The TuTalk Authoring Interface

1.1 What is TuTalk?

The focus of our proposed work is to provide an infrastructure that will allow learning researchers to study dialogue in new ways and for educational technology researchers to quickly build dialogue based help systems for their tutoring systems. Most tutorial dialogue systems that to date have undergone successful evaluations (CIRCSIM, AutoTutor, WHY-Atlas, the Geometry Explanation Tutor) represent development efforts of many man-years.

These systems were instrumental in pushing the technology forward and in proving that tutorial dialogue systems are feasible and useful in realistic educational contexts, although not always provably better on a pedagogical level than the more challenging alternatives to which they have been compared.

We are now entering a new phase in which we as a research community must not only continue to improve the effectiveness of basic tutorial dialogue technology but also provide tools that support investigating the effective use of dialogue as a learning intervention as well as application of tutorial dialogue systems by those who are not dialogue system researchers.

We propose to develop a community resource to address all three of these problems on a grand scale, building upon our prior work developing both basic dialogue technology and tools for rapid development of running dialogue systems.

1.2 Example Applications

TuTalk can be used to create tutor-student dialogues that can assist the student in learning a concept in a subject, by creating a dialogue where in the tutor poses questions or makes a statement to teach the concept better to the student who may respond accordingly.

The following is an example of a dialogue between the tutor and the student, created to explain the concept of the ideal gas law.
In order to create the dialogue, it is advisable to follow the following procedure:

**Create a paragraph** that includes within it, all the concepts that you as a tutor would wish to convey to the student. For this it is advisable to use real life examples to explain the concept.

Based upon the paragraph, **map out the student-tutor dialogue** with the tutor questions/statements and the expected student responses.

For the example that we created,

The following was the paragraph listing what the tutor wished to convey:

“Let us consider a hot air balloon with the air within it, being heated up by the burners. We know of the implication of increasing temperature upon the volume of an object while the pressure is kept constant. The Volume would increase. This is based upon the ideal gas law that states “The state of an amount of gas is determined by its pressure(P), volume(V), and temperature(T)” and may be represented by PV=NRT.

Thus when the temperature within the balloon would increase, the volume would increase as well since the pressure is primarily constant, and this would lead to the balloon expanding.

Based on the same principle if we consider the effect of increased temperature on a closed container. Since the container is a closed one, the volume of the same remains constant. Thus an increase in temperature would result in an increase of the pressure of the gas within it.”

The **final dialogue** might look like this:

(NOTE : ‘Jenny’ is the default name of the student)

Tutor: Hi! Welcome to this chemistry lesson! Let us consider a hot air balloon with the air within it being heated up by burners. Would this lead to an increase or decrease in the volume of the Balloon?

jenny: decrease
Tutor: No, it will increase. If that were true, then would hot air popcorn popping machines work correctly?

jenny: no

Tutor: That's right. To elucidate further, as the temperature inside the popcorn making machine is increased, the volume of the popcorn increases (Since the temperature is constant). This would lead to the popcorn popping out. The underlying principle behind the above phenomenon is the ideal gas law. Have you heard of it before?

jenny: yes

Tutor: Good. To elaborate it states ‘The state of an amount of gas is determined by its pressure (P), volume (V), and temperature (T)’ Thus when the temperature within the balloon would increase, the volume would increase as well since the pressure is primarily constant, and this would lead to the balloon expanding. Now consider the effect of increased temperature on the gas in a closed container. Would that lead to an increase or decrease in the pressure of the container?

jenny: increase

Tutor: That is correct. Since the container is a closed one, the volume of the same remains constant. Thus an increase in temperature would result in an increase of the pressure of the gas within it. This session is now finished. I have logged you out..

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The following was the mapped out tutor-student dialogue:

Tutor : <Greeting>

Tutor (T) : Let us consider a hot air balloon with the air within it being heated up by burners. Would this lead to an increase or decrease in the volume of the Balloon?

Student (S) : Options : Increase, Decrease, Anything Else

If increase → Tutor says “That’s correct”

If decrease → Tutor says “No, The Volume would increase”

As a sub goal to the response ‘decrease’ by the student,

Tutor: “If that were true, then would hot air popcorn popping machines work correctly?”

