File I/O - Binary

Last updated 2/17/20

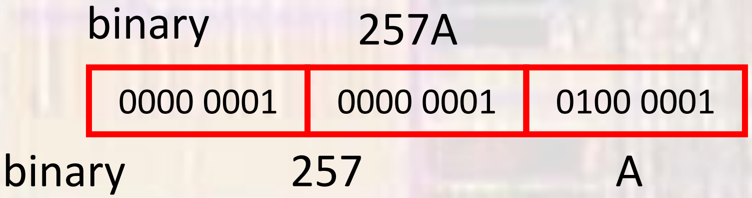
File I/O - Binary

- These slides introduce reading and writing to a binary file
- Upon completion: You should be able to read and write to binary files

File I/O

- File Formats
  - Files can contain information in 2 different formats

  - Binary
    - Raw bytes
    - File terminated by “end of file” EOF



binary 257A

0000 0001	0000 0001	0100 0001

binary 257 A

This assumes 257 was a 16b integer
a full sized int would require 4 bytes 0x00000101

File I/O - Binary

- Stream
  - Need to create a “stream” to transfer the data to/from the file from/to our program
  - Identify the stream by name
  - Use a pointer

```
FILE* pointer_name;

FILE* StudentData_ptr;
```

File I/O - Binary

- Stream Pointer
  - Need to identify the file we are creating the stream to/from
  - “open” the file
  - assign the pointer to the opened file

```
file_pointer = fopen(“filename”, “mode”);

Student_Data_ptr = fopen(“ee1910.bin”, “rb”);

Student_Data_ptr =
        fopen(“C:\\users\\tim\\winter\\ee1910.bin”, “rb”);
```

the file extension .bin is commonly used

File I/O - Binary

- Open file – modes

rb read binary only, start at beginning
if does not exist → error

wb write binary only, start at beginning
(erase all contents)
if does not exist → creates it

ab append binary only, start at end of current data
if does not exist → creates it

Returns address(pointer) of file or NULL if an error occurs

NULL is defined in the stdio library

File I/O - Binary

- Open file – modes

r+b read binary (can write), start at beginning
if does not exist → error

w+b write binary (can read), start at beginning
(erase all contents)
if does not exist → creates it

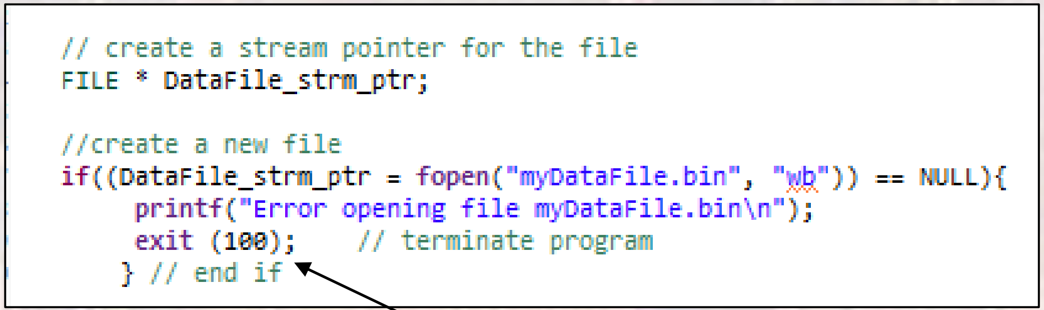
a+b append binary (can read), start at end of current data
if does not exist → creates it

Returns address(pointer) of file or NULL if an error occurs

NULL is defined in the stdio library

File I/O - Binary

- Error checking
  - If the fopen() returns a NULL – we have an error



```
// create a stream pointer for the file
FILE * DataFile_strm_ptr;

//create a new file
if((DataFile_strm_ptr = fopen("myDataFile.bin", "wb")) == NULL){
     printf("Error opening file myDataFile.bin\n");
     exit (100);    // terminate program
    } // end if
```

