

Individualized Pathways and Resources to Adaptive Control Theory-Inspired Scientific Education (iPRACTISE)

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iPRACTISE - What Is It?

iPRACTISE is a digital education system that provides personalized training and testing as guided by user input and automated control theory algorithm.

- **Goals:**
 - Develop a scalable prototype for iPRACTISE that can be used in undergraduate as well as graduate teaching of statistics
 - Compare the results of personalized training to uniform training in traditional classroom settings

Why Personalized Education?

- **Heterogeneity in Students' Knowledge:**
 - The diversity in student preexisting knowledge and expertise has greatly limited the scope and depth of traditional data science training [5]
 - Linear and uniform training modules preclude students who lack specific kinds of skills from entry into certain training or career paths
 - Homogeneous solutions to heterogeneous student body is inefficient and may serve no one well
- **Explosiveness in Un-Navigated Materials:**
 - The digital age has allowed for unlimited sharing of training contents
 - Selection of appropriate training materials that fit an individual's current ability and learning goal is similar to "finding needle in a haystack" [4]

iPRACTISE as the "Cruise Control" in Personalized Education

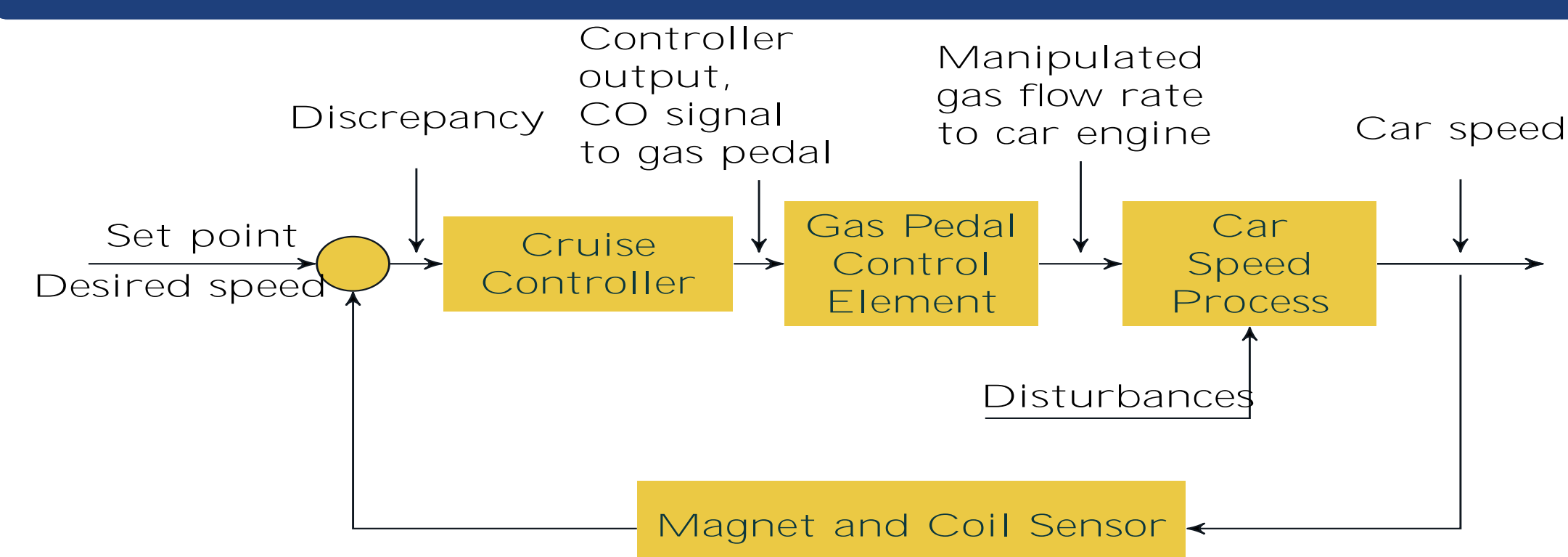


Figure 1: Cruise Control Analogy

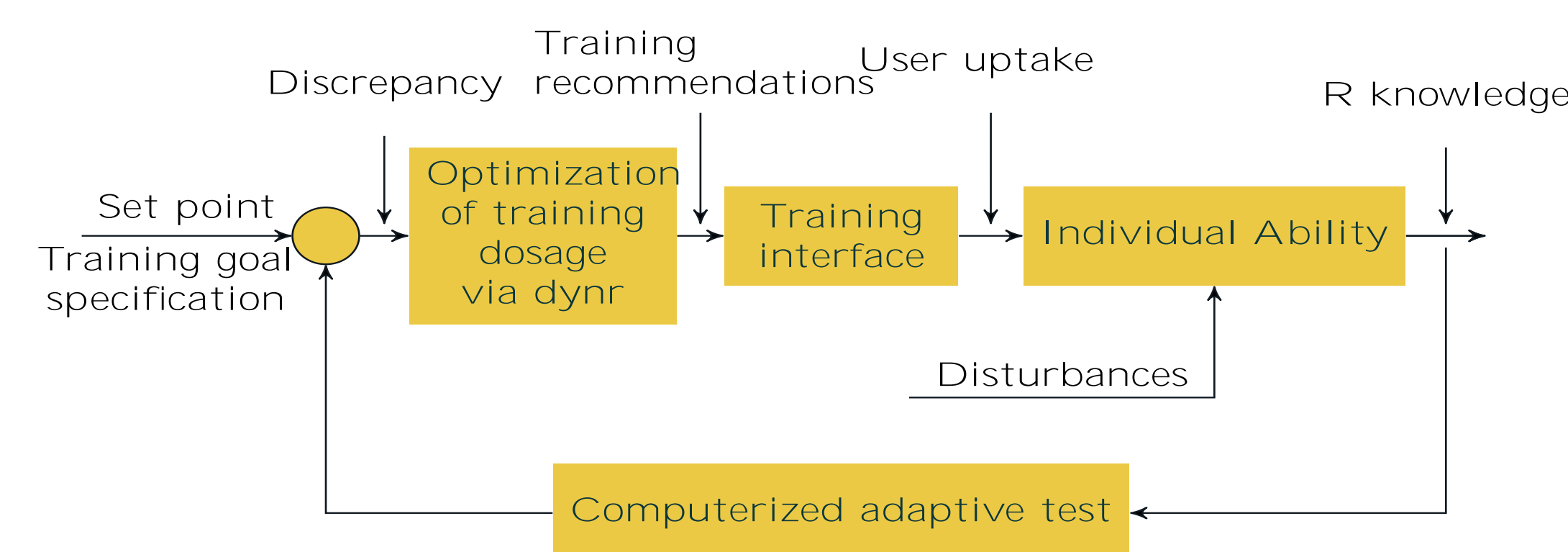


