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.

```
1  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
```

```
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.

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.

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;
}

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`.

```
    string texts[] = {
    "Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?",
    "Given string arr[] = {\"Hello\", \"Hi\", \"Hey\"}, what is arr[2]?",
    "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.",
    "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.",
    "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.",
    "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}",
    "Write a condition to represent that char variable ch is none of the
   following: 'a', 'b', or 'c'."
    };
```

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.
```

```
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')
true

number of correct problems: 7
percentage of correct: 100%
excellent
```

2.3 A sample run when result is good

Highlight parts are user inputs.

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

```
question: question text
answer: expected answer for the question
explanation: explan why we get the answer
version: year and version of an exam
label: problem label in the original exam
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.

```
question: Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?
answer: 'B'
explanation: arr[1] is the second element of array arr, which is 'B' in this example.
version: f24 v2
label: 1.1
type: array

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).
answer: void increase(int arr[], int size);
explanation: (1) the first parameter is int arr[], the name of array arr, which also
   implies the address of the first element of array.
(2) the second parameter represents the number of elements of the array.
version: f24 v2
label: 1.2
type: function; array


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.
answer: int lastDigit = n % 10;
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: arithmetic; 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
```

```
label: 1.4
type: integer division; 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.
```

```
(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.
(4) Also, 1 <= 80 returns true. However, 90 is not in [60,80].
version: f24 v2
label: 1.10
type: condition
```

Here is another file `civics_65_20.txt`.

```
source: https://www.uscis.gov/sites/default/files/document/questions-and-answers/100q.pdf
rev 1/19
Civics Questions for the 65/20 Exemption

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.


question: What is one right or freedom from the First Amendment?
answer: speech
type: Principles of American Democracy

question: What is the economic system in the United States?
answer: capitalist economy
type: Principles of American Democracy

question: Name one branch or part of the government.
answer: Congress
type: System of Government

question: What are the two parts of the U.S. Congress?
answer: the Senate and House (of Representatives)
type: System of Government

question: Who is one of your state's U.S. Senators now?
answer: Chuck Shumer
type: System of Government

question: In what month do we vote for President?
answer: November
type: System of Government

question: What is the name of the President of the United States now?
```

```
answer: Donald Trump
type: System of Government

question: What is the capital of your state?
answer: Albany
type: System of Government

question: What are the two major political parties in the United States?
answer: Democratic and Republican
type: System of Government

question: What is one responsibility that is only for United States citizens?
answer: serve on a jury
type: Rights and Responsibilities

question: How old do citizens have to be to vote for President?
answer: eighteen (18) and older
type: Rights and Responsibilities

question: When is the last day you can send in federal income tax forms?
answer: April 15
type: Rights and Responsibilities

question: Who was the first President?
answer: (George) Washington
type: Colonial Period and Independence


question: What was one important thing that Abraham Lincoln did?
answer: freed the slaves (Emancipation Proclamation)
type: 1800s

question: Name one war fought by the United States in the 1900s.
answer: World War II
type: Recent American History and Other Important Historical Information

question: What did Martin Luther King, Jr. do?
answer: fought for civil rights
type: Recent American History and Other Important Historical Information

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

question: Where is the Statue of Liberty?
answer: New York (Harbor)
```

```
type: Geography

question: Why does the flag have 50 stars?
answer: because there are 50 states
type: Symbols

question: When do we celebrate Independence Day?
answer: July 4
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.

```
struct Question {
    string text; //question text
    string answer;
    string explanation;
    string version;
    string type;
    string label;
};
```

Here is an example on how to use Question type.

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

//define Question outside a function,
//so that every function defined after struct Question
//can use it.
struct Question {
    string text; //question text
    string answer;
    string explanation;
    string version;
    string type;
    string label;
};

int main() {
    Question q;

    q.text = "What is the value of 2 - 3 / 2?";
    q.answer = "1";
```

```
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.

```
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.
answer: int lastDigit = n % 10;
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: arithmetic; modular; remainder
```

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

```
question: What is the capital of the United States?
answer: Washington, D.C.
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
```

```
false

Explanation: (1) && means and. That is, n >= 60 and n <= 80.
(2) Condition in C++ needs to be enclosed in a pair of parentheses.
(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.
(4) Also, 1 <= 80 returns true. However, 90 is not in [60,80].


number of correct problems: 6
percentage of correct: 60%
pass
```

