C Programming Essentials
Unit 3: Basic Data Structures

CHAPTER 9: STRING

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Strings

A string is a sequence of characters treated as a group

We have already used some string literals:

- “filename”
- “output string”

Strings are important in many programming contexts:

- names
- other objects (numbers, identifiers, etc.)

Outline

- Strings
  - Representation in C
  - String Literals
  - String Variables
  - String Input/Output
    - printf, scanf, gets, fgets, puts, fputs
  - String Functions

    strlen, strcpy, strncpy, strcmp, strncmp, strcat, strncat, strchr, strrchr, strstr, strspn, strcspn, strtok
  - Reading from/Printing to Strings

    sprintf, sscanf

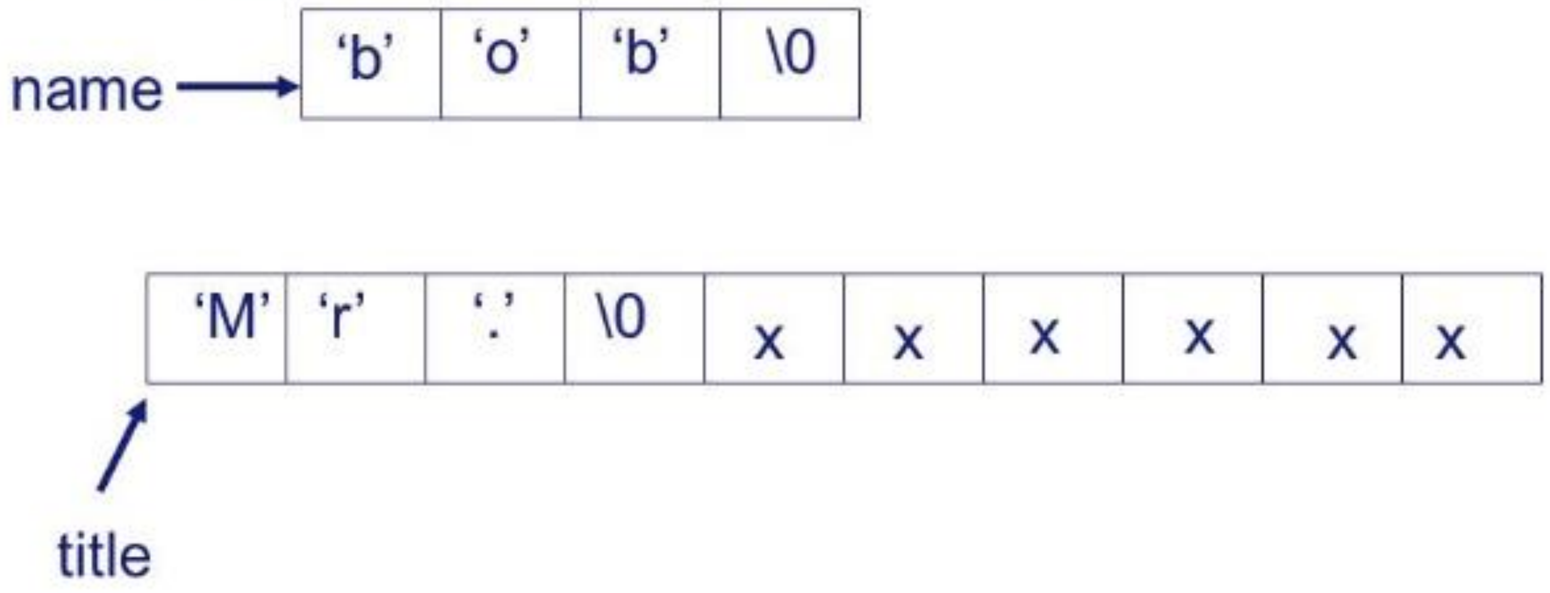
LECTURE 1

C String Representation

Strings in C

- In C, a string is an array of characters terminated with the “null” character (‘\0’, value = 0).

```
char name[4] = “bob”;
char title[10] = “Mr.”;
```



Strings in C

- No explicit type, instead strings are maintained as arrays of characters
- Representing strings in C
  - stored in arrays of characters
  - array can be of any length
  - end of string is indicated by a *delimiter*, the zero character ‘\0’

"A String"

A		S	t	r	i	n	g	\0

Character and String

C only has a concept of numbers and characters. It very often comes as a surprise to some programmers who learnt a beginner's language such as BASIC that C has no understanding of strings but a string is only an array of characters and C does have a concept of arrays which we shall be meeting later in this course.

Notice that you can only store a single character in a char variable. Later we will be discussing using character strings, which has a very real potential for confusion because a string constant is written between double quotes. But for the moment remember that a char variable is 'A' and not "A".

Array of Characters

To declare an array of characters:

```
char a[] = {‘a’, ‘b’, ‘c’};
Or,
char a[] = {‘d’, ‘e’, ‘f’};
char *b = a;
```

These statements declared and initialized arrays of characters. They represent a collection of characters in the format of arrays. But, they are not strings. String operations don’t apply to them.

Array of Characters

```
char *b = calloc(1, sizeof(char));    // this is legal
char  *b = {‘a’, ‘b’, ‘c’, ‘d’};    // this is not legal. rvalue is of char[] type


char a[];   // a is address of array of character type
char *a;   // a’s body is of char type.
```

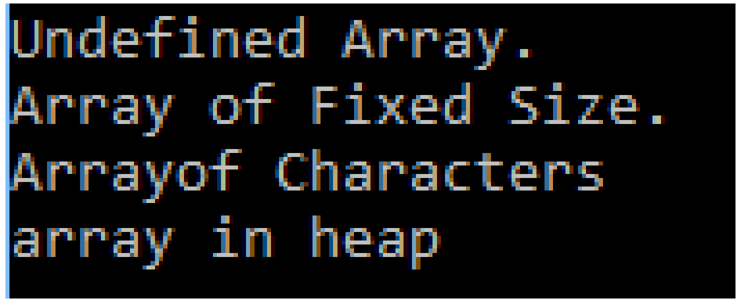
These two both hold the address value of the array of characters. They can be used interchangeably in many places. But, not always. Especially, when the literals of array of character are used.

Demo Program:

chrAry0.c

Go gcc!!!

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

char  a1[] = "Undefined Array. ";
char  a2[256] = "Array of Fixed Size. ";
//char *a3 = "Pointer of character Doest not work. "
char  a4[] = {'A','r','r', 'a', 'y', 'o', 'f', ' ', 'C', 'h', 'a', 'r', 'a','c','t','e','r','s', '\0'};
char *a5;
int main(){
    a5 = (char *)calloc(256, sizeof(char));
    a5 = "array in heap";
    printf("%s\n", a1);
    printf("%s\n", a2);
    //printf("%s\n", a3);
    printf("%s\n", a4);
    printf("%s\n", a5);
    return 0;
}
```



```
Undefined Array.
Array of Fixed Size.
Arrayof Characters
array in heap
```

LECTURE 2

C String Literals

String Literals

- String literal values are represented by sequences of characters between double quotes (“)
- Examples
  - “” - **empty** string
  - “hello”
- “a” versus ‘a’
  - ‘a’ is a **single** character value (stored in 1 byte) as the ASCII value for a
  - “a” is an array with two characters, the first is a, the second is the character value \0

Referring to String Literals

- String literal is an array, can refer to a single character from the literal as a character
- Example:
  - printf(“%c”,”hello”[1]);
  - outputs the character ‘e’
- During compilation, C creates space for each string literal (# of characters in the literal + 1)
  - referring to the literal refers to that space (as if it is an array)

Duplicate String Literals

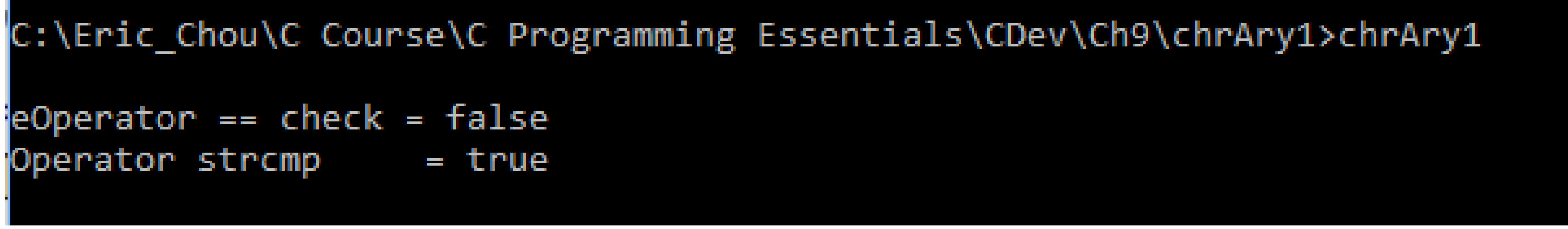
- Each string literal in a C program is stored at a different location
- So even if the string literals contain the same string, they are not equal (in the == sense)
- Example:
  - char string1[6] = “hello”;
  - char string2[6] = “hello”;
  - but string1 does not equal string2 (they are stored at different locations)

String Literal Examples

Demo Program: chrAry1.c