Student : Yes, No, Anything Else

If yes → Tutor says “No they wouldn’t. See, as the temperature inside the popcorn making machine is increased, the volume of the popcorn increases (Since the temperature is constant). This would lead to the popcorn popping out. However, according to what you said, the volume would not increase, but decrease and by that logic the popcorn would not pop out and the machine would not work.”

If no → Tutor says “That's right. To elucidate further, as the temperature inside the popcorn making machine is increased, the volume of the popcorn increases (Since the temperature is constant). This would lead to the popcorn popping out.”

If Anything Else → Tutor says “Let me explain this. As the temperature inside the popcorn making machine is increased, the volume of the popcorn increases (Since the temperature is constant). This would lead to the popcorn popping out.”
T: The underlying principle behind the above phenomenon is the ideal gas law. Have you heard of it before?

S: Answer options: Yes, No, Anything else

If yes → Tutor says “Good. To elaborate it states ‘The state of an amount of gas is determined by its pressure (P), volume (V), and temperature (T)’ “

If No → Tutor says “The ideal gas law states ‘The state of an amount of gas is determined by its pressure (P), volume (V), and temperature (T)’ “.

T: Thus when the temperature within the balloon would increase, the volume would increase as well since the pressure is primarily constant, and this would lead to the balloon expanding.

T: Now consider the effect of increased temperature on the gas in a closed container. Would that lead to an increase or decrease in the pressure of the container?

S: Answer options: Increase, decrease, Anything else.

If increase → Tutor says “That is correct. Since the container is a closed one, the volume of the same remains constant. Thus an increase in temperature would result in an increase of the pressure of the gas within it.”

If decrease → Tutor says “That is not correct. The pressure would increase. Since the container is a closed one, the volume of the same remains constant. Thus an increase in temperature would result in an increase of the pressure of the gas within it.”
1.3 Installing and Running TuTalk

1. Download **TuTalk.zip** from [http://www.cs.cmu.edu/~emayfiel/TuTalk.zip](http://www.cs.cmu.edu/~emayfiel/TuTalk.zip) and extract the TuTalk folder to somewhere nice.

   *Windows*: Skip to step 6.
   *Mac OS X and otherwise*: continue below.

2. The database included with TuTalk is Windows-specific, so we'll have to install one of our own.

   Download MySQL from [http://dev.mysql.com/downloads/mysql/5.0.html](http://dev.mysql.com/downloads/mysql/5.0.html)
   *Mac OS X*: Get the **DMG** with the installer package, not the TAR archive.

3. Install MySQL.

   *Mac OS X*:
   Open the DMG and double-click the installer package
   (it has a name like **mysql-5.5.13-osx10.6-x86.pkg**)
   Continue through the installer dialog.
   Install **MySQL.prefpane** from the DMG as well - once it's installed, the preference pane will open in System Preferences.
   Click the *Start MySQL Server* button to start the MySQL server.

4. Open a Terminal window and move to the MySQL directory:

   ```bash
   cd /usr/local/mysql/
   ```

5. In the Terminal, enter the commands below:

   ```bash
   bin/mysqladmin -u root password NEWPASSWORD
   bin/mysqladmin -u root -p create tutalkdatabase
   bin/mysql -u root -p tutalkdatabase < /path/to/TuTalk/MySQL/bin/tutalkdb.sql
   ```

   In the first command, replace **NEWPASSWORD** with a new password
   This will be the root password for MySQL – after the second and third commands, you'll be prompted to enter this password.
In the last command, replace /path/to/TuTalk/ with the path to your TuTalk folder (e.g. ~/Desktop/TuTalk/MySQL/bin/tutalkdb.sql)

6. Configure TuTalk to talk to MySQL.

   Windows:
   In the MySQL folder within your TuTalkFolder, edit “my.ini” so the “basedir” and “datadir” entries to reflect the location of your TuTalk folder. Save the file and close it.

