Information and Computer Science Department

First Semester 161

ICS 103 – Computer Programming in C

Final Examination

Saturday, January 14, 2017

Duration: 120 minutes

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| Name: | KEY | Lect Serial # |  |

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Please tick your section:

|  |  |
| --- | --- |
| Instructor | Section |
| Mr. Said Abdallah Muhammad | [ ] 01 (UT 7:00 – 7:50) [ ] 02 (UT 7:00 – 7:50) |
| Dr. Hamood Al-Jamaan | [ ] 03 (UT 8:00 – 8:50) [ ] 04 (UT 8:00 – 8:50) |
| Dr. Rafiul Hassan | [ ] 05 (UT 11:00 – 11:50) [ ] 06 (UT 11:00 – 11:50)  [ ] 07 (UT 13:10 – 14:00) [ ] 08 (UT 13:10 – 14:00) |
| Dr. Muhammad Balah | [ ] 09 (MW 7:00 – 7:50) [ ] 10 (MW 7:00 – 7:50) |
| Mr. Muhammad Aslam | [ ] 11 (MW 8:00 – 8:50) [ ] 12 (MW 8:00 – 8:50) |
| Dr. Samer Arafat | [ ] 13 (MW 9:00 – 9:50) [ ] 14 (MW 9:00 – 9:50)  [ ] 15 (MW 10:00 – 10:50) [ ] 16 (MW 10:00 – 10:50) |
| Dr. Louai Al-Awami | [ ] 17 (MW 11:00 – 11:50) [ ] 18 (MW 11:00 – 11:50)  [ ] 19 (MW 13:10 – 14:00) [ ] 20 (MW 13:10 – 14:00) |

Instructions**:**

1. Answer all questions. Make sure your answers are clear and readable.

2. The exam is closed book and closed notes. No calculators or any helping aides are allowed. Make sure

to turn off your mobile phone and keep it in your pocket.

3. If there is no space on the front of a question’s page, use the back of the page. Indicate this clearly.

|  |  |  |  |
| --- | --- | --- | --- |
| Question # | Maximum Grade | Obtained Grade | Remarks |
| 1 | 15 |  |  |
| 2 | 35 |  |  |
| 3 | 15 |  |  |
| 4 | 15 |  |  |
| 5 | 20 |  |  |
| Total | 100 |  |  |

Question # 1 [15 points]

1. [5 points] Convert the following C if-statement into equivalent switch-statements. Assume that k and m are integer variables and that x is initialized.

|  |  |
| --- | --- |
| if(k == 2|| k == 5)  x += 2;  else{  if(m == 8)  x -= 3;  else if(m == 10)  x += 4;  } | **switch(k){**  **case 2:**  **case 5: x += 2;**  **break;**  **default: switch(m){**  **case 8: x -= 3;**  **break;**  **case 10: x += 4;**  **}**  **}** |

1. [5 points] Convert the following program fragment into an equivalent fragment that uses while-loops instead of for-loops:

|  |  |
| --- | --- |
| double product = 1 ;  int k, m;  for(k = 1; k < 16; k += 2){  for(m = k; m <= 12; m++ )  product \*= (k + m);  printf("p = %f\n",product);  } | **double product = 1;**  **int k, m;**  **k = 1;**  **while(k < 16){**  **m = k;**  **while(m <= 12){**  **product \*= (k + m);**  **m++;**  **}**  **printf("p = %f\n",product);**  **k += 2;**  **}** |

1. [5 points] Given the following declarations:

int k, m;

char ch = 'A';

Write C nested loops to print the following pattern:

**1A 2A 3A 4A 5A 6A**

**1B 2B 3B 4B 5B**

**1C 2C 3C 4C**

**1D 2D 3D**

**1E 2E**

**1F**

**for(k = 6; k >= 1; k--){**

**for(m = 1; m <= k; m++ ){**

**printf("%d%c ", m, ch);**

**}**

**ch++;**

**printf("\n");**

**}**

**Question # 2 [35 points]**

Write the output of each of the following C programs or program fragments:

