

# Capitolo 11 – Elaborazione di file

1

## Outline

- 11.1 Introduzione
- 11.2 La gerarchia dei dati
- 11.3 File e Stream
- 11.4 Creare un file ad accesso sequenziale
- 11.5 Lettura di dati da un file ad accesso sequenziale
- 11.6 File ad accesso casuale
- 11.7 Creare un file ad accesso casuale
- 11.8 Scrittura di dati casuali in un file ad accesso casuale
- 11.9 Lettura di dati casuali da un file ad accesso casuale

## Obiettivi

2

- In questo capitolo, apprenderemo a:
  - Creare, leggere, scrivere e modificare i file.
  - Prendere familiarità con i file ad accesso sequenziale.
  - Prendere familiarità con i file ad accesso casuale.

3

## 11.1 Introduzione

- I file
  - Possono essere creati, modificati, ed elaborati da programmi scritti in C
  - Sono utilizzati per la memorizzazione permanente dei dati
    - La memorizzazione di dati in variabili ed array è solo temporanea

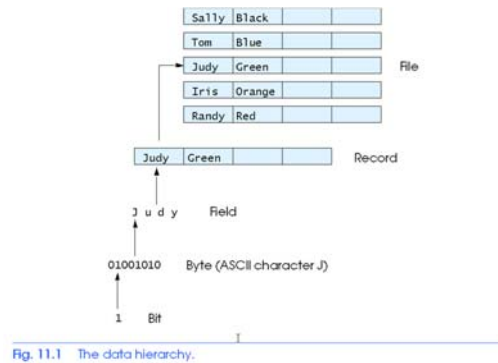
4

## 11.2 La gerarchia dei dati

- Gerarchia dei dati:
  - Bit – il più piccolo
    - Valore 0 o 1
  - Byte – 8 bits
    - Utilizzato per memorizzare un carattere
      - Cifre decimali, lettere, e simboli speciali
  - Campi – gruppo di caratteri
    - Esempio: your name
  - Record – gruppo di campi
    - Rappresentato da `struct` o `class`
    - Esempio: In a payroll system, a record for a particular employee that contained his/her identification number, name, address, etc.

## 11.2 La gerarchia dei dati

- Gerarchia dei dati:
  - File – gruppo di record
    - Esempio: payroll file
  - Database – gruppo di files



## 11.2 La gerarchia dei dati

- File
  - Record chiave
    - Identifica un record per facilitare il ritrovamento di uno specifico record da un file
  - File sequenziale
    - I record sono tipicamente ordinati in base alla chiave

## 11.3 File e Stream

- Il C vede un file come una sequenza di byte
  - I file terminano con un marcatore di fine file
    - O, terminano con uno specifico byte
- Quando si apre un file si crea uno stream
  - Fornisce il canale di comunicazione tra file e programma
  - L'apertura di un file restituisce un puntatore ad una struttura FILE
    - Esempi:
      - `stdin` - standard input (keyboard)
      - `stdout` - standard output (screen)
      - `stderr` - standard error (screen)

## 11.3 File e Stream

- Struttura FILE
  - Descrittore di file
    - Index into operating system array called the open file table
  - File Control Block (FCB)
    - Found in every array element, system uses it to administer the file

## 11.3 File e Stream

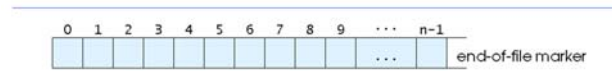


Fig. 11.2 C's view of a file of  $n$  bytes.

## 11.3 File e Stream

- Funzioni di lettura/scrittura
  - fgetc
    - Legge un carattere da un file
    - Puntatore FILE come argomento
    - fgetc( stdin ) è equivalente a getchar()
  - fputc
    - Scrive un carattere su un file
    - Puntatore FILE e un carattere come argomento
    - fputc( 'a', stdout ) è equivalente a putchar( 'a' )
  - fgets
    - Legge una linea da un file
  - fputs
    - Scrive una linea su un file
  - fscanf / fprintf
    - Versioni per file equivalenti di scanf e printf

```

1 /* Fig. 11.3: fig11_03.c
2  Create a sequential file */
3 #include <stdio.h>
4
5 int main()
6 {
7     int account; /* account number */
8     char name[ 30 ]; /* account name */
9     double balance; /* account balance */
10
11     FILE *cFPtr; /* cFPtr = clients.dat file pointer */
12
13     /* fopen opens file. Exit program if unable to create file */
14     if ( ( cFPtr = fopen("clients.dat", "w") ) == NULL ) {
15         printf("File could not be opened\n");
16     } /* end if */
17     else {
18         printf("Enter the account, name, and balance.\n");
19         printf("Enter EOF to end input.\n");
20         printf("? ");
21         scanf("%d%s%f", &account, name, &balance );
22