   Mac OS X:
   Edit the file "password.txt". After "root", replace "mysqlycui" with your MySQL root password from step 5. Save the file and close it.

7. If you have another installed version of MySQL running, stop it.
   Windows: Control Panel > Administrative Tools > Services > MySQL > Stop

8. If MySQL is not already running, start it.
   Windows: double-click "StartMySQL.bat" in your TuTalk folder. 
   Mac OS X: in System Preferences, select the MySQL preference pane and click the "Start MySQL Server" button.

9. From your TuTalk folder, launch the TuTalk Authoring Interface by double-clicking "TuTalkGUI.jar"

10. Create excellent tutors.

11. When you're done using TuTalk, stop the MySQL server.
   Windows: double-click "StopMySQL.bat" in your TuTalk folder. 
   Mac OS X: in System Preferences, select the MySQL preference pane and click the "Stop MySQL Server" button.

Feel free to email David Adamson (dadamson@cs.cmu.edu) if you have questions about installing and running TuTalk.
1.4 Basic Instructions

Looking at the view of the TuTalk GUI that you get when you first start it up will help you think about the process of authoring a dialogue. You’ll see that there are three tabs on the tabbed interface, namely the Author panel, the Preview panel, and the Test Dialogue panel. In line with this, the typical authoring process consists of building a representation of how your authored dialogue will operate, possibly checking that flow on the Preview panel and then running it so that you can actually interact with the running dialogue that results on the Test Dialogue panel.

Here we will step through the process of doing the authoring. As you interact with the TuTalk GUI, the result of your authoring actions will be written to a file referred to as a Script. So to start the process off, you have to open a new script file.

Step 1: Start a new script
To start a new script file, click on the Author menu as you see displayed in Figure 2. Then select New Script File.

You can think of Script Files as being sort of like File Folders where you might keep notes for teaching one lesson. Within that folder, you will keep several sheets of paper, which each contain instructions for teaching one main idea that is part of that lesson, keeping in mind that all of the ideas that are part of a lesson fit together somehow.

Some of those ideas will consist of multiple smaller “sub-ideas”. And other sheets of paper within the folder may expand a single one of those smaller ideas into an even more fine-grained break down of smaller ideas. We will refer to those sheets of paper as Templates.

And we'll refer to the name of the main idea that the template specifies how to teach as the goal name. Note that there may be multiple templates with the same goal name within the same script file because often there is more than one way to teach an idea.
Step 2: Start a new template

![New Template window](image)

After you have started a script file, you will start to fill it with templates, recalling that each template is like a sheet of paper in your script file, which is like a file folder. Once you have completed step 1 above to create a new script file, a window named “New Template” will automatically appear, as you see in Figure 3.

Click the button labeled “New” next to the pulldown menu under “Please select goal name:”. You should name this initial goal “start”, ensuring that you have used a lowercase s in order to avoid runtime errors later.

Thus, the template that specifies how to satisfy the start goal, which represents the lesson corresponding to the script file you just created, is the first one you will start to construct.

![Beginning to add content to a Template](image)
After you click OK, a new New Template window will appear, as displayed in Figure 4.

Each template is composed of a series of steps. You could think of these as steps in a process that are required to achieve a goal. For example, if you were ordering in a restaurant, you might first order an entrée, then specify side dishes, and finally order your drink.

You’ll see three options listed in Figure 4, but mainly two of them will be relevant for these simple instructions, namely Insert Sentence and Insert Step/Pair.

Insert Sentence is used when a step in the process can be accomplished just by outputting some text, where no student response is required. Insert Step/Pair is used when the tutor will utter something that has a response associated with it. We will begin with the Insert Step/Pair option.

**Step 3: Insert an Initiation/Response Pair**

In the New Template window displayed in Figure 4, select Insert Step/Pair and click OK. Then the interface displayed in Figure 5 will appear. This is the interface for specifying the series of steps contained within the corresponding template. Note that the template has been initialized with a single Initiation/Response pair. You can type text into the initiation and response boxes.
The initiation is the tutor’s turn and the response is the student’s turn. Note that several possible responses can be associated with a single initiation. This is desirable since a student may respond in many different ways. For example, if the tutor asks whether the student has heard of a concept before, the student may respond with “yes”, “no”, or any of a range of unexpected ways, such as “my tooth hurts!”. Each of these responses can be associated with a different tutor reaction. We’ll describe how to author the tutor’s reaction in Step 7.

