2024. 04. 11. Project Proposal Talk

Visualizing Fuzzing Status on Def-Use Graph and its impact

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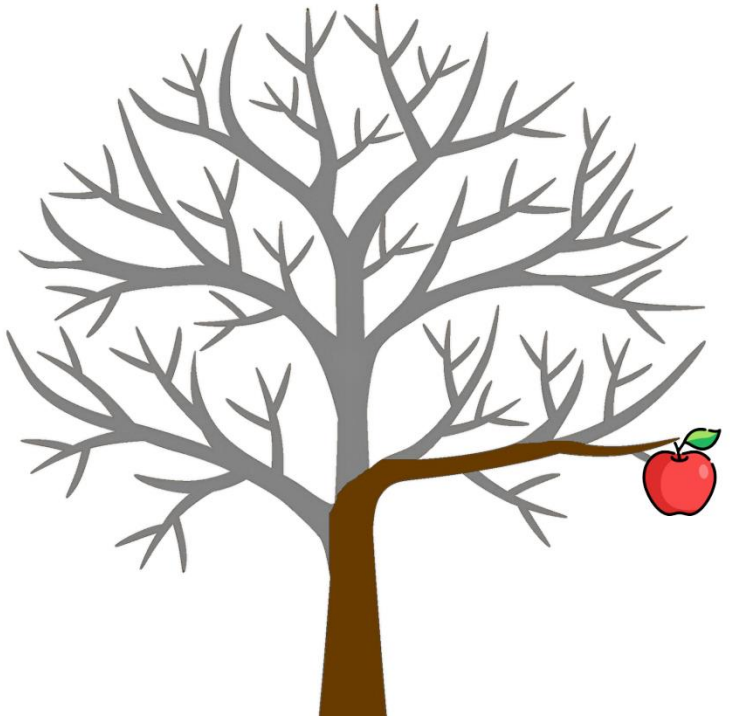

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  - e.g., Google's OSS Fuzz project, AFL
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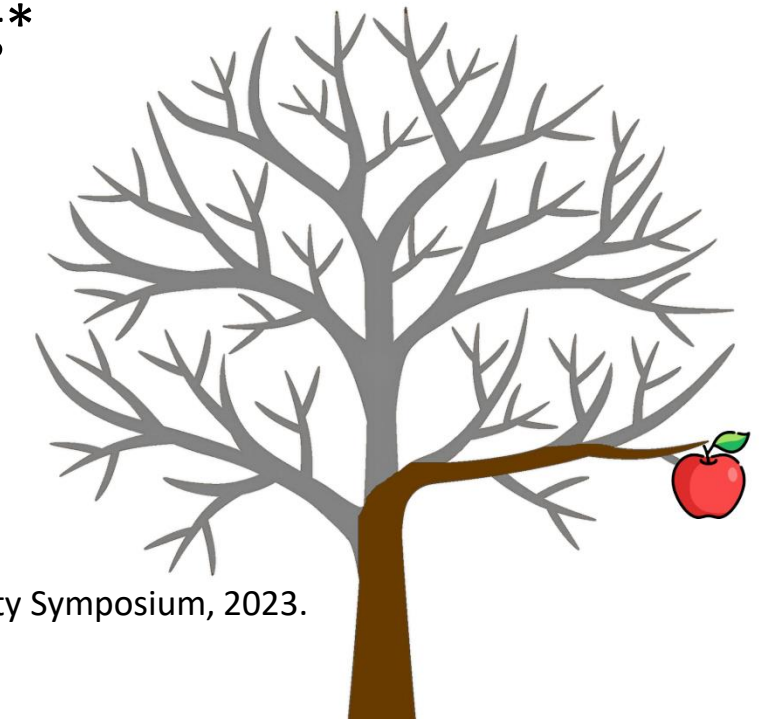
  - e.g., Examine recently changed code area, generate crashing input from bug report
- Reproduces bug 1.93 times faster than undirected fuzzing*
  - Undirected fuzzing: AFL, directed fuzzing: DAFL



* Tae Eun Kim et al., DAFL: Directed Grey-box Fuzzing guided by Data Dependency. USENIX Security Symposium, 2023.

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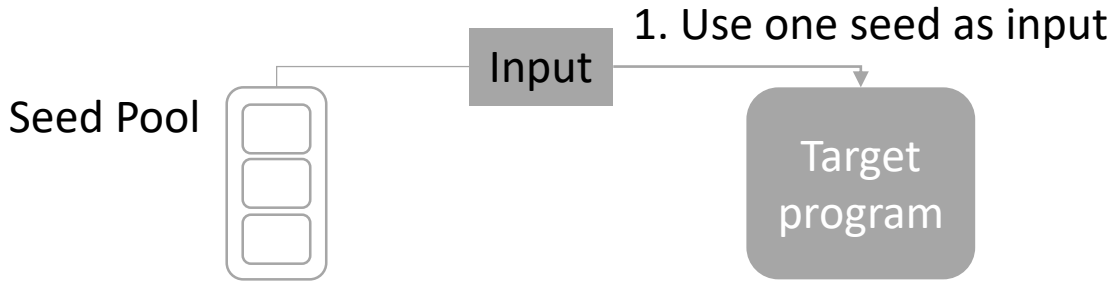

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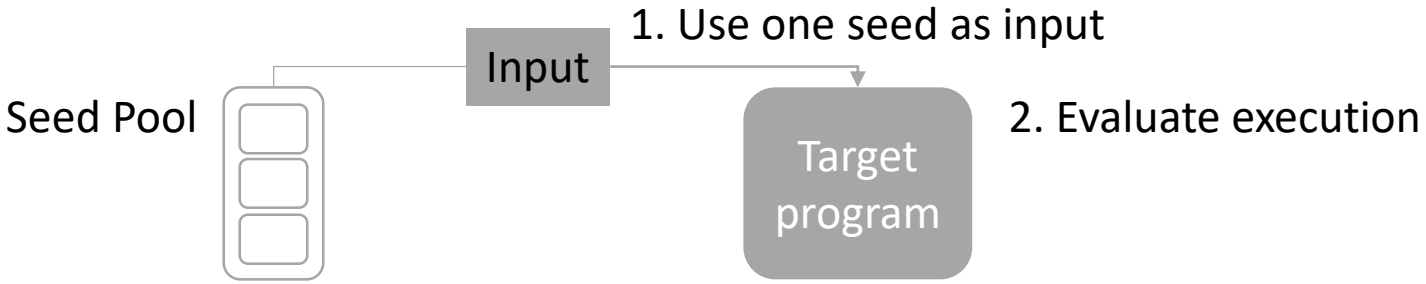

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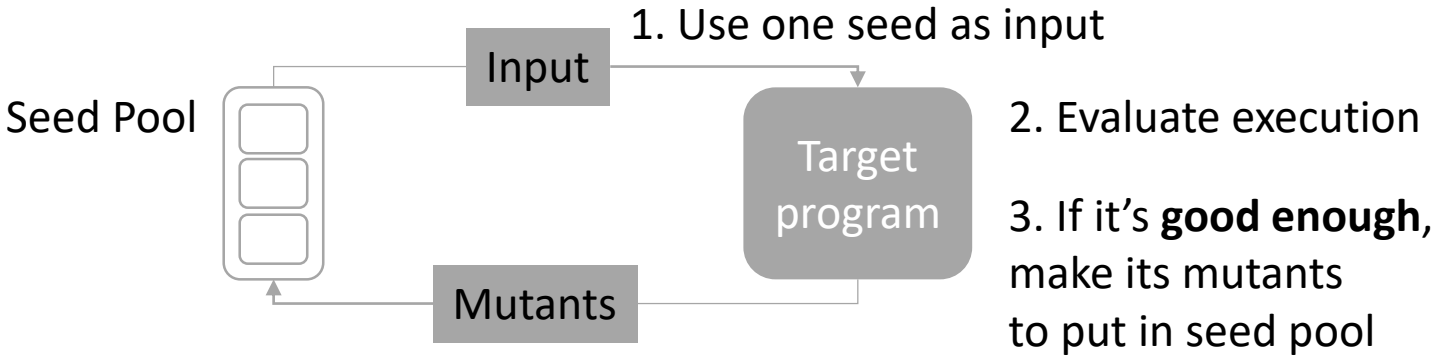

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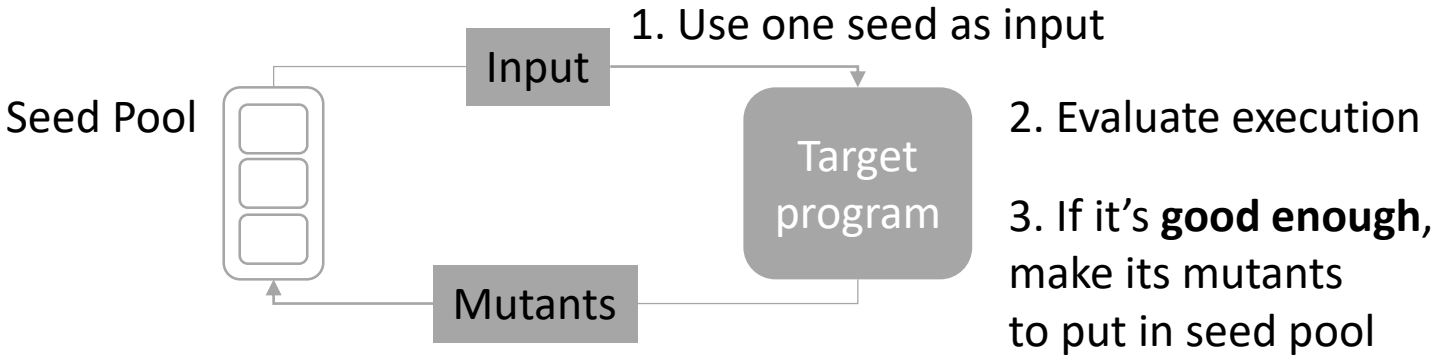

- What is the criteria for the execution to be **good enough**?

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- For undirected **fuzzing**, increasing code coverage is considered important

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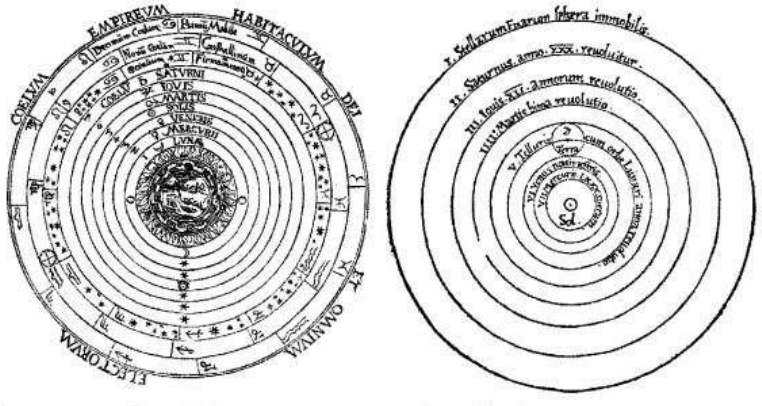

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was made by observing motions of celestials

describe the structure of the solar system

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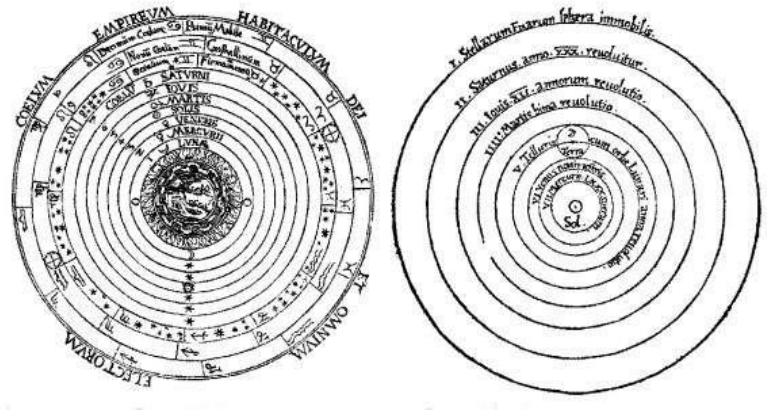

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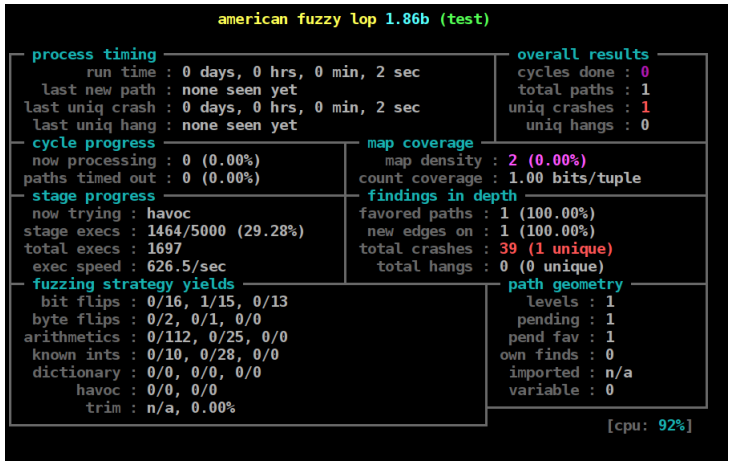