```
Go gcc!!!
```

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

char *check(bool b){
    char *a=malloc(sizeof(char));
    a = b ? "true" : "false";
    return a;
}
int main(){
    printf("%s\n", "");
    printf("%c","hello"[1]);
    char string1[6] = "hello";
    char string2[6] = "hello";
    bool string_equal_sign = string1 == string2;
    bool string_equal_equal = strcmp(string1, string2) ? false : true;
    char *s1 = check(string_equal_sign);
    char *s2 = check(string_equal_equal);
    printf("Operator == check = %s\n", s1);
    printf("Operator strcmp     = %s\n", s2);
    return 0;
}
```



```
C:\Eric_Chou\C Course\C Programming Essentials\CDev\Ch9\chrAry1>chrAry1

eOperator == check = false
Operator strcmp    = true
```

LECTURE 3

String Variables

String Variables

- Allocate an array of a size large enough to hold the string (plus 1 extra value for the delimiter)
- Examples (with initialization):
  - char str1[6] = “Hello”;
  - char str2[] = “Hello”;
  - char *str3 = “Hello”;
  - char str4[6] = {‘H’,’e’,’l’,’l’,’o’,’\0’};
- Note, each variable is considered a constant in that the space it is connected to cannot be changed
  - str1 = str2; /* not allowable, but we can copy the contents of str2 to str1 (more later) */

Changing String Variables

- Cannot change space string variables connected to, but can use pointer variables that can be changed
- Example:

```
char *str1 = “hello”;   /* str1 unchangeable */
char *str2 = “goodbye”; /* str2 unchangeable */
char *str3; /* Not tied to space */
str3 = str1; /* str3 points to same space s1 connected to */
str3 = str2;
```

Changing String Variables (cont)

- Can change parts of a string variable

```
char str1[6] = “hello”;
str1[0] = ‘y’;
/* str1 is now “yello” */
str1[4] = ‘\0’;
/* str1 is now “yell” */
```

- Important to retain delimiter (replacing str1[5] in the original string with something other than ‘\0’ makes a string that does not end)
- Have to stay within limits of array

LECTURE 4

String I/O

String Input

- Use %s field specification in **scanf** to read string
  - ignores leading white space
  - reads characters until next white space encountered
  - C stores **null** (\0) char after last non-white space char
  - Reads into array (no & before name, array is a pointer)
- Example:

```
char Name[11];
scanf("%s",Name);
```

- Problem: no limit on number of characters read (need one for delimiter), if too many characters for array, problems may occur

String Input (cont)

Get a Token

- Can use the width value in the field specification to limit the number of characters read:

```
char Name[11];
scanf(“%10s”,Name);
```

- Remember, you need one space for the \0
  - width should be one less than size of array
- Strings shorter than the field specification are read normally, but C always stops after reading 10 characters

String Input (cont)

Get a Line with Regular Expression

- Edit set input %[*ListofChars*]
  - **ListofChars** specifies set of characters (called scan set)
  - Characters read as long as character falls in scan set
  - Stops when first non scan set character encountered
  - Note, does not ignored leading white space
  - Any character may be specified except]
  - Putting **^** at the start to negate the set (any character BUT list is allowed)
- Examples:

```
scanf("%[-+0123456789]",Number);
scanf("%[^\n]",Line); /* read until newline char */
```

String Output

- Use **%s** field specification in printf:
  - characters in string printed until \0 encountered

```
char Name[10] = “Rich”;
printf(“|%s|”,Name); /* outputs |Rich| */
```

- Can use width value to print string in space:

```
printf(“|%10s|”,Name); /* outputs |      Rich| */
```

- Use - flag to left justify:

```
printf(“|%-10s|”,Name); /* outputs |Rich      | */
```

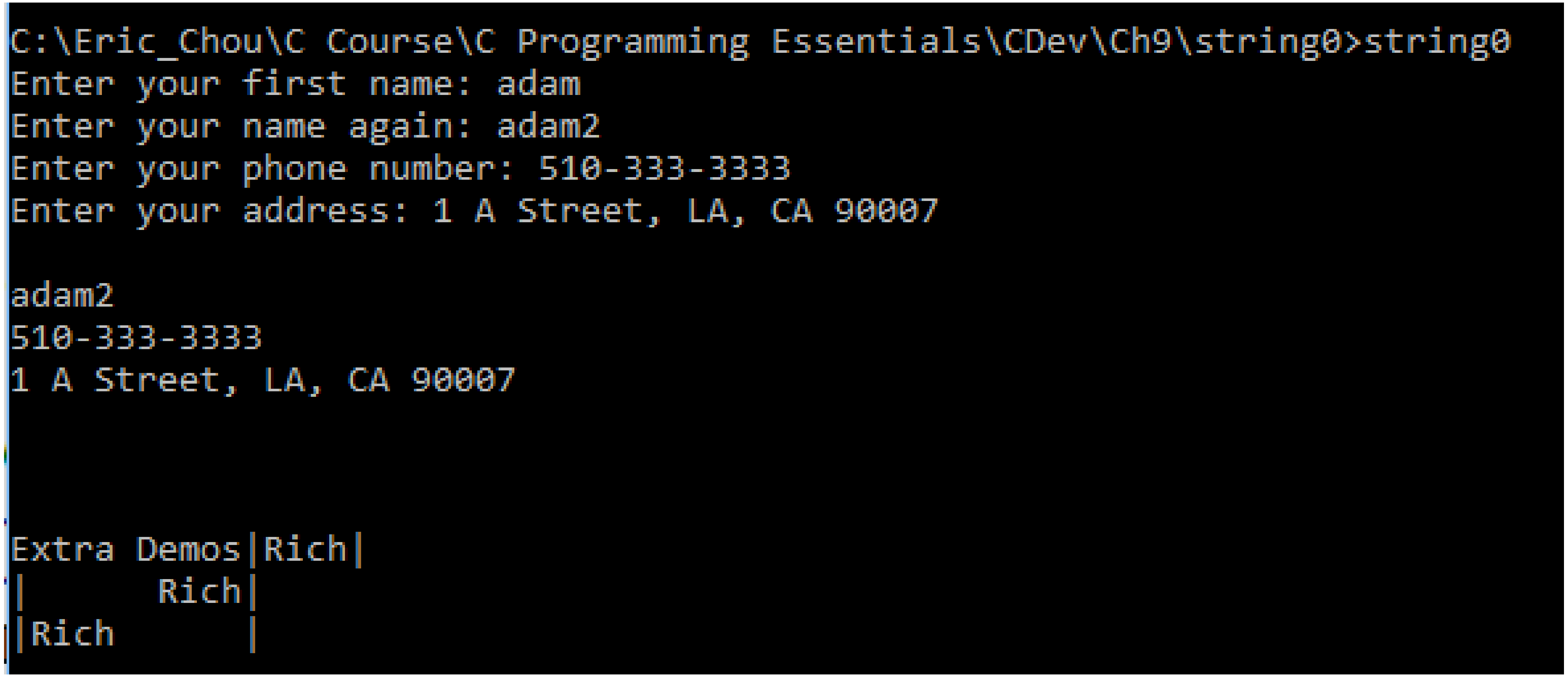
String I/O

Demo Program: string0.c

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

char Name[11];
char Number[13];
char Address[256];

int main(){
    printf("Enter your first name: ");   // unguarded input
    scanf("%s", Name);
    printf("Enter your name again: ");
    scanf("%10s", Name);
    getchar();                           // consume the extra \n char input.nextLine()
    printf("Enter your phone number: ");
    scanf("%[-+0123456789]", Number);  // equal to next() for phone numbers and dash in C
    getchar();                           // consume the extra \n char input.nextLine()
    printf("Enter your address: ");
    scanf("%[^\n]", Address);
    getchar();                           // consume the extra \n char input.nextLine()
    printf("\n%s\n", Name);
    printf("%s\n", Number);
    printf("%s\n", Address);
    printf("\n\n\nExtra Demos");
    char Name1[11] = "Rich";
    printf("|%s|\n",Name1); /* outputs |Rich| */
    printf("|%10s|\n",Name1); /* outputs |      Rich| */
    printf("|%-10s|\n",Name1); /* outputs |Rich      | */
    return 0;
}
```

String I/O

Demo Program: string0.c

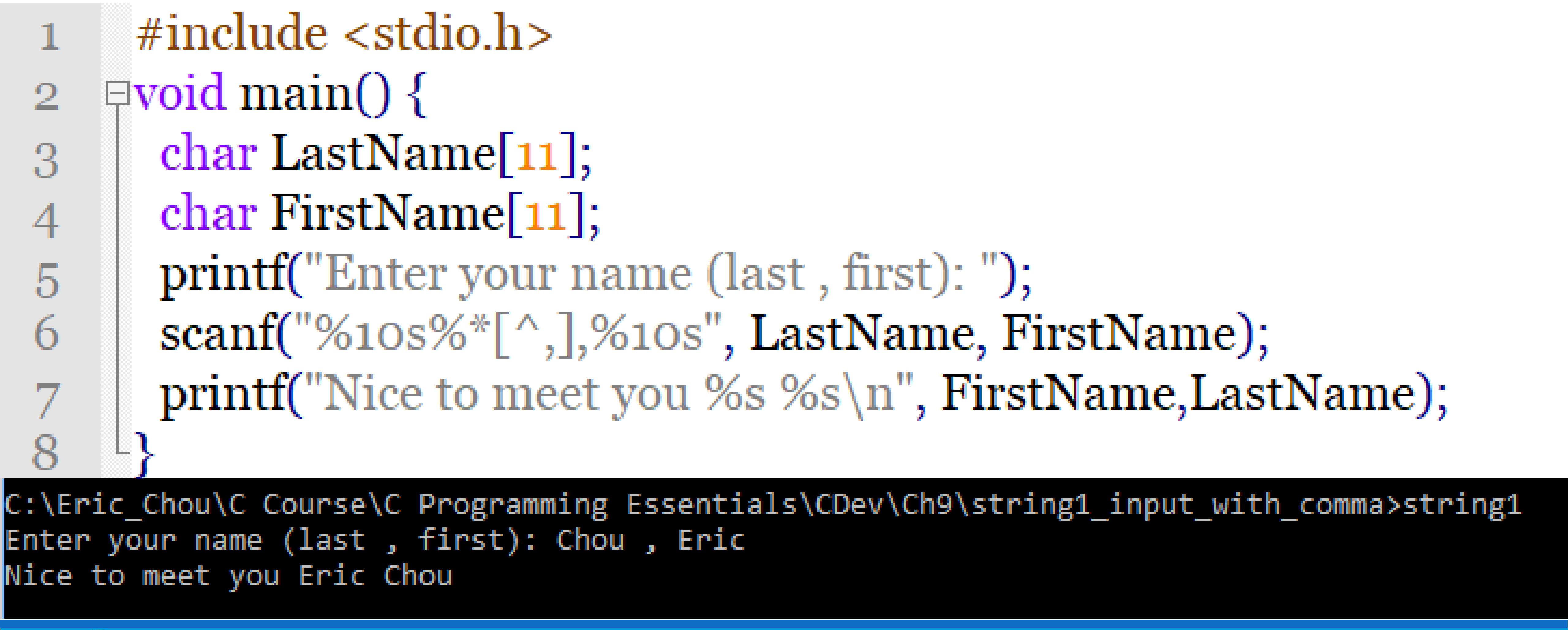


