

A Tutoring Page Markup Suite for Integrating Sharable Knowledge Objects (SKO) with HTML

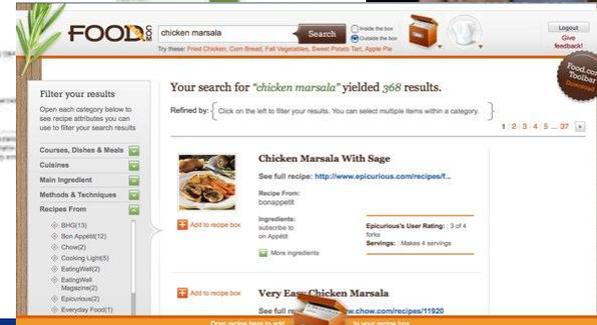
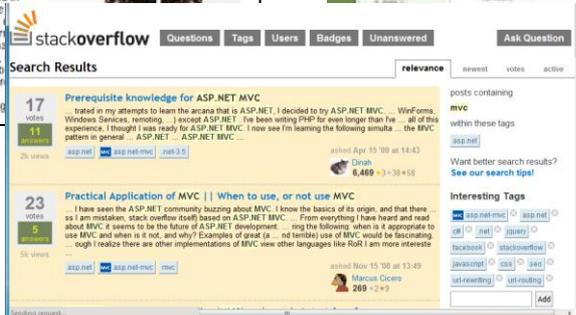
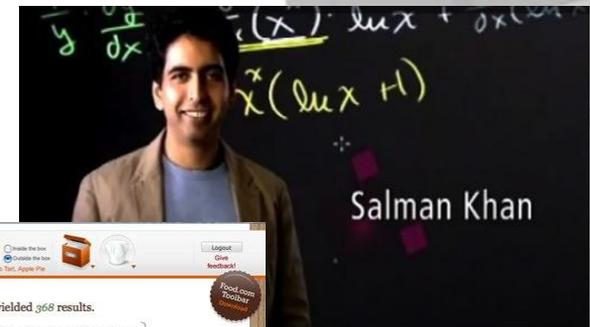
Benjamin D. Nye, Mohammad Faisal
Rahman, Man Yang, Patrick Hays, Zhiqiang
Cai, Arthur C. Graesser, and Xiangen Hu

The University of Memphis

Goal: Add Tutoring to Web Content

- Current Situation

- The Internet has vast learning resources
- Almost all of these are non-interactive
- Some of these are high-quality
- Wide range of domains (STEM, medicine, how-to...)



Goal: Add Tutoring to Web Content

- Approach: Tutoring as a Service
 - Mark up existing HTML with targeted ITS activities
 - Use natural language ITS to talk about content
 - Enhance and assess knowledge simultaneously
 - Simplify authoring for domain and pedagogy experts

ALEKS: Onr Stem

https://secure.aleks.com/alekscgi/x/isl.exe/1o_u-igNslid1r5Rv2K3IFi9Jt43gZD2GH2b4uCGU4Cud5mhpKp3ZmDCOpN

ALEKS®

MyPie Review Dictionary Calculator Assignments Calendar Algebra 1

HELP WORKSHEET INBOX REPORT OPTIONS English EXIT

Please take a moment to think about why substitution.

Tutor Agent

Peer Agent

Input text and press enter to send.

A textbook store sold a combined total of 368 math and psychology textbooks in a week. The number of math textbooks sold was 64 more than the number of psychology textbooks sold. How many textbooks of each type were sold?

Solution

- Let x be the number of math textbooks sold.
- Let y be the number of psychology textbooks sold.
- We can translate the given information into equations.
 - The store sold a combined total of 368 math and psychology textbooks.
 - $x + y = 368$