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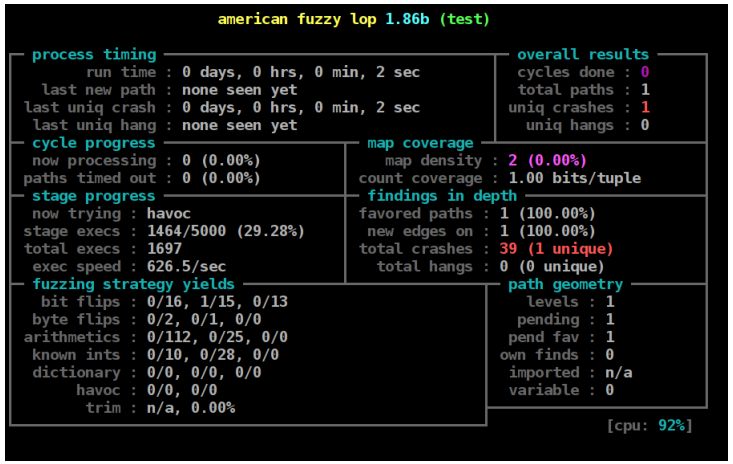

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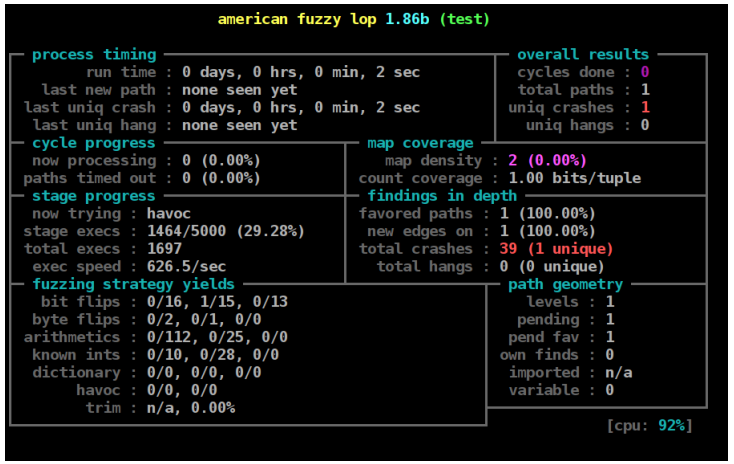

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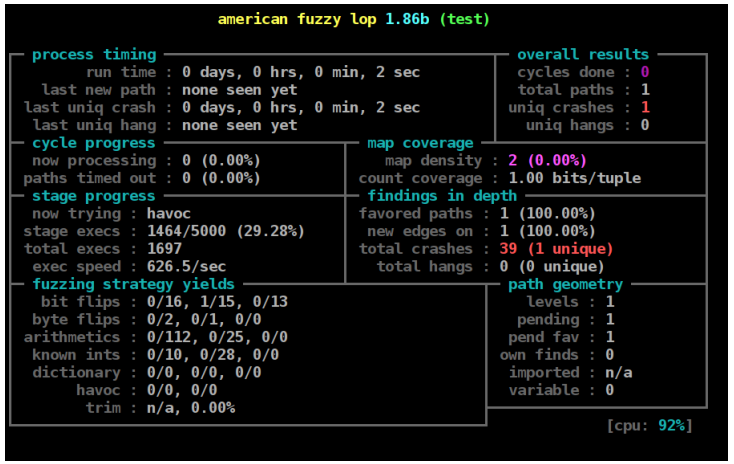

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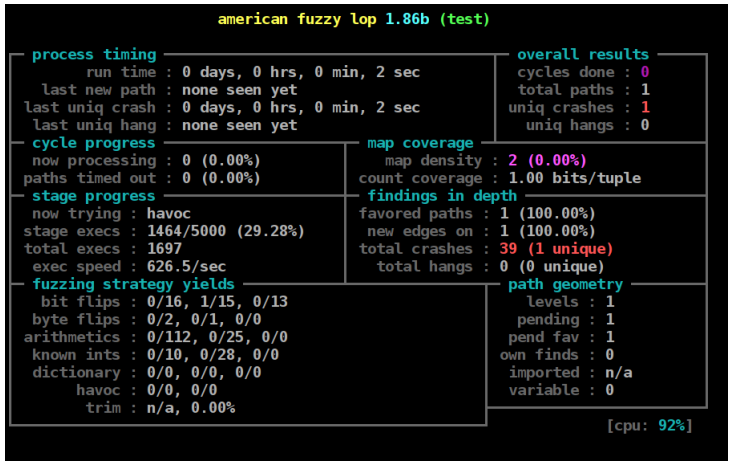

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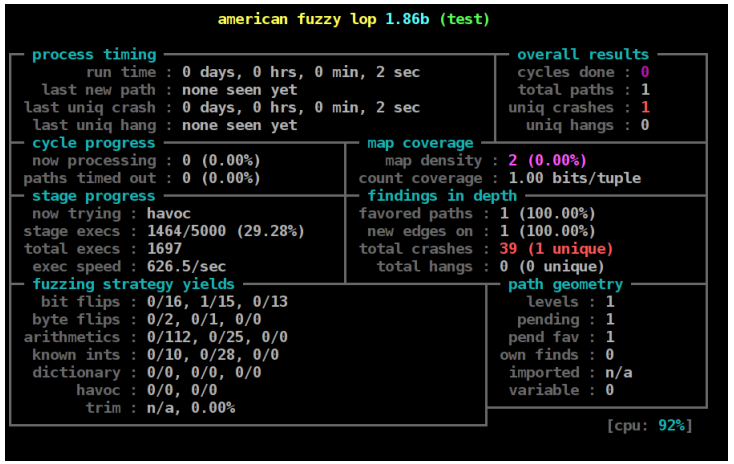
- **None** visualizing tool for directed fuzzing **yet!**



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- One key aspect is **data-flow coverage**

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- We can focus on data-flow that affects the target line

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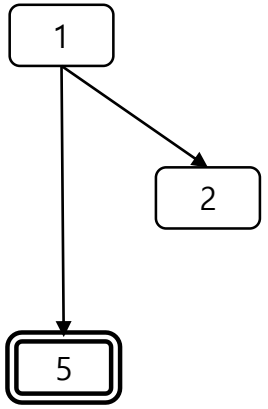

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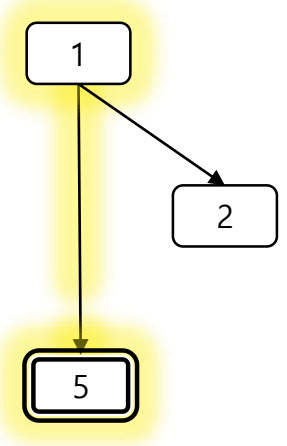

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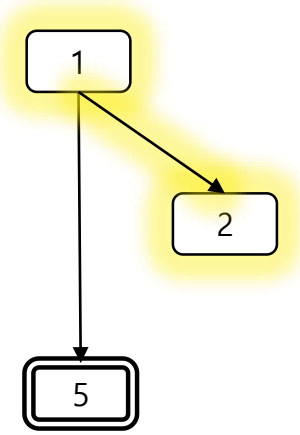

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Visualizing data-flow

- How to visualize such information?
- Transform code to **def-use graph**.
- It is **yet first** to observe data-flow in fuzzing.

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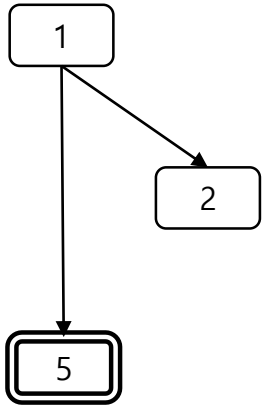
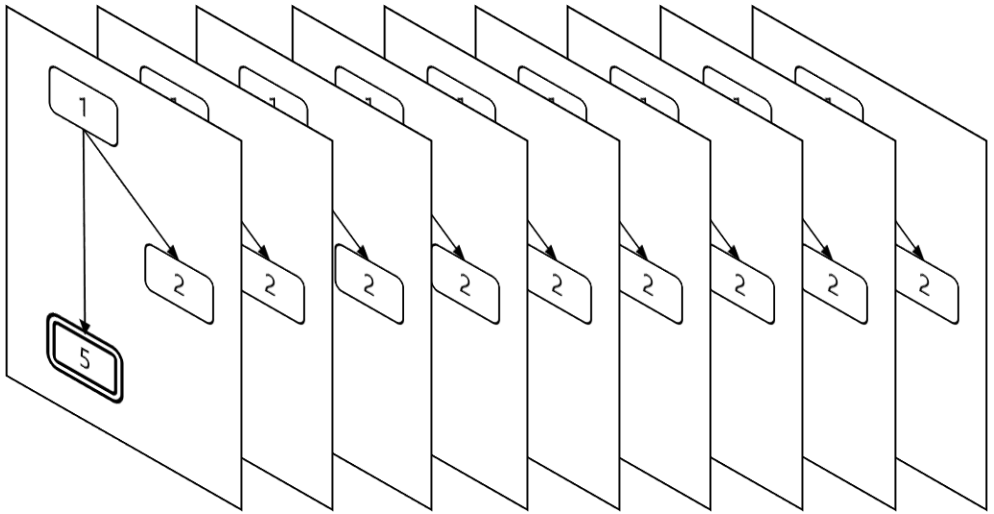
data-flow



def-use graph

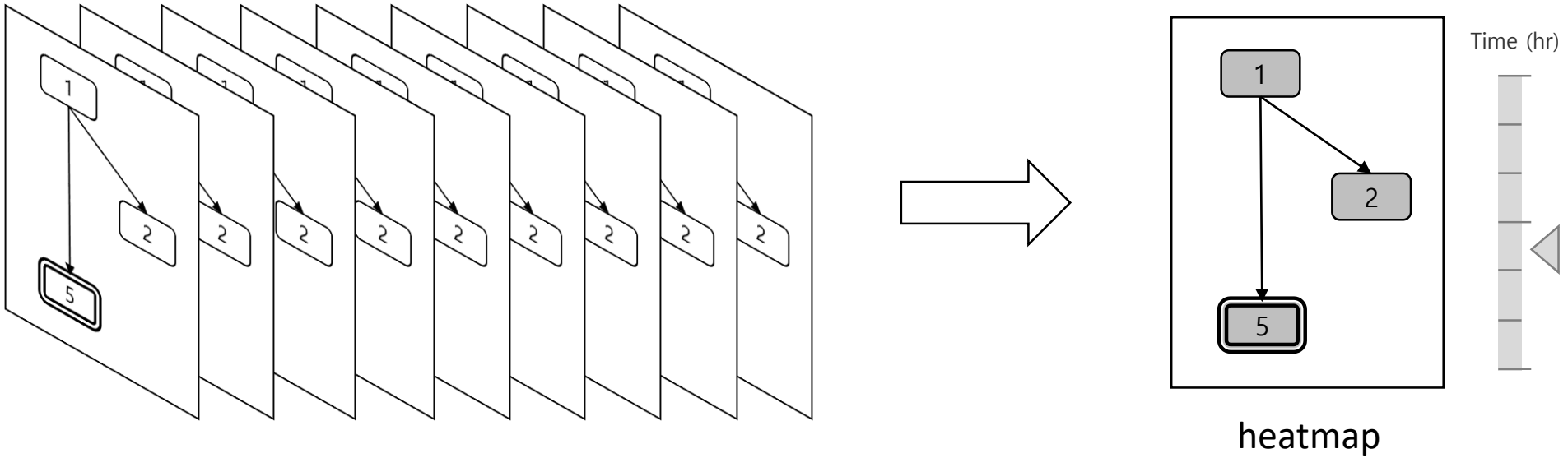
Visualizing data-flow over time

- How to see the hourly status of performance?