**Step 4: Creating a Concept**

For any response, there may be multiple ways the student may express the same idea. Furthermore, there may be subsequent tutor initiations that may be similar in terms of the range of expected responses. Because of this, an additional layer of representation referred to as a Concept is introduced here. If the range of ways of expressing an idea is represented with a Concept, then in subsequent Initiation/Response pairs the same Concept can be reused.

A concept is an idea that a student or tutor might express. A Concept is defined as a list of phrases, each of which is a way of expressing a concept. Phrases can be expressed in a very “sketchy” way. For responses, they are used as patterns that match against what students type.

So it’s good to keep them somewhat underspecified. For example, if you think a student might say something like “My toe is really big”, and you want to distinguish that from when students say “My toe is really small”, then maybe you really only have to use a concept for Big and a concept for Small to distinguish between these two responses.

Or, if you want to distinguish between when students say their toe is big from places where students say their fingers are too small, you could have a toe-big concept where phrases would include “big toe” and “toe big” and a finger-small concept where the phrases might be “finger small” and “small finger”. “toe big” will match against “My toe is big” or even “My toes are big”. Expressing concepts with general patterns is more efficient that listing many very specific phrasings that differ in irrelevant ways.

In order to make concepts as reusable as possible, the set of phrases associated with a concept should all mean the same thing in addition to being responses that the tutor
would treat the same way in terms of deciding how to respond. So for example, if the
tutor asks “Do you know what 2 + 2 is?”, two different expected responses might be
ways of saying “4” and ways of saying “yes”. Since these don’t mean the same thing,
there should be two different concepts, one for each of these types of responses. But
you may author the response associated with each concept the same way so that the
behavior of the tutor in response to either of these ideas can be the same.

For both the initiation and each response, you need to fill in a concept. If you simply
type text into the text box, a corresponding concept with a meaningless name like
“Concept-54” will be created. A better way of filling in a concept is to use the menu
options you can get to by right clicking near “Select Concept”, which is to the right of
the Initiation and each response in Figure 5. You’ll see three options, namely, Pick
Concept, Remove Concept, and New Concept. If you want to reuse a previously defined
concept, you can select Pick Concept, which will then lead you to a set of menu options
including all previously defined concepts. Remove Concept will take a previously
selected or created concept off the current initiation or response, but note that it will not
delete it. To actually delete a created concept from the script file, see Step 6 below.
Select New Concept in order to create a new concept.
After you have selected New Concept from the menu, the interface appearing in Figure 7 will appear. Here you can enter the name of the concept and one representative phrasing. Since this is the phrase that will show up on the interface, it’s a good idea to pick something that will remind you of the full meaning of the concept since some of your phrasings will be more sketchy. Note that the Concept Name should not contain any spaces or characters other than letters, numbers, dashes, or underscore characters.

Once you have created a concept, you can elaborate its definition by adding additional phrasings. You start this process by right clicking in the text box corresponding to the concept. You can see the resulting menu in Figure 8. If you select Expand, you can see all the alternative phrasings currently in the Concept. If you select Colapse, you can
retract that list of alternative phrasings so that only the initial one is showing. To add a new phrasing, select Add Phrase.

When you click in one of the alternative phrasing text boxes, you’ll get a slightly different menu than when you click in the main text box associated with the concept, as you see in Figure 9. You’ll see three options, namely Add, Edit, and Delete. Add is for adding an additional phrasing. Edit allows you to modify a phrasing that is already in the list. And delete is used to remove an alternative phrasing from the list. You won’t be able to remove the initial one.

The process of creating a concept that represents the tutor’s initiation is the same as for creating a concept for a response. Note that as mentioned above you may have multiple response concepts for a single initiation, and a template may have many such initiation/response pairs. So the next step is to elaborate the template definition in this way.

