INTRODUCTION TO SCIENTIFIC AND ENGINEERING COMPUTATION
2017-2018 SPRING FINAL EXAM

120 minutes Jun 1, 2018

Id	Full Name	Signature

Q1	Q2	Q3	Total
/ 30	/ 35	/ 35	/ 100

No questions are allowed. Answer the questions to the best of your understanding. If you need to make extra assumptions, state them clearly. Make sure that all your answers are sufficiently explained. WHEN YOU ARE ASKED TO WRITE A FUNCTION, ONLY WRITE THAT FUNCTION, NOT A WHOLE PROGRAM.

1. When scoring a set in a volleyball game, the team that wins a rally (one round of play) earns a point, regardless of which team is serving. A set is played up to 25 points, but must be won by at least two points.

   (a) Simulate the scoring in one set of game using the code pattern given below. At every iteration, the code prints the points for both teams. Assume that both teams are equally likely to win each rally.

```
srand(___)
int team1 = ___
int team2 = ___
while (___) {
    int outcome = ___
    if (outcome == ___) {
        ___
    } else {
        ___
    }
    printf("%2d - %2d\n", team1, team2);
}
```

   WRITE YOUR CODE BELOW.

(b) In a different style of scoring, a team can earn a point only if they win a rally when they are serving. If they lose during their serve, no team earns a point and the other team serves the next rally. Sets are played up to 15 points, but must be won by at least two points. Implement the same piece of code as in (a) using this scoring style. At each iteration, also print which team is serving.

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2. The Luhn algorithm can be used to calculate whether a number sequence (such as a credit card number) is valid or not. The steps are as follows:

   - Sum up all digits starting from the end.
   - However, each second digit (2nd from the end, 4th from the end and so on) is not added "as is" - instead it is multiplied by 2. If the multiplication produces a value greater than 9, subtract 9 from it.
   - If the sum is not a multiple of 10, then the number is invalid.

   For example, if the number sequence is "4123175904981754", the calculation becomes:

   $$4+(5*2-9)+7+(1*2)+8+(9*2-9)+4+(0*2)+9+(5*2-9)+7+(1*2)+3+(2*2)+1+(4*2) = 70$$

   (a) Write a function `check_num` which takes a string of digits and returns a boolean value indicating whether the sequence is valid or not. For example, `check_num("4123175904981754")` should return `true`. You can assume that the input string will not contain any non-digit characters. *Note*: If the variable `c` is a character, the expression `c-'0'` will give you its integer value. For example, `'7'-'0'=7`.

(b) Write a function `fix_num` which takes a string of digits where one of the digits is unknown (represented by `a '?'`) and replaces it with the appropriate digit to make the sequence valid. For example, if the `digits` variable contains the string "`41231?5904981754`", then after calling `fix_num(digits)` its content should be "`4123175904981754`". You can assume that there will be one and only one `'?'` in the input string.

3) Wrıte your Code on a seperate sheet(s)

In order to perform update operation on a text file, one may suggest to append the new file to the end of the file and invalidate the previous record. In order to invalidation previous records one may use a counter to set the valid instance count for the valid record.

In the example given below (Fig.1), a is representing the content of the text file (xref.txt) . The first column keeps the unique keys (student ids) and the second column keeps the number of records in the data file. b is representing the content of the text file (data.txt) consisting of records. A record in the data file consists of a student id (the key, the unique value), a name, a surname, three integers for examination results and a double for average.

The valid record for the key 150150162 is the second line from the bottom since the counter is set to 3. Similarly the for the key 150160156, it is the first line in data file since the counter is 1.

150160156	1
150140149	1
150160128	2
150150162	3
150140112	1

(a) xref.txt

```
150160156 Donald Knuth 80 70 85
150140149 Grace Hopper 100 90 74
150160128 Richard Stallman 0 0 0 0.00
150150162 Mark Zuckerberg 30
150150162 Mark Zuckerberg 30 20
150160128 Richard Stallman 60 75 50
150150162 Mark Zuckerberg 30 20 10
150140112 Edger Dijkstra 80 70 96
```

(b) data.txt

Fig 1. Accessing the recent update for a key to a text file through a cross reference text file.

Write C functions to perform the mentioned operations. Please note that there will be **no use of user I/O function calls such as printf and scanf in the functions** you are going to implement.

a) to search for a record (to be used in the following functions)
b) to read a record
c) to write a new record /to update an existing record
d) to delete a record (you are expected to find a way to represent a deleted record first)
e) to create a new file consisting of only the latest record for a key.