Visualizing data-flow over time

- How to see the hourly status of performance?
- Create a **heatmap** (how often node was hit) with adjustable time frames
- Good for evaluation: More often target line is hit, better chance to trigger bug



Visualizing data-flow over time

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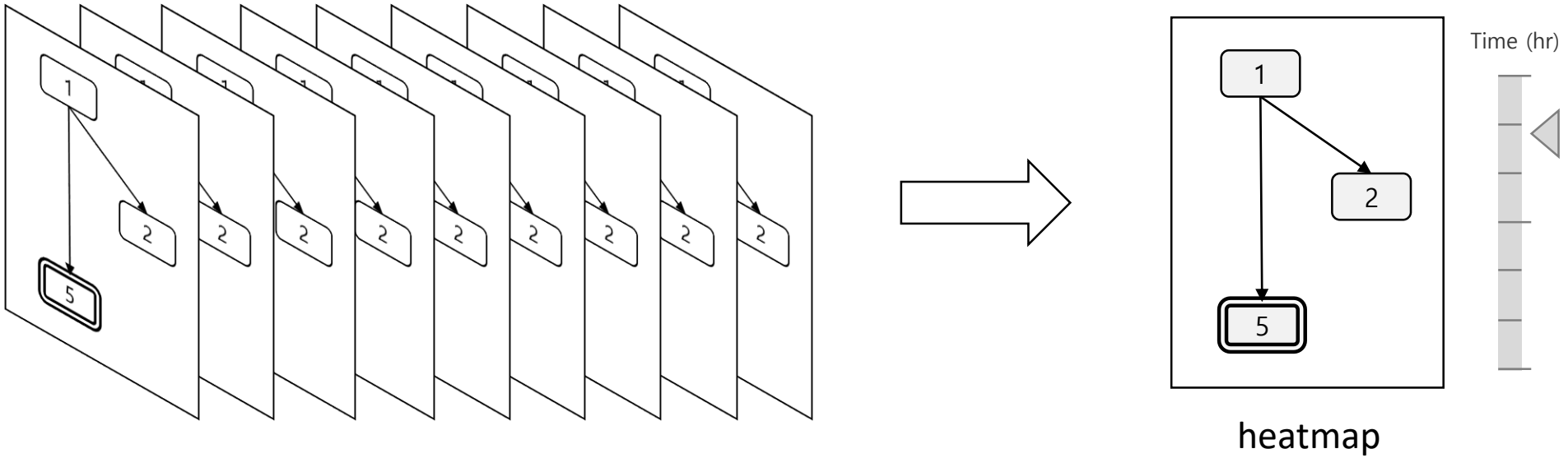

Visualizing data-flow over time

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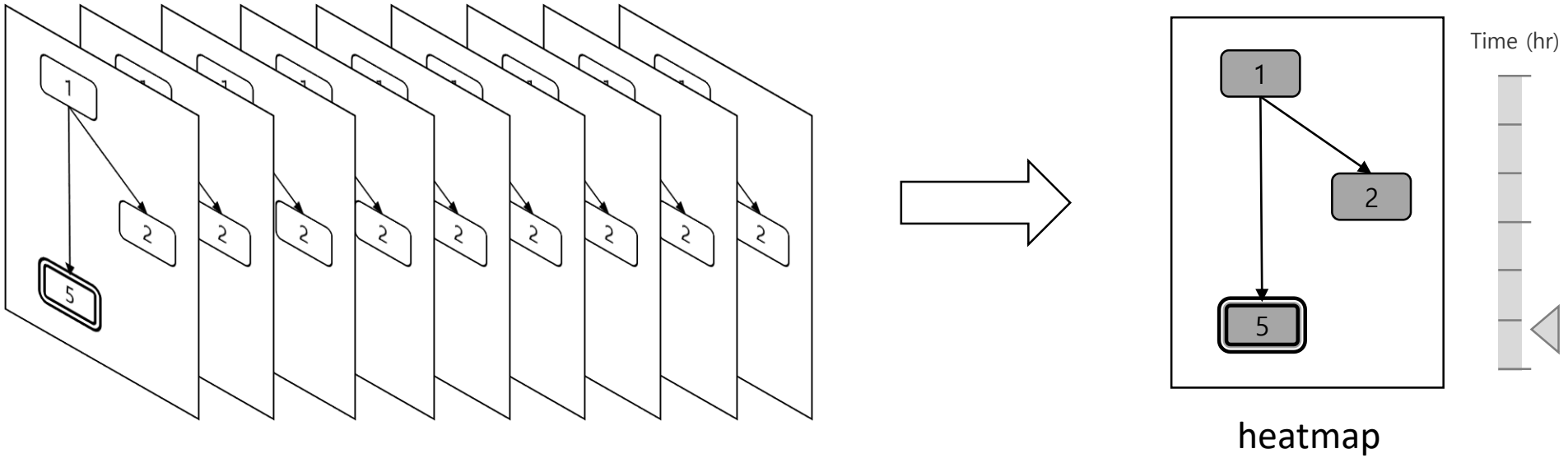
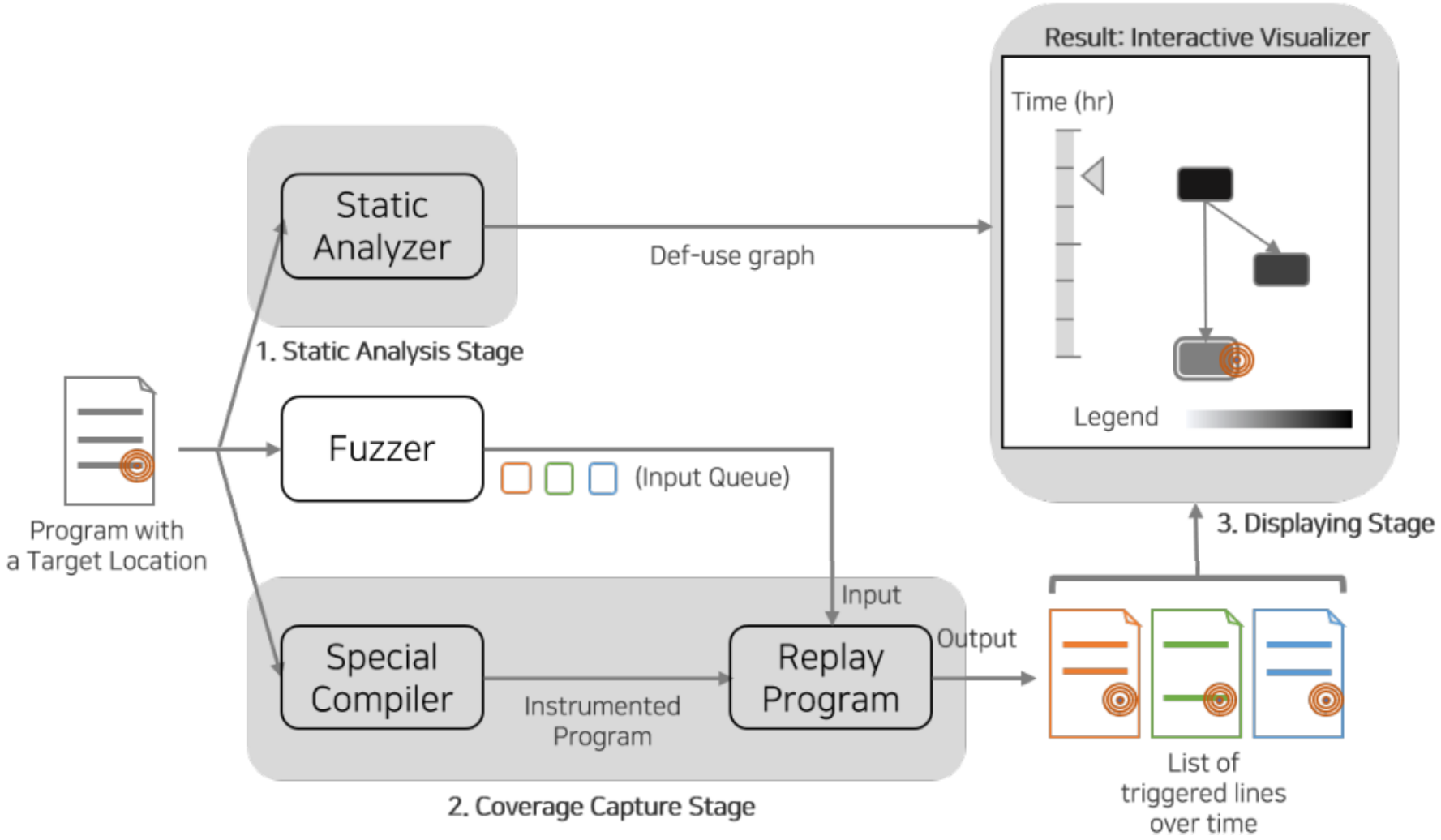


Visualizer Architecture

Visualizer Architecture

Visualizer Architecture



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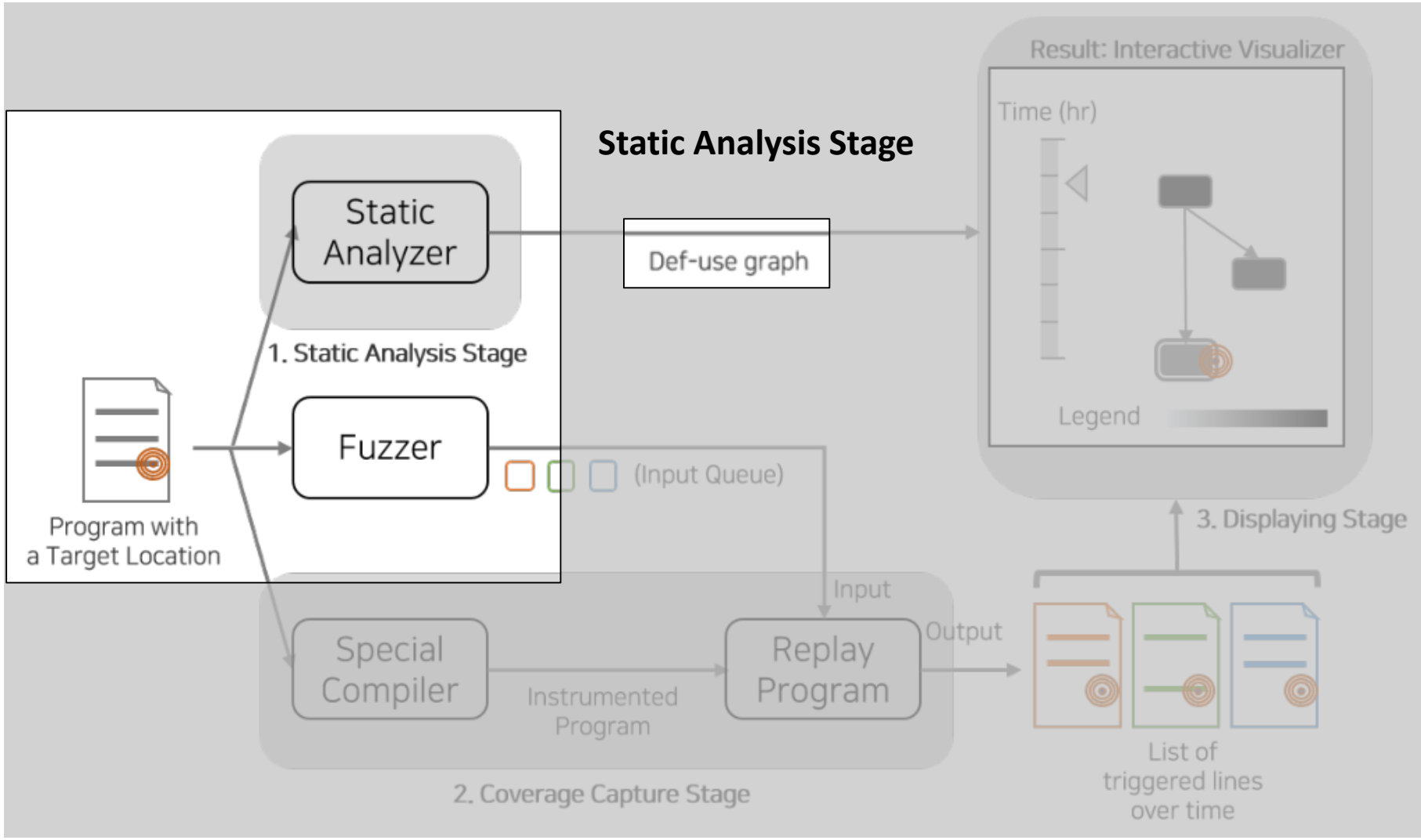
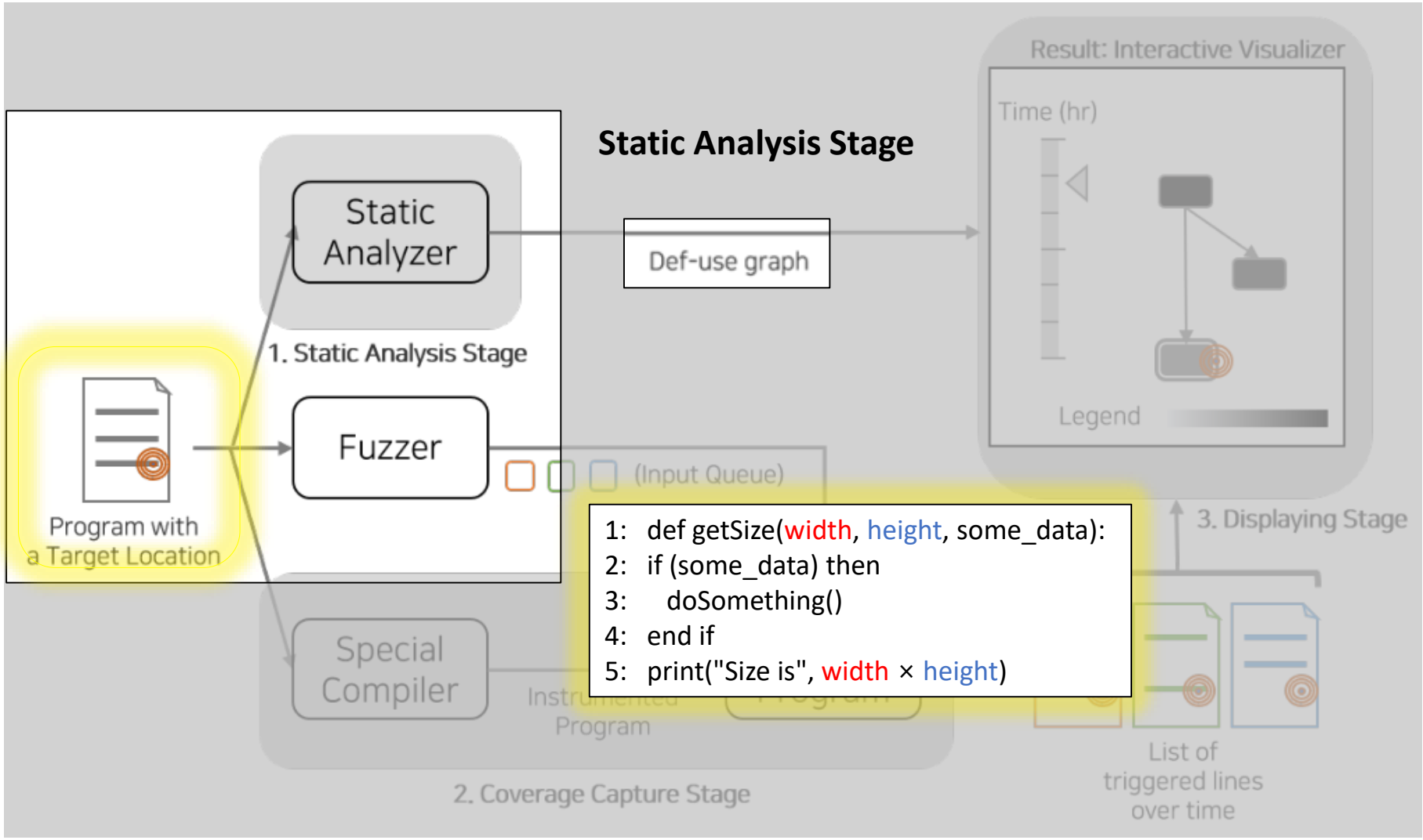
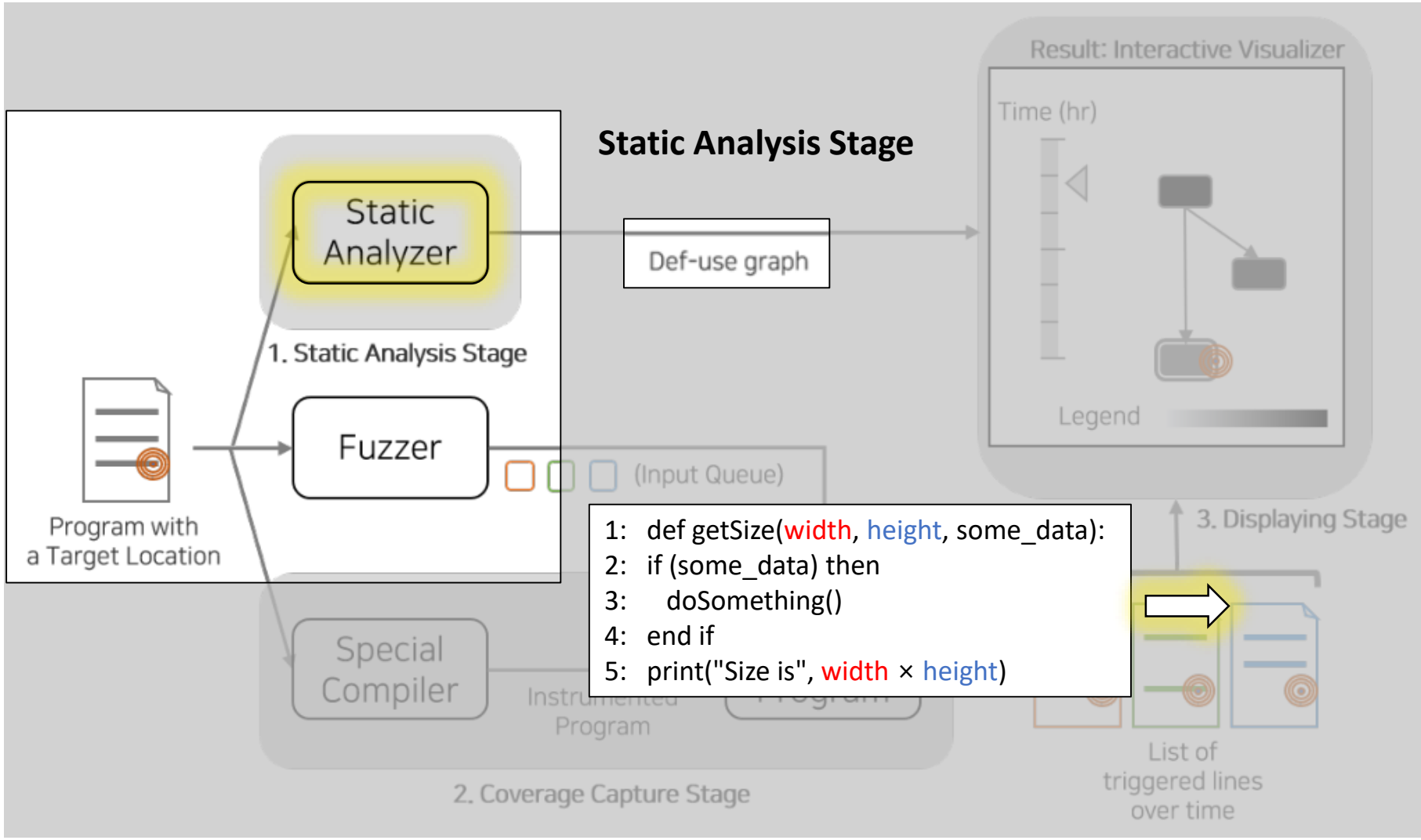