exit – exits the program
requires <stdlib.h>

File I/O - Binary

- Close a file

```
fclose(file_pointer);

fclose(Student_Data_ptr );
```

File I/O - Binary

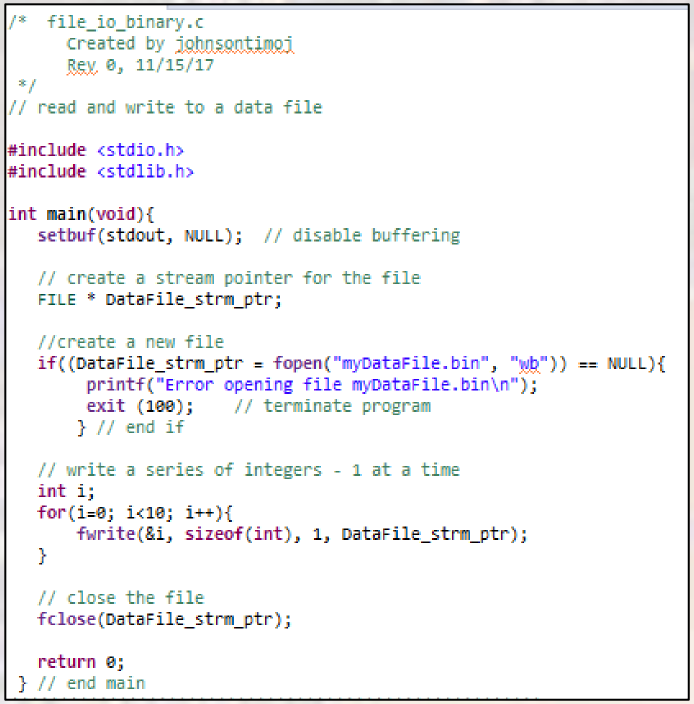
- Formatting stream data - write
  - Block format – no conversions, raw bytes

```
int fwrite(  void*    out_location_ptr,
             int      element_size,
             int      count,
             FILE*    stream_ptr);
```

returns the # of items written

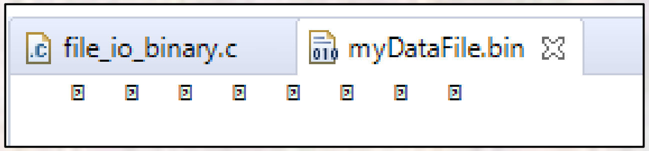
File I/O - Binary

- Write a series of integers to a file

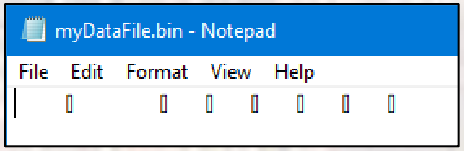


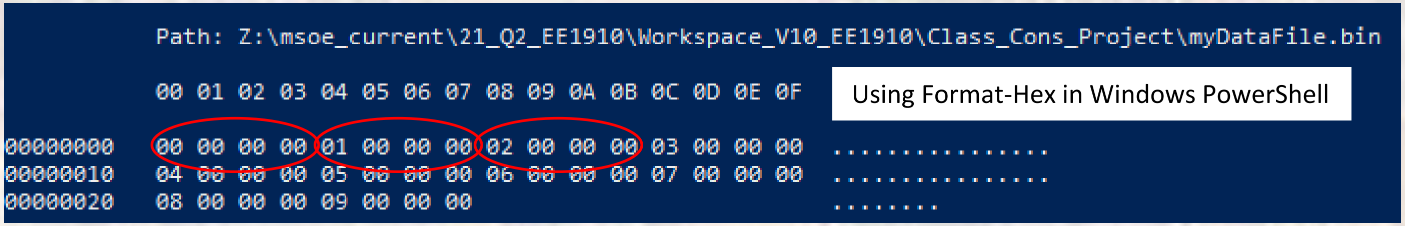
```
/*  file_io_binary.c
      Created by johnsontimoj
      Rev 0, 11/15/17
 */
// read and write to a data file

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

int main(void){
   setbuf(stdout, NULL);  // disable buffering

   // create a stream pointer for the file
   FILE * DataFile_strm_ptr;

   //create a new file
   if((DataFile_strm_ptr = fopen("myDataFile.bin", "wb")) == NULL){
        printf("Error opening file myDataFile.bin\n");
        exit (100);     // terminate program
       } // end if

   // write a series of integers - 1 at a time
   int i;
   for(i=0; i<10; i++){
       fwrite(&i, sizeof(int), 1, DataFile_strm_ptr);
   }

   // close the file
   fclose(DataFile_strm_ptr);

   return 0;
 } // end main
```

