

CTL Model Checker

Project Report

Group 8

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AIM:

The goal is to create a Java standalone program for CTL model validation and CTL temporal logic verification.

DESCRIPTION:

The user interface (UI) allows the user to upload a file containing the Kripke structure definition that is used to verify a property and a CTL formula.

- Once the file has been uploaded, the CTL formula will be inserted in the designated text field.
- The state can be chosen by the user using the drop-down menu.
- When the check button is clicked, the program verifies syntax and displays an error message if there are any issues with the Kripke structure.
- Only when the kripke structure is successfully checked against the formula will the result—whether the kripke structure for the given state holds for the formula or not—be shown in the Result text box.
- If the kripke structure is not fully parsed, the application displays an error message.

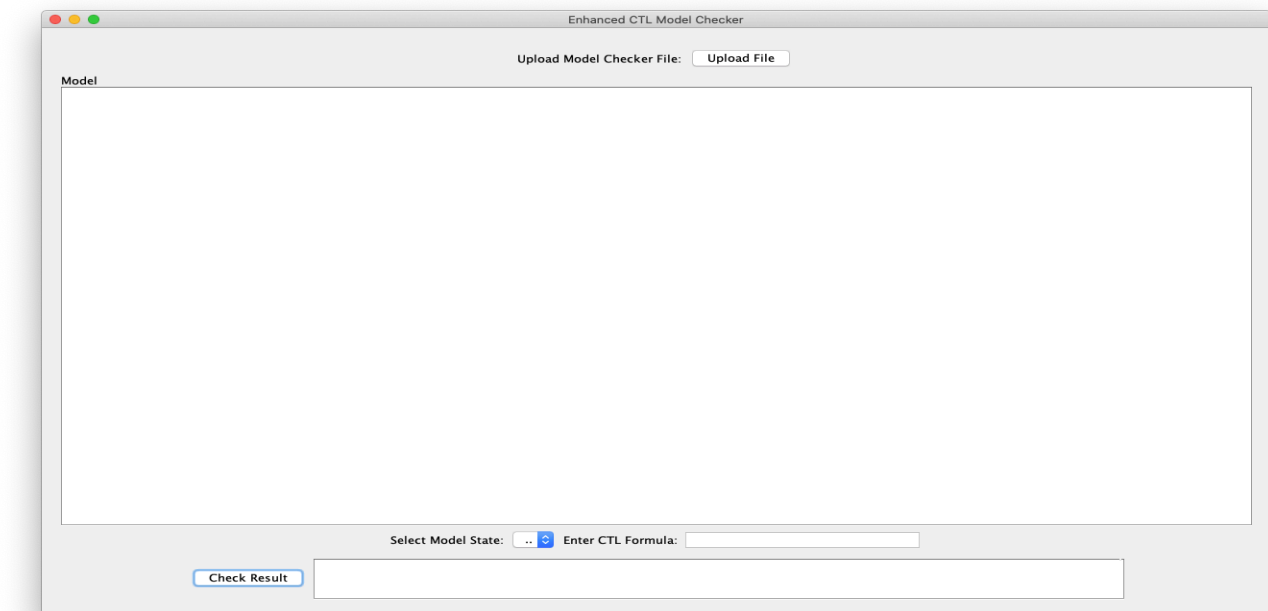


FIG 1 : GUI OF MODEL CHECKER

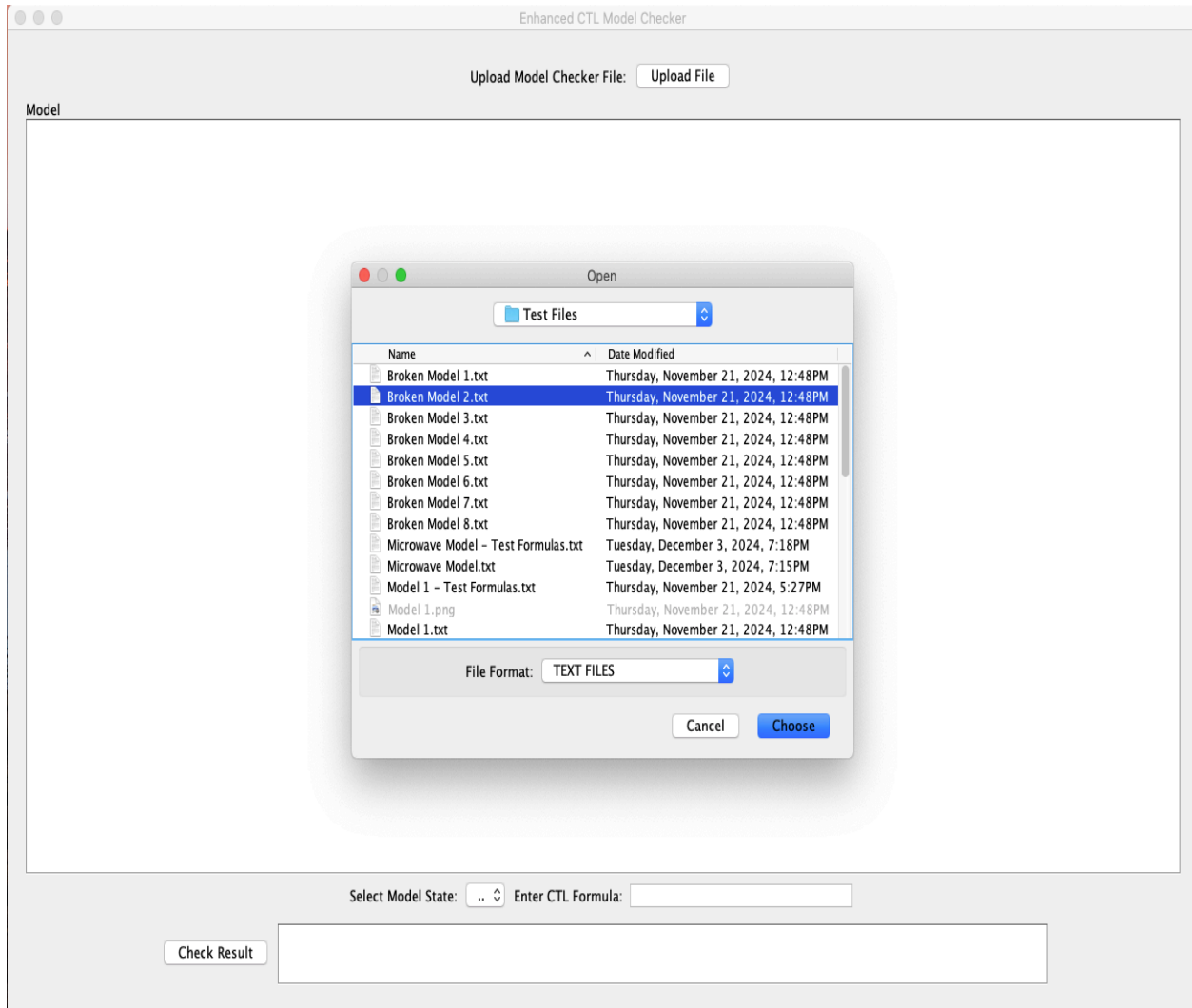


FIG 2: LOADING A KRIPKE STRUCTURE TEST FILE

Acceptance testcases:

For the CTL Formulas, sample test cases are provided for:

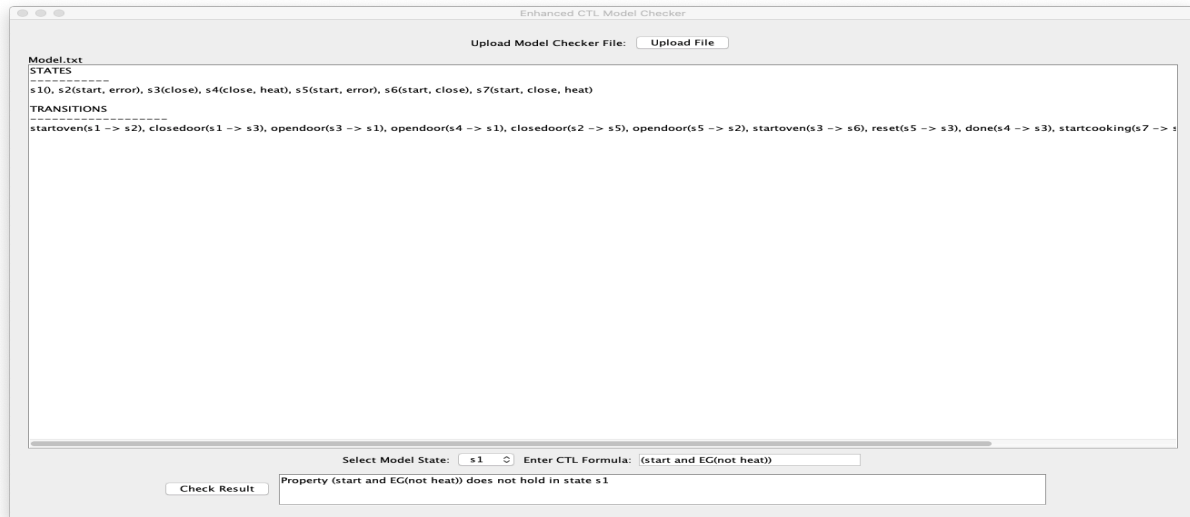
1. Microwave model,
2. Model 1,
3. Model 2, and
4. Model 4.

