CS 50: Software Design and Implementation

File I/O

A note about Lab 2

word.c [filename] [filename] ...

A dash (-) indicates read from stdin instead of a file

Example: ./words file1 – file2

- 1. Read file1 and print all the words in the file with one word per line
- 2. Read from stdin (due to the dash) instead of a file and print all words input, each word on its own line (use control-D to end input from stdin)
- 3. Read file2 and print all the words in the file with one word per line

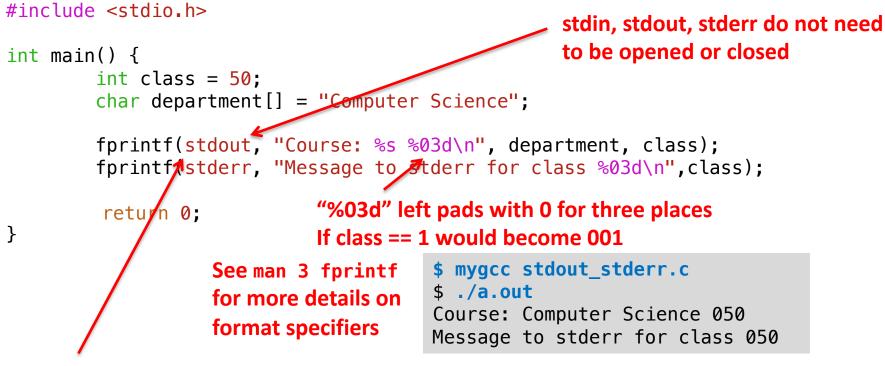
Agenda



- 2. Read files
- 3. Activity

stdin, stdout, and stderr are always available for input and output

stdout_stderr.c



fprintf prints formatted output to a file

- stdin, stdout, stderr are treated as files by Linux
- fprintf(stdout, "...") is equivalent to printf("...")
- printf prints to stdout
- fprintf can print to files too

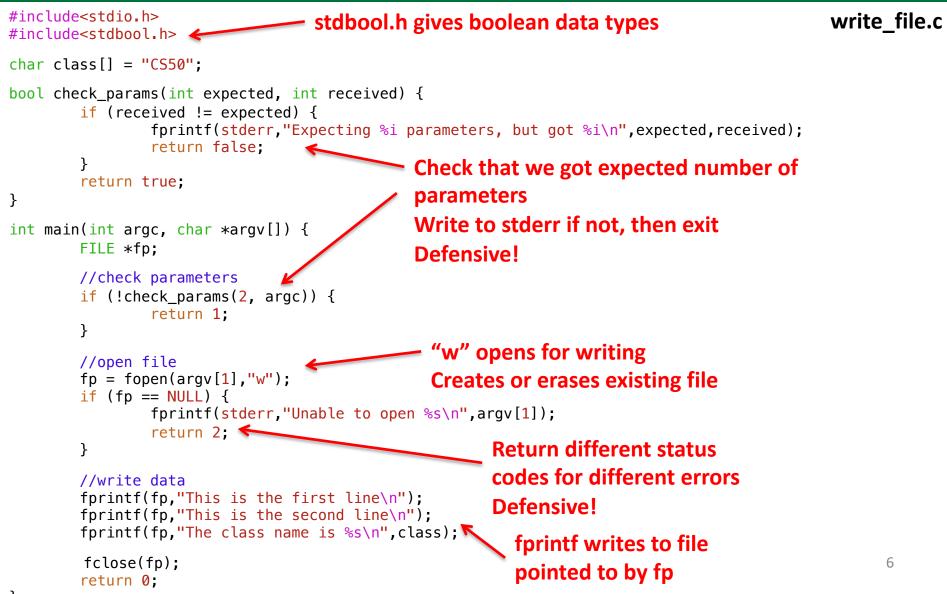
Use fopen to open a file, make sure to check the operation succeeded!

#include<stdio.h>

open_file.c

Modes: **Create file pointer fp** int main(int argc, char *argv[]) { $\mathbf{r} = \mathbf{read}$ FILE *fp; ← w=write printf("Trying to open %s\n",argv[1]); r+ = read/write a=append $(fp == NULL) \{$ fprintf(stderr,"Unable to open %s\n",argv[1]); **Check if** return 1; operation Here we print to stderr if succeeded printf("Successfully opened %s\n", argv[1]); operations fails, then exit fclose(fp); with status code 1 Returns NULL if not return 0: Remember status code 0 } means successful Don't forget to close the completion Defensive programming, file when done assume operation failed!

