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Opening a coach
NOTE: The file dialog will vary from OS to OS and browser to browser.

Step 1: Navigate to http://palweb.spa.umn.edu:8080/PhysicsTutor/PhysicsTutor.html

Step 2: Choose Instructor (editing) or Student mode. Student mode is already preselected when loaded.

Step 2b: If you choose instructor, enter the password “123” to enter editing mode. Click “Enter Password” or hit enter.
Step 3: Click on the “File” menu system and select “Load” to load a new coach.

Step 4: Select “Load Existing Coach File” to bring up the file selection dialog box. Navigate to the folder with the provided template coach file. Select the file and hit open. Here loading “Sliding Puck” is demonstrated.
Step 6: Wait for the coach to fully load. The clock icon will complete and a regular cursor should return. Select “Edit Coach” to edit the coach (or Run Coach if in student mode).

Saving a coach
Step 1: Access the coach menu by using clicking on “File” then “Save”.
Step 2: Select “Save Active Coach File”. Navigate where you would like to save the file. Choose a file name and hit “Save”.

Step 3: To continue editing or running the coach, close the dialog box or hit “Edit coach/Run Coach”
Tasks
The tasks listed below are designed to be representative of a subset of the types of modifications that instructors might make to the coaches in order to create new problems or to customize the coaches for their classes. The tasks exemplify progressively more complex modifications, requiring a deeper knowledge of the inner workings of the coaches. Tasks 1, 2, and 3 are relatively simple, involving adding, removing and editing existing elements. Tasks 4 and 5 are more complex, involving changing the logic structure of the coach.

Tasks Overview
Task 1: Make simple edits to existing variable names, student feedback, picture elements, question text and responses.

Task 2: Add a new element (a force) to the problem by defining it and inserting it into the picture.

Task 3: Add a picture as a response, rather than just text, to a multiple-choice question.

Task 4: Add a new element (a force) to the problem and create the questions and actions necessary for students to specify it.

Task 5: Editing/Creating Node questions. These questions are useful in a script coach, not as useful in a fully object free-form coach. They do have advantages that logic is prebuilt in their creation.

Task 6: Creating new pictures/snapshots. This is demonstrating the system to have a new blank “canvas” for a physics representation.

Task 7: Exploring logic. A glossary of terms is at the end of the task list to help with this aspect of coach editing. This is the most complicated part of coach editing and is best left for exploration as it is very free-form.
Task 1: Editing existing elements
To make an existing coach more consistent with your teaching preferences, you want to change the label used for the gravitational force as well as the length of the corresponding vector in the picture. In addition, you want to change the wording of a question as well as the wording of some of the feedback messages in order to make them clearer and to give your students more coaching using the Conservation of Energy approach.

Your tasks

1) Change the label for the gravitational force in the coach as well as its value.
2) Change the length of the gravitational force vector in the pictures.
3) Navigate to find the question to be changed. Modify the wording of the question and some of its corresponding feedback.

You may try these tasks on your own before looking at the guide or asking for assistance.

1a: Changing the label for the gravitational force.
Step 1: Load “Sliding Puck” in the instructor view. Locate the definition for the gravitational force in the list in the lower right portion of the coach. Hit the “edit” icon, which is middle of the three icons at the top of the box.
Step 2: Delete the “g” in the label box and replace “F” with “W”. Note, everywhere this label was used (in equations, pictures etc.) is automatically updated with the new label. Only text in questions and responses are not affected by this change.

To change the value, click on “mix=max?” checkbox to make the minimum value of the quantity equal to the maximum value of the quantity. Then, change the value of the force. If you want, scroll down to change the units as well. (More advanced instructions will be available if you want to add more units). Click on “Assign Va...” (Assign Value) button to update the value of the quantity.

You may also edit the vector and label colors, value, units, as well as renaming the title of the quantity. The title is used in tooltips for the student as well as in other parts of the instructor editing. You can also change the type of value from direct, scientific, infinite and unknown with the pulldown menu.
1b: Changing the location and length of the gravitational force vector in a picture.

Step 1: Navigate to the picture tab. From the pull down menu in the picture tab, select the “At the start of the puck’s motion, side view” element. We call each tab “pictures” and the different pulldown elements “snapshots”. The best way to think of the organization is that the picture tabs are a gallery and each snapshot (pulldown element) is a canvas.

