CS 101
Computer Programming and utilization

IIT BOMBAY

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Session 13, Strings and Files

Friday, September 9, 2011

Overview

- More on parameter passing
- Formatted Output and input
  - Functions printf() and scanf()
- More string functions
  - strcpy, strcmp, sprintf, sscanf
- File handling in C++
  - Files on disk
  - Sequential text files
  - Binary files
  - Direct access file
- Announcements

Passing parameters to functions

```
int  f (int x, int y){
        int sum;
        sum = 5*x + y%10;
        return sum;
    }
```

To use this function in our program

```
int A, B, C;
cin >> A  >> B;
C = f(A, B);
cout << C;
```

Parameter passing

- Normally, parameters are passed by ‘value’
  - Values of actual parameters are copied to locations of formal parameters,
    - when the function is invoked
  - Only the return value comes back.
- Significant overhead of copying
  - What if a parameter is a large array?

Parameter passing …

- We may wish to change some parameter values inside the function, and send these back to the actual parameters in the calling program
  - Example: Solving simultaneous equations

```
int  simsolve (int N, float C[100,100], float B[100], float X[100]);
```

- We will supply the coefficient matrix C, and the RHS array B
  - We wish to get back the result array X. How?
- The type declared for the function (int), which describes the type of value normally returned, has no relevance

Function to swap values in locations a and b

```
int swap (int a, int b){
    int temp;
    temp = a; a= b; b = temp;
    return 0;
}
```

- In the main program, we may write:

```
int dummy, X, Y; X= 5; Y =10;
dummy = swap(X,Y);
```

Passing by reference

- Alternate mechanism for passing parameters
  - A pointer can be passed to the function
  - Operations within the function will be carried out directly on the actual parameters
  - No copying,
  - Parameter logically ‘returns’ back

Passing by reference …

```
int main() {
   int x=5, y=10;
   swap(&x, &y);
   cout << "x=" << x
   cout << " y=" << y << “\n”;
 }
```

Passing by reference

```
void swap(int *a, int *b) {     // call by reference
    int temp;
    temp = *a;
    *a = *b;
    *b = temp;
  }
```

Passing Array parameters

- Arrays, passed to a function, come back with modified values.
  - Why?
- Array name, when passed as a parameter, is automatically treated as a pointer to the 0th element of the array.

I/O functions in C++

- C++ does not have any instruction for reading or writing data
- How is input/output to external world handled?
  - Using cin and cout

```
cin   >> x >> y;
z = 2.5 * x -7.32 * y;
cout  << “Value of z is: ”  << z ;
```

printf(), scanf()

- Special functions in C++ library to perform formatted input and output

  scanf() and printf()

- Parameters to these functions include a “format” string, followed by data values (expressions) to be read/printed
- C++ applies the appropriate pattern to each value
  - for interpreting characters in the input string and converting these to values
  - for generating output string from given values

printf(“format-string”, value, value, …)

- This function displays one or more values on the user terminal

  printf("%d is a number\n", N);
- If value of N is, say, 523, output produced by this function call is:

  523 is a number

- The format string has a “format specifier” (%d), which is used to interpret N and convert it to a formatted value. Other characters are displayed as they are. \n introduces a new line
- Specifiers can appear anywhere, each must correspond to a value appearing after the format string

Examples of format specification

%6d - 6 digit integer

%7s - string fitted in 7 characters space

%8.2f - float, 8 digits total, 2 after decimal point

%8.2g - same, switch to E notation if required

scanf(“format-string”, &var, &var, ..)

- scanf needs to be passed *pointers* to its arguments, so that the values read can be assigned to the proper destinations.
- Forgetting to pass a pointer is a very common error, and one which the compiler cannot detect
- The “format-string” is used to control interpretation of input characters (bytes containing ASCII codes)
- These input bytes contain values to be assigned to the objects pointed to by the remaining arguments to scanf.

