Choosing a Student Model for a Real World Application

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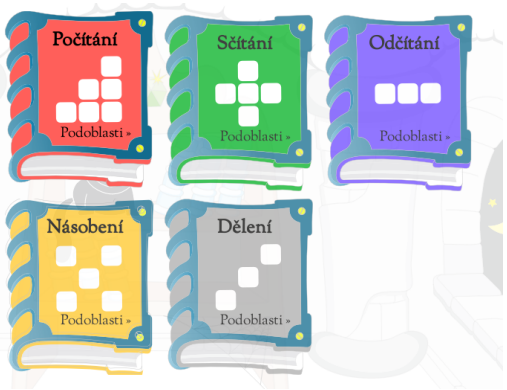
Development of applications: matmat.cz, outlinemaps.org, ...

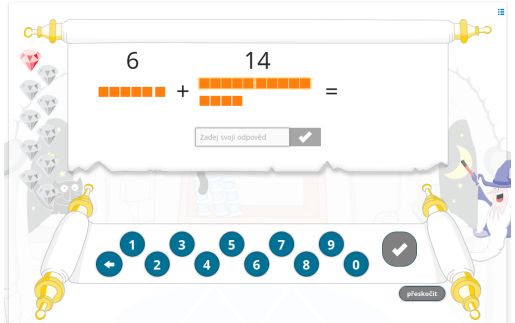
- Which student model to choose
- How to set parameters
- How many answers model needs
- ...

Adaptive Learning

matmat.cz

- online, free, without ads
- basic arithmetic - $+, -, \times, \div$
- 150 000 answers, 2 000 items
- adaptive practice
- importance of response time





Adaptive Learning

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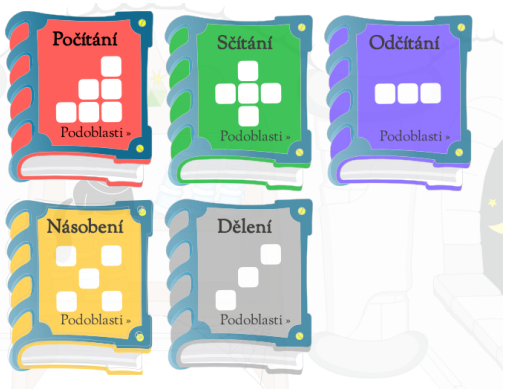
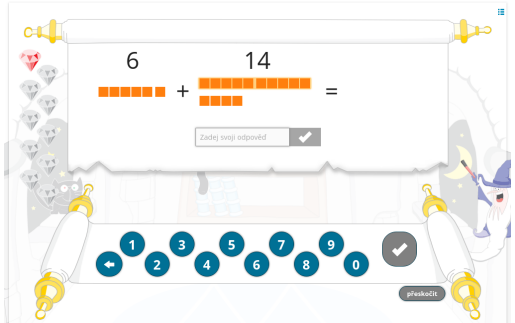
- basic arithmetic - $+, -, \times, \div$
- 150 000 answers, 2 000 items
- adaptive practice
- importance of response time
  - correct answer to 3×5 in **2** seconds
  - correct answer to 3×5 in **14** seconds

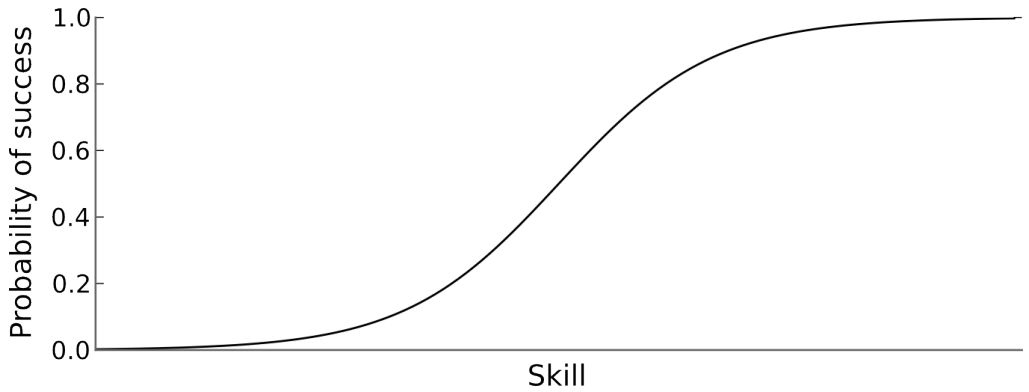




Adaptive Learning

Adaptability

- selection of question - targeting 75% success rate
- model parameters - **difficulties** of items and **skills** of learners
- domain model - several skills per learner
- use of response time



Adaptive Learning

What aspects of student modeling are most important?