View file in CodeComposer



View file in Notepad in Windows





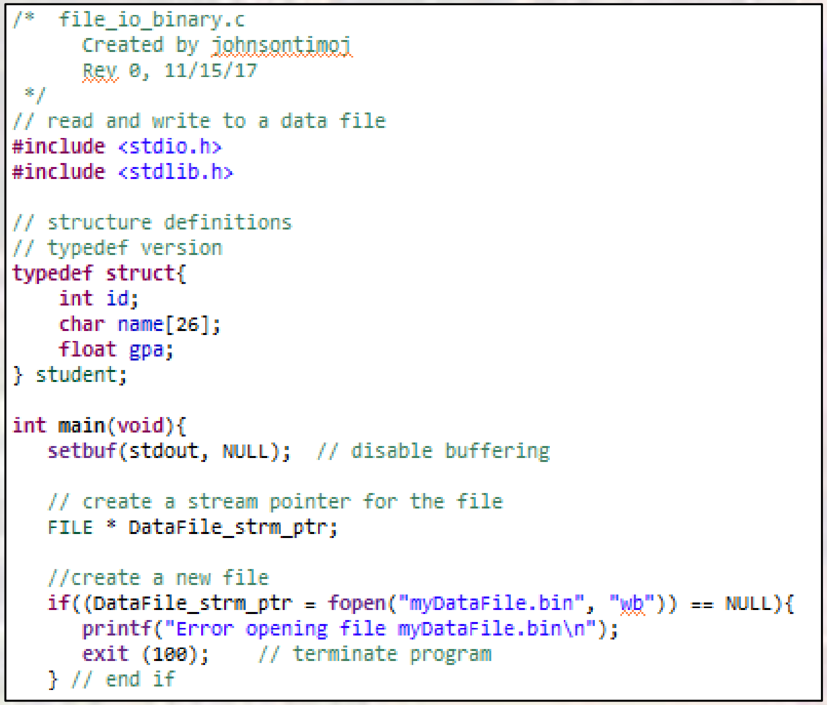
```
           Path: Z:\msoe_current\21_Q2_EE1910\Workspace_V10_EE1910\Class_Cons_Project\myDataFile.bin

           00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

00000000   00 00 00 00 01 00 00 00 02 00 00 00 03 00 00 00  ................
00000010   04 00 00 00 05 00 00 00 06 00 00 00 07 00 00 00  ................
00000020   08 00 00 00 09 00 00 00                          ........
```

