Study Guide Project

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In this project, we display questions and answer them. If the answer is correct, we display true, otherwise, we display false. This project can serve as a study guide for our courses or Civics (History and Government) Questions for the Naturalization Test, as in `https://www.uscis.gov/sites/default/files/document/questions-and-answers/100q.pdf`.

Warning:

1. These are copyrighted materials and cannot be uploaded to the Internet.

2. Only ask help from teaching staff of this course.

3. Use solutions from ChatGPT or online tutoring websites like, but not limited to, chegg.com, violates academic integrity and is not allowed.

1 Task A

1.1 Requirements

In this task, we initialize two questions and their expected answers, then take answers from users. If a user-input answer matches exactly, **including spelling, spaces and cases**, to the provided expected answer, display true, otherwise, display false.

The first question is as follows.

```
What is -1 + 5 / 3 ?
```

The expected answer is 0. Explanation is as follows.

1. Division operator / has higher precedance than plus operator +, so 5 / 3 runs first. Since both numerator 5 and denominator 3 are integers, the division result should be an integer. It is like to divide 5 pens among three person, each person gets 1 pen. That is, 5 / 3 returns 1.

2. Add -1 and the result of 5 / 3, which is 1, the sum is 0.

The second question is

```
Assume that n is properly declared and initialized. Write a condition to represent that
    n does NOT satisify 0 < n < 100.
```

An expected answer is (`n <= 0 || n >= 100`). That is, either n is less than or equal to 0 or n is larger than or equal to 100. Here is an explanation.

1. Pay attention to borderline case. For example, `n <= 0` cannot be replaced by `n < 0`. Reason: when n is 0, it does not satisfy `0 < n < 100`.

   Similarly, `n >= 100` cannot be replaced by `n > 100`.

2. A condition in C++ should be enclosed in a pair of parentheses.

3. Cannot write as `(n <= 0 && n >= 100)`, where && means and. Never can integer n satisfy `n <= 0` and `n >= 100`. That is, integer that is less than or equal to 0 and at the same time is larger than or equals to 100 does not exist.

1.2 Steps of Task A

1. Name the source code as `checkAnswer.cpp`.

2. Declare two string variables, one for question text, the other for expected answer.

   (a) Even though some answers are numbers, for example, the answer to question `What is -1 + 5 / 3 ?` is 0, we still need to save them as strings, to be consistent with all other problems whose answers are strings.

3. Initialize question text to be the question text of the first problem and expected answer to be the corresponding value.

4. Delcare a string variable to hold user answer.

5. Use getline function to input from console and put the value to user answer.

   (a) `cin >> variable;` takes input from console and stop at the first space character or new line character, whichever is encountered first. The variable can be of primitive type of int, double, string, and char. That is, >> (extraction or push from) operator reads a word from the keyboard buffer, then extract the value to the corresponding type of the variable as in `cin >> variable;`

   (b) `getline(cin, stringVariable);` takes a whole line from console and put the value to `stringVariable`. The first parameter of `getline` is either the Standard input stream object like cin or an `ifstream` object, which reads input from a file. The second parameter must be a string variable. That is, `getline` can only save the input to a string.

6. If the input user answer match exactly to the expected answer, print true, otherwise, print false.

   (a) Hint: you may print a boolean (type `bool` in C++) value `cout << boolean_expression;`, where `boolean_expression` is obtained by comparing two variables. If the result is true, the print out is 1, otherwise, the print out is 0.

   However, we would like to see word "true" instead of 1 and "false" instead of 0. We can use `boolalpha` from standard name space, illustrated as follows. Then, if the boolean expression returns true, then the print is true, otherwise, the print is false.

   ```
   cout << boolalpha << boolean_expression;
   ```

7. Work the second problem similarly.

A sample input is as follows.

```
What is -1 + 5 / 3 ?
Your Answer: 2
false

Assume that n is properly declared and initialized. Write a condition to represent that
    n does NOT satisify 0 < n < 100.
Your Answer: (n >= 0 && n <= 100)
false
```

Another sample run is as follows.

```
What is -1 + 5 / 3 ?
Your Answer: 0
true

Assume that n is properly declared and initialized. Write a condition to represent that
    n does NOT satisify 0 < n < 100.
Your Answer: (n <= 0 || n >= 100)
true
```

1.3 Resources

Please read class notes on January 30, 2025 and February 3, 2025 to learn input and output statements.
You may also use branch statements.