Step 2: Select the end of the arrow representing the gravitational force (note the changed label), and move it, shorten/lengthen it etc. For a better view, hit the magnifying glass to get a larger window for better edits. You can also move the label of the vector independently of the arrow.
1c: Navigate and find the question you want to change. Change the wording and feedback.
Step 1: Through student mode, you found that module # 220. There are two ways to find this module. 
1) Type in the module number in the bottom left, and hit “Find Module” or 2) Expand the module 
navigator by using the arrow buttons next to the module names. The question is located in folder: 
Describe the Physics -> Which approach -> Cons. Of Energy -> Fundamental Eq -> Puck+Earth, Horiz-x -> 
Define Initial Energy. Once clicked, use the middle window to change the question text.

Step 2: To edit feedback, find the appropriate response that needs better feedback. Select the “text 
bubble” icon. Change the feedback. Feedback can be changed for either correct or incorrect answers.
Task 2: Creating a new element
To give your students additional practice, you want to change the sliding puck problem to one involving pushing a box up a ramp. In addition to changing the text of the problem, you will also need to add a new force to the picture.

Your tasks

1) Change the text in the word problem to add the new force.
2) Add a new force to the coach problem.
3) Add the new force to the picture of the problem.
4) (Challenge) Add a new force to the diagram and change the diagram question accordingly to define the new force. (Similar to Task 3 + Logic changes/additions)

You may try these tasks on your own before looking at the guide or asking for assistance.

2a: Change the text in the word problem
Step 1: Open the coach. Click on the word problem. Edit the text to what you want. Currently only basic text and characters are allowed. A word problem editor is on the list of things to complete.
2b: Add a new force to the coach problem.
Step 1: We call the building blocks of the coach “primitives”. To add a new primitive, click the + button in the lower right hand portion of the instructor interface. Select “Quantity”.

Step 2: Scroll to the bottom of the primitive list and find your new blank quantity. Hit the “edit” icon which is the middle of 3 icons. This brings up the quantity edit dialog box.
Step 3: Give your new force a title, variable name, value, quantity type and unit. If the force has a range of available values, deselect “Min=max?” and assign both a lower and upper bound. Be sure to click the assign value button to apply the value changes.

2c: Add the new force to the picture of the problem.
Step 1: Select the “snapshot/canvas” to which you want to add the force. Hit the “Focus” tab and select the “At the end of the puck’s motion, Side view” canvas.
Step 2: Scroll to the bottom of the primitive list and find your new blank quantity. Hit the “edit” icon which is the middle icon. This brings up the quantity edit dialog box. Select the type of “sketch” you wish to add to the picture. You have many choices. You can try any one. For now, let’s use the “Arrow” sketch which will draw a vector representation that lies in the plane of the canvas. You can also choose a color. For this coach, “red” was selected as the color for forces.

Step 3: Hold CTRL and drag the primitive box into your selected picture. Edit the vector by moving the ends so it is in the position and orientation that you wish. Note: The screenshot includes the magnified picture. You can adjust your sketch by dragging the arrow and/or the label to your desired position.
Task 3: Creating a new picture response for a multiple-choice question
You find that students in your class typically forget to include the proper acceleration for Newton’s laws so you want to include it in the force diagram as a reminder. To encourage including the acceleration, you want to make an incorrect choice in the question about force diagrams with a missing acceleration so you can give your students specific feedback.

Your task:

1) Add a new picture response to the diagram question. Edit the picture to represent the common mistake. Add appropriate feedback to the new response.

You may try this task on your own before looking at the guide or asking for assistance.

3a: Add a new picture response to the diagram question.
Step 1: Use the navigator on the left to find the diagram question in the dynamics portion of the sliding puck coach. Select this question to load it for editing. (For ease, it is Module 344 if you want to use the search function).
Step 2: Click the “New Response” button and click “Picture”. This will add a new picture response to the question. We now need to fill it with elements. Note: This question uses a unique input for the students called “Picture Input”. The students drag elements into the input box to create the diagram. Where the elements appear is determined by the instructor (in the middle box). The answers with specific feedback (including the correct answer) is set by the response list.

