

```
1: // $Id: oclib.h,v 1.10 2019-04-25 12:52:07-07 - - $
2:
3: // Bilingual file useable as a header file for both oc and c++.
4:
5: #ifndef __OCLIB_H__
6: #define __OCLIB_H__
7:
8: #ifdef __cplusplus
9:     using string = char*;
10:     extern "C" {
11: #endif
12:
13: #define SUCCESS 0
14: #define FAILURE 1
15: #define BOOL int
16: #define TRUE 1
17: #define FALSE 0
18: #define EOF (-1)
19:
20: #define assert(expr) {if (not (expr)) fail (#expr, __FILE__, __LINE__);}
21:
22: void fail (string expr, string file, int line);
23:
24: void putchar (int chr);
25: void putint (int num);
26: void putstr (string str);
27:
28: int getchr();
29: string getstr();
30: string getln();
31:
32: #ifdef __cplusplus
33:     }
34: #endif
35:
36: #endif
37:
```

```
1: // $Id: octypes.h,v 1.3 2019-04-22 13:46:03-07 - - $
2:
3: // Type definitions to compile oc programs with c++ compiler.
4:
5: #ifndef __OCDEFS_H__
6: #define __OCDEFS_H__
7:
8: #include <type_traits>
9:
10: using string = char*;
11:
12: template <typename type>
13: using ptr = std::enable_if_t<std::is_class<type>::value,type*>;
14:
15: template <typename type>
16: struct array {
17:     using array_value_type = type;
18:     type* data {};
19:     array() = default;
20:     array (type* that) { data = that; }
21:     array& operator= (type* that) { data = that; return *this; }
22:     type& operator[] (int i) { return data[i]; }
23: };
24:
25: template <typename type>
26: std::enable_if_t<std::is_class<type>::value,ptr<type>>
27: alloc() {
28:     return new type();
29: }
30:
31: template <typename type>
32: array<typename type::array_value_type>
33: alloc (int size) {
34:     auto result = new typename type::array_value_type [size] {};
35:     using result_t = array<typename type::array_value_type>;
36:     return *reinterpret_cast<result_t> (&result);
37: }
38:
39: template <typename type>
40: std::enable_if_t<std::is_same<type,string>::value,string>
41: alloc (int size) {
42:     return new char[size] {};
43: }
44:
45: #endif
46:
```

```
1: // $Id: oclib.c,v 1.6 2019-04-24 17:46:41-07 - - $
2:
3: #include <stdio.h>
4: #include <stdlib.h>
5: #include <string.h>
6:
7: #define not !
8: #define nullptr 0
9: #define string char*
10:
11: #include "oclib.h"
12:
13: void fail (string expr, string file, int line) {
14:     fprintf (stderr, "%s:%d: assert (%s) failed\n", file, line, expr);
15:     abort();
16: }
17:
18: void* xcalloc (int nelem, int size) {
19:     void* result = calloc (nelem, size);
20:     assert (result != nullptr);
21:     return result;
22: }
23:
24: void putchar (int chr) { printf ("%c", chr); }
25: void putint (int num) { printf ("%d", num); }
26: void putstr (string str) { printf ("%s", str); }
27:
28: int getch() { return getchar(); }
29:
30: string getstr (void) {
31:     char buffer[0x1000];
32:     char format[16];
33:     sprintf (format, "%%zds", sizeof buffer - 1);
34:     int count = scanf (format, buffer);
35:     return count != 1 ? nullptr : strdup (buffer);
36: }
37:
38: string getln (void) {
39:     char buffer[0x1000];
40:     string result = fgets (buffer, sizeof buffer, stdin);
41:     return result == nullptr ? nullptr : strdup (result);
42: }
43:
```

```
1: // $Id: 00-trivial.oc,v 1.1 2019-04-16 12:14:45-07 - - $  
2:  
3: int main(){}
```

```
1: // $Id: 01-hello.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2: // Simple hello world program.
