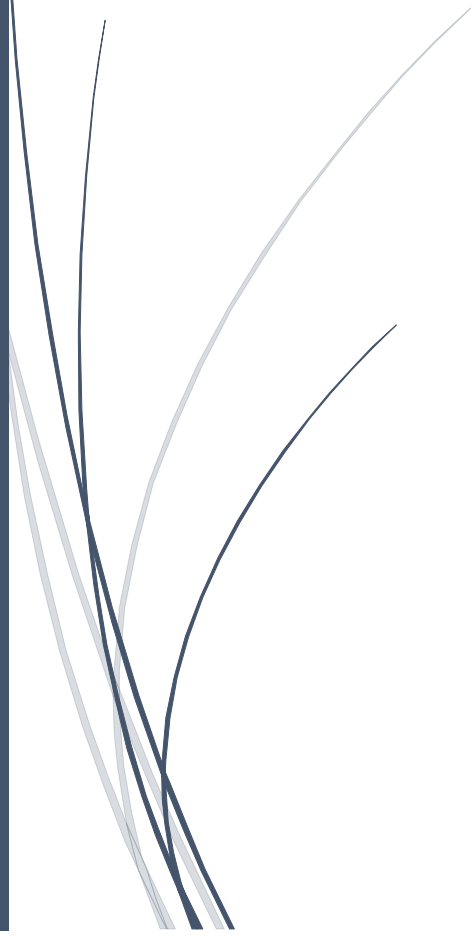
9/17/2021

Final Project

Perl

The core functionality and all extensions have been implemented



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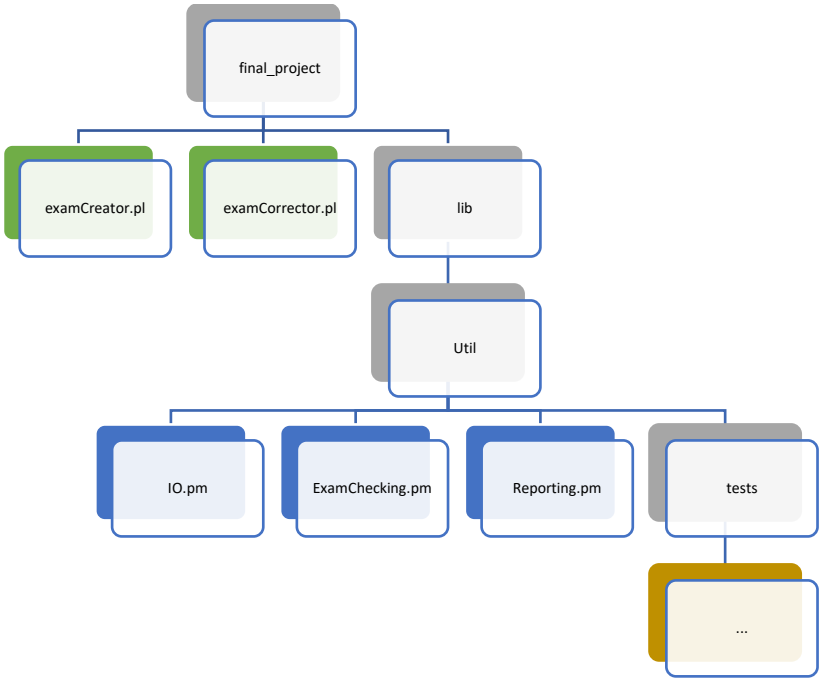
Code structure



The two green classes are the two starter classes to create or evaluate exams. These two classes access the functionalities of the blue classes in the library.
The functionalities of the library are tested. All tests are in the folder “tests”.

Initial step

In order for the library to be recognized, the location of the library should be specified in the two green starter classes as well as in the testing classes.
To do this, adapt the following path:

```
use lib "/Users/louisa/fhnw/perl/final_project/lib";
use Util::IO;
use Util::Reporting;
use Util::ExamChecking;
```

Create exam file from solution

How:

To generate a new exam file the following call is necessary:

```
perl examCreator.pl your_masterfile.txt optional_path_where_to_save_generated_file
```

Result:

The program generates a new file with the name:
„YYYYMMDD-HHMMSS-your_masterfile.txt“
(where the front part corresponds to the current timestamp).

The answers in the generated file appear in random order and are not checked. In addition, the answers are nicely formatted in a consistent manner.
Everything else is copied exactly as it appears in the master file.