Practice

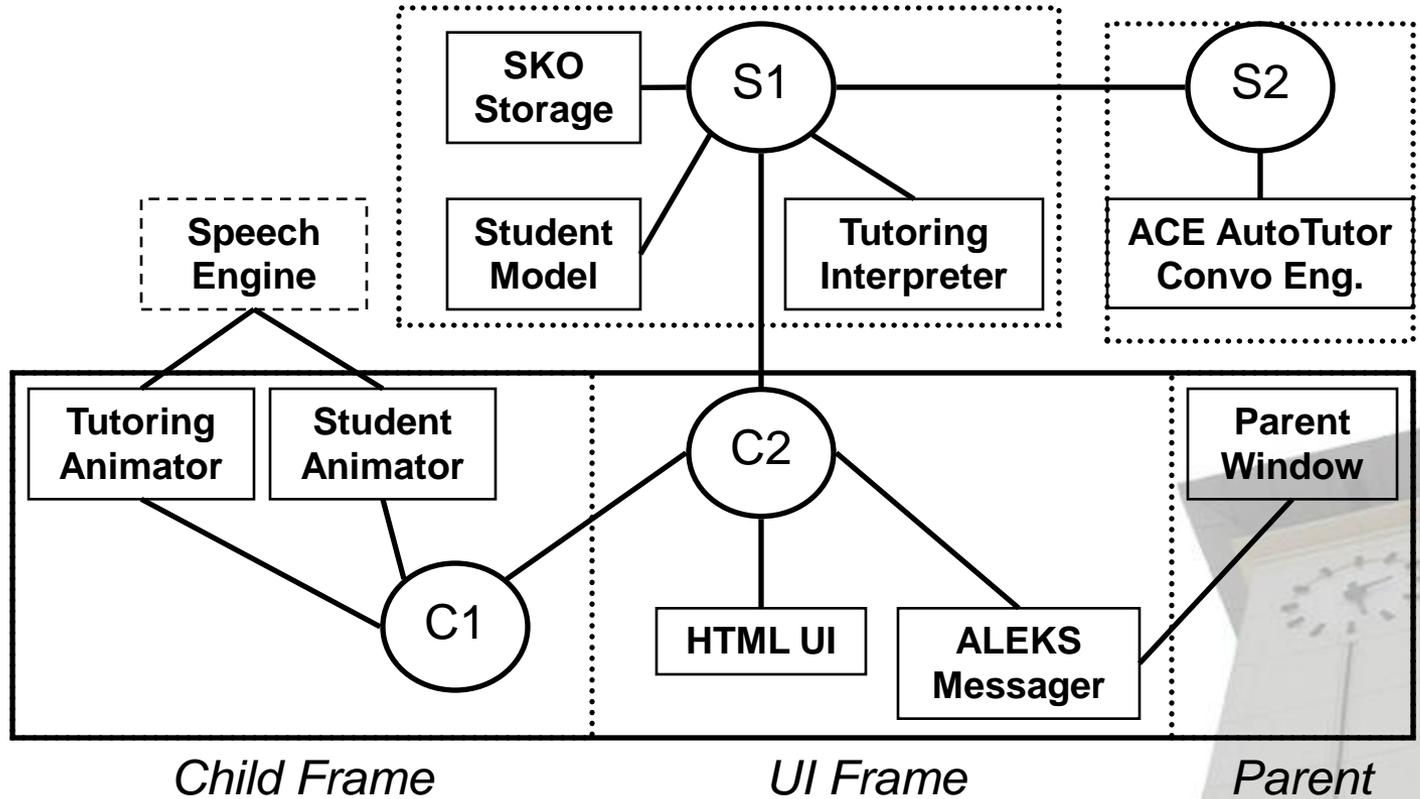
Solution



Services Under the Hood

Web Services

Web Client
(Browser)

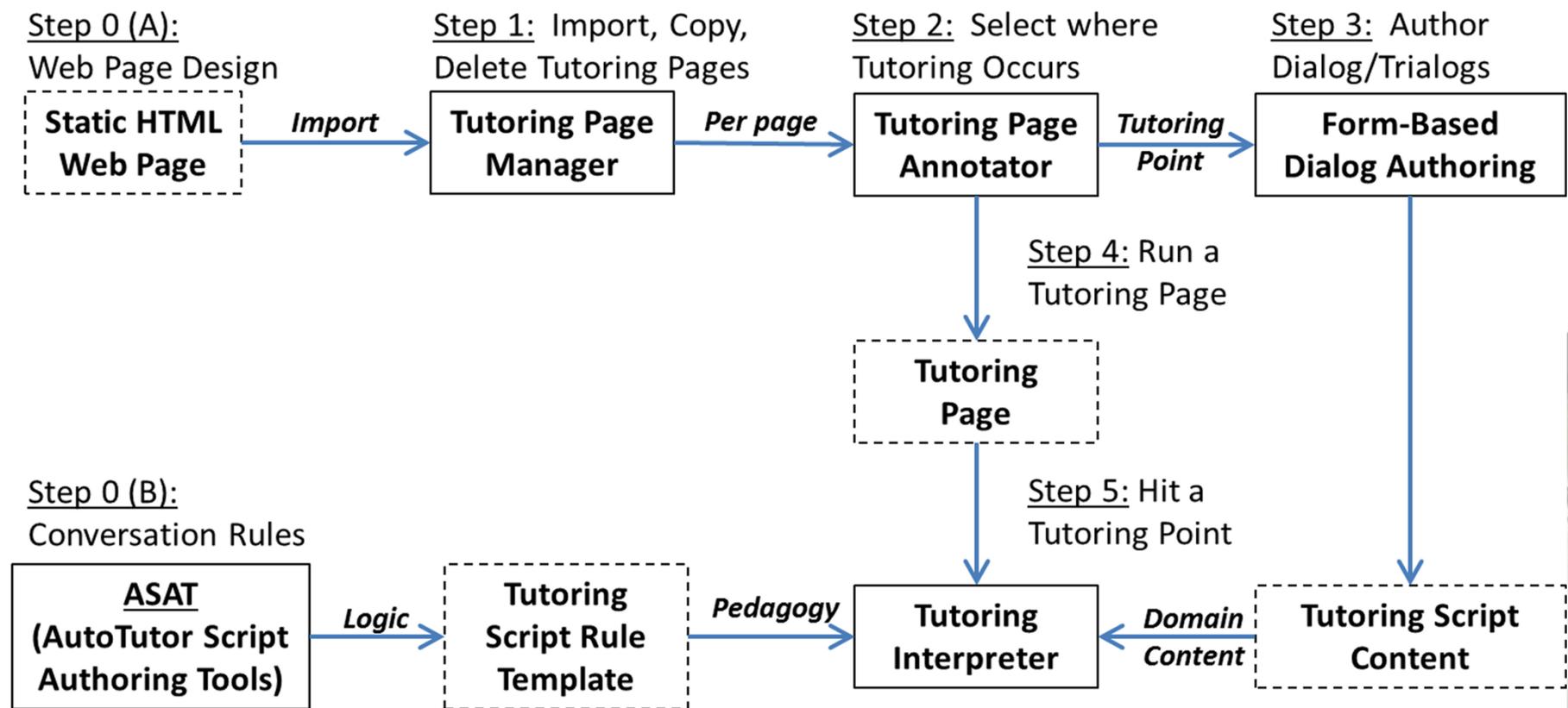


Tool Suite

- Tutoring Page Manager: Create/Import/Delete Pages
- Tutoring Page Annotator: Tutoring Locations
- Form-Based Authoring Tool: Tutoring Content
- (ASAT): Tutoring Logic Template
- (Python Scripts): Content pre-processing for templates
- (HTML/CSS Editors): Display Formatting

