Scrutinize

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https://github.com/SillyFreak/typst-packages/tree/main/scrutinize

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Abstract

Scrutinize is a library for building exams, tests, etc. with Typst. It provides utilities for common question types and supports creating grading keys and sample solutions.

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I Introduction

Scrutinize has three general areas of focus:

- It helps with grading information: record the points that can be reached for each question and make them available for creating grading keys.
- It provides a selection of question writing utilities, such as multiple choice or true/false questions.
- It supports the creation of sample solutions by allowing to switch between the normal and "pre-filled" exam.

Right now, providing a styled template is not part of this package's scope.

II Questions and question metadata

Let's start with a really basic example that doesn't really show any of the benefits of this library yet:

```
#import "@preview/scrutinize:0.1.0": grading, question, questions

// you usually want to alias this, as you'll need it often
#import question: q

#q(points: 2)[
  == Question

  #lorem(20)
]
```

Question
Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat.

After importing the library's modules and aliasing an important function, we simply get the same output as if we didn't do anything. The one peculiar thing here is `points: 2`: this adds some metadata to the question. Any metadata can be specified, but `points` is special insofar as it is used by the `grading` module. There are two additional pieces of metadata that are automatically available:

- `body`: the complete content that was rendered as the question
- `location`: the location where the question started and the Typst `metadata` element was inserted

The body is rendered as-is, but the location and custom fields are not used unless you explicitly do; let's look at how to do that. Let's say we want to show the points in each question's header:

```
#show heading: it => {
  // here, we need to access the current question's metadata
  question.current(q => [#it.body #h(1fr) / #q.points])
}
```

Question / 2

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat.

Here we're using the `question.current()` function to access the metadata of the current question. Like Typst's `locate()` function, ordinarily, any computation has to happen inside as it can only return content – however, see the function's documentation for an escape hatch.

III Grading

The final puzzle piece is grading. There are many different possibilities to grade a test; Scrutinize tries not to be tied to specific grading strategies, but it does assume that each question gets assigned points and that the grade results from looking at some kinds of sums of these points. If your test does not fit that schema, you can simply use less of the related features.

The first step in creating a typical grading scheme is determining how many points can be achieved in total, using `grading.total-points()`. We also need to use `question.all()` to get access to the metadata distributed throughout the document:

```
#question.all(qs => [
  #let total = grading.total-points(qs)
  #let hard = grading.total-points(qs, filter: q => q.points >= 5)

  Total points: #total

  Points from hard questions: #hard
])

#q(points: 6)[
  == Hard Question

  #lorem(20)
]
```

Total points: 8

Points from hard questions: 6

Hard Question / 6

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat.

Question / 2

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat.

Once we have the total points of the text figured out, we need to define the grading key. Let's say the grades are in a three-grade system of "bad", "okay", and "good". We could define these grades like this:

```
#question.all(qs => [
  #let total = grading.total-points(qs)

  #let grades = grading.grades(
    [bad], total * 2/4, [okay], total * 3/4, [good]
  )

  #grades
])
```

```
(
  (body: [bad], lower-limit: none, upper-limit: 4),
  (body: [okay], lower-limit: 4, upper-limit: 6),
  (body: [good], lower-limit: 6, upper-limit: none),
)
```

Hard Question / 6

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat.

Question / 2

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat.

Obviously we would not want to render this representation as-is, but `grading.grades()` gives us a convenient way to have all the necessary information, without assuming things like inclusive or exclusive point ranges. The `test.typ` example in the gallery has a more complete demonstration of a grading key.

IV Question templates and sample solutions

With the test structure out of the way, the next step is to actually write questions. There are endless ways of formulating questions, but some recurring formats come up regularly.

> *Note:* customizing the styles is currently very limited/not possible. I would be interested in changing this, so if you have ideas on how to achieve this, contact me and/or open a pull request. Until then, feel free to "customize using copy/paste".

