

Rational Cognitive Task Analysis 3

Goals for today

- Quick review/example
 - CTA => instructional redesign
 - OLI Statistics online course (CTA1 slides)
 - CTA => automated instruction
 - algebra cognitive tutor example
- Discussion of Alevan, Klahr, & Siegler
 - What are the tasks?
 - What CTA methods used?
 - What is the output of the CTA?
 - How is (or could) CTA used to improve ed?
- Applying CTA to your own research

CTA and instructional design

- CTA yields a representation of knowledge or a “cognitive model” of student thinking
 - Model has elements: production rules, concepts, skills, schemas ... “knowledge components” (KCs)
- Cognitive model guides instructional design
 - Direct verbal instruction corresponding with KCs
 - Select activities: Examples & tasks
 - Order activities: Aid learning of then- and if-parts
 - Assess & remediate based on KCs
 - Make intermediate steps visible (reify)

Secondary point

- Another example (besides Zhu & Simon) that production systems can represent multiple solution paths

Algebra Cognitive Tutor: Example Activity

Analyze real world problem scenarios

An experimental aircraft has sunk off the coast of South Africa at a depth of 12,790 feet. The military have located the aircraft and are in the process of raising it to the surface. It is currently 7625 feet below the surface and is being raised at the rate of 185 feet per hour. (Hint: Consider the direction above sea level to be positive)

- How deep was the aircraft five hours ago?
- How deep will the aircraft be five hours from now?
- When did the military start raising the aircraft?
- When will the aircraft reach the surface?

To write an expression, define a variable for the time from now and use this variable to write a rule for the depth of the aircraft.

Use table, spreadsheet

	TIME	DEPTH
Unit	HOURS	FEET
Expression	H	-7625+185H
1	-5	-8,550
2	5	-6,700
3	-27.9189...	-12,790

Model tracing to provide context-sensitive instruction

Messages

You have entered the given 0 in the wrong column of the worksheet.

Use graphs, graphics calculator

	Lower Bound	Upper Bound	Interval
TIME Settings	-5	15	1
DEPTH Settings	-15,000	0	1,000

Use equations, symbolic calculator

$-7625+185H = -12790$

Add 7625

$185H = -5,165$

Divide by 185

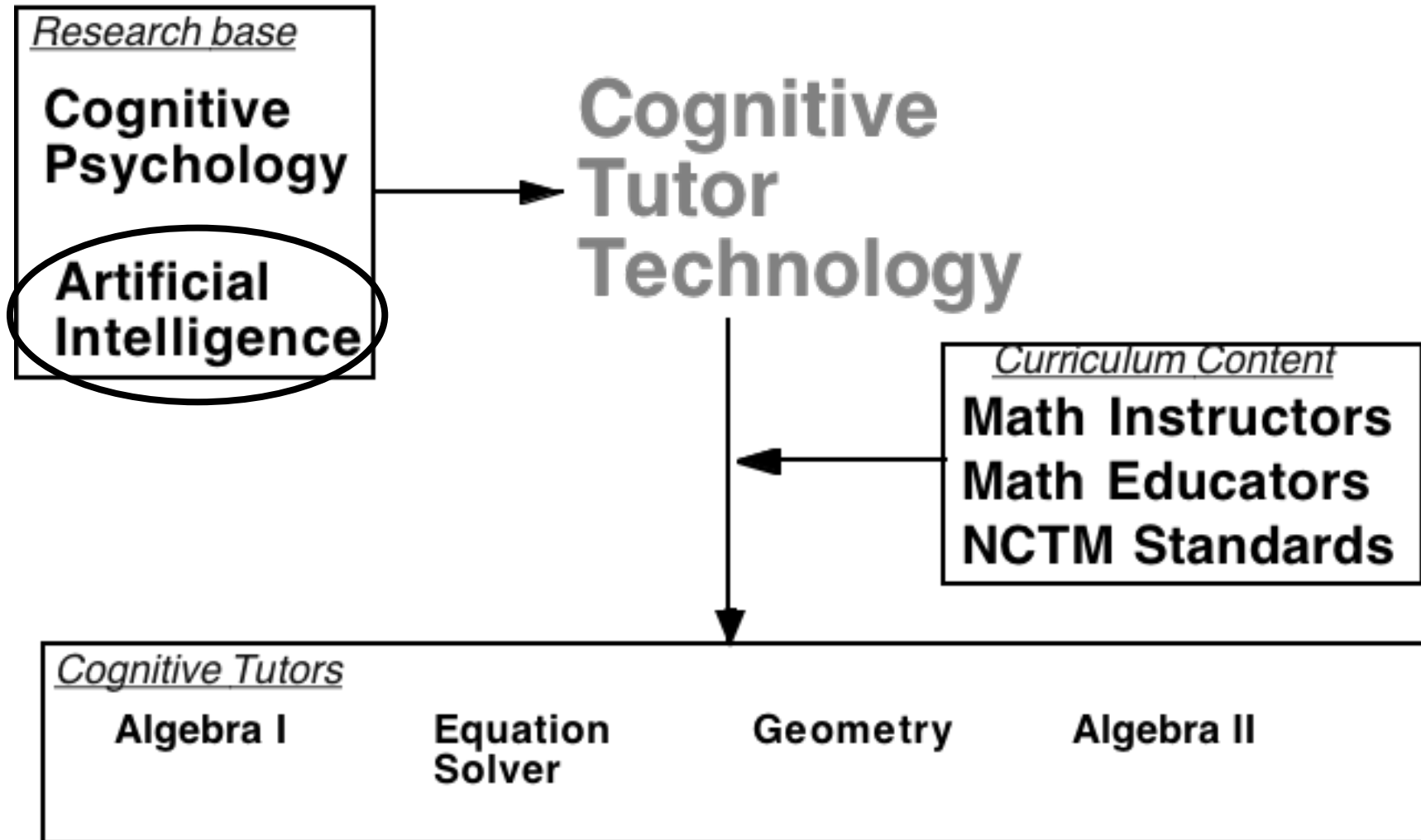
$H = -1,033/37$

Tracked by knowledge tracing

- Changing axis bounds
- Changing axis intervals
- Correctly placing points
- Write expression, any form
- Find Y, any form
- Find X, any form
- Identifying units
- Entering a given