```



Outline

11

fig11\_03.c (1 of 2)

```

23     /* write account, name and balance into file with fprintf */
24     while ( !feof( stdin ) ) {
25         fprintf( cFPtr, "%d %s %2f\n", account, name, balance );
26         printf("? ");
27         scanf("%d%s%f", &account, name, &balance );
28     } /* end while */
29
30     fclose( cFPtr ); /* fclose closes file */
31 } /* end else */
32
33 return 0; /* indicates successful termination */
34
35 } /* end main */

```



Outline

12

fig11\_03.c (2 of 2)

```

Enter the account, name, and balance.
Enter EOF to end input.
? 100 Jones 24.98
? 200 Doe 345.67
? 300 White 0.00
? 400 Stone -42.16
? 500 Rich 224.62
? ^Z

```

Program Output

## 11.4 Creazione di un file ad accesso sequenziale

- Il C non impone una struttura file
  - Non esiste la nozione di record in un file
  - Il programmatore deve fornire la struttura
- Creare un file
  - FILE \*cfPtr;
    - Crea un puntatore FILE chiamato cfPtr
  - cfPtr = fopen("clients.dat", "w");
    - La funzione fopen restituisce un puntatore FILE al file specificato
    - Ha due argomenti – il file da aprire e la modalità d'apertura
    - Se l'apertura fallisce viene restituito NULL

## 11.4 Creazione di un file ad accesso sequenziale

Computer system	Key combination
UNIX systems	<return> <ctrl> d
IBM PC and compatibles	<ctrl> z
Macintosh	<ctrl> d

Fig. 11.4 End-of-file key combinations for various popular computer systems.

## 11.4 Creazione di un file ad accesso sequenziale

- fpri ntf
  - Utilizzato per stampare in un file
  - Come la pri ntf, eccetto che il primo argomento è un puntatore FILE (puntatore al file in cui si vuole stampare)
- feof( FILEpointer )
  - Restituisce l'indicatore end-of-file
- fclose( FILEpointer )
  - Chiude il file specificato
  - Eseguito automaticamente quando termina il programma
  - È buona pratica chiudere il file esplicitamente
- Dettagli
  - I programmi possono operare su un file, su più file o su nessun file
  - Ogni file deve avere un nome unico ed il suo rispettivo puntatore

## 11.4 Creazione di un file ad accesso sequenziale



Mode	Description
r	Open a file for reading.
w	Create a file for writing. If the file already exists, discard the current contents.
a	Append; open or create a file for writing at end of file.
r+	Open a file for update (reading and writing).
w+	Create a file for update. If the file already exists, discard the current contents.
a+	Append; open or create a file for update; writing is done at the end of the file.
rb	Open a file for reading in binary mode.
wb	Create a file for writing in binary mode. If the file already exists, discard the current contents.
ab	Append; open or create a file for writing at end of file in binary mode.
rb+	Open a file for update (reading and writing) in binary mode.
wb+	Create a file for update in binary mode. If the file already exists, discard the current contents.
ab+	Append; open or create a file for update in binary mode; writing is done at the end of the file.

Fig. 11.6 File open modes.

## 11.5 Lettura da un file ad accesso sequenziale



17

- Lettura
  - Crea un puntatore FILE, collegarlo al file da leggere  
cfPtr = fopen( "clients.dat", "r" );
  - Utilizzare la fscanf per leggere dal file
    - Come la scanf, eccetto che il primo argomento è un puntatore FILE  
fscanf( cfPtr, "%d%s%f", &account, name, &balance );
  - Dati letti dall'inizio alla fine
  - Puntatore di posizione del file
    - Indica il numero del prossimo byte da leggere/scrivere
    - Non è veramente un puntatore, ma un valore intero (specifica la locazione in byte)
    - Detto anche byte offset
  - rewind( cfPtr )
    - Riposizionamento del puntatore posizione all'inizio del file (byte 0)