```
C:\Eric_Chou\C Course\C Programming Essentials\CDev\Ch9\string0>string0
Enter your first name: adam
Enter your name again: adam2
Enter your phone number: 510-333-3333
Enter your address: 1 A Street, LA, CA 90007

adam2
510-333-3333
1 A Street, LA, CA 90007




Extra Demos|Rich|
|       Rich|
|Rich       |
```

Input/Output Example

```
#include <stdio.h>
void main() {
  char LastName[11];
  char FirstName[11];
  printf("Enter your name (last , first): ");
  scanf("%10s%*[^,],%10s", LastName, FirstName);
  printf("Nice to meet you %s %s\n", FirstName,LastName);
}
```

string1.c



```c
#include <stdio.h>
void main() {
  char LastName[11];
  char FirstName[11];
  printf("Enter your name (last , first): ");
  scanf("%10s%*[^,],%10s", LastName, FirstName);
  printf("Nice to meet you %s %s\n", FirstName,LastName);
}
```

```
C:\Eric_Chou\C Course\C Programming Essentials\CDev\Ch9\string1_input_with_comma>string1
Enter your name (last , first): Chou , Eric
Nice to meet you Eric Chou
```

Reading a Whole Line

Commands:

char *gets(char *str)

- reads the next line (up to the next newline) from keyboard and stores it in the array of chars pointed to by str
- returns str if string read or NULL if problem/end-of-file
- not limited in how many chars read (may read too many for array)
- newline included in string read

char *fgets(char *str, int size, FILE *fp)

- reads next line from file connected to fp, stores string in str
- fp must be an input connection
- reads at most size characters (plus one for \0)
- returns str if string read or NULL if problem/end-of-file
- to read from keyboard: fgets(mystring,100,stdin)
- newline included in string read

Printing a String

Commands:

int puts(char *str)

- prints the string pointed to by str to the screen
- prints until delimiter reached (string better have a \0)
- returns EOF if the puts fails
- outputs newline if \n encountered (for strings read with gets or fgets)

int fputs(char *str, FILE *fp)

- prints the string pointed to by str to the file connected to fp
- fp must be an output connection
- returns EOF if the fputs fails
- outputs newline if \n encountered

fgets/fputs Example

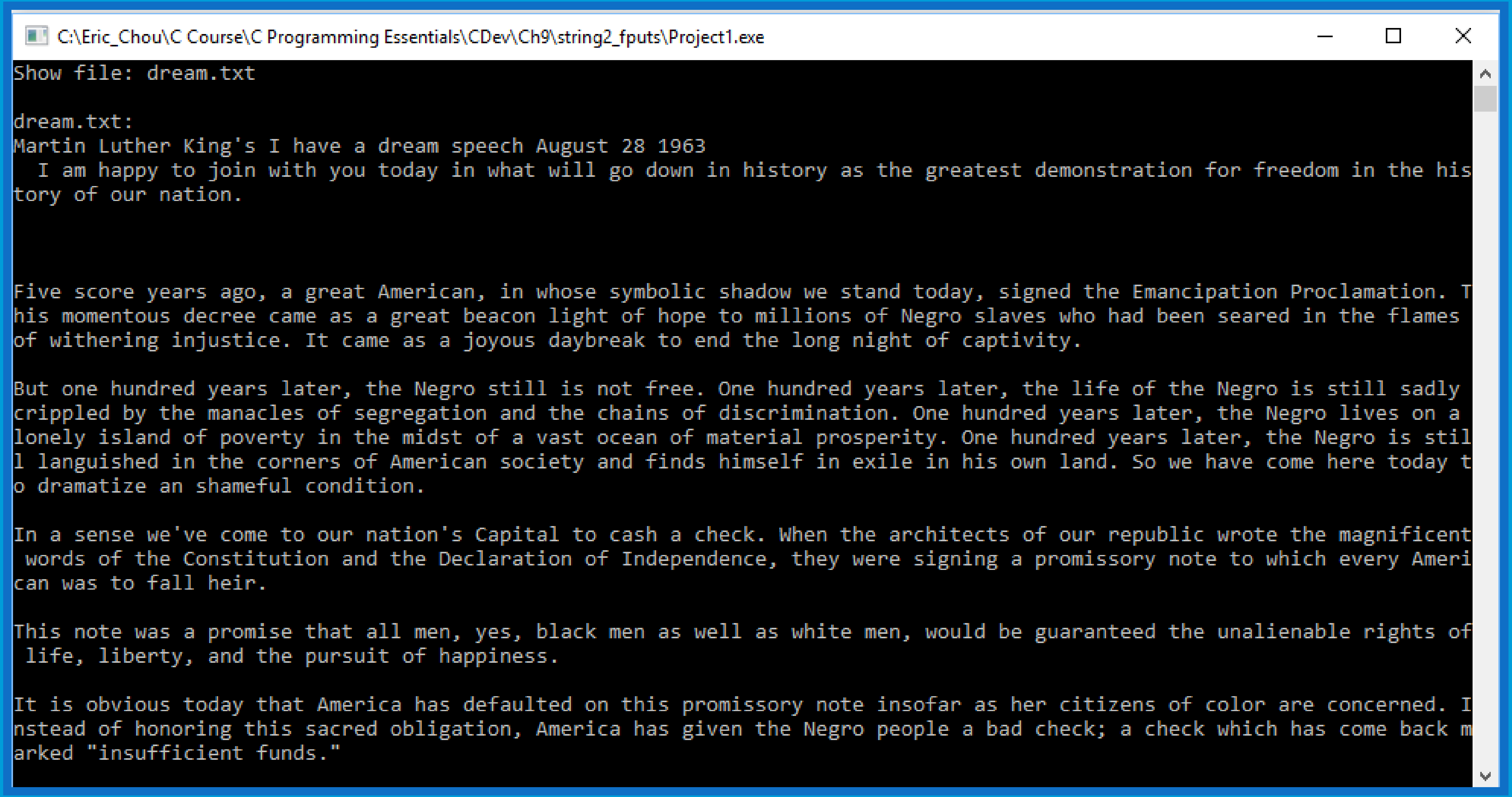
```
#include <stdio.h>
void main() {
  char fname[81];
  char buffer[101];
  FILE *instream;
  printf("Show file: ");
  scanf("%80s", fname);
  if ((instream = fopen(fname,"r")) == NULL) {
    printf("Unable to open file %s\n", fname);
    exit(-1);
  }
```

fgets/fputs Example (cont)

Demo Program: string_puts project

Go gcc!!!

```c
#include <stdio.h>
#include <stdlib.h>
int main(void) {
  char fname[81];
  char buffer[101];
  FILE *instream;
  printf("Show file: ");
  scanf("%80s", fname);  // dream.txt
  if ((instream = fopen(fname,"r")) == NULL) {   // open file
    printf("Unable to open file %s\n", fname);
    exit(-1);
  }
  printf("\n%s:\n",fname);
  while (fgets(buffer,sizeof(buffer)-1, instream)
            != NULL)
    fputs(buffer,stdout);
  fclose(instream);
  return 0;
}
```



C:\Eric_Chou\C Course\C Programming Essentials\CDev\Ch9\string2_fputs\Project1.exe

```
Show file: dream.txt

dream.txt:
Martin Luther King's I have a dream speech August 28 1963
  I am happy to join with you today in what will go down in history as the greatest demonstration for freedom in the his
tory of our nation.