Using Format-Hex in Windows PowerShell

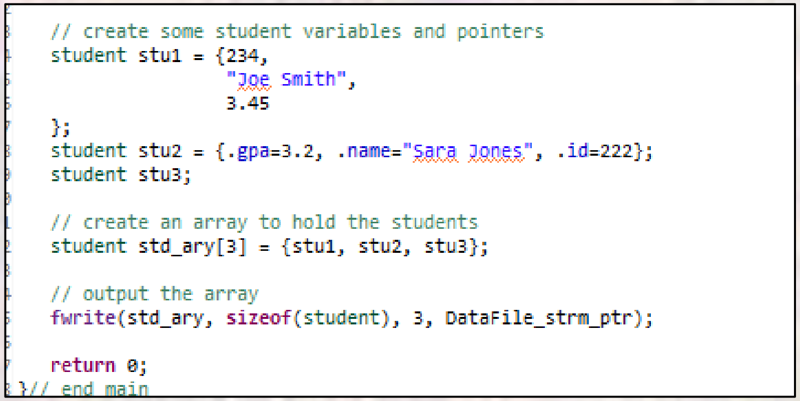
Note: Little Endian

File I/O - Binary

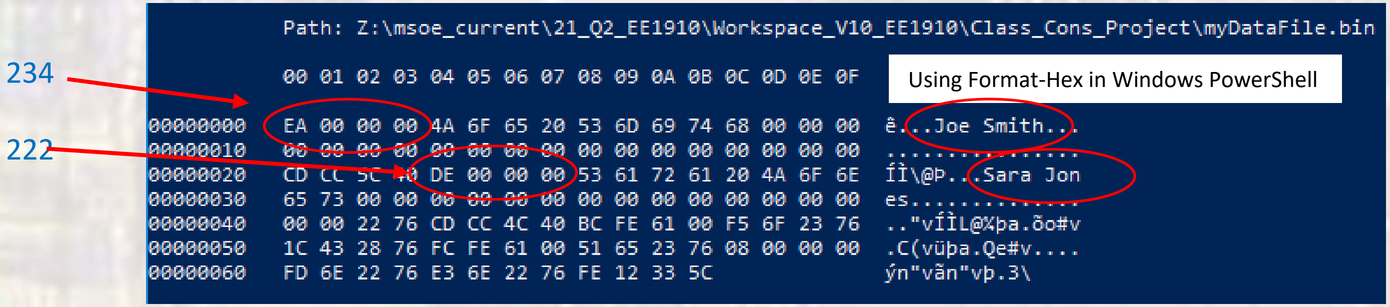
- Write a series of structures to a file



```
/*  file_io_binary.c
      Created by johnsontimoj
      Rev 0, 11/15/17
 */
// read and write to a data file
#include <stdio.h>
#include <stdlib.h>

// structure definitions
// typedef version
typedef struct{
    int id;
    char name[26];
    float gpa;
} student;

int main(void){
   setbuf(stdout, NULL);  // disable buffering

   // create a stream pointer for the file
   FILE * DataFile_strm_ptr;

   //create a new file
   if((DataFile_strm_ptr = fopen("myDataFile.bin", "wb")) == NULL){
      printf("Error opening file myDataFile.bin\n");
      exit (100);     // terminate program
   } // end if
```



```
   // create some student variables and pointers
   student stu1 = {234,
                   "Joe Smith",
                   3.45
   };
   student stu2 = {.gpa=3.2, .name="Sara Jones", .id=222};
   student stu3;

   // create an array to hold the students
   student std_ary[3] = {stu1, stu2, stu3};

   // output the array
   fwrite(std_ary, sizeof(student), 3, DataFile_strm_ptr);

   return 0;
}// end main
```



Using Format-Hex in Windows PowerShell

```
           Path: Z:\msoe_current\21_Q2_EE1910\Workspace_V10_EE1910\Class_Cons_Project\myDataFile.bin

           00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

00000000   EA 00 00 00 4A 6F 65 20 53 6D 69 74 68 00 00 00   ê...Joe Smith...
00000010   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
00000020   CD CC 5C 40 DE 00 00 00 53 61 72 61 20 4A 6F 6E   ÍÌ\@Þ...Sara Jon
00000030   65 73 00 00 00 00 00 00 00 00 00 00 00 00 00 00   es..............
00000040   00 00 22 76 CD CC 4C 40 BC FE 61 00 F5 6F 23 76   .."vÍÌL@¼þa.õo#v
00000050   1C 43 28 76 FC FE 61 00 51 65 23 76 08 00 00 00   .C(vüþa.Qe#v....
00000060   FD 6E 22 76 E3 6E 22 76 FE 12 33 5C               ýn"vãn"vþ.3\
```

