Going in the Deep-End: Batch-Generating Question Banks for Moodle Quizzes

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Online Exams – Wishlist

• Many variations of a question
  • Maintain academic integrity

• Manage large number of questions easily

• Check and edit questions and answers easily

• Ask a range of questions (not just MC)

➤ Question Banks!
For example ...

10-50 variations per question.

Distribution: asynchronous, timed, open-book online exam (non-deferring students only)

Average: 79%
For example ...

... Combine numeric and multiple choice question with regard to same set-up.

This question is worth 2 points. Try to spend no more than 10 minutes on it.

To get a better sense for the workings of the Lagrangian, it is a good idea to work out a one-dimensional constrained optimization problem. For example, consider the following optimization problem

$$\max_x 21x - 3x^2 \quad s.t. \quad x \leq 3.$$ 

Write down the Lagrangian, derive, and solve the first order conditions.

Answer:

$$x^* = \underline{\quad \quad} \quad \lambda^* = \underline{\quad \quad}$$

Note that the Lagrangian multiplier $$\lambda^*$$ in this case is \(\underline{\quad}\). Therefore, the constraint

\(\underline{\quad}\).

(As an aside: If you have taken up the practice of drawing contour plots for different objective functions, I encourage you (after the exam, maybe) to check graphically what happens as the constraint increases and compare this to how the Lagrangian multiplier changes.)
For example ...

... Embed graphics/ tables in a question and ask various questions.
Workflow overview

Develop question → Create document with (large) number of variations of question → Compile in Moodle-compatible format

Import as category to Moodle Question Bank → Create and Edit Quiz in Moodle → Add random question from category

(repeat)

For this talk: We’ll work backward through the workflow.

First: Reminder on bottom row elements.
Category = Grouping of questions
Sub-Category = Subgrouping of question

In Person Exam

Exam Version A
Question 1A
Question 2A
Question 3A

Exam Version B
Question 1B
Question 2B
Question 3B

Exam Version C
Question 1C
Question 2C
Question 3C
Add random question from category

**Category** = Grouping of questions  
**Sub-Category** = Subgrouping of question

Online Exam

- **Question 1**
  - Question 1A
  - Question 1B
  - Question 1C

- **Question 2**
  - Question 2A
  - Question 2B
  - Question 2C

- **Question 3**
  - Question 3A
  - Question 3B
  - Question 3C

**Moodle Categories**  
from which random questions are drawn
Step 1: Edit quiz.

Step 2: On right hand side, click “add question.” Then select “from question bank.”

Step 3: in pop-up window, select question category and number of questions to be chosen for quiz. Click “add selected questions.”
Step 1: On course front page, turn editing on

Step 2: Add activity or resource

Step 3: Select Quiz activity, click “Add”

Step 4: Enter Name and description

Step 5: Choose settings for timing, display, grading, etc.

Step 6: Select “save and display”
For more details on those steps and settings, see:

• G. Colby: “Creating Online Multiple Choice Exams with Random Question Pools Using the Moodle Quiz Activity”
  https://teachingcommons.yorku.ca/teaching-commons-webinar/

• Moodle documentation
  https://docs.moodle.org/38/en/Quiz_settings
Import as category to Moodle Question Bank

Step 1: Click on cog wheel in top right hand corner of course front page.

Step 2: Select “More.”

Step 3: Scroll to the bottom of the page to “Question Bank.”

Step 4: Click on “Import.”
Import as category to Moodle Question Bank

Step 5: Select the appropriate File Format.

Step 6: Under “General”, set the categorization.

Step 7: Choose the file with questions – typical Moodle upload.

Step 8: Click on “Import.”
Import as category to Moodle Question Bank

Step 9: On next page, review questions.

Step 10: Click “continue.”

On the next page, all questions are listed.

Step 11: Click on a magnifying glass to double check selected questions.

A pop-up window will show question as displayed in the quiz.
Some file formats (GIFT, XML) allow category to be included in the question upload. No further action needed.

For other file formats (AIKEN), set-up the category under the category tab.

Then select the category in the General tab when importing.
Workflow overview

Develop question → Create document with (large) number of variations of question → Compile in Moodle-compatible format → Import as category to Moodle Question Bank → Create and Edit Quiz in Moodle → Add random question from category

(repeat)

Next: Top row – core of this presentation.
Moodle import supports a variety of question bank formats. In this webinar, focus on three.
Compile in Moodle-compatible format

Mark-Up Language
Using tags along with questions/answer texts. Tags are interpreted by Moodle. Question/answer texts are displayed.