Each question naturally has an answer, and producing sample solutions can be made very convenient if they are stored with the question right away. To facilitate this, this package provides three basic functions:

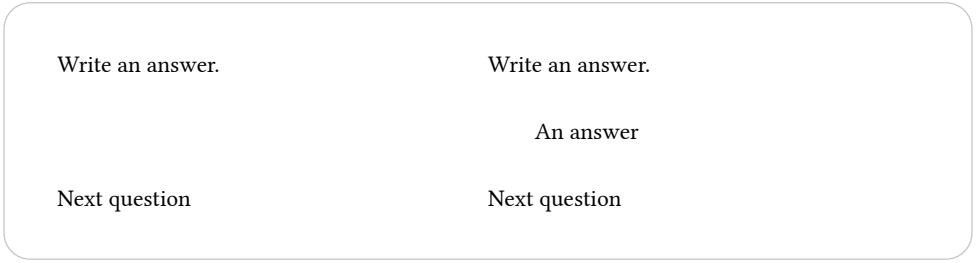
- `questions.set-solution()` and `questions.unset-solution()`: these can be used to toggle display of solutions. The latter may be useful to render answered example questions in the beginning, then proper questions. (It's also useful for this documentation!)
- `questions.is-solution()`: This function is used by question templates, or custom questions not using a template, to decide whether to render a solution.

Let's look at a free text question as a simple example:

IV.a Free text questions

In free text questions, the student simply has some free space in which to put their answer:

```
#import "@preview/scrutinize:0.1.0": grading, question, questions

#import questions: set-solution, free-text-answer

// toggle this comment to produce a sample solution
// #set-solution()

Write an answer.

#free-text-answer[
  An answer
]

Next question
```



Left is the unanswered version, right the answered one. Note that the answer occupies the same space regardless of whether it is displayed or not, and that the height can also be overridden - see `questions.free-text-answer()`. The content of the answer is of course not limited to text.

IV.b single and multiple choice questions

These question types allow making a mark next to one or multiple choices. See `questions.single-choice()` and `questions.multiple-choice()` for details.

```
#import "@preview/scrutinize:0.1.0": grading, question, questions

#import questions: single-choice, multiple-choice

Which of these is the fourth answer?

#single-choice(
  range(1, 6).map(i => [Answer #i]),
  // 0-based indexing
  3,
)

Which of these answers are even?

#multiple-choice(
  range(1, 6).map(i => ([Answer #i], calc.even(i))),
)
```

Which of these is the fourth answer?

Answer 1	☐
Answer 2	☐
Answer 3	☐
Answer 4	☐
Answer 5	☐

Which of these is the fourth answer?

Answer 1	☐
Answer 2	☐
Answer 3	☐
Answer 4	☒
Answer 5	☐

Which of these answers are even?

Answer 1	☐
Answer 2	☐
Answer 3	☐
Answer 4	☐
Answer 5	☐

Which of these answers are even?

Answer 1	☐
Answer 2	☒
Answer 3	☐
Answer 4	☒
Answer 5	☐

V Module reference

V.a `scrutinize.question`

- q()
- current()
- all()

q(body: `content`, ..args: `string`) -> `content`

Adds a question with its metadata, and renders it. The questions can later be accessed using the other functions in this module.

Parameters:

`body` (`content`) – the content to be displayed for this question

`..args` (`string`) – only named parameters: values to be added to the question's metadata

current(func-or-loc: `function` `location`) -> `content` `dictionary`

Locates the most recently defined question; within a q() call, that is the question *currently* being defined.

If a function is provided as a parameter, the located question's metadata is used to call it and content is returned. If a location is provided instead, the question's metadata is located there and returned directly.

Example:

```
#question.current(q => [This question is worth #q.points points.])

#locate(loc => {
  let points = question.current(loc).points
  // note that `points` is an integer, not a content!
  let points-with-extra = points + 1
  // but eventually, `locate()` will convert to content
  [I may award up to #points-with-extra points for great answers!]
})
```

Parameters:

`func-or-loc` (`function` or `location`) – either a function that receives metadata and returns content, or the location at which to locate the question

all(func-or-loc: `function` `location`) -> `content` `array`

Locates all questions in the document, which can then be used to create grading keys etc. The array of question metadata is used to call the provided function.