Pay attention to the difference between `cin >> variable;` and `getline(cin, stringVariable);`.

2 Task B

2.1 Requirements

In this task, we do the following.

1. Define a source code called `checkAnswer_array.cpp`.

2. Declare and initialize two arrays of strings.

   (a) The first array stores question texts. Save the following questions in the given order.

   ```
   1 Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?
   2
   3 Given string arr[] = {"Hello", "Hi", "Hey"}, what is arr[2]?
   4
   5 Given two double variables a and b, find out the return of a^b, that is, a
         raised to the power of b. Hint: use pow function.
   6
   ```

```
7   Suppose n is properly declared and initialized as an integer. Write a
        statement to throw away the least significant digit from n. For example, if
         n is 12, after the statement, n changes to be 1.

8

9   Assume that n is properly declared and initialized. Write a statement to
        declare lastDigit as an integer and initialize it to be the least
        significant digit of integer n. Suppose n is 123, after the statement,
        lastDigit is 3.

10

11  What is the output?

12  #include <iostream>

13  using namespace std;

14

15  int main() {

16      int count = 0;

17      for (int i = -6; i < 2; i += 3)

18          count++;

19

20      cout << count << endl;

21      return 0;

22  }

23

24  Write a condition to represent that char variable ch is none of the following:
        'a', 'b', or 'c'.
```

Here are codes to declare and initialize the array called `texts`.

```
1       string texts[] = {
2       "Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?",
3       "Given string arr[] = {\"Hello\", \"Hi\", \"Hey\"}, what is arr[2]?",
4       "Given two double variables a and b, find out the return of a^b, that is,
        a raised to the power of b. Hint: use pow function.",
5        "Suppose n is properly declared and initialized as an integer. Write a
        statement to throw away the least significant digit from n. For example, if
         n is 12, after the statement, n changes to be 1.",
6        "Assume that n is properly declared and initialized. Write a statement to
        declare lastDigit as an integer and initialize it to be the least
        significant digit of integer n. Suppose n is 123, after the statement,
        lastDigit is 3.",
7        "What is the output?\n#include <iostream>\nusing namespace std;\n\nint
        main() {\n    int count = 0;\n    for (int i = -6; i < 2; i += 3)\n
        count++;\n\n    cout << count << endl;\n    return 0;\n}",
8        "Write a condition to represent that char variable ch is none of the
        following: 'a', 'b', or 'c'."
9        };
```

Here is some explanation.

i. To include double quotes symbols " inside a string, need to use escape sequence \", as shown in Line 3.
      Without backslash \ immediately before double quotes ", double quotes " by itself is treated as beginning or end of a string literal, which results in compilation error.
   ii. Similarly, \n is a newline character. That is, move to the next line. See Line 7.

```
1  "Given string arr[] = {\"Hello\", \"Hi\", \"Hey\"}, what is arr[2]?"
```

(b) The second array saves the expected answers for the above problems. The answers are as follows. Warning: need to save each answer as a string and save in the second array in the same order.

```
1   'B'
2
3   "Hey"
4
5   pow(a, b)
6
7   n /= 10;
8
9   int lastDigit = n % 10;
10
11  3
12
13  (ch != 'a' && ch != 'b' && ch != 'c')
```

3. Display the above question texts, get answers from users. Compare answers with users. If the user answer matches the expected answer, display "true" (without quotes), otherwise, display "false".

4. Find out the number of correct answers and print out the value.

5. Calculate percentage of correct answers.

6. If percentage is at least 90%, print "excellent", otherwise, if percentage is at least 80%, print "good", otherwise, if percentage is at least 60%, print "pass", otherwise, print "please ask help ASAP".