Aspects to Compare

Three aspects of student modeling

- domain models
- response times uses
- missing answers

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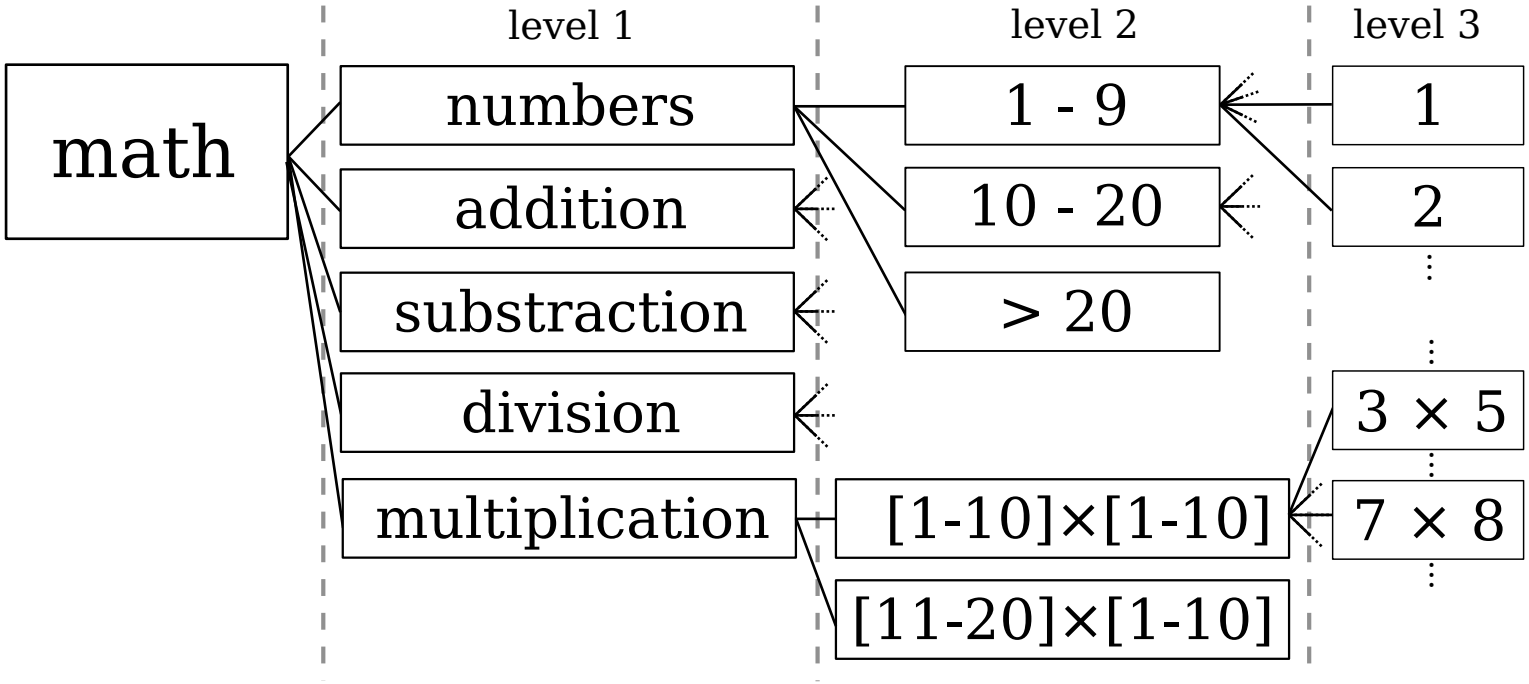
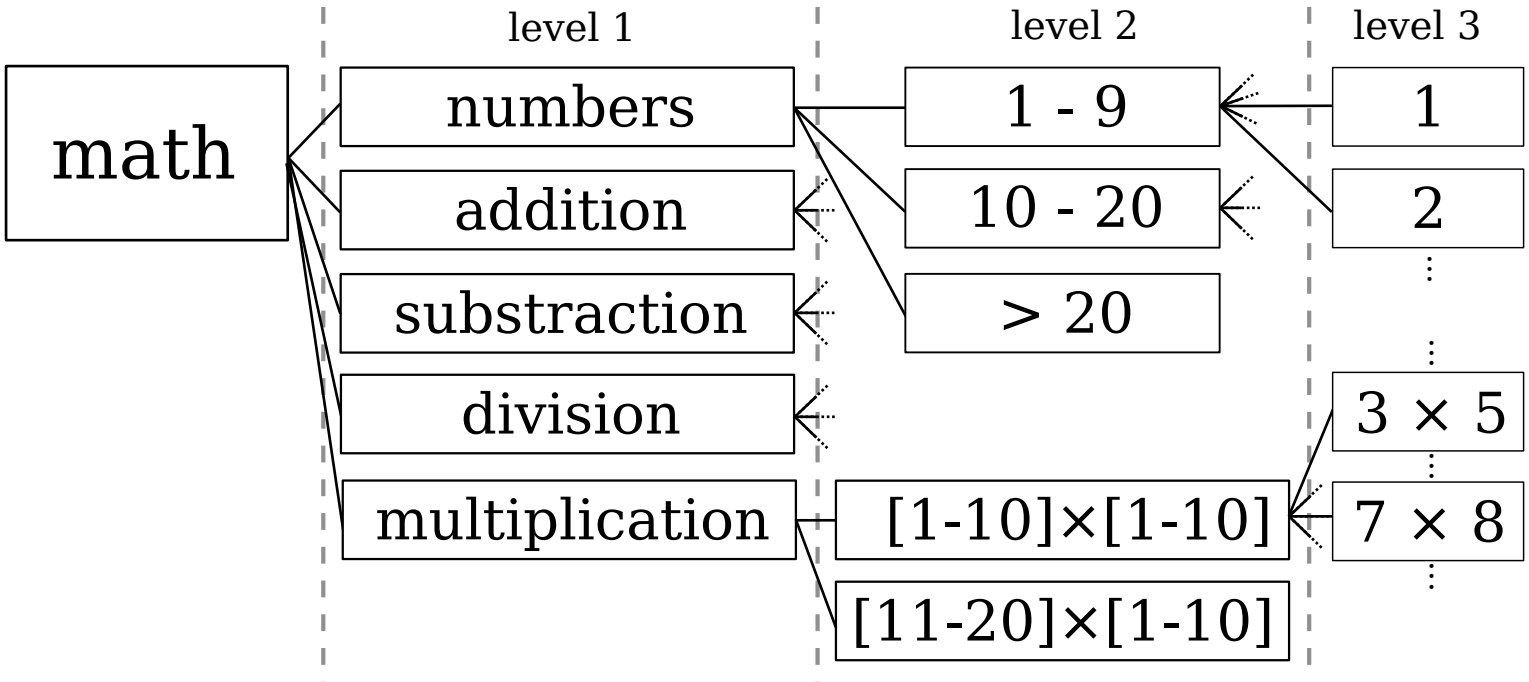
Domain Modeling