AIKEN

One plus one is zero.
A. True
B. False
ANSWER: B

GIFT

::Q1:: One plus one is zero. {F}
Mark-Up Language
Using tags along with questions/answer texts. Tags are interpreted by Moodle. Question/answer texts are displayed.

One plus one is zero.
A. True
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ANSWER: B

::Q1:: One plus one is zero. {F}
<table>
<thead>
<tr>
<th>Question Type</th>
<th>True/False</th>
<th>Multiple Choice</th>
<th>Multiple Answers</th>
<th>Short Answers</th>
<th>Matching</th>
<th>Missing Word(s)</th>
<th>Numerical</th>
<th>Embedded Questions</th>
<th>Can include graphics</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIKEN</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIFT</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>XML</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Avoid, due to high “chance performance.” Use MA instead.

Be mindful of formatting concerns. See next slides.
Multiple Answer format in Moodle

- Requires that weight assigned to “yes” answers add to 100%.
- Requires specifying negative weights for “no” answers.
- Default: Selecting all answers yields 100%.
- Assigning equal weights to correct “yes” and correct “no” answers typically not possible.
  - Better implemented as multiple T/F statements in Cloze environment.

Numerical Format

- Moodle cannot interpret fractions, e.g., “1/2,” but allows them.
  - Include instructions in question text, to enter answer in decimal format.
Compile in Moodle-compatible format

Warning

Short Answer format
• Allows students to write answer in free form.
➢ Only use this format, if you can specify complete list of acceptable answers, including all misspellings, etc. or if you can specify format of answer in instructions.

Matching format
• Asks students to match, e.g., capitals to countries.
➢ Do not use this format for “ordering” questions such as “bring the following steps in the right order by matching them with “step 1,” “step 2,” ... etc.” Moodle cannot assign partial credit if step 3-5 are conditionally correct.
Create document with (large) number of variations of question

<table>
<thead>
<tr>
<th>Moodle Format</th>
<th>Editor</th>
<th>Generation</th>
<th>File Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIKEN</td>
<td><img src="#" alt="W" /></td>
<td><img src="#" alt="X" /></td>
<td>.txt (UTF-8)</td>
</tr>
<tr>
<td>GIFT</td>
<td><img src="#" alt="W" /></td>
<td><img src="#" alt="X" /></td>
<td>.txt (UTF-8)</td>
</tr>
<tr>
<td>XML</td>
<td><img src="#" alt="LaTeX" /> <img src="#" alt="TeXstudio" /> <img src="#" alt="MATLAB" /> <img src="#" alt="Python" /></td>
<td>.xml</td>
<td></td>
</tr>
</tbody>
</table>
Software Used

• LMS: York Moodle


• Tex-compiler (free): Miktex https://miktex.org/ (other tex compiler available for Mac, Unix)

• Tex-editor (free): TexStudio https://www.texstudio.org/ (other editor available for Windows, Mac, Unix)

• Matlab (York license): https://matlab.info.yorku.ca/
Create document with (large) number of variations of question

- No special code.
- No line breaks in question text.
- Each answer must start with a single uppercase letter, followed by a period "." or a right parenthesis ")", then a space or line break.
- The answer line must immediately follow, starting with "ANSWER: " (with a space after the colon) and then give the letter for the correct answer.
- Questions are separated by line breaks.
- Safe as “txt” file. Choose Unicode UTF-8 format.
Albert Camus wrote Wuthering Heights.
A. True
B. False
ANSWER: B

In which country does the city of Toronto lie?
A. Canada
B. Nigeria
C. Mali
D. Ireland
ANSWER: A
Step 1: Create document (in Word or notepad), following formatting standards.

Step 2: Save as “name_AIKEN.txt” file. Choose “other encoding,” then “Unicode (UTF-8).”

Step 3: Within Moodle question bank, create a new category.

Step 4: Import “name_AIKEN.txt” into Moodle. Choose created category under general tab.
Create document with (large) number of variations of question

UTF-8 Text file

Moodle Imported file
Create document with (large) number of variations of question

- Questions are separated by line breaks.
- Safe as “txt” file. Choose Unicode UTF-8 format.

