ISTA+ User Guide

December 10, 2023

1 Introduction

ISTA+ (Intelligent System Test Automation Plus) is an advanced tool for automatic test case generation and optimization based on neural coverage analysis. It supports both image and text data types and is designed to improve test adequacy for intelligent systems.

2 System Requirements

- Python 3.7
- TensorFlow 2.6.0
- Additional dependencies as required

3 Installation Guide

3.1 Cloning the Repository

```
git clone https://github.com/wuxiaoxue/ISTAplus
```

Clone the ISTA+ repository from its source to get the latest version of the code.

3.2 Setting Up the Environment

- Creating a Python 3.7 environment:

```
# On Unix/Linux/macOS
python3.7 -m venv ista_env
source ista_env/bin/activate

# On Windows
python3.7 -m venv ista_env
.\ista_env\Scripts\activate
```

- Install the required dependencies:

```
pip install -r requirements.txt
```

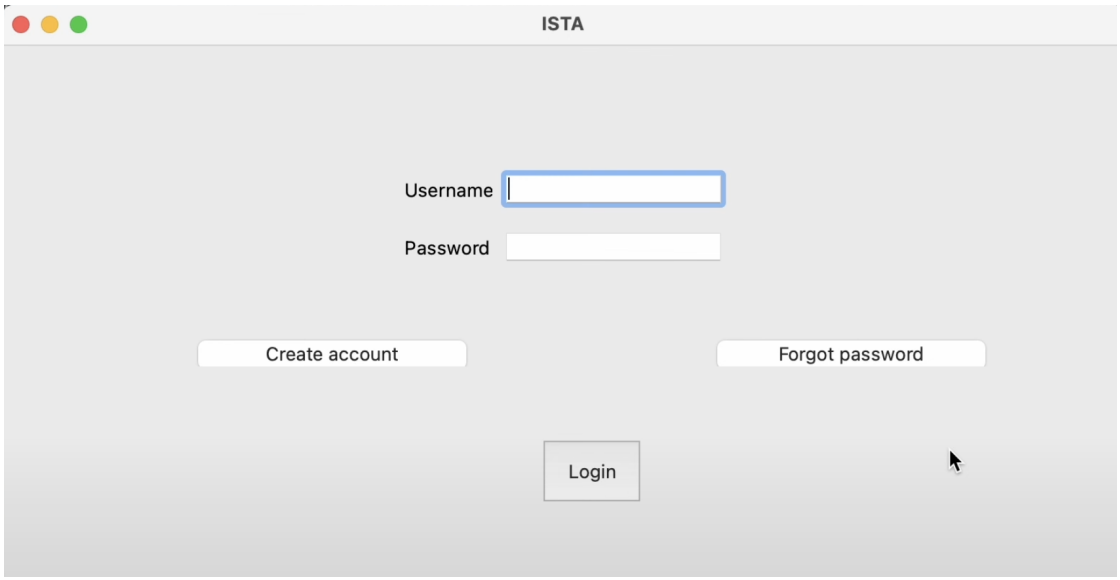
4 Running ISTA+

To run the ISTA+ software, execute the following command:

```
python run.py
```

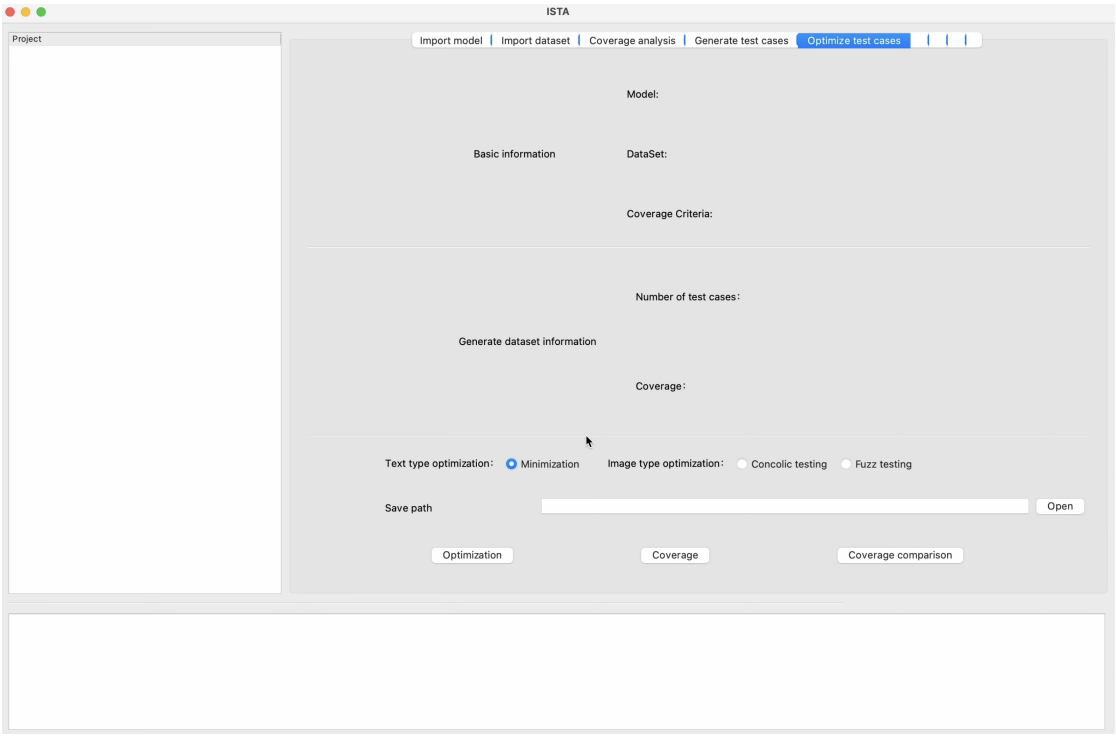
4.1 Post-Run Workflow

1. **Login**: Input username and password for successful login.



[ISTA+ Login Page]

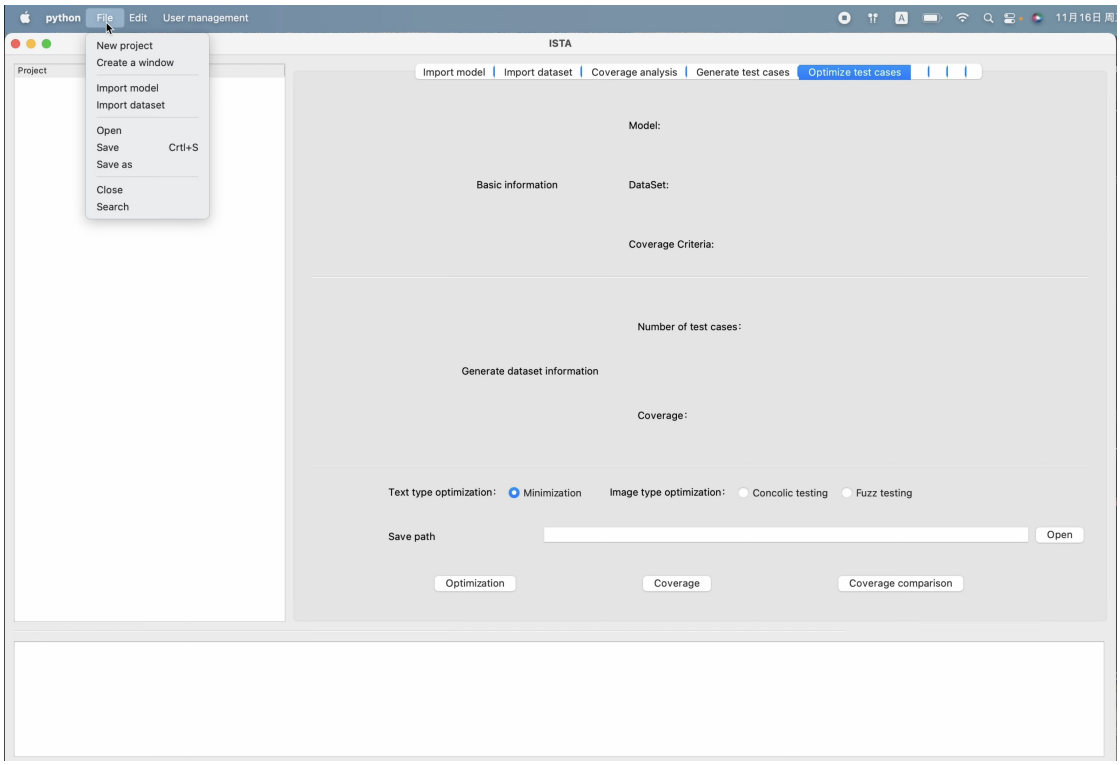
2. **Main Interface**: The main interface is divided into three areas:
    - *Project Directory Area* (Left Side)
    - *Function Operation Display Area* (Middle)
    - *Log Information Display Area* (Bottom)



