Creating an exam on Moodle and the time-tested protocols that work in IIT Delhi environment for online exams

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History

- Moodle at IIT Delhi in its modern avatar has been around since 2014. My MTP student, Phani Mahesh (also the creator of repo.iitd.ac.in) set it up with active help from Pardeep.

- First Moodle exam on campus conducted by Prof. Shouri Chatterjee (EE), for a class quiz.

- In 2014, I requested Moodle authors (Open University) to create a special question type – deferred feedback with explanation. Idea: autograding is fine, but I want to see the working so that I can give out partial credits. They created it (thanks to Tim Hunt). It is currently one of their more popular question types, ported to ver. 3.9.

- Fall 2014 Mid Term 1 ELL111/EEL218. First full Moodle exam on campus. Acknowledge: Dean’s office support, especially Prof. M. R. Ravi for critical support, especially on policy, and HoD (EE): Prof. B. Bhaumik, Prof. Bhim Singh.

- Fall 2015 ELL100. Mid Term 1: Two stage exam with groups. CSC. The second group came in immediately after the first. ~250 students in each group. Acknowledge: critical support from CSC: Prof. S. Arun Kumar, Mr. Sunil Kak, Prof. Huzur Saran. My co-instructor: Prof. Saif Mohammad (EE).

- Fall 2015 ELL100. Mid Term 2: LHC commissioned. Diesel generators (UPS was pending installation at that time). Used LHC and CSC to conduct a simultaneous exam for 455 students. Special thanks to Sunil Kak, N. C. Kalra, Sandeep, Ms. Usha.

- Fall 2015 ELL100. End Term: CVL100 and ELL100 exams conducted using Moodle on the same day. 500+ students each.

- Usage since has grown. In 2017, it was estimated that around 30 courses were using Moodle exams at least once in a semester. Class sizes for which this has been tested: 3 (smallest) – 500 (largest).

- There is a particular protocol I have developed to make exams work. Needs specific Moodle components used in a particular manner, and sequence of steps. This protocol assumes proctoring. Will need to be modified accordingly now.

- Why? I am lazy. I do not believe that mechanical grading of 100 identical answers should be done by a human being unless human judgment is actually needed. It is a waste of valuable time, both for the instructor and the TA.
Exam protocol

-15 days
Start thinking about holding an exam on Moodle

-8 days
Prepare questions in question bank. Work out solutions. Type in the solutions, identifying partial credit opportunities (use %, not points). Define ranges for parameters appropriately.

-5 days
Take a second look at the questions. Think of how students can make mistakes. Identify “popular” mistakes.

-4 days
Add additional answers with partial credits. Update the solution.

-4 days
Create Quiz activity. Define Instructions, date, time, passwords, IP ranges, hiding restrictions. Setup regrade forum with a +72 hr Deadline.

-4 days
Announce date, time and venue on Moodle and in class.

-4 hours
Add questions from question bank to quiz.

-15 minutes
Quiz Activity starts

-10 minutes
Students arrive, and log in.

0 minutes
Announce quiz password and start watching the attempt screen.

+10 minutes
Start sign in process on sheet. Warn about explanations box.

+60 minutes
“Halftime up”. Warn again about explanations box.

+110 minutes
10 minute warning

+120 minutes
Quiz autosubmission.

+150 minutes
Quiz Activity ends

+150 minutes
Students see autograded scores and solutions.

+150 minutes
Regrade forum becomes visible.

+3 days
Regrade request period ends.
First stop: the question bank

Question bank

Select a category:

Default for 1902-ELL231 (2)

The default category for questions shared in context '1902-ELL231'.
No tag filters applied

Filter by tags...

☐ Show question text in the question list

Search options ▼

☐ Also show questions from subcategories

☐ Also show old questions

Create a new question ...