Domain Modeling



Too complicated?

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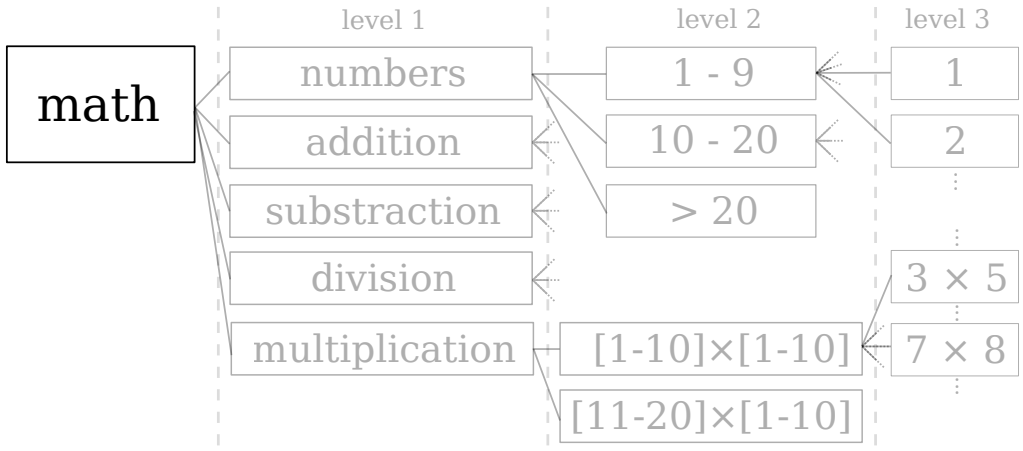
Domain Modeling

- Item average - no skill

Domain Modeling

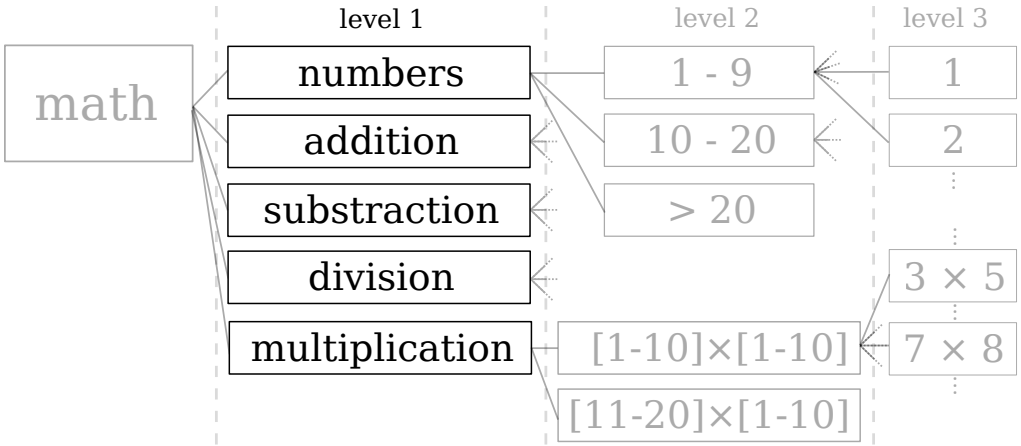
- Item average - no skill
- Basic model - one global skill