[ISTA+ Main Interface]

3. **Create a New Project**:

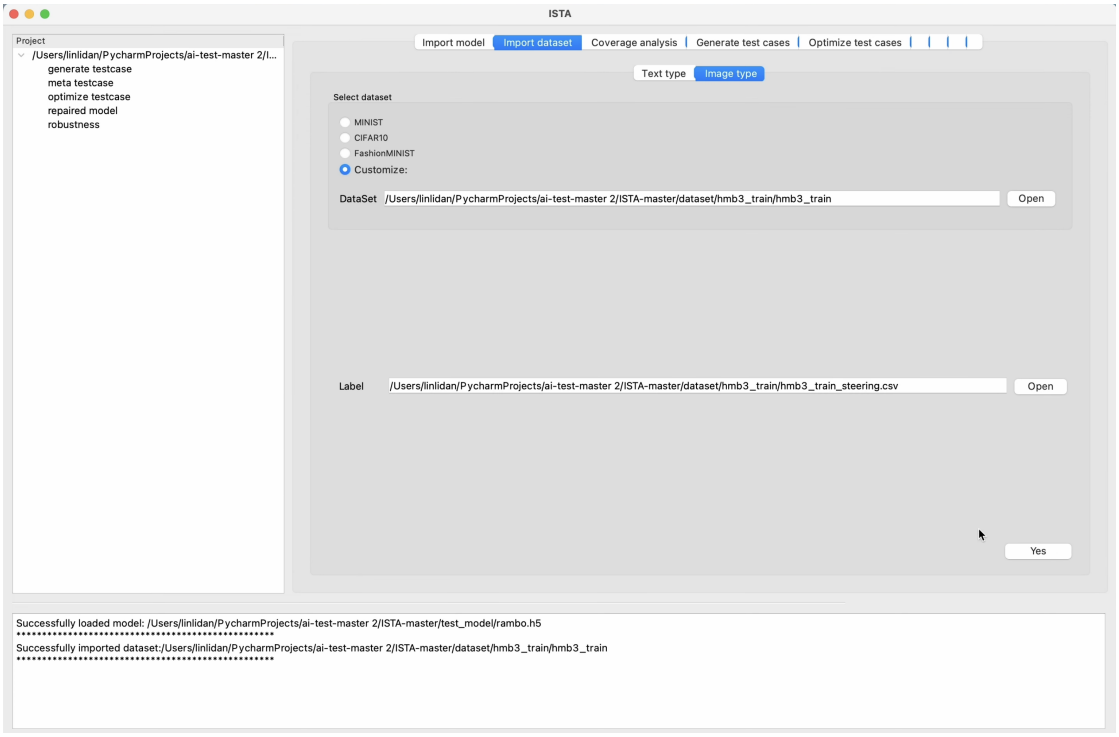
   - Select the ‘File‘ option, then ‘New Project‘.
   - Create an empty folder in the project root directory and select this directory.
   - Upon creation, subfolders are automatically generated in the project path to save result files from subsequent operations.