**Step 5: Elaborating the Template**
On the left of the template authoring panel is a bank of buttons that allow you to either add or delete responses in the current Initiation/Response pair or add or delete subsequent Initiation/Response pairs, displayed in Figure 10.

This button can be used to add another step, or in other words, another tutor-student initiation-response pair.

This button can be used to delete a step. For doing that, check the step(s) that need(s) to be deleted and then click on this button.

This button can be used to add another response that could be expected by a student. Example: We've created a response for an affirmative answer, we could create a new response for any answer that would indicate a 'no' from the student.

This button can be used to delete a response. For doing that, check the response(s) that need(s) to be deleted and then click on this button.

Figure 10 Buttons for elaborating the template
In the same template, you may include additional Initiation/response pairs. You add these using the Add Step button, and can subsequently remove one by clicking on the Delete step button closest to it. For the current template, for example, you may follow the initiation/response pair in Figure 11 with the one in Figure 12. For each initiation/response pairs you will create concepts as specified in Step 4. Note that in the initiation/response pair in Figure 12, the concepts defined for the initiation/response pair in Figure 11 have been reused by selecting the Pick Concept option after right clicking near the Select Concept label to the right of the corresponding text box.

**Step 6: Managing Concepts with the Concept Manager**

If you want to modify or delete a previously created concept, or even create a new one, you can do so at any time using the Concept Manager. From there, you can also take inventory of all of the concepts you have created up until that point. You can get to the Concept Manager from the same Author Menu you used to start the authoring process. This time select Concept Manager as you see in Figure 13.
Figure 13 Navigating to the Concept Manager through the Author menu.

Figure 14 The Concept Manager

Figure 14 displays the Concept Manager interface. If you want to create a new concept, click on the New Concept button. Any operation you want to perform on an existing concept will be done by first selecting that concept from the menu you see on the left
side of the Concept Manager. If you want to then change the name of the selected concept, you can click on the Rename Concept button. To delete the selected concept, click on Delete Concept. Once a concept is selected, you will see the phrases associated with that concept to the right. You can edit that list using the Add Phrase, Edit Phrase, and Delete Phrase buttons. To close the Concept Manager, click on the Close button.

**Step 7: Authoring the Tutor’s Reaction to a Response**

Frequently if a student offers the expected response to a tutor’s initiation, no response will be authored. Instead, the dialogue will just proceed to the next step. However, if a specific response is desired, there are two main responses that can be offered before the dialogue proceeds on to the next step. The first of those is a very simple response consisting just of a simple text. That is referred to as a Say. To include that sort of response, right click near Select Goals near the associated response as you see in Figure 15, and select Add Say. After you do that, a text box will appear where you can type in the text you would want the tutor to say.

![Figure 15 Adding a "Say" reaction associated with a response.](image)

If a more elaborate reaction is desired, consisting of one or more initiation/response pairs, then instead of Selecting Add Say, you should select New Goal to create a goal associated with a new reaction you would like to author. Alternatively, if there is
already one authored, you could select a goal using Pick Goal from a list of goals that already have templates authored for them.

If you choose to create a new goal, then you will have the option of either putting the current template on hold so you can go ahead and author a template corresponding to the new goal, or you can wait. The interface displayed in Figure 17 will appear after you have selected New Goal, as you see in Figure 16.

![Figure 16: Selecting New Goal so that a new template can then be authored.](image)

If you choose to go ahead and author the subdialogue now (by clicking ‘Yes’ above), you will then be creating a new template, just as you began doing in Step 2, and thus you will end up triggering the same interface as was displayed above in Figure 4. From
there, the process is the same as what we have just covered for Steps 2 through the current one, except that you will be authoring a template associated with a response to one of the steps in the template you had been authoring. In this way you can author and navigate the hierarchical structure of the dialogue script.