|  |  |
| --- | --- |
| [3 points]  int x = 5, y = 8;  printf("%d\n", x++ + --y);  printf("%d %d\n", x, y); | Output:  **12**  **6 7** |
| [3 points]  #include <stdio.h>  #include <ctype.h>  int main(void){  char str[ ] = "Ab";  tolower(str[0]);  toupper(str[1]);  puts(str);  return 0;  } | Output:  **Ab** |
| [3 points]  What is the output if the input is:  DHAHRAN IS COLD TODAY  char str1[81], str2[81];  scanf("%s", str1);  gets(str2);  printf("%s", str2);  puts(str1);  printf("%s", str1); | Output:  **IS COLD TODAYDHAHRAN**  **DHAHRAN** |
| [5 points]  int matrix[][4] = {{5, 12, 8, 1},  {9, 5, 4, 2}, {3, 7, 1, 4},  {11, 20, 13, 16}}, k, m;  for(m = 2; m >= 0; m--){  for(k = 2; k >= 0; k--){  printf("%2d ",matrix[m][k]+ matrix[k][3]);  }  printf("\n");  } | Output:  **5 9 4**  **8 7 10**  **12 14 6** |
| [4 points]  int a = 4, b = 5, \*p1, \*p2;  p1 = &a;  p2 = &b;  \*p2 = \*p2 + 5;  b = \*p1 \* \*p2;  \*p1 = 6;  printf("%d %d", a, \*p2 ); | Output:  **6 40** |

|  |  |
| --- | --- |
| [5 points]  #include <stdio.h>  int funcn(int a, int\* b);  int main(void) {  int x[] = {1, 2, 3, 4};  printf("%d %d\n",funcn(x[1], &x[3]), x[3]);  printf("%d %d\n", x[1], x[3]);  return 0;  }  int funcn(int a, int\* b) {  \*b = 3 \* \*b;  a = 2;  return a + \*b;  } | Output:  **14 4**  **2 12** |
| [7 points]  #include <stdio.h>  #include <strings.h>  int main(void) {  char strings[][80]  = {"THIS", "IS", "THE", "BEST"};  int k, m;  for(k = 0; k <= 3; k++){  for(m = strlen(strings[k]) - 1; m >= 0; m--){  printf("%c", strings[k][m]);  }  printf("\n");  }  printf("\n");  for(k = 0; k <= 2; k++){  strcat(strings[k], strings[k + 1]);  }  for(k = 0;k < 4; k++)  puts(strings[k]);    return 0;  } | Output:  **SIHT**  **SI**  **EHT**  **TSEB**    **THISIS**  **ISTHE**  **THEBEST**  **BEST** |
| [5 points]  char str[ ] = "\n32\tRba\*";  int k;  printf("%d\n", strlen(str));  for(k = 0; k < strlen(str); k++){  if( islower(str[k]))  str[k] = toupper(str[k]);  else if(isspace(str[k]))  str[k] = '\*';  else if(isdigit(str[k]))  str[k] = str[k] + 3;  else  str[k] = '?';  }  puts(str); | Output:  **8**  **\*65\*?BA?** |

**Question # 3 [15 points]**

Write a function that receives two integer 1D-arrays **x** and **y** and the sizes of these arrays: **sizeX** and **sizeY** [Assume that each of the arrays is filled with values]

The function returns **1** if **y** contains a sub-array whose size is the same as **sizeX** and whose sum equals the sum of array **x**. If no such sub-array of **y** exists the function returns **0**.

Examples for four different calls to the function:

|  |  |  |  |
| --- | --- | --- | --- |
| Array x | Array y | Returned value | Reason |
| {2, 1, 5} | {**3, 2, 3**, 4, 1} | 1 | Sum of subarray {3, 2, 3} equals sum of array x |
| {2, 1, 5, 3} | {3, 2, **3, 4, 1, 3**, 5} | 1 | Sum of subarray {3, 4, 1, 3} equals sum of array x |
| {4, 6, 9} | {4, 6} | 0 | No subarray of y of size 3 has sum equal to array x |
| {3, 2, 5} | {3, 2, 3, 7, 1} | 0 | No subarray of y of size 3 has sum equal to array x |

For line 2 where x = {2, 1, 5, 3} and sumx = 11. The subarrays of **y** checked are:

{3, 2, 3, 4} with sum = 12, then {2, 3, 4, 1} with sum = 10, then {3, 4, 1, 3} with sum = 11 which is equal sumx. The function will stop here and return 1.

For the last line where x = {3, 2, 5} and sumx = 10. The subarrays of **y** checked are:

{3, 2, 3} with sum = 8, then {2, 3, 7} with sum = 12, then the last subarray is {3, 7, 1} with sum = 11. Since all subarrays sums are not equal to 10 the function returns 0.