File I/O - Binary

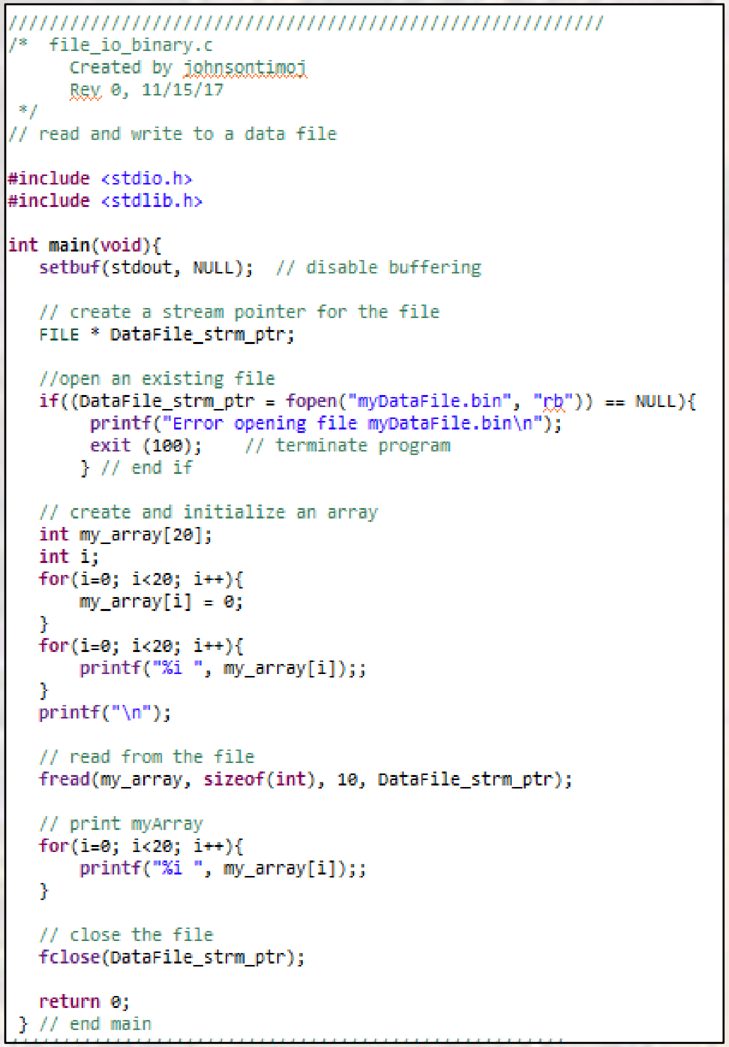
- Formatting stream data - read
  - Block format – no conversions, raw bytes

```
int fread(   void*     in_location_ptr,
             int       element_size,
             int       count,
             FILE*     stream_ptr);
```

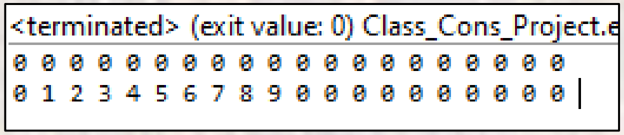
returns the # of items read

File I/O - Binary

- Read a series of integers from a file



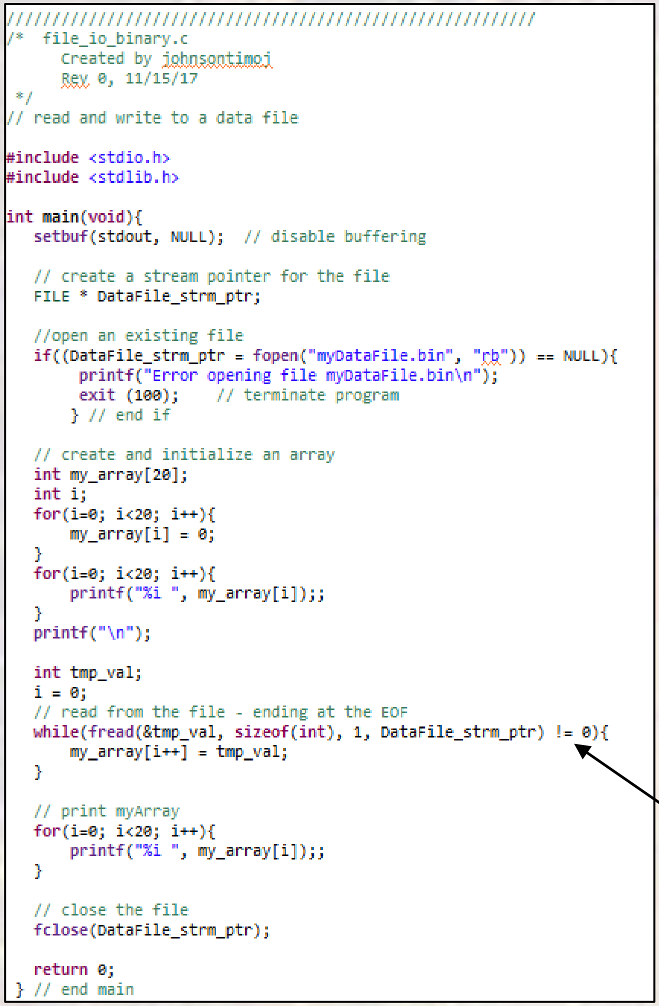
```
/////////////////////////////////////////////////////////////
/*  file_io_binary.c
      Created by johnsontimoj
      Rev 0, 11/15/17
 */
// read and write to a data file

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

int main(void){
   setbuf(stdout, NULL);  // disable buffering

   // create a stream pointer for the file
   FILE * DataFile_strm_ptr;

   //open an existing file
   if((DataFile_strm_ptr = fopen("myDataFile.bin", "rb")) == NULL){
        printf("Error opening file myDataFile.bin\n");
        exit (100);    // terminate program
       } // end if

   // create and initialize an array
   int my_array[20];
   int i;
   for(i=0; i<20; i++){
       my_array[i] = 0;
   }
   for(i=0; i<20; i++){
       printf("%i ", my_array[i]);;
   }
   printf("\n");

   // read from the file
   fread(my_array, sizeof(int), 10, DataFile_strm_ptr);

   // print myArray
   for(i=0; i<20; i++){
       printf("%i ", my_array[i]);;
   }

   // close the file
   fclose(DataFile_strm_ptr);

   return 0;
 } // end main
```