Adaptive Learning

Domain Modeling

- Item average - no skill
- Basic model - one global skill
- Concepts model - 5 skills



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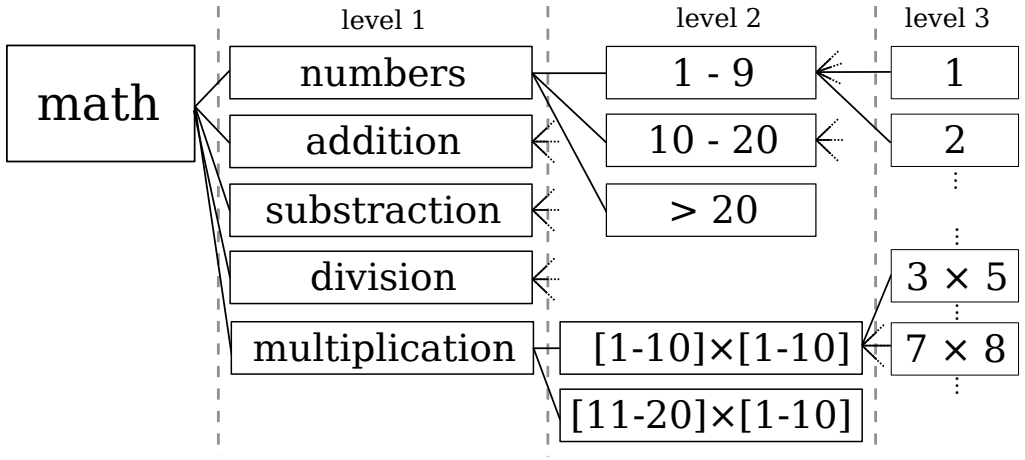
Domain Modeling

- Item average - no skill
- Basic model - one global skill
- Concepts model - 5 skills
- Hierarchical model



Response Times

- classic response:
  - $r = 0$ - wrong answer
  - $r = 1$ - correct answer
- use of response time:
  - $r = 0$ - wrong answer
  - $r \in [0, 1]$ - correct answer

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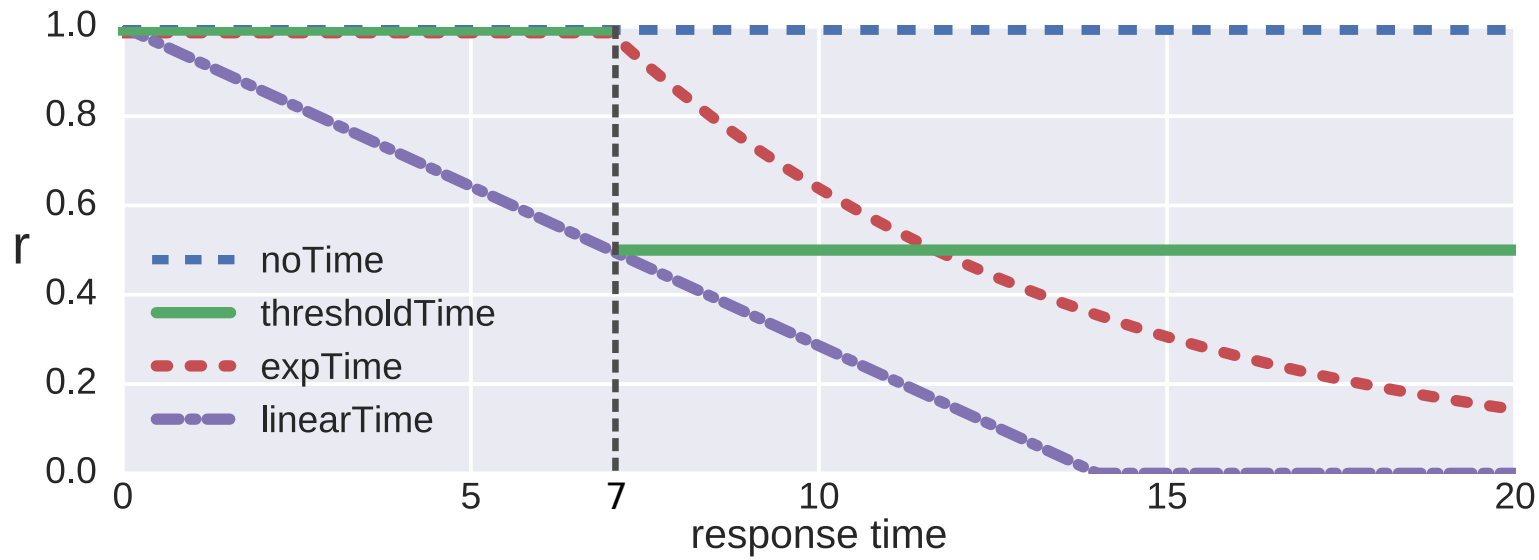
Response Times