Microwave Model

i) CTL formula: (start and EG(not heat))

Starting state: s1

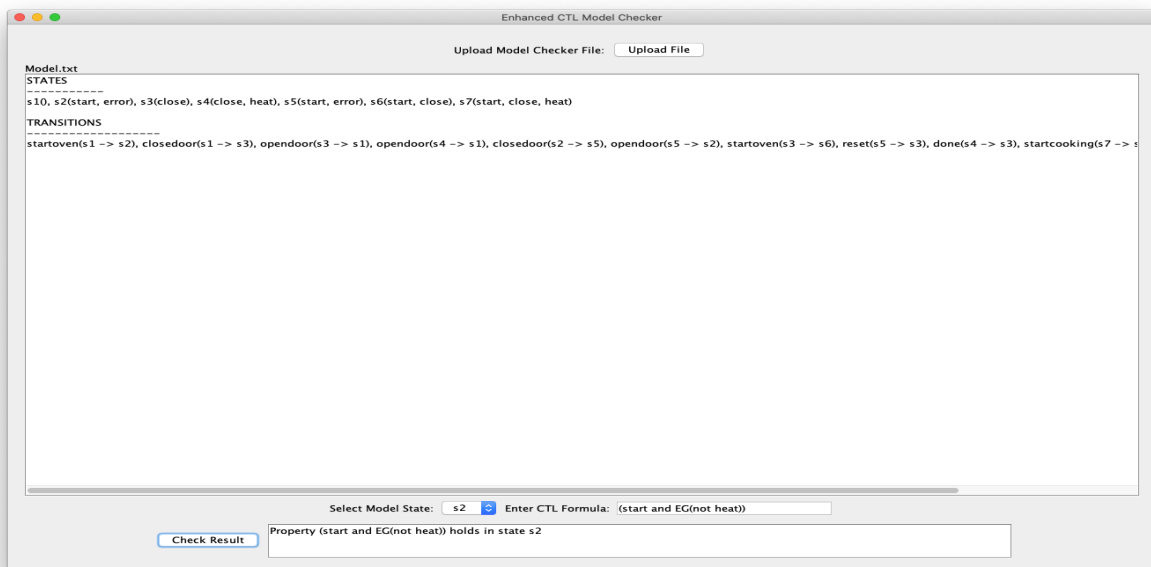
Property (start and EG(not heat)) does not hold in state s1



ii) CTL formula: (start and EG(not heat))