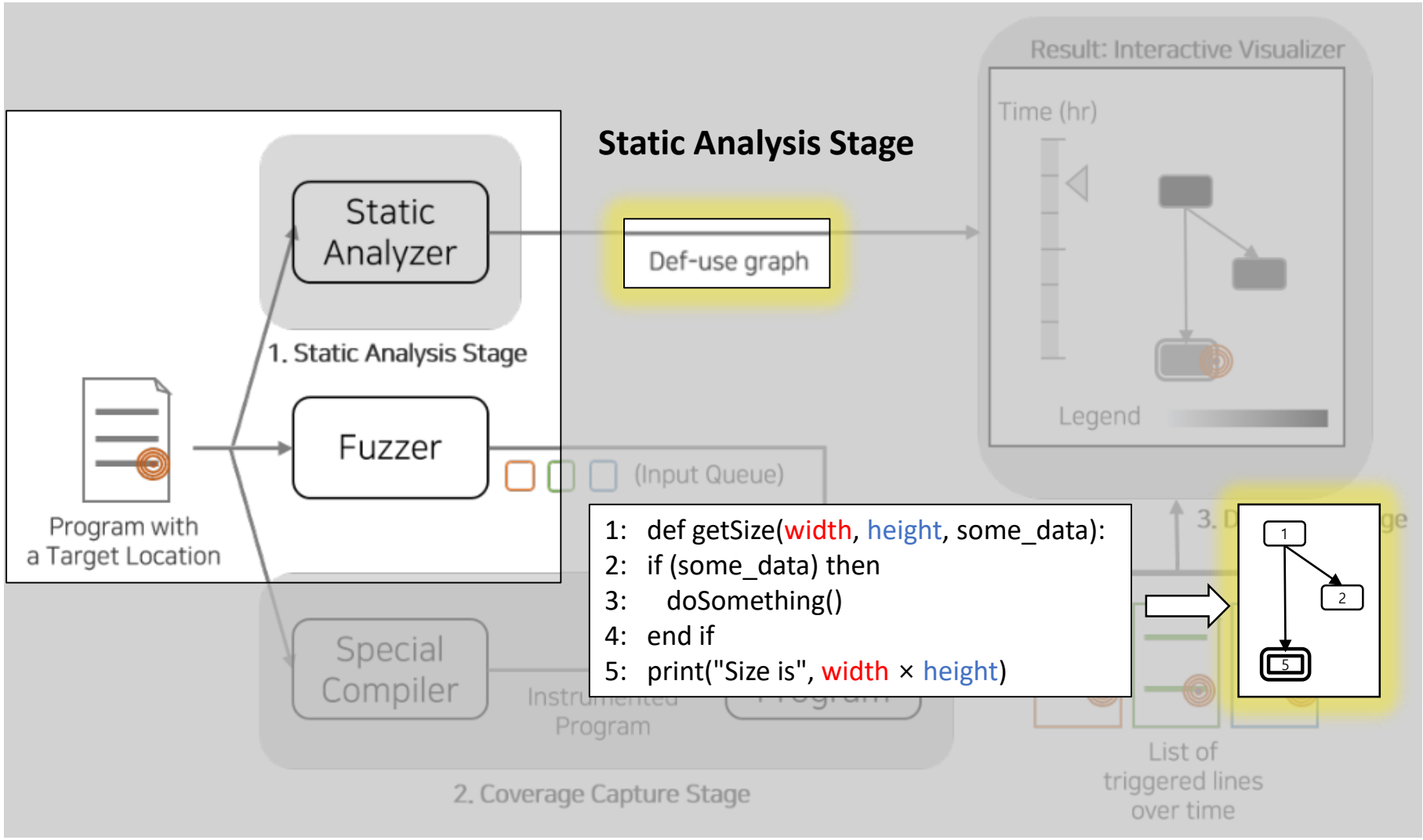
Visualizer Architecture



Visualizer Architecture



Visualizer Architecture



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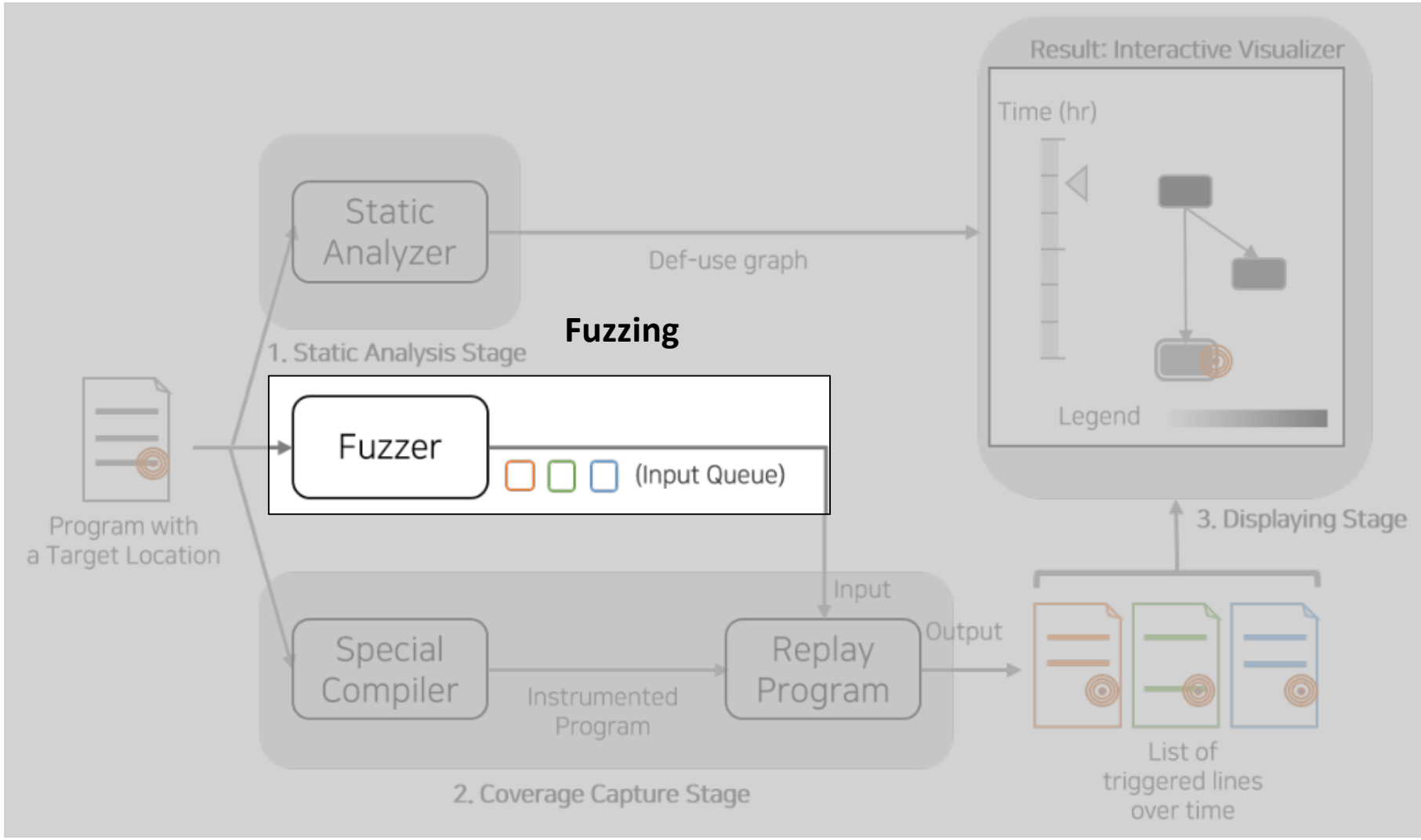

