Exercise 1 *(2 points – C Program)*

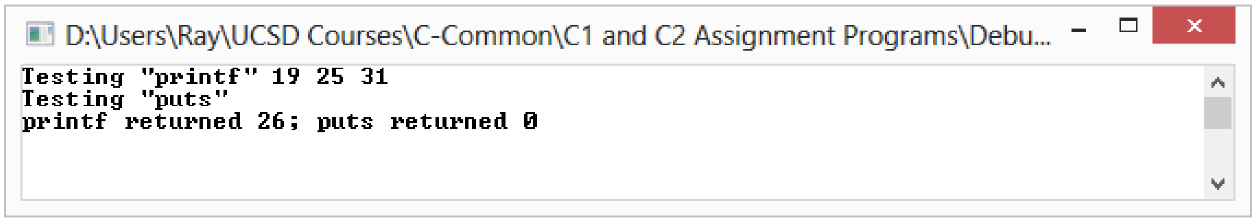
```c

#include <stdio.h>

/*
 * This function returns a pointer to the standard library
 * printf function and does nothing else.
 */
int (*GetPrintfPointer(void))(const char *format, ...)
{
   int (*pPrintf)(const char *format, ...) = printf;
   return pPrintf;
}

/*
 * This function returns a pointer to the standard library
 * puts function and does nothing else.
 */
int (*GetPutsPointer(void))(const char *str)
{
   int (*pPuts)(const char *str) = puts;
   return pPuts;
}
```

C2A6E1 Screen Shot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```
Testing "printf" 19 25 31
Testing "puts"
printf returned 26; puts returned 0
```

Exercise 2 (4 points – C++ Program)

** FILE C2A6E2_GetValues.cpp **

```cpp
#include <iostream>

//
// Prompt the user to enter the number of floating point values specified
// by <elements> and store them in the array in <first>.  <first> is
// returned.
//
float *GetValues(float *first, size_t elements)
{
   std::cout << "Enter " << int(elements) << " floating point values: ";
   // Get one user entry per iteration and store in successive array elements.
   for (float *end = first + elements; first < end; ++first)
      std::cin >> *first;
   return first - elements;
}
```

** FILE C2A6E2_SortValues.cpp **

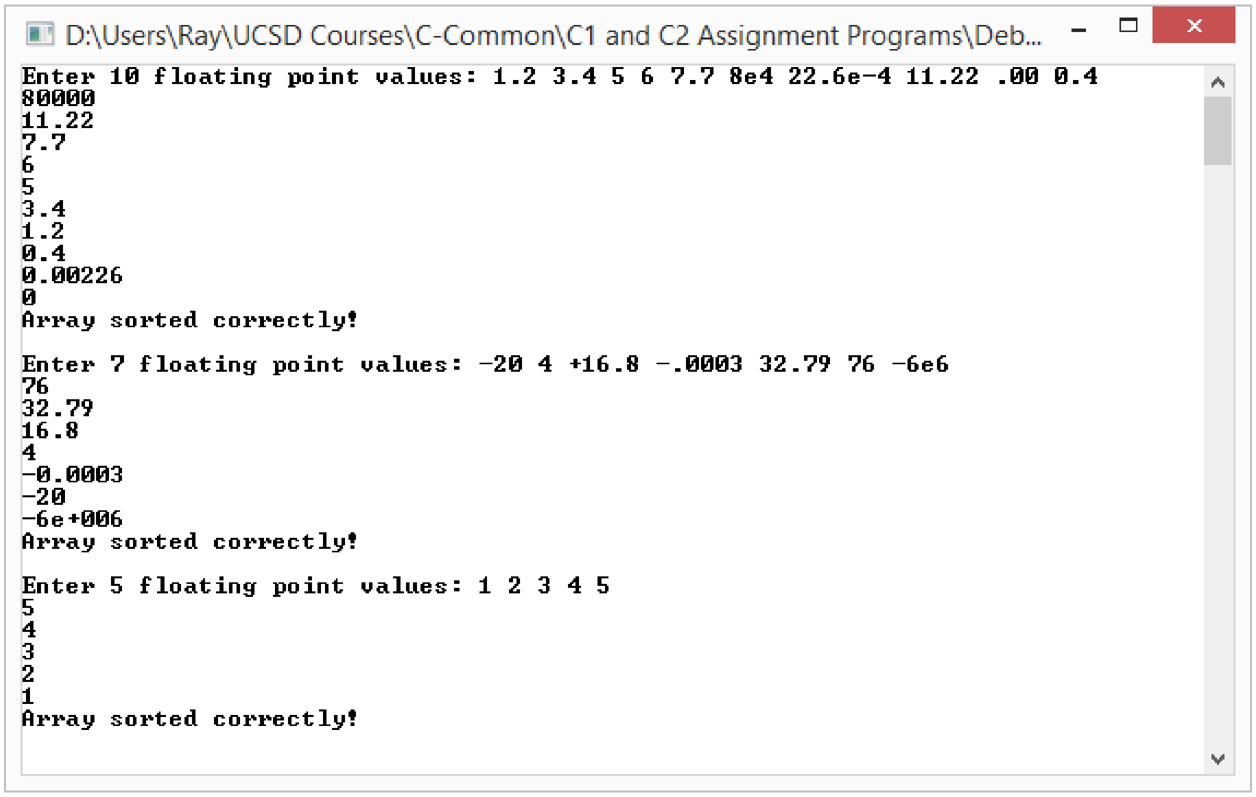
```cpp
#include <cstddef>