3:
4: #include "oclib.h"
5:
6: int main() {
7:     putstr ("Hello, world!\n");
8:     return SUCCESS;
9: }
10:
```

```
1: // $Id: 03-test3.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2:
3: #include "oclib.h"
4:
5: int main() {
6:     int a = 3;
7:     int b = 8;
8:     int c = a + b;
9:     a = b + c;
10:    putint (a);
11:    putchar ('\n');
12:    return SUCCESS;
13: }
14:
```

```
1: // $Id: 04-test4.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2:
3: #include "oclib.h"
4:
5: struct foo {
6:     int a;
7: };
8:
9: int main() {
10:     int a = 6;
11:     ptr<struct foo> b = alloc<struct foo>();
12:     b->a = 8;
13:     a = a * b->a + 6;;
14:     putint (a);
15:     putchar ( ' ');
16:     putint (b->a);
17:     putchar ( '\n' );
18:     return SUCCESS;
19: }
20:
```

```
1: // $Id: 06-test6.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2:
3: #include "oclib.h"
4:
5: struct foo {};
6: struct bar {};
7:
8: int f0();
9: int f1 (int a);
10: int f2 (int a, int b);
11: int f3 (string a, string b, string c);
12: int f4 (ptr<struct foo> a, ptr<struct bar> b);
13:
14: int main() {
15:     string s = "a";
16:     array<string> sa = alloc<array<string>>(10);
17:     return SUCCESS;
18: }
19:
```



```
1: // $Id: 07-assert.oc,v 1.2 2019-04-16 13:14:01-07 - - $
2:
3: #include "oclib.h"
4:
5: int main() {
6:     assert ("nullptr" == nullptr);
7:     return FAILURE;
8: }
9:
```

```
1: // $Id: 10-hundred.oc,v 1.2 2019-04-17 13:23:14-07 - - $
2:
3: #include "oclib.h"
4:
5: int main() {
6:     int count = 0;
7:     while (count < 16) {
8:         count = count + 1;
9:         putint (count);
10:        putchar ('\n');
11:    }
12:    return SUCCESS;
13: }
14:
```

```
1: // $Id: 11-numbers.oc,v 1.2 2019-04-18 14:06:21-07 - - $
2:
3: #include "oclib.h"
4:
5: int main() {
6:     int number = 1;
7:     BOOL done = FALSE;
8:     while (not done) {
9:         putint (number);
10:        putchar ('\n');
11:        if (number <= 0) done = TRUE;
12:        number = number + number;
13:    }
14:    return SUCCESS;
15: }
16:
```

```
1: // $Id: 12-elseif.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2:
3: #include "oclib.h"
4:
5: int main (int argc) {
6:     if (argc == 1) putstr ("one");
7:     else if (argc == 2) putstr ("two");
8:     else if (argc == 3) putstr ("three");
9:     else putstr ("many");
10:    putchar ('\n');
11:    return SUCCESS;
12: }
13:
```

```
1: // $Id: 13-macros.oc,v 1.3 2019-04-23 15:25:57-07 - - $
2:
3: #include "oclib.h"
4:
5: int main (int argc, array<string> argv) {
6:     putstr (argv[0]);
7:     putstr (": ");
8:     putstr (__FILE__);
9:     putchar ('[');
10:    putint (__LINE__);
11:    putstr ("] compiled ");
12:    putstr (__DATE__);
13:    putstr (" ");
14:    putstr (__TIME__);
15:    putstr ("\n");
16:    return SUCCESS;
17: }
18:
```

```
1: // $Id: 14-ocecho.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2:
3: #include "oclib.h"
4:
5: int main(int argc, array<string> argv) {
6:     int argi = 1;
7:     while (argi < argc) {
8:         if (argi > 1) putchar ( ' ');
9:         putstr (argv[argi]);
10:        argi = argi + 1;
11:    }
12:    putstr ("\n");
13:    return SUCCESS;
14: }
15:
```

```
1: // $Id: 20-fib-array.oc,v 1.3 2019-04-23 15:22:03-07 - - $
2: //
3: // Put Fibonacci numbers in an array, then print them.