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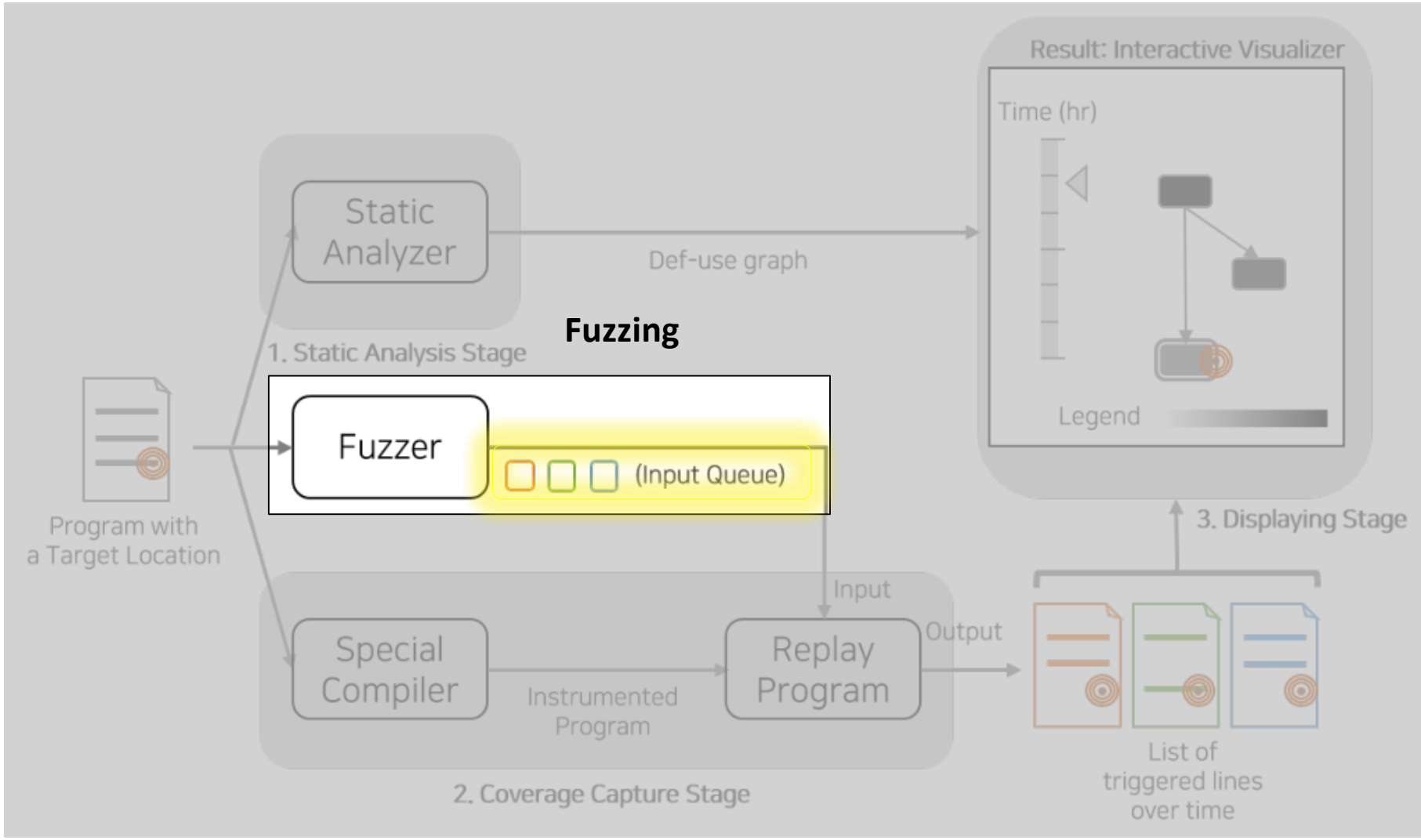

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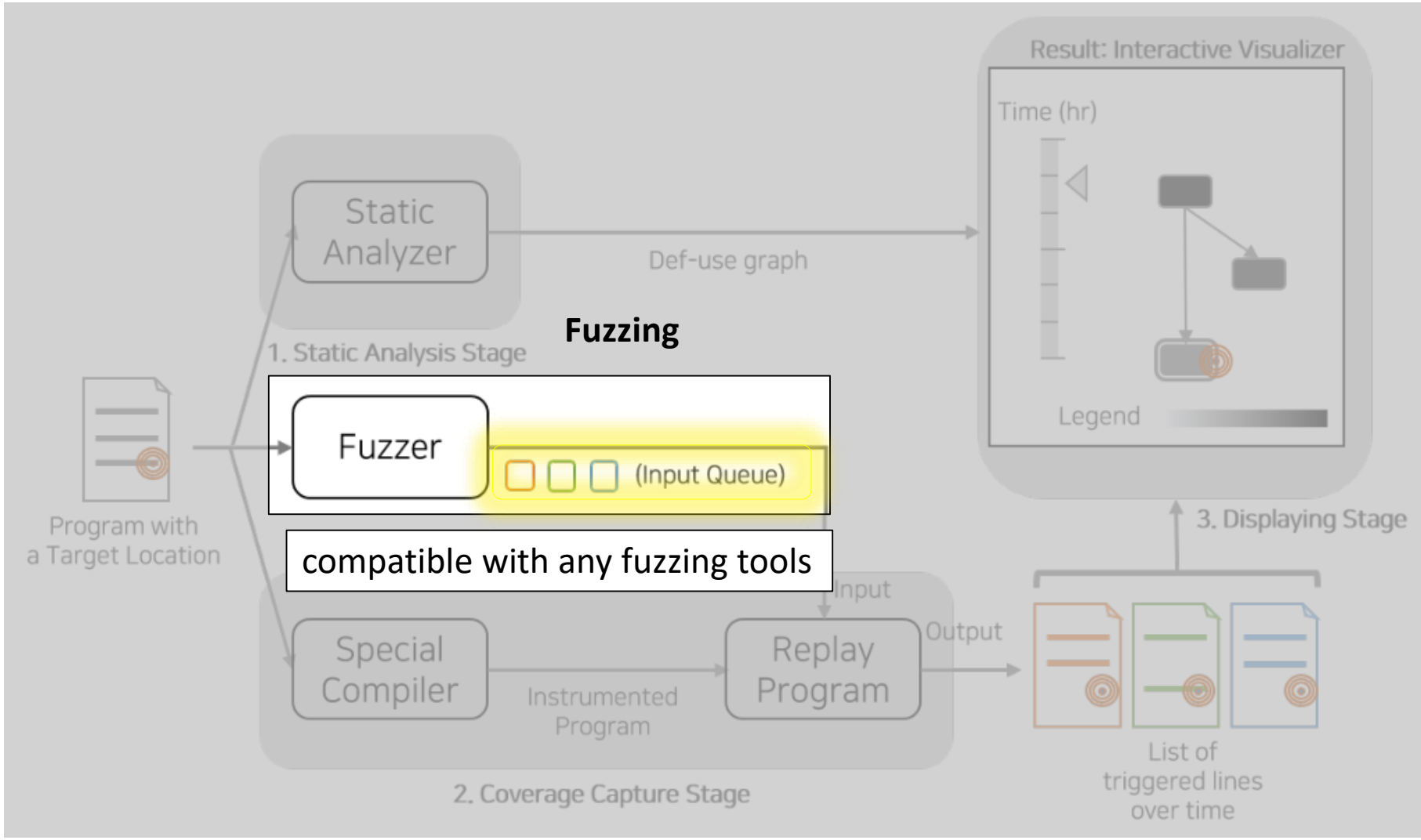

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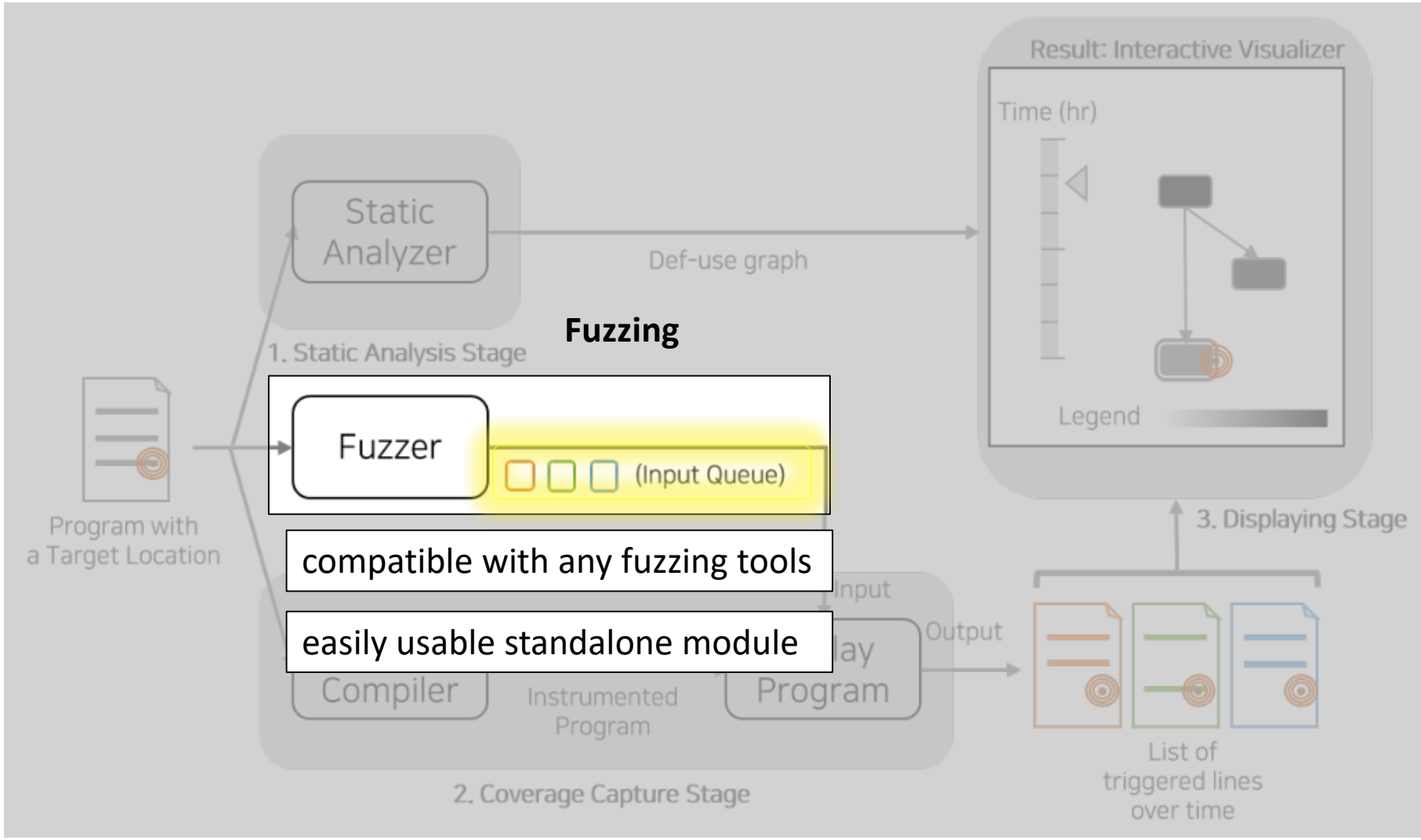

