Lerninseln Digital - Modern Learning Materials for Engineering Mathematics

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Exercise Types

Frage-Tests und eingesetzte Varianten

Lösen Sie die Gleichung $\ln(\sqrt{x}) + 1.5\,\ln(x) = \ln(6\,x)$ und geben Sie die Lösungsmenge an.

$\mathbb{L} =$ [ ].

Hinweis: Geben Sie die Lösungsmenge in geschweiften Klammern an. Ist Ihre Lösung $x_1 = a,\ x_2 = b,\ x_3 = c$, so schreiben sie $\mathbb{L} = \{a, b, c\}$. Runden Sie Ihre Lösung nicht, d.h. schreiben Sie ln(1), nicht 0.693.

Algebraic Input Type Question

Frage-Tests und eingesetzte Varianten

Bestimmen Sie die Implikationen für folgende Tabelle. Wenn keine der Optionen ⇒, ⇐ oder ⇔ zutrifft, wählen sie das Feld " - ".

Aussage A	Implikator	Aussage B
$-36 = a^2$	Keine Antwort ausgewählt	$a \in \mathbb{R}$
$x \leq 16$	Keine Antwort ausgewählt	$x \leq 14$
$x = 4$	Keine Antwort ausgewählt	$x^2 + 16 = 8 \cdot x$

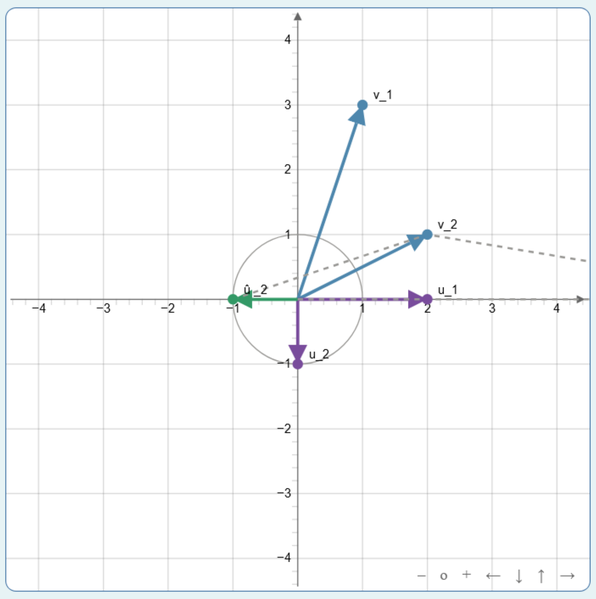
Multiple Choice Type Question

Frage-Tests und eingesetzte Varianten

Bestimmen Sie mit dem Gram-Schmidt-Verfahren eine ONB von $\mathbb{R}^2$ (bzgl. des Standardskalarprodukts) aus den gegebenen v_1 und v_2, die bereits im Koordinatensystem eingetragen sind.

$$v_1 = \begin{bmatrix}1\\3\end{bmatrix},\ v_2 = \begin{bmatrix}2\\1\end{bmatrix}$$

Skizzieren Sie u_1 und u_2 sowie den Zwischenschritt $\hat{u}_2$ im Koordinatensystem.



Graphic Type Question using JSXGraph

Frage-Tests und eingesetzte Varianten

Vervollständigen Sie den folgenden Lückentext.

Wir bestimmen den Grenzwert von $\lim_{x\to 0} \frac{\cos(x)-1}{3\,x^2} = \lim_{x\to 0} \frac{f(x)}{g(x)}$.

Es gilt $\lim_{x\to 0} f(x) =$ [ ] und $\lim_{x\to 0} g(x) =$ [ ].

Wir verwenden also **die Regel von Benoulli/de l'Hospital** um den Grenzwert zu ermitteln:

$\lim_{x\to 0} \frac{\cos(x)-1}{3\,x^2} = \lim_{x\to 0}$ [ ] $= \lim_{x\to 0}$ [ ] $=$ [ ]

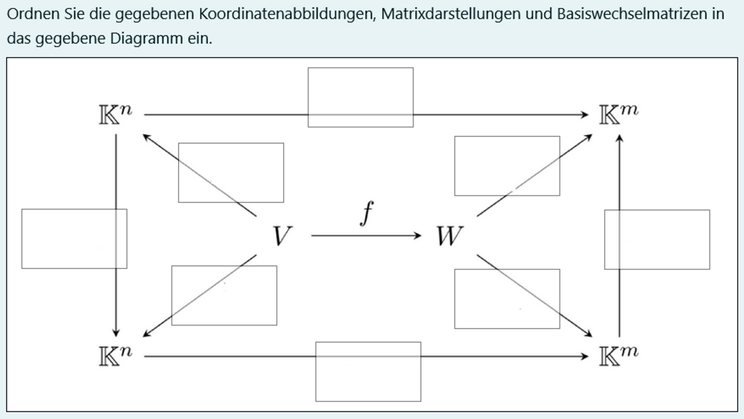
.