 [Outline](#)  
 [fig11\\_07.c \(1 of 2\)](#)

```
1 /* Fig. 11.7: fig11_07.c
2 Reading and printing a sequential file */
3 #include <stdio.h>
4
5 int main()
6 {
7     int account; /* account number */
8     char name[ 30 ]; /* account name */
9     double balance; /* account balance */
10
11     FILE *cfPtr; /* cfPtr = clients.dat file pointer */
12
13     /* fopen opens file; exits program if file cannot be opened */
14     if ( ( cfPtr = fopen( "clients.dat", "r" ) ) == NULL ) {
15         printf( "File could not be opened\n" );
16     } /* end if */
17     else { /* read account, name and balance from file */
18         printf( "%-10s%-13s\n", "Account", "Name", "Balance" );
19         fscanf( cfPtr, "%d%s%f", &account, name, &balance );
20
21         /* while not end of file */
22         while ( !feof( cfPtr ) ) {
23             printf( "%-10d%-13s\n", account, name, balance );
24             fscanf( cfPtr, "%d%s%f", &account, name, &balance );
25         } /* end while */
26     }
```



```
27     fclose( cfPtr ); /* fclose closes the file */
28 } /* end else */
29
30 return 0; /* Indicates successful termination */
31
32 } /* end main */
```

 [Outline](#)  
 [fig11\\_07.c \(2 of 2\)](#)

19

Account	Name	Balance
100	Jones	24.98
200	Doe	345.67
300	White	0.00
400	Stone	-42.16
500	Rich	224.62

```
1 /* Fig. 11.8: fig11_08.c
2 Credit Inquiry program */
3 #include <stdio.h>
4
5 /* function main begins program execution */
6 int main()
7 {
8     int request; /* request number */
9     int account; /* account number */
10    double balance; /* account balance */
11    char name[ 30 ]; /* account name */
12    FILE *cfPtr; /* clients.dat file pointer */
13
14    /* fopen opens the file; exits program if file cannot be opened */
15    if ( ( cfPtr = fopen( "clients.dat", "r" ) ) == NULL ) {
16        printf( "File could not be opened\n" );
17    } /* end if */
18    else {
19
20        /* display request options */
21        printf( "Enter request\n"
22            " 1 - List accounts with zero balances\n"
23            " 2 - List accounts with credit balances\n"
24            " 3 - List accounts with debit balances\n"
25            " 4 - End of run? ");
```

 [Outline](#)  
 [fig11\\_08.c \(1 of 5\)](#)

20

```

26 scanf( "%d", &request );
27
28 /* process user's request */
29 while ( request != 4 ) {
30
31     /* read account, name and balance from file */
32     fscanf( cfPtr, "%d%s%f", &account, name, &balance );
33
34     switch ( request ) {
35
36     case 1:
37         printf( "\nAccounts with zero balances:\n" );
38
39         /* read file contents (until eof) */
40         while ( !feof( cfPtr ) ) {
41
42             if ( balance == 0 ) {
43                 printf( "%-10d%-13s%7.2f\n",
44                     account, name, balance );
45             } /* end if */
46
47             /* read account, name and balance from file */
48             fscanf( cfPtr, "%d%s%f",
49                 &account, name, &balance );
50         } /* end while */
51

```



Outline

21

fig11\_08.c (2 of 5)

```

52     break;
53
54     case 2:
55         printf( "\nAccounts with credit balances:\n" );
56
57         /* read file contents (until eof) */
58         while ( !feof( cfPtr ) ) {
59
60             if ( balance < 0 ) {
61                 printf( "%-10d%-13s%7.2f\n",
62                     account, name, balance );
63             } /* end if */
64
65             /* read account, name and balance from file */
66             fscanf( cfPtr, "%d%s%f",
67                 &account, name, &balance );
68         } /* end while */
69
70         break;
71
72     case 3:
73         printf( "\nAccounts with debit balances:\n" );
74