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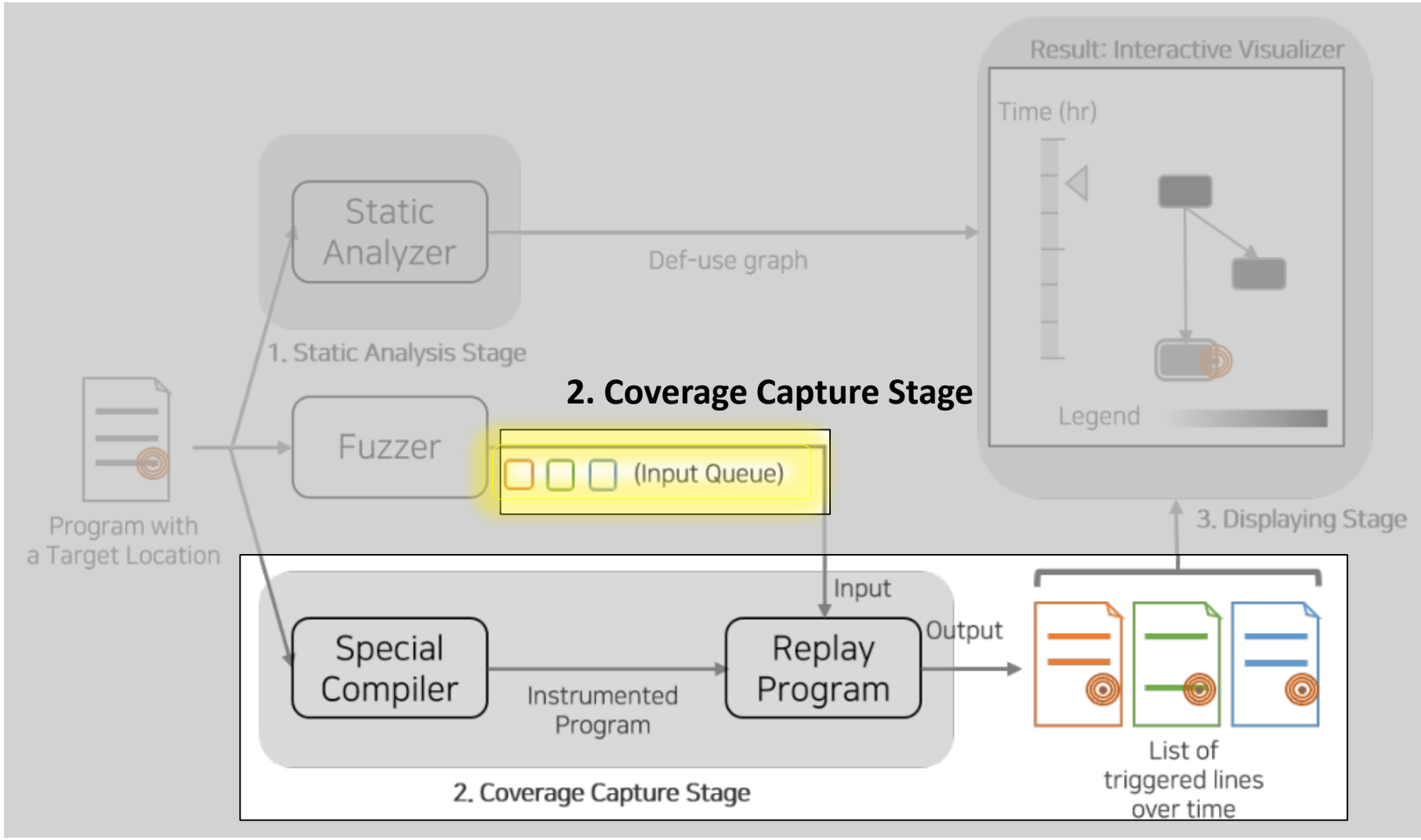
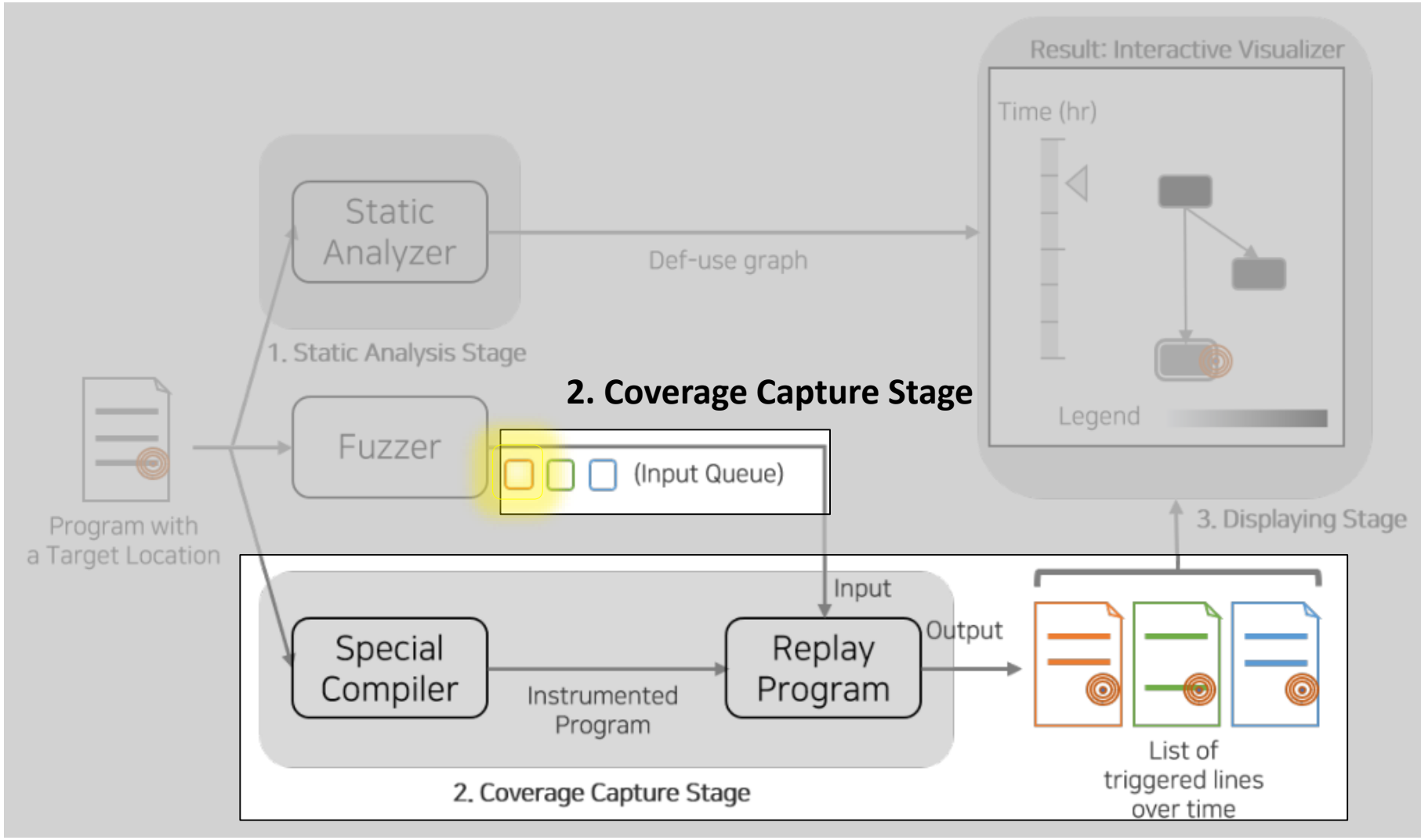


Visualizer Architecture



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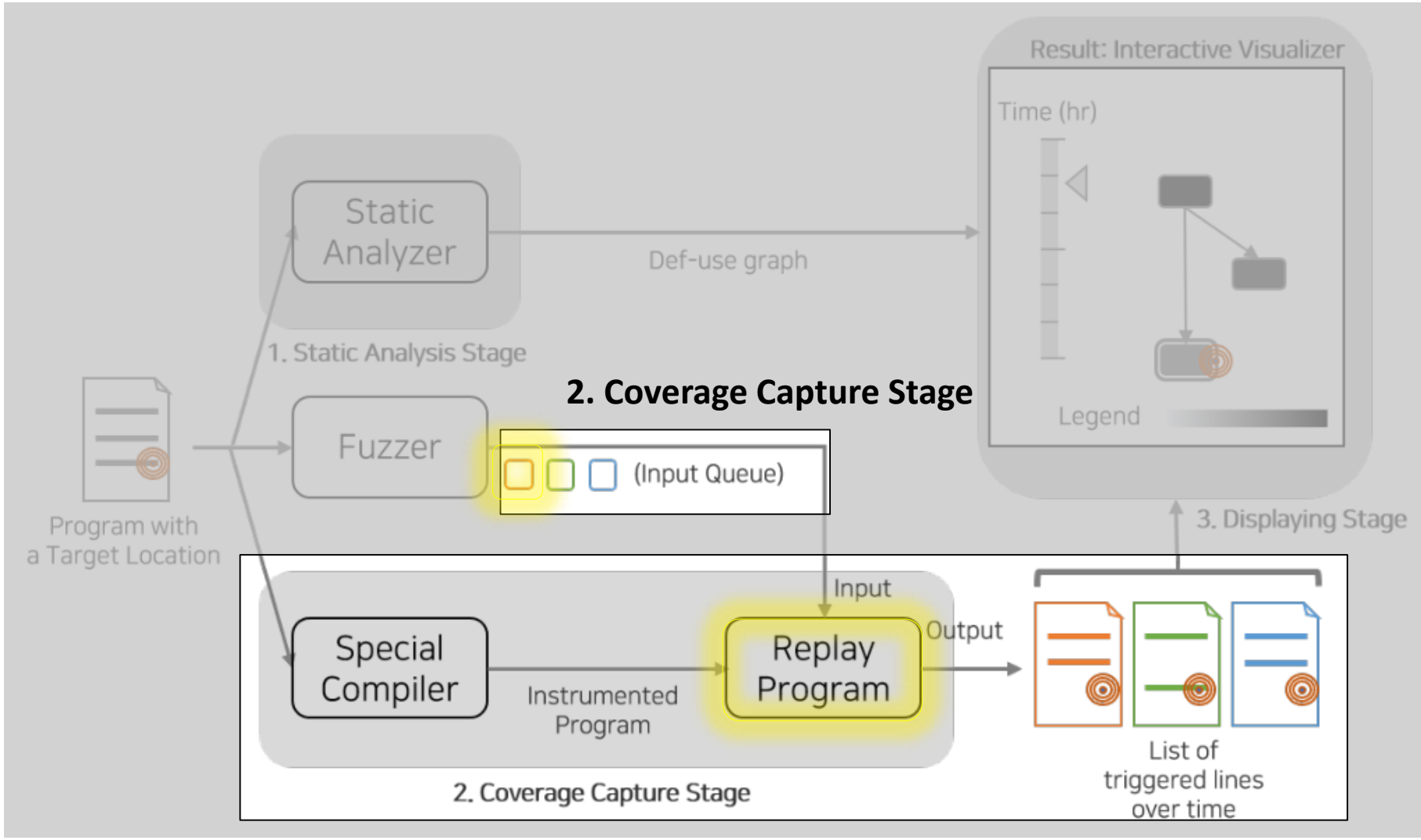
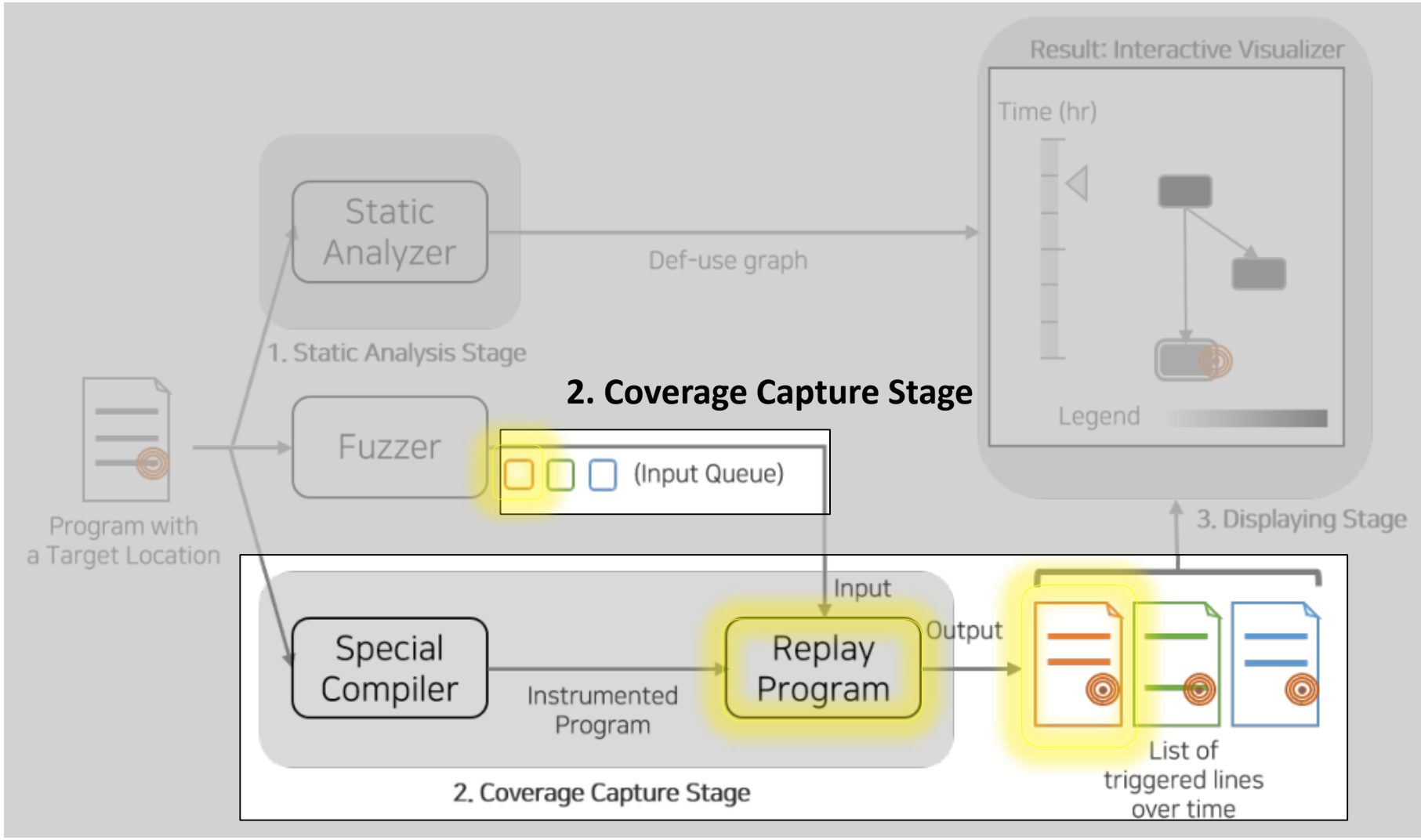
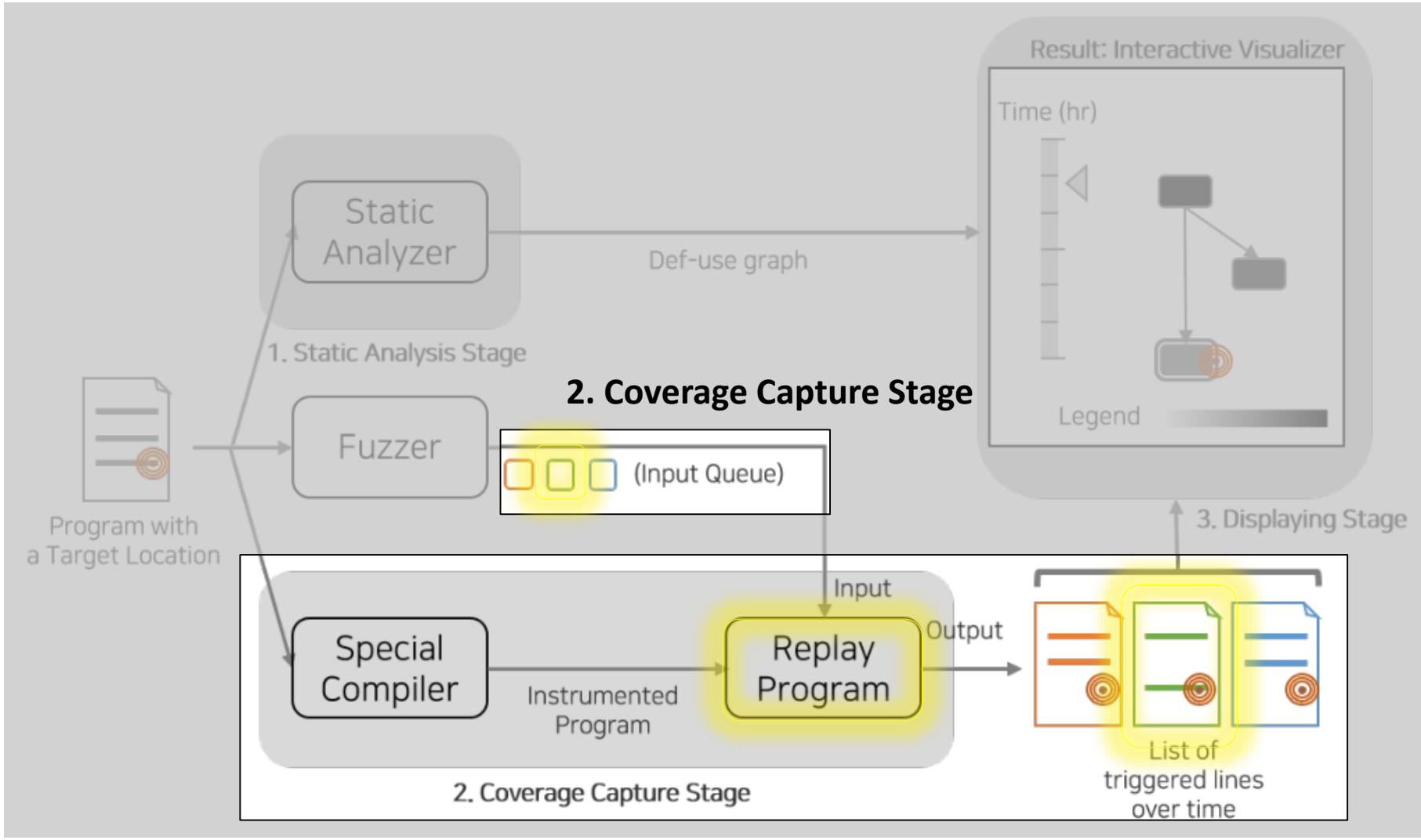