[ISTA+ New Project Creation]

4. **Import Model and Dataset**:

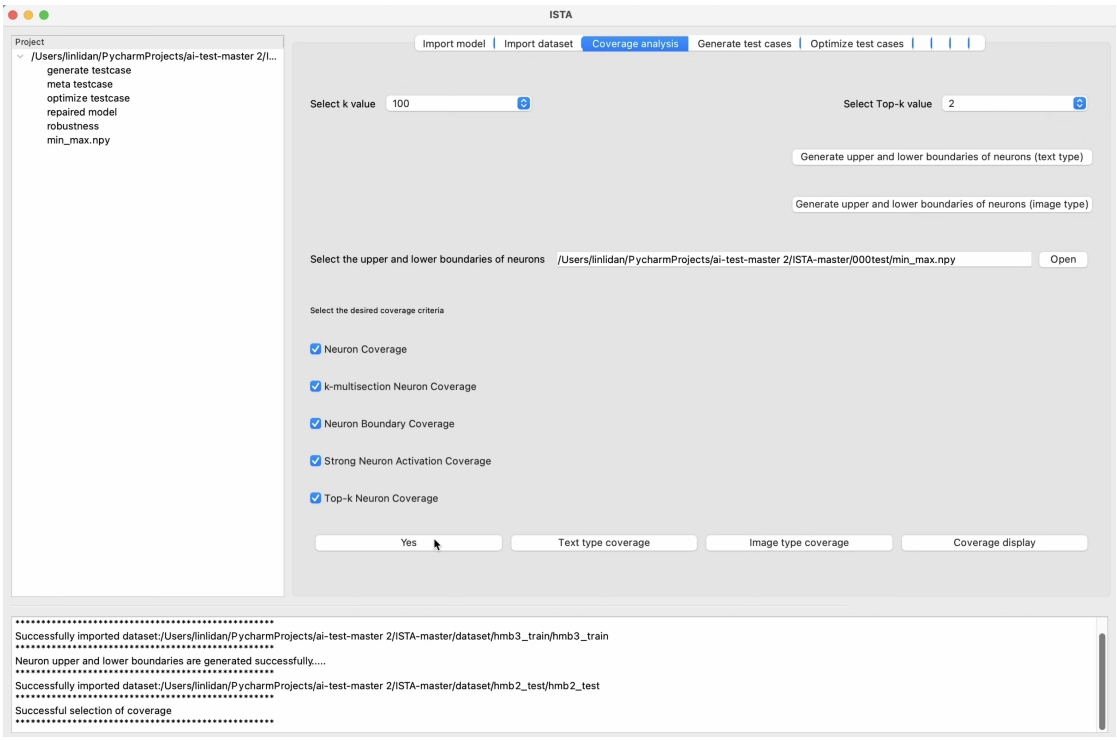
   - Click on the `Import Model` tab.
   - In the `Import Model` tab, click the `Open` button next to `Select Model`, then select the `rambo.h5` model prepared in the `test_model` folder at the project root path. Click `Yes` to confirm.
   - Click on the `Import Dataset` tab. Then, click the `Open` button next to `Dataset`, and choose the `hmb3_train` image dataset prepared in the `dataset/hmb3_train/` directory at the project root path. Click `Yes` to confirm. Following this, click the `Open` button next to `Label`, and select the `hmb3_train_steering.csv` file located in the `dataset/hmb3_train/` directory. Click `Yes` to confirm your selection.



[ISTA+ Importing Model and Dataset]

5. **Coverage Analysis**:

