Conceptual Issues in Mastery Criteria: Differentiating Uncertainty and Degrees of Knowledge

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Mastery Learning

TODO img

- student performance
- student modeling
- mastery criterion

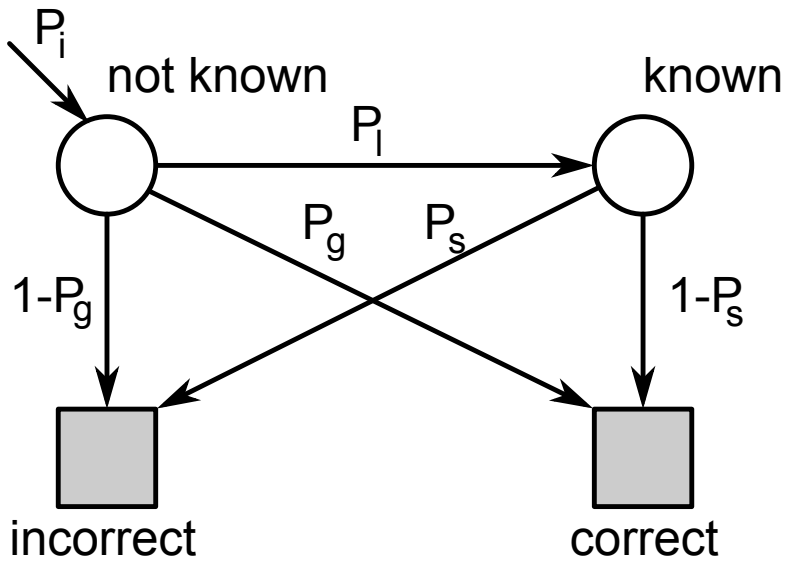
Threshold Criterion

$$\theta > 0.95$$

What does this mean?

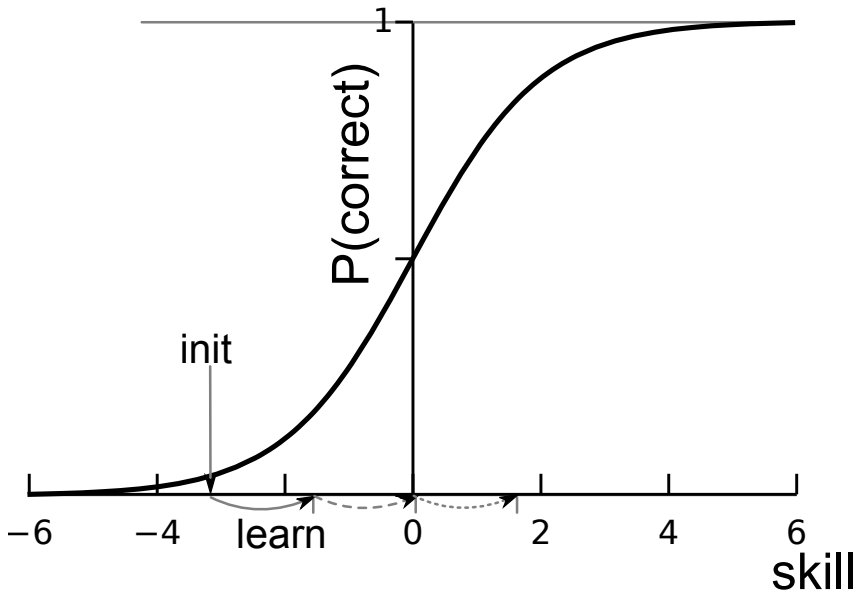
- portion of the topic that the learner mastered?
- uncertainty of the estimate?