```



Outline

22

fig11\_08.c (3 of 5)

```

75     /* read file contents (until eof) */
76     while ( !feof( cfPtr ) ) {
77
78         if ( balance > 0 ) {
79             printf( "%-10d%-13s%7.2f\n",
80                 account, name, balance );
81         } /* end if */
82
83         /* read account, name and balance from file */
84         fscanf( cfPtr, "%d%s%f",
85             &account, name, &balance );
86     } /* end while */
87
88     break;
89
90 } /* end switch */
91
92 rewind( cfPtr ); /* return cfPtr to beginning of file */
93
94 printf( "\n? " );
95 scanf( "%d", &request );
96 } /* end while */
97

```



Outline

23

fig11\_08.c (4 of 5)

```

98     printf( "End of run.\n" );
99     fclose( cfPtr ); /* fclose closes the file */
100 } /* end else */
101
102 return 0; /* indicates successful termination */
103
104 } /* end main */

```



Outline

24

fig11\_08.c (5 of 5)

```

Enter request
1 - List accounts with zero balances
2 - List accounts with credit balances
3 - List accounts with debit balances
4 - End of run
? 1

Accounts with zero balances:
300    White    0.00

? 2

Accounts with credit balances:
400    Stone    -42.16

? 3

Accounts with debit balances:
100    Jones     24.98
200    Doe       345.67
500    Rich      224.62

? 4
End of run.

```

Program Output

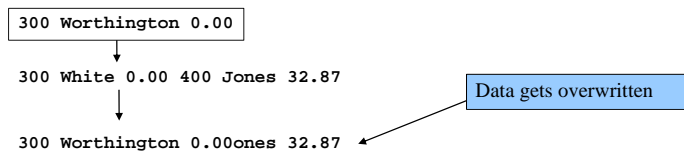
## 11.5 Lettura da un file ad accesso sequenziale

- File ad accesso sequenziale

- Non può essere modificato senza il rischio di distruggere i dati
- I campi possono variare in dimensione
  - Diverse rappresentazioni nei file
  - 1, 34, -890 sono tutti `int`, ma hanno diverse dimensioni su disco

300 White 0.00 400 Jones 32.87 (old data in file)

If we want to change White's name to Worthington,



## 11.6 File ad accesso casuale

- File ad accesso casuale

- L'accesso ai singoli record senza effettuare la ricerca attraverso gli altri record
- Accesso istantaneo ai record nel file
- I dati possono essere inseriti senza distruggere gli altri dati
- I dati precedentemente memorizzati possono essere aggiornati o cancellati senza sovrascrivere

- Implementato utilizzando la lunghezza fissa dei record

- I file sequenziali non hanno record di lunghezza fissa
- 

## 11.7 Creazione di un file ad accesso casuale

- Dati in un file ad accesso casuale

- Non formattati (memorizzati come "raw bytes")
  - Tutti i dati dello stesso tipo (`int`, per esempio) utilizzano la stessa quantità di memoria
  - Tutti i record dello stesso tipo hanno una lunghezza fissa
  - I dati non sono human readable

## 11.7 Creazione di un file ad accesso casuale

- Funzioni I/O non formattate

- `fwrite`
  - Trasferisce i byte da una locazione di memoria al file
- `fread`
  - Trasferisce i byte da file ad una locazione di memoria

– Esempio:

```
fwrite( &number, sizeof( int ), 1, myPtr );
```

- `&number` – Locazione dei byte da trasferire
- `sizeof( int )` – Numero di byte da trasferire
- `1` – per gli array, numero di elementi da trasferire
  - In questo caso, "un elemento" di un array da trasferire
- `myPtr` – file da trasferire da o a



## 11.7 Creazione di un file ad accesso casuale

- Scrivere struct
  - `fwrite( &myObject, sizeof (struct myStruct), 1, myPtr );`
  - `sizeof` – restituisce la dimensione in byte dell'oggetto in parentesi
- Per scrivere più elementi di un array
  - Puntatore all'array come primo argomento
  - Numero di elementi da scrivere come terzo argomento

```

1  /* Fig. 11.11: fig11_11.c
2  Creating a randomly accessed file sequentially */
3  #include <stdio.h>
4
5  /* clientData structure definition */
6  struct clientData {
7      int acctNum; /* account number */
8      char lastName[ 15 ]; /* account last name */
9      char firstName[ 10 ]; /* account first name */
10     double balance; /* account balance */
11 }; /* end structure clientData */
12
13 int main()
14 {
15     int i; /* counter */
16
17     /* create clientData with no information */
18     struct clientData blankClient = { 0, "", "", 0.0 };
19
20     FILE *cfPtr; /* credit.dat file pointer */
21
22     /* fopen opens the file; exits if file cannot be opened */
23     if ( ( cfPtr = fopen("credit.dat", "wb" ) ) == NULL ) {
24         printf("File could not be opened.\n");
25     } /* end if */