If the optinal path is omitted, the generated file is saved to the current repository.

Example:

In the following folder: lib/Util/tests/testingFiles/masterFiles you can find some examples how the Masterfile should look like.

It is important that the sections are split through underscores (“_____”)

Scoring of student responses

How:

Um exam files zu bewerten ist folgender Aufruf nötig:

```
perl examCreator.pl your_masterfile.txt student_file_*.txt
```

Result:

Various Reports are printed out:

- Report: Results
- Report: Below Expectation
- Report: Cohort Performance
- Report: Missing Elements
- Report: Possible academic misconduct

Inexact Matching:

A functionality is implemented that allows small changes to the question or answer texts. The texts are first normalized before they are compared.
If the normalized exam text and the normalized solution text are very similar (more precisely, the Levensthein distance is no more than 10% of the length), then the two texts are considered to be the same element and are evaluated. If the distance is greater, the element is not further evaluated.
Elements that have a Levensthein distance greater than 0 appear in the Report: Missing Elements.

Reports

Report: Results

The result for each exam-file is printed.
The front number indicates how many questions were answered correctly / the back number is the total number of questions (this is the same for all exam-files, because all exam-files have the same solution-file). If questions / answers or both are missing, they will be shown in the Report: Missing Elements, so that these exam-files can be reviewed again.

Example:

```
________RESULTS________

lib/Util/tests/testingFiles/exam1/student_0correct_horrible.txt                        : 0/3
lib/Util/tests/testingFiles/exam1/student_0correct_horrible_cheater.txt                : 0/3
lib/Util/tests/testingFiles/exam1/student_0correct_lazy_no_checks.txt                  : 0/3
lib/Util/tests/testingFiles/exam1/student_1correct_because_deleter.txt                 : 1/3
lib/Util/tests/testingFiles/exam1/student_1correct_because_question_deleter.txt        : 1/3
lib/Util/tests/testingFiles/exam1/student_1correct_deleted2sections.txt                : 1/3
lib/Util/tests/testingFiles/exam1/student_1correct_swaped_questions.txt                : 1/3
lib/Util/tests/testingFiles/exam1/student_2correct.txt                                 : 2/3
lib/Util/tests/testingFiles/exam1/student_3correct_excellent.txt                       : 3/3
lib/Util/tests/testingFiles/exam1/student_3correct_good_but_edited_answers.txt         : 3/3
lib/Util/tests/testingFiles/exam1/student_3correct_perfect.txt                         : 3/3
lib/Util/tests/testingFiles/exam1/student_3correct_swaped_sections.txt                 : 3/3
```

Report: Below Expectation

This report lists the exam files that have performed the worst.
You can see how many questions were answered correctly and afterwards the reason why this file appears in this report.

There are 2 possible reasons:

- If the grade would be calculated according to the standard calculation of Switzerland
(correctly answered questions / total questions * 5 + 1) these students would have failed (grade worse than 3.75)
(See Example 1)
- The Exam files that passed by grade but are in the worst 25% of all scores.

Example 1:

```
________BELOW EXPECTATION________

lib/Util/tests/testingFiles/exam1/student_0correct_horrible.txt                        : 0/3 (not passed -> reached grade: 1.00)
lib/Util/tests/testingFiles/exam1/student_0correct_horrible_cheater.txt                : 0/3 (not passed -> reached grade: 1.00)
lib/Util/tests/testingFiles/exam1/student_0correct_lazy_no_checks.txt                  : 0/3 (not passed -> reached grade: 1.00)
lib/Util/tests/testingFiles/exam1/student_1correct_because_deleter.txt                 : 1/3 (not passed -> reached grade: 2.67)
lib/Util/tests/testingFiles/exam1/student_1correct_because_question_deleter.txt        : 1/3 (not passed -> reached grade: 2.67)
lib/Util/tests/testingFiles/exam1/student_1correct_deleted2sections.txt                : 1/3 (not passed -> reached grade: 2.67)
lib/Util/tests/testingFiles/exam1/student_1correct_swaped_questions.txt                : 1/3 (not passed -> reached grade: 2.67)
```

Example 2:

```
________BELOW EXPECTATION________

lib/Util/tests/testingFiles/exam1/student_2correct.txt                          : 2/3 (bottom 25% of cohort)
```

Report: Cohort Performance

This report gives an overall view of the performance of the class:

Example:

```
________COHORT PERFORMENCE________

Average number of answered questions    : 2.5
Minimum                                 : 0 (1 student)
Maximum                                 : 3 (9 students)

Average number of correct answers       : 1.5
Minimum                                 : 0 (3 students)
Maximum                                 : 3 (4 students)
```

Report: Missing Elements

This report prints missing or modified questions and answers per exam file.