**Basic Symbols**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>::title::</td>
<td>Question title (optional)</td>
</tr>
<tr>
<td>text</td>
<td>Question text (becomes title if no title specified)</td>
</tr>
<tr>
<td>{ ..... }</td>
<td>Start answer(s) -- without any answers, text is a description of</td>
</tr>
<tr>
<td></td>
<td>following questions .... End answer(s)</td>
</tr>
<tr>
<td>{T} or {F}</td>
<td>True or False answer; also {TRUE} and {FALSE}</td>
</tr>
<tr>
<td>{ ... ~right ... }</td>
<td>Correct answer for multiple choice, multiple answer, or fill-in-the-</td>
</tr>
<tr>
<td></td>
<td>blank</td>
</tr>
<tr>
<td>{ ... ~wrong ... }</td>
<td>Incorrect answer for multiple choice or multiple answer</td>
</tr>
<tr>
<td>{# .... }</td>
<td>Start numeric answer(s) ... end answer(s).</td>
</tr>
</tbody>
</table>

For further symbols, see [https://docs.moodle.org/39/en/GIFT_format](https://docs.moodle.org/39/en/GIFT_format)
::Q1:: Albert Camus wrote Wuthering Heights. {F}

::Q2:: In which country does the city of Toronto lie?
{ =Canada ~Nigeria ~Mali ~Ireland }
Step 1: Create document (in Word or notepad), following formatting standards.

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Create document with (large) number of variations of question

UTF-8 Text file

Moodle Imported file
Create document with (large) number of variations of question

LaTeX: document preparation system.
Write: plain text + code.
Compiler: Interprets code and outputs formatted text.

Examples:
\section{Introduction} \emph{this} item
yields
1. Introduction \textit{this} item

Compiler: generates pdf output.
can be set to generate XML.
Framing:
\documentclass[12pt]{article}
\usepackage{moodle}
\begin{document}

\begin{quiz}{Question06}
\end{quiz}

\end{document}

Beginning of document
Bracketing of collection of questions; “Question06” specifies Moodle category
End of document; Compiler ignores text beyond

Moodle package by Anders Hendrickson
For more information: http://tug.ctan.org/tex-archive/macrolatex/contrib/moodle/moodle.pdf
Multiple Choice:

\begin{multi}[points =1]{Capitals}

What is the capital of France?

\item Berlin
\item Ottawa
\item* Paris
\item New York

\end{multi}

Beginning of question; Assigned points; Question title

\quad

Answer choices.

* Marks correct answer.

End of question

Moodle package by Anders Hendrickson
Create document with (large) number of variations of question

Numerical:
\begin{numerical}[points =1]{Summation}
What is 34.2 + 27.3?
\item[tolerance=0.1] 61.5
\end{numerical}

Beginning of question; Assigned points; Question title

Question and correct Answer.

End of question

Moodle package by Anders Hendrickson
Create document with (large) number of variations of question

<table>
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<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIFT</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
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Advantage

XML and AIKEN support True/False and Multiple Choice, while GIFT supports a large number of variations and can include graphics.
Blocks of Questions - Cloze

Objective: Ask multiple questions with regard to same graph/ table/ case study – but randomize such that different students see different graphs/ tables/ case studies.

Solution: Embed multiple questions within one Moodle question.

➢ Cloze question.
Consider the function $f(x) = x$. It is
- a decreasing
- an increasing function. Its value at $x = 2$ is
- $2$ (tolerance=0.05)
Create document with (large) number of variations of question

\documentclass[12pt]{article}
\usepackage{moodle}
\usepackage{enumerate}
\usepackage{amsmath}

\begin{document}

\begin{quiz}{Logic Puzzle}
\begin{enumerate}[label=\textbf{\textit{\theenumi}}]
\item The youngest who got the second award won the dance badge.
\item Angelina won the first aid badge.
\item Beverly was awarded 1 spot after the girl who won the leadership badge.
\item Patsy was awarded 2 spots after the girl who won the leadership badge.
\end{enumerate}

You may find it helpful to create a copy of the following table in your notebook to think through the clues.

\begin{center}
\includegraphics[width=4in]{girls_badges.png}
\end{center}

According to the clues Winning the dance badge is a necessary and sufficient condition for receiving the merit badge awarded second.

Not being Patsy is a
When question text repeats – automatize question generation:

- Create text blocks and answer choices in Excel
- Open new Word document
- Use “Mail Merge” to auto-generate questions
- Save new document in txt format. (don’t worry about page breaks)

- Generate parameters for question. Use \texttt{fprint} command to write to file and generate a .tex file.
- Compile tex file with LaTeX to generate XML file.
Create document with (large) number of variations of question

Generate Excel file – one question per row. First row headings. Can use numbers, text. Save as Excel file.