Examples of scanf

```
int main(){
    int M, N; float x, y; char name[40];
    scanf("%d %d",&M, &N);
    cout<<M<<" "<<N<<endl;
    scanf(:"%f %f %s", &x, &y, name);
    cout<< x << " " << y <<endl;
    cout << name <<endl;
    return 0;
}
```

Another example of scanf

```
int main(){
    int a; float x; char itemcode[8];
    // The input data line contains
    //  123456fanbelt150.50
    scanf("%6d%7s%f", &a, itemcode, &x);
    printf("%6d %7s %f\n", a, itemcode, x);
    return 0;
}
```

Other string functions

- strcmp,
  - Compare two strings
- strcpy
  - Copying one string into another
- sprintf
  - ‘print’ formatted values onto a string, rather than to terminal

Using sprintf()

```
char   s[75];
int roll = 12345,  int batch =112;
….
sprintf( s, “%5d %3d\n”, roll, batch):
…
```

This will produce the following string in s

“12345 112\n”

Files

- A File is regarded as a large collection of bytes, stored outside the main memory, typically on a disk.
- Files on the disk are managed by the OS
  - By a component called file system.
- A new file can be created, data can be written to it, and data can be retrieved from it
- Data can be inserted into or deleted from an existing file

File properties

- Each file has certain properties.
  - It has a name (and extension), a ‘path’, permissions, etc.
- Physical location of a file and its properties, are known to the OS
- Logically, C++ treats a file as a large array of bytes
  - May contain character data (Text files)
  - May contain ‘encoded’ data (binary files)

Handling file within a program

- A file is handled through a file pointer, declared by

  FILE *fp;

  FILE *infile, *outfile;

- A file has to be opened. Records can then be read or written to the file. It should be closed at the end

Handling text files

- Consider a file

10101,Anil,112,
10102,Amit,111,
10103,Shefali,112,
10104,Rajesh,111,
10105,Nandan,111,
10106,Avinash,112,
10107,Srikant,112,
10108,Nilmani,111,
10110,Rajesh,112,
10115,Ketan,111,

Problem

- Read records (lines) from the text file, extract the three strings from each record in three separate arrays.
- Then construct a single string containing these three parts
  - Ensure that these parts have exactly 5, 29, and 3 characters

Algorithm Logic for our program

A sample line in the file is shown below:

10108,Nilmani,111,

read_text_file.cpp

```
int main() {
  char linestr[80];
  char sroll[6], sname[30], sbatch[4];
  int i,j,k,N =0;
  FILE *fp;
  fp = fopen("inputdata.txt", "r" );
  if (fp == NULL){
     cout << "Could not open file" << endl;
     return -1;
  }
  /* file is opened at this point. Each record will be read,
     then split into three parts, and these parts will be printed*/
```

Program …

```
fgets(linestr, 79, fp);
while (!feof (fp)){
    /* valid string, separate the parts */
    i =0; k =0;
    while ((sroll[i++] = linestr[k++]) != ',');
    sroll[i-1]='\0'; i=0;
    while ((sname[i++] = linestr[k++])!= ',');
    for (j = i-1; j<29; j++) sname[j] = ' ';
    sname[29] ='\0'; i=0;
    while ((sbatch[i++] = linestr[k++]) != ',');
    sbatch[i-1] = '\0';
```

Program …

```
        cout << N++ << "  " << sroll << "  ";
        cout << sname << "  " << sbatch << endl;
        fgets(linestr, 79, fp);
    }
    cout << "inputfile has been read and printed\n";
    cout << endl << endl;
    fclose(fp);

}
```

Program “read_write_text_files.cpp”

```
#include <iostream>
#include <cstring>
using namespace std;
int main() {
  char linestr[80]; char outstr[80];
  char sroll[6], sname[30], sbatch[4];
  int i,j,k,N =0;
  FILE *fp; FILE* fpout;
```

Program …

```
 fp = fopen("inputdata.txt", "r" );
 if (fp == NULL){
   cout << "Could not open file" << endl;
   return -1;
}

fpout = fopen ("studentdb.txt", "w");
if (fpout == NULL){
   cout << "Could not create output file" << endl;
   return -1;
}
```

Program …

```
/*Input  file is open at this point, read records one by one */
  fgets(linestr, 79, fp);
  while (!feof (fp)){
    /* valid string, separate the parts */
    i =0; k =0;
    while ((sroll[i++] = linestr[k++]) != ',');
    sroll[i-1]='\0'; i=0;
    while ((sname[i++] = linestr[k++])!= ',');
    for (j = i-1; j<29; j++) sname[j] = ' ';
    sname[29] ='\0'; i=0;
    while ((sbatch[i++] = linestr[k++]) != ',');
    sbatch[i-1] = '\0';
```