```

 [Outline](#)  
 fig11\_11.c (1 of 2)

```

26     else {
27
28         /* output 100 blank records to file */
29         for ( i = 1; i <= 100; i++ ) {
30             fwrite( &blankClient, sizeof( struct clientData ), 1, cfPtr );
31         } /* end for */
32
33         fclose ( cfPtr ); /* fclose closes the file */
34     } /* end else */
35
36     return 0; /* Indicates successful termination */
37
38 } /* end main */

```

 [Outline](#)  
 fig11\_11.c (2 of 2)

## 11.8 Scrittura su un file ad accesso casuale



- `fseek`
  - Setta il puntatore della posizione del file ad una specifica posizione
  - `fseek( pointer, offset, symbolic_constant );`
    - *pointer* – puntatore al file
    - *offset* – puntatore della posizione sul file (0 è la prima locazione)
    - *symbolic\_constant* – specifica da dove leggere nel file
    - `SEEK_SET` – seek starts at beginning of file
    - `SEEK_CUR` – seek starts at current location in file
    - `SEEK_END` – seek starts at end of file



```

1 /* Fig. 11.12: fig11_12.c
2 Writing to a random access file */
3 #include <stdio.h>
4
5 /* clientData structure definition */
6 struct clientData {
7     int acctNum; /* account number */
8     char lastName[ 15 ]; /* account last name */
9     char firstName[ 10 ]; /* account first name */
10    double balance; /* account balance */
11 }; /* end structure clientData */
12
13 int main()
14 {
15     FILE *cfPtr; /* credit.dat file pointer */
16
17     /* create clientData with no information */
18     struct clientData client = { 0, "", "", 0.0 };
19
20     /* fopen opens the file; exits if file cannot be opened */
21     if ( ( cfPtr = fopen( "credit.dat", "rb+" ) ) == NULL ) {
22         printf( "File could not be opened.\n" );
23     } /* end if */
24     else {
25



```

 Outline 33  
 fig11\_12.c (1 of 3)

```

26 /* require user to specify account number */
27 printf( "Enter account number
28         " ( 1 to 100, 0 to end input )\n? " );
29 scanf( "%d", &client.acctNum );
30
31 /* user enters information, which is copied into file */
32 while ( client.acctNum != 0 ) {
33
34     /* user enters last name, first name and balance */
35     printf( "Enter lastname, firstname, balance\n? " );
36
37     /* set record lastName, firstName and balance value */
38     fscanf( stdin, "%s%s%lf", client.lastName,
39            client.firstName, &client.balance );
40
41     /* seek position in file of user-specified record */
42     fseek( cfPtr, ( client.acctNum - 1 ) *
43           sizeof( struct clientData ), SEEK_SET );
44
45     /* write user-specified information in file */
46     fwrite( &client, sizeof( struct clientData ), 1, cfPtr );
47
48     /* enable user to specify another account number */
49     printf( "Enter account number\n? " );
50     scanf( "%d", &client.acctNum );



```

 Outline 34  
 fig11\_12.c (2 of 3)

```

51 } /* end while */
52
53 fclose( cfPtr ); /* fclose closes the file */
54 } /* end else */
55
56 return 0; /* indicates successful termination */
57
58 } /* end main */

```

 Outline 35  
 fig11\_12.c (3 of 3)

```

Enter account number ( 1 to 100, 0 to end input )
? 37
Enter lastname, firstname, balance
? Barker Doug 0.00
Enter account number
? 29
Enter lastname, firstname, balance
? Brown Nancy -24.54
Enter account number
? 96
Enter lastname, firstname, balance
? Stone Sam 34.98
Enter account number
? 88
Enter lastname, firstname, balance
? Smith Dave 258.34
Enter account number
? 33
Enter lastname, firstname, balance
? Dunn Stacey 314.33
Enter account number
? 0

```

Program Output

## 11.8 Scrittura su un file ad accesso casuale

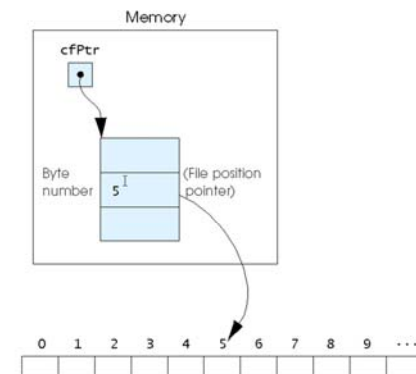


Fig. 11.14 The file position pointer indicating an offset of 5 bytes from the beginning of the file.