<table>
<thead>
<tr>
<th>T</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>Carrier concentration</td>
</tr>
<tr>
<td>☐</td>
<td>Devices employed as sensor backplanes</td>
</tr>
<tr>
<td>☐</td>
<td>Fermi level location</td>
</tr>
<tr>
<td>☐</td>
<td>Ge Fermi level</td>
</tr>
<tr>
<td>☐</td>
<td>Mercury</td>
</tr>
<tr>
<td>☐</td>
<td>Packing fraction</td>
</tr>
<tr>
<td>☐</td>
<td>Particle in a 3D box</td>
</tr>
<tr>
<td>☐</td>
<td>Find the false statements</td>
</tr>
</tbody>
</table>

With selected:

Delete □ Move to >> □ Default for 1902-ELL231 (2) □

Jump to...
Numerical problems with differing data sets, autograded

Question type: Calculated

We have the most common question types installed.

If you need something else, go to Moodle homepage after searching. Look for question type plugins (there are thousands of plugins for different activities).

If there is a question type you want, tell me. I will try to install it for you with Pardeep’s help.
Numerical problems with differing data sets, autograded

Click: Add

This is a descriptive name that students will see.

You enter the problem statement here, including any graphics.

You assign some points here. You can change it later.
Numerical problems with differing data sets, autograded

Enter the problem and solution.

We use wildcards within {} for the quantities that will change from student to student.

The solution.
Numerical problems with differing data sets, autograded

Enter the answer for Moodle to use for autograding

By Newton’s second law, we can write,

\[ F = m \cdot a \]

(30% credit for mentioning Newton’s second law. Additional 20% credit for writing down the equation)

Plug and chug.

Define tolerances, grade % for this answer, and number of digits to keep

You can add more answers. For alternate solutions / “popular” mistakes.
Numerical problems with differing data sets, autograded

Setup units

You usually want units. Set penalty to zero, and always use a drop down menu.

Unit handling
The unit must be given, and will be graded.

Unit penalty: 0
as a fraction (0-1) of the response grade

Units are input using: a drop-down menu

Units go: on the right, for example 1.00cm or 1.00km

Contents of the drop down menu. Define scale factors for units.

Units

Unit 1: Newtons
Multiplier: 1

Unit 2: kg m/s^2
Multiplier: 1

Unit 3: dynes
Multiplier: 1e-5

Multiple tries

Tags

Use this button to keep saving changes (if you have a long solution)

Use this button to move to the next step
Numerical problems with differing data sets, autograded

Define wildcard properties:

Choose wildcards dataset properties

The wild cards \{x..\} will be substituted by a numerical value from their dataset

<table>
<thead>
<tr>
<th>Mandatory wild cards present in answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild card {m1} will use a new shared dataset</td>
</tr>
<tr>
<td>Wild card {a1} will use a new shared dataset</td>
</tr>
</tbody>
</table>

New shared dataset for unconnected questions.
Existing datasets can be used for syncing with other questions – multipart questions.

Possible wild cards present only in the question text

Synchronise the data from shared datasets with other questions in a quiz

Define synchronization

- Do not synchronise
- Synchronise
- Synchronise and display the shared datasets name as prefix of the question name

Use this button to move to the next step
Numerical problems with differing data sets, autograded

Define wildcard properties:

<table>
<thead>
<tr>
<th>Name</th>
<th>Items Count</th>
<th>Used in Question</th>
<th>Quiz</th>
<th>Attempts</th>
</tr>
</thead>
<tbody>
<tr>
<td>m1</td>
<td>0</td>
<td>Calculating force</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>a1</td>
<td>0</td>
<td>Calculating force</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Update the parameters when done.

Define value ranges and distribution – uniform or log uniform.
Numerical problems with differing data sets, autograded

Setup answer tolerance and digits

Decimal places 2

Distribution Uniform

Answers tolerance parameters

Update the answers tolerance parameters

\{m1\}'a1\} 5.5'1.2 = 6.600 Newtons
Correct answer: 6.600 Newtons inside limits of true value
Min: 6.26999999999 --- Max: 6.930000000001

Tolerance ± 0.05

Tolerance type Relative

Correct answer shows 3

Format decimals

You will need to click on “Show more …” to access these controls.

Update the tolerance when done.
Numerical problems with differing data sets, autograded

Add wildcard sets

Select the choice that makes sense – if you have an independent question, choose force regeneration of all wildcards, otherwise exercise caution. Click Get new ‘Item to Add’ row when done.