- no time
- threshold time
- exponential time
- linear time



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Wrong Answers

- many missing answers - skips
- long sequences of missing answers
  - adults trying system
  - gaming system
- simple model extension:
  - probability of missing next answer
  - based on number of previous missing answers

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Aspects to Compare

Three aspects of student modeling

- domain models - 4
- response times uses - 4
- missing answers - with and without

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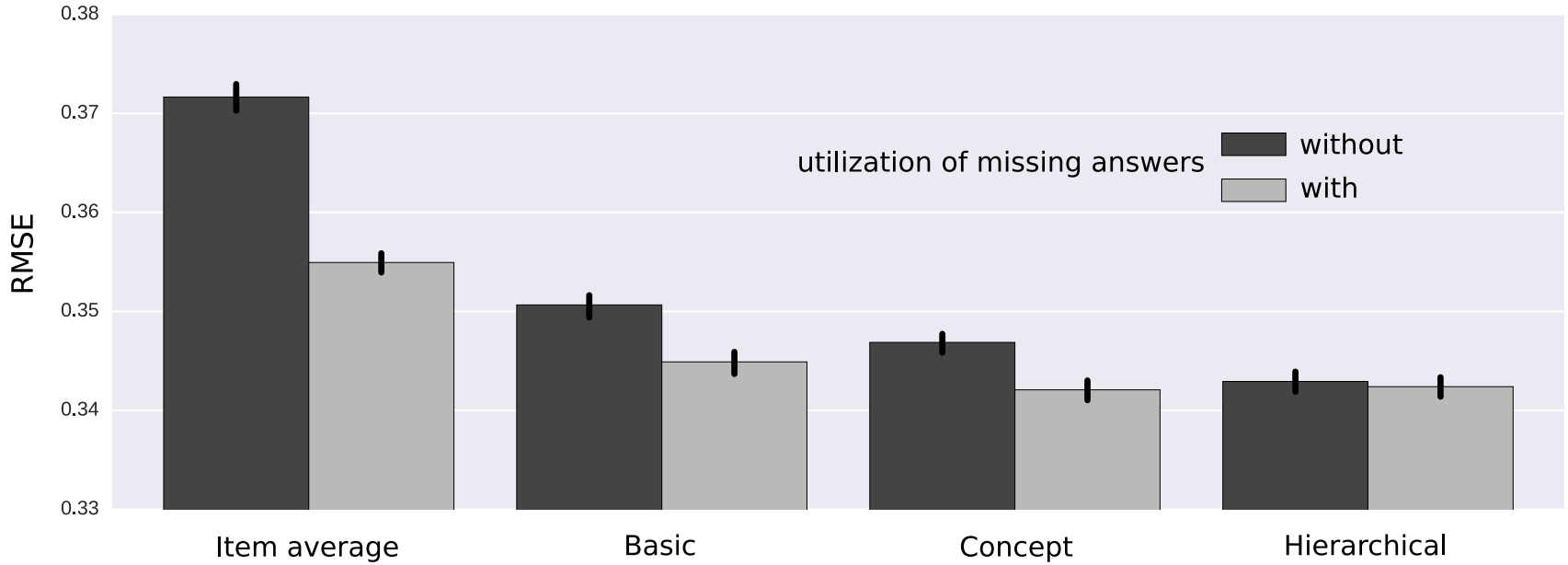
Prediction Accuracy



1. Large improvement over baseline does not mean usefulness for more complex models.

Prediction Accuracy - Time

Comparing models with different time utilization

- models are trained to predict different absolute values
- direct comparison is not possible

