

An Intelligent Tutoring System for Source Code Comprehension

This interactive demo will show a first prototype of an intelligent tutoring system developed by the ongoing project CSEdPad, funded by the National Science Foundation. The CSEdPad project aims at developing an effective and engaging instructional intervention to improve comprehension and learning in introductory Computer Science courses at the college level, to reduce attrition rates and increase retention, and to ultimately produce more and better-trained graduates. The result will be a win-win-win situation for aspiring students, CS programs and their organizations, and the overall economy.

Understanding source code is a critical skill for both learners and software developers. Learners spend a significant amount of time looking at code examples, e.g., given by an instructor or in a textbook. Similarly, software developers spend a significant portion of their time looking at someone else's code, e.g., code written by a teammate.

One working hypothesis of our project is that instructional strategies such as eliciting self-explanations will result in mental models that are more accurate, which in turn will positively impact learning, self-efficacy, and retention. The positive role of self-explanations is well documented for science learning but less so for learning computer programming.

In this demo, we will show a first prototype of the system – see the snapshot below. Students are given one code example at a time and asked to self-explain what it does. Furthermore, students are prompted to trace the execution of targeted parts of the code, e.g., parts that introduce new concepts that have not been covered by previous code examples, or parts of the code related to concepts that students have not shown yet mastery. When entering values for various variables in the trace table they will be prompted to explain their reasoning. If a major misconception is detected it is promptly corrected. Students are then given an hint and given another chance to infer the correct value for the target variable. The goal is to help students understand code examples and learning programming through instructional strategies such as eliciting self-explanations.

DEMO MOVIE: www.cs.memphis.edu/~vrus/demo/aied-2019.mp4

The screenshot displays the CSEdPad Coding Edition interface. On the left, a code editor shows a Java program with a `main` method and a `swap` function. The code includes comments and variable declarations. In the center, a 'Trace Table' is visible with columns for 'Line', 'Value', and 'Output'. On the right, a tutoring dialog is open, providing hints and prompts to the user. The dialog includes a 'Problem Description' section, a 'Let's begin' section with a hint, and a 'Register' section with a prompt. The user's answer is entered in a text box at the bottom of the dialog.

Problem Description

Look at the given code example carefully and try to predict the correct output values. To predict output correctly, you need understand local and global variables and the scope of such variables. You also need know how to correctly call function with right kind of parameters. Please, answer the value of x, y, num1 and num2 after calling swap function. Give reasoning behind your answer.

```
1 public class FunctionExample {
2     static double num1 = 1.1;
3     static double num2 = 2.2;
4     public static void main(String[] args) {
5         int x = 10; int y = 20;
6         swap(x,y);
7         System.out.println("The value after calling");
8         " swap x=" + x + " y=" + y);
9         swap(num1, num2);
10        System.out.println("The value after calling");
11        " swap num1=" + num1 + " num2=" + num2);
12    }
13    public static void swap(double a, double b){
14        double c = num1;
15        num1 = num2;
16        num2 = c;
17    }
18    public static void swap(int a, int b){
19        double c = a;
20        a = b;
21        b = c;
22    }
23 }
```

Line	Value	Output
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CSEdPad Tutor Programming

Let's begin. Start writing your answer with explanations.

The value of x is 20 and the value of y is 10 after calling the swap function. The value of num1 is 5.1 and the value of num2 is 6.1

Okay

swap(num1, num2) call at line 9 invokes Line 13 swap function. This is because double type of integer is passed to the function and the swap function at line 13 is the right function accepting parameter of double type.

There are two swap functions, one at line 13 which accepts double parameters and other at line 18 which accepts integer parameters. Which line swap function is invoked by swap(x,y) call at line number 6? Explain why?

The swap invoked function is the line 18

Let me try again.

What is the data type of the variable passed to swap(x,y) function?

integers

Register

We know that data type of passing and accepting function should be same. Now, can you say which line swap function is called by swap(x,y) at line 6?

Enter your answer