Cloze Type Question

Sei V ein $\mathbb{K}$-Vektorraum mit Basis $\mathcal{B}_1 = \{b_1, \ldots, b_n\}$ und einer weiteren Basis $\mathcal{B}_2$.
Sei W ein $\mathbb{K}$-Vektorraum mit Basis $\mathcal{C}_1 = \{b_1, \ldots, b_m\}$ und einer weiteren Basis $\mathcal{C}_2$.

Weiterhin sei $f : V \to W$ linear.

Ordnen Sie die gegebenen Koordinatenabbildungen, Matrixdarstellungen und Basiswechselmatrizen in das gegebene Diagramm ein.



$f_{\mathcal{B}_1,\mathcal{C}_1}$	$f_{\mathcal{B}_2,\mathcal{C}_2}$	$\mathrm{id}_{\mathcal{B}_2,\mathcal{B}_1}$	$\mathrm{id}_{\mathcal{C}_1,\mathcal{C}_2}$
$K_{\mathcal{B}_2}$	$K_{\mathcal{C}_2}$	$K_{\mathcal{B}_1}$	$K_{\mathcal{C}_1}$

Drag and Drop Type Question (not in Stack)

In this poster I present the use of Stack and other moodle question formats for the course Analysis I and Linear Algebra for Engineers

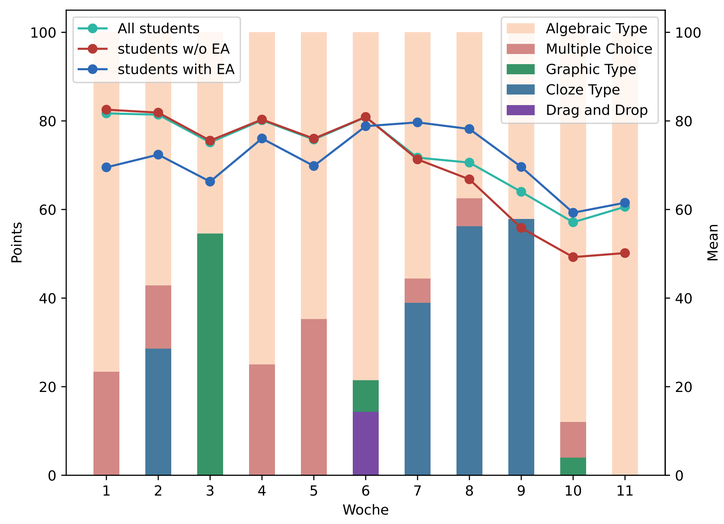
- largest course offered by TU Berlin with up to 3000 students from 30 majors in the winter term
- 3 lectures per week, 43 in total,31 of which Calculus and 12 Linear Algebra
- in addition to the lecture, an optional large exercise is held to practice material

For the course, we offer two types of exercises for our students:

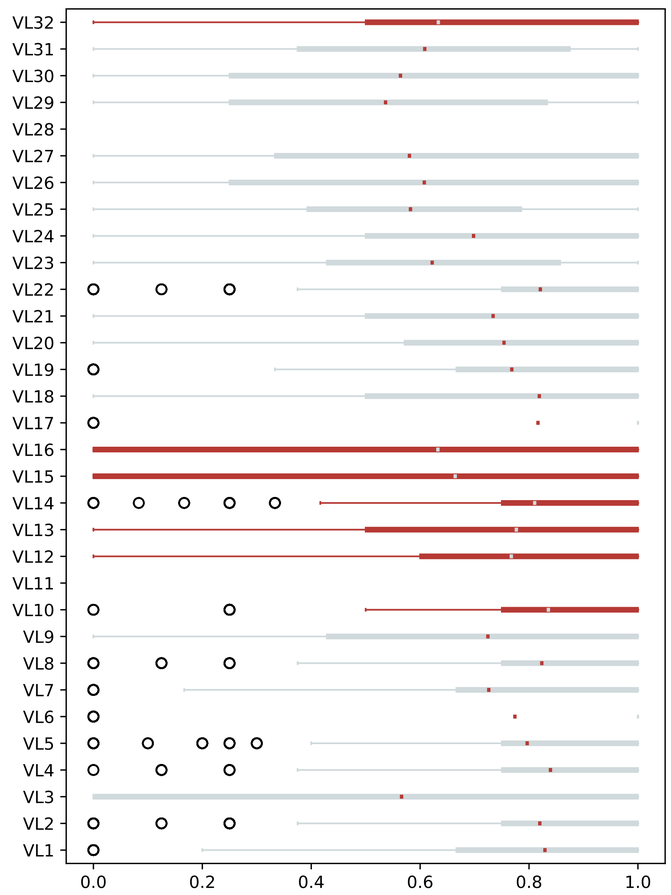
1. **Tutorial questions**
   - worked on in small group sessions or the open learning space that is supervised by our tutors
   - materials for different skill levels
   - different approaches like interactive and randomised exercises to improve understanding of lecture materials
2. **Homework questions**
   - to test understanding of lecture materials
   - students need 60% of points to participate in the final exam (exam admission)
   - 11 weekly homework sets

   In the winter term, we digitized all homework and some tutorial questions.