Figure 2: iPRACTISE in Application

- **Computerized Adaptive Test**
 - iPRACTISE provides Item Response Theory (IRT; [2]) based assessment tools to adaptively measure students' individual ability during training
- **Optimization of Training Dosage**
 - A novel control theory algorithm [3] is used to automate the delivery of individualized training modules and dosages
- **Training Interface**
 - Training materials are tagged in various aspects, including but not limited to topic, difficulty, and expected time spent
 - Instructors can create their own course structure using iPRACTISE

User Interface of iPRACTISE

To see a demo go to: <https://tinyurl.com/iPRACTISE-Demo>

• Student View: Computerized Assessment

Figure 3: Example Assessment Items for Adaptive Test

• Instructor View: Constructing Course

– Interface Creating Tree Structure

Figure 4: Example Tree: Learning Basics in R

Computerized Adaptive Testing (CAT)

- Ongoing, individualized assessments of student's R ability using the R package, Computerized Adaptive Testing with Multidimensional Item Response Theory (*mirtCAT*) [1]
 - Classical testing paradigms capitalize on fixed-length tests at a fixed range of item difficulty levels
 - CAT selects test items that tailor continuously to an individual's ongoing ability estimate to allow for better approximation of latent ability [2]
- iPRACTISE will leverage the information from CAT to provide the optimal dosage of training materials (e.g., difficulty- and aptitude-matched)