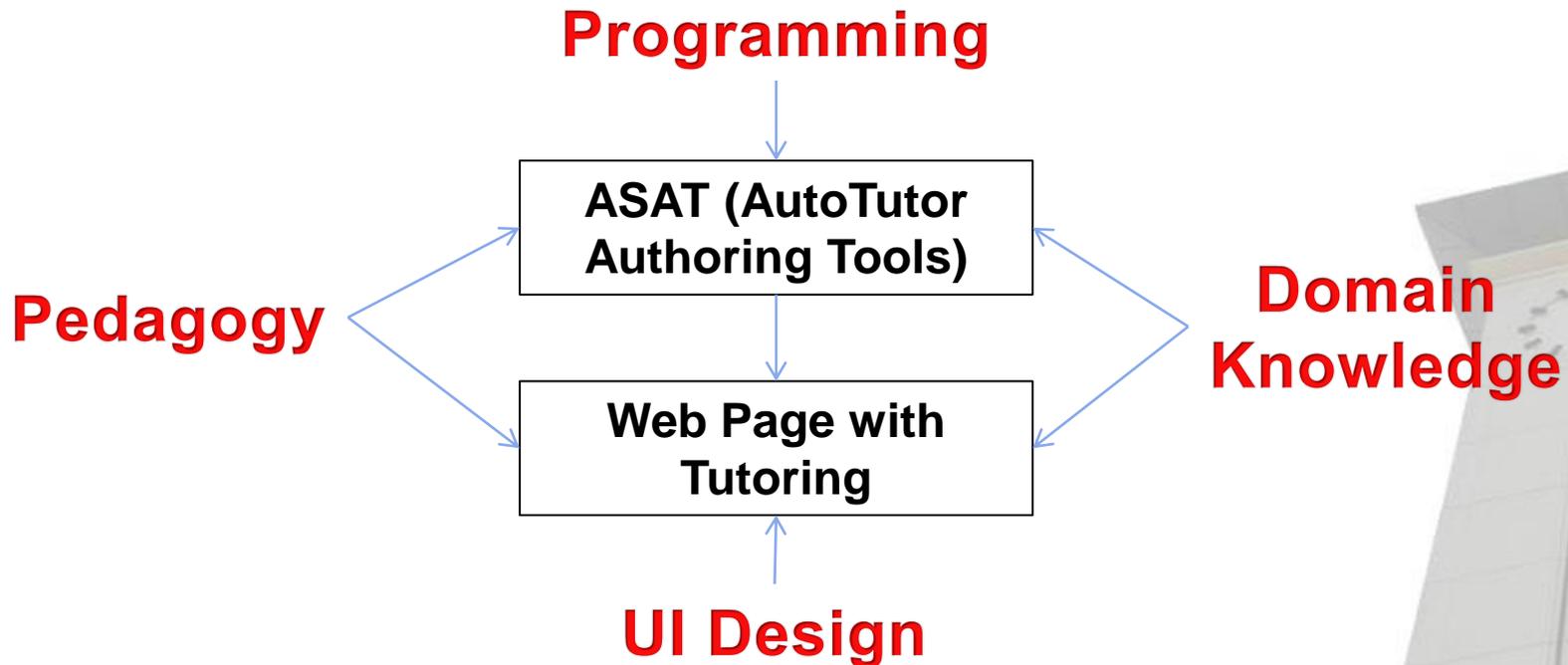


Tool Suite



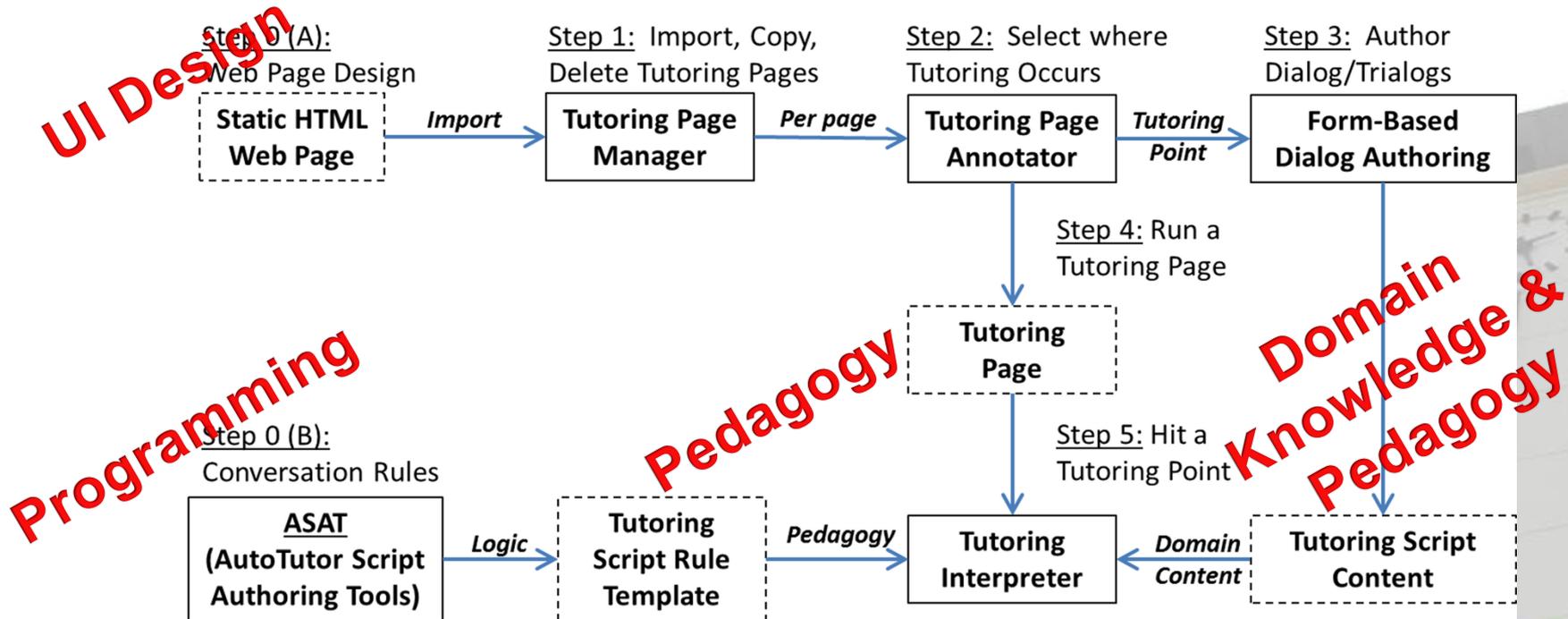
Theoretical Underpinnings

- Our Traditional Approach
 - Super-Experts: Specialized graduate-level researchers
 - Close Team Collaboration: Combine expertise