If a function is provided as a parameter, the array of located questions' metadata is used to call it and content is returned. If a location is provided instead, it is used to retrieve the metadata and they are returned directly.

Example:

```
#question.all(qs => [There are #qs.len() questions.])

#locate(loc => {
  let qs = question.all(loc)
  // note that `qs` is an array, not a content!
  // but eventually, `locate()` will convert to content
  [The first question is worth #qs.first().points points!]
})
```

Parameters:

`func-or-loc` (`function` or `location`) – either a function that receives metadata and returns content, or the location at which to locate the question

counter `counter`

The question counter

Example:

```
#show heading: it => [Question #question.counter.display()]
```

V.b `scrutinize.grading`

- total-points()
- grades()

total-points(questions: `array`, filter: `function`) -> `integer`

Takes an array of question `metadata` objects (not dictionaries) and returns the sum of their points. Note that the points metadata is optional and may therefore be `none`; if your test may contain questions without points, you have to take care of that.

This function also optionally takes a filter function. If given, the function will get the metadata of each question and must return a boolean.

Parameters:

`questions` (`array`) – an array of question `metadata` objects

`filter` (`function` = `none`) – an optional filter function for determining which questions to sum up

grades(..args: `any`) -> `array`

A utility function for generating grades with upper and lower point limits. The parameters must alternate between grade names and threshold scores, with grades in ascending order. these will be combined in dictionaries for each grade with keys `body`, `lower-limit`, and `upper-limit`. The first (lowest) grade will have a `lower-limit` of `none`; the last (highest) grade will have an `upper-limit` of `none`.

Example:

```
#let total = 8
#let (bad, okay, good) = grading.grades(
  [bad], total * 2/4, [okay], total * 3/4, [good]
)
[
  You will need #okay.lower-limit points to pass,
  everything below is a #bad.body grade.
]
```

Parameters:

`..args` (`any`) – only positional: any number of grade names interspersed with scores

V.c `scrutinize.questions`

- set-solution()
- unset-solution()
- is-solution()
- free-text-answer()
- checkbox()
- multiple-choice()
- single-choice()

set-solution() -> `content`

Shows solutions in the document.

unset-solution() -> `content`

Hides solutions in the document.

is-solution(func-or-loc: `function` `location`) -> `content` `boolean`

Queries the current solution display state.

If a function is provided as a parameter, the boolean is used to call it and content is returned. If a location is provided instead, it is used to retrieve the boolean state and it is returned directly.

Parameters:

`func-or-loc` (`function` or `location`) – either a function that receives metadata and returns content, or the location at which to locate the question

free-text-answer(answer: `content` , height: `auto` `relative`) -> `content`

An answer to a free text question. If the document is not in solution mode, the answer is hidden but the height of the element is preserved.

Parameters:

`answer` (`content`) – the answer to (maybe) display

`height` (`auto` or `relative` = `auto`) – the height of the region where an answer can be written

checkbox(correct: `boolean`) -> `content`

A checkbox which can be ticked by the student. If the checkbox is a correct answer and the document is in solution mode, it will be ticked.

Parameters:

`correct` (`boolean`) – whether the checkbox is of a correct answer

multiple-choice(options: `array`) -> `content`

A table with multiple options that can each be true or false. Each option is a tuple consisting of content and a boolean for whether the option is correct or not.

Parameters:

`options` (`array`) – an array of (option, correct) pairs

single-choice(options: `array` , answer: `integer`) -> `content`

A table with multiple options of which one can be true or false. Each option is a content, and a second parameter specifies which option is correct.

Parameters:

`options` (`array`) – an array of contents

`answer` (`integer`) – the index of the correct answer, zero-based