LEARNING ANALYTICS SYSTEMS USE BKT TO PREDICT WHAT SKILLS STUDENTS MASTERED
http://www.cs.williams.edu/~iris/res/bkt/

WHY BAYESIAN KNOWLEDGE TRACING?

• Maintains an estimate of the probability that students have learned a particular set of skills in Technologically Enhanced Learning Environments
• Used in the Open Learning Initiative, Open Analytics Research Service, etc. within Learning Analytics systems
• Instructors rely on BKT to assist in making decisions in the classroom
• Concepts to review Students to follow up with • Exam question identification

EXPLAINABLES

A 2-node dynamic Bayesian network

P(L) = P(L_{n+1}):

P(T): Probability student learned after learning opportunity

P(G): Probability student guessed correctly

P(S): Probability student made a mistake on known skill

If P(L) > 0.95 → Skill is mastered

FUTURE WORK

• Interactivity of Explainables → Understanding the Algorithm
• Understanding the Algorithm → Trust, Fairness, Model Interrogation, Decision-making, ...

DESIGN PRINCIPLES FROM THE LEARNING SCIENCES

• Learning by doing: Learning increases with interactive activities vs. watching videos
• Backward Design: Identify learning goals first, then assessments then learning activities
• Cognitive Task Analysis: Systematically identify hierarchical skills & concepts to learn
• Zone of Proximal Development: ‘Goldilocks’ of learning challenging concepts

DOES UNDERSTANDING THE ALGORITHM MATTER, IF THE USER CAN’T CHANGE THE SYSTEM?

EXPLAINABLES

Visualization of Explainables Implemented in the Page

DESIGN PROCESS

Brainstorm Paper Prototype Usability Testing Implement Usability Testing

Themes: Consider individual differences, Refine the level of detail, Usability design principles

• “Am I supposed to be remembering all these [parameters]? Because that ain’t gonna happen.”
• “I was able to understand it more because it was more in depth.”
• Yeah, now I think I’d believe that [BKT works]!”

SAMPLE SCREENSHOTS

Visual Cooking Narrative Implemented in ren.py

REFERENCES

Individualized Bayesian knowledge tracing models by Flachton, Scardamalia, & Gordon (2016).