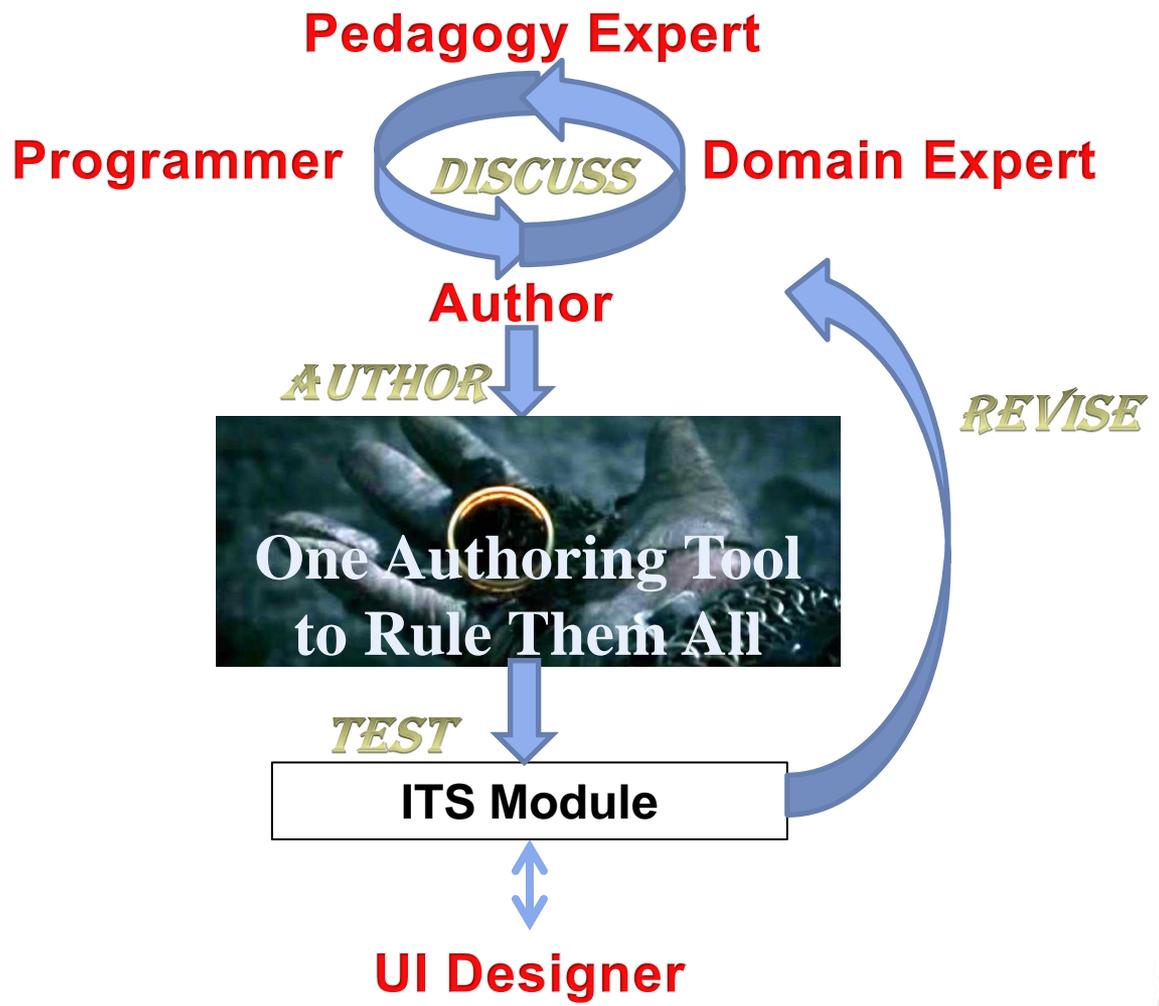


Theoretical Underpinnings

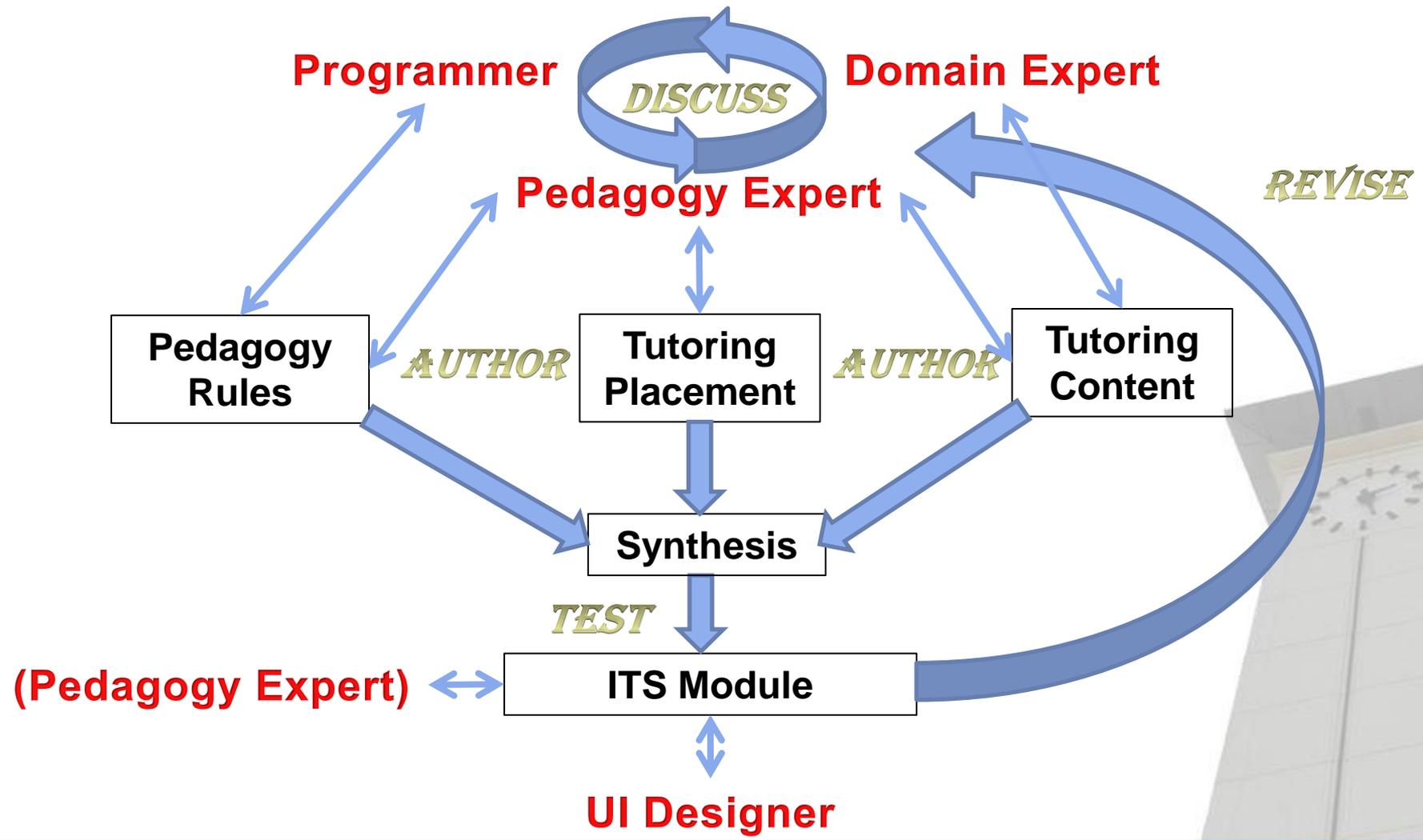
- Assembly-Line Division of Expertise
 - UI Design (Communication, Pedagogy)
 - Tutoring Content (Domain Knowledge, Pedagogy)
 - Tutoring Logic (Pedagogy)



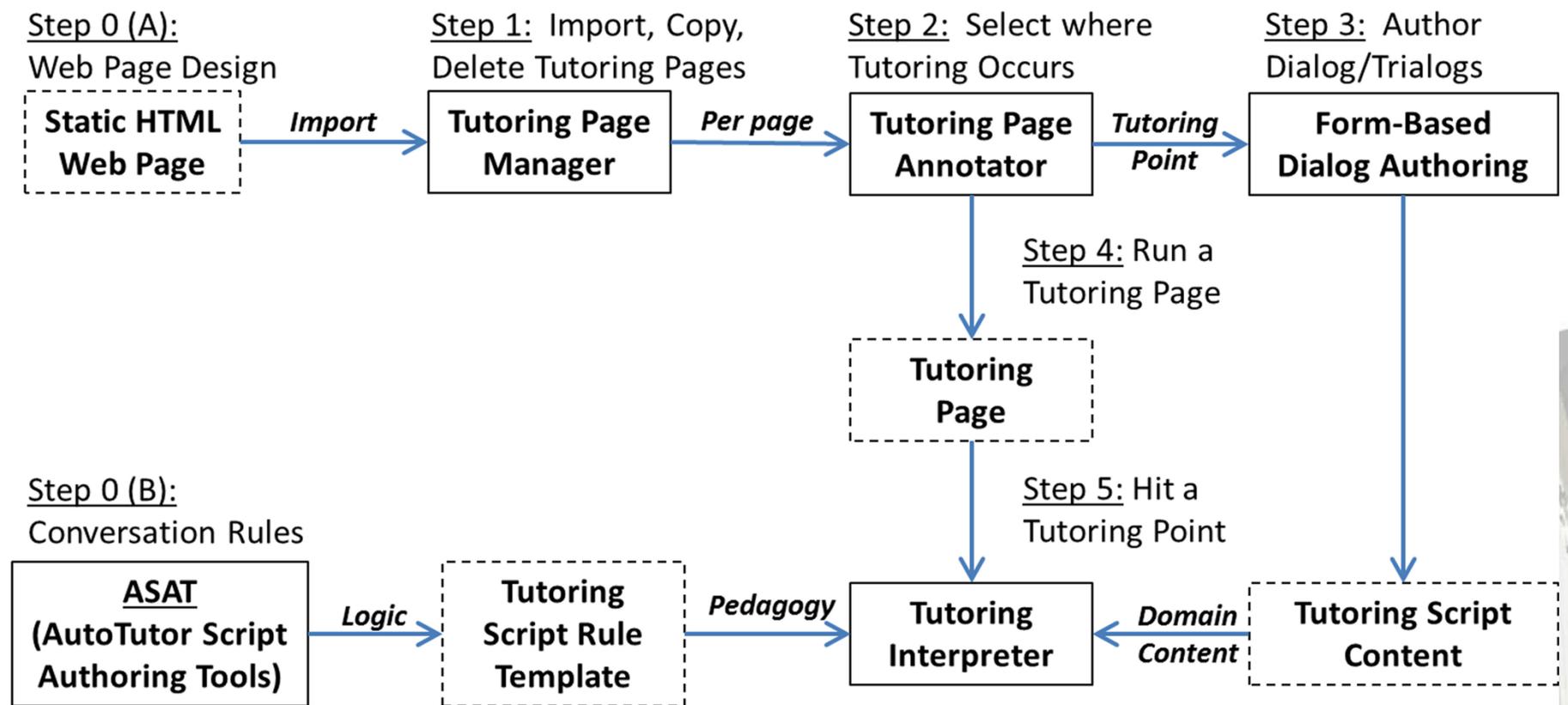
Workflow: Iterative Team Collaboration



Workflow: Suite-Based Collaboration



Tool Suite



Tool Suite

- Tutoring Page Manager (Domain Expert)
- Tutoring Page Annotator (Domain Pedagogy Expert)
- Form-Based Authoring Tool (Domain Pedagogy Expert)
- ASAT (Pedagogy Expert w/some Programming Concepts)
- Python Scripts (Programmer w/NLP skills)
- HTML/CSS Editors (Programmer w/HCI skill)