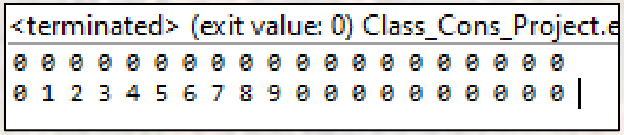
```
<terminated> (exit value: 0) Class_Cons_Project.e
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 1 2 3 4 5 6 7 8 9 0 0 0 0 0 0 0 0 0 0
```

File I/O - Binary

- Read a series of integers from a file until the end



```
///////////////////////////////////////////////////////////
/*  file_io_binary.c
      Created by johnsontimoj
      Rev 0, 11/15/17
 */
// read and write to a data file

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

int main(void){
   setbuf(stdout, NULL);  // disable buffering

   // create a stream pointer for the file
   FILE * DataFile_strm_ptr;

   //open an existing file
   if((DataFile_strm_ptr = fopen("myDataFile.bin", "rb")) == NULL){
        printf("Error opening file myDataFile.bin\n");
        exit (100);    // terminate program
       } // end if

   // create and initialize an array
   int my_array[20];
   int i;
   for(i=0; i<20; i++){
       my_array[i] = 0;
   }
   for(i=0; i<20; i++){
       printf("%i ", my_array[i]);;
   }
   printf("\n");

   int tmp_val;
   i = 0;
   // read from the file - ending at the EOF
   while(fread(&tmp_val, sizeof(int), 1, DataFile_strm_ptr) != 0){
       my_array[i++] = tmp_val;
   }

   // print myArray
   for(i=0; i<20; i++){
       printf("%i ", my_array[i]);;
   }

   // close the file
   fclose(DataFile_strm_ptr);

   return 0;
 } // end main
```