2.2   A sample run when result is excellent

Highlight parts are user inputs.

```
1  Question 1: Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?
2  Enter your answer: 'B'
3  true
4
5  Question 2: Given string arr[] = {"Hello", "Hi", "Hey"}, what is arr[2]?
6  Enter your answer: "Hey"
7  true
8
9  Question 3: Given two double variables a and b, find out the return of a^b, that is, a
      raised to the power of b. Hint: use pow function.
```

```
10   Enter your answer: pow(a, b)
11   true
12
13   Question 4: Suppose n is properly declared and initialized as an integer. Write a
         statement to throw away the least significant digit from n. For example, if n is 12,
          after the statement, n changes to be 1.
14   Enter your answer: n /= 10;
15   true
16
17   Question 5: Assume that n is properly declared and initialized. Write a statement to
         declare lastDigit as an integer and initialize it to be the least significant digit
         of integer n. Suppose n is 123, after the statement, lastDigit is 3.
18   Enter your answer: int lastDigit = n % 10;
19   true
20
21   Question 6: What is the output?
22   #include <iostream>
23   using namespace std;
24
25   int main() {
26       int count = 0;
27       for (int i = -6; i < 2; i += 3)
28           count++;
29
30       cout << count << endl;
31       return 0;
32   }
33   Enter your answer: 3
34   true
35
36   Question 7: Write a condition to represent that char variable ch is none of the
         following: 'a', 'b', or 'c'.
37   Enter your answer: (ch != 'a' && ch != 'b' && ch != 'c')
38   true
39
40   number of correct problems: 7
41   percentage of correct: 100%
42   excellent
```

2.3   A sample run when result is good

Highlight parts are user inputs.

```
1   Question 1: Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?
2   Enter your answer: 'B'
3   true
```

Question 2: Given string arr[] = {"Hello", "Hi", "Hey"}, what is arr[2]?
Enter your answer: "Hey"
true

Question 3: Given two double variables a and b, find out the return of a^b, that is, a
    raised to the power of b. Hint: use pow function.
Enter your answer: pow(a, b)
true

Question 4: Suppose n is properly declared and initialized as an integer. Write a
    statement to throw away the least significant digit from n. For example, if n is 12,
    after the statement, n changes to be 1.
Enter your answer: n /= 10;
true

Question 5: Assume that n is properly declared and initialized. Write a statement to
    declare lastDigit as an integer and initialize it to be the least significant digit
    of integer n. Suppose n is 123, after the statement, lastDigit is 3.
Enter your answer: int lastDigit = n % 10;
true

Question 6: What is the output?
```
#include <iostream>
using namespace std;

int main() {
    int count = 0;
    for (int i = -6; i < 2; i += 3)
        count++;

    cout << count << endl;
    return 0;
}
```
Enter your answer: 3
true

Question 7: Write a condition to represent that char variable ch is none of the
    following: 'a', 'b', or 'c'.
Enter your answer: (ch != 'a' || ch != 'b' || ch != 'c')
false

number of correct problems: 6
percentage of correct: 85.7143%
good

2.4 Resources

To finish Task B, you need to learn array and repetition statements. See notes on Feb 6 and Feb 10.

3 Task C

In Task A, we can only work two problems. In Task B, we organize two arrays, one for question text, the other for expected answers. However, if we want to add more problems, we need to change the source codes, recompile and rerun the code.

In this task, we read from a text file with following formats. Then organize the contents in an array of questions. Then answer questions.

```
1  question: question text
2  answer: expected answer for the question
3  explanation: explan why we get the answer
4  version: year and version of an exam
5  label: problem label in the original exam
6  type: keywords for related topics for the question
```

Note that question text and answer are must, but explanation, type, version, and label can be optional.

The following is `cs135_midterm_f24_v2.txt`, which contains the ten short-answer questions in the midterm of Fall 2024, V2.

```
1  question: Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?
2  answer: 'B'
3  explanation: arr[1] is the second element of array arr, which is 'B' in this example.
4  version: f24 v2
5  label: 1.1
6  type: array
7
8  question: Declare function increase, given an integer array arr with size many elements
      , increase each element of the array by 1. Return type is void. Define the function
      header (no implementation is needed).
9  answer: void increase(int arr[], int size);
10 explanation: (1) the first parameter is int arr[], the name of array arr, which also
      implies the address of the first element of array.
11 (2) the second parameter represents the number of elements of the array.
12 version: f24 v2
13 label: 1.2
14 type: function; array
15
16
17 question: Assume that n is properly declared and initialized. Write a statement to
      declare lastDigit as an integer and initialize it to be the least significant digit
      of integer n. Suppose n is 123, after the statement, lastDigit is 3.
18 answer: int lastDigit = n % 10;
19 explanation: (1) operator % is called remainder or modular operator.
```

(2) For example, 12 % 10 means the remainder when dividing 12 pens among 10 students, each student gets 1 pen, and there are 2 pens left.

(3) In general, n % 10 returns the last digit, or the rightmost digit (least significant digit), of n.

