

Task Tutor Toolkit

Rapid Development of Intelligent Tutoring Scenarios

Create Intelligent Tutors Easily

The Task Tutor Toolkit™ (T³) is a set of Java software libraries and applications that lets you create *intelligent tutoring system* scenarios quickly and easily, without programming. Scenario-based tutoring systems provide the benefits of one-on-one coaching, automatically and cost-effectively, by:

- Presenting the situation and goals to the student at the beginning of each scenario,
- Monitoring and evaluating the student's actions carried out within a simulator,
- Assessing the student's knowledge and skills by detecting correct and incorrect sequences of actions and simulation states, and
- Providing hints and instructional feedback based on the student's performance.

The Task Tutor Toolkit is designed to teach subject areas in which it is possible to specify a *solution template* that specifies the possible actions that should be carried out during each scenario. Solution templates organize actions hierarchically in groups and subgroups and specify the ordering constraints that apply to each group. For example, students may need to carry out actions in one group in a certain order, and they may be permitted to carry out actions in another group in any order. In addition, the solution template can specify alternate groups of acceptable student actions. For example, if there are two different ways of carrying out a particular task, two groups of actions could each represent a correct sequence of actions for carrying out the task.

The Task Tutor Toolkit teaches more than just rote memorization or mechanical skills. Tutoring scenarios enable students to practice and demonstrate their ability to *apply* their knowledge and skills, by:

- Assessing realistic, complex situations (common and exceptional),
- Identifying relevant facts, procedures, guidelines, and strategies, and
- Selecting and carrying out appropriate actions to achieve desired results.

The Task Tutor Toolkit's application programming interface lets you integrate the Toolkit with application-specific simulators to support diverse training areas. The Task Tutor Toolkit's built-in discrete event simulation engine and user interface lets you prototype simulations quickly and easily, by specifying possible student actions and optional simulation rules that specify how the simulated world responds to each action or to the passage of time.

Evaluate Student Actions

The T3 Tutoring System is a software module that interfaces with diverse simulators to create application-specific tutoring systems that run T3 scenarios. At the beginning of each T3 scenario run, the T3 Tutoring System presents a briefing that describes the situation and the goals the student should pursue. Each T3 Scenario contains a solution template that specifies a partially-ordered sequence of action patterns that match correct sequences of student actions. During each scenario, the simulator notifies the T3 Tutoring System of each student action and sends updated values of the simulation's state variables. The T3 Tutoring System evaluates each student action by comparing it with the scenario's solution template and with error rules that detect incorrect actions. After each action taken by the student, the Tutoring System displays whether the student's action was:

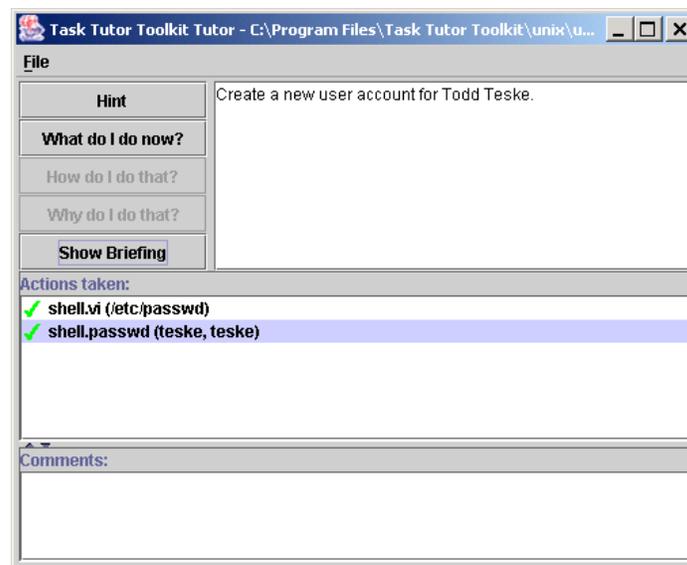
- **Expected** - The student's action is correct because it matches an action pattern in the solution template, and the student has already carried out all prerequisite actions that should precede this action.