3.4 Yet another sample input/output

```
question 1: What is one right or freedom from the First Amendment?
Enter you answer: speech
number of tries: 1
true

question 2: What is the economic system in the United States?
Enter you answer: capitalist economy
number of tries: 1
true

question 3: Name one branch or part of the government.
Enter you answer: Congress
number of tries: 1
true

question 4: What are the two parts of the U.S. Congress?
Enter you answer: Democrat and Republican
number of tries: 1
false
Enter you answer: Senator and House
number of tries: 2
false
Enter you answer: Senator and House (of representatives)
number of tries: 3
false


question 5: Who is one of your state's U.S. Senators now?
Enter you answer: Chuck Schmer
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?
```

```
Enter you answer: New York (harbor)
number of tries: 1
false
Enter you answer: New York (Harbor)
number of tries: 2
true

question 19: Why does the flag  have 50 stars?
Enter you answer: because there are 50 states
number of tries: 1
true

question 20: When do we celebrate Independence Day?
Enter you answer: July 4
number of tries: 1
true

number of correct problems: 17
percentage of correct: 85%
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>`.

```
g++ -std=c++20 checkAnswer_file.cpp -o checkAnswer
./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 a space cannot be misplaced. And it does not choose another valid answer.

We will add regular expression match to this problem.

4 Task D: extract and sort types, answer questions by types

Motivation: sometimes we would not like to answer all questions, but concentrate on some types (aka topics). To do so, we need to find all possible types in that file, then sort them. Let user to choose a type, and answer questions on those types.

In Task D, we do the following.

1. Name your source code `checkAnswer_sort_filter.cpp`.
2. Extract types and save in array of strings. Note that if a type is in the array already, no need to save it again. That is, no redundant elements in the array.
3. Sort the types in array in alphabetic order.
4. Display sorted types by labels starting from 1, select a type by that label, then answer questions on that type.

   For each question, a user can try for at most three times. If fail three tries and explanation entry of the question is not empty, display it.
5. Calculate the number of correct problems, percentage of correctness.

   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".,

4.1 Extract Types and Save in an Array of Strings

For example, given **link to civics exam**, its types are highlighted as follows.

```
source: https://www.uscis.gov/sites/default/files/document/questions-and-answers/100q.pdf
rev 1/19
Civics Questions for the 65/20 Exemption

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.


question: What is one right or freedom from the First Amendment?
answer: speech
type: Principles of American Democracy

question: What is the economic system in the United States?
answer: capitalist economy
type: Principles of American Democracy

question: Name one branch or part of the government.
answer: Congress
type: System of Government

question: What are the two parts of the U.S. Congress?
```

```
answer: the Senate and House (of Representatives)
type: System of Government

question: Who is one of your state's U.S. Senators now?
answer: Chuck Shumer
type: System of Government

question: In what month do we vote for President?
answer: November
type: System of Government

question: What is the name of the President of the United States now?
answer: Donald Trump
type: System of Government

question: What is the capital of your state?
answer: Albany
type: System of Government

question: What are the two major political parties in the United States?
answer: Democratic and Republican
type: System of Government

question: What is one responsibility that is only for United States citizens?
answer: serve on a jury
type: Rights and Responsibilities

question: How old do citizens have to be to vote for President?
answer: eighteen (18) and older
type: Rights and Responsibilities

question: When is the last day you can send in federal income tax forms?
answer: April 15
type: Rights and Responsibilities

question: Who was the first President?
answer: (George) Washington
type: Colonial Period and Independence


question: What was one important thing that Abraham Lincoln did?
answer: freed the slaves (Emancipation Proclamation)
type: 1800s

question: Name one war fought by the United States in the 1900s.
answer: World War II
```

```
type: Recent American History and Other Important Historical Information

question: What did Martin Luther King, Jr. do?
answer: fought for civil rights
type: Recent American History and Other Important Historical Information

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

question: Where is the Statue of Liberty?
answer: New York (Harbor)
type: Geography

question: Why does the flag have 50 stars?
answer: because there are 50 states
type: Symbols

question: When do we celebrate Independence Day?
answer: July 4
type: Holidays
```

From the codes in Task C, you can read `type` entries of Question array, and save those items in an array of strings. Note that if an item is in the array already, no need to add it into the array again.

After this step, the array of types should have the following elements:

```
"Principles of American Democracy",
"System of Government",
"Rights and Responsibilities",
"Colonial Period and Independence",
"1800s",
"Recent American History and Other Important Historical Information",
"Geography",
"Symbols",
"Holidays"
```

Given `cs135_midterm_f24_v2.txt` from **cs135 midterm f24 v2**, its types are highlighted as follows. Correction: I modified the types of Question 1.3 from `modular; remainder` to `arithmetic; modular; remainder`. The type of 1.4 from `modular; remainder; array` to `integer division; array`. This change will not affect your codes, it will only affect which questions are chosen when you select a type.

```
question: Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?
answer: 'B'
explanation: arr[1] is the second element of array arr, which is 'B' in this example.
version: f24 v2
label: 1.1
type: array

```

```
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).
answer: void increase(int arr[], int size);
explanation: (1) the first parameter is int arr[], the name of array arr, which also
   implies the address of the first element of array.
(2) the second parameter represents the number of elements of the array.
version: f24 v2
label: 1.2
type: function; array


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.
answer: int lastDigit = n % 10;
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: arithmetic; 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
label: 1.4
type: integer division; 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. Then
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.
(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.
(4) Also, 1 <= 80 returns true. However, 90 is not in [60,80].
version: f24 v2
label: 1.10
type: condition
```

Note that in the above file, a question might involve two or more types (topics) separated by semi colon symbol (;). So we need to use `find` and `substr` methods of `string` class to extract those types.