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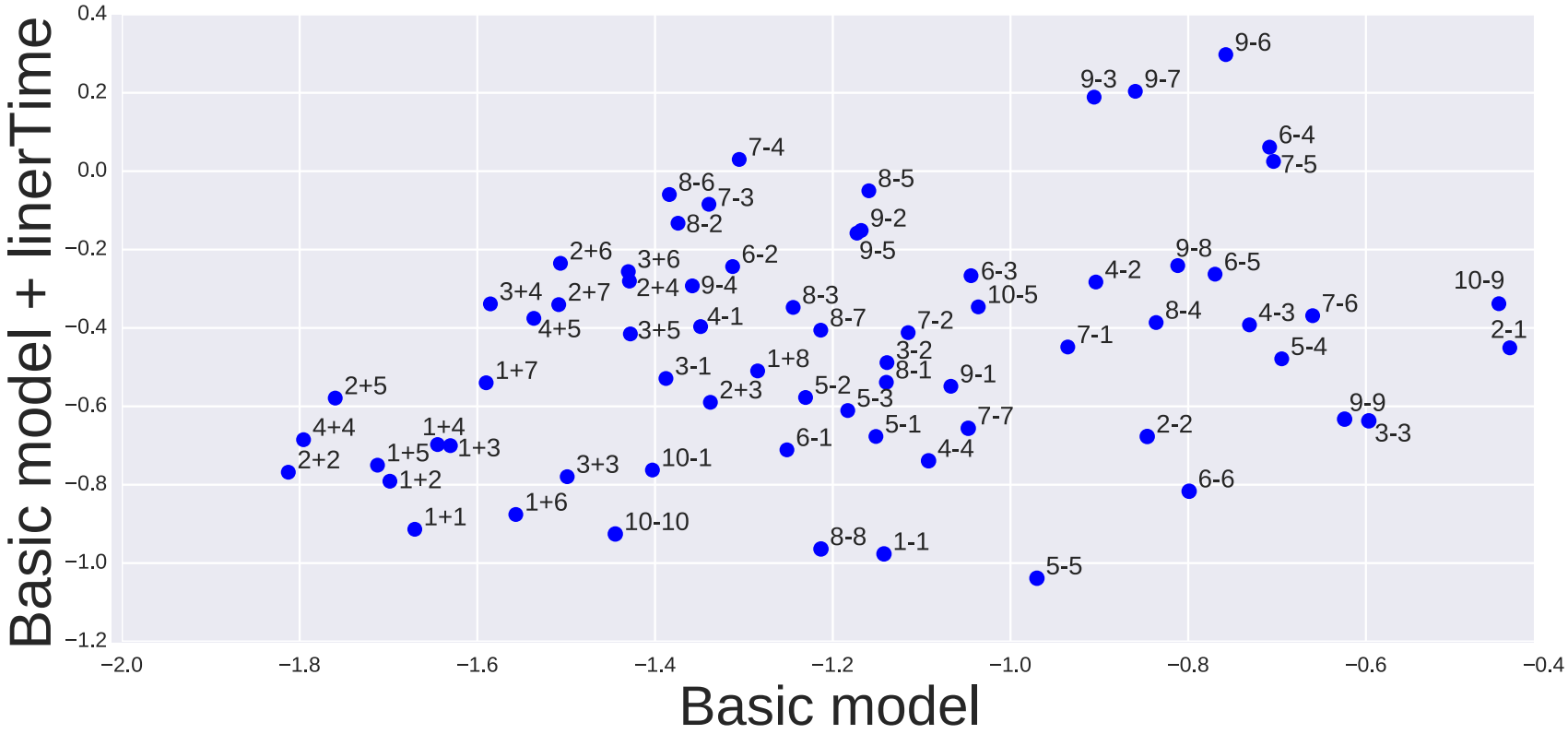
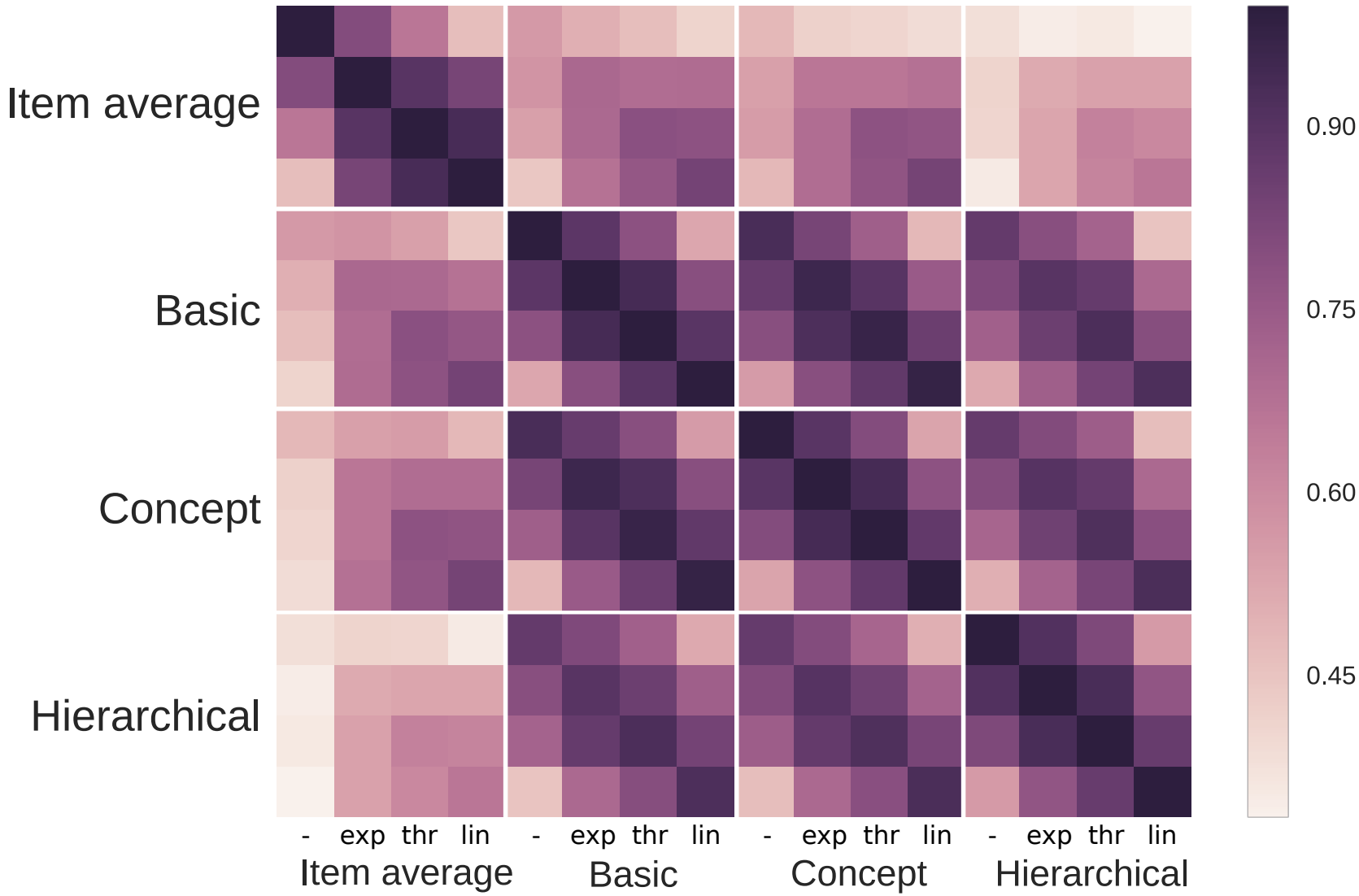
Estimated Parameters - Difficulties