- **Acceptable** - The student's action matches an action pattern in the solution template, and the student has already carried out all prerequisite actions that should precede this action. However, the solution template specified a preferred ordering among steps within a group, and the student's action does not match this ordering.
- **Unexpected** - the action does not match any action pattern in the procedure template, or the action has already been carried out, or not all pre-requisite steps have been carried out. When a student carries out an unexpected action, that action may change the state of the simulated world in a way that invalidates the template's expectations for appropriate next steps.
- **Continuable** - The action is unexpected but benign, so the action did not change the state of the simulated world in a way that invalidated the solution template's expectations. The student can proceed with the scenario, and the tutor can continue to rely on the solution template to correctly evaluate subsequent actions.

Request Hints

Students can request hints and ask questions by pressing buttons in the T3 Tutoring System window:

- **Give me a hint** – The Tutoring System displays a short hint that helps the student identify an appropriate next action to take.
- **What do I do?** - The Tutoring System recommends an appropriate action.
- **How do I do that?** -- The Tutoring System describes how the student should carry out the recommended action using the simulator.
- **Why do I do that?** -- The T3 Tutoring System explains why the recommended action should be taken. This explanation may be scenario-specific, or it may describe general principles associated with the recommended action.

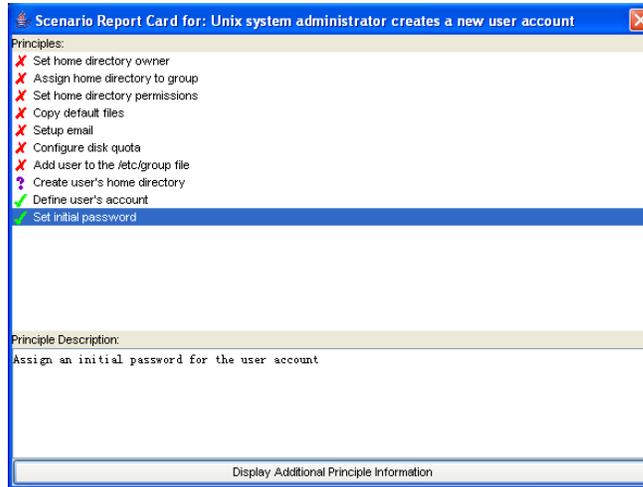


Students press buttons in the left part of the window to ask for hints. Replies are displayed in the upper right pane. The middle area lists each action taken by the student. Green check marks show that both actions carried out so far were correct. The Comments section displays general principles or scenario-specific reasons that explain why the selected action was appropriate.

Report Mastery of Principles

The author of each scenario can associate principles with each action or group of actions in the solution template. When the student carries out a correct action specified by the solution template, the T3 Tutoring System gives credit to the student for applying the principles linked to the action. For example, suppose there is a principle that one should connect cables to electrical equipment only when the power has been turned off (i.e., the value of simulation state variable "power" = "off".) If the student turns the power off before connecting the cable, the T3 Tutoring System gives the student credit for demonstrating this principle.

At the end of each scenario, the Tutoring System displays a Report Card that lists the principles the student successfully demonstrated and the principles the student failed to demonstrate. These passed and failed principles can be sent to a learning management system to record the student's performance, knowledge, and skills.

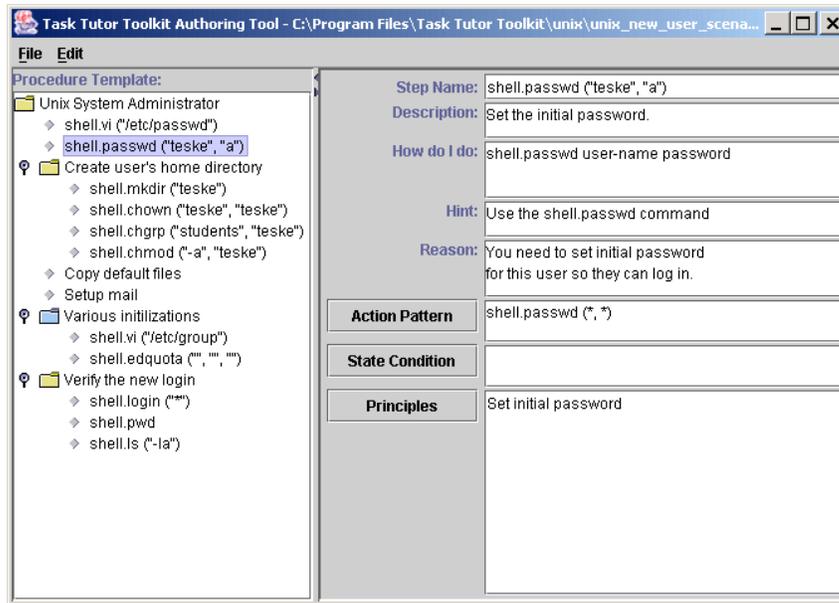


Report Cards display principles passed, passed with help, and failed by the student during the scenario. The Principle Description provides details about the principle selected at the top of the window.