Tutoring Page Manager

Name	Weblink	Template
Algebra 512	./location.html	layout.html

Name:

Weblink:

Template:

Content:

```

<ul style='padding:0;margin:0;padding-left:20px'>
<li type=circle>Let x be the number of math textbooks sold.</li>
<li type=circle>Let y be the number of
    
```

1. Import
2. Name
3. Save
4. Edit

www.somepage.com/math.html

Writing a multi-step inequality for a real-world situation

In a race, Car #1 went an average of 150 miles per hour for x hours before dropping out. Car #2 went an average of 160 miles per hour for y hours before dropping out. The distance Car #1 travelled was at least that of Car #2. Using the values and variables given, write an inequality describing this.

Car #1 went an average of 150 miles per hour for x hours. So, it went a distance of $150x$ miles.

Car #2 went an average of 160 miles per hour for y hours. So, it went a distance of $160y$ miles.

The distance that Car #1 travelled was at least that of Car #2.

So, $150x \geq 160y$.

Notice that at least means greater than or equal to.

The answer is $150x \geq 160y$.

TEST

Please take a moment to think about why substitution.

Input text and press enter to send.

A textbook store sold a combined total of 368 math and psychology textbooks in a week. The number of math textbooks sold was 64 more than the number of psychology textbooks sold. How many textbooks of each type were sold?

Solution

- Let x be the number of math textbooks sold.
- Let y be the number of psychology textbooks sold.
- We can translate the given information into equations.
 - The store sold a combined total of 368 math and psychology textbooks.
 - $x + y = 368$

ANNOTATION

```

[[
A textbook store sold a combined total of 368 math and psychology textbooks in a week. The number of math textbooks sold was 64 more than the number of psychology textbooks sold. How many textbooks of each type were sold?
]]

```

Solution

- Let x be the number of math textbooks sold.
- Let y be the number of psychology textbooks sold.

Tutoring Page Annotator

- Author where tutoring happens in page
- Tutoring Group: One or more tutoring sessions
- Content-Editable: Delete/modify page text
- Sequencing: Rest of page hidden until group done

The screenshot displays the Tutoring Page Annotator interface. At the top, there are five buttons: "Add Tutoring Group", "Remove Tutoring Group", "Add Tutoring Point", "Add Tutoring Button", and "Add Link". Below these buttons is a form for defining a tutoring group, with fields for "Concept:", "Main Dialogue Index:", and "SKO Names:", along with a "Submit" button. The main content area shows a math problem: "A total of 100 math and psychology textbooks in a week. The number of math textbooks sold is 10 more than the number of psychology textbooks sold. How many textbooks of each type were sold?" The solution is provided below: "Solution: Let x be the number of math textbooks sold. Let y be the number of psychology textbooks sold." Annotations include:

- "Group Start" pointing to the opening double square bracket "[[".
- "Tutoring Point" pointing to the problem text.
- "Group End" pointing to the closing double square bracket "]]".
- "Tutoring Button" pointing to a small icon of a person's head.
- "Live Content Editable HTML" pointing to the solution text.

Tutoring Page Annotator

- Can import/export annotated HTML
- This HTML is combined with tutoring dialog by JavaScript inside “Tutoring Page” UI templates
- This is converted to JSON for storage and delivery

```
<body>
<TutorGroupStart id="Reality Problem to Algebra " concept="RealProblemToAlg" SKO_names="['ALGE078_1','ALGE078_2']" maindialogindex="0"/>
  <span>A
  textbook store sold a combined total of 368 math and psychology
  textbooks in a week.</span>
  <span class='inline-block'>
  <span>&nbsp;</span>
  <span>The number
  of math textbooks sold was 64 &nbsp;<span>more than the number of
  psychology textbooks sold</span>
  <span class='inline-block'>
<TutorGroupEnd/>
<TutorGroupStart id="Finding the Number of Solutions" concept="FindNumSolutions" SKO_names="['ALGE078_3']" maindialogindex="0"/>
  <span>. How many
  textbooks of each type were sold?</span>
  <span class='inline-block'>
<TutorGroupEnd/>
</p>
<p>
```

Form-Based Dialog Authoring Tool

- Author content of tutoring dialogues (up to 3/group)
- Create new dialogues or select from existing ones



Form-Based Dialog Authoring Tool

- Author content one short form at a time
- Content is used for NLP and for agent speech

- Steps:

1. Main questions
2. Expectations
3. Hints
4. Prompts
5. Misconceptions

Step 1 - Main Question

What is the main question you would like to ask the student?

Example: What do you know about quadratic equations?

Student: Type questions here and press ENTER.

Teacher: How are 6000 pounds and 96000 ounces related?

Student: Hmm. Is 6000 pounds more than 96000 ounces? Or maybe is it 11

Step 2 - Main Ideas

Try to think about ideas, skills, or strategies that students need to know to answer your question.

Example: If we want the student to understand quadratic equations, then they need to know the following ideas:

1. know how to use +/-
2. understand square roots
3. know how to simplify radicals

Type ideas here and press ENTER.