Example:

```
________MISSING ELEMENTS________

lib/Util/tests/testingFiles/exam1/student_0correct_horrible_cheater.txt:
Section 2 - Missing answer              : Dr Damian Conway

lib/Util/tests/testingFiles/exam1/student_1correct_because_deleter.txt:
Section 2 - Missing question            : 2. The lecturer for this class is:
          Used instead                  : 2. The lecturer for this class:
Section 2 - Missing answer              : Dr Who
Section 2 - Missing answer              : Dr Theodor Seuss Geisel

lib/Util/tests/testingFiles/exam1/student_1correct_because_question_deleter.txt:
Section 1 - Missing answer              : Introduction to Perl for Programmers
Section 1 - Missing answer              : Introduction to Python for Slytherins
Section 1 - Missing answer              : Introduction to Aussies for Europeans
Section 1 - Missing answer              : Introduction to Perl for Programmers and Other Crazy People
Section 1 - Missing answer              : Introduction to Programming for Pearlers
Section 2 - Missing answer              : Dr Who
Section 3 - Missing question            : 3. The correct way to answer each question is:
```

Only slightly modified questions / answers with a Levenshtein distance no more than 10% of the length of the normalized original string are used and evaluated. These appear in the report with an additional "Used instead".

All other questions / answers appearing in the report were not scored.

A section is recognized by the question.
Missing answers are always displayed with regards to the question.

If the question is missing, there is no point for the question and possibly missing answers are not printed. Without them the student could not give a meaningful answer and the section must be looked at again manually.

Further example:
(question 1 moved from section 1 to section 3, one answer in section 2 is missing)

```
_____________________________________________________________________________


    [g] Introduction to Perl for Programmers
    [ ] Introduction to Perl for Programmers and Other Crazy People
    [ ] Introduction to Programming for Pearlers
    [ ] Introduction to Aussies for Europeans
    [ ] Introduction to Python for Slytherins
_____________________________________________________________________________
2. The lecturer for this class is:
    [ ] Dr Theodor Seuss Geisel
    [ ] Dr Sigmund Freud
    [ ] Dr Victor von Doom
    [X] Dr Damian Conway


_____________________________________________________________________________

1. The name of this class is:

    [ ] To put an X in the box beside the correct answer
    [ ] To put an X in every box, except the one beside the correct answer
    [3] To put an smiley-face emoji in the box beside the correct answer
    [4] To delete the box beside the correct answer
    [X] To delete the correct answer


_____________________________________________________________________________
```

Corresponding report:

```
exam1/student_2correct_because_question_deleter.txt:
Section 1 - Missing answer              : Introduction to Programming for Pearlers
Section 1 - Missing answer              : Introduction to Python for Slytherins
Section 1 - Missing answer              : Introduction to Perl for Programmers and Other Crazy People
Section 1 - Missing answer              : Introduction to Perl for Programmers
Section 1 - Missing answer              : Introduction to Aussies for Europeans
Section 2 - Missing answer              : Dr Who
Section 3 - Missing question            : 3. The correct way to answer each question is:
```

(question 1 is in the file, but below the question are not the corresponding answers, therefore the answers are listed. Unlike question 3, which is not present in the file.)

Report: Possible academic misconduct

This report shows possible academic misconduct.

With many correctly answered questions, it cannot be assumed that cheating occurred, but rather that students prepared for the exam.
Therefore, only the incorrectly answered questions are compared in this report.

All incorrectly answered questions from all files are compared. If a wrongly answered question has exactly the same answer as in another file, both files appear in the report. Behind the files you can see how many questions were answered wrongly in the same way out of how many questions were answered wrongly in total.
Behind it the probability appears that the editor of this file has copied from the one above/below.