(4) int lastDigit = n % 10; is a statement to declare lastDigit as an int and initialize it by the last digit of n.

version: f24 v2

label: 1.3

type: modular; remainder

question: What is the output?

```
string tens_name(int n);

int main() {
    cout << tens_name(82) << endl;
    return 0;
}

string tens_name(int n) {
    if (n < 20 || n > 99)
        return "";

    string names[] = {"", "", "twenty", "thirty", "forty", "fifty", "sixty", "seventy", "eighty", "ninety"};

    return names[n / 10];
}
```
answer: eighty

explanation: (1) When calling tens_name(82), n in tens_name is initialized to be 82.

(2) Since 82 is not less than 20 or 82 is not larger than 99, no return "";

(3) 82 / 10 is integer division. It is like to divide 82 pens among 10 students, each student get 8 pens. So 82 / 10 returns 8.

(4) names[n / 10] is names[82 / 10], which is names[8].

```
index    0  1     2       3      4      5      6       7        8

element +--+--+--------+-------+------+------+------+--------+-------+...
        |""|""|"twenty"|"thirty"|"forty"|"fifty"|"sixty"|"seventy"|"eighty"|...
        +--+--+--------+-------+------+------+------+--------+-------+...
```

(5) The return of tens_name(82) is "eighty".

(6) In main function, print tens_name(82), so the print out is "eighty" (without quotes).

version: f24 v2

9

label: 1.4
type: modular; remainder; array

question: Given string greeting = "How are you?"; What is the value for greeting.substr (4, 5)?
answer: "are y"
explanation: (1) greeting.substr(4, 5) extracts a substring from greeting from its index 4 and span 5 characters.
(2) The character indexed at 4 in string greeting with value "How are you?" is the fifth character, which is letter 'a'.
(3) Starting from letter 'a', take a total of 5 letters. And we get "are y".
version: f24 v2
label: 1.5
type: string; substring

question: What is the value of 2 - 3 / 2?
answer: 1
explanation: (1) operator / has higher precedence than operator -.
(2) 3 / 2 is integer division, which returns 1. It can be interpreted as 3 pens divided by 2 persons, each person gets one (1) pen.
(3) 2 - 3 / 2 is the same as 2 - 1, which is 1.
version: f24 v2
label: 1.6
type: arithmetic; integer division

question: The area of a trapezoid with bases a, b, and height h is (a+b)/2 h. Assume that a, b, h are properly declared as double types and initialized, write a statement to declare area and save the value of the area.
answer: double area = 1 / 2.0 * (a+b) * h;
explanation: (1) Cannot use 1 / 2. * (a + b) * h; which is not a statement.
(2) Cannot use double area = 1 / 2 * (a + b) * h; since 1 / 2 returns 0.
(3) 1 / 2.0 returns 0.5.
version: f24 v2
label: 1.7
type: arithmetic; integer division

question: What is the output of the following code?

```
#include <iostream>
using namespace std;

int main() {
    int count = 0;
    for (int i = 9; i >= 2; i -= 3)
```

```
        count++;

    cout << count << endl;

    return 0;
}
```

answer: 3
explanation: Variable i starts from 9 and counts starts from 0.

i	i >= 2 ?	count++;	i -= 3
9	yes	count is 1	i is 6
6	yes	count is 2	i is 3
3	yes	count is 3	i is 0
0	no		

After the loop, print the value of count, which is 3.
version: f24 v2
label: 1.8
type: repetition

question: Write a statement to call foo function on integer variables a and b, both are properly declared and initialized.
```
void foo(int& a, int& b);
```
answer: foo(a, b);
explanation: (1) int& means to pass by reference, it is like the original copy of int. So the first paramerer is a.
(2) Similarly, the second parameter is b. Do not forget to add ; after calling the function.
(3) Return type of foo(a, b) is void. There is no need to use a variable to hold the return of foo function.
version: f24 v2
label: 1.9
type: function

question: Write a condition in C++ to represent that an integer variable n is in the range of [60,80], where both ends are included, that is, 60 <= n <= 80 in mathematic representation.
answer: (n >= 60 && n <= 80)
explanation: (1) && means and. That is, n >= 60 and n <= 80.
(2) Condition in C++ needs to be enclosed in a pair of parentheses.

```
140  (3) Warning: cannot write (n >= 60 && n <= 80) as (60 <= n <= 80). Otherwise, suppose n
         is 90, then 60 <= n returns true, which is 1.
141  (4) Also, 1 <= 80 returns true. However, 90 is not in [60,80].
142  version: f24 v2
143  label: 1.10
144  type: condition
```