Starting state: s2

Property (start and EG(not heat)) holds in state s2

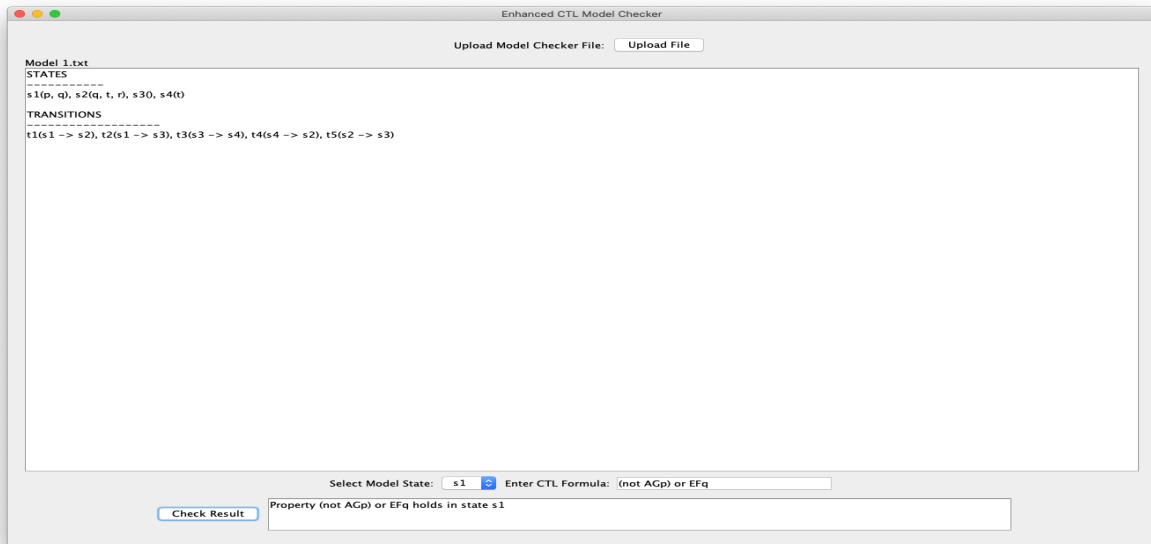


Model 1

i) CTL formula: (not AGp) or EFq

Starting state: s1

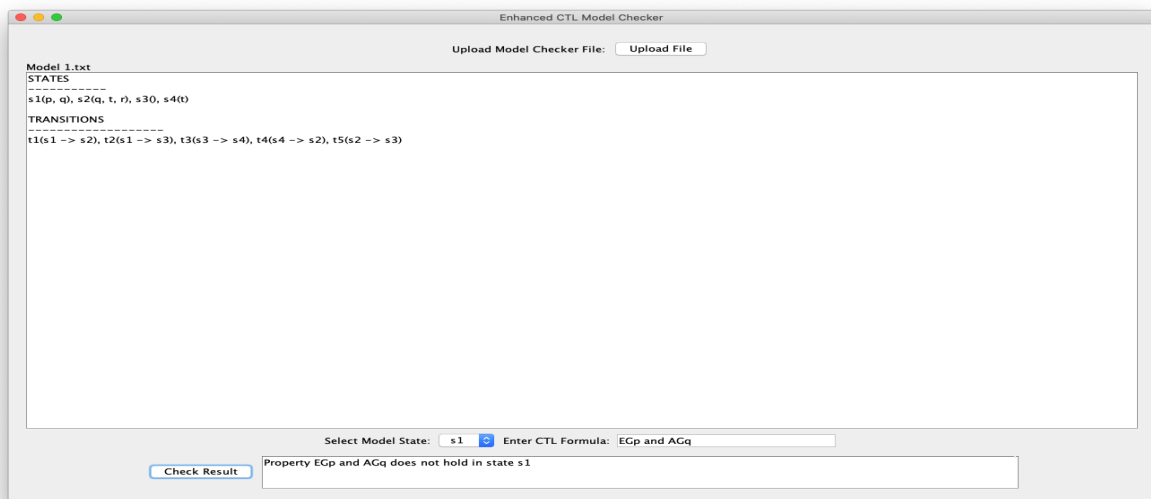
Property (not AGp) or EFq holds in state s1