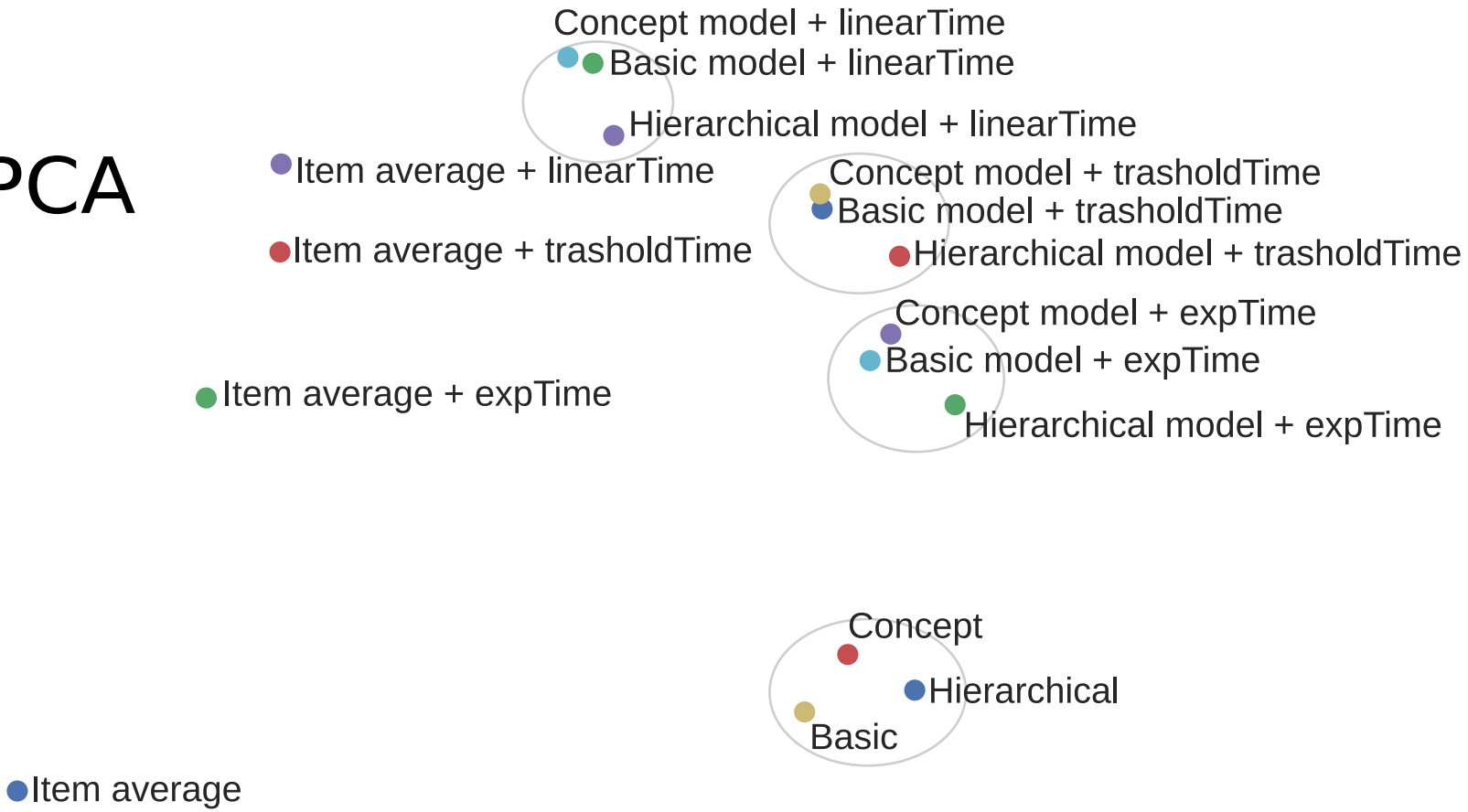


Correlations of Estimated Parameters



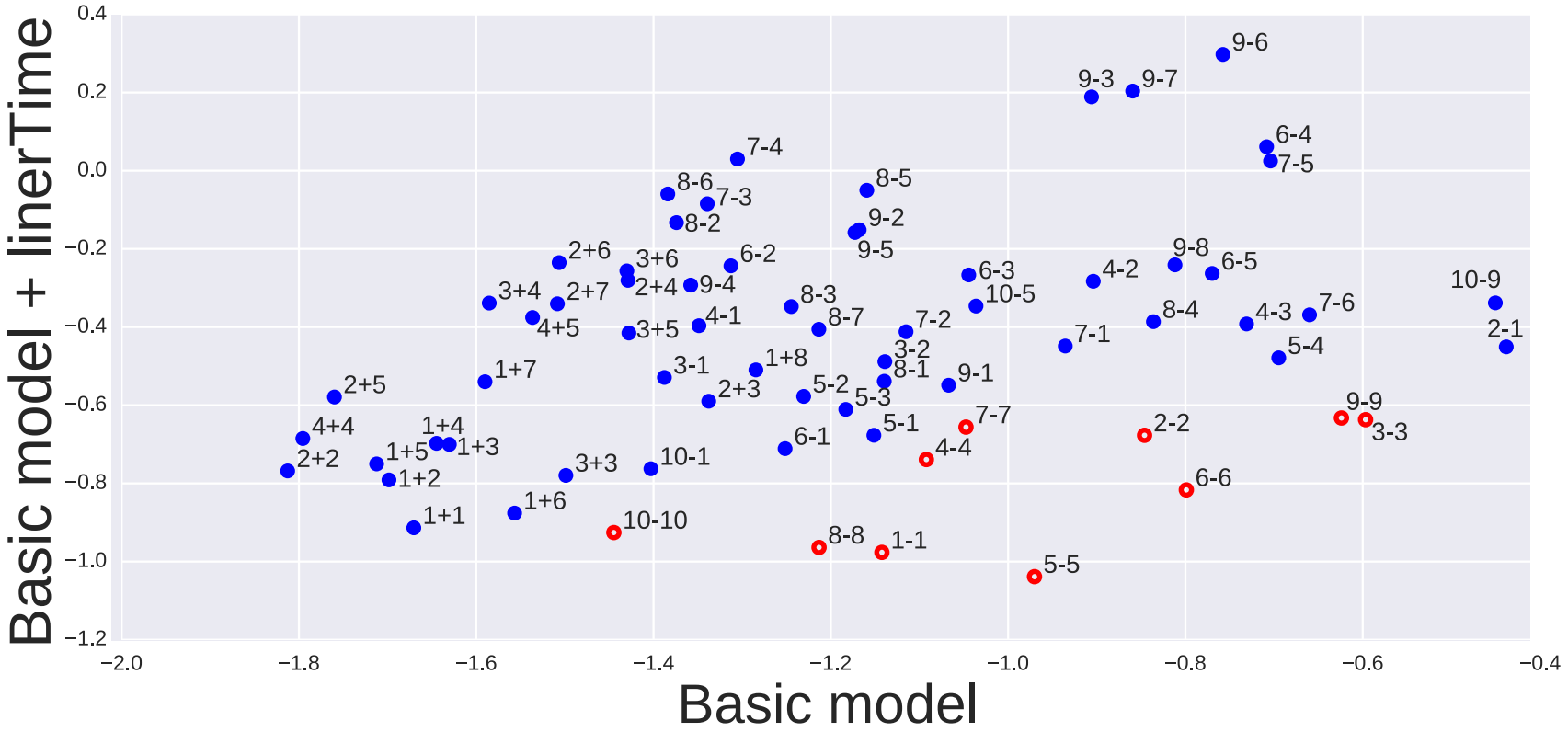
Correlations of Estimated Parameters

PCA



2. Response time use have larger impact on trained parameters that domain modeling.

Estimated Parameters



Estimated Parameters - Stability

3. Utilization of response time have large impact on model stability.

Conclusion

1. Large improvement over baseline does not mean usefulness for more complex models.
2. Response time use have larger impact on trained parameters that domain modeling.
3. Utilization of response time have large impact on model stability.

Incorporation of different aspects of student modeling may be more important than detailed modeling of one particular aspect.

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