Five score years ago, a great American, in whose symbolic shadow we stand today, signed the Emancipation Proclamation. T
his momentous decree came as a great beacon light of hope to millions of Negro slaves who had been seared in the flames
of withering injustice. It came as a joyous daybreak to end the long night of captivity.

But one hundred years later, the Negro still is not free. One hundred years later, the life of the Negro is still sadly
crippled by the manacles of segregation and the chains of discrimination. One hundred years later, the Negro lives on a
lonely island of poverty in the midst of a vast ocean of material prosperity. One hundred years later, the Negro is stil
l languished in the corners of American society and finds himself in exile in his own land. So we have come here today t
o dramatize an shameful condition.

In a sense we've come to our nation's Capital to cash a check. When the architects of our republic wrote the magnificent
 words of the Constitution and the Declaration of Independence, they were signing a promissory note to which every Ameri
can was to fall heir.

This note was a promise that all men, yes, black men as well as white men, would be guaranteed the unalienable rights of
 life, liberty, and the pursuit of happiness.

It is obvious today that America has defaulted on this promissory note insofar as her citizens of color are concerned. I
nstead of honoring this sacred obligation, America has given the Negro people a bad check; a check which has come back m
arked "insufficient funds."
```

LECTURE 6

Array of Strings

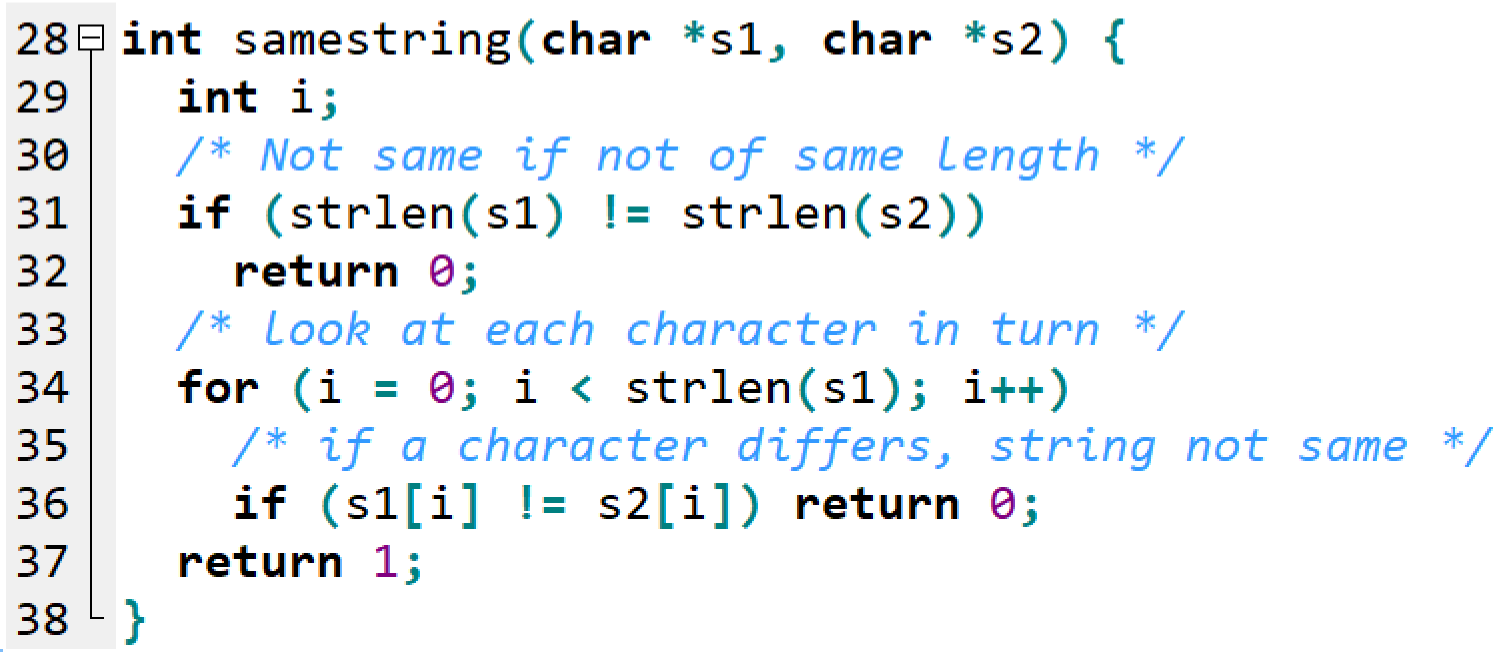
Array of Strings

Demo Program: string_array Project

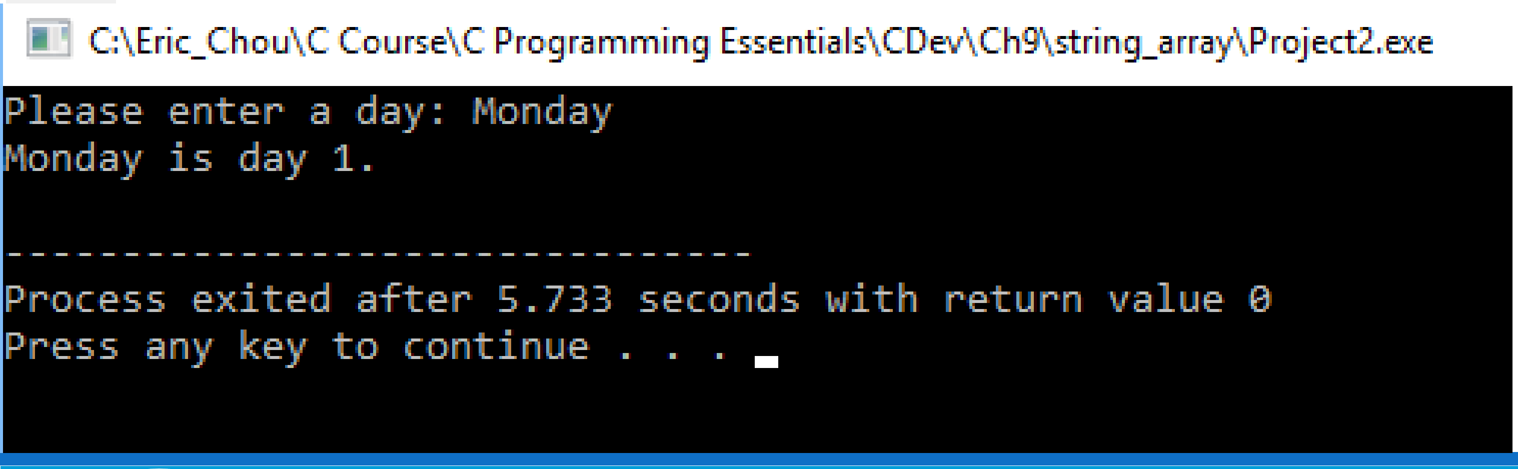
- Sometimes useful to have an array of string values
- Each string could be of different length (producing a ragged string array)
- Example:

```
char *MonthNames[13]; /* an array of 13 strings */
MonthNames[1] = “January”; /* String with 8 chars */
MonthNames[2] = “February”; /* String with 9 chars */
MonthNames[3] = “March”; /* String with 6 chars */
etc.
```

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

int main() {
  char *days[7];
  char TheDay[10];
  int day;
  days[0] = "Sunday";
  days[1] = "Monday";
  days[2] = "Tuesday";
  days[3] = "Wednesday";
  days[4] = "Thursday";
  days[5] = "Friday";
  days[6] = "Saturday";
  printf("Please enter a day: ");
  scanf("%9s",TheDay);
  day = 0;
  while ((day < 7) && (!samestring(TheDay,days[day])))
    day++;
  if (day < 7)
    printf("%s is day %d.\n",TheDay,day);
  else
    printf("No day %s!\n",TheDay);
  return 0;
}
```



```c
int samestring(char *s1, char *s2) {
  int i;
  /* Not same if not of same length */
  if (strlen(s1) != strlen(s2))
    return 0;
  /* look at each character in turn */
  for (i = 0; i < strlen(s1); i++)
    /* if a character differs, string not same */
    if (s1[i] != s2[i]) return 0;
  return 1;
}
```



C:\Eric_Chou\C Course\C Programming Essentials\CDev\Ch9\string_array\Project2.exe

```
Please enter a day: Monday
Monday is day 1.

--------------------------------
Process exited after 5.733 seconds with return value 0
Press any key to continue . . .
```

LECTURE 6

String Functions I

String Functions

- C provides a wide range of string functions for performing different string tasks
- Examples

  strlen(str) - calculate string length

  strcpy(dst,src) - copy string at src to dst

  strcmp(str1,str2) - compare str1 to str2
- Functions come from the utility library string.h
  - #include <string.h> to use

String Length

- Syntax: int strlen(char *str)
  - returns the length (integer) of the string argument
  - counts the number of characters until an \0 encountered
  - does not count \0 char
- Example:

  char str1 = “hello”;

  strlen(str1) would return 5

Copying a String

Syntax:

char *strcpy(char *dst, char *src)