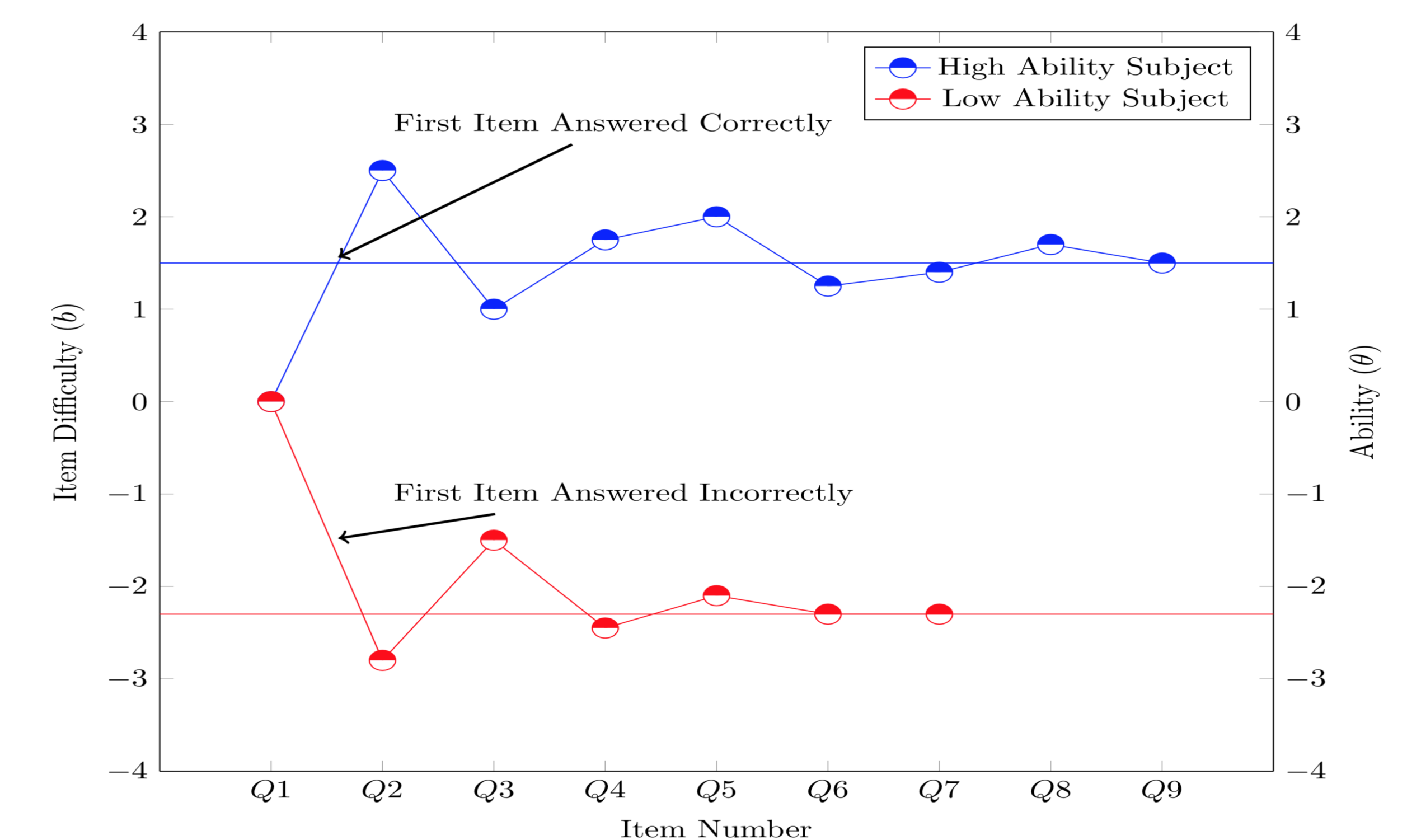


Figure 5: Illustration of CAT

Conclusions

- Individual components of iPRACTISE (e.g., item bank, control theory algorithm) will be shared with the broader research community
- iPRACTISE system could be adapted for application to a wide array of educational settings, and has the potential to serve as a model for the future of personalized digital instruction

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