4: //
5:
6: #include "oclib.h"
7:
8: #define FIB_SIZE 30
9:
10: int main() {
11:     array<int> fibonacci = alloc<array<int>> (FIB_SIZE);
12:     fibonacci[0] = 0;
13:     fibonacci[1] = 1;
14:     int index = 2;
15:     while (index < FIB_SIZE) {
16:         fibonacci[index] = fibonacci[index - 1] + fibonacci[index - 2];
17:         index = index + 1;
18:     }
19:     index = 0;
20:     putstr ("Numeri di figlio Bonacci\n");
21:     while (index < FIB_SIZE) {
22:         putstr ("fibonacci[");
23:         putint (index);
24:         putstr ("] = ");
25:         putint (fibonacci[index]);
26:         putchar ('\n');
27:         index = index + 1;
28:     }
29:     return SUCCESS;
30: }
31:
```

```
1: // $Id: 21-eratosthenes.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2:
3: #include "oclib.h"
4:
5: #define SIZE 100
6: #define LOWPRIME 2
7:
8: int main() {
9:     int prime = LOWPRIME;
10:    int index = LOWPRIME;
11:    array<int> sieve = alloc<array<int>>(SIZE);
12:
13:    while (index < SIZE) {
14:        sieve[index] = TRUE;
15:        index = index + 1;
16:    }
17:
18:    while (prime < SIZE) {
19:        if (sieve[prime]) {
20:            index = prime * 2;
21:            while (index < SIZE) {
22:                sieve[index] = FALSE;
23:                index = index + prime;
24:            }
25:        }
26:        prime = prime + 1;
27:    }
28:
29:    index = LOWPRIME;
30:    while (index < SIZE) {
31:        if (sieve[index]) {
32:            putint (index);
33:            putchar ('\n');
34:        }
35:        index = index + 1;
36:    }
37:
38:    return SUCCESS;
39: }
40:
```



```
1: // $Id: 23-atoi.oc,v 1.3 2019-04-23 15:22:03-07 - - $
2:
3: #include "oclib.h"
4:
5: int atoi (string str) {
6:     BOOL neg = FALSE;
7:     int num = 0;
8:     int digit = 0;
9:     assert (str != nullptr);
10:    if (str[0] != '\0') {
11:        if (str[0] == '-') {
12:            digit = digit + 1;
13:            neg = TRUE;
14:        }
15:        BOOL contin = TRUE;
16:        while (contin) {
17:            if (str[digit] == '\0') {
18:                contin = FALSE;
19:            }else {
20:                int chr = str[digit];
21:                digit = digit + 1;
22:                if (chr < '0') contin = FALSE;
23:                else if (chr > '9') contin = FALSE;
24:                else num = num * 10 + chr - '0';
25:            }
26:        }
27:        if (neg) num = - num;
28:    }
29:    return num;
30: }
31:
32: int main (int argc, array<string> argv) {
33:     int argi = 1;
34:     string arg = nullptr;
35:     while (argi < argc) {
36:         arg = argv[argi];
37:         putstr (arg);
38:         putstr (" = ");
39:         putint (atoi (arg));
40:         putchar ('\n');
41:         argi = argi + 1;
42:     }
43:     return SUCCESS;
44: }
45:
```

```
1: // $Id: 30-fac-fnloop.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2: //
3: // Function uses a loop to compute factorial.
4: //
5:
6: #include "oclib.h"
7:
8: int fac (int n) {
9:     int f = 1;
10:    while (n > 1) {
11:        f = f * n;
12:        n = n - 1;
13:    }
14:    return f;
15: }
16:
17: int main() {
18:     int n = 1;
19:     while (n <= 5) {
20:         putint (fac (n));
21:         putchar ('\n');
22:         n = n + 1;
23:     }
24:     return SUCCESS;
25: }
26:
```

```
1: // $Id: 31-fib-2supn.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2: //
3: // Very slow program, computes Fibonacci numbers with  $O(2^n)$  speed.