//
// Sort the <elements> in the array in <first> in descending numerical
// order using the Bubble Sort algorithm.  <first> is returned.
//
float *SortValues(float *first, size_t elements)
{
   float *last = &first[elements - 1];
   bool swapped;

   // Loop until no swap occurs during a complete pass through the array.
   do
   {
      swapped = false;
      //
      // One complete set of loop iterations represents one complete pass
      // through the array.
      //
      for (float *ptr = first, *next = first + 1; ptr < last; ++ptr, ++next)
      {
         if (*ptr < *next)       // need to exchange
         {
            float temp = *ptr;   // do the...
            *ptr = *next;        // ...3 step...
            *next = temp;        // ...swap
            swapped = true;      // indicate swap occurred
         }
      }
      --last;
   } while (swapped);

   return first;
}
```

C2A6E2 Screen Shot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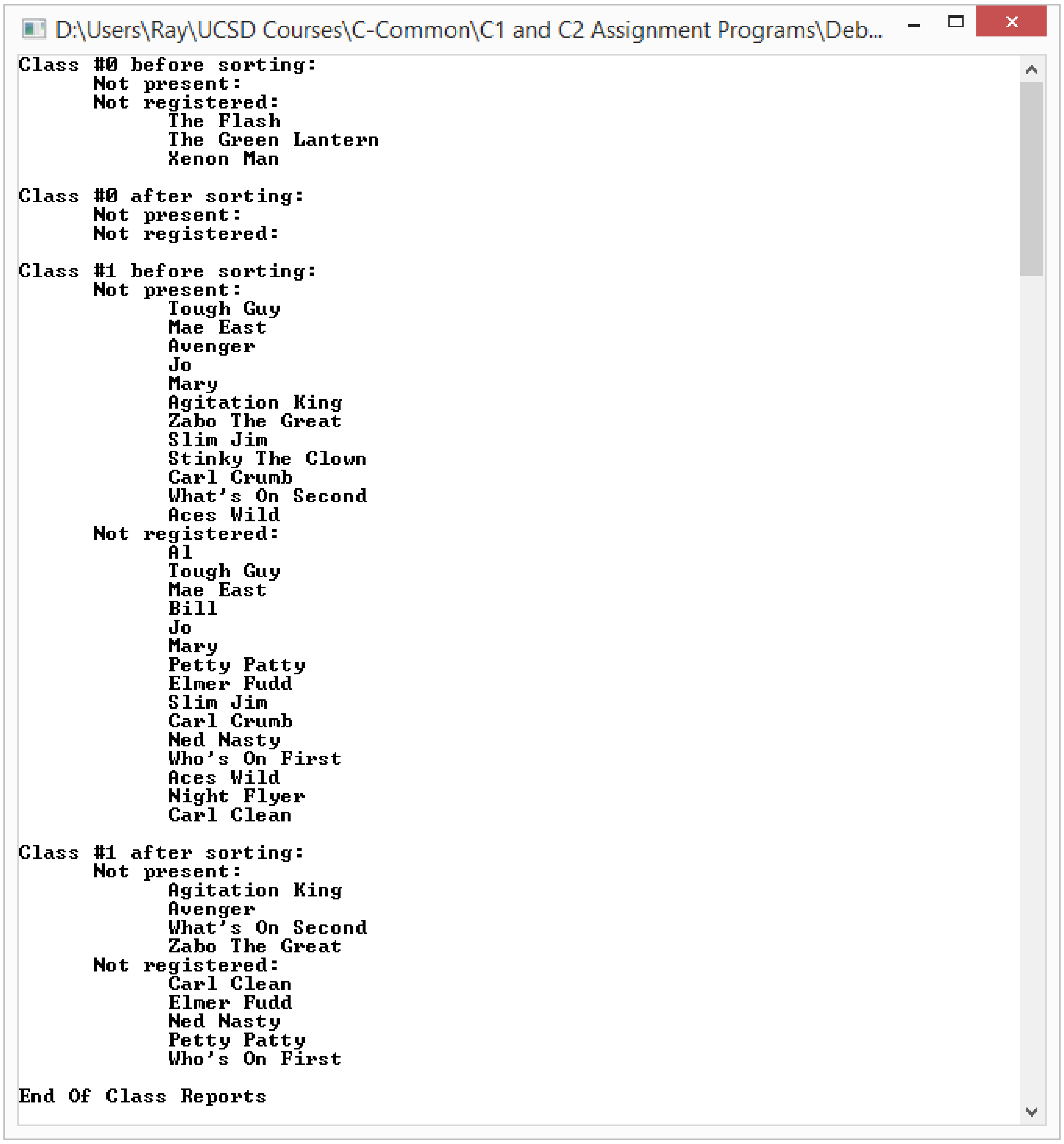
```
Enter 10 floating point values: 1.2 3.4 5 6 7.7 8e4 22.6e-4 11.22 .00 0.4
80000
11.22
7.7
6
5
3.4
1.2
0.4
0.00226
0
Array sorted correctly!

Enter 7 floating point values: -20 4 +16.8 -.0003 32.79 76 -6e6
76
32.79
16.8
4
-0.0003
-20
-6e+006
Array sorted correctly!

Enter 5 floating point values: 1 2 3 4 5
5
4
3
2
1
Array sorted correctly!
```

Exercise 3 (6 points – C Program)

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

/*
 * Compare the C-strings in <elemA> and <elemB> using the standard library
 * function strcmp and return the result directly from strcmp.
 */
int Compare(const void *elemA, const void *elemB)
{
   return(strcmp(*(char **)elemA, *(char **)elemB));
}

/*
 * Call the standard library function qsort to sort <studentCount> C-strings
 * in the array in <studentList>.