Here is another file `civics_65_20.txt`.

```
1   source: https://www.uscis.gov/sites/default/files/document/questions-and-answers/100q.
        pdf
2   rev 1/19
3   Civics Questions for the 65/20 Exemption
4
5   The Immigration and Nationality Act provides for special consideration of the civics
        test for applicants who, at the time of filing their Form N-400, Application for
        Naturalization, are over 65 years old and have been a permanent resident for at
        least 20 years. These applicants qualify to take the civics test in the language of
        their choice. They are also given special consideration as they are only required to
         study 20 of the 100 civics test questions for the naturalization test.
6
7
8   question: What is one right or freedom from the First Amendment?
9   answer: speech
10  type: Principles of American Democracy
11
12  question: What is the economic system in the United States?
13  answer: capitalist economy
14  type: Principles of American Democracy
15
16  question: Name one branch or part of the government.
17  answer: Congress
18  type: System of Government
19
20  question: What are the two parts of the U.S. Congress?
21  answer: the Senate and House (of Representatives)
22  type: System of Government
23
24  question: Who is one of your state's U.S. Senators now?
25  answer: Chuck Shumer
26  type: System of Government
27
28  question: In what month do we vote for President?
29  answer: November
30  type: System of Government
31
32  question: What is the name of the President of the United States now?
```

```
33   answer: Donald Trump
34   type: System of Government
35
36   question: What is the capital of your state?
37   answer: Albany
38   type: System of Government
39
40   question: What are the two major political parties in the United States?
41   answer: Democratic and Republican
42   type: System of Government
43
44   question: What is one responsibility that is only for United States citizens?
45   answer: serve on a jury
46   type: Rights and Responsibilities
47
48   question: How old do citizens have to be to vote for President?
49   answer: eighteen (18) and older
50   type: Rights and Responsibilities
51
52   question: When is the last day you can send in federal income tax forms?
53   answer: April 15
54   type: Rights and Responsibilities
55
56   question: Who was the first President?
57   answer: (George) Washington
58   type: Colonial Period and Independence
59
60
61   question: What was one important thing that Abraham Lincoln did?
62   answer: freed the slaves (Emancipation Proclamation)
63   type: 1800s
64
65   question: Name one war fought by the United States in the 1900s.
66   answer: World War II
67   type: Recent American History and Other Important Historical Information
68
69   question: What did Martin Luther King, Jr. do?
70   answer: fought for civil rights
71   type: Recent American History and Other Important Historical Information
72
73   question: What is the capital of the United States?
74   answer: Washington, D.C.
75   type: Geography
76
77   question: Where is the Statue of Liberty?
78   answer: New York (Harbor)
```

```
79  type: Geography
80
81  question: Why does the flag have 50 stars?
82  answer: because there are 50 states
83  type: Symbols
84
85  question: When do we celebrate Independence Day?
86  answer: July 4
87  type: Holidays
```

3.1   Represent a question

To represent a question, we use a struct called Question, defined as follows. In C++, struct is a type that may contain different types of elements.

```
1  struct Question {
2      string text; //question text
3      string answer;
4      string explanation;
5      string version;
6      string type;
7      string label;
8  };
```

Here is an example on how to use Question type.

```
1  #include <iostream>
2  #include <string>
3  using namespace std;
4
5  //define Question outside a function,
6  //so that every function defined after struct Question
7  //can use it.
8  struct Question {
9      string text; //question text
10     string answer;
11     string explanation;
12     string version;
13     string type;
14     string label;
15 };
16
17 int main() {
18     Question q;
19
20     q.text = "What is the value of 2 - 3 / 2?";
21     q.answer = "1";
```

```cpp
22      q.version = "f24 midterm v2";
23      q.type = "arithmetic; integer division";
24      q.label = "1.6";
25      q.explanation = "(1) operator / has higher precedence than operator -.\n(2) 3 / 2
        is integer division, which returns 1. It can be interpreted as 3 pens divided by 2
        persons, each person gets one (1) pen.\n(3) 2 - 3 / 2 is the same as 2 - 1, which is
         1.";
26      cout << "\033[1m" << "question 1: " << "\033[0m"<< "\033[35m" << q.text << "\033[0m
        " << endl;
27      //\033[1m bold font
28      //\033[0m regular font
29      //\033[35m is pink color
30      //\033[0m is black color
31      cout << "\033[1m" << "Enter you answer: " << "\033[0m";
32
33      cout << "\033[34m"; //blue color
34      string userAns;
35      getline(cin, userAns); //input is shown in blue font
36      cout << "\033[0m"; //restore back to black color
37
38      if (userAns != q.answer)
39          cout << "\033[31m" << "false" << "\033[0m" << endl << endl; //\033[31m red color
        //display false in red font
40      //\033[0m is black color, after display false in red font,
41      //restore back to black color
42      else
43          cout << "\033[32m" << "true" << "\033[0m" << endl; //\033[32m green color //
        display true in green font
44
45      return 0;
46  }
```