4: //
5:
6: #include "oclib.h"
7:
8: int fibonacci (int n) {
9:     if (n < 2) return n;
10:    return fibonacci (n - 1) + fibonacci (n - 2);
11: }
12:
13: int main() {
14:     int n = 0;
15:     while (n < 10) {
16:         putstr ("fibonacci(");
17:         putint (n);
18:         putstr (") = ");
19:         putint (fibonacci (n));
20:         putchar ('\n');
21:         n = n + 1;
22:     }
23:     return SUCCESS;
24: }
25:
```

```
1: // $Id: 40-arraystack.oc,v 1.2 2019-04-17 13:23:14-07 - - $
2:
3: #include "oclib.h"
4:
5: #define EMPTY (-1)
6:
7: struct stack {
8:     array<string> data;
9:     int size;
10:    int top;
11: };
12:
13: ptr<struct stack> new_stack (int size) {
14:     ptr<struct stack> stack = alloc<struct stack>();
15:     stack->data = alloc<array<string>> (size);
16:     stack->size = size;
17:     stack->top = EMPTY;
18:     return stack;
19: }
20:
21: void push (ptr<struct stack> stack, string str) {
22:     assert (stack->top < stack->size - 1);
23:     stack->top = stack->top + 1;
24:     stack->data[stack->top] = str;
25: }
26:
27: string pop (ptr<struct stack> stack) {
28:     string tmp = stack->data[stack->top];
29:     assert (stack->top != EMPTY);
30:     stack->top = stack->top - 1;
31:     return tmp;
32: }
33:
34: int empty (ptr<struct stack> stack) {
35:     return stack->top == EMPTY;
36: }
37:
38: int main (int argc, array<string> argv) {
39:     ptr<struct stack> stack = new_stack (100);
40:     int argi = 0;
41:     while (argi < argc) {
42:         push (stack, argv[argi]);
43:         argi = argi + 1;
44:     }
45:     while (not empty (stack)) {
46:         putstr (pop (stack));
47:         putchar ('\n');
48:     }
49:     return SUCCESS;
50: }
51:
```

```
1: // $Id: 41-linkedstack.oc,v 1.2 2019-04-17 13:23:14-07 - - $
2:
3: #include "oclib.h"
4:
5: struct node {
6:     string data;
7:     ptr<node> link;
8: };
9:
10: struct stack {
11:     ptr<node> top;
12: };
13:
14: int empty (ptr<struct stack> stack) {
15:     assert (stack != nullptr);
16:     return stack->top == nullptr;
17: }
18:
19: ptr<struct stack> new_stack() {
20:     ptr<struct stack> stack = alloc<struct stack>();
21:     stack->top = nullptr;
22:     return stack;
23: }
24:
25: void push (ptr<struct stack> stack, string str) {
26:     ptr<node> tmp = alloc<node>();
27:     assert (stack != nullptr);
28:     tmp->data = str;
29:     tmp->link = stack->top;
30:     stack->top = tmp;
31: }
32:
33: string pop (ptr<struct stack> stack) {
34:     string tmp = stack->top->data;
35:     assert (stack != nullptr);
36:     assert (not empty (stack));
37:     stack->top = stack->top->link;
38:     return tmp;
39: }
40:
41: int main (int argc, array<string> argv) {
42:     int argi = 0;
43:     ptr<struct stack> stack = new_stack();
44:     while (argi < argc) {
45:         push (stack, argv[argi]);
46:         argi = argi + 1;
47:     }
48:     while (not empty (stack)) {
49:         putstr (pop (stack));
50:         putchar ('\n');
51:     }
52:     return SUCCESS;
53: }
54:
```

```
1: // $Id: 42-viii queens.oc,v 1.1 2019-04-16 12:14:45-07 - - $
2:
3: #include "oclib.h"
4:
5: #define BOARD_SIZE 8
6: array<int> board = nullptr;
7:
8: int is_safe (int newcol) {
9:     int col = 0;
10:    int diagonal = 0;
11:    while (col < newcol) {
12:        if (board[col] == board[newcol]) return FALSE;
13:        diagonal = board[col] - board[newcol];
14:        if (diagonal == col - newcol) return FALSE;
15:        if (diagonal == newcol - col) return FALSE;
16:        col = col + 1;
17:    }
18:    return TRUE;
19: }
20:
21: void printqueens() {