 */
void SortStudents(const char *studentList[], size_t studentCount)
{
   qsort((void *)studentList, studentCount, sizeof(*studentList), Compare);
}


/*
 * Use the standard library bsearch function to search the array of C-strings
 * in <attendees> for each C-string in the array in <registrants>.  Then use
 * the standard library bsearch function to search the array of C-strings in
 * <registrants> for each C-string in the array in <attendees>.  In each
 * case display the C-strings NOT found.
 */
void DisplayClassStatus(const char *registrants[], size_t registrantCount,
                      const char *attendees[], size_t attendeeCount)
{
   const char **cpp, **end;

   /*
    * For each name searched for bsearch returns a pointer to the appropriate
    * element if the name is found and a null pointer if not.  Each element
    * is a pointer to a char and, therefore, the first bsearch argument must
    * be a pointer to a pointer to a char (type casted to a void pointer).
    */

   /* See how many registrants are listed in the attendees array. */
   printf("      Not present:\n");
   for (cpp = registrants, end = cpp + registrantCount; cpp < end; ++cpp)
      /* If the name was not found in the array, display it. */
      if (!bsearch((void *)cpp, (void *)attendees, attendeeCount,
                   sizeof(*attendees), Compare))
         printf("            %s\n", *cpp);

   /* See how many attendees are listed in the registrants array. */
   printf("      Not registered:\n");
   for (cpp = attendees, end = cpp + attendeeCount; cpp < end; ++cpp)
      /* If the name was not found in the array, display it. */
      if (!bsearch((void *)cpp, (void *)registrants, registrantCount,
                    sizeof(*registrants), Compare))
          printf("            %s\n", *cpp);
}
```