## 11.9 Lettura da un file ad accesso casuale

- fread

- Legge un numero specificato di byte dal file in memoria  
fread( &client, sizeof(struct clientData), 1, myPtr );
- Può leggere più elementi di lunghezza-fissa di un array
  - Fornisce il puntatore all' array
  - Indica il numero di elementi da leggere
- Per leggere più elementi, si specifica il terzo elemento

```

24 else {
25     printf( "%-6s%-16s%-11s%10s\n", "Acct", "Last Name",
26           "First Name", "Balance" );
27
28     /* read all records from file (until eof) */
29     while ( !feof( cfPtr ) ) {
30         fread( &client, sizeof( struct clientData ), 1, cfPtr );
31
32         /* display record */
33         if ( client.acctNum != 0 ) {
34             printf( "%-6d%-16s%-11s%10.2f\n",
35                   client.acctNum, client.lastName,
36                   client.firstName, client.balance );
37         } /* end if */
38     } /* end while */
39
40     fclose( cfPtr ); /* fclose closes the file */
41 } /* end else */
42
43
44 return 0; /* indicates successful termination */
45
46 } /* end main */

```




 [Outline](#)

 fig11\_15.c (2 of 2)

```

1 /* Fig. 11.15: fig11_15.c
2 Reading a random access file sequentially */
3 #include <stdio.h>
4
5 /* clientData structure definition */
6 struct clientData {
7     int acctNum; /* account number */
8     char lastName[ 15 ]; /* account last name */
9     char firstName[ 10 ]; /* account first name */
10    double balance; /* account balance */
11 }; /* end structure clientData */
12
13 int main()
14 {
15     FILE *cfPtr; /* credit.dat file pointer */
16
17     /* create clientData with no information */
18     struct clientData client = { 0, "", "", 0.0 };
19
20     /* fopen opens the file; exits if file cannot be opened */
21     if ( ( cfPtr = fopen( "credit.dat", "rb" ) ) == NULL ) {
22         printf( "File could not be opened.\n" );
23     } /* end if */

```

 [Outline](#)  
 fig11\_15.c (1 of 2)

Acct	Last Name	First Name	Balance
29	Brown	Nancy	-24.54
33	Dunn	Stacey	314.33
37	Barker	Doug	0.00
88	Smith	Dave	258.34
96	Stone	Sam	34.98

 [Outline](#)



 Program Output

## 11.10 Case Study: A Transaction Processing Program



41

- This program
  - Demonstrates using random access files to achieve instant access processing of a bank's account information
- We will
  - Update existing accounts
  - Add new accounts
  - Delete accounts
  - Store a formatted listing of all accounts in a text file



```
1 /* Fig. 11.16: fig11_16.c
2 This program reads a random access file sequentially, updates data
3 already written to the file, creates new data to be placed in the
4 file, and deletes data previously in the file. */
5 #include <stdio.h>
6
7 /* clientData structure definition */
8 struct clientData {
9     int acctNum; /* account number */
10    char lastName[ 15 ]; /* account last name */
11    char firstName[ 10 ]; /* account first name */
12    double balance; /* account balance */
13 }; /* end structure clientData */
14
15 /* prototypes */
16 int enterChoice( void );
17 void textFile( FILE *readPtr );
18 void updateRecord( FILE *fPtr );
19 void newRecord( FILE *fPtr );
20 void deleteRecord( FILE *fPtr );
21
22 int main()
23 {
24     FILE *cfPtr; /* credit.dat file pointer */
25     int choice; /* user's choice */
26
```