Bayesian Knowledge Tracing



- threshold on uncertainty
- binary knowledge assumption

Logistic Models

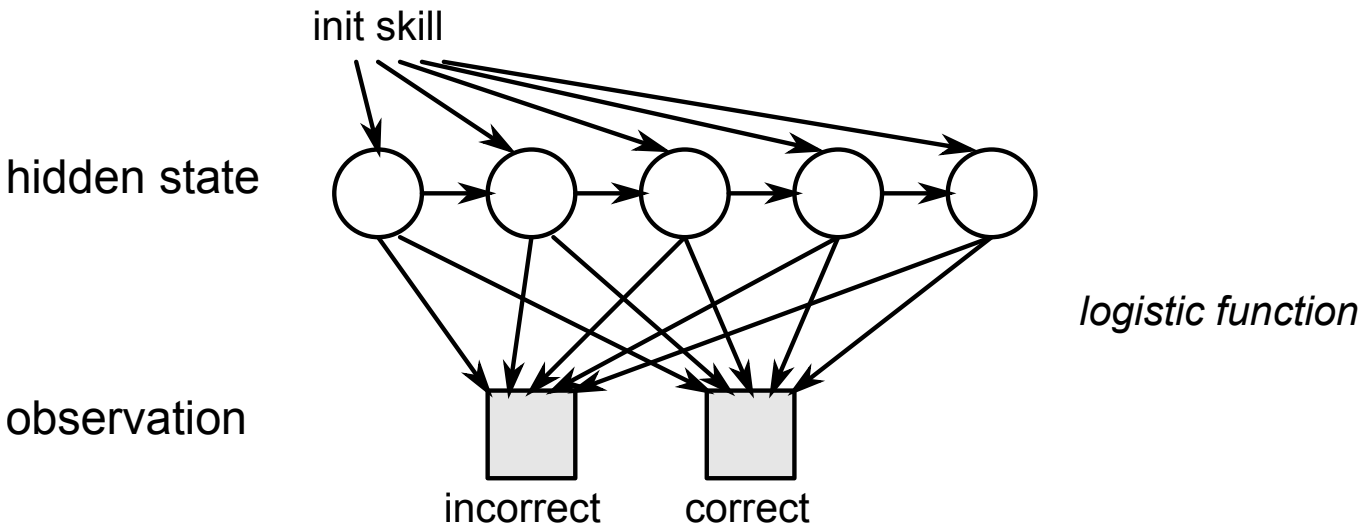


- degrees of knowledge
- uncertainty of estimate not explicitly quantified

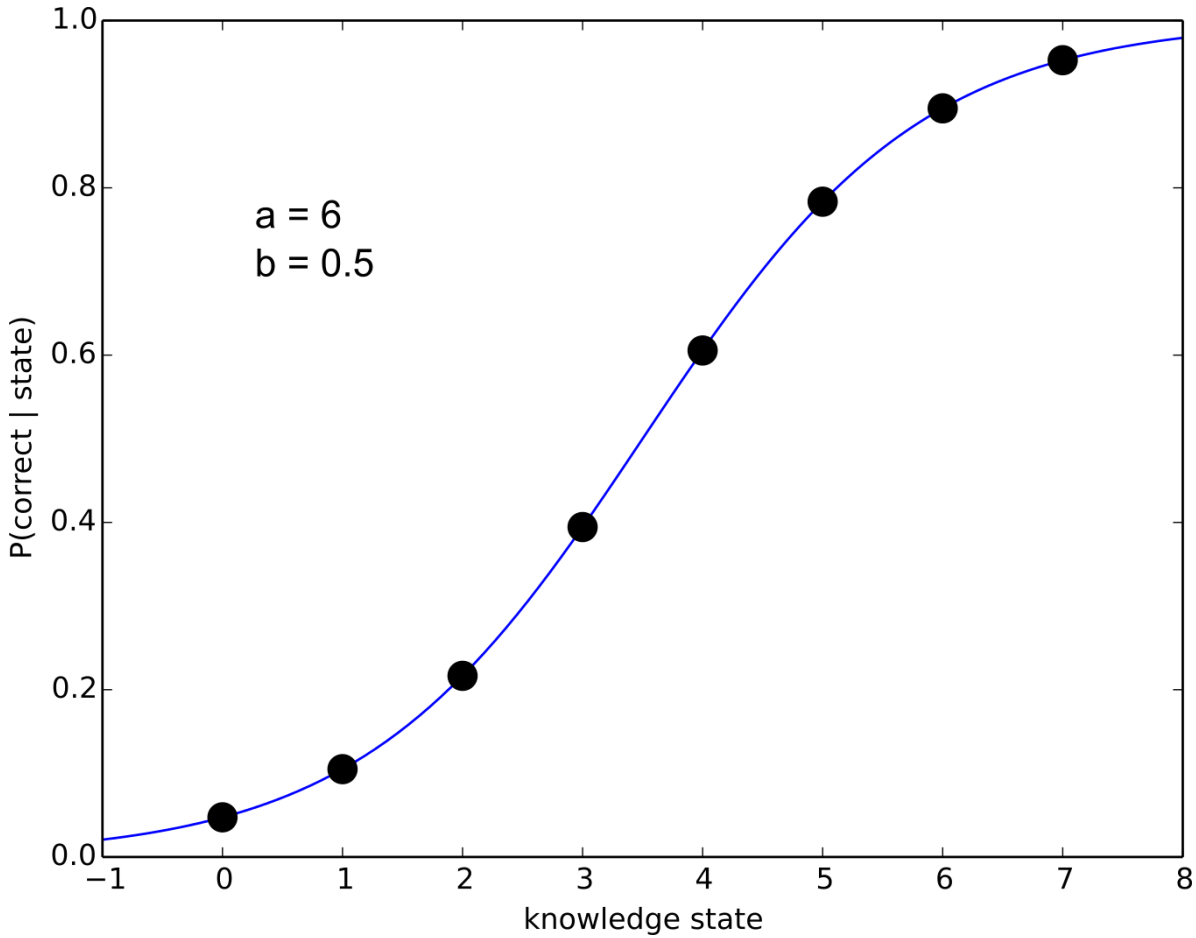
LogisticHMM

- generalization of BKT and logistic models
- goal of the model:
  - clarification of conceptual issues: uncertainty vs degrees of knowledge
  - not practical modeling