C2A6E3 Screen Shot



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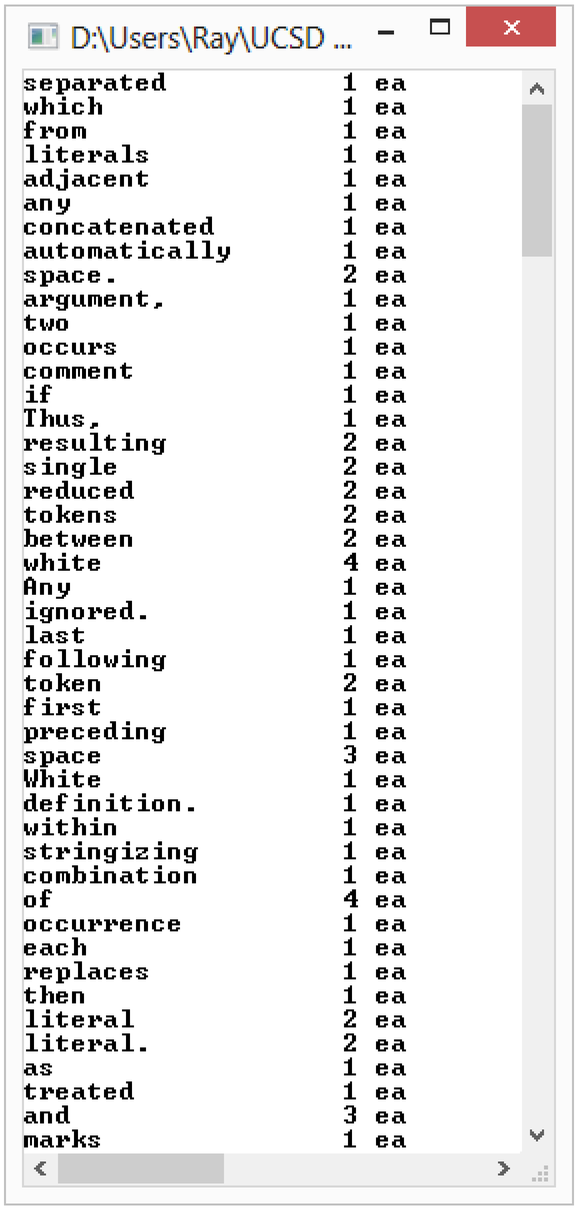
```
Class #0 before sorting:
      Not present:
      Not registered:
            The Flash
            The Green Lantern
            Xenon Man

Class #0 after sorting:
      Not present:
      Not registered:

Class #1 before sorting:
      Not present:
            Tough Guy
            Mae East
            Avenger
            Jo
            Mary
            Agitation King
            Zabo The Great
            Slim Jim
            Stinky The Clown
            Carl Crumb
            What's On Second
            Aces Wild
      Not registered:
            Al
            Tough Guy
            Mae East
            Bill
            Jo
            Mary
            Petty Patty
            Elmer Fudd
            Slim Jim
            Carl Crumb
            Ned Nasty
            Who's On First
            Aces Wild
            Night Flyer
            Carl Clean

Class #1 after sorting:
      Not present:
            Agitation King
            Avenger
            What's On Second
            Zabo The Great
      Not registered:
            Carl Clean
            Elmer Fudd
            Ned Nasty
            Petty Patty
            Who's On First

End Of Class Reports
```