ii) CTL formula: EGp and AGq

Starting state: s1

Property EGp and AGq does not hold in state s1

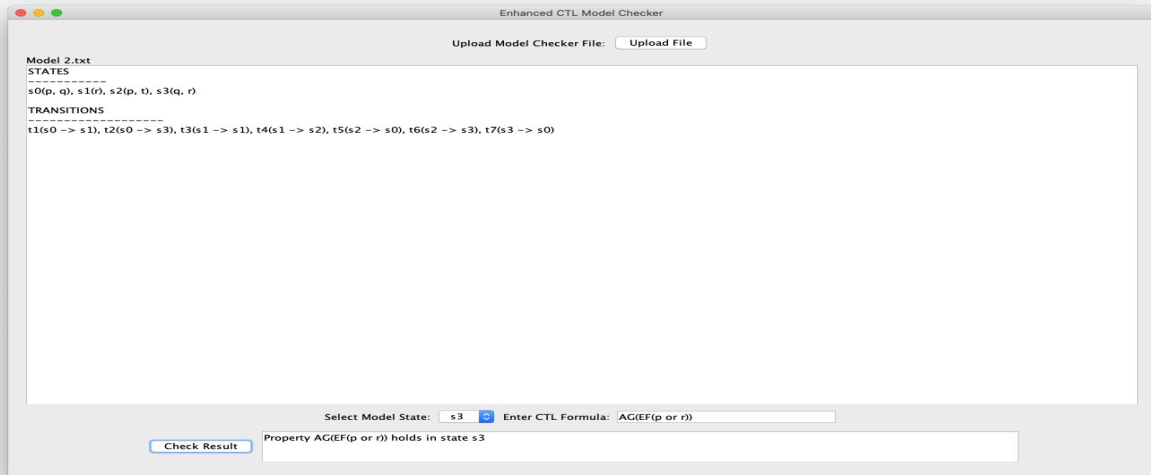


Model 2

i) CTL formula: $AG(EF(p \text{ or } r))$

Starting state: s3

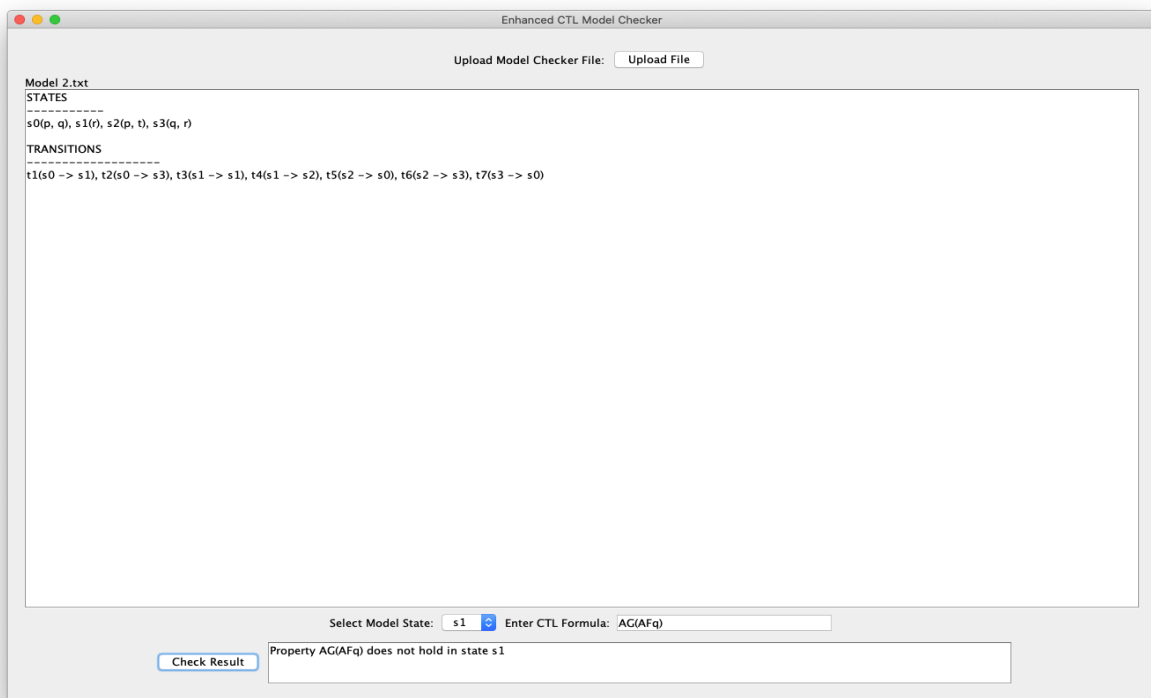
Property $AG(EF(p \text{ or } r))$ holds in state s3



ii) CTL formula: $AG(AFq)$

Starting state: s1

Property $AG(AFq)$ does not hold in state s1



Model 4

i) CTL formula: $AG(t1 \rightarrow AF c1)$

Starting state: s3

Property $AG(t1 \rightarrow AF c1)$ holds in state s3

The screenshot shows the 'Enhanced CTL Model Checker' window. The 'Model 4.txt' file is loaded, displaying the following content:

```
Model 4.txt
-----
STATES
s1(n1, n2, 0), s2(t1, n2, 1), s3(c1, n2, 1), s4(c1, t2, 1), s5(t1, t2, 1), s6(n1, t2, 2), s7(t1, t2, 2), s8(t1, c2, 2), s9(n1, c2, 2)
-----
TRANSITIONS
t1(s1 -> s2), t2(s2 -> s3), t3(s3 -> s4), t4(s5 -> s4), t5(s2 -> s5), t6(s4 -> s6), t7(s8 -> s2), t8(s1 -> s6), t9(s6 -> s7), t10(s7 -> s8), t11(s9 -> s8), t12(s6 -> s9)
```