Step 3: Click on the “Describe” picture tab. Select the “x-axis along the Ramp, Forces, Puck Alone” snapshot.
Step 4: Hold CTRL and drag the elements that you want to include in the response. The students will have to match perfectly this response to get the feedback you want. You want to include all the elements from the expected input except the acceleration. To do this quickly, hold CTRL and select the title bar “Puck Alone, Dynamics, Tilted Coordinate System” and drag it to the response picture box.

Step 5: Click the magnifying glass for the response picture. Remove the force components, angle, equation sketches and acceleration from your diagram. Add feedback to your new incorrect response. When your students match this incorrect answer, they will get feedback specific to missing acceleration.
Task 4: Adding questions and modifying logic for students to specify new elements

To give your students additional practice, you want to change the sliding puck problem to one involving pushing a box up a ramp. In addition to defining a new force quantity, you will also need to add the questions necessary for students to specify the force when defining quantities. Because these questions fit into the logic tree in some way, this will also include adding choice logic to guide students to answer this question. This task highlights the “parent/child” relationship of the tree structure and how it can be manipulated and changed for student interactions.

Changing student logic is the most complicated edit one can make with the coaching software. There are many types of logic edits, this highlights the most prevalent type.

Your tasks

1) Add a new force to the coach problem.
2) Add the new force question to the Quantities section with appropriate logic.
3) Create an appropriate action which will activate when the student answers the question correctly.
4) Modify the logic (choice logic) to guide students to the new force question.

4a: Add a new force to the coach problem.
Step 1: See Task 2b.

4b: Add the new force question to the Quantities folder section.
Step 1: Navigate to the Quantities folder in Focus the Problem. In the tree structure, create a new “Action Module” which represents the new force you created. To create this module is created as a child of the “By which obj” question. Select module 133 and hit next to the module name. Select “Action” in the menu to create an “Action” module. Name the new action “Push”.

![Image of tree structure with numbered steps]
Step 2: Select the “Push” action and create a child question. This is the question to ask students about the new force.

Step 3: Select the new “Question” module. It can contain as many individual questions that you would like. We will create two questions, one for direction and one for magnitude. To do this, click the “New Question” button in the middle of the screen to add one more question to the module to bring the total to two.
Step 4: We will make the first question a direction question and the second question a value question. For the first question, change the question text to ask about the direction, change the instructions to reflect the direction choice and change the input to “Direction Input”. Direction input brings up a compass like input for students. It needs “Direction Responses” to check against for correct answers.

Step 5: Add two responses to the question by clicking on “New Response”. The first response is a “Direction Response” which will reflect the correct answer to the direction input, the 2nd response is a “Default” response which will give feedback to the students if their input reflects any of the possible responses. In the direction response, select the right answer and click the left checkbox to indicate that this response is indeed a correct response. If you choose, you can add feedback to each response.
Step 6: Repeat this for the 2nd question. For this question, we will use a radio button question and give multiple possible “Text” responses. Checkbox and Radio buttons do not require a Default Response whereas all other input types do need Default responses. Try to match the screenshot by editing the 2nd question. If you choose, explore the other input/response types to see the possibilities.

4c: Create an appropriate action to unlock the force.
Step 1: We will now use an “Action” to unlock representations of the force when a student has a correct response. To create an action, click the ☆ icon on the response line. This opens the response action.
Step 2: Add a default action by pressing the “New conditional group” which opens up the “Default” action. Actions are changes to the state of the coach from the student perspective. We want to create an “unlock” action which unlocks the element for the student to see. Here the “default” is applied every time the response is selected by the student.

Step 3: Hold CTRL and drag the quantity from the building blocks list (primitive list) to create a “primitive action”. Explore all the options for primitives. Here, we want to unlock the primitive, its sketches, variable and its value. This is done by making sure the icon is highlighted in the action. Use the tooltips (mouseover) to see what can be done. A glossary of icon terms is at the end of this pamphlet.
4d: Modify the logic (choice logic) to guide students to the new force question.
The logic of how the coach behaves is through actions. There are response actions which are direct actions after a student input and Action Modules. Action modules do not require direct student responses but act as navigation through the coach by checking the current student state of the coach when the module is reached.