Cognitive Tutors: Combining Cognitive

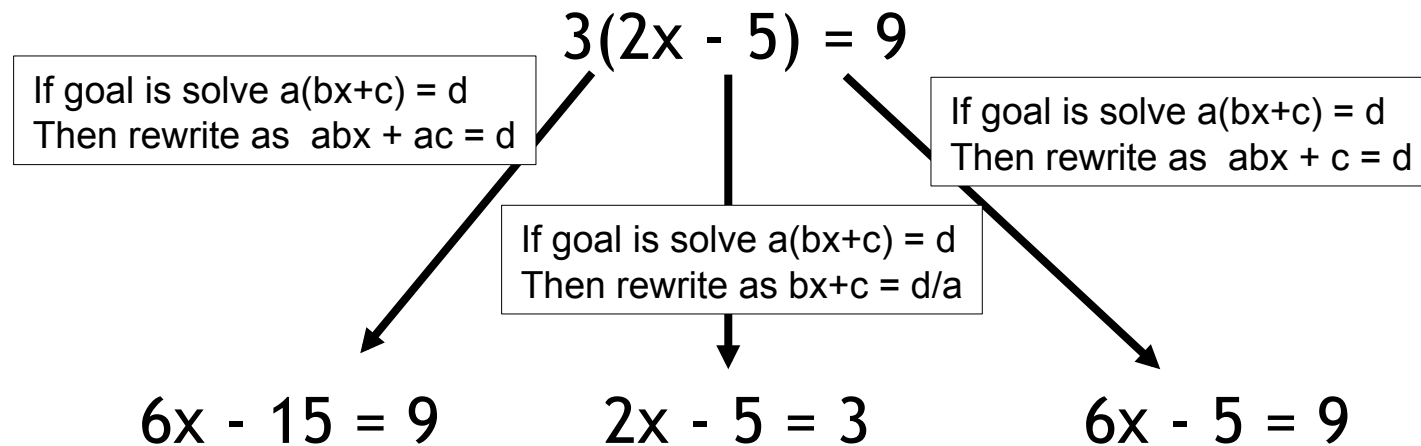
b Psychology & Intelligent tutoring systems



Cognitive Tutor Technology

Use cognitive model to individualize instruction

- Cognitive Model: A system that can solve problems in the various ways students can

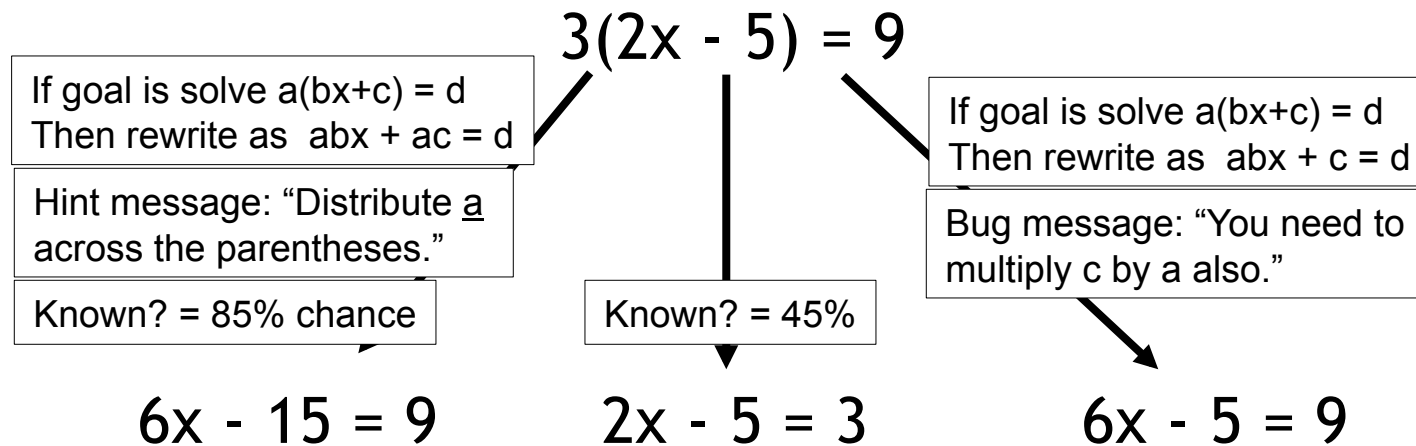


- Model Tracing: Follows student through their individual approach to a problem -> context-sensitive instruction

Cognitive Tutor Technology

Use cognitive model to individualize instruction

- Cognitive Model: A system that can solve problems in the various ways students can



- Model Tracing: Follows student through their individual approach to a problem -> context-sensitive instruction
- Knowledge Tracing: Assesses student's knowledge growth -> individualized activity selection and pacing

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Connecting to your research

- What domain would you do a CTA in?
- How would you do it?
 - Empirical or theoretical/rational?
 - Descriptive, prescriptive?
 - Which technique?
- How might you represent your results?
- How would you use your results to redesign instruction?