**Note:** Your function must be general and it must not contain **scanf** or **printf**.

DO NOT WRITE THE MAIN FUNCTION

**int subArrayExists(int x[], int y[], int sizeX, int sizeY){**

**if(sizeX > sizeY)**

**return 0;**

**int i, k, sumX = 0, sumY;**

**for(k = 0; k <= sizeX - 1; k++)**

**sumX += x[k];**

**i = 0;**

**while(sizeX + i - 1 < sizeY){**

**sumY = 0;**

**for(k = i; k <= sizeX + i - 1; k++){**

**sumY += y[k];**

**}**

**if(sumX == sumY)**

**return 1;**

**else**

**i++;**

**}**

**return 0;**

**}**

**Question # 4 [15 points]**

Write a function that receives the number of students in a class, the number of quizzes they have taken, and a 2D-array containing the student scores, where each row stores the scores of a particular student. The function returns an integer 1D-array containing the quiz numbers of the Quizzes with average above **1.5** and the size of this array.

**Sample** input array for a class of 6 students who have taken 6 quizzes each:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Qz1** | **Qz2** | **Qz3** | **Qz4** | **Qz5** | **Qz6** |  |  |  |  |
| Student1 | 3.0 | 1.0 | 3.0 | 1.0 | 0.5 | 1.0 | . . . |  |  |  |
| Student2 | 2.7 | 1.7 | 3.0 | 1.8 | 1.5 | 1.8 | . . . |  |  |  |
| Student3 | 3.0 | 0.0 | 2.9 | 1.0 | 1.1 | 2.0 | . . . |  |  |  |
| Student4 | 2.5 | 1.2 | 2.8 | 1.2 | 0.0 | 1.2 | . . . |  |  |  |
| Student5 | 3.0 | 1.5 | 3.0 | 1.2 | 1.3 | 1.5 | . . . |  |  |  |
| Student6 | 2.7 | 1.3 | 3.0 | 1.4 | 0.0 | 1.7 | . . . |  |  |  |
|  | .  .  . | .  .  . | .  .  . | .  .  . | .  .  . |  |  |  |  |  |
|  |  |  |  |  |  |  | . . . |  |  |  |
|  |  |  |  |  |  |  | . . . |  |  |  |

Since the averages of Quiz1, Quiz2, Quiz3, Quiz4, Quiz5 and Quiz6 are **2.81**, 1.11, **2.95**, 1.26, 0.73 and **1.53** respectively, the returned output array of quiz numbers will be:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 3 | 6 |  |  | . . . |  |  |

And the returned array size is 3

**Note:**

* You may assume that a constant **MAXQUIZZES** is declared before the main function.
* Your function must be general. It must work for any valid number of students and any valid number of quizzes.
* Your function must not contain **scanf** or **printf** calls.
* DO NOT WRITE THE MAIN FUNCTION.

**void getQuizzNumbers(int numStudents, int numQuizzes,**

**double scores[][MAXQUIZZES], int quizNums[], int\* quizCount){**

**int colmn, row, index = 0;**

**double quizSum, average;**

**for(colmn = 0; colmn <= numQuizzes - 1; colmn++){**

**quizSum = 0;**

**for(row = 0; row <= numStudents - 1; row++){**

**quizSum += scores[row][colmn];**

**}**

**average = quizSum / numStudents;**

**if(average > 1.5){**

**quizNums[index] = colmn + 1;**

**index++;**

**}**

**}**

**\*quizCount = index;**

**}**

**Question # 5 [20 points]**

Write a complete C program that reads a text-file **input.txt** that contains English words and writes to an output file **output.txt** all words in **input.txt** that are in uppercase followed by the number of uppercase words found. Your program must display an error message on the screen if **input.txt** does not have an uppercase word.

A word is separated from the next word by any number of the following nine characters: blank character **‘ ‘** , tab character **‘\t’** , new line character **‘\n’** **,** full stop **‘.‘** , comma **‘,‘** , semi-colon  **‘;‘** , colon **‘:‘**, exclamation mark **‘!‘**, and question mark **‘?’**.

Note:

* Your program must be general; it must work for any input text-file.
* You may assume the maximum number of characters in a line is 120
* Your program **may** use an **int** function **wordIsUpperCase** that receives a string and returns **1** if all the characters in the string are uppercase; otherwise it returns **0**

**[Note: A function that receives a string may also receive a pointer of type char\*]**

* The behavior of your program must be similar to the sample run shown below.