fprintf can write to files, here we write to the file name given by argv[1]



fprintf can write to files, here we write to the file name given by argv[1]

```
#include<stdio.h>
                                                                                          write file.c
#include<stdbool.h>
char class[] = "CS50";
bool check_params(int expected, int received) {
       if (received != expected) {
               fprintf(stderr,"Expecting %i parameters, but got %i\n",expected,received);
               return false;
       }
       return true;
}
                                                          $ myqcc write file.c
int main(int argc, char *argv[]) {
                                                          $ ./a.out test.txt
       FILE *fp;
                                                          $ cat test.txt
       //check parameters
                                                          This is the first line
       if (!check_params(2, argc)) {
                                                          This is the second line
               return 1;
                                                          The class name is CS50
       }
       //open file
       fp = fopen(argv[1],"w");
       if (fp == NULL) {
               fprintf(stderr,"Unable to open %s\n",argv[1]);
               return 2;
       }
                                                             Lines written to file with name
       //write data
       fprintf(fp,"This is the first line\n"); 
                                                             given by parameter 1
       fprintf(fp,"This is the second line\n");
       fprintf(fp,"The class name is %s\n",class);
        fclose(fp);
        return 0;
```

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int puts (const char *s);	Writes the string s and a trailing newline to stdout (similar to System.out.println in Java)

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int printf (const char *format,);	Write output to stdout

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int fprintf (FILE *fp, const char *format,);	Write output to fp; if fp is stdout, same as printf
int printf (const char *format,);	Write output to stdout
int snprintf (char *str, size_t size, const char *format,);	Write a maximum of size bytes to the character string str



- 1. Write files
- 2. Read files
 - 3. Activity

Files can be read line by line, here we read the file name given by argv[1]

```
read_file_line_by_line.c
bool check_params(int expected, int received) {
       if (received != expected) {
              fprintf(stderr,"Expecting %i parameters, but got %i\n",expected,received);
              return false:
       }
                                               FOR GOODNESS SAKE DO NOT USE gets()!
       return true;
}
                                               Why not?
int main(int argc, char *argv[]) {
                                               Possible buffer overflow because size not
       FILE* fp;
       char buffer[MAX SIZE];
                                               checked
       //check parameters
       if (!check_params(2,argc)) {
              return 1;
                                     Open file for reading with "r"
       }
                                     Check for error
       //open file
       fp = fopen(argv[1], "r");
       if (fp == NULL) {
                                                perror will print your message, plus a
              perror("Error opening file"); 
              return 2;
                                                description of the error (ex. file not found)
       }
       //read line by line
                                                     Read fp until:
       while(fgets(buffer, MAX_SIZE, fp) != NULL) {
                                                        end of line
              printf("%s",buffer);
       }
                                                        end of file
       fclose(fp);
                                                        MAX_SIZE characters read
                                                                                          16
       return 0;
}
```

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bool check_params(int expected, int received) {
       if (received != expected) {
              fprintf(stderr,"Expecting %i parameters, but got %i\n",expected,received);
              return false:
       }
                                                  $ mygcc read_file_by_line.c
       return true;
}
                                                  $ ./a.out test.txt
                                                  This is the first line
int main(int argc, char *argv[]) {
                                                  This is the second line
       FILE* fp;
                                                  The class name is CS50
       char buffer[MAX SIZE];
       //check parameters
       if (!check_params(2,argc)) {
               return 1;
                                      Open file for reading with "r"
       }
                                      Check for error
       //open file
       fp = fopen(argv[1], "r");
       if (fp == NULL) {
                                                 perror will print your message, plus a
              perror("Error opening file"); 
              return 2;
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       }
       //read line by line
                                                      Read fp until:
       while(fgets(buffer, MAX_SIZE, fp) != NULL) {
                                                         end of line
              printf("%s",buffer);
       }
                                                         end of file
       fclose(fp);
                                                         MAX SIZE characters read
                                                                                           17
       return 0;
}
```

Files can also be read char by char

read_file_character_by_character.c

```
<snip>
int main(int argc, char *argv[]) {
        FILE* fp;
        //check parameters
        if (!check_params(2,argc)) {
                return 1;
        }
                                             Open file and check for errors
        //open file
        fp = fopen(argv[1], "r");
        if (fp == NULL) {
                perror("Error opening file");
                return 2;
        }
                                    Loop until end of file
        //read char by char
        while(!feof(fp)) {
                printf("%c",(char)fgetc(fp));
        }
                                                 Read int and cast to char
        fclose(fp);
        return 0;
                No need to set buffer size here, reading one char at a time
```

See lecture extra on course web page

}

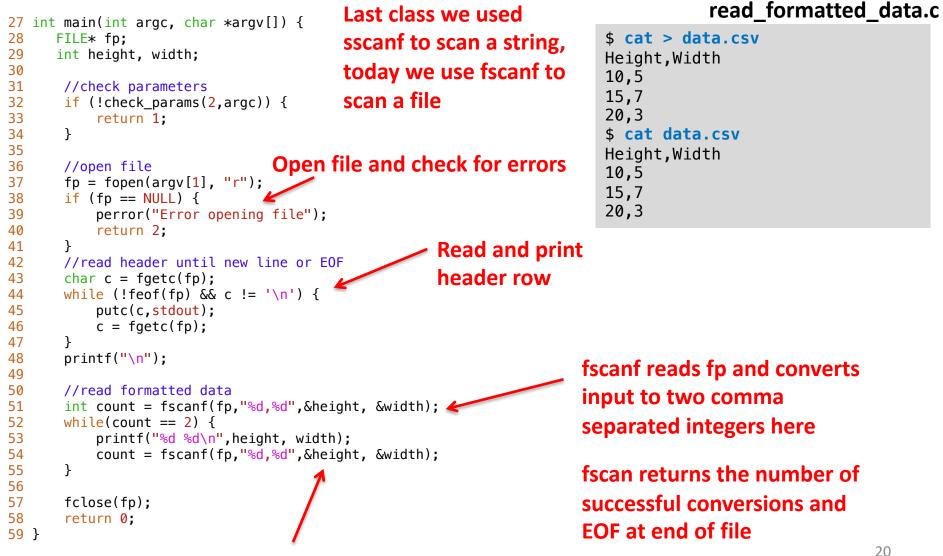
Formatted data can be read using fscanf

27 int main(int argc, char *argv[]) {

read_formatted_data.c