22:     int col = 0;
23:     while (col < BOARD_SIZE) {
24:         putchar (board[col] + '1');
25:         col = col + 1;
26:     }
27:     putchar ('\n');
28: }
29:
30: void queens (int newcol) {
31:     int row = 0;
32:     if (newcol == BOARD_SIZE) printqueens();
33:     else {
34:         while (row < BOARD_SIZE) {
35:             board[newcol] = row;
36:             if (is_safe (newcol)) queens (newcol + 1);
37:             row = row + 1;
38:         }
39:     }
40: }
41:
42: int main() {
43:     board = alloc<array<int>> (BOARD_SIZE);
44:     queens (0);
45:     return SUCCESS;
46: }
47:
```

```
1: // $Id: 44-dot-product.oc,v 1.2 2019-04-23 15:22:03-07 - - $
2:
3: #include "oclib.h"
4:
5: int dot_product (int size, array<int> vec1, array<int> vec2) {
6:     int index = 0;
7:     int dot = 0;
8:     while (index < size) {
9:         dot = dot + vec1[index] * vec2[index];
10:        index = index + 1;
11:    }
12:    return dot;
13: }
14:
15: #define SIZE 10
16:
17: int main() {
18:     array<int> vec1 = alloc<array<int>> (SIZE);
19:     array<int> vec2 = alloc<array<int>> (SIZE);
20:     int index = 0;
21:     while (index < SIZE) {
22:         vec1[index] = index + 10;
23:         vec2[index] = index * 10;
24:         index = index + 1;
25:     }
26:     putint (dot_product (SIZE, vec1, vec2));
27:     putchar ('\n');
28:     return SUCCESS;
29: }
30:
```

```
1: // $Id: 45-towers-of-hanoi.oc,v 1.2 2019-04-25 12:55:47-07 - - $
2:
3: #include "oclib.h"
4:
5: void move (string src, string dst) {
6:    _putstr ("Move a disk from the ");
7:    _putstr (src);
8:    _putstr (" to the ");
9:    _putstr (dst);
10:   _putstr (".\n");
11: }
12:
13: void towers (int ndisks, string src, string tmp, string dst) {
14:     if (ndisks < 1) return;
15:     towers (ndisks - 1, src, dst, tmp);
16:     move (src, dst);
17:     towers (ndisks - 1, tmp, src, dst);
18: }
19:
20: int main (int argc, array<string> argv) {
21:     assert (argc == 2);
22:     int count = argv[1][0] - '0';
23:     assert (count > 0);
24:     assert (count < 9);
25:    _putstr (argv[0]);
26:    _putstr (": ");
27:     putint (count);
28:    _putstr (" disks\n");
29:     towers (count, "source", "temporary", "distination");
30:     return SUCCESS;
31: }
32:
```



```
1: // $Id: 51-stringcat.oc,v 1.3 2019-04-23 15:22:03-07 - - $
2: //
3: // Allocate and concatenate strings.
4: //
5:
6: #include "oclib.h"
7:
8: int strlen (string str) {
9:     int len = 0;
10:    while (str[len] != '\0') len = len + 1;
11:    return len;
12: }
13:
14: void strcat (string dest, string src) {
15:     int pos = strlen (dest);
16:     int srcix = 0;
17:     while (src[srcix] != '\0') {
18:         dest[pos] = src[srcix];
19:         pos = pos + 1;
20:         srcix = srcix + 1;
21:     }
22:     dest[pos] = '\0';
23: }
24:
25: int main (int argc, array<string> argv) {
26:     int length = 0;
27:     int argi = 1;
28:     while (argi < argc) {
29:         length = length + strlen (argv[argi]) + 2;
30:         argi = argi + 1;
31:     }
32:     putstr ("concat length = ");
33:     putint (length);
34:     putchar ('\n');
35:     string concat = alloc<string> (length);
36:     argi = 1;
37:     putchar ('[');
38:     while (argi < argc) {
39:         strcat (concat, "(");
40:         strcat (concat, argv[argi]);
41:         strcat (concat, ")");
42:         argi = argi + 1;
43:     }
44:     putstr (concat);
45:     putstr ("]\n");
46:     return SUCCESS;
47: }
```

```
1: // $Id: 53-insertionsort.oc,v 1.4 2019-04-18 14:06:21-07 - - $
2: //
3: // Use insertion sort to print argv in sorted order.