Note that we display **question:** and **answer:** both in bold fonts. Display question text in pink font, user input in blue font. If user answer is correct (ie, match expected answer), then print true in green color, otherwise, print false in red font.

Note that color fonts are optional.

Here is a sample input/output when output is false.

```
question 1: What is the value of 2 - 3 / 2?
Enter you answer: 2
false
```

Here is a sample input/output when output is true.

```
question 1: What is the value of 2 - 3 / 2?
Enter you answer: 1
true
```

3.2 Requirements

1. Name the source code `checkAnswer_file.cpp`.

2. Download `civics_65_20.txt` from link to civics exam and `cs135_midterm_f24_v2.txt` from cs135 midterm f24 v2 to the same folder as the source code.

3. The text files are in the following format.

   (a) Question text is after `question:` . There is a space after `question:`. A question text may spread more than one line.

   (b) Answer follows `answer:` . There is a space after `answer:` . An answer may spread more than one line.

   (c) Followed by `explanation:` . Explanation may spread more than one line.

   (d) Followed by `version:` .

   (e) Followed by `type:` . There can be more than one type. If so, the types are separated by a semi-column symbol ;.

   Here is an example.

```
1  question: Assume that n is properly declared and initialized. Write a
       statement to declare lastDigit as an integer and initialize it to be the
       least significant digit of integer n. Suppose n is 123, after the statement
       , lastDigit is 3.
2  answer: int lastDigit = n % 10;
3  explanation: (1) operator % is called remainder or modular operator.
4  (2) For example, 12 % 10 means the remainder when dividing 12 pens among 10
       students, each student gets 1 pen, and there are 2 pens left.
5  (3) In general, n % 10 returns the last digit, or the rightmost digit (least
       significant digit), of n.
6  (4) int lastDigit = n % 10; is a statement to declare lastDigit as an int and
       initialize it by the last digit of n.
7  version: f24 v2
8  label: 1.3
9  type: modular; remainder
```

   (f) Note that explanation, version, label, and type are optional. Here are another example from `civics_65_20.txt`.

```
1  question: What is the capital of the United States?
2  answer: Washington, D.C.
3  type: Geography
```

4. Define struct Question before main function.

5. In main function, do the following.

   (a) Enter a file name.

(b) Declare an array of Questions with capacity 200 or more. Yes, we can have an array of non-primitive type.

(c) Read the text file and fill in the entries of the above array.

To make sure that your code reads the file correctly, you may print the contents of the array as an intermediate steps. You can comment this piece code out in submission.

  i. A file may have several lines before the first question as in `civics_65_20.txt`, which helps to explain the cotents of the file.
     A file might contain empty lines as well.

(d) Then for each question in the array, display question text, solicit a user answer, compare that answer with expected answer. If true, display "true", otherwise, display "false".

(e) You have at most three tries to answer a question. If a user fails to answer the question correctly in three tries, and if the explanation entry of the question is not empty, display explanation.

(f) Count the number of questions correctly answered (may be take more than one try).

(g) Count the percentage of correctly answered questions.

(h) If percentage is at least 90%, print "excellent", otherwise, if percentage is at least 80%, print "good", otherwise, if percentage is at least 60%, print "pass", otherwise, print "please ask help ASAP".

