A Message to CourseKata

Edmond Niu, Sarah Tran, Amaris Man, Sherry He

The Problem

- **Most students have an accurate confidence level in what they learned in the previous chapter**
  - Their confidence level reflects how well they did in the previous End of Chapter (EOC) review
  - Students who reported higher confidence (4/5) tend to perform better on EOC (>0.65 accuracy)
  - Students who reported lower confidence (0/1) tend to perform worse on EOC (<0.6 accuracy)
- **There is a subset of individuals that overestimated their confidence and performance on the EOC**
  - 56% percent of students estimated that they would perform better than they did
  - Dunning-Kruger Effect

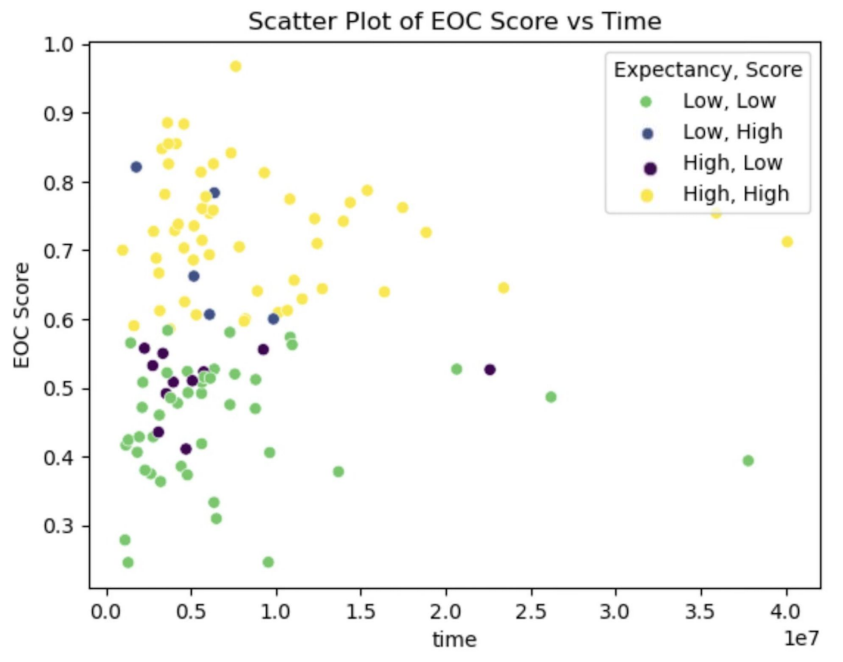
The Dunning-Kruger Effect

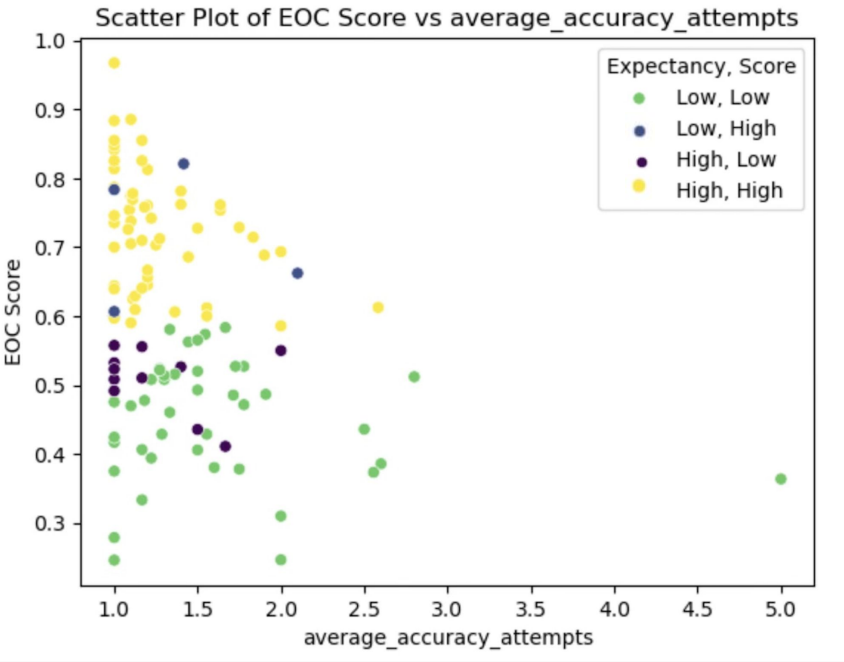
The Dunning–Kruger effect *is a cognitive bias in which people with limited competence in a particular domain overestimate their abilities. Some researchers also include the opposite effect for high performers: their tendency to underestimate their skills.*