The action module may be reached multiple times and each time the student state may be different. The conditional group can be expanded further to see an “If -> Then -> Else” logical statement for action items which checks the current state of the coach before applying an action item. Here we utilize this logic to finish adding our new question.

Step 1: We need to modify the “By which obj.” to have the Push in the list. First we need an object which will push the puck. Create a new Object primitive (building block). Select the pictoral representation and name the object. (In order to add it to your pictures, you would need to complete task 3 and edit the appropriate “Which objects” question. This will be left as an exercise to you. For now, it is unnecessary.)
Step 2: Next, we will add this object as a possible response to the “By which obj.” force question. Navigate to this module (#133) and add a “Primitive Response”. Cycle through the primitive response until you find the new object. Be sure to select it as a correct response. Note: By using a primitive response, if you edit the name in the primitive, the response changes automatically.

Step 3: If you noticed, the correct answers in the question have actions. These actions utilize the “Flag” action. We will mimic this action for the new response. Select the ⭐ to open the action. We will flag the new object as well as the “Force” situation. CTRL+Drag the new object to create the Object ActionItem. CTRL+Drag the “Force” to create the Situation ActionItem. If you want, you can filter the primitive by hitting the 👜 filter for objects and the 👜 filter for situations.
Step 4: Now that we changed the question, we need to change the “blocker”. Go back to the “push” action module that you created in the previous task. We need to make this similar to the “Earth” action. First, if they choose the Push, we want the students to go to our question on direction and magnitude. We will use the conditional logic. Hit “New Conditional Group” twice to create the first conditional logic (non-default).

Step 5: We want to check the “flag” for the “Force” and “Person”. Again, we create these with CTRL+ Drag/Drop, just like the previous Step but drag into the “IF” section. Because these are in the “IF” section, they do not set the flags, but actually check the student state. Because you may want different logic for true or false, there are different checks for both states.
Step 6: SAVE BEFORE CONTINUING!!!!!! If the flag combination is true, then we want the students to go to our newly created question. This is done by making a “Module Action” in the “THEN” section. Again, CTRL+DRAG/DROP the destination question into the “THEN” block of the action. NOTE: Rarely, the modules disappear from the module list when creating module actions. This is intermittent, a known bug with no known fix. It is good practice to save before making Module Actions.

Sets the next module to be visited by the coach to be “548 Question”

Resets the question so that any previous answers to the question are erased.

Step 7: What about if they did not make the choice? We would like to skip the Question. Because the natural tree structure will bring us to the question as it is the first child module, we need to skip it if it wasn’t chosen. This is the “ELSE” block. CTRL+DRAG “reset all flag” action module into the ELSE block to complete the logic.

Sets the next module to be visited by the coach to be “548 Question”

Resets the question so that any previous answers to the question are erased.

Requires the students to answer “548 Module” regardless if they have answered this question previously.
Step 8: Because we used the GOTO, we want to be sure the previous answers that “skipped” the ramp forces goes to the “push” action. Select Module 132, “ramp?” action module. Find the conditional statement that checks to see if the student did not choose “ramp”. It should point to “reset all flags”.

Step 9: Replace this action item with the “push?” action module. CTRL+DRAG/DROP the “push?” action module into the “THEN” statement.
Step 10: To finish adding the choice to the loop, we want to reset our choices at the end of forces. Open “reset all flags”. In the default, add the “pusher” object action item and set the “unflag” action.

This completed adding the new force into the problem. You can also add the new object into your picture or change the object question to unlock the “Person pushing” object. Adding (or removing) new questions/primitives into a coach is by far the most complicated thing you can do when editing a coach. Because the logic can be complicated and linked extensively to the building blocks, removing the primitive (like removing friction) without addressing the logic first can be detrimental. Changing the logic to block a path may be far easier than removing objects from the building blocks.

The logic can be done in many different ways. The one thing to remember is that the IF/THEN/ELSE statements are not nested therefore the later ones always overwrite the earlier ones in an Action. This can create interesting logic loops.

If you explore the other logic chains in the FORCE section, you can see additional logic to handle if the students previously tried to unlock the Push force. It will prevent the students from repeatedly answering the same question. This is unnecessary if you want to allow students to continuously answer the same question. Also, the ELSE was not used but the reverse “FALSE” flag as an IF statement was used. There are many ways that can be done to accomplish the same thing.
Task 5: Editing Node/Leaf questions.