- copies the characters (including the \0) from the source string (src) to the destination string (dst)
- dst should have enough space to receive entire string (if not, other data may get written over)
- if the two strings overlap (e.g., copying a string onto itself) the results are unpredictable
- return value is the destination string (dst)

char *strncpy(char *dst, char *src, int n)

similar to strcpy, but the copy stops after n characters

if n non-null (not \0) characters are copied, then no \0 is copied

String Comparison

Syntax:

```
int strcmp(char *str1, char *str2)
```

- compares str1 to str2, returns a value based on the first character they differ at:
  - *less than 0*
  - if ASCII value of the character they differ at is smaller for str1
  - or if str1 starts the same as str2 (and str2 is longer)
  - *greater than 0*
  - if ASCII value of the character they differ at is larger for str1
  - or if str2 starts the same as str1 (and str1 is longer)
  - 0 if the two strings do not differ

String Comparison (cont)

- strcmp examples:

  strcmp(“hello”,”hello”) -- returns 0

  strcmp(“yello”,”hello”) -- returns value > 0

  strcmp(“Hello”,”hello”) -- returns value < 0

  strcmp(“hello”,”hello there”) -- returns value < 0

  strcmp(“some diff”,”some dift”) -- returns value < 0

- expression for determining if two strings s1,s2 hold the same string value:

  !strcmp(s1,s2)

String Comparison (cont)

- Sometimes we only want to compare first n chars:

  int strncmp(char *s1, char *s2, int n)

- Works the same as strcmp except that it stops at the nth character
  - looks at less than n characters if either string is shorter than n

  strcmp(“some diff”,”some DIFF”) -- returns value > 0

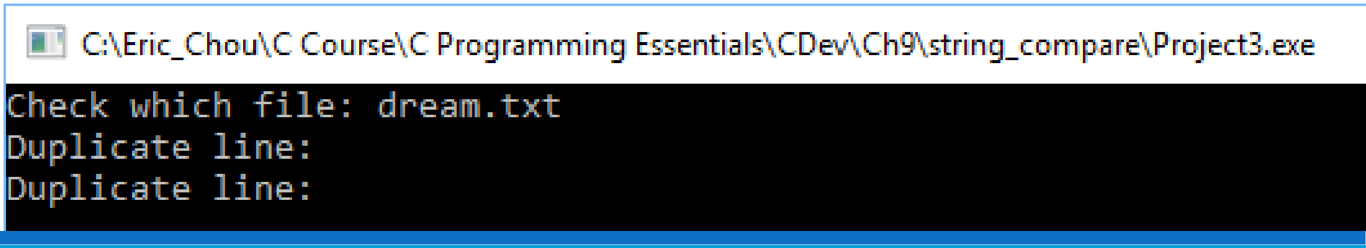
  strncmp(“some diff”,”some DIFF”,4) -- returns 0

strcpy/strcmp Example

Demo Program: string_compare package

Go gcc!!!

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
void main() {
  char fname[81];
  char prevline[101] = "";
  char buffer[101];
  FILE *instream;
  printf("Check which file: ");
  scanf("%80s",fname);
  if ((instream = fopen(fname,"r")) == NULL) {
    printf("Unable to open file %s\n",fname);
    exit(-1);
  }
    /* read a line of characters */
  while (fgets(buffer,sizeof(buffer)-1,instream) != NULL) {
    /* if current line same as previous */
    if (!strcmp(buffer,prevline))
      printf("Duplicate line: %s",buffer);
    /* otherwise if the first 10 characters of the current
       and previous line are the same */
    else if (!strncmp(buffer,prevline,10))
      printf("Start the same:\n  %s  %s",prevline,buffer);
    /* Copy the current line (in buffer) to the previous
       line (in prevline) */
    strcpy(prevline,buffer);
  }
  fclose(instream);
}
```


C:\Eric_Chou\C Course\C Programming Essentials\CDev\Ch9\string_compare\Project3.exe

```
Check which file: dream.txt
Duplicate line:
Duplicate line:
```

String Comparison (ignoring case)

Syntax:

int strcasecmp(char *str1, char *str2)

- similar to strcmp except that upper and lower case characters (e.g., ‘a’ and ‘A’) are considered to be equal

int strncasecmp(char *str1, char *str2, int n)

- version of strncmp that ignores case

LECTURE 7

String Function II

String Concatenation

Syntax:

char *strcat(char *dstS, char *addS)

- appends the string at addS to the string dstS (after dstS's delimiter)
- returns the string dstS
- can cause problems if the resulting string is too long to fit in dstS

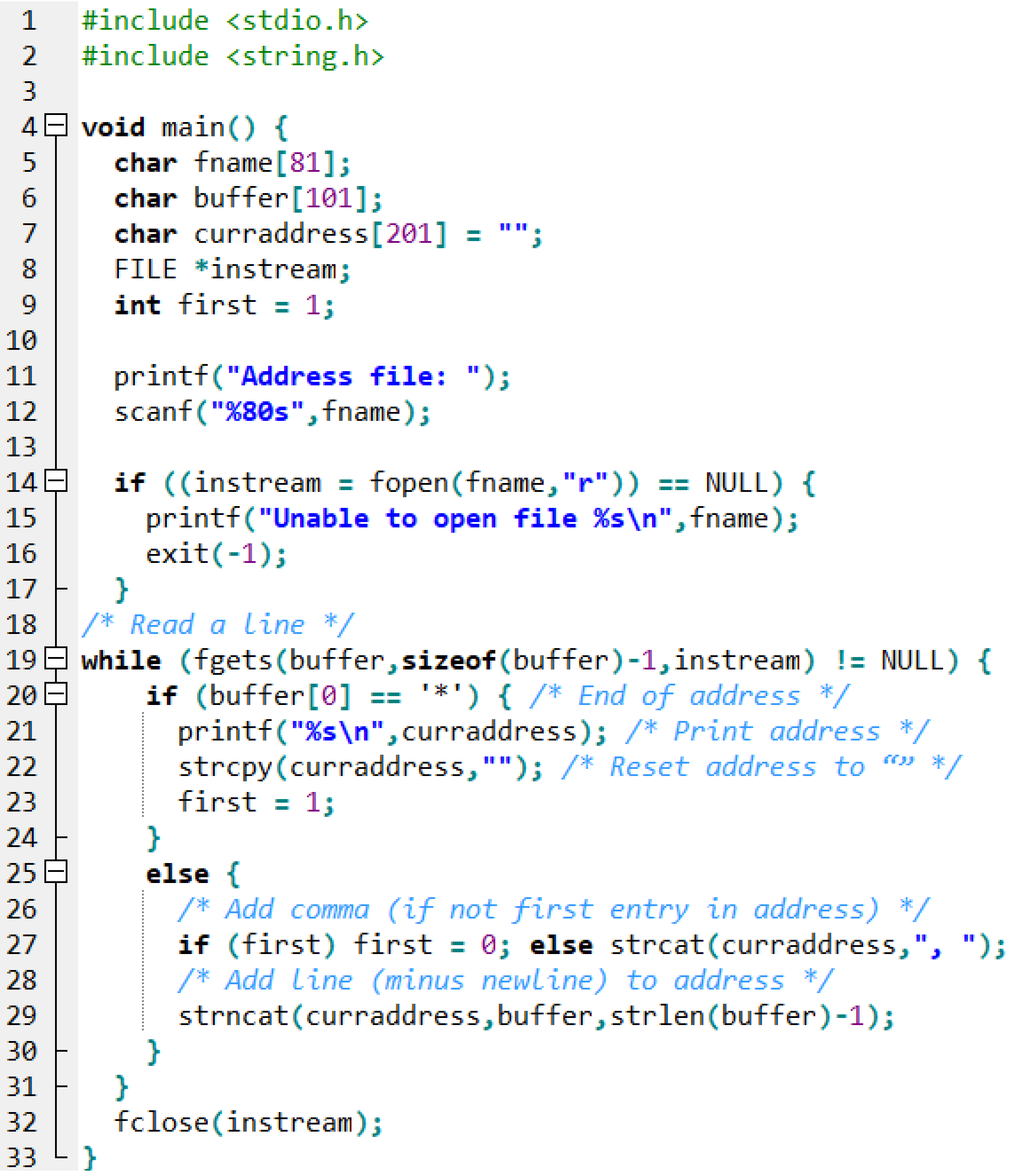
char *strncat(char *dstS, char *addS, int n)

- appends the first n characters of addS to dstS
- if less than n characters in addS only the characters in addS appended
- always appends a \0 character

strcat Example

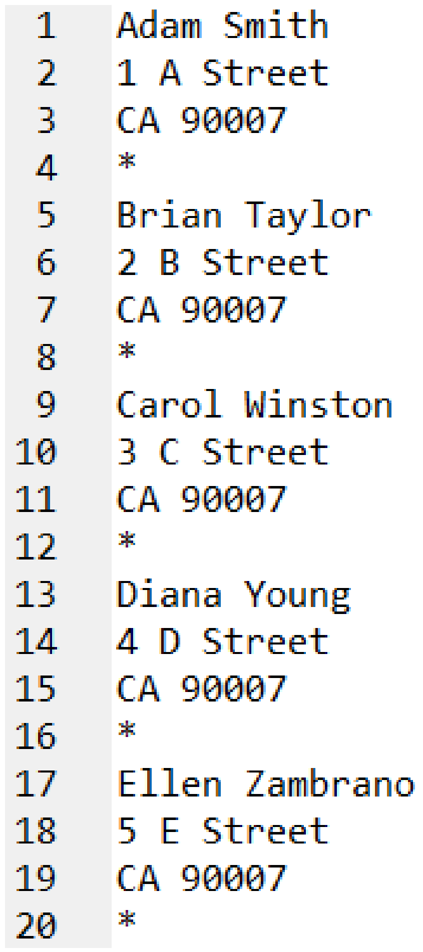
Demo Program: string_concatenation Package

Go gcc!!!

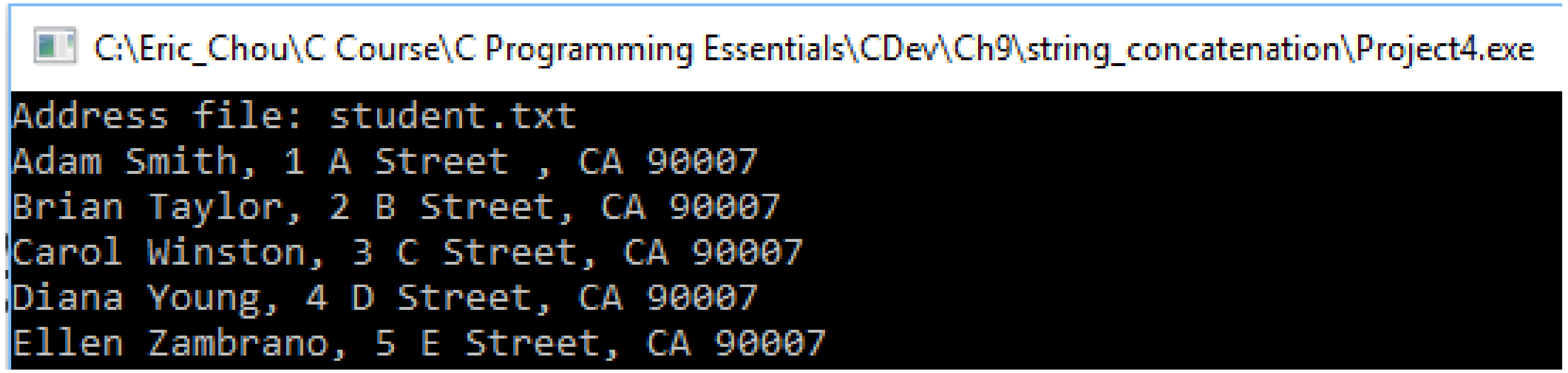


