

# Lab session 5

Machine Learning for Behavioral Data (CS-421)

March 24, 2021

# Today

- **08:15 08:35 Debriefing Previous Week**
    - Feedback from tutorial 4 and homework 2
    - Debriefing on homework 2 and questions time
  - **08:35 09:00 Tutorial on Bayesian Knowledge Tracing (fundamentals)**
  - **09:00 09:10 SHORT BREAK**
  - **09:10 09:45 Tutorial on Bayesian Knowledge Tracing (short exercises)**
  - **09:45 10:00 What's Next**
    - Next steps for the project and questions time
    - Introduction to homework 4 and questions time
-

# Feedback tutorial 4 (n=1)

4 What do you like about this lecture? What should be kept?

Respondent

Response

The notebooks have been great from the start, with a good level of detail and explanations. I think the level of detail and depth you're going into is great (wouldn't complain about more though :))

Total responses to  
question

1/1

Other points from previous feedback forms:

- Keep SpeakUp and little quizzes.
- Detailed explanations and walkthrough guidance.
- Openness and time to answer questions.
- Well-documented notebooks.

# Feedback tutorial 4 (n=1)

5

What do you dislike about this lecture? What should be changed (and how)?

**Respondent**

**Response**

They should be recorded - this session was indisputably a lecture, and not a lab session. If this is the way they'll be going forward, preparing a short presentation would be preferable to scrolling \*

Total responses to  
question

1/1

Other points from previous feedback forms:

- Hard to know what library or function to use and when. Provide supporting information.
- Provide a bit more time to complete exercise cells with nice results.
- Control the pace of the tutorial and provide more non-copy-and-pasting exercises.

# Feedback tutorial 4 (n=1)

8

Any additional comment?

**Respondent**

**Response**

I really appreciate the TAs and know they're doing their best I just think a slight shift in direction along the lines of my suggestions could make their best even better for us. Thank you :)

Total responses to  
question

1/1

Other points from previous feedback forms:

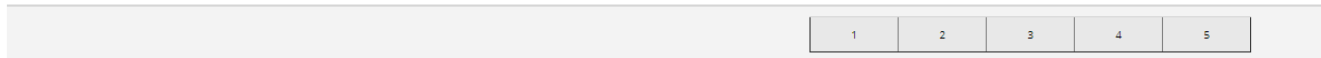
- Time of uploading for the material.
- Investigating the possibility of recording lab sessions.

# Feedback homework 2 (n=18)

1

The length of the homework was appropriate, from 1 (too short) to 5 (too long)

Average rank



1

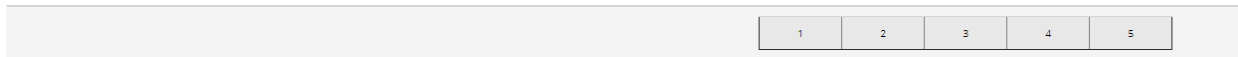
4.5

Responses	1	2	3	4	5	Total
1	0	0	0	0	0	0

2

The difficulty was appropriate, from 1 (extremely easy) to 5 (extremely hard)

Average rank



1

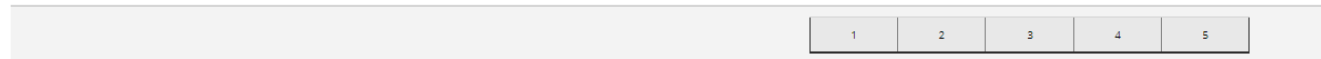
3.4

Responses	1	2	3	4	5	Total
1	0	0	0	7 (39%)	1 (6%)	18

3

The instructions were clear, from 1 (totally disagree) to 5 (totally agree)

Average rank



1

2.8

Responses	1	2	3	4	5	Total
1	2 (11%)	7 (39%)	5 (28%)	1 (6%)	3 (17%)	18

# Feedback homework 2 (n=18)

4

What do you like about this homework? What should be kept?