At the bottom, the 'Select Model State' dropdown is set to 's3'. The 'Enter CTL Formula' field contains ' $AG(t1 \rightarrow AF c1)$ '. The 'Check Result' button is highlighted, and the output box displays: 'Property $AG(t1 \rightarrow AF c1)$ holds in state s3'.

ii) CTL formula: $AG(t1 \rightarrow AF c1)$

Starting state: s5

Property $AG(t1 \rightarrow AF c1)$ holds in state s5

The screenshot shows the 'Enhanced CTL Model Checker' window with the same 'Model 4.txt' file loaded. The 'Select Model State' dropdown is now set to 's5'. The 'Enter CTL Formula' field still contains ' $AG(t1 \rightarrow AF c1)$ '. The 'Check Result' button is highlighted, and the output box displays: 'Property $AG(t1 \rightarrow AF c1)$ holds in state s5'.

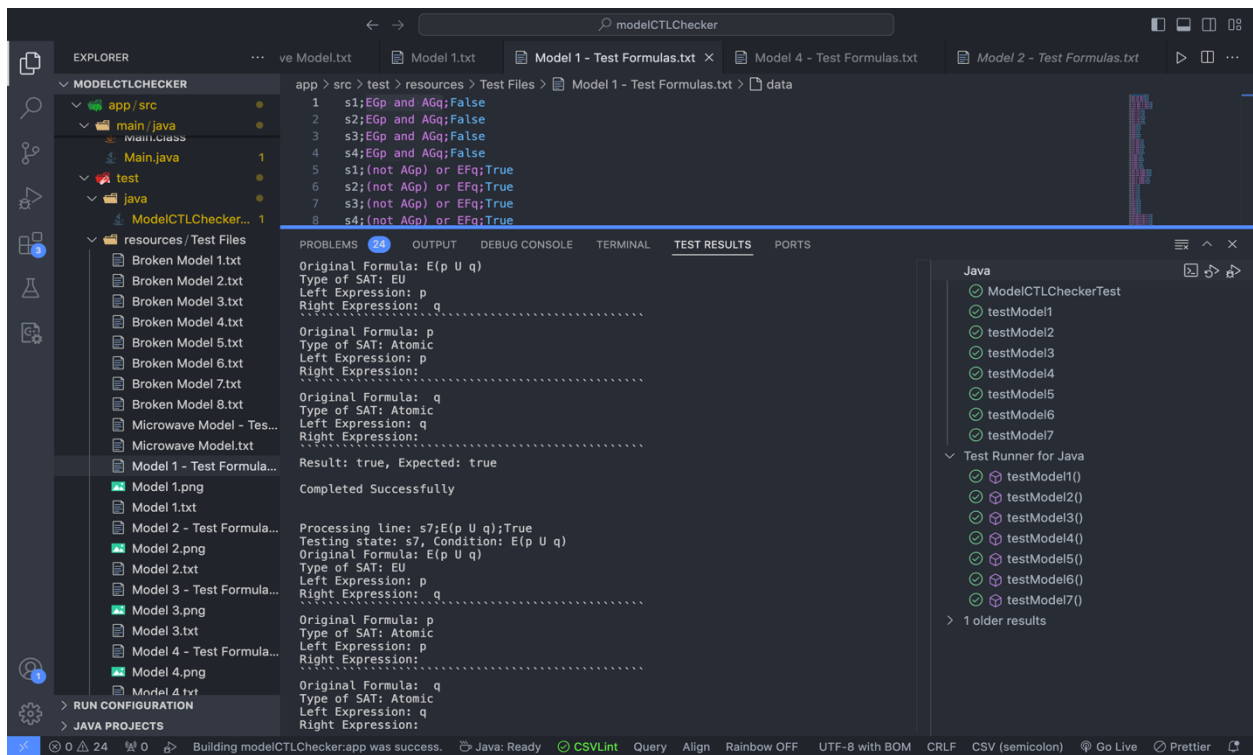
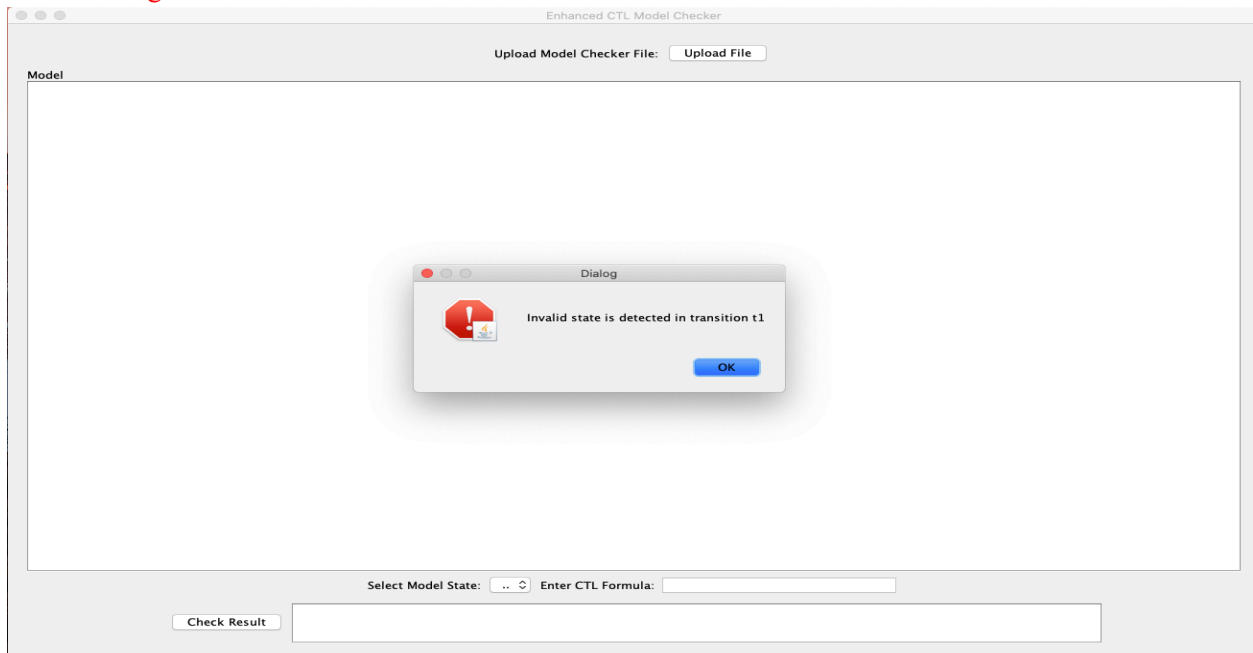
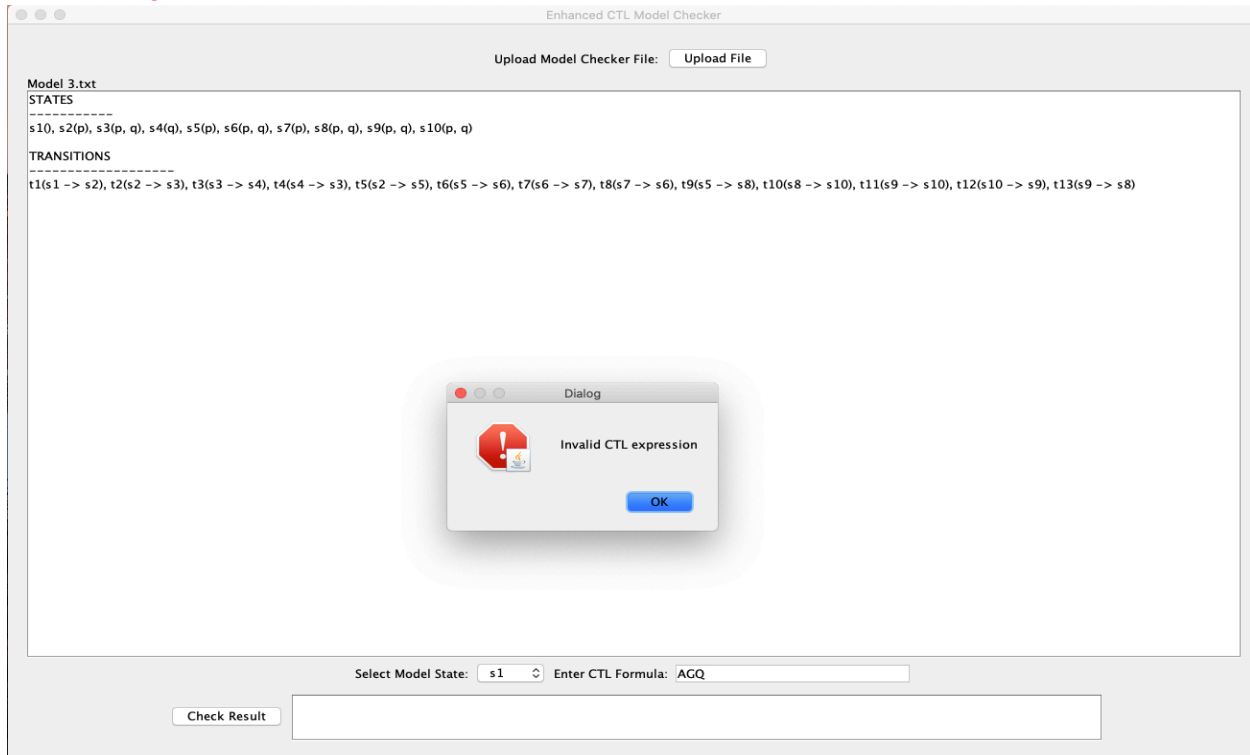