They are the same weight, just in different units. That is because 1

Key Words

Step 3 - Hints

Idea was:

What do you know about the +/- (plus-minus) symbol?"

Create one or more hints for this question below.

Example: If idea #1 was "know how to use +/-", a good question might be "What do you know about the +/- (plus-minus) symbol?"
 Good Answer: I represents two equations in one formula.
 Bad answer: the plus and minus cancel each other out

Type hint question here ...

There are 16 ounces in one pound. If we convert 96000 ounces into pounds, how is 11

Good: They are the same. Both weigh 6000 pounds, but the

Bad: 96000 ounces is more.

Bad: 6000 pounds is more.

Bad: Type hint answer here ...

Step 4 - Prompts

Idea was:

What do you know about the +/- (plus-minus) symbol?"

Create one or more prompts for this question below.

Example: A prompt for the question "What do you know about the +/- (plus-minus) symbol?" might be "This is a really great prompt."

Type a prompt here and press ENTER ...

If we have 6000*16 and 96000, then these are both the .?

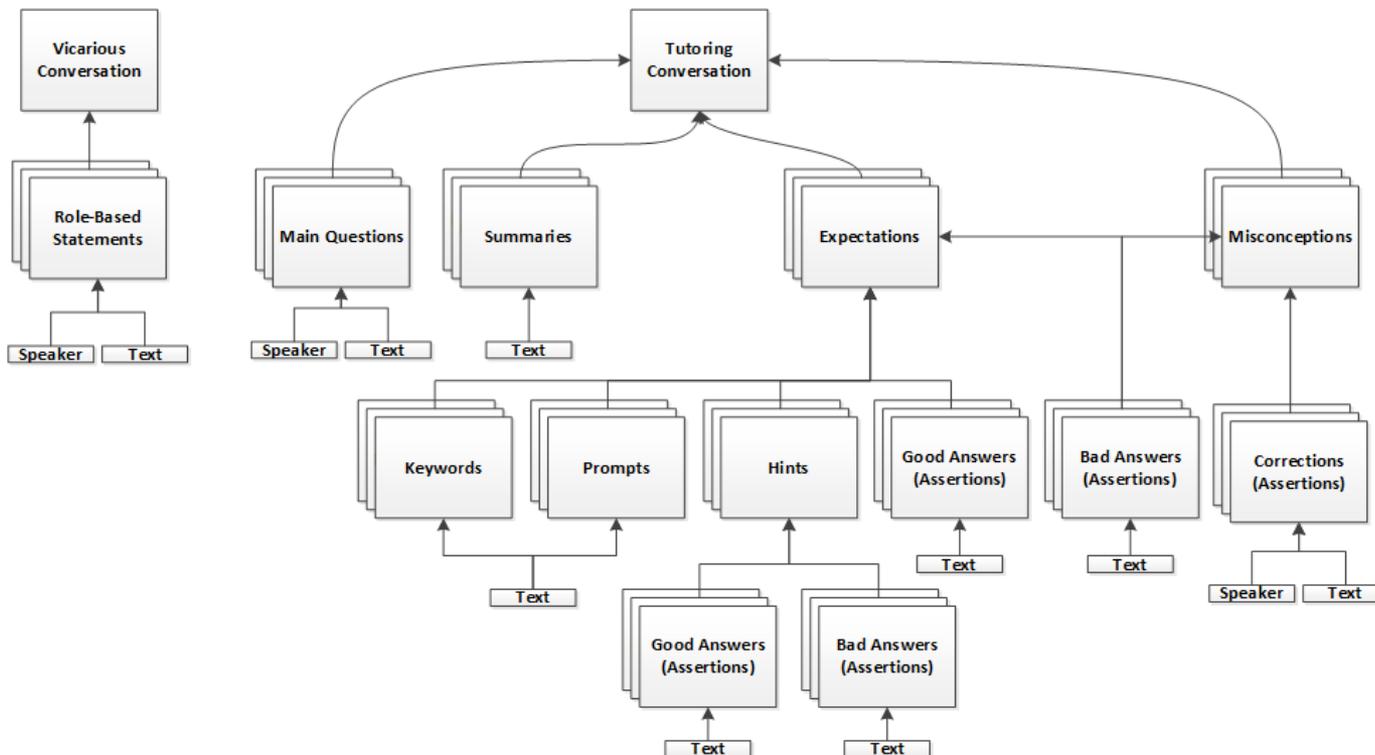
Both values represent a type of weight: ounces and pounds. What are ounces

Keywords

Type keywords here and press return ...

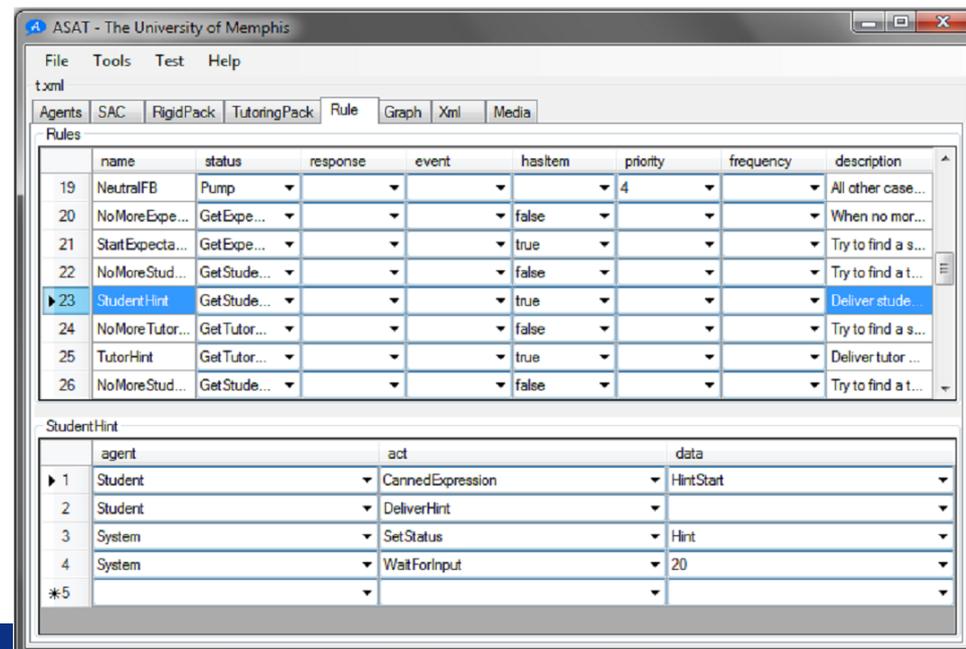
Form-Based Dialog Authoring Tool

- Content is authored in a minimal fashion
- Some elements duplicated/pre-processed before combining with an ASAT template