3.3 Sample input/output

For simplicity, I do not display bold font or color fonts. You can use them to make your output look nice.

```
question 1: Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?
Enter you answer: 'C'
number of tries: 1
false
Enter you answer: 'A'
number of tries: 2
false
Enter you answer: 'B'
number of tries: 3
true

question 2: Declare function increase, given an integer array arr with size many
    elements, increase each element of the array by 1. Return type is void. Define the
    function header (no implementation is needed).
Enter you answer: void increase(int arr[]);
number of tries: 1
false
Enter you answer: void increase(int arr[], int size)
number of tries: 2
false
Enter you answer: void increase(int[] arr, int size);
number of tries: 3
false
```

```
22
23  Explanation: (1) the first parameter is int arr[], the name of array arr, which also
        implies the address of the first element of array.
24  (2) the second parameter represents the number of elements of the array.
25
26
27  question 3: Assume that n is properly declared and initialized. Write a statement to
        declare lastDigit as an integer and initialize it to be the least significant digit
        of integer n. Suppose n is 123, after the statement, lastDigit is 3.
28  Enter you answer: int lastDigit = n / 10;
29  number of tries: 1
30  false
31  Enter you answer: int lastDigit = n % 10;
32  number of tries: 2
33  true
34
35  question 4: What is the output?
36  string tens_name(int n);
37
38  int main() {
39      cout << tens_name(82) << endl;
40      return 0;
41  }
42
43  string tens_name(int n) {
44      if (n < 20 || n > 99)
45          return "";
46
47      string names[] = {"", "", "twenty", "thirty", "forty", "fifty", "sixty", "seventy",
            "eighty", "ninety"};
48
49      return names[n / 10];
50  }
51
52  Enter you answer: twenty
53  number of tries: 1
54  false
55  Enter you answer: thirty
56  number of tries: 2
57  false
58  Enter you answer: ninety
59  number of tries: 3
60  false
61
62  Explanation: (1) When calling tens_name(82), n in tens_name is initialized to be 82.
63  (2) Since 82 is not less than 20 or 82 is not larger than 99, no return "";
```

(3) 82 / 10 is integer division. It is like to divide 82 pens among 10 students, each
    student get 8 pens. So 82 / 10 returns 8.
(4) names[n / 10] is names[82 / 10], which is names[8].

index   0 1   2   3   4   5   6   7   8

element +--+--+--------+--------+-------+-------+------+---------+--------+...
        |""|""|"twenty"|"thirty"|"forty"|"fifty"|"sixty"|"seventy"|"eighty"|...
        +--+--+--------+--------+-------+-------+------+---------+--------+...

(5) The return of tens_name(82) is "eighty".
(6) In main function, print tens_name(82), so the print out is "eighty" (without quotes
).

question 5: Given string greeting = "How are you?"; What is the value for greeting.
    substr(4, 5)?
Enter you answer: "are"
number of tries: 1
false
Enter you answer: "are you"
number of tries: 2
false
Enter you answer: "re yo"
number of tries: 3
false

Explanation: (1) greeting.substr(4, 5) extracts a substring from greeting from its
    index 4 and span 5 characters.
(2) The character indexed at 4 in string greeting with value "How are you?" is the
    fifth character, which is letter 'a'.
(3) Starting from letter 'a', take a total of 5 letters. And we get "are y".

question 6: What is the value of 2 - 3 / 2?
Enter you answer: 2
number of tries: 1
false
Enter you answer: 1
number of tries: 2
true

question 7: The area of a trapezoid with bases a, b, and height h is (a+b)/2 h. Assume
    that a, b, h are properly declared as double types and initialized, write a
    statement to declare area and save the value of the area.
Enter you answer: double area = 1 / 2.0 * (a+b) * h;

```
number of tries: 1
true

question 8: What is the output of the following code?
#include <iostream>
using namespace std;

int main() {
    int count = 0;
    for (int i = 9; i >= 2; i -= 3)
        count++;

    cout << count << endl;

    return 0;
}


Enter you answer: 3
number of tries: 1
true

question 9: Write a statement to call foo function on integer variables a and b, both
    are properly declared and initialized.void foo(int& a, int& b);

Enter you answer: foo(int a, int b);
number of tries: 1
false
Enter you answer: foo(&a, &b);
number of tries: 2
false
Enter you answer: foo(a, b);
number of tries: 3
true

question 10: Write a condition in C++ to represent that an integer variable n is in the
    range of [60,80], where both ends are included, that is, 60 <= n <= 80 in
    mathematic representation.
Enter you answer: 60 <= n <= 80
number of tries: 1
false
Enter you answer: n >= 60 || n <= 80
number of tries: 2
false
Enter you answer: (n >= 60 || n <= 80)
number of tries: 3
```

```
146   false
147
148   Explanation: (1) && means and. That is, n >= 60 and n <= 80.
149   (2) Condition in C++ needs to be enclosed in a pair of parentheses.
150   (3) Warning: cannot write (n >= 60 && n <= 80) as (60 <= n <= 80). Otherwise, suppose n
          is 90, then 60 <= n returns true, which is 1.
151   (4) Also, 1 <= 80 returns true. However, 90 is not in [60,80].
152
153
154   number of correct problems: 6
155   percentage of correct: 60%
156   pass
```