Visualizer Architecture



Visualizer Architecture



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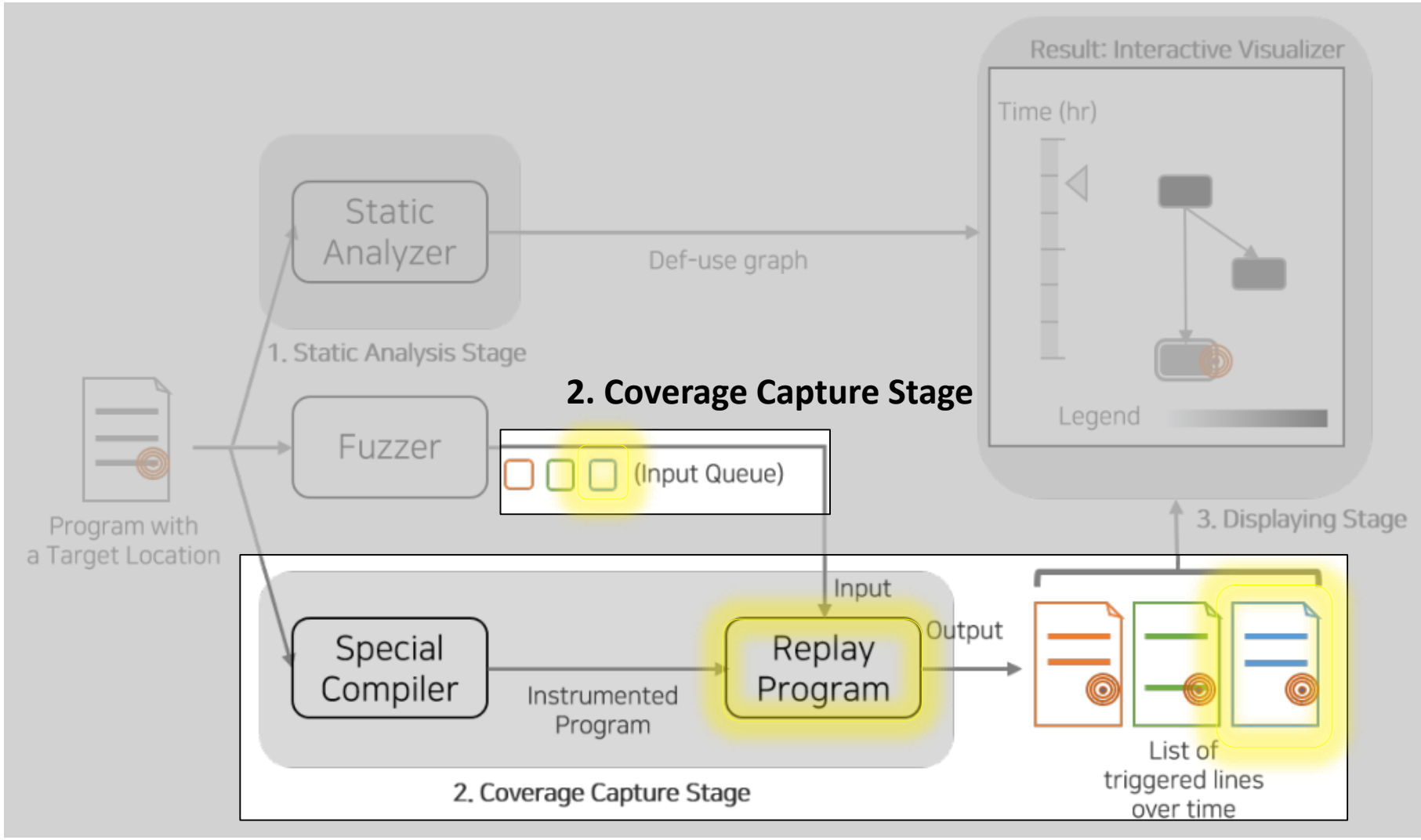
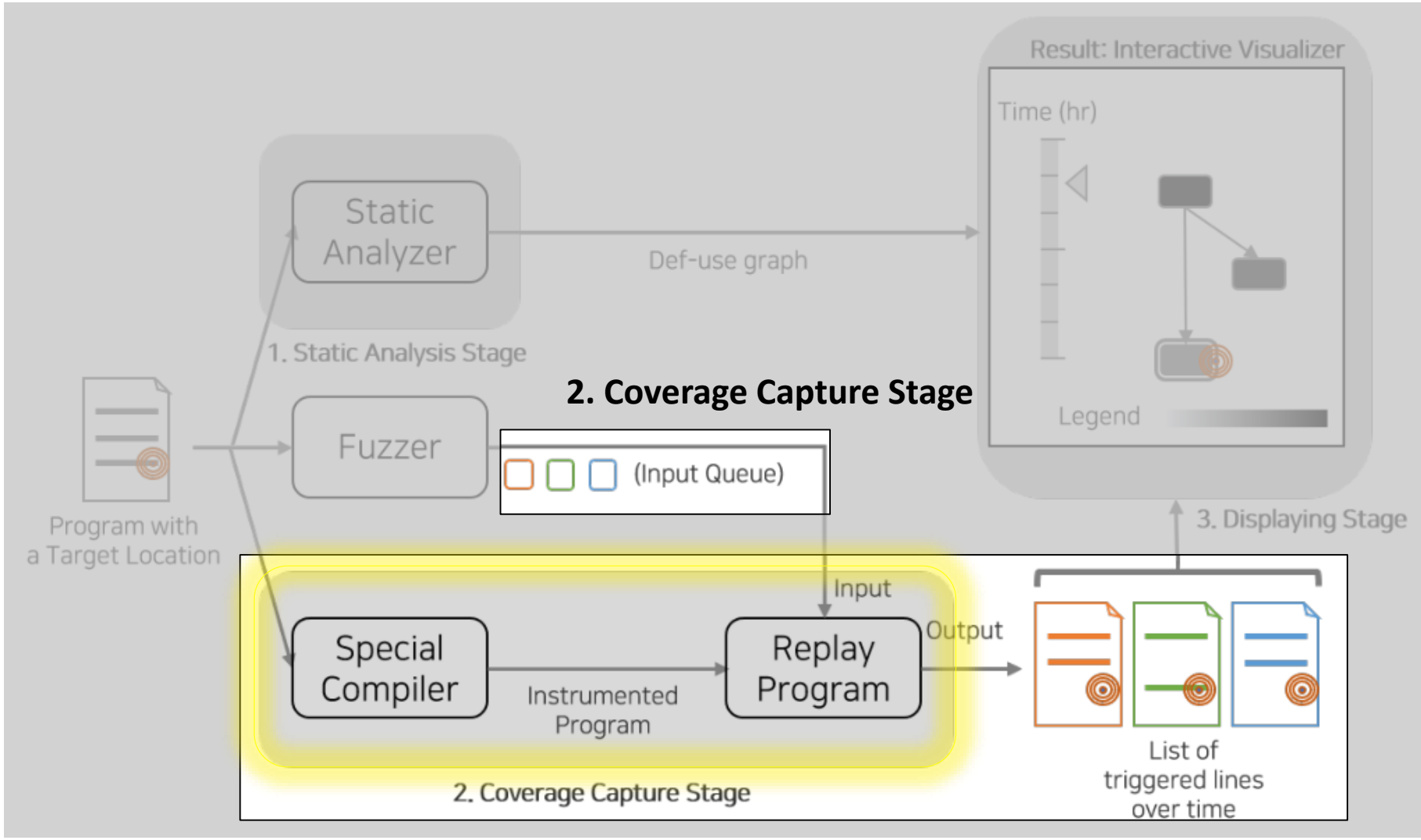