Study patterns of high expectancy low performance students

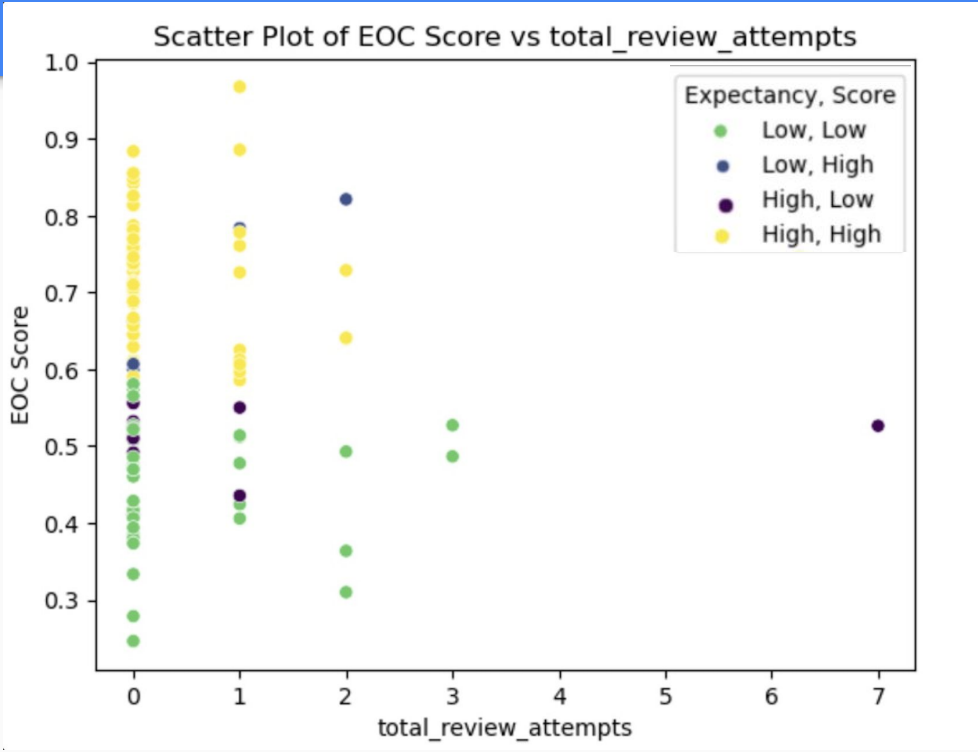
- **Their scores correlate to…**
  - The accuracy of their solutions
  - Time spent engaged on material
  - Attempts taken reviewing previous material

Study patterns of high expectancy low performance students





Study patterns of high expectancy low performance students



- Data shows that these students spend less time studying and reviewing, even compared to their low-performance counterparts that also had a low expectancy of themselves.
- This suggests wasted potential.

Potential features for helping these individuals

- **Discussion Forums:** encouraging knowledge sharing between users and providing a channel to see the insights/responses of other users
- **Reflective Prompts:** integrate more opportunities to reflect on the learning experiences
- **Case Studies & Real World Examples:** stimulations to apply knowledge to real-world scenarios
- **Peer Comparison:** allows user to compare their quiz scores/progress/time spent with other users anonymously (Alicke & Govorun, 2005)
- **Reward based on accurate self-assessment:** copes with the lack of incentive to give accurate self-assessments (Dunning, 2011)
- **Model predicting EOS scores** (example on subsequent slides)

EOC-Predict: Re-evaluation of Confidence

- **A way for AI to predict students' EOC performance based on chapter engagement**
- **Especially helpful for those that are not prepared, but still confident**
  - May induce them to study more and do some more reviewing
  - Can provide personal recommendations / areas of weaknesses / improvement

Our Model

- **Predicts EOC Scores with accuracy of ~75%**
- **Convolutional Neural Network (Deep Learning Model)**
- **Pytorch Machine Learning Framework Library**
- **Trained on 3 different dimensions:**
  - **Num_passed**: Total number of code chunks passed (per chapter per student)
  - **Engaged:** Total time spent engaged (per chapter per student)
  - **Length:** Total word count of all summary questions (per chapter per student)
- Predicts **EOC** accuracy:
  - percent questions correct for the end of chapter quiz

Our Model (Continued)

- 80/20 split: training and testing data
- Normalization: Input features are normalized to have mean 0 & variance 1
- Two fully connected layers
  - First layer (fc1) 3 input features → 50 features (ReLU)
  - Second layer (fc2) 50 features → 1 output value (EOC accuracy)
- Loss Function: Mean Squared Error Loss
- Adam optimizer with learning rate of 0.01
- Trained for 1000 epochs

Training Data

Feature Inputs (3)

Label

Unnamed: 0	student_id	chapter_number	num_passed	engaged	length	EOC
0	001824fb-a2fd-431d-aef6-7a1250d97a62	1.0	24	5663330.0	131	0.921053
1	001824fb-a2fd-431d-aef6-7a1250d97a62	2.0	26	30902762.0	91	0.839080
2	001824fb-a2fd-431d-aef6-7a1250d97a62	3.0	29	34127489.0	65	0.769231
3	001824fb-a2fd-431d-aef6-7a1250d97a62	5.0	12	15971898.0	71	0.777778
4	001824fb-a2fd-431d-aef6-7a1250d97a62	6.0	19	17611781.0	73	0.697917
...	...	...	...	...	...	...
5995	a3ac1e2d-7dc6-4ff1-a8df-bb6ff0f52e67	12.0	14	6230812.0	40	0.560000
5996	a41d13e7-0e8b-402c-be3c-26313c7d28ce	1.0	24	5341326.0	47	0.945946
5997	a41d13e7-0e8b-402c-be3c-26313c7d28ce	2.0	26	11551124.0	88	0.879518
5998	a41d13e7-0e8b-402c-be3c-26313c7d28ce	3.0	29	10541477.0	115	0.816327
5999	a41d13e7-0e8b-402c-be3c-26313c7d28ce	5.0	12	5999197.0	61	0.714286

6000 rows x 7 columns

Test Data

Feature Inputs (3)

Unnamed: 0	student_id	chapter_number	num_passed	engaged	length
6001	a41d13e7-0e8b-402c-be3c-26313c7d28ce	9.0	13	5099303.0	53
6002	a41d13e7-0e8b-402c-be3c-26313c7d28ce	10.0	12	4668429.0	34
6003	a41d13e7-0e8b-402c-be3c-26313c7d28ce	11.0	16	5589897.0	29
6004	a41d13e7-0e8b-402c-be3c-26313c7d28ce	12.0	14	4784469.0	23
6005	a446e23a-ace7-4cb4-b630-9f50a52248fe	1.0	24	3550720.0	75
...	...	...	...	...	...
9233	ff6ec9fe-de1d-4b45-8136-59465d9c85ab	5.0	12	9989833.0	48
9234	ff6ec9fe-de1d-4b45-8136-59465d9c85ab	6.0	19	16650582.0	56
9235	ff6ec9fe-de1d-4b45-8136-59465d9c85ab	9.0	13	14206097.0	91
9236	ff6ec9fe-de1d-4b45-8136-59465d9c85ab	10.0	12	8793743.0	40
9237	ff6ec9fe-de1d-4b45-8136-59465d9c85ab	11.0	16	10646661.0	54

3237 rows x 6 columns

Results

```
[29]: df['perc_error'].mean()

[29]: 0.25203619419468953
```

Feature Inputs (3)		
num_passed	engaged	length
13	5099303.0	53
12	4668429.0	34
16	5589897.0	29
14	4784469.0	23
24	3550720.0	75
...	...	...
12	9989833.0	48
19	16650582.0	56
13	14206097.0	91
12	8793743.0	40
16	10646661.0	54

Actual	Predicted
EOC	Pred_EOC
0.596154	0.630910
0.721311	0.611050
0.640000	0.528446
0.560000	0.576863
0.755556	0.857072
...	...
0.641791	0.644638
0.500000	0.685258
0.611650	0.739731
0.469697	0.628444
0.518519	0.647440

Error
perc_error
0.058300
0.152862
0.174303
0.030113
0.134360
...
0.004437
0.370516
0.209402
0.337978
0.248635

Conclusion

- We identify the problem of confident students over-estimating their scores, leading to them reviewing less and spending less time.
- Using a CNN machine learning model, we predict students' end of chapter scores based on their number of code chunks passed, time spent reviewing, and word density of typed responses.
- We use this information to offer students personalized advice on how they can improve their scores.