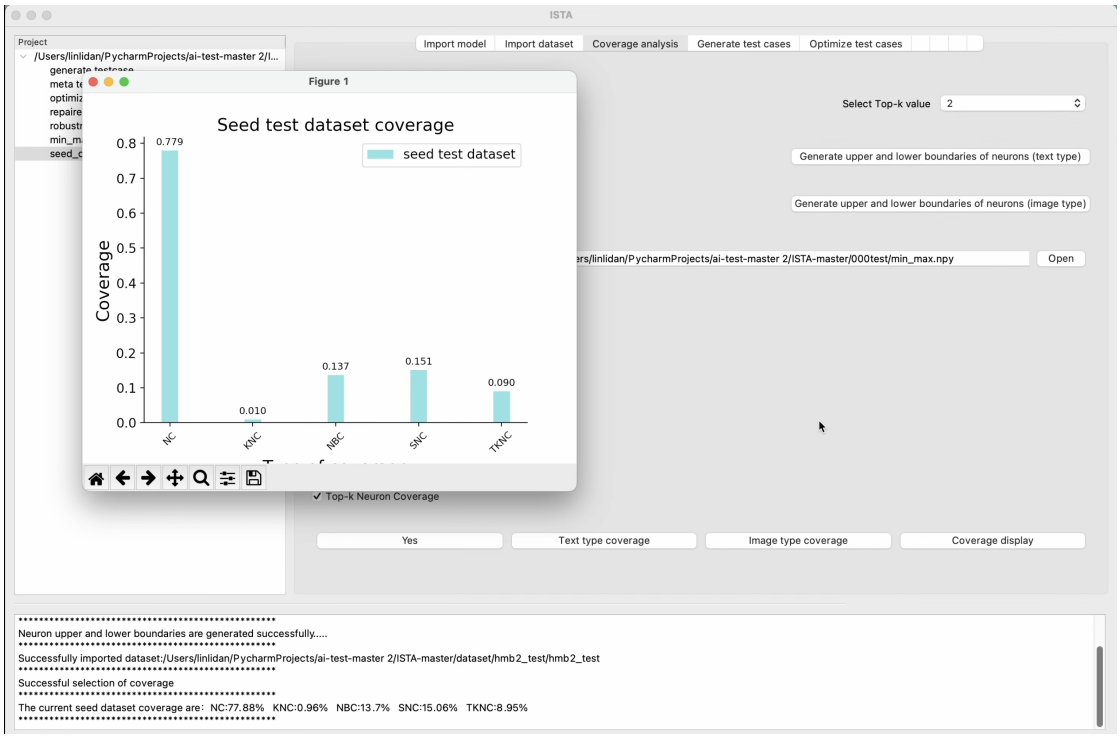
   - Click ‘Open‘ to generate upper and lower boundaries of neurons.
   - After successful generation, view the ‘min_ max.npy ‘ file in the directory area.
   - Reimport the test dataset by returning to the import dataset step.
   - Return to the ‘Coverage Analysis‘ tab and click ‘Yes‘. Then you can see the log information displaying ‘Successful selection of coverage‘.



[ISTA+ Coverage Analysis]

6. **Coverage Calculation and Display**:

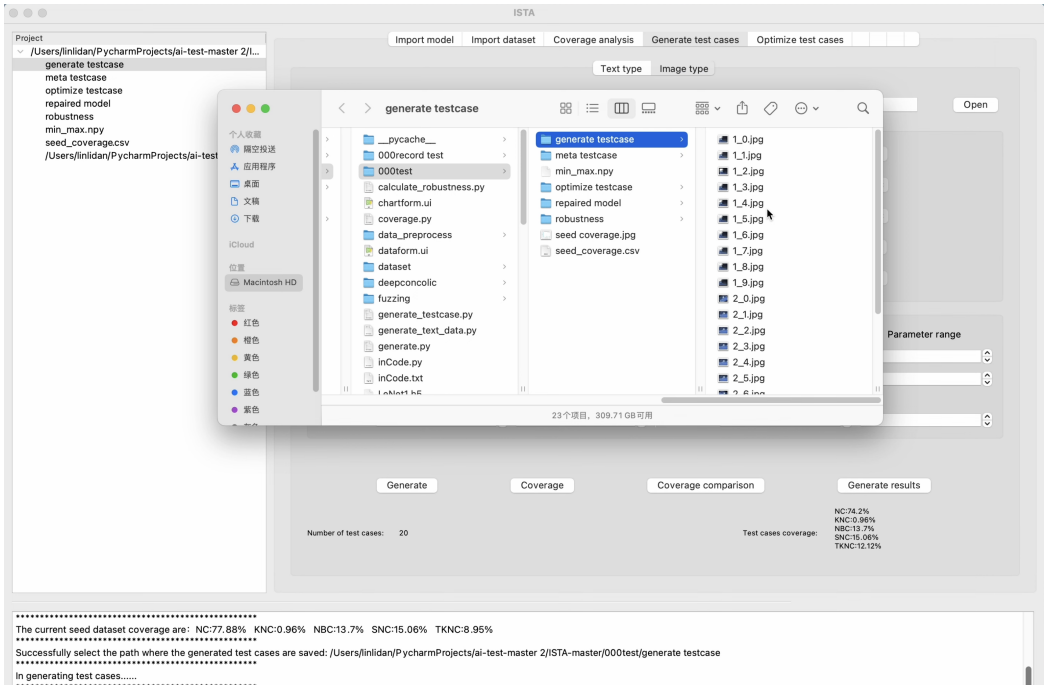
   - Next, click on the ‘Image Type Coverage‘. The log area will show the results of the coverage calculation.
   - In the directory area, the results file will be displayed, which you can click to view.
   - Additionally, you can click on ‘Coverage Display‘ to visually see the coverage.