Program

```
    /* prepare output string and write to database*/
    sprintf(outstr, "%2d %5s %30s %3s\n",N,sroll,sname, sbatch);
    fputs(outstr,fpout);
    fgets(linestr, 79, fp);
    N=N+1;
  }
  cout << "inputfile has been read and printed\n";
  cout << " studentdb.txt file created\n";
  fclose(fp);  fclose(fpout);
  return 0;
}
```

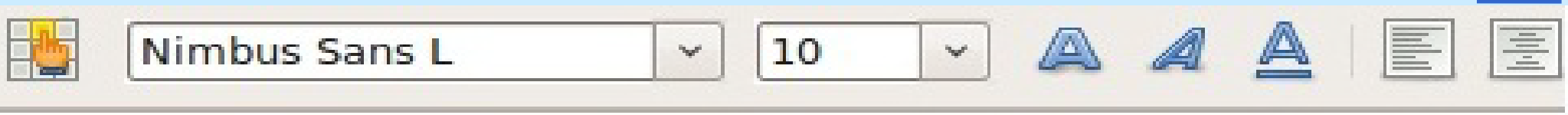
Execution results

```
$a.out
inputfile has been read and printed
 studentdb.txt file created
$
```

Results …

```
$cat studentdb.txt
 0 10101  Anil                112
 1 10102  Amit                111
 2 10103  Shefali             112
 3 10104  Rajesh              111
 4 10105  Nandan              111
 5 10106  Avinash             112
 6 10107  Srikant             112
 7 10108  Nilmani             111
 8 10110  Rajesh              112
 9 10115  Ketan               111
$
```

A sample spread sheet



	A	B	C	D	E
1	10101	Anil Shah	112	12.5	
2	10102	Amit Jadhav	111	15	
3	10103	Shephali Pandya	112	17	
4	10104	Rajesh Mashruwala	111	19	
5	10105	Nandan Meshram	111	16	
6	10106	Avinash Adsule	112	14	
7	10107	Srikant Rao	112	14.5	
8	10108	nilmani Raut	111	11.5	
9	10110	Rajesh Singh	112	10	
10	10115	Ketan Maheshwari	111	12	
11					
12					

Comma Separated Values format (.csv)

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10101,Anil Shah,112,12.5

10102,Amit Jadhav,111,15

10103,Shefali Pandya,112,17

10104,Rajesh Mashruwala,111,19

10105,Nandan Meshram,111,16

10106,Avinash Adsule,112,14

10107,Srikant Rao,112,14.5

10108,Nilmani Raut,111,11.5

10110,Rajesh Singh,112,10

10115,Ketan Maheshwari,111,12

Announcements

- Midsem Exam

- Schedule:

  Date and Time: Friday, 16th September 2011, 08:30 to 10:30

  Venue: Convocation Hall.

- You will have to check the exact seating arrangement which will be displayed in the Convocation Hall foyer, and take your seat
- Please assemble in the hall foyer latest by 08:15
- Midsem Exam will be open notes like the quiz.

- Syllabus: Every thing covered up to this lecture, except files

Programming Contest

- Programming Contest for CS101 1st Semester

(Curtsey: Mr Avinash Awate, Program director, Ekalavya project)

- Produce an industry standard program to output IIT JEE ranking
  Inputs :

  I.1) A file containing Roll number (7 digits) and marks in PCM
  I.2) Cutoff percentage (Qualifying top %ile in each rank)
  I.3) Number of merit list ranks to be output

Outputs:

O.1) Merit list comprising Rank and Roll number
O.2) Total number of candidates in merit list
O.3) Errors (invalid input and abnormal conditions)

Contest …

- You have to submit a file containing two functions

```
int readinput(FILE *inputfp)
        // returns number of valid student records
int meritlist(int cutoffpercentile, int ranksrequired)
        // returns number of students in merit list
```

Your code will call the following functions:

```
void printerror(int errornum, int linenum)
        // prints errors during processing
void printmerit(int rank, long rollnum)
        // prints a merit rank
```

Contest …

- Prizes to top 3 programmers of each slot (two sets)

  ` 5000, 3000, 2000

  If we get excellent quality programs, a further (timed) contest will be held for the 6 winners to decide the CODEMATSER of semester I

  DETAILED SPECIFICATION (Error Numbers/Test Files/Sample code) AVAILABLE on Moodle
  Queries to be sent to Anup Naik (anupnaik[at]cse.iitb.ac.in)

  Submission deadline: 2nd January 2012