Respondent	Response
	nothing
	I would just like to use this questionnaire to say how greatly this course is organized, everything is clear, accessible, explained and it seems like the teaching team is putting a lot of effort which
	I liked the creative extension part
	I like their general idea, I really do, but I think their implementation needs a bit rethinking.
	It made sure we correctly understand the concepts saw in class and the implementation saw in the tutorial
	The diversity of work to do, field studied
	It's a good way to review what we have done in tutos
	I like the type of exercises we get to do
	It's useful and good for applying what we learn in lectures
	Progress on the clarity of the questions
	The task is simple and it's easy to get into building the models
Total responses to question	11/18

# Feedback homework 2 (n=18)

5

What do you dislike about this homework? What should be changed (and how)?

Respondent	Response
	The homework felt very long and unclear too me. I had trouble understanding some descriptions and instructions and was not sure whether this was due to me missing the background knowledge or not
	Data was unclear requiring multiple iterations for solutions which makes this more of a project and less of hw rendering the tasks as irrelevant and wrong to follow
	I appreciate a lot, amazing job! Thank you all for that!
	I'm not a fan of the open questions, and the "justify your answers" things.
	The homework was too long because it had many cells for explanations. Additionally, the tricky part was in the first task, so if we had decided to make changes there, we needed to redo other parts.
	It was way too long, and often too vague in its instructions too. Shorter and more focused homeworks can also be great homeworks.
	The data used was very hard to understand and interpret. The interpretation are not clear, often we do not know how precise we should are, how much analysis we should perform
	It definitely required theory that was not covered by the course, which is very annoying. If I never learnt how to interpret a model or coefficients, how should I know what to do.
	It was hard to find proper resources to answer question or to establish argument to select features
	The length, it's too long for me, specially when we have a day less to do the hw.
	I think this one in particular was too hard, I don't think we really covered everything we needed to know in the lectures/labs
	The features were really hard to understand. And also sometimes the interpretations I don't know what to say.
	That dataset was unbalanced and many things that could show difference in methods and processing of data didn't work
	The provided dataset is not appropriate for all the analysis, too small and class imbalance.
	It's way too long for a 4 credit course
	Too long... I spend more than a day by week for these HWs, and I am a MA4 student having done these kind of HW during my whole master.
	The results were very much affected my randomness, and one observation would not make sense the second time you would run the model. Very annoying. Maybe should use a dataset with lower accuracy.



# Feedback homework 2 (n=18)

8

Any additional comment?

**Respondent**

**Response**

I think I would prefer to have a linear progress in the homework. Implement then explain. rather than implement everything, then explain at the end, which requires a lot of back and forth.

Same as for Hw1, this homework was too long. This course needs to either require less working time, or have much more credits, because we struggle to keep up !

I think this was a bad homework. The data used was really imbalanced, we we're ask for feature selection/extraction but those subjects were not covered in class, hw would take 2 muchtime if im no MA4

I think that the feature selection methodology has not been discussed in the lectures/tutorials

Total responses to

4/18

# Extensive debriefing on homework 2

## Homework 02: Behavior Detection

### Introduction

Computer environments such as those based on educational games, interactive simulations, and educational platforms are providing more and more data, which can enable a personalized adaptation of the environment itself. For instance, this data can be used to train models able to detect the extent to which students are using the educational platform properly and react accordingly. Empowering platforms with these models can serve as a means for adaptive interventions that are of paramount importance to ensure no student is left behind.

The goal of this homework is to build a **behavior detector**, namely a classifier. Specifically, you are asked to build a detector able to classify the extent to which the students are off-task, i.e., whether students are performing interactions that are not related to the classroom's objectives. To this end, we will use a public data set which is stored in `ca1-dataset.csv` in a CSV format. The dataset includes features at the grain size of all the actions that occurred during 20-second field observations for a student (so one student can occur in more than one record of the dataset). An example feature associated with one record of the dataset is the number of wrong actions made by the corresponding student in the last 20 seconds (more details on the features will be provided later). In addition to features, each record includes the "OffTask" label (Y or N), which is the target we ask you to predict, based on the values of the features.