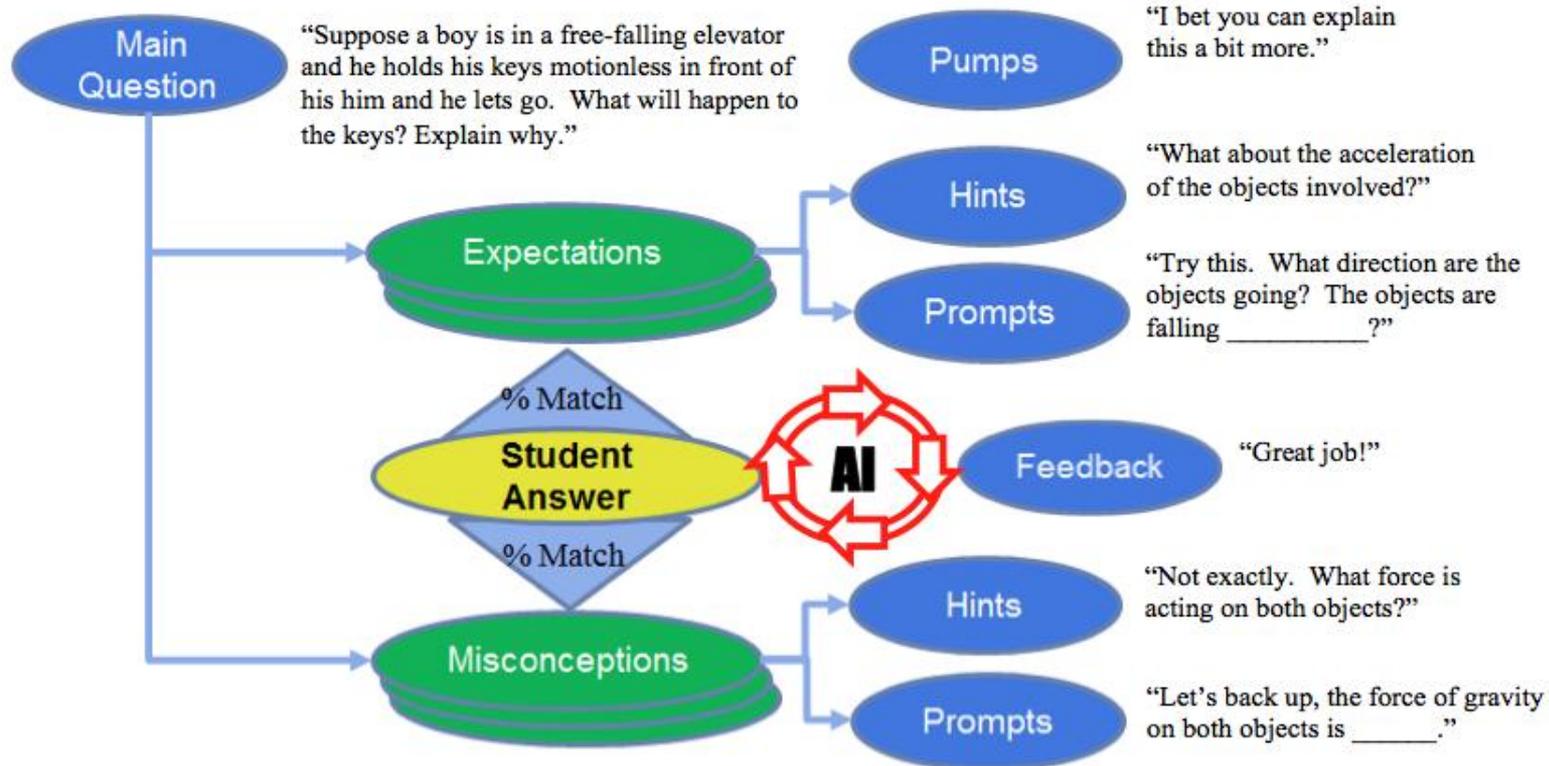
ASAT: Trialog Templates

- Form-based trialogs are content only, no logic
- Combined at run-time with ASAT rule templates
- Templates:
 - Vicarious: No human input, agents talk with each other
 - AutoTutor-style Expectation-Misconception Tutoring
 - Collaborative Lecturing (In Progress)
- Preprocessing Content
 - Depends on template type
 - Done with code scripts
 - Make speech-friendly text
 - Remove stopwords
 - Canonicalize keywords



ASAT: Trialog Templates

- AutoTutor-Style Expectation-Misconception Tailored (EMT) Dialog



Future Directions

- Suite online (internal use) starting this month
 - Form-based tool needs to be connected to cloud storage server
 - First use: Revising math tutoring dialogs
 - Bugfixes and usability checks will occur throughout the summer
- Enhancements on deck
 - Detect and flag semantically ill-formed content
 - Support authoring test inputs (good/bad responses)
 - Store rule templates in storage service (currently static)
 - New template for collaborative lecturing (e.g., linear lecture with checks for knowledge and attention)
 - Looking at better updating for collaborative editing: Multiple users on form-based tool could overwrite
 - This approach may work for interleaving w/video