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Value</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albert Camus</td>
<td>Wuthering Heights</td>
<td>F</td>
<td>B</td>
</tr>
<tr>
<td>Albert Camus</td>
<td>The Stranger</td>
<td>T</td>
<td>A</td>
</tr>
<tr>
<td>Alfred Doblin</td>
<td>Complete Poems</td>
<td>F</td>
<td>B</td>
</tr>
<tr>
<td>Alfred Doblin</td>
<td>Berlin Alexanderplatz</td>
<td>T</td>
<td>A</td>
</tr>
<tr>
<td>Anon</td>
<td>Love in the Time of Cholera</td>
<td>F</td>
<td>B</td>
</tr>
<tr>
<td>Anon</td>
<td>King Lear</td>
<td>F</td>
<td>B</td>
</tr>
<tr>
<td>Anon</td>
<td>Othello</td>
<td>F</td>
<td>B</td>
</tr>
<tr>
<td>Anon</td>
<td>The Epic of Gilgamesh</td>
<td>T</td>
<td>A</td>
</tr>
<tr>
<td>Anon</td>
<td>The Book of Job</td>
<td>T</td>
<td>A</td>
</tr>
<tr>
<td>Anon</td>
<td>Mahabharata</td>
<td>T</td>
<td>A</td>
</tr>
<tr>
<td>Anton Chekhov</td>
<td>The Complete Tales</td>
<td>F</td>
<td>B</td>
</tr>
<tr>
<td>Anton Chekhov</td>
<td>The Iliad</td>
<td>F</td>
<td>B</td>
</tr>
<tr>
<td>Anton Chekhov</td>
<td>Selected Stories</td>
<td>T</td>
<td>A</td>
</tr>
<tr>
<td>Anton Chekhov</td>
<td>Thousand and One Nights</td>
<td>T</td>
<td>A</td>
</tr>
</tbody>
</table>

Use Column C for GIFT. GIFT distinguishes T/F from MC questions.

Use Column D for AIKEN. AIKEN only accepts A, B, ... as answer.
Create document with (large) number of variations of question

Mail merge

Step 1: Open new Word document

Step 2: Choose mailings Ribbon

Step 3: Start mail merge for Word document

Step 4: Click “Select Recipients” and select “Using Existing List.” Pick excel file (which must be closed).
Create document with (large) number of variations of question

Mail merge

Step 5: Select the appropriate worksheet and select “contains column header”

Step 6: Write the question and insert text blocks as appropriate.

Step 7: Click on “Finish Merge” & select “Edit Individual Documents…”

Note: Ignore page breaks introduced through mail merge. Saving document as UTF-8 will cut the page breaks.
Create document with (large) number of variations of question

Matlab codes run through parameter loop. Use `fprintf` command to create tex file.

Then compile tex file with LaTeX compiler.
• Ensure the first student writing your exam is not worse off than the 100\textsuperscript{th} student.

• Ensure that seeing other students’ questions (w/o answers) is not more informative than seeing practice/homework questions.

• Avoid MC questions – there’s auto-grading! Replace them with short answer question (to test mastery of terminology), numeric question (to test ability to execute), multiple answer questions (to at least reduce the “chance score”).
Workflow overview

1. Develop question
2. Create document with (large) number of variations of question
3. Compile in Moodle-compatible format
4. Import as category to Moodle Question Bank
5. Create and Edit Quiz in Moodle
6. Add random question from category

(repeat; approx. 2h per question)
Online Exams – Wishlist

✓ Many variations of a question
  ✓ Maintain academic integrity

✓ Meaningful way to manage large number of questions

✓ Can double check and correct questions and answers in reasonable way

✓ Can ask a range of questions (not just MC)
Q & A

• Can you generate calculated numeric questions?
  • No directly. But not needed.
  • Calculated questions in Moodle generate variations of questions by varying parameters in the question. Also: formulas/ algorithms are limited.
  • Instead: Run through parameters in Excel/ Matlab/ Python, then generate all variations through LaTex or MailMerge. Upload questions as category to Moodle.

• How do you generate the drop-down MC format we saw in some examples?
  • Within the Cloze environment, MC questions can be represented as vertical, horizontal, or drop-down options. Drop-down is the default. The other options can be specified.
Thank you.
Technical notes

- Webcam: My smartphone.
- Software used for this presentation:
  (all free or freely available to the York community)
  - Virtual call: Zoom
  - Slide deck: Powerpoint
  - Smartphone-as-webcam app: ivCam (free version)
  - Background image: Douglas reading room at QU
  - Blurred with a 1.5-radius Gaussian Filter in Gimp