```c
#include <stdio.h>
#include <string.h>

void main() {
  char fname[81];
  char buffer[101];
  char curraddress[201] = "";
  FILE *instream;
  int first = 1;

  printf("Address file: ");
  scanf("%80s",fname);

  if ((instream = fopen(fname,"r")) == NULL) {
    printf("Unable to open file %s\n",fname);
    exit(-1);
  }
/* Read a line */
while (fgets(buffer,sizeof(buffer)-1,instream) != NULL) {
    if (buffer[0] == '*') { /* End of address */
      printf("%s\n",curraddress); /* Print address */
      strcpy(curraddress,""); /* Reset address to “” */
      first = 1;
    }
    else {
      /* Add comma (if not first entry in address) */
      if (first) first = 0; else strcat(curraddress,", ");
      /* Add line (minus newline) to address */
      strncat(curraddress,buffer,strlen(buffer)-1);
    }
  }
  fclose(instream);
}
```

Concatenation of Addresses



```
Adam Smith
1 A Street
CA 90007
*
Brian Taylor
2 B Street
CA 90007
*
Carol Winston
3 C Street
CA 90007
*
Diana Young
4 D Street
CA 90007
*
Ellen Zambrano
5 E Street
CA 90007
*
```



C:\Eric_Chou\C Course\C Programming Essentials\CDev\Ch9\string_concatenation\Project4.exe

```
Address file: student.txt
Adam Smith, 1 A Street , CA 90007
Brian Taylor, 2 B Street, CA 90007
Carol Winston, 3 C Street, CA 90007
Diana Young, 4 D Street, CA 90007
Ellen Zambrano, 5 E Street, CA 90007
```

Searching for a Character/String

Demo Program: string_search package

Syntax:

char *strchr(char *str, int ch)

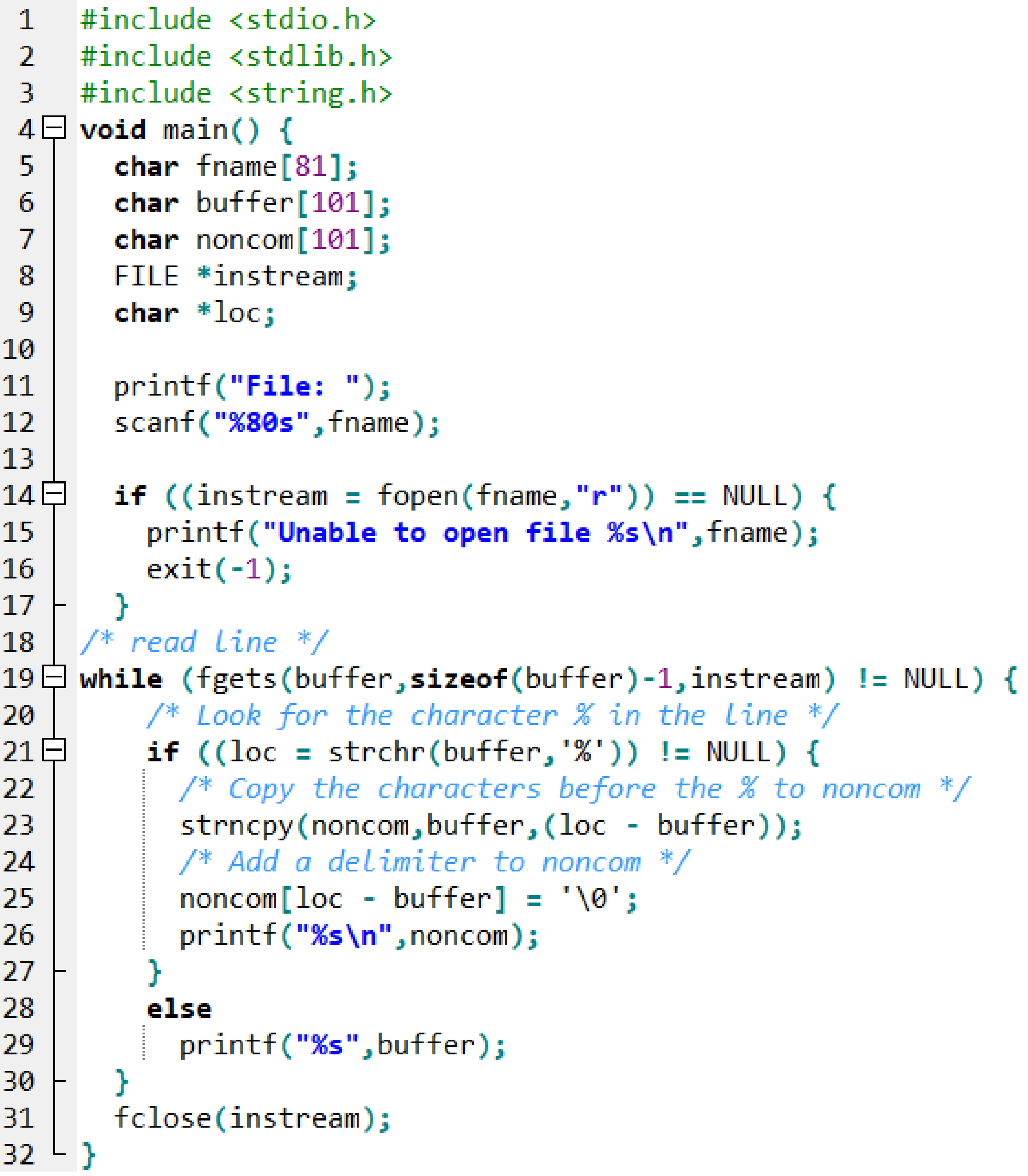
- returns a pointer (a char *) to the first occurrence of ch in str
- returns NULL if ch does not occur in str
- can subtract original pointer from result pointer to determine which character in array

char *strstr(char *str, char *searchstr)

- similar to strchr, but looks for the first occurrence of the string searchstr in str

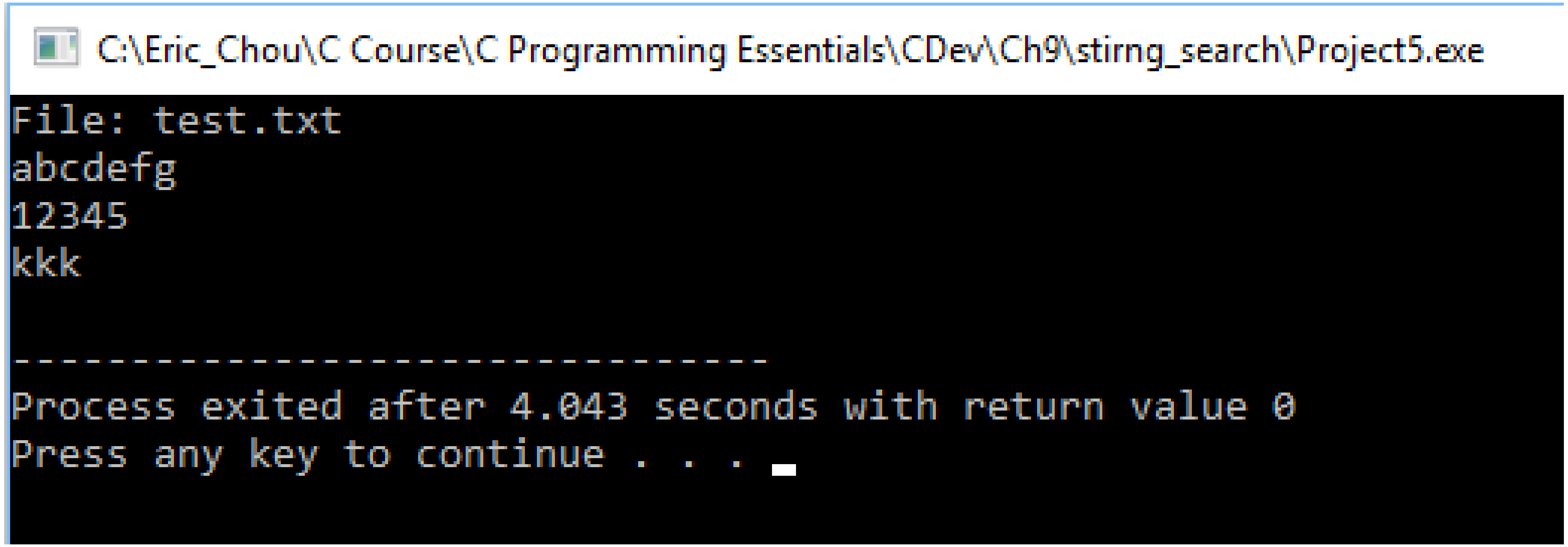
char *strrchr(char *str, int ch)

- similar to strchr except that the search starts from the end of string str and works backward