```
$ cat > data.csv
28
     FILE* fp;
29
      int height, width;
                                                                          Height,Width
                                                Make data file
30
                                                                          10,5
31
      //check parameters
                                                with header
                                                                          15,7
32
      if (!check params(2,argc)) {
                                                                          20,3
33
                                                row then two
           return 1:
34
      }
                                                                          $ cat data.csv
                                                variables per
35
                                                                          Height,Width
36
      //open file
                                                                          10,5
                                                line in csv
37
      fp = fopen(argv[1], "r");
                                                                         15,7
38
      if (fp == NULL) {
                                                format
                                                                          20,3
39
          perror("Error opening file");
40
           return 2;
                                                                                          Check file
41
       }
42
      //read header until new line or EOF
                                                                                          contain what
43
      char c = fgetc(fp);
      while (!feof(fp) && c != '\n') {
44
                                                                                          we expect
45
          putc(c,stdout);
46
          c = fgetc(fp);
47
       }
48
      printf("\n");
49
50
      //read formatted data
51
      int count = fscanf(fp,"%d,%d",&height, &width);
52
      while(count == 2) {
53
          printf("%d %d\n",height, width);
54
          count = fscanf(fp,"%d,%d",&height, &width);
55
      }
56
57
      fclose(fp);
58
       return 0:
59 }
```

Formatted data can be read using fs canf



Pass address of variables to be changed with &

Formatted data can be read using fscanf

```
read_formatted_data.c
                                       Last class we used
27 int main(int argc, char *argv[]) {
28
                                                                      $ cat > data.csv
     FILE* fp;
                                       sscanf to scan a string,
     int height, width;
29
                                                                      Height,Width
                                       today we use fscanf to
30
                                                                      10,5
31
      //check parameters
                                                                      15,7
                                       scan a file
32
      if (!check params(2,argc)) {
                                                                      20,3
33
          return 1:
34
                                                                      $ cat data.csv
      }
35
                                                                      Height, Width
                               Open file and check for errors
36
      //open file
                                                                      10,5
37
      fp = fopen(argv[1], "r");
                                                                      15,7
      if (fp == NULL) {
38
                                                                      20,3
39
          perror("Error opening file");
40
          return 2;
                                                                      $ mygcc read formatted data.c
41
      }
                                                  Read and print
                                                                      $ ./a.out data.csv
42
      //read header until new line or EOF
                                                                      Height,Width
                                                  header row
43
      char c = fgetc(fp);
                                                                      10 5
      while (!feof(fp) && c != '\n') {
44
                                                                      15 7
45
          putc(c,stdout);
46
          c = fgetc(fp);
                                                                      20 3
47
      }
48
      printf("\n");
                                                                   fscanf reads fp and converts
49
50
      //read formatted data
                                                                   input to two comma
51
      int count = fscanf(fp,"%d,%d",&height, &width);
52
      while(count == 2) {
                                                                   separated integers here
53
          printf("%d %d\n",height, width);
54
          count = fscanf(fp,"%d,%d",&height, &width);
55
      }
                                                                   fscan returns the number of
56
57
      fclose(fp);
                                                                   successful conversions and
58
      return 0:
                                                                   EOF at end of file
59 }
```

```
Pass address of variables to be changed with &
```

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int fgetc (FILE *fp);	Reads the next character from fp and returns it as an unsigned char cast to an int, or EOF on end of file or error

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char * fgets (char *s, int size, FILE *fp);	Reads in at most one less than size characters from fp and stores them into the buffer pointed to by s. Reading stops after an EOF or a newline. If a newline is read, it is stored into the buffer. A terminating null byte ('\0') is stored after the last character in the buffer

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int scanf (const char *format,);	Reads formatted input from stdin

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int scanf (const char *format,);	Reads formatted input from stdin
int fscanf (FILE *fp, const char *format,);	Reads formatted input from fp

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int scanf (const char *format,);	Reads formatted input from stdin
int fscanf (FILE *fp, const char *format,);	Reads formatted input from fp
int sscanf (const char *str, const char *format,);	Reads formatted input from the string pointed to by str

Agenda

- 1. Write files
- 2. Read files