For flexibility, we may have zero, one or more spaces spaces after a semi colon symbol (;). So after the above extraction, there might be leading- or succeeding- spaces in a string, where leading spaces are the spaces before the first non-space character and succeeding spaces are spaces after the last non-space character. For example, given `" array "`, there are leading and succeeding spaces.

We need to trim (aka remove) leading or succeeding spaces in a string. However, no `trim` method in string class in C++ as it in python. To implement `trim` functionality, we may use the following approach.

1. Use repetition statement or `find_first_not_of` method of string class to search for the first non-space character in a string.
2. Use repetition statement or `find_last_not_of` method to get the last non-space character in a string.
3. Use `substr` method to extract a string without its leading/succeeding spaces.

After coding, the array of types should contain the following elements.

```
"array",
"function",
"modular",
"remainder",
"integer division",
```

```
"string",
"substring",
"arithmetic",
"repetition",
"condition"
```

4.2 Sort the Array of types

We would like to see items sorted in alphabetic order. To sort an array, we may use bubble sort array. A video can be shown in `https://www.youtube.com/watch?v=YGbp4FS8RpQ`.

For example, after sorting the types for **link to civics exam**, the elements of the array is ordered as follows.

```
"1800s",
"Colonial Period and Independence",
"Geography",
"Holidays",
"Principles of American Democracy",
"Recent American History and Other Important Historical Information",
"Rights and Responsibilities",
"Symbols",
"System of Government"
```

After sorting of types in **cs135 midterm f24 v2**, we get the following.

```
"arithmetic",
"array",
"condition",
"function",
"integer division",
"modular",
"remainder",
"repetition",
"string",
"substring"
```

4.3 Select a type and answer questions in that type

Next, we woule display sorted types by labels starting from 1. Choose one label, then test students on all questions in that type.

4.3.1 a sample input/output

The highlighted area are user input. All the other parts are user output.

```
Enter a txt file name with at least question and answer entries: civics_65_20.txt
1. 1800s
```

```
2. Colonial Period and Independence
3. Geography
4. Holidays
5. Principles of American Democracy
6. Recent American History and Other Important Historical Information
7. Rights and Responsibilities
8. Symbols
9. System of Government
Enter a type: 3
question 17: What is the capital of the United States?
Enter you answer: Washington DC
number of tries: 1
false
Enter you answer: Washington
number of tries: 2
false
Enter you answer: Dc
number of tries: 3
false

question 18: Where is the Statue of Liberty?
Enter you answer: New York (harbor)
number of tries: 1
false
Enter you answer: New york (harbor)
number of tries: 2
false
Enter you answer: New York (Harbor)
number of tries: 3
true

number of correct problems: 1
percentage of correct: 50%
please ask help ASAP
```

4.3.2 yet another sample input/output

The highlighted area are user input. All the other parts are user output.

```
Enter a txt file name with at least question and answer entries:
    cs135_midterm_f24_v2.txt
1. arithmetic
2. array
3. condition
4. function
5. integer division
6. modular
```

```
7. remainder
8. repetition
9. string
10. substring
Enter a type: 2
question 1: Given char arr[] = {'A', 'B', 'C'}, what is arr[1]?
Enter you answer: b
number of tries: 1
false
Enter you answer: 'c'
number of tries: 2
false
Enter you answer: 'a'
number of tries: 3
false

Explanation: arr[1] is the second element of array arr, which is 'B' in this example.


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[], int size)
number of tries: 1
false
Enter you answer: void increase(int arr[], int size);
number of tries: 2
true

question 4: 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];
}
```

```
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: eighty
59 number of tries: 3
60 true
61
62 number of correct problems: 2
63 percentage of correct: 66.6667%
64 pass
```

Before submission, test your code in a local computer with the above testing cases.

4.4 Resources

You may read methods of string class, especially `find`, `substr`, `find_first_not_of` and `find_last_not_of`.

You may also apply repetition statements to test whether an item is in an array or not and to sort an array.

4.5 What to expect next?

Organize your codes in functions to remove redundant codes and and to put questions in similar files to the same array. This will be Task A of Project 2.