```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
void main() {
  char fname[81];
  char buffer[101];
  char noncom[101];
  FILE *instream;
  char *loc;

  printf("File: ");
  scanf("%80s",fname);

  if ((instream = fopen(fname,"r")) == NULL) {
    printf("Unable to open file %s\n",fname);
    exit(-1);
  }
/* read line */
while (fgets(buffer,sizeof(buffer)-1,instream) != NULL) {
    /* Look for the character % in the line */
    if ((loc = strchr(buffer,'%')) != NULL) {
      /* Copy the characters before the % to noncom */
      strncpy(noncom,buffer,(loc - buffer));
      /* Add a delimiter to noncom */
      noncom[loc - buffer] = '\0';
      printf("%s\n",noncom);
    }
    else
      printf("%s",buffer);
  }
  fclose(instream);
}
```

Search for % and Truncation


C:\Eric_Chou\C Course\C Programming Essentials\CDev\Ch9\stirng_search\Project5.exe

```
File: test.txt
abcdefg
12345
kkk


--------------------------------
Process exited after 4.043 seconds with return value 0
Press any key to continue . . .
```

String Spans (Searching)

Syntax:

int strspn(char *str, char *cset)

- specify a set of characters as a string cset
- strspn searches for the first character in str that is not part of cset
- returns the number of characters in set found before first non-set character found

int strcspn(char *str, char *cset)

- similar to strspn except that it stops when a character that is part of the set is found

- Examples:

strspn(“a vowel”,”bvcwl”) returns 2

strcspn(“a vowel”,”@,*e”) returns 5

LECTURE 8

String Functions III

Parsing Strings (split() in Java)

- The **strtok** routine can be used to break a string of characters into a set of tokens
  - we specify the characters (e.g., whitespace) that separate tokens
  - **strtok** returns a pointer to the first string corresponding to a token, the next call returns the next pointer, etc.
  - example:
    - call strtok repeatedly on “A short string\n” with whitespace (space, \t, \n) as delimiters, should return
      - first call: pointer to string consisting of “A”
      - second call: pointer to string consisting of “short”
      - third call: pointer to string consisting of “string”
      - fourth call: NULL pointer

Parsing Strings

Syntax:

```
char *strtok(char *str, char *delimiters)
```

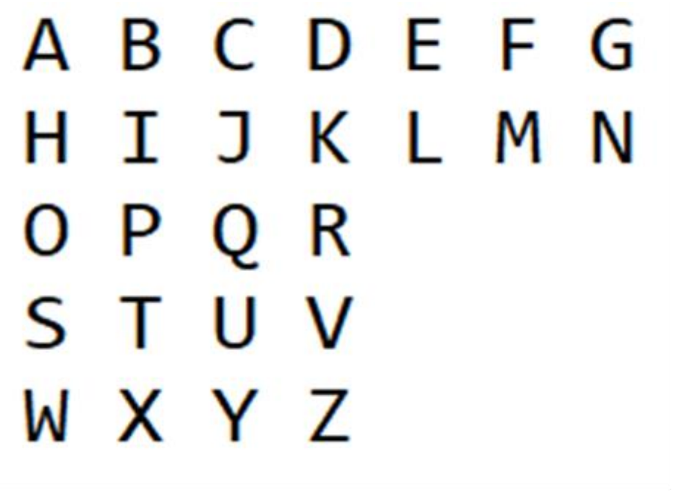
- delimiters is a string consisting of the delimiter characters (are ignored, end tokens)
- if we call strtok with a string argument as the first argument it finds the first string separated by the delimiters in str
- if we call strtok with NULL as the first argument it finds the next string separated by the delimiters in the string it is currently processing
- strtok makes alterations to the string str (best to make a copy of it first if you want a clean copy)

strtok Example

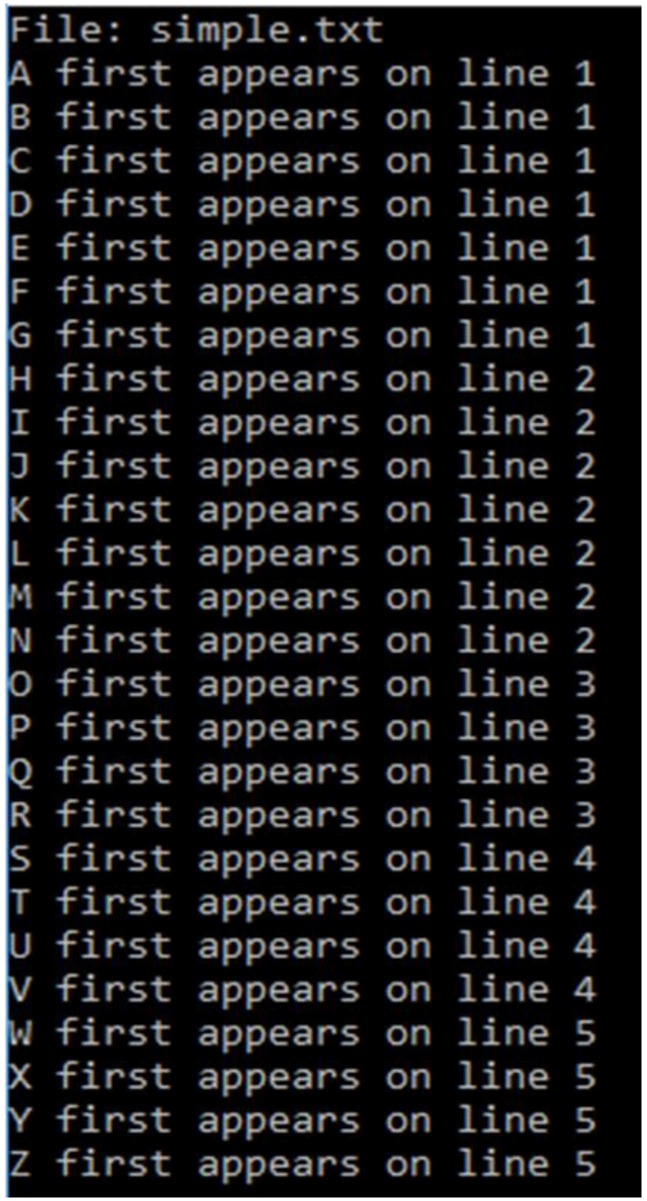
Demo Program: string_parsing package

Go gcc!!!

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

void main() {
  FILE *instream;
  char fname[81];
  char buffer[101];   /* current line */
  char *token;        /* pointer to current token */
  char *tokens[100];  /* array of unique tokens in file */
  int tokenline[100]; /* line number where token found */
  int ntokens = 0;    /* number of tokens found so far */
  int linenum = 0;    /* current line number */
  int tnum;

  printf("File: ");
  scanf("%80s",fname);

  if ((instream = fopen(fname,"r")) == NULL) {
    printf("Unable to open file %s\n",fname);
    exit(-1);
  }

  while (fgets(buffer,sizeof(buffer)-1,instream) != NULL) {
    linenum++;
    /* Get first token from string buffer */
    token = strtok(buffer," \t\n");
    while (token != NULL) {
      tnum = 0;
      /* Search for current token in tokens */
      while ((tnum < ntokens) && (strcmp(token,tokens[tnum])))
        tnum++;
      /* If the token isn't found, add it to the tokens */
      if (tnum == ntokens) {
        tokens[tnum] =
          (char *) calloc(strlen(token) + 1,sizeof(char));
        strcpy(tokens[tnum],token);
        tokenline[tnum] = linenum;
        ntokens++;
      }
      /* Get next token from string buffer */
      token = strtok(NULL," \t\n");
    }
  }

/* print out the set of tokens appearing in the file */
  for (tnum = 0; tnum < ntokens; tnum++)
    printf("%s first appears on line %d\n",
        tokens[tnum],tokenline[tnum]);

  fclose(instream);
}
```



```
A B C D E F G
H I J K L M N
O P Q R
S T U V
W X Y Z
```



```
File: simple.txt
A first appears on line 1
B first appears on line 1
C first appears on line 1
D first appears on line 1
E first appears on line 1
F first appears on line 1
G first appears on line 1
H first appears on line 2
I first appears on line 2
J first appears on line 2
K first appears on line 2
L first appears on line 2
M first appears on line 2
N first appears on line 2
O first appears on line 3
P first appears on line 3
Q first appears on line 3
R first appears on line 3
S first appears on line 4
T first appears on line 4
U first appears on line 4
V first appears on line 4
W first appears on line 5
X first appears on line 5
Y first appears on line 5
Z first appears on line 5
```