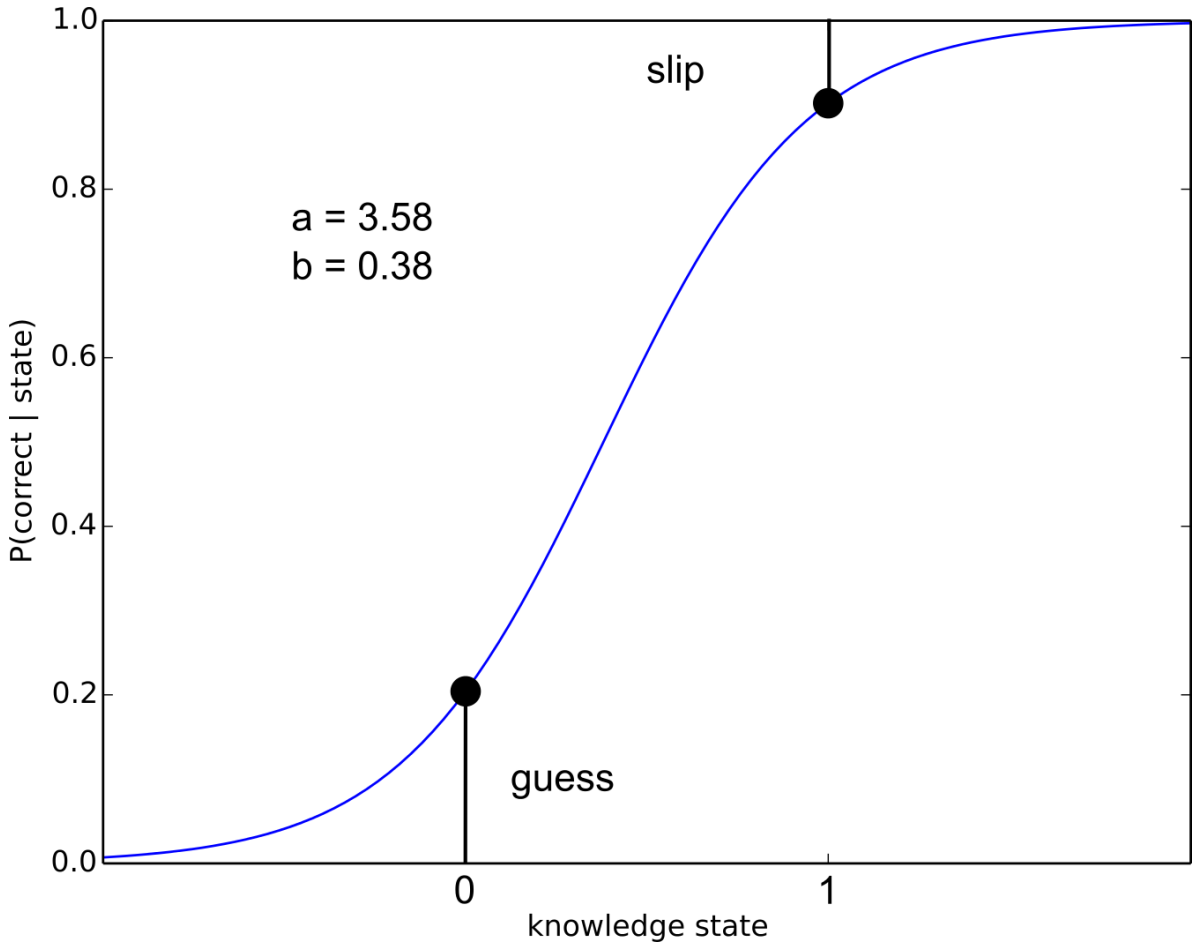
LogisticHMM



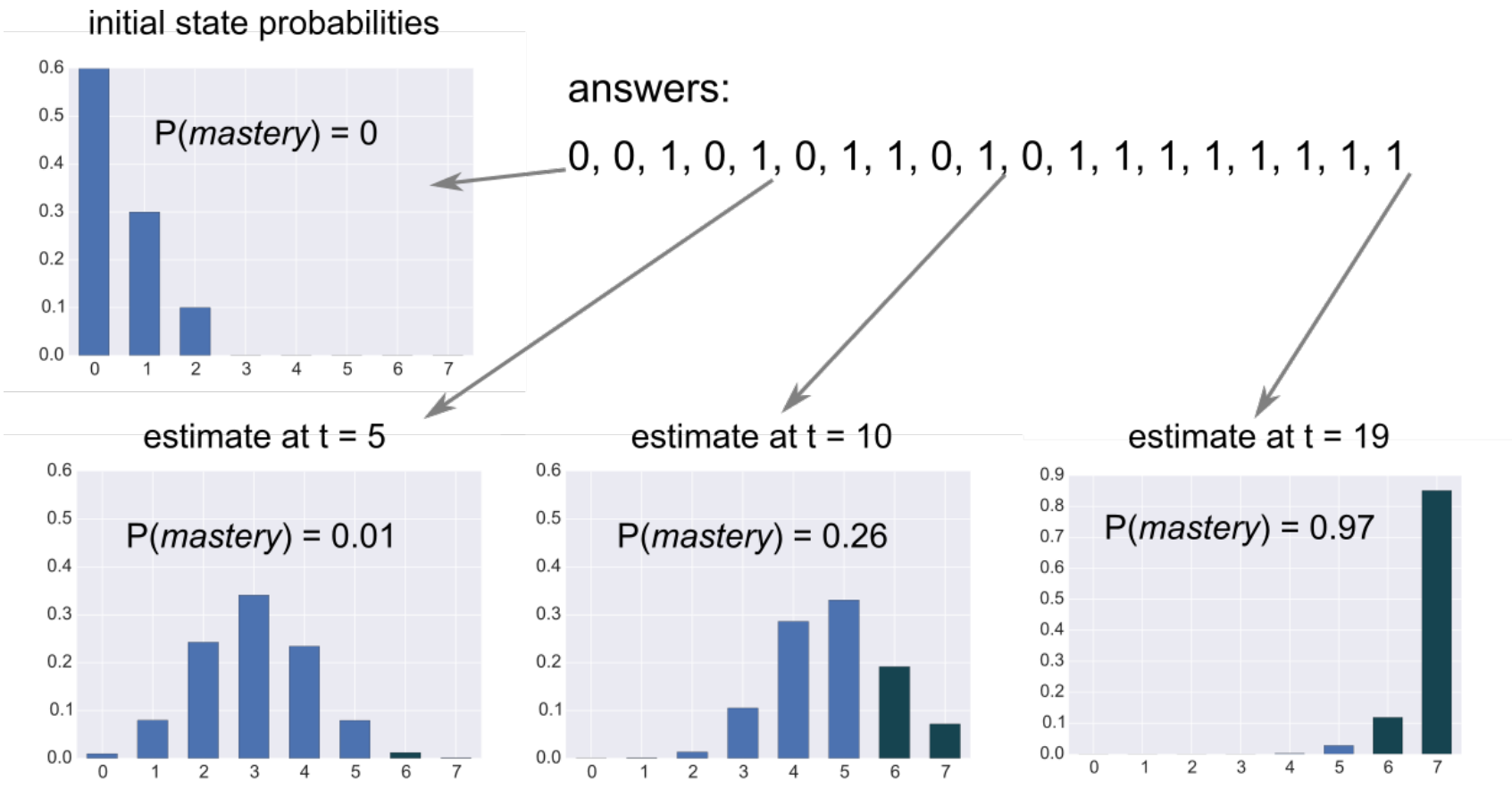
Emmision Probabilities



LogisticHMM and BKT



Using the Model



Experiments

Experiments with simulated data, generated by the LogisticHMM ...
Comparision with other mastery criteria

- N consecutive correct
- Exponential moving average
- BKT

Comparison with Simple Criteria

- N consecutive correct
  - difference when...
- Exponential moving average
  - similar performance possible...
  - not clear how to set parameters... exp. weight, threshold...

Comparison with BKT

BKT fit...

Consequences for Practice

the point is not that we should use LogisticHMM
differentiate uncertainty and degrees of knowledge
simple criteria may be sufficient ... number of attempts, average recent performance... with suitable thresholds...

Other Issues and Future Work

- wheel-spinning students – unable to master a topic
- relation to more complex student models
- multiple skills, forgetting, ...

mastery criteria are important and underexplored