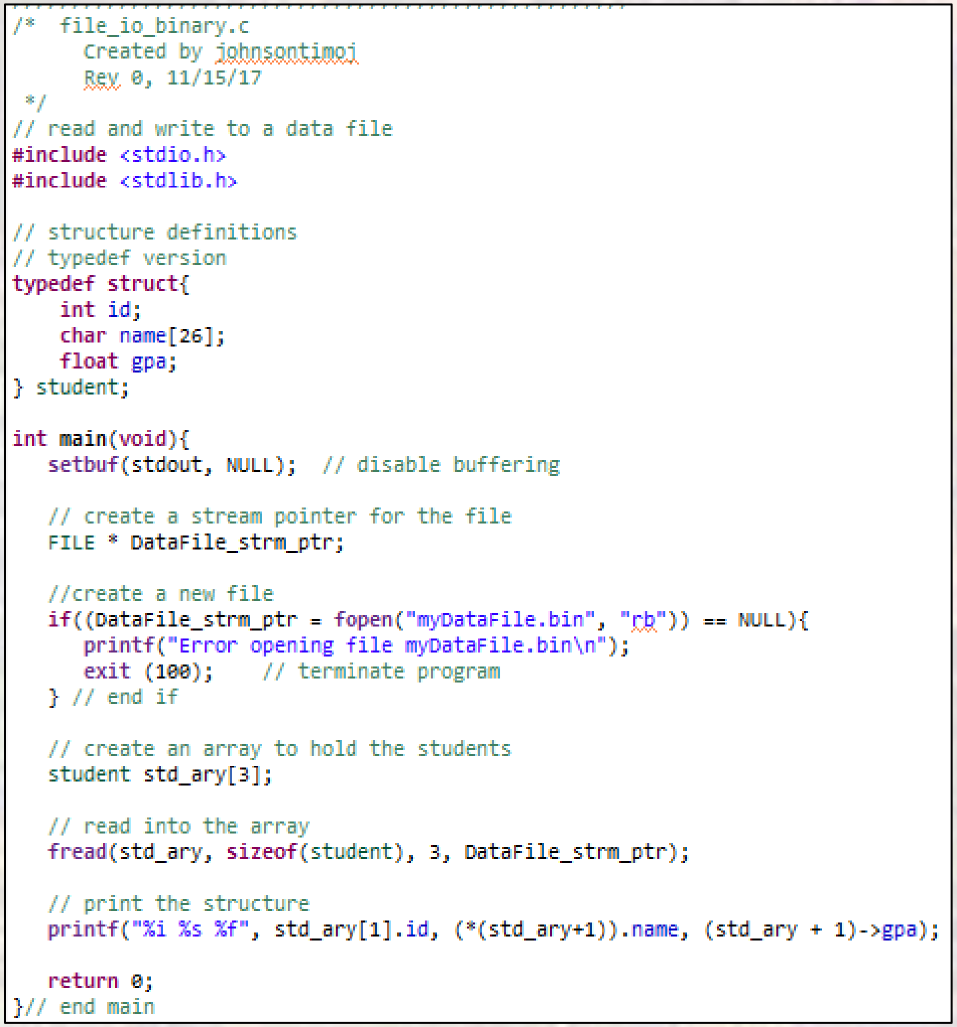
```
<terminated> (exit value: 0) Class_Cons_Project.e
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 1 2 3 4 5 6 7 8 9 0 0 0 0 0 0 0 0 0 0
```

fread returns the number of things read

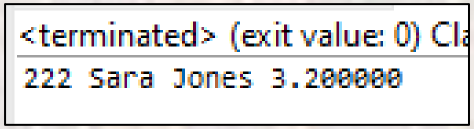
at the end of the file nothing is read
and fread returns 0

File I/O - Binary

- Read a structure from a file



```
/*  file_io_binary.c
      Created by johnsontimoj
      Rev 0, 11/15/17
 */
// read and write to a data file
#include <stdio.h>
#include <stdlib.h>

// structure definitions
// typedef version
typedef struct{
    int id;
    char name[26];
    float gpa;
} student;

int main(void){
   setbuf(stdout, NULL);  // disable buffering

   // create a stream pointer for the file
   FILE * DataFile_strm_ptr;

   //create a new file
   if((DataFile_strm_ptr = fopen("myDataFile.bin", "rb")) == NULL){
      printf("Error opening file myDataFile.bin\n");
      exit (100);    // terminate program
   } // end if

   // create an array to hold the students
   student std_ary[3];

   // read into the array
   fread(std_ary, sizeof(student), 3, DataFile_strm_ptr);

   // print the structure
   printf("%i %s %f", std_ary[1].id, (*(std_ary+1)).name, (std_ary + 1)->gpa);

   return 0;
}// end main
```



```
<terminated> (exit value: 0) Cla
222 Sara Jones 3.200000
```