Choose the number of wildcards you want. For a class of 74 students, choose 70-80 (should be sufficient). Click “Add” when done.

You can choose to examine wildcard sets if you want (usually unnecessary).
**Numerical problems with differing data sets, autograded**

Display generated wildcards

<table>
<thead>
<tr>
<th>Set 80</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shared wild card (m1)</strong></td>
</tr>
<tr>
<td><strong>Shared wild card (a1)</strong></td>
</tr>
<tr>
<td>(7.6 \times 3.75 = 28.500) Newtons</td>
</tr>
<tr>
<td>Correct answer: 28.500 Newtons inside limits of true value</td>
</tr>
<tr>
<td>Min: 27.075 --- Max: 29.925</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set 79</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shared wild card (m1)</strong></td>
</tr>
<tr>
<td><strong>Shared wild card (a1)</strong></td>
</tr>
<tr>
<td>(2.5 \times 3.73 = 9.325) Newtons</td>
</tr>
<tr>
<td>Correct answer: 9.325 Newtons inside limits of true value</td>
</tr>
<tr>
<td>Min: 8.858749999999999 --- Max: 9.7912500000001</td>
</tr>
</tbody>
</table>

Each set is shown with calculated answer.

A problem can arise if one of the answers is outside the limits. You cannot save until you fix that – modify tolerance and digits to address that problem.

Save changes when done. Don’t preview here. Save it first.
Numerical problems with differing data sets, autograded

Previewing your question

Question bank

Select a category:

Default for 1902-ELL231 (3)

The default category for questions shared in context '1902-ELL231'.

No tag filters applied

Filter by tags...

- Show question text in the question list
- Also show questions from subcategories
- Also show old questions

Create a new question ...

New question added

Controls.

<table>
<thead>
<tr>
<th>Question</th>
<th>Created by</th>
<th>Last modified by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculating force</td>
<td>Madhusudan Singh</td>
<td>Madhusudan Singh</td>
</tr>
<tr>
<td>Carriers concentration</td>
<td>Madhusudan Singh</td>
<td>Madhusudan Singh</td>
</tr>
<tr>
<td>Devices employed as sensor backplanes</td>
<td>Madhusudan Singh</td>
<td>Madhusudan Singh</td>
</tr>
<tr>
<td>Fermi level location</td>
<td>Madhusudan Singh</td>
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</tr>
<tr>
<td>Ge Fermi level</td>
<td>Madhusudan Singh</td>
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<td>Madhusudan Singh</td>
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</table>

With selected:

Delete  Move to >>  Default for 1902-ELL231 (3)
Numerical problems with differing data sets, autograded

Previewing your question

Preview question: Calculating force

Estimate the force exerted on a particle with mass 2.3 kg if it is seen to accelerate from rest to 2.01 m/s^2.

Answer: [blank]

This is what it will look like to the students. Don't worry about the explanations box yet! You can simulate the submission of the correct answer here.
Numerical problems with differing data sets, autograded

Preview question: Calculating force

Question 1
Correct
Mark 5.00 out of 5.00

Estimate the force exerted on a particle with mass 8.4 kg if it is seen to accelerate from rest to 9.33 m/s².

Answer: 78.372 Newtons

By Newton's second law, we can write,

\[ F = m \cdot a \]

(30% credit for mentioning Newton's second law. Additional 20% credit for writing down the equation)

Plug and chug.

The correct answer is: 78.372 Newtons

This is the solution you wrote down.
Will show how to create a Quiz activity and add this question to it. Supplemented with real-life examples. And a word on Math.
Other interesting question types

• **Grading of algebra.** STACK – inbuilt CAS. Question versions are generated from template, with dynamic plots based on the question. Mathematical properties of answers are evaluated with Maxima. Rubric driven step by step checking with partial credit. Response trees – based on multi-part mathematical questions. An alternative plugin directly uses GeoGebra. *I have not tested this, but reports are that it is rather complete as it uses a full CAS.*

• **Drag and drop.** Can ask students to label an image from a jumbled set of possible labels. Matching. *Tried it once three years ago. Appeared to work fine.*

• **Poodll.** This is an entire class of possible question types – video, audio and hand drawing. Generally useful for language teaching. Filter has a 30 day free trial.