 [Outline](#) 42  
 fig11\_16.c (1 of 11)

```
27 /* fopen opens the file; exits if file cannot be opened */
28 if ( ( cfPtr = fopen( "credit.dat", "rb+" ) ) == NULL ) {
29     printf( "File could not be opened.\n" );
30 } /* end if */
31 else {
32
33     /* enable user to specify action */
34     while ( ( choice = enterChoice() ) != 5 ) {
35
36         switch ( choice ) {
37
38             /* create text file from record file */
39             case 1:
40                 textFile( cfPtr );
41                 break;
42
43             /* update record */
44             case 2:
45                 updateRecord( cfPtr );
46                 break;
47
```

 [Outline](#) 43  
 fig11\_16.c (2 of 11)



```
48     /* create record */
49     case 3:
50         newRecord( cfPtr );
51         break;
52
53     /* delete existing record */
54     case 4:
55         deleteRecord( cfPtr );
56         break;
57
58     /* display message if user does not select valid choice */
59     default:
60         printf( "Incorrect choice\n" );
61         break;
62
63     } /* end switch */
64
65     } /* end while */
66
67     fclose( cfPtr ); /* fclose closes the file */
68 } /* end else */
69
70 return 0; /* indicates successful termination */
71
72 } /* end main */
73
```

 [Outline](#) 44  
 fig11\_16.c (3 of 11)

```

74 /* create formatted text file for printing */
75 void textFile( FILE *readPtr )
76 {
77     FILE *writePtr; /* accounts.txt file pointer */
78
79     /* create clientData with no information */
80     struct clientData client = {0, "", "", 0.0};
81
82     /* fopen opens the file; exits if file cannot be opened */
83     if ( ( writePtr = fopen("accounts.txt", "w") ) == NULL ) {
84         printf("File could not be opened.\n");
85     } /* end if */
86     else {
87         rewind( readPtr ); /* sets pointer to beginning of record file */
88         fprintf( writePtr, "%-6s%-16s%-11s%10s\n",
89                 "Acct", "Last Name", "First Name", "Balance" );
90
91         /* copy all records from record file into text file */
92         while ( !feof( readPtr ) ) {
93             fread( &client, sizeof( struct clientData ), 1, readPtr );
94



```

 Outline 45  
 **fig11\_16.c (4 of 11)**

```

95     /* write single record to text file */
96     if ( client.acctNum != 0 ) {
97         fprintf( writePtr, "%-6d%-16s%-11s%10.2f\n",
98                 client.acctNum, client.lastName,
99                 client.firstName, client.balance );
100     } /* end if */
101
102     } /* end while */
103
104     fclose( writePtr ); /* fclose closes the file */
105 } /* end else */
106
107 } /* end function textFile */
108
109 /* update balance in record */
110 void updateRecord( FILE *fPtr )
111 {
112     int account; /* account number */
113     double transaction; /* account transaction */
114
115     /* create clientData with no information */
116     struct clientData client = {0, "", "", 0.0};
117



```

 Outline 46  
 **fig11\_16.c (5 of 11)**

```

118 /* obtain number of account to update */
119 printf( "Enter account to update ( 1 - 100 ): " );
120 scanf( "%d", &account );
121
122 /* move file pointer to correct record in file */
123 fseek( fPtr, ( account - 1 ) * sizeof( struct clientData ),
124         SEEK_SET );
125
126 /* read record from file */
127 fread( &client, sizeof( struct clientData ), 1, fPtr );
128
129 /* display error if account does not exist */
130 if ( client.acctNum == 0 ) {
131     printf( "Account #%d has no information.\n", account );
132 } /* end if */
133 else { /* update record */
134     printf( "%-6d%-16s%-11s%10.2f\n\n",
135             client.acctNum, client.lastName,
136             client.firstName, client.balance );
137
138     /* request user to specify transaction */
139     printf( "Enter charge ( + ) or payment ( - ): " );
140     scanf( "%lf", &transaction );
141     client.balance += transaction; /* update record balance */
142



```

 Outline 47  
 **fig11\_16.c (6 of 11)**

```

143     printf( "%-6d%-16s%-11s%10.2f\n",
144             client.acctNum, client.lastName,
145             client.firstName, client.balance );
146
147     /* move file pointer to correct record in file */
148     fseek( fPtr, ( account - 1 ) * sizeof( struct clientData ),
149           SEEK_SET );
150
151     /* write updated record over old record in file */
152     fwrite( &client, sizeof( struct clientData ), 1, fPtr );
153 } /* end else */
154
155 } /* end function updateRecord */
156
157 /* delete an existing record */
158 void deleteRecord( FILE *fPtr )
159 {
160     /* create two clientDatas and initialize blankClient */
161     struct clientData client;
162     struct clientData blankClient = {0, "", "", 0};
163
164     int accountNum; /* account number */
165