3.4   Yet another sample input/output

```
1   question 1: What is one right or freedom from the First Amendment?
2   Enter you answer: speech
3   number of tries: 1
4   true
5
6   question 2: What is the economic system in the United States?
7   Enter you answer: capitalist economy
8   number of tries: 1
9   true
10
11  question 3: Name one branch or part of the government.
12  Enter you answer: Congress
13  number of tries: 1
14  true
15
16  question 4: What are the two parts of the U.S. Congress?
17  Enter you answer: Democrat and Republican
18  number of tries: 1
19  false
20  Enter you answer: Senator and House
21  number of tries: 2
22  false
23  Enter you answer: Senator and House (of representatives)
24  number of tries: 3
25  false
26
27
28  question 5: Who is one of your state's U.S. Senators now?
29  Enter you answer: Chuck Schmer
30  number of tries: 1
```

```
false
Enter you answer: Chuck Shumer
number of tries: 2
true

question 6: In what month do we vote for President?
Enter you answer: November
number of tries: 1
true

question 7: What is the name of the President of the United States now?
Enter you answer: Donald Trump
number of tries: 1
true

question 8: What is the capital of your state?
Enter you answer: Albany
number of tries: 1
true

question 9: What are the two major political parties in the United States?
Enter you answer: Democrat and Republican
number of tries: 1
false
Enter you answer: Democratic and Republican
number of tries: 2
true

question 10: What is one responsibility that is only for United States citizens?
Enter you answer: serve on jury
number of tries: 1
false
Enter you answer: vote
number of tries: 2
false
Enter you answer: I do not know
number of tries: 3
false


question 11: How old do citizens have to be to vote for President?
Enter you answer: 18 and older
number of tries: 1
false
Enter you answer: 19 and older
number of tries: 2
```

```
false
Enter you answer: 20 and older
number of tries: 3
false


question 12: When is the last day you can send in federal income tax forms?
Enter you answer: april 15
number of tries: 1
false
Enter you answer: April 15
number of tries: 2
true

question 13: Who was the first  President?
Enter you answer: (George) Washington
number of tries: 1
true

question 14: What was one important thing that Abraham Lincoln did?
Enter you answer: free the slaves
number of tries: 1
false
Enter you answer: freed the slaves (Emancipation Proclamation)
number of tries: 2
true

question 15: Name one war fought by the United States in the 1900s.
Enter you answer: World War II
number of tries: 1
true

question 16: What did Martin Luther King, Jr. do?
Enter you answer: fought for the civil rights
number of tries: 1
false
Enter you answer: fought for civil rights
number of tries: 2
true

question 17: What is the capital of the United States?
Enter you answer: Washington, D.C.
number of tries: 1
true

question 18: Where is the Statue of Liberty?
```

```
123  Enter you answer: New York (harbor)
124  number of tries: 1
125  false
126  Enter you answer: New York (Harbor)
127  number of tries: 2
128  true
129
130  question 19: Why does the flag  have 50 stars?
131  Enter you answer: because there are 50 states
132  number of tries: 1
133  true
134
135  question 20: When do we celebrate Independence Day?
136  Enter you answer: July 4
137  number of tries: 1
138  true
139
140  number of correct problems: 17
141  percentage of correct: 85%
142  good
```

3.5 resources

Read file reading, string processing, and nested repetition statements.

You may want to use `starts_with` method of string class, which comes in c++20. So you need to run your code as follows.

To use string class, need to use `#include <string>`.

```
1  g++ -std=c++20 checkAnswer_file.cpp -o checkAnswer
2  ./checkAnswer
```

Also, to find the length of a c-style string like `"question: "`, you need to import `#include <string.h>` and use `strlen("question: ")`.

3.6 bonus: regex match

We notice that in the above approach, we need the user's answer is an exact match of the expected answer, case to case, letter to letter, even space is required. And it does not choose another valid answer.

We will add regular expression match to this problem.