Specifically, in this homework, we will ask you to:

1. **Part 1: 15 Points** Explore the dataset and select up to 5 features from those in the CSV file that you think are the most predictive of the off-task label.
2. **Part 2: 25 Points** Design, fit, and interpret a Regression model for off-task prediction, based on the features you selected.
3. **Part 3: 20 Points** Design, fit, and interpret a Decision Tree classifier for off-task prediction, based on the features you selected, and investigate the impact of one hyper-parameter on the final results you obtain.
4. **Part 4: 20 Points** Design, fit, and interpret a Random Forest classifier for off-task prediction, based on the features you selected, investigate the impact of one hyper-parameter on the final results you obtain, and compare your findings with those you obtained with a single decision tree.
5. **Part 5: 20 Points** Conduct feature engineering to improve the features in the original data set, using the data in a second more fine-grained dataset we will provide to you. Specifically, you will be asked to create at least 5 new features that cannot be created using just the original data set, add the new features to the original data set, and see what impact they have on the Random Forest classifier.

The complete solution of this homework has been uploaded on the public GitHub repository at:

<https://github.com/d-vet-ml4ed/mlbd/blob/main/Homework/Homework02/Homework02-BehaviorDetection-Example-Solution.ipynb>

**Questions?**

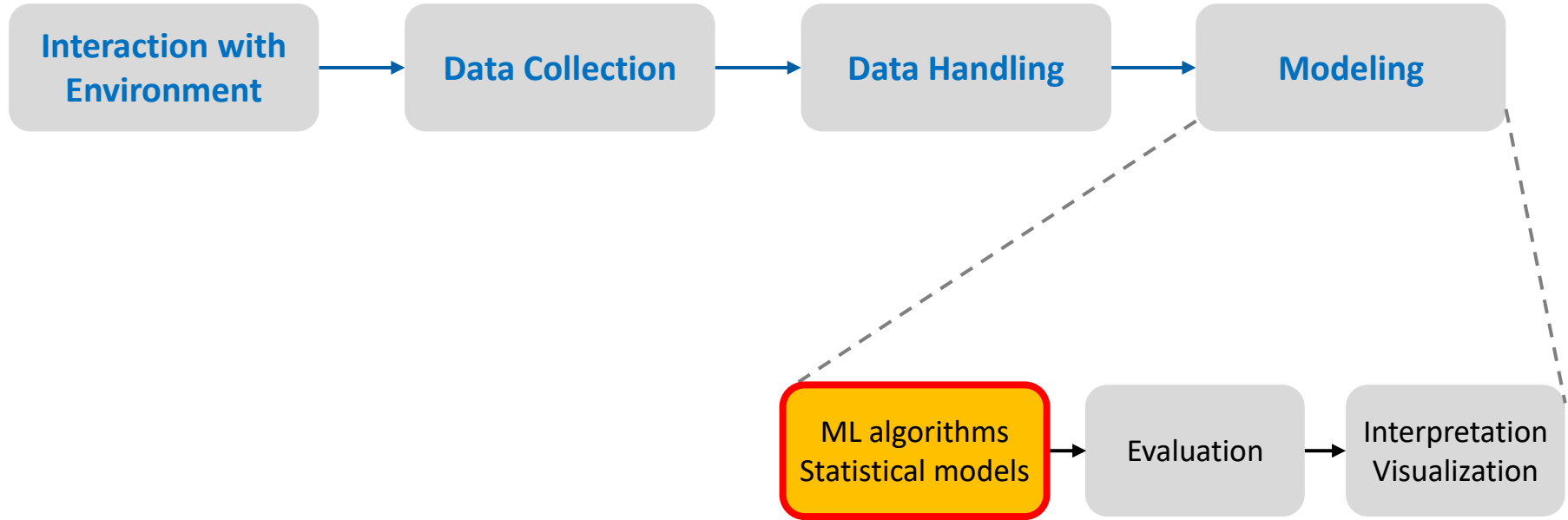
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# Where we are

Week	Lecture	Lab Sessions	Project
1	Introduction	Tutorial	
2	Data Handling	Tutorial + <b>Homework</b>	
3	Regression & Classification	Tutorial + <b>Homework</b>	
4	Model Selection & Evaluation	Tutorial + <b>Homework</b>	Presentation of data sets and research questions
5	Latent Variable Models	Tutorial + <b>Homework</b>	M1: Preferences on team members and data sets
6	Unsupervised Learning	Tutorial + <b>Homework</b> + PO	
7	Spring Break	Spring Break	Spring Break