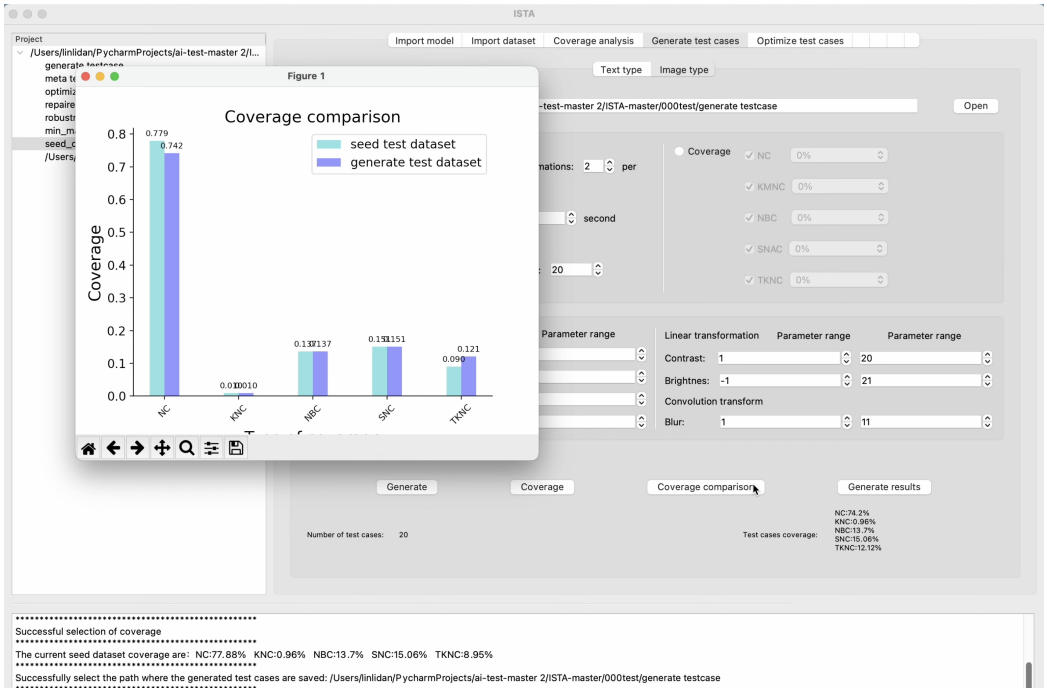
[ISTA+ Coverage Calculation and Display]

7. **Generate Test Cases and Coverage Comparison**:

   - Navigate to the ‘Generate Test Cases‘ tab, select the image type, and click ‘Open‘.
   - After configuring the necessary parameters, click ‘Generate‘ to start generating test cases.
   - Once the test cases are generated, click on ‘Coverage‘ to proceed.
   - Then select ‘Coverage Comparison‘ to conduct a visual comparison of the coverage results between the original test dataset and the generated test dataset.
   - You can also click on the ‘Generate Test Case folder‘ to access the newly generated test cases.
   - The coverage information file for the generated test dataset will also be saved.