Printing to a String

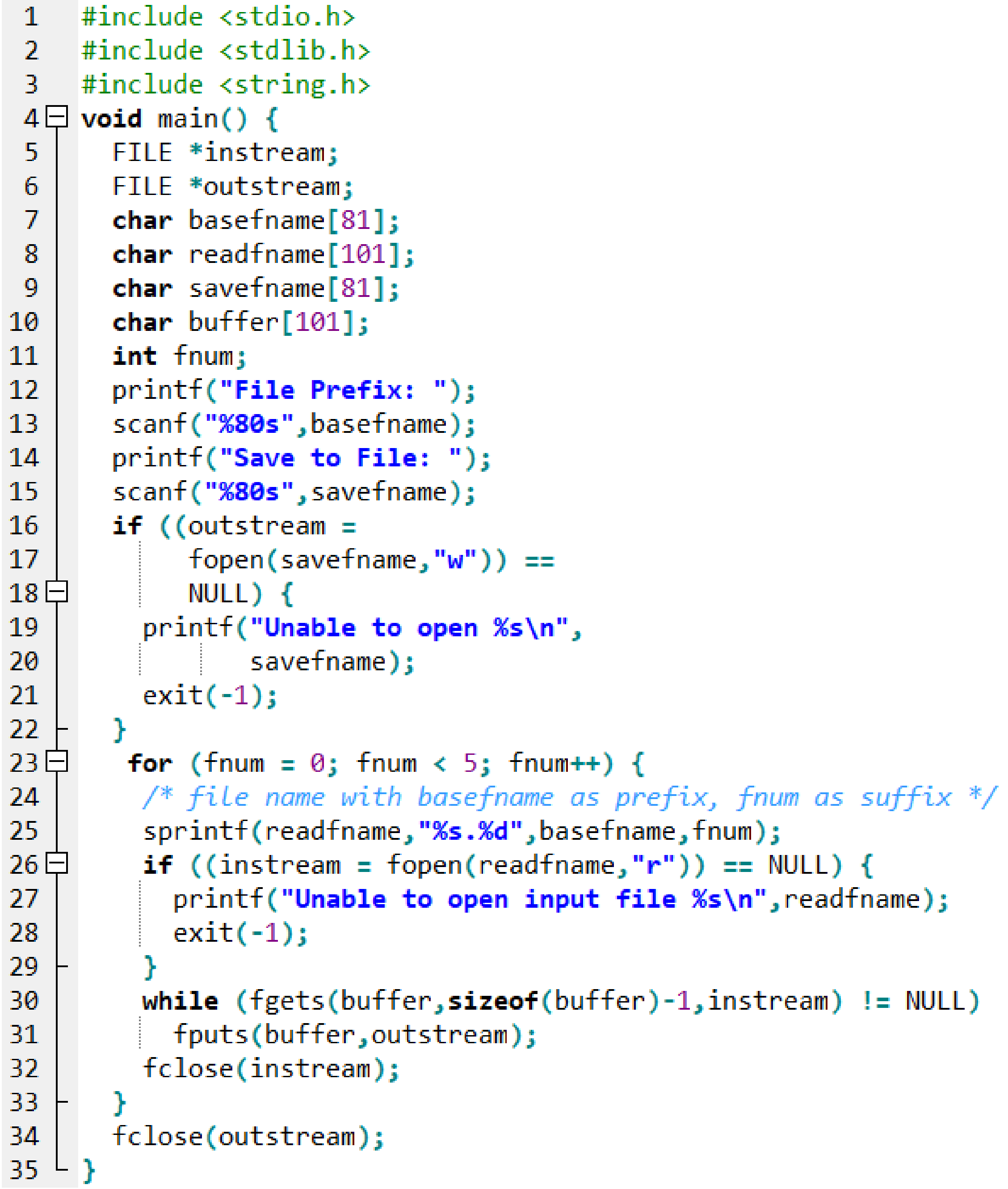
- The sprintf function allows us to print to a string argument using printf formatting rules
- First argument of sprintf is string to print to, remaining arguments are as in printf
- Example:

```
char buffer[100];
sprintf(buffer,”%s, %s”,LastName,FirstName);
if (strlen(buffer) > 15)
  printf(“Long name %s %s\n”,FirstName,LastName);
```

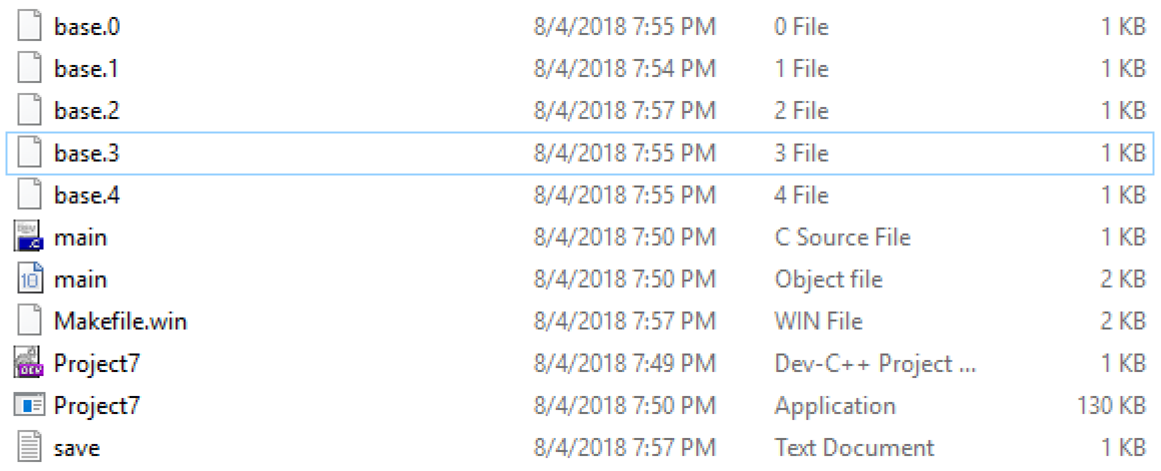
sprintf Example

Demo Program: string_format package

Go gcc!!!



```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
void main() {
  FILE *instream;
  FILE *outstream;
  char basefname[81];
  char readfname[101];
  char savefname[81];
  char buffer[101];
  int fnum;
  printf("File Prefix: ");
  scanf("%80s",basefname);
  printf("Save to File: ");
  scanf("%80s",savefname);
  if ((outstream =
       fopen(savefname,"w")) ==
       NULL) {
    printf("Unable to open %s\n",
           savefname);
    exit(-1);
  }
   for (fnum = 0; fnum < 5; fnum++) {
    /* file name with basefname as prefix, fnum as suffix */
    sprintf(readfname,"%s.%d",basefname,fnum);
    if ((instream = fopen(readfname,"r")) == NULL) {
      printf("Unable to open input file %s\n",readfname);
      exit(-1);
    }
    while (fgets(buffer,sizeof(buffer)-1,instream) != NULL)
      fputs(buffer,outstream);
    fclose(instream);
  }
  fclose(outstream);
}
```



base.0	8/4/2018 7:55 PM	0 File	1 KB
base.1	8/4/2018 7:54 PM	1 File	1 KB
base.2	8/4/2018 7:57 PM	2 File	1 KB
base.3	8/4/2018 7:55 PM	3 File	1 KB
base.4	8/4/2018 7:55 PM	4 File	1 KB
main	8/4/2018 7:50 PM	C Source File	1 KB
main	8/4/2018 7:50 PM	Object file	2 KB
Makefile.win	8/4/2018 7:57 PM	WIN File	2 KB
Project7	8/4/2018 7:49 PM	Dev-C++ Project ...	1 KB
Project7	8/4/2018 7:50 PM	Application	130 KB
save	8/4/2018 7:57 PM	Text Document	1 KB

Reading from a String

- The sscanf function allows us to read from a string argument using scanf rules
- First argument of sscanf is string to read from, remaining arguments are as in scanf
- Example:

```
char buffer[100] = “A10 50.0”;
sscanf(buffer,”%c%d%f”,&ch,&inum,&fnum);
/* puts ‘A’ in ch, 10 in inum and 50.0 in fnum */
```