Evaluation of Homework Questions

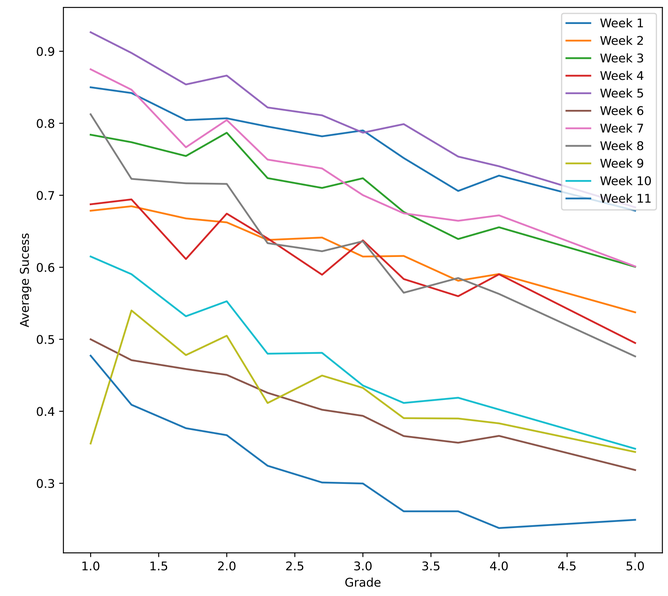


Used Question types for each week, along with average points, for all students, and those with and without exam criteria.

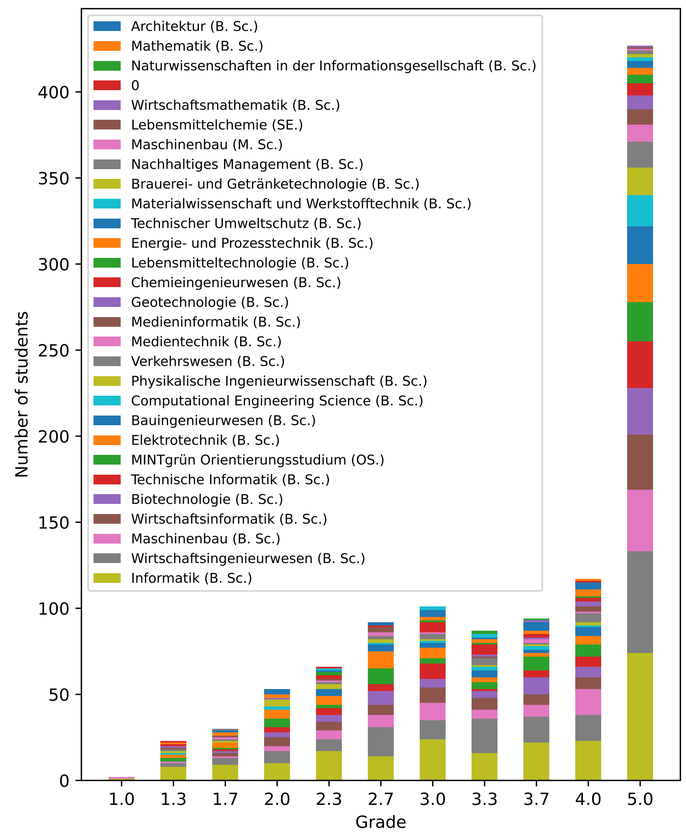


Average points, along with 25th and 75th percentile, in relation to each lecture. Grey bars symbolise Calculus lectures and red bars Linear Algebra lectures.

Exam Results



Comparison of the exam grade (horizontal axis) and average points per homework set (vertical axis) that the students with this grade achieved.



Students exam grade in relation to their major.
Students in their first semester can take the exam as a free shot with no negative consequences if they fail, which explains the high fail rate.

Review and Outlook

Student feedback to the new system was overall positive. Students liked graphical exercises the most, while cloze type questions were less popular.
By using Stack-Type questions, we were able to analyse homework performance in detail for the first time.

Goals for the upcoming semesters:

- improve existing question with the help of student feedback
- digitize all tutorial exercises
- with more tutorial questions we will be able to compare tutorial participance with homework results
- implement this system in other mathematics courses for engineers e.g. Analysis II for Engineers
- analyse performance of existing questions

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