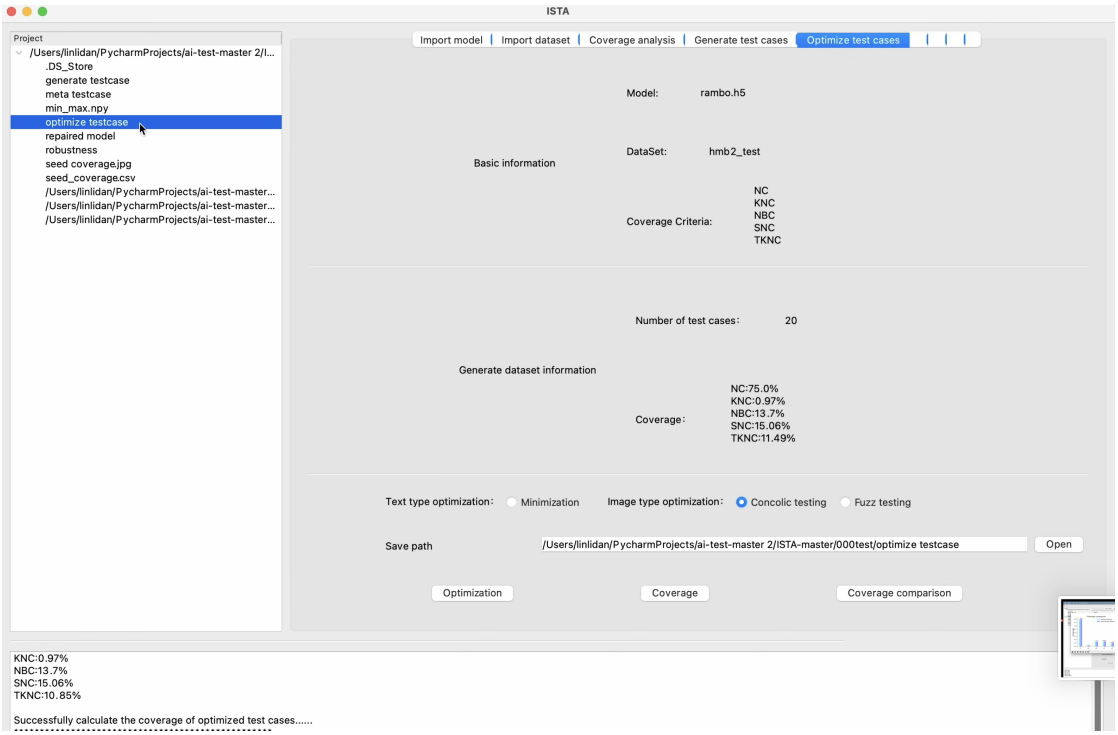
[ISTA+ Test Case Generation]



[ISTA+ Test Case Comparison]

8. **Test Case Optimization**:

   - On the ‘Test Case Optimization‘ page, you will see the basic information along with the generated dataset information.
   - Click ‘Open‘ to start the process.
   - Proceed by clicking on ‘Concolic Testing‘ to initiate concolic testing procedures.
   - Click ‘Optimization‘ to optimize the test cases using the provided tools and configurations.
   - After optimization, click on ‘Coverage‘ to review the coverage metrics.
   - Then, click on ‘Coverage Comparison‘ to compare coverage results before and after optimization, allowing for an evaluation of the optimization’s effectiveness.
   - Additionally, you can view the ‘Optimize Test Case‘ folder to examine the optimized test cases.



[ISTA+ Test Case Optimization]

5 Conclusion

This paper has showcased ISTA+, a tool for enhancing test case generation and optimization through neural coverage analysis. ISTA+ boosts testing adequacy for intelligent systems handling various data types such as text and images.

ISTA+ is currently equipped with foundational features and is poised for further development to include a wider array of testing methods for additional data forms. The team is actively working to broaden ISTA+'s scope to better serve the evolving landscape of intelligent system testing.

We invite the community to contribute to this endeavor. ISTA+ is an open-source project, and we welcome all forks and contributions that can be made at `https://github.com/wuxiaoxue/ISTAplus`. For a more in-depth understanding of ISTA+, we also provide a comprehensive video introduction available at `https://www.youtube.com/watch?v=6CkzMJ0ghq8`. Your participation and feedback will drive the evolution of ISTA+, fostering a robust toolkit for intelligent system adequacy testing.