Sample input.txt

|  |
| --- |
| this IS  a story OF a SMALL boy, aged NINE  WHO saved the LIFE of a person.  It HAPPENED one COLD;;;DAY  In,a small VILLAGE  In the MOUNTAINS south OF here.  What????a wonderful story! |

Sample output.txt

|  |
| --- |
| IS  OF SMALL NINE  WHO LIFE  HAPPENED COLD DAY  VILLAGE  MOUNTAINS OF  Number of uppercase words found = 12 |

**// Solution 01: Assuming a maximum line size of 120 characters and using function**

**#include <stdio.h>**

**#include <stdlib.h>**

**#include <string.h>**

**#include <ctype.h>**

**int wordIsUpperCase(char st[]);**

**int main(void){**

**FILE \*infile, \*outfile;**

**infile = fopen("input.txt", "r");**

**if(infile == NULL){**

**printf("Error in opening input.txt");**

**exit(1);**

**}**

**outfile = fopen("output.txt", "w");**

**char line[121], delimeters[] = " .,;:!?\n\t";**

**char \*word;**

**int wordCount = 0, k;**

**while( fgets(line, 121, infile) != NULL){**

**word = strtok(line, delimeters);**

**while(word != NULL){**

**if(wordIsUpperCase(word)){**

**fprintf(outfile, "%s ", word);**

**wordCount++;**

**}**

**word = strtok(NULL, delimeters);**

**}**

**fprintf(outfile, "\n");**

**}**

**if(wordCount == 0)**

**printf("Error: No uppecase word in input.txt");**

**else**

**fprintf(outfile,"Number of uppercase words found = %d\n",wordCount);**

**fclose(infile);**

**fclose(outfile);**

**return 0;**

**}**

**int wordIsUpperCase(char st[]){**

**int i;**

**for(i=0; st[i]!='\0';i++) {**

**if(!isupper(st[i]))**

**return 0;**

**}**

**return 1;**

**}**

**Solution 02 : Assuming a maximum line size of 120 characters**

**#include <stdio.h>**

**#include <stdlib.h>**

**#include <string.h>**

**#include <ctype.h>**

**int main(void){**

**FILE \*infile, \*outfile;**

**infile = fopen("input.txt", "r");**

**if(infile == NULL){**

**printf("Error in opening input.txt");**

**exit(1);**

**}**

**outfile = fopen("output.txt", "w");**

**char line[121], delimeters[] = " .,;:!?\n\t";**

**char \*word;**

**int wordCount = 0, wordIsUpperCase, k;**

**while( fgets(line, 121, infile) != NULL){**

**word = strtok(line, delimeters);**

**while(word != NULL){**

**wordIsUpperCase = 1;**

**for(k = 0; k <= strlen(word) - 1; k++){**

**if(! isupper(word[k])){**

**wordIsUpperCase = 0;**

**break;**

**}**

**}**

**if(wordIsUpperCase){**

**fprintf(outfile, "%s ", word);**

**wordCount++;**

**}**

**word = strtok(NULL, delimeters);**

**}**

**fprintf(outfile, "\n");**

**}**

**if(wordCount == 0)**

**printf("Error: No uppecase word in input.txt");**

**else**

**fprintf(outfile,"Number of uppercase words found = %d\n",wordCount);**

**fclose(infile);**

**fclose(outfile);**

**return 0;**

**}**

**Solution 03: Solution that does not use strtok and that can accommodate any line size**

**#include <stdio.h>**

**#include <stdlib.h>**

**#include <ctype.h>**

**int main(void){**

**FILE \*infile, \*outfile;**

**infile = fopen("input.txt", "r");**

**if(infile == NULL){**

**printf("Error in opening input.txt");**

**exit(1);**

**}**

**outfile = fopen("output.txt", "w");**

**int inWord = 0, k, index = 0, wordCount = 0, wordIsUpperCase;**

**char ch, word[20];**

**while( fscanf(infile, "%c", &ch) != EOF){**

**if(isalpha(ch)){**

**inWord = 1;**

**word[index] = ch;**

**index++;**

**}**

**else if(inWord && ! isalpha(ch)){**

**inWord = 0;**

**wordIsUpperCase = 1;**

**for(k = 0; k < index; k++){**

**if(! isupper(word[k])){**

**wordIsUpperCase = 0;**

**break;**

**}**

**}**

**if(wordIsUpperCase){**

**word[index] = '\0';**

**wordCount++;**

**fprintf(outfile, "%s ", word);**

**}**

**index = 0;**

**}**

**if(ch == '\n')**

**fprintf(outfile, "\n");**

**}**

**if(wordCount == 0)**

**printf("Error: The file has no uppercase word");**

**else**

**fprintf(outfile,"Number of uppercase words found = %d\n",wordCount);**

**fclose(infile);**

**fclose(outfile);**

**return 0;**

**}**