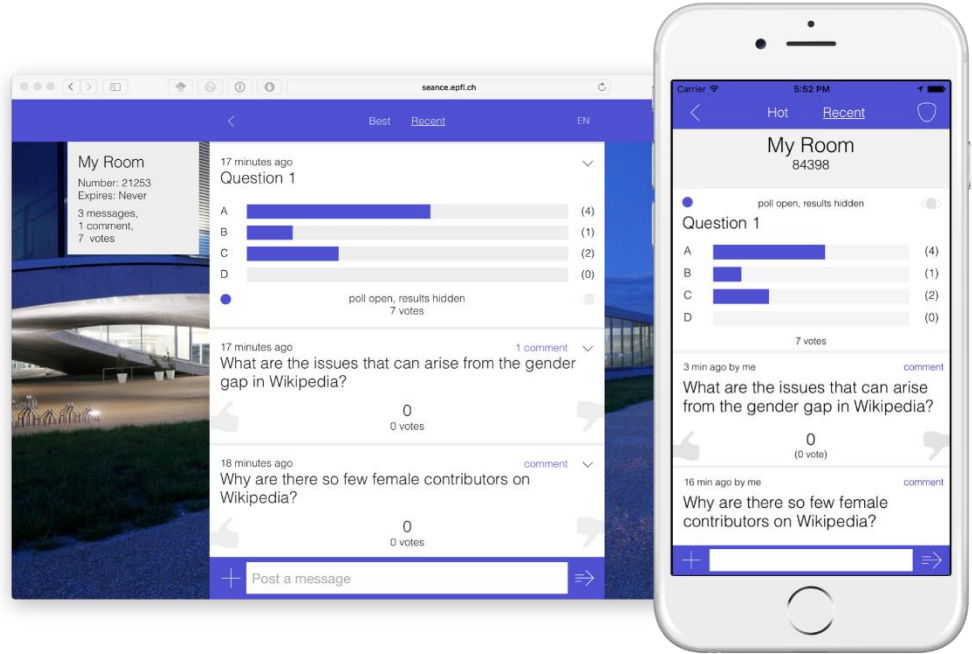
PO = project office hours

# ML for Behavioral Data: Modeling



# SpeakUp

- **Android / iOS:**  
<http://speakup.info/>
- **Web App:**  
<https://web.speakup.info/>
- **Room number:** 20787



# PyBKT

**SpeakUp:** How do you feel about pyBKT?

A: I have never heard of pyBKT.

B: I am **not confident at all** about using pyBKT.

C: I am **slightly confident** about using pyBKT.

D: I am **fairly confident** about using pyBKT.

E: I am **very confident** at all about using pyBKT.

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# BKT parameters

**SpeakUp:** Which of the following parameters is not included in traditional BKT?

A: The probability that the skill is known before the first practice opportunity.

B: The probability that the skill will be learned at each practice opportunity.

C: The probability that the student will guess how to apply the skill.

D: The probability that the skill is recognized at each practice opportunity.

E: The probability that the student will slip and incorrectly apply the skill.

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# Example platforms



<https://new.assistments.org/>

Video Introduction (2 mins)  
<https://youtu.be/1F4eJlZ8PGk>



<https://www.khanacademy.org/>

Video Introduction (5 mins)  
<https://youtu.be/Qh1B2xfbhgg>

# Tutorial 5 Agenda

- **05 mins [us]** Short introduction to the tutorial.
- **15 mins [you]** Pull tutorial 5 and go throughout the showcase, step-by-step.
- **05 mins [all]** Q&A time on the showcase.
- **10 mins SHORT BREAK**
- **20 mins [you]** Complete the short exercises included in the notebook.
- **10 mins [all]** Walkthrough on the short exercise solutions + Q&A time.

If you have any question or doubt while going throughout the showcase and/or the exercises, do not hesitate to ask in chat or in audio-video mode. We will be happy to support you during the lab session at any time.