If the logic chain of the choices is to open ended and you want to script questions, there is another option that is used which predetermines the logic and that is NODE/LEAF questions. These questions are very restrictive, but are useful in a few cases, specifically if you want to restrict students to answer correctly a combination of checkbox responses before continuing. This task is set up to explore the plusses and minuses of using Node/Leaf questions.

Step 1: Open a Node/Leaf question. The easiest accessible question is Module 211. You can see that the question is a “Node” question by the button at the top.
Step 2: When students correctly answer a NODE question, it automatically opens the next question based on that response combination (single or multiple). Here only one response is correct, click “Tilted coordinates with x...”. This will then open the corresponding followup question. Scroll down to see it.

Step 3: Since you want to allow students to also choose the horizontal coordinate for this node question we can add new question responses. To do this, deselect “Tilted coordinates” and select the “Horizontal coordinates”. Notice the follow-up question disappears.
Step 4: To create the new followup question, click “New Question Group from Selected Responses”. 

BUG REPORT: The visualizations are asynchronous and the new question group unfortunately does not update automatically until you deselect and reselect your response.

You can change the follow up question to be another NODE question by clicking the “LEAF” button and changing it to a “NODE”. As you can see, this takes care of much of the logic for you but can be a major restriction, especially if you want to skip questions or check flag before opening up a followup question. Because of this, the UMN PER group now uses these NODE questions sparingly.
Appendix A: Glossary of Terms and Icon explanations.

Note: Many of these icons and systems are currently under a redesign so they will likely change. However, the functionality will be retained in some way. Also, some of the terminology may change as we increase instructor usability.

General User interface:

Navigator Panel: The module tree which highlights the natural parent/child logical progression between decisions and the behavior of the coach. This progression is superceded and supplemented by using actions which are

Module Panel: This panel contains the editing tool to edit the decisions the student will make. The interconnectivity between coach elements through actions are also edited in this panel by using actions.

Picture Panel: This panel contains the visual representations of the physics. The individual representations are called “sketches” and are created from the building blocks of the coach. Some examples of representations are vectors, free-body diagrams, picture of a ramp, visualization of equations, etc.

Primitive Panel: This panel contains the building blocks of the coach. These include quantities, approaches, equations, objects etc.
Navigator Panel (Logic tree)
(Under construction)

Module Panel (Editing student decisions and connectivity between elements)
(Under construction)

Folder Modules
(Under construction)

Question Modules
(Under construction)

Expression Input
When using expression input as drag/drop, the base equation is created with quantity categories as placeholders. Only quantity primitives that have the same category are allowed to be dropped to replace the preexisting category placeholders.

Plan Modules
(Under construction)

Action Modules
(Under construction)

These modules contain only actions which will check and change the student visual state of the coach. Unlike actions in responses (see Question Modules), these actions will ALWAYS activate when reached in the logic tree, irrespective of student interaction.
Actions (Editing logic and student visual state of the coach)

Checks and changes the student state of the program. These contain condition statements for logic. The two primary functions for the actions are Locking/Unlocking elements and Directing students to other modules or decisions based on the current student state of the coach.

1) Unlocked elements become visible to students in the interface. All elements start as “Locked” except for modules where only certain folders are visible and questions are made visible through background interactions.
2) Students are directed to other modules through module actions and the “NextModule” action. The student state is checked (locked, unlocked, flagged etc.) using condition items in “IF” blocks.
**Condition Items**: Condition items are always contained in IF statements of actions. They are created via CTRL + DRAG/DROP from other elements of the coach. These CHECK the student state of the coach. The student state is checked if the icon is highlighted yellow.

**Module Condition Items:**

<table>
<thead>
<tr>
<th>Module ID</th>
<th>Module Name</th>
<th>Completed?</th>
<th>Courseware</th>
<th>Time</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>192</td>
<td>Focus the Problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td>11 Which situation(s)?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td>10 Puck Defined?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AND</td>
<td>449 Plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


“192 Focus the Problem”: The module ID number and Module name linked (pointed) to the condition item. It is a sort of representation of the pointer for the module property.