Exercise 4 *(8 points – C Program)*

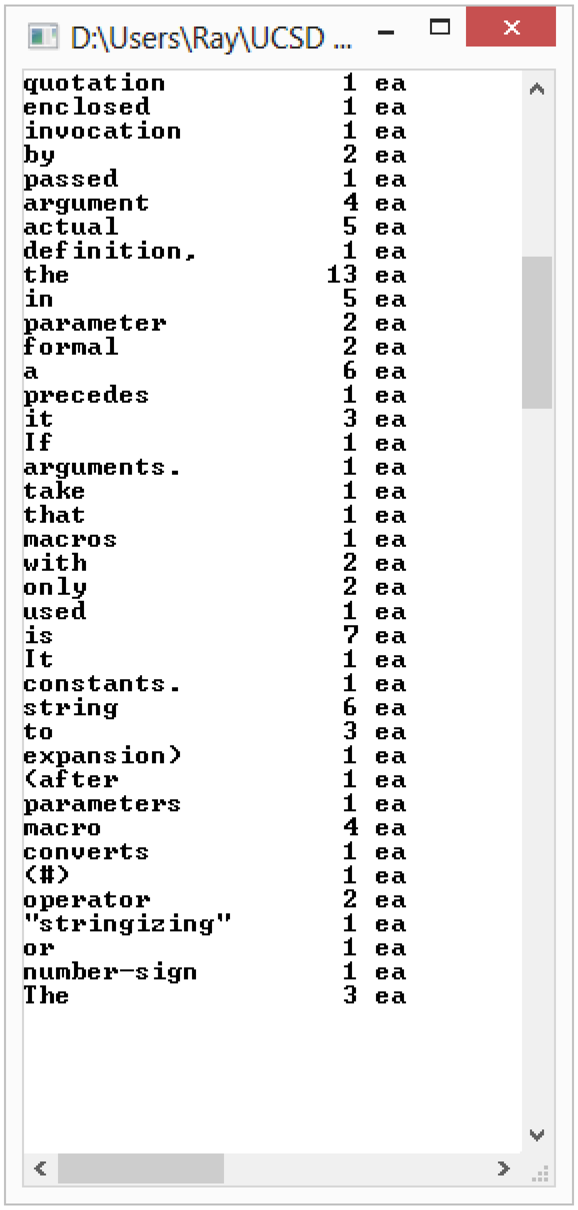
```
  ****************************************  FILE C2A6E4_OpenFile.c  ****************************************
#include <stdio.h>
#include <stdlib.h>

/*
 * Open the file named in <fileName> in the "read only" mode and return its
 * FILE pointer if the open succeeds.  If it fails display an error message
 * and terminate the program with an error code.
 */
FILE *OpenFile(const char *fileName)
{
   FILE *fp;

   /* Open the file named in <fileName> in the read-only mode. */
   if ((fp = fopen(fileName, "r")) == NULL)
   {
      /* Print an error message and terminate with an error code. */
      fprintf(stderr, "File %s didn't open.\n", fileName);
      exit(EXIT_FAILURE);
   }
   return fp;
}

  ********************************************  FILE C2A6E4_List.c  ********************************************
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include "C2A6E4_List-Driver.h"

#define BUFSIZE 256                             /* size of input buffer */
#define BUFFMT "%255"                           /* scanf field for buffer */

/*
 * The syntax and functionality of SafeMalloc is identical to that of malloc
 * with the following exception: If SafeMalloc fails to obtain the requested
 * memory it prints an error message to stderr and terminates the program
 * with an error code.
 */
static void *SafeMalloc(size_t size)
{
   void *vp;

   /*
    * Request <size> bytes of dynamically-allocated memory and terminate the
    * program with an error message and code if the allocation fails.
    */
   if ((vp = malloc(size)) == NULL)
   {
      fputs("Out of memory\n", stderr);
      exit(EXIT_FAILURE);
   }
   return(vp);
}

/*
```

```
 * Create a singly-linked list where each node represents a unique
 * whitespace-separated string from the text file in <fp>.  A new node is
 * created and pushed at the head of the list if a string not already in
 * the list is read from the file.  If a node for that string already
 * exists its occurrence count is merely incremented.
 */
List *CreateList(FILE *fp)
{
   List *head;                                    /* pointer into list */
   char buf[BUFSIZE];                             /* for string input */

   /* loop to get strings for insertion at top of list */
   for (head = NULL; fscanf(fp, BUFFMT "s", buf) != EOF;)
   {
      List *p;                                    /* pointer into list */
      /* loop to find duplicates; order of logical && operands is critical */
      for (p = head; p != NULL && strcmp(p->str, buf); p = p->next)
         ;
      if (p != NULL)                              /* found same string */
         ++p->count;                              /* incr. string count */
      else                                        /* add new string at top */
      {
         size_t length;

         p = (List *)SafeMalloc(sizeof(List));     /* allocate new node */
         p->next = head;                          /* next = head pointer */
         head = p;                                /* point head to node */
         p->count = 1;                            /* init. string count */
         length = strlen(buf) + 1;                /* string len + the '\0' */
         p->str = (char *)SafeMalloc(length);     /* alloc string storage */
         memcpy(p->str, buf, length);             /* copy string */
      }
   }
   return head;
}

/*
 * Print the string and the number of occurrences of it represented by each
 * node in the list in head-to-tail order.
 */
List *PrintList(const List *head)
{
   const List *p;                                    /* pointer into list */

   for (p = head; p != NULL; p = p->next)            /* printing loop */
      printf("%-15s%4d ea\n", p->str, p->count);     /* string & count */

   return (List *)head;
}


/*
 * Free all dynamically-allocated memory in the list in head-to-tail order.
 */
void FreeList(List *head)
{
   List *p;                            /* pointer into list */

   for (p = head; p != NULL;)          /* loop to free dynamic storage */
   {
      List *pTmp = p;                  /* save pointer to current node */

      p = p->next;                     /* get pointer to next node */
      free(pTmp->str);                 /* free current node's str storage */
      free(pTmp);                      /* free current node's storage */
   }
}
```