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# Tutorial 5 Hands on

We will use Noto, but feel free to use your own environment:

- Go to <https://noto.epfl.ch/>.
  - Login with your GASPAR.
  - If you have **NOT** already cloned the repository:
    - Go to Git → Clone → <https://github.com/d-vet-ml4ed/mlbd>.
  - Go to Git → Pull.
  - Go through [Tutorials/Tutorial05/Bayesian\\_Knowledge\\_Tracing.ipynb](#).
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# Debriefing on tutorial 5

**SpeakUp:** Which model variant has the smallest test AUC for the skill entitled 'Addition and Subtraction Integers'?

A: Default

B: Forgets.

C: I have not finished this exercise yet.

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# Debriefing on tutorial 5

**SpeakUp:** Which bin results in the highest  $P_L$  score?

A: Less than 20s.

B: Less than 30s.

C: Less than 40s.

D: Less than 50s.

E: I have not finished this exercise yet.

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# Debriefing on tutorial 5

**SpeakUp:** Does the binned-response-time-based multilearn BKT model improve the AUC, when compared to the default template\_id multilearn BKT model?

A: The binned-response-time-based multilearn BKT model leads to a **higher** AUC.

B: The binned-response-time-based multilearn BKT model leads to a **lower** AUC.

C: The BKT models have the same AUC.

D: I have not finished this exercise yet.

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**Questions?**

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# Class project milestones

- **M01** on Preferences on Tracks and Group Members
  - due **March 23, 2021 23:59 CET - MANDATORY**
- **M02** on Research Questions and Exploratory Analysis
  - due **April 13, 2021 23:59 CET - optional**
- **M03** on Implemented Approach and Preliminary Results
  - due **May 04, 2021 23:59 CET - optional**
- **M04** on Mature Approach and Results with Discussion
  - due **May 18, 2021 23:59 CET – optional**
- **Project Presentation** for Course Evaluation
  - to be given on **May 31, 2021 - MANDATORY**
- **Final Project Deliverable** for Course Evaluation
  - due **June 11, 2021 23:59 CET - MANDATORY**



# This year's project tracks

**SpeakUp:** What's your favorite project track?

A: Track 1: E-Tutoring.

B: Track 2: E-Commerce.

C: Track 3: Music.

D: Track 4: E-Learning.

E: None of the above.



# Give your suggestion for future tracks

**Zoom Chat:** Which project track would you add in the next runs?



# Debriefing on milestone M01

By the end of this week:

- Completed groups (3 members) will receive a confirmation from us.
  - Groups with fewer than 3 members will be completed by us based on the provided preferences, and groups members will be put in contact by us.
  - Groups and tracks should not change over the semester. Any change must be requested to us and motivated by e-mail and, finally, approved by us.
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# Your feedback is essential [project]

- Please, tell us how to improve the project planning till now.
- Anonymous feedback on project guidelines and M01 on Moodle.

<https://moodle.epfl.ch/mod/questionnaire/view.php?id=1141660>



Quick Anonymous Feedback on Project Guidelines and M01



**Questions?**

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# Introduction to homework 4

- You will go deeply into the data set and task you dealt with in the previous homework.
  - In the previous homework, you have:
    - Computed demographic and behavioral features (and pre-processed them) for being fed into a machine-learning model.
    - Chosen and evaluated the machine-learning model you thought that might have been the best one on this task.
  - In this homework, under given evaluation method and performance metrics, we ask you to:
    - Experiment with distance matrices and KNN classifiers fed with only demographic features or only behavioral features.
    - Experiment with distance matrices and KNN classifiers fed with both demographic and behavioral features.
    - Report, visually, the performance of the three fine-tuned KNN classifiers (demographic, tuned), (behavioral, tuned), and (combined, tuned), and discuss/compare them.
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# Important upcoming dates

- Mar 26, 2021 15:00 16:00
    - Office Hour
  - Mar 29, 2021 15:15 17:00
    - Lecture #6
  - By Mar 30, 2021 23:59 CET
    - Submission Deadline for Homework #4
  - Mar 31, 2021 08:15 10:00
    - Lab Session #6
-

# Your feedback is essential [lab session 5]

- It is a new course, please give feedback on how to improve it.
- Short anonymous feedback forms on Moodle.



Quick Anonymous Feedback on Lab Session 5



<https://moodle.epfl.ch/mod/questionnaire/view.php?id=1132930>



**Questions?**

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