```

 Outline 48  
 **fig11\_16.c (7 of 11)**

```

166 /* obtain number of account to delete */
167 printf("Enter account number to delete ( 1 - 100 ): ");
168 scanf("%d", &accountNum);
169
170 /* move file pointer to correct record in file */
171 fseek( fPtr, ( accountNum - 1 ) * sizeof( struct clientData ),
172        SEEK_SET );
173
174 /* read record from file */
175 fread( &client, sizeof( struct clientData ), 1, fPtr );
176
177 /* display error if record does not exist */
178 if ( client.acctNum == 0 ) {
179     printf("Account %d does not exist.\n", accountNum );
180 } /* end if */
181 else { /* delete record */
182
183     /* move file pointer to correct record in file */
184     fseek( fPtr, ( accountNum - 1 ) * sizeof( struct clientData ),
185            SEEK_SET );
186
187     /* replace existing record with blank record */
188     fwrite( &blankClient,
189            sizeof( struct clientData ), 1, fPtr );
190 } /* end else */
191

```



Outline

49

fig11\_16.c (8 of 11)

```

192 } /* end function deleteRecord */
193
194 /* create and insert record */
195 void newRecord( FILE *fPtr )
196 {
197     /* create clientData with no information */
198     struct clientData client = { 0, "", "", 0.0 };
199
200     int accountNum; /* account number */
201
202     /* obtain number of account to create */
203     printf("Enter new account number ( 1 - 100 ): ");
204     scanf("%d", &accountNum );
205
206     /* move file pointer to correct record in file */
207     fseek( fPtr, ( accountNum - 1 ) * sizeof( struct clientData ),
208            SEEK_SET );
209
210     /* read record from file */
211     fread( &client, sizeof( struct clientData ), 1, fPtr );
212

```



Outline

50

fig11\_16.c (9 of 11)

```

213 /* display error if account previously exists */
214 if ( client.acctNum != 0 ) {
215     printf("Account %d already contains information.\n",
216            client.acctNum );
217 } /* end if */
218 else { /* create record */
219
220     /* user enters last name, first name and balance */
221     printf("Enter lastname, firstname, balance\n? ");
222     scanf(" %s%sl f", &client.lastName, &client.firstName,
223            &client.balance );
224
225     client.acctNum = accountNum;
226
227     /* move file pointer to correct record in file */
228     fseek( fPtr, ( client.acctNum - 1 ) *
229            sizeof( struct clientData ), SEEK_SET );
230
231     /* insert record in file */
232     fwrite( &client,
233            sizeof( struct clientData ), 1, fPtr );
234 } /* end else */
235
236 } /* end function newRecord */
237

```



Outline

51

fig11\_16.c (10 of 11)

```

238 /* enable user to input menu choice */
239 int enterChoice( void )
240 {
241     int menuChoice; /* variable to store user's choice */
242
243     /* display available options */
244     printf("\nEnter your choice\n");
245     "1 - store a formatted text file of accounts called\n"
246     "   \"accounts.txt\" for printing\n"
247     "2 - update an account\n"
248     "3 - add a new account\n"
249     "4 - delete an account\n"
250     "5 - end program\n? ";
251
252     scanf("%d", &menuChoice ); /* receive choice from user */
253
254     return menuChoice;
255
256 } /* end function enterChoice */

```



Outline

52

fig11\_16.c (11 of 11)

After choosing option 1 accounts.txt contains:

Acct	Last Name	First Name	Balance
29	Brown	Nancy	-24.54
33	Dunn	Stacey	314.33
37	Barker	Doug	0.00
88	Smith	Dave	258.34
96	Stone	Sam	34.98

After choosing option 2 accounts.txt contains:

```
Enter account to update ( 1 - 100 ): 37
37  Barker          Doug          0.00

Enter charge ( + ) or payment ( - ): +87.99
37  Barker          Doug          87.99
```

After choosing option 3 accounts.txt contains:

```
Enter new account number ( 1 - 100 ): 22
Enter lastname, firstname, balance
? Johnston Sarah 247.45
```