C2A6E4 Screen Shots



```
separated                1 ea
which                    1 ea
from                     1 ea
literals                 1 ea
adjacent                 1 ea
any                      1 ea
concatenated             1 ea
automatically            1 ea
space.                   2 ea
argument,                1 ea
two                      1 ea
occurs                   1 ea
comment                  1 ea
if                       1 ea
Thus,                    1 ea
resulting                2 ea
single                   2 ea
reduced                  2 ea
tokens                   2 ea
between                  2 ea
white                    4 ea
Any                      1 ea
ignored.                 1 ea
last                     1 ea
following                1 ea
token                    2 ea
first                    1 ea
preceding                1 ea
space                    3 ea
White                    1 ea
definition.              1 ea
within                   1 ea
stringizing              1 ea
combination              1 ea
of                       4 ea
occurrence               1 ea
each                     1 ea
replaces                 1 ea
then                     1 ea
literal                  2 ea
literal.                 2 ea
as                       1 ea
treated                  1 ea
and                      3 ea
marks                    1 ea
```



```
quotation                1 ea
enclosed                 1 ea
invocation               1 ea
by                       2 ea
passed                   1 ea
argument                 4 ea
actual                   5 ea
definition,              1 ea
the                     13 ea
in                       5 ea
parameter                2 ea
formal                   2 ea
a                        6 ea
precedes                 1 ea
it                       3 ea
If                       1 ea
arguments.               1 ea
take                     1 ea
that                     1 ea
macros                   1 ea
with                     2 ea
only                     2 ea
used                     1 ea
is                       7 ea
It                       1 ea
constants.               1 ea
string                   6 ea
to                       3 ea
expansion)               1 ea
(after                   1 ea
parameters               1 ea
macro                    4 ea
converts                 1 ea
(#)                      1 ea
operator                 2 ea
"stringizing"            1 ea
or                       1 ea
number-sign              1 ea
The                      3 ea
```