: Completed? This icon when highlighted will check if the module is completed.
- 🚧: Not completed? This icon when highlighted will check if the module has not been completed;

- 🚧_unlocked?: Unlocked? This icon when highlighted will check if the module is unlocked. It is obsolete for modules and scheduled for removal for Modules.

- 🚧_not_unlocked?: Not unlocked? This icon when highlighted will check if the module is not unlocked. It is obsolete for modules and scheduled for removal for Modules.

- 🔴: Flagged? This icon when highlighted will check if the module flag property is true.

- 🔴_not_flagged?: Not Flagged? This icon when highlighted will check if the module flag property is set to false.

**Sketch ConditionItems:**

- Preview of the sketch that is linked to the condition item. The sketch is highlighted when it is selected in its appropriate canvas/snapshot.

“x-axis along the Ramp”: Primitive name linked to the sketch for the condition item.

- 🚧_unlocked?: Unlocked? This icon when highlighted will check if the sketch is unlocked. Only unlocked elements are visible to students.

- 🚧_not_unlocked?: Not unlocked? This icon when highlighted will check if the sketch is not unlocked.

- 🔴: Flagged? This icon when highlighted will check if the sketch flag property is true.

- 🔴_not_flagged?: Not Flagged? This icon when highlighted will check if the sketch flag property is set to false.
Primitive Condition Items:

- Color coded cog which represents the type of primitive. See the PrimitivePanel section for color explanations.

- "Conservation of Energy": This is the name of the primitive which is accessed for this condition.

- Unlocked? This icon when highlighted will check if the primitive is unlocked.

- Not unlocked? This icon when highlighted will check if the primitive is not unlocked.

- Flagged? This icon when highlighted will check if the primitive flag property is true.

- Not Flagged? This icon when highlighted will check if the primitive flag property is set to false.

Quantity Specific Conditions:

- Left: Value Unlocked? When highlighted, the condition will check if the value for the quantity as been unlocked. You may choose to unlock/lock the primitives and sketches but keep the value separately locked/unlocked. If the value is locked, it is not visible for the student.

- Right: Value Locked? (This icon will change)

Action Items:

Action items are always contained in DEFAULT/THEN/ELSE statements of actions. They are created via CTRL + DRAG/DROP from other elements of the coach. These CHANGE the student state of the coach. Only actions corresponding to the yellow highlighted icons will activate.
Module Action Items:

1. Lock Pict./Diag
2. Which object(s)?
3. Question(s)
4. 449 Plan

- Folder Module
- Question Module
- Action Module
- Plan Module

“192 Focus the Problem”: The module ID number and Module name linked (pointed) to the condition item. It is a sort of representation of the pointer for the module property.

“Next Module” When highlighted, the action will set the linked module as the next module to be accessed by the student. If it is a folder, it inserts itself into the logic tree and begins

“Force Stop” When highlighted, the action will set the linked module as not completed. This will force the student to stop at this module when it is reached in the logic, whether or not the module was completed previously.

“Reset” When highlighted, the action will erase or reset all answers and visible feedback in the module. It does not force the student to reanswer the question.

“Unlock” This icon when highlighted will set the unlocked property module to true or “unlocked”. This functionality is obsolete and scheduled for removal.
Lock. This icon when highlighted will set the unlocked property module to false or “locked”. This functionality is obsolete and scheduled for removal.

Flag. This icon when highlighted will set the flag property of the module to true.

Unflag. This icon when highlighted will set the flag property of the module to false.

**Sketch ActionItems**

- Preview of the sketch that is linked to the action item. The sketch is highlighted when it is selected in its appropriate canvas/snapshot.

“Earth”: The primitive name linked to the sketch for the action item.

Lock. When highlighted will set the unlocked property of the sketch to false or “locked”.

Unlock. When highlighted will set the unlocked property of the sketch to true or “unlocked”. Only unlocked elements are visible to students.

Flag. This icon when highlighted will check if the sketch flag property is true.

Unflag. This icon when highlighted will check if the sketch flag property is set to false.

**Primitive ActionItems**

- Color coded cog which represents the type of primitive. See the PrimitivePanel section for color explanations.
“Question”: This is the name of the primitive which is accessed for this action.