Author Scenarios

To create an application-specific authoring tool, you interface the T3 Authoring Tool module with the simulator. Instructors and subject matter experts (scenario authors) create new T3 scenarios by using the simulator to **demonstrate** a correct sequence of actions for the scenario. The T3 Authoring Tool records these actions to create an initial solution template. Scenario authors then use the T3 Authoring Tool to:

- **Generalize** this solution template so that it accepts other valid sequences of actions. For example, the author could specify that the actions in a group of actions can be carried out in any order.
- **Specify conditions** on simulation state variable values that must be satisfied in order for an action to be correct. For example, instructor could specify that an action should be carried out only when the simulation variable named "temperature" ≥ 500 .
- **Annotate** the solution template by linking principles with actions or groups of actions. These links let the T3 tutoring system identify principles the student appears to know when the student carries out the action or group of actions.

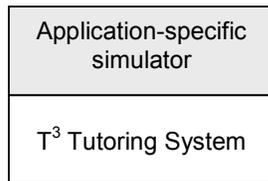


This T3 Authoring Tool window lets authors display and edit tutoring scenarios. The left pane shows actions and groups of actions that make up the scenario's solution template. The right pane lets authors edit the attributes of the selected action or group of actions.

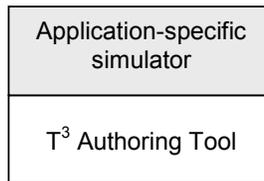
The author can also specify error rules that detect failed principles by noticing student actions that are incorrect when certain simulation conditions exist. For example, an error rule might check if the student connects a cable when the value of simulation variable "power" is "on". If this error rule fires, the tutoring system can infer that the student failed the principle that one should turn the power off before connecting cables.

Integrate with Diverse Simulators

The T3 Tutoring System module and T3 Authoring Tool module are implemented as Java class libraries that can be interfaced with your simulator and embedded within Java applets or applications to create application-specific authoring tools and tutoring systems, as shown below:



Application-specific tutoring system

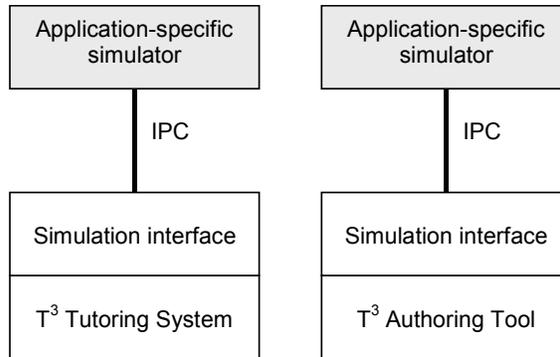


Application-specific authoring tool

An application specific simulator, implemented as a Java applet or application, calls Java methods defined by the T3 Tutoring System and T3 Authoring Tool APIs.

For example, you can integrate the Task Tutor Toolkit with simulations and other interactive learning environments created by using the SimVentive™ toolkit (www.simventive.com).

If your simulator is implemented in a language other than Java, such as C or C++, or if your simulator sends action and state updates but cannot be instrumented with calls to the Task Tutor Toolkit APIs, you can integrate your simulator with the T3 modules by creating a simulation interface that interfaces your simulator with the T3 modules.



A simulator can send notifications of user actions and simulation state to a simulation interface via inter-process communication (IPC). The simulation interface, in turn, calls Java methods provided by the Task Tutor Toolkit API.

Prototype Simulators

The Task Tutor Toolkit provides built-in tutoring system and authoring tool applications that integrate a discrete event simulation engine and user interface with the T3 Authoring Tool and T3 Tutoring System. These applications provide a generic user interface for prototyping simple simulations rapidly. You can configure the generic simulation user interface without programming by:

- specifying possible user actions and their parameters, and
- creating simulation rules that specify how the state of the simulation and the appearance of the user interface changes in response to user actions and the passage of simulated time.