If you choose to not go ahead and author the subdialogue now (By clicking ‘No’ above), you will remain in the same tutor page as before. The goal will be created, but the template for the goal will not be defined until you go to the goal (By clicking on ‘Go’ beside the goal name) and select ‘New template’ from the ‘Author’ tab. Now you will end up triggering the same interface as was displayed above in Figure 4. From there, the process is the same as what we have just covered for Steps 2 through the current one, except that you will be authoring a template associated with a response to one of the steps in the template you had been authoring. In this way you can author and navigate the hierarchical structure of the dialogue script.

As you are authoring the hierarchical structure of the script file, it will often be necessary to navigate from one template to another one that is triggered by a response to one of the initiations in that template. And once there, it will eventually be necessary to navigate back. This is accomplished in TuTalk with a browser-like interaction. Clicking on the Go button next to a response will take you to a template authored for the associated sub-goal.

There is also the advised option of creating multiple templates for a single sub-goal. This can be achieved by clicking on Author > New Template.
This creates an alternate template that may be accessed by the user when (s)he accesses the sub-goal through a certain response.

It may be useful to have multiple templates for a number of reasons:

a) It’s possible to generate a wider variety of dialogues. In some cases, a student may go through a dialogue more than once - especially for foreign language classes where a student might be practicing having a conversation in a particular scenario, or for another type of course where the same issue may come up multiple times, maybe over multiple sessions related to the same general topic. So then the dialogue does not seem like just a repeat.

b) Moreover, if there's more variation in the responses that the student gets from the tutor in this way, it also makes the agent seem more realistic.

c) Another possible use for alternate templates is that it allows the agent to try to teach the same idea in multiple ways, in case the first way does not help the student much, maybe approaching the same idea from a different direction would work.
Once in the sub-goal window, you can navigate back using the Back button as displayed in figure 18. If you choose to create the sub dialogue when you select New Goal, and then navigate back after having completed that, you will see something like Figure 19, which shows a goal associated with the decrease response.

Figure 19  In this interface we see the Back Button, which is used to navigate back to the template you were authoring when you clicked Go to get to the current template.
Figure 18 An initiation/response pair where one response is associated with a subgoal, specifically the decrease response is associated with the subgoal alternate.

**Step 8: Previewing an Authored Dialogue**

Figure 19 The Preview panel can be used to examine different paths through the authored dialogue script.

Figure 20 displays the Preview panel, which can be used to review what you have authored so far without having to compile first. It can be faster to get a sense for how the dialogue flows this way because you can manipulate what responses are triggered at different choice points without starting the dialogue all over again. On the left you can see a representation of the whole script, including all of the choice points. At each
choice point, a single choice has been made. By default, the first response associated with every initiation is selected. But you can change that by double clicking on a different response. The dialogue displayed at the right will show how the dialogue will flow given all of the choices that are selected in the representation of the script at the left.

**Step 9: Compiling and Testing a Dialogue**

Testing frequently throughout the authoring process is a good practice, especially when you are a new author since sometimes it is difficult to keep the flow of the dialogue you have authored in your head. The first thing to do when you want to test the running dialogue is to compile the script into XML. You will do this by going to the Author menu and selecting Compile and Test -> From GUI as displayed in Figure 21.

![Figure 20](image)

In order to run your authored script, first select Compile and Test -> From GUI from the Author menu.

After you have started the compile from GUI process, you will see the interface displayed in Figure 22, which shows the XML representation for your script.
Once the XML representation of the script is showing, as in figure 22, click on Test to bring up the test interface you see in Figure 23. You can then interact with the running dialogue by typing into the text input box at the bottom of the interface. That text box is displayed in grey in Figure 23.
Figure 22 The interface for interacting with the running, authored dialogue scripts.

Notes:

a) Whenever a response box is open and the tutor saved, a corresponding concept is attached to the response, even if it may be empty (No text). To avoid this, check the response box, if you don’t intend to use it, and click delete box before saving the tutor. If the tutor has already been saved and the extraneous concepts created, the concepts can be deleted from the concept manager.

b) Avoid using spaces while naming a starting goal, subgoal or concept (The underscore ‘_’ may be used instead).

c) Try avoiding the usage of the word ‘Start’ (With a capital ‘S’ ) as the name of the starting goal of your tutor to avoid a run time error.