🔒: Lock Sketches. This icon when highlighted will set the unlocked property of most sketches associated with this primitive to be false or “Locked”. Only the input/response sketches are not locked with this action.

🔓: Unlock Sketches. This icon when highlighted will set the unlocked property of most sketches associated with this primitive to be true or “Unlocked”. Only the input/response sketches are not unlocked with this action.

🔒: Lock. This icon when highlighted will set the unlocked property of the primitive to be false or “Locked”.

🔓: Unlock. This icon when highlighted will set the unlocked property of the primitive to be true or “Unlocked”. Only unlocked elements of the coach are visible to students.

.Flagged? This icon when highlighted will check if the primitive flag property is true.

 Ngb: Not Flagged? This icon when highlighted will check if the primitive flag property is set to false.

**Quantity Primitive Action Items**

Left🔒: Lock Value. This icon when highlighted will set the unlocked property of the quantity value associated with this primitive to be false or “Locked”.

Left🔓: Unlock Value. This icon when highlighted will set the unlocked property of the quantity value associated with this primitive to be true or “Unlocked”.

Right🔒: Lock Sketches. This icon when highlighted will set the unlocked property of most sketches associated with this primitive to be false or “Locked”. Only the input/response sketches are not locked with this action.

Right🔓: Unlock Sketches. This icon when highlighted will set the unlocked property of most sketches associated with this primitive to be true or “Unlocked”. Only the input/response sketches are not unlocked with this action.

⭕: Set as Target. This icon when highlighted will set the quantity as a target. This is used primarily in the “What is the target” question. It is vitally important for use in the “Plan Module”.
Plan Primitive Action Items

🔗: Link with Plan. When highlighted, this action will link the stored student plan of the coach into the plan primitive so it can be displayed. The stored student plan is filled upon successful completion of a plan module.

❓: Remove from Plan. When highlighted, this action will remove the stored student plan in the plan primitive.

Picture Panel (Editing representations)
(Under construction)

Primitive Panel (Editing building blocks)

Primitive Filter and Definitions
Each cog in the primitive filter represents a specific type of primitive. When clicked, only that type of primitive will be displayed.

🔧: Approach. The approach represents the physical approach (Conservation of Energy, Kinematics, etc.) for the student. It is used as a choice filter and canvas/snapshot filter for coach creation.

🛠️: Assumption. The assumption class represents textual assumptions and question for the student. “Ignore Friction” and “What is the sliding distance?” are examples.

⚙️: Coordinate. The coordinate class represents the coordinate systems used in the problem.
Expression. The expression class represents mathematical equations/expressions used in the problem. These are created using quantities and quantity categories.

Object. The object class represents the physical objects of the problem. Examples: “Ramp”, “Electron”, “Earth”, “Boat”, etc.

Plan. The plan class is a primitive placeholder for the student plans of the solution. It is created with no information and only filled through “Plan ActionItems”.

Quantity. The quantity class is all physical quantities of the problem. It is used for all required known and unknown quantities. “Final velocity”, “Initial time”, “Gravitational Force” are examples.

Situation. The situation class is used for the physical situation of the problem as well as choice situations. Example of physical situation is “Just after the puck begins its motion”. Example of choice situations are “Determining Forces” or “Determining Initial Energy”. These are used as primary choice primitives for flags in the coach where module flags are not enough.

System. The system class represents combinations of Object Primitives as a physical system. “Puck + Earth” is one such example.

Add Primitive

+ This icon brings a list of primitive types that when selected, creates that type of primitive.

Building Blocks

The building blocks represent the already created primitives.

Duplicate. This icon when selected will create an exact copy of the primitive. It will not duplicate any sketches, conditions or action items.

Edit. This icon, when selected, will trigger a popup which will show possible editable properties of each primitive class. Most of these are easy such as primitive name and a text line. The more complicate popups are explained in this appendix.

Delete. When selected, the primitive, all associated sketches, responses, condition and action items are removed. WARNING: Please check to be sure this does not create logic holes in the coach before deleting. There are tools being developed to assist in this process. The first of which is the “Condition Item List” button in the primitive popups.
**Primitive Popups**
This is a summary of the popups for the most intricate primitives.

**Expression Popup**

“Expression Display”: The display is self explanatory. The “Edit” button allows the instructor to edit and change the placeholder variable for quantity categories. The “Delete” button removes the selected element from the expression.