FIG 3: TEST RESULTS AND FORMULA VERIFICATION

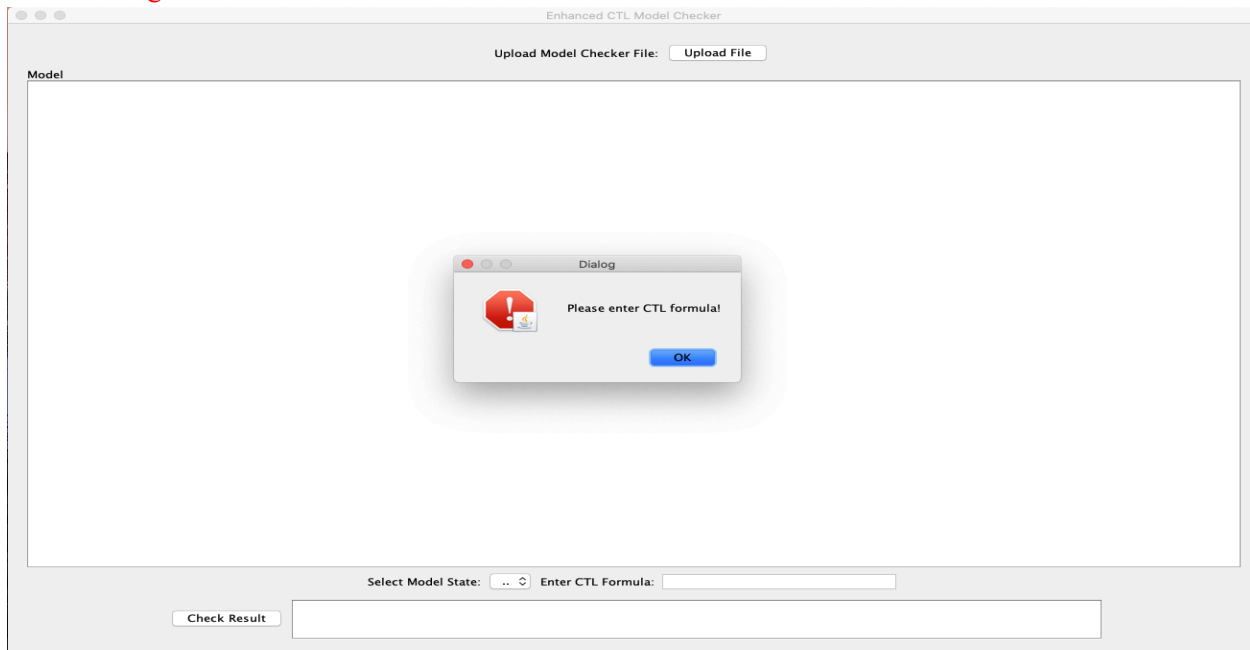
Error messages if transition refers to a state that is not defined



Error messages if CTL formula is invalid:



Error message if CTL formula is not entered:



UML class diagram for the software system

UML Class diagram present in the modelCheckCTL directory named UML Diagram.png

Source code (archive of directory structure starting from modelCheckCTL dir)

Source code is present in the “src” folder.

Tools used Vscode, Gradle, JDK 21.0.2