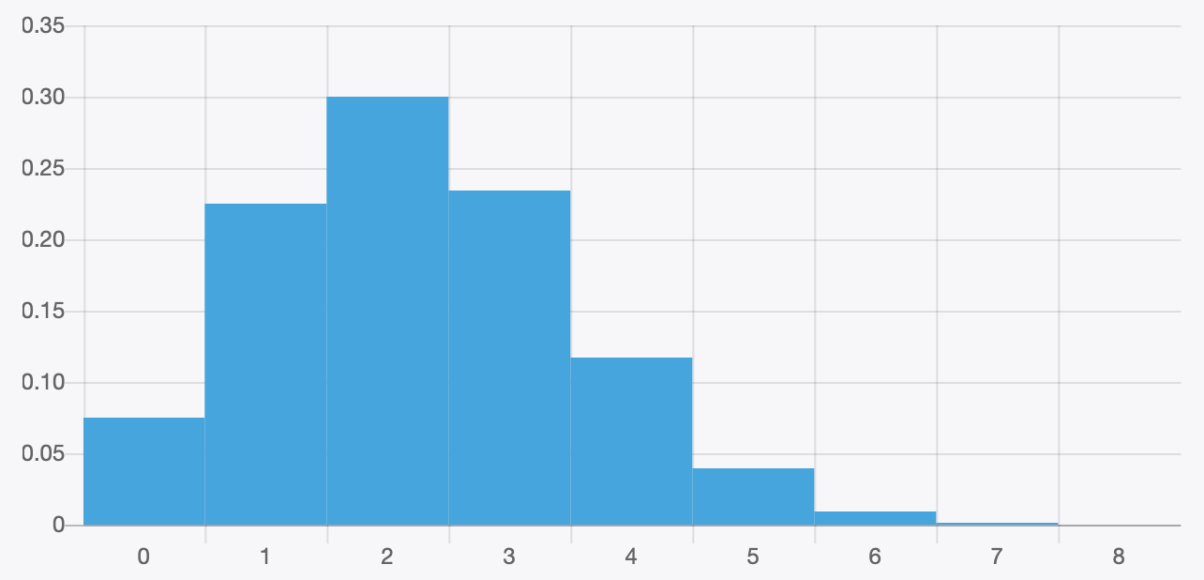
Always 2 files are compared with each other. (In the following File A and File B)

For this calculation the binomial distribution was used:

$$P(X = k) = \binom{n}{k} \cdot p^k \cdot (1-p)^{n-k}$$

n = total number of incorrectly answered questions in File A.
p = probability that File A randomly gives exactly the same wrong answer as File B. (It is assumed that each question has the same number of possible answers. If there are 5 answer choices, 4 of them are wrong. In this case, p = ¼).
k = number of incorrectly answered questions answered exactly the same by File A and File B.

For the example n=9, p=0.25 would result in the following distribution:



If there are 9 wrong questions, it is most probable that 2 of them were answered exactly the same as in other files.
After that, the probability that the student cheated increases.

Therefore P(X=k) is used up to the maximum (in this example X=2) and after that 1 - P(X=k) (i.e. 100% minus the probability that it was a coincidence).

Since the two files compared may have different numbers of incorrectly answered questions, the probabilities may differ.

Example:

```
________POSSIBLE ACADEMIC MISCONDUCT________
number of same wrong answers/ wrong answered questions in total (cheating probability in %)

     lib/Util/tests/testingFiles/exam1/student_1correct_because_deleter.txt              1/2 (62.5%)
 and lib/Util/tests/testingFiles/exam1/student_2correct.txt                              1/1 (75.0%)

     lib/Util/tests/testingFiles/exam1/student_0correct_horrible.txt                     2/3 (85.9%)
 and lib/Util/tests/testingFiles/exam1/student_0correct_horrible_cheater.txt             2/3 (85.9%)
```

For the first file pair, it is more likely that the second file copied from the first file than vice versa.

Tests

If you are in the tests folder, you can run the tests of the 3 library classes with the following commands:

```
perl ExamCheckingTest.t

perl IOTest.t

perl ReportingTest.t
```

Example-Output:

```
(base) louisa@Louisas-MBP tests % perl ExamCheckingTest.t
1..5
ok 1 - number of answered questions per file
ok 2 - number of correct answers per file
ok 3 - same missing elements per file
ok 4 - overall structure of hash examResults (Per file: nr of questions, nr of correct answers, missed elements)
ok 5 - overall structure of hash wrongAnsweredQ (Per file: section, wrongly checked answers in section)
```