“Operators and Numbers”: This contains the list of operators. Here, the operators all have internal functionality for the operation.

“Constants”: The constants of the problem. There is an ability to add more constants by instructors (non-trivially).

“Quantities”: The dynamically created list of quantities in the problem.

“Quantity Categories”: The categories of the problem which can be used to generate general placeholder variables in the expression.

“Non-calculable Operators”: If you scroll down in this list, there is a list of non-calculable operators (integrals, greater than, vector products) that are also available. More operators can be added to the problem into this list by instructors (non-trivially).
“Sketch types”: When a representation is created using CTRL+DRAG/DROP from the primitive list into a canvas/snapshot, the type of sketch created is based on which of these type icons are selected. Therefore you must select the representation type BEFORE creating it.

🔗: Object sketch. When selected, a pictoral will be created to represent the object which can be scaled and rotated as desired.

🔗🔗: Dot Sketch. When selected, a simple dot will be created to represent the object.

“Available Pictures”: This box contains a list of available for the object. Currently, it is non-trivial to add additional images to the list, but the software does not need to be recompiled to add images.
“Quantity Category”: This list contains the available quantity categories for the quantity. The Green Plus allows you to add more quantity categories as well as accesses the units/categories interface to add more units.

“Color selector and Type”: When a representation is created using CTRL+DRAG/DROP from the primitive list into a canvas/snapshot for quantity, the type of sketch and color created is based on which of these type icons and color are selected. Select the representation type BEFORE creating it.

Left ⬇️: Arrow. Creates a vector like arrow with a label.

❌: IntoVector. Creates an “arrow fletch” representation for an into the plane vector.

⊙: OutVector. Creates a “arrow tip” representation for an out of plane vector.

🔗: Bracket. Creates a line with bracketed ends which cooresponds to a distance between to points.

Left ⬇️: Label. Creates a simple variable label in the canvas/snapshot.

Right ⬆️: Label + Value. Creates a simple variable = value units sketch. If the value is locked, it only displays the variable. If the value is unknown, it displays ?? for the unknown value.

Right ⬆️: Arc. Creates a quadratic arc + variable. This can be used for angles (double angle problems) or trajectories in the problem.
“Variable, value and Units”. In this section the variable, superscript and subscript are edited. Also the value and value type (direct, scientific, unknown, and infinite) are edited here. The Min=Max? button when selected forces both the min and max value to be the same. Quantities may have value ranges associated with them. When editing the value, hit “Assign Value” to store the value into the quantity. Reset Value is there in case there are string/number errors which occur when assigning a value.
Appendix B: List of Known Bugs

The current version 2 is in the beta stage. There are various bugs in the program that are known and are being addressed but could not be finished before this workshop. These bugs prevent the user from using some of the advanced features of the program but do not restrict regular usage and testing. Most of the bugs have ways to bypass the errors.

1. Visual bugs
   a. The feedback box size at times does not display all of the feedback. Resize your interface to fully see the feedback.
   b. Textboxes clip size in different browsers/OS due to font issues.
   c. The axis labels on coordinate systems become mixed when displayed.
   d. Expression visual spacing is not quite accurate.
   e. When creating a new leaf/node from a node answers, the new question group does not display immediately when created. To see the newly created group, you need to deselect your node responses then reselect the correct combination again after creation.

2. Operational bugs for Student view
   a. Pictures and Diagrams do not always automatically display when appropriate for the given template. This is fixed through editing a coach as instructor.
   b. The navigator does not update properly for the folder that you are currently solving. This makes the navigator not as useful as desired.

3. Operational bugs in the Instructor editing perspective
   a. When CTRL+dragging a module to create a module action item, sometimes (very infrequent, not repeatable) the modules will disappear. This is due to a known moving module bug. Be careful when moving modules.
   b. When dragging modules around to change the tree order, sometimes (again very infrequent, not repeatable), the modules will disappear. This is due to a known moving module bug. Again, be careful when moving modules.

There are other small bugs either in the program or in the created template which are not listed. Most of the bugs from the created template are fixable by utilizing existing tools through a series of edits. The remaining bugs are being addressed by our “programmer” (Post-Doc).