Visualizer Architecture



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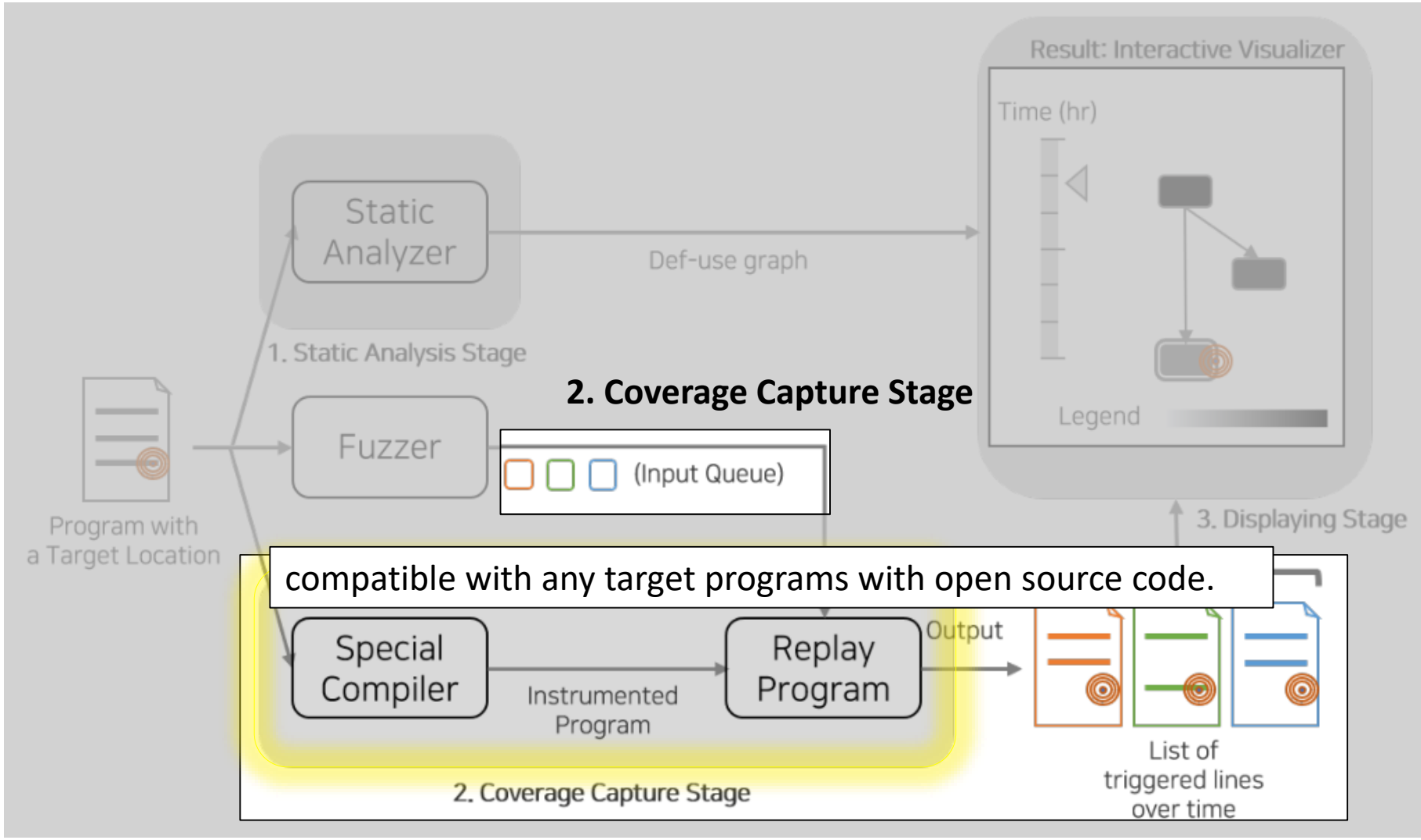
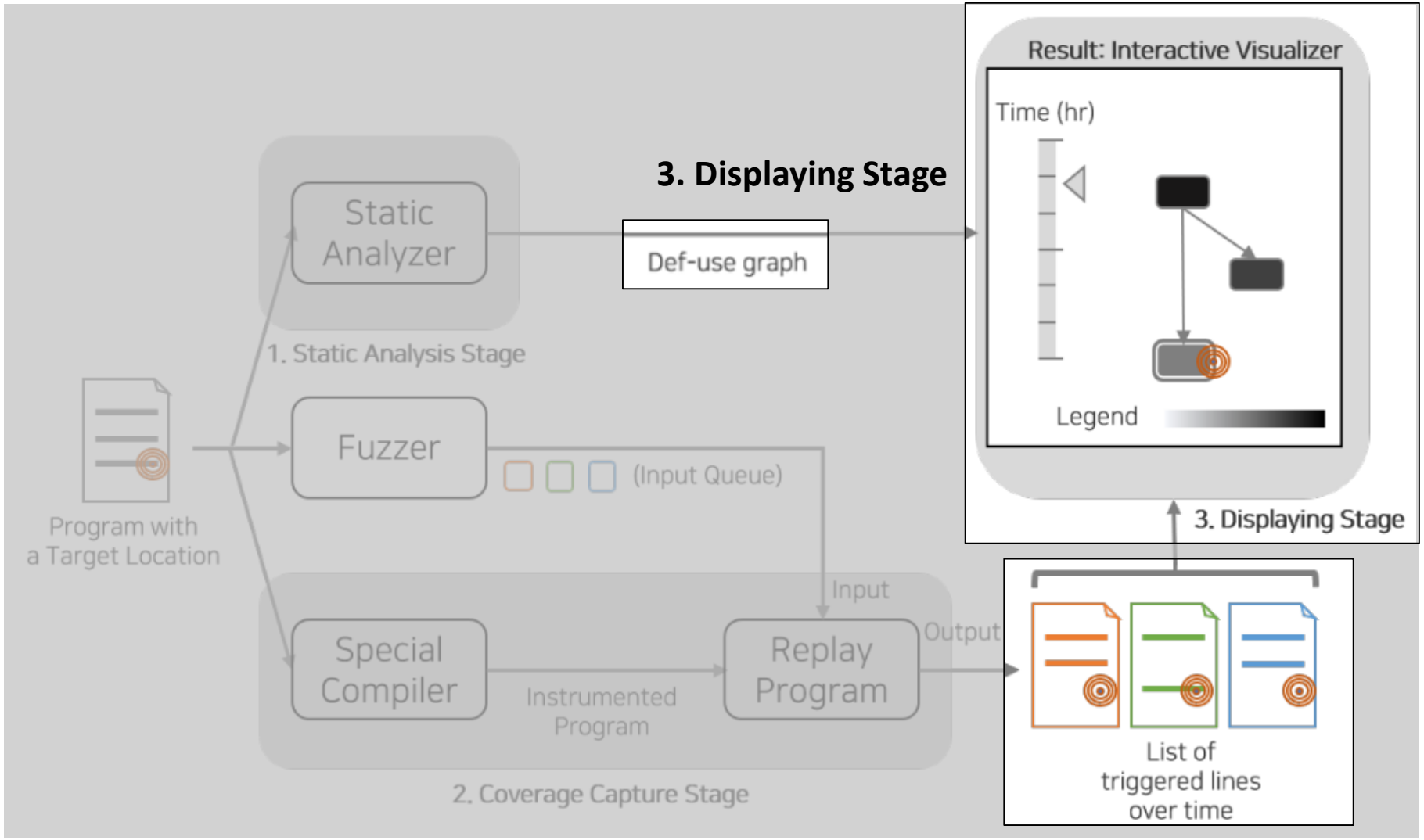
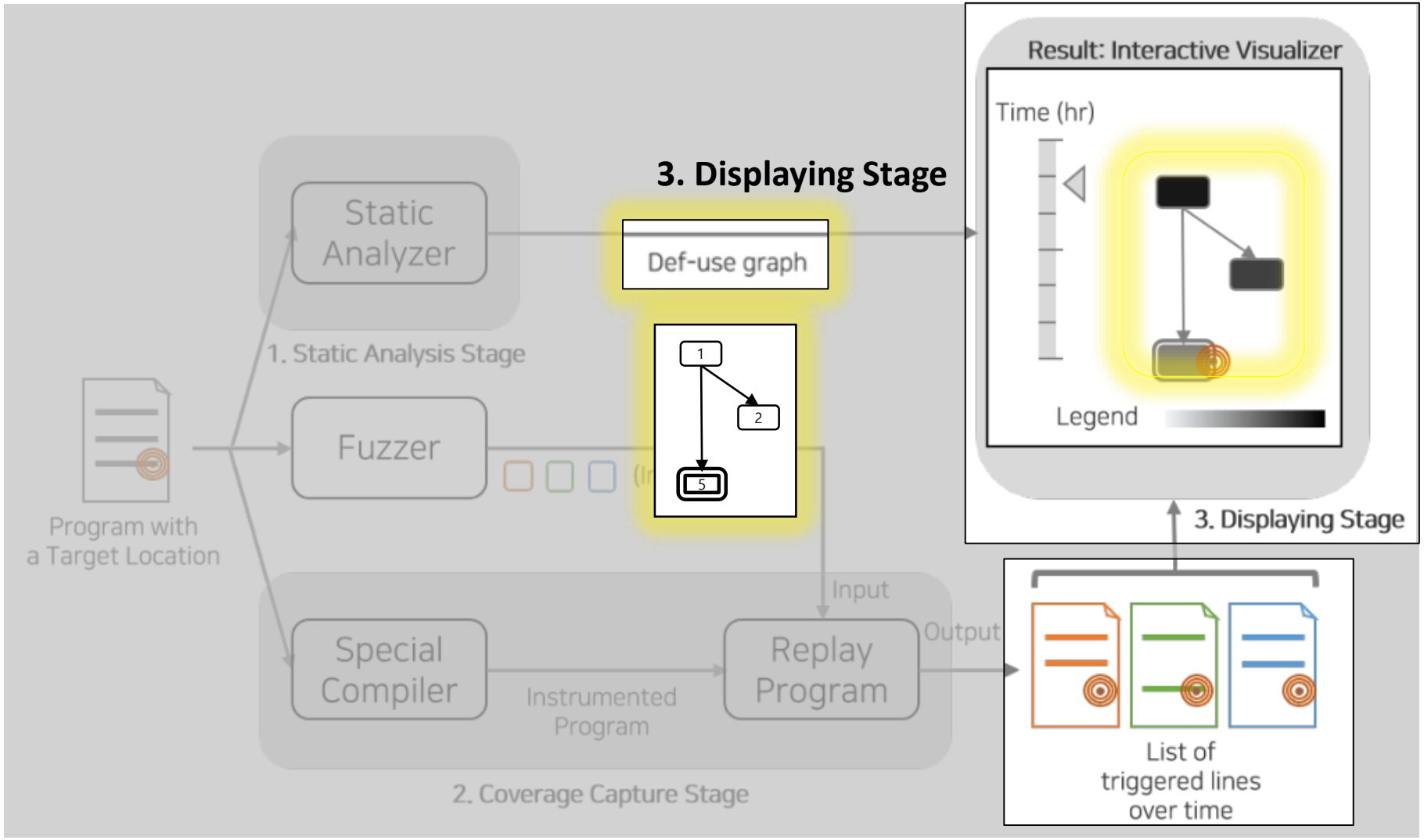


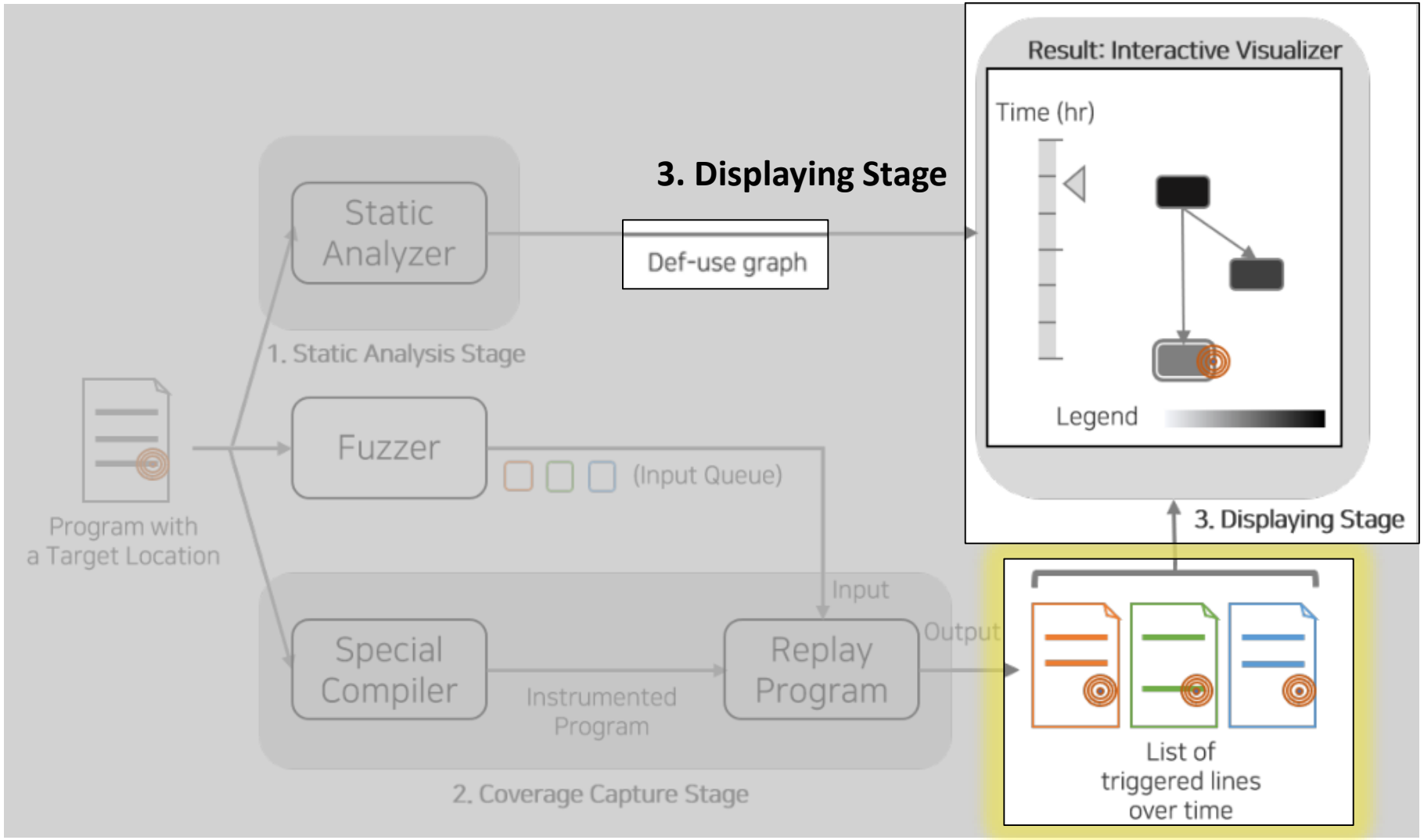
Visualizer Architecture