4: //
5:
6: #include "oclib.h"
7:
8: int strcmp (string s1, string s2) {
9:     int index = 0;
10:    BOOL contin = TRUE;
11:    int s1c = 0;
12:    int s2c = 0;
13:    int cmp = 0;
14:    while (contin) {
15:        s1c = s1[index];
16:        s2c = s2[index];
17:        cmp = s1c - s2c;
18:        if (cmp != 0) return cmp;
19:        if (s1c == '\0') contin = FALSE;
20:        if (s2c == '\0') contin = FALSE;
21:        index = index + 1;
22:    }
23:    return 0;
24: }
25:
26: void insertion_sort (int size, array<string> array) {
27:     int sorted = 1;
28:     int slot = 0;
29:     string element = nullptr;
30:     BOOL contin = FALSE;
31:     while (sorted < size) {
32:         slot = sorted;
33:         element = array[slot];
34:         contin = TRUE;
35:         while (contin) {
36:             if (slot == 0) {
37:                 contin = FALSE;
38:             }else if (strcmp (array[slot - 1], element) <= 0) {
39:                 contin = FALSE;
40:             }else {
41:                 array[slot] = array[slot - 1];
42:                 slot = slot - 1;
43:             }
44:         }
45:         array[slot] = element;
46:         sorted = sorted + 1;
47:     }
48: }
49:
```

```
50:
51: void print_array (int size, array<string> array) {
52:     int index = 0;
53:     while (index < size) {
54:         putstr (array[index]);
55:         putchar ('\n');
56:         index = index + 1;
57:     }
58: }
59:
60: int read_words (int size, array<string> words) {
61:     int count = 0;
62:     string word = nullptr;
63:     while (TRUE) {
64:         if (count == size) return count;
65:         word = getstr();
66:         if (word == nullptr) return count;
67:         words[count] = word;
68:         count = count + 1;
69:     }
70: }
71:
72: int main() {
73:     int count = 100;
74:     array<string> words = alloc<array<string>>(count);
75:     count = read_words (count, words);
76:     insertion_sort (count, words);
77:     print_array (count, words);
78:     return SUCCESS;
79: }
80:
```

```
1: # $Id: Makefile,v 1.18 2019-04-24 14:23:25-07 - - $
2:
3: UTILDIR = /afs/cats.ucsc.edu/courses/cmps104a-wm/bin
4:
5: NOWARN = -Wno-write-strings -Wno-main
6: OCGPP = g++ ${NOWARN} -x c++ -include octypes.h
7:
8: OCSRC = ${sort ${wildcard *.oc}}
9: LIBSRC = oclib.c
10: LIBOBJ = ${LIBSRC:.c=.o}
11: HEADERS = oclib.h octypes.h
12: OCOBJ = ${OCSRC:.oc=.o}
13: EXECS = ${OCSRC:.oc=.elf}
14: ALLSRC = ${HEADERS} ${LIBSRC} ${OCSRC} Makefile
15: LISTING = Listing.oc-programs
16:
17: all : ${EXECS}
18:
19: %.elf : %.o ${LIBOBJ}
20:      g++ $< ${LIBOBJ} -o $@
21:
22: %.o : %.oc ${HEADERS}
23:      ${OCGPP} -c $<
24:
25: ${LIBOBJ} : ${LIBSRC}
26:      gcc -c $<
27:
28: spotless : clean
29:      - rm ${LISTING}.{ps,pdf} ${EXECS}
30:
31: clean :
32:      -rm ${OCOBJ} ${LIBOBJ} oclib.nm Listing.asm.{ps,pdf}
33:
34: ci :
35:      ${UTILDIR}/cid + ${ALLSRC}
36:
37: lis :
38:      ${UTILDIR}/checksource ${ALLSRC}
39:      ${UTILDIR}/mkpspdf ${LISTING}.ps ${ALLSRC}
40:
41: asm : ${LIBOBJ}
42:      nm -a ${LIBOBJ} >oclib.nm
43:      ${UTILDIR}/mkpspdf Listing.asm.ps \
44:          oclib.h oclib.c oclib.nm oclib.s
45:
46: again :
47:      make --no-print-directory clean ci all lis
```