hello.c

65: /tmp/cc65bAnI.s:16 .text:00000000 main

66:

67: UNDEFINED SYMBOLS

68: puts

```
1:      .file    "hello.c"
2:      .section .rodata
3: .LC0:
4:      .string "hello, world"
5:      .text
6: .globl main
7:      .type    main, @function
8: main:
9:      leal     4(%esp), %ecx
10:     andl     $-16, %esp
11:     pushl    -4(%ecx)
12:     pushl    %ebp
13:     movl     %esp, %ebp
14:     pushl    %ecx
15:     subl     $4, %esp
16:     movl     $.LC0, (%esp)
17:     call     puts
18:     addl     $4, %esp
19:     popl     %ecx
20:     popl     %ebp
21:     leal     -4(%ecx), %esp
22:     ret
23:     .size    main, .-main
24:     .ident   "GCC: (GNU) 4.2.2"
25:     .section .note.GNU-stack,"",@progbits
```

```
1: #
2: # Makefile
3: #
4: # Computer Science 50
5: # Week 8
6: #
7:
8: assembly:
9:     gcc -S -c hello.c
10:
11: both:
12:     gcc -c -g -Wa,-a,-ad hello.c > hello.lst
13:
```

```
1:  /*****
2:   * swap2.c
3:   *
4:   * Computer Science 50
5:   * David J. Malan
6:   *
7:   * Swaps two variables' values.
8:   *
9:   * Demonstrates (clever use of) bitwise operators.
10:  *****/
11:
12: #include <stdio.h>
13:
14:
15: // function prototype
16: void swap(int *, int *);
17:
18:
19: int
20: main(int argc, char * argv[])
21: {
22:     int x = 1;
23:     int y = 2;
24:
25:     printf("x is %d\n", x);
26:     printf("y is %d\n", y);
27:     printf("Swapping...\n");
28:     swap(&x, &y);
29:     printf("Swapped!\n");
30:     printf("x is %d\n", x);
31:     printf("y is %d\n", y);
32: }
33:
34:
35: /*
36:  * void
37:  * swap(int *a, int *b)
38:  *
39:  * Swap arguments' values.
40:  */
41:
42: void
43: swap(int *a, int *b)
44: {
45:     *a = *a ^ *b;
46:     *b = *a ^ *b;
47:     *a = *a ^ *b;
48: }
```

```
1:  /*****
2:  * tolower.c
3:  *
4:  * Computer Science 50
5:  * David J. Malan
6:  *
7:  * Converts an uppercase character to lowercase.
8:  *
9:  * Demonstrates bitwise operators.
10:  *****/
11:
12: #include <cs50.h>
13: #include <ctype.h>
14: #include <stdio.h>
15:
16:
17: int
18: main(int argc, char * argv[])
19: {
20:     // prompt user for an uppercase character
21:     char c;
22:     do
23:     {
24:         printf("Uppercase character please: ");
25:         c = GetChar();
26:     }
27:     while (c < 'A' || c > 'Z');
28:
29:     // print number in lowercase
30:     printf("%c\n", c | 0x20);
31:
32:     // that's all folks
33:     return 0;
34: }
35:
```



```
1:  /*****
2:  * toupper.c
3:  *
4:  * Computer Science 50
5:  * David J. Malan
6:  *
7:  * Converts a lowercase character to uppercase.
8:  *
9:  * Demonstrates bitwise operators.
10:  *****/
11:
12: #include <cs50.h>
13: #include <ctype.h>
14: #include <stdio.h>
15:
16:
17: int
18: main(int argc, char * argv[])
19: {
20:     // prompt user for a lowercase character
21:     char c;
22:     do
23:     {
24:         printf("Lowercase character please: ");
25:         c = GetChar();
26:     }
27:     while (c < 'a' || c > 'z');
28:
29:     // print number in lowercase
30:     printf("%c\n", c & 0xdf);
31:
32:     // that's all folks
33:     return 0;
34: }
35:
```