• **Concept map.** Permits students to submit mind maps or concept maps.

• **Atto: Sketch.** Atto is a class of plugins that implement an embeddable HTML editor (permits MS Word import, CSS, MathType (typed and handwritten math), Chemistry structures and reactions editor, etc). Contains Sketch that opens up a Paint like whiteboard for students to enter their freehand drawings. *Untested, but worth implementing next semester.*

• **Freehand drawing.** Permits students to sketch an answer on top of a provided background image. The answer is matched against the solution (not visible to students). *This plugin is not maintained anymore. It seems to work in ver. 3.3. Risky.*

• **Cloze.** Permits multipart answers (fill in the blanks) in a single shot. These can be different types. Specific syntax. Online Cloze generators are available. *Needs a bit of practice. Not recommended for colleagues unfamiliar with Moodle.*
Some interesting capabilities applicable for this situation

- **Offline quiz mode. Plugin-name: Quiz fault-tolerant mode.** *Browsing from question to question does not require an active network connection. Question paper is downloaded to the client machine. User does not lose work. Can resume when network resumes.* **Untested.**

- **PDF feedback.** Grader can annotate the PDF.

- **Groups.** You can set up Moodle groups to subdivide your class. Different question papers for different parts of the class. Use case: you schedule three exams, one after the other for three different groups.
Things you should NOT do

• **Don’t keep time margins too tight.** The exam time window should be large enough to accommodate a) length of the exam, b) the typical delayed student at IIT Delhi who shows up 10 minutes late, c) Network issues that require moving a student from one machine to another (can take 5 minutes). Assume that at least 10% of the machines will give you problems. Ask for a larger lab than you have students. *I call this the 10-10 rule. 10% padding of time and 10% extra seats.*

• **Don’t pressurize the students.** Guarantee them that no matter when they started, they will get their 60/120 minutes. *The clock on the screen will do the pressuring for you, but they need reassurance as human beings.*

• **Don’t skimp on instructions.** Please mention these in gory detail. Allocate a certain amount of time (I give them 10 minutes – the enforced boredom helps calm them down) when students are forced to read this.

• **Don’t miss clearly stating the regrade requirements.** Corollary of “Don’t skimp on instructions”. Tell them at least twice during the exam that if they do not write anything in the explanations box, they will get no regrades no matter what the sob story is.

• **Don’t announce password too early, or too late.** Exams are supposed to start on time. Avoidable mess. I know that that kid needs help logging in, but get a TA to do that.

• **Don’t miss the manual attendance.** This allows you to check who actually showed up for the exam.

• **Don’t skip watching the attempt screen during the exam.** This will tell you early if there are any problems. If someone logs out or logs in, this can indicate possible trouble.

• **Don’t EVER edit a live exam.** Confession: I once tried to do this. Crashed the whole exam and wasted 1 hour of students’ time. Some questions can be edited safely while the exam is live. The ones that require database changes, can’t. There is no predictable way to tell which is which. *Moral: once the exam starts, keep those itchy fingers to yourself even if you see that you gave away too much information/have an ill-posed question/have an ambiguity that cannot be verbally addressed without giving away the solution, etc. Just accept that that question will require you to manually grade responses.*
Common misconceptions

- “Online exams can only do objective type tests” (ref: GATE/JEE)
- “You can’t test students on steps of a question – it is all or nothing.”
- “If everyone gets the same question, won’t they copy from each other?”
- “No way to check for conceptual shortfalls – it is all plug-and-chug”.
- “Once Moodle grades, there is no going back. It could be wrong, or have failed to account for an alternate answer.”

Most definitely not!

You can pick “popular” mistakes and give out partial grades. Or use steps. Define a grading pattern And ask for regrade requests.

Even with a calculated question, each student gets a different question. If he or she copies, guaranteed to get it wrong.

Design the questions so that conceptual problems lead to given wrong answers.

Regrades are easily possible.