Key Points:

- Main objective of our project is to update the level of the user after each question he/she attempts and recommend the next question which can maximize his/her level.

- For the update we use the mathematical model, the explanation of which will be listed below. Using this we can update the level of the user for each question he /she attempts based on his responses(Like whether he solved it correctly / incorrectly or skipped it and also how much time he takes to solve the question and also the average time which other users took to solve it).

Mathematical Model:

Correctness is whether the user got the question correct/incorrect/skipped i.e 1,-1,0;

X1=(Correctness +1)/2
X2=(Correctness -1)/2

Correctness Factor:

update= (X1*(5-init level)/5 * 0.7*(alpha) + X2*(init level)/5 * 0.7*(alpha))

Where init level= Initial Level of the user

$$\text{Alpha} = x^* \frac{(\sqrt{e^{(x^2)/37} - 1})}{5}$$

X=value obtained by the user after answering a question i.e if level 4 question is correct then 4x1=4, if level 5 question is incorrect then (5-6)=-1

To add factor based on past responses-

wrong_responses=number of wrong responses in last 5 questions
correct_responses=number of correct responses in last 5 questions
If update>0, **update**=update*(30-wrong_responses)/30
Else, **update**=update*(30-correct_responses)/30

Time Factor:

update=(X1*(5-init level)/5 *0.3*beta + X2*(init level/5) * 0.3*(beta1))
Where beta 1 is:

$$\text{Beta1}=\left(e^{-\frac{average\ time}{time\ taken * |x|}} \right)$$

Where |x| is the difficulty of the question.

https://colab.research.google.com/drive/1KMCJWKuvF_Un_InlFkG_kcnYKaY-84dx

https://docs.google.com/spreadsheets/d/1pnuTNT_UJ0aBa4mh14kcg9u8KrsrskjKTdMph3edHuM/edit?usp=sharing

- We use this mathematical model as a custom estimator function in catsim(A Computerized Adaptive Testing library implemented in python) and we use the RandomSequenceSelector for selecting our next question for the user. The RandomSequenceSelector selects on the principle of which question gives the maximum information. Like each question has its different parameters and using those parameters it calculates the maximum log-likelihood of the questions. The question giving the highest information is selected next and given to the user to solve.

- For the estimation of parameters of a particular question we use the girth module which is an IRT(Item Response Theory) Package. It calculates the parameters solely based on the questions's responses by the users i.e, how many responses for that question were incorrect and how many were correct. The more responses we have for a question the more stable the estimation is by girth.

- We also use an NLP approach to determine the parameters of a question, which uses the parameters estimated by girth as target variables for our estimation using nlp and error is calculated according to that. In NLP method the parameters are estimated by either :
    1. Using the text of question only
    2. Using the text of both question and correct option
    3. Using the text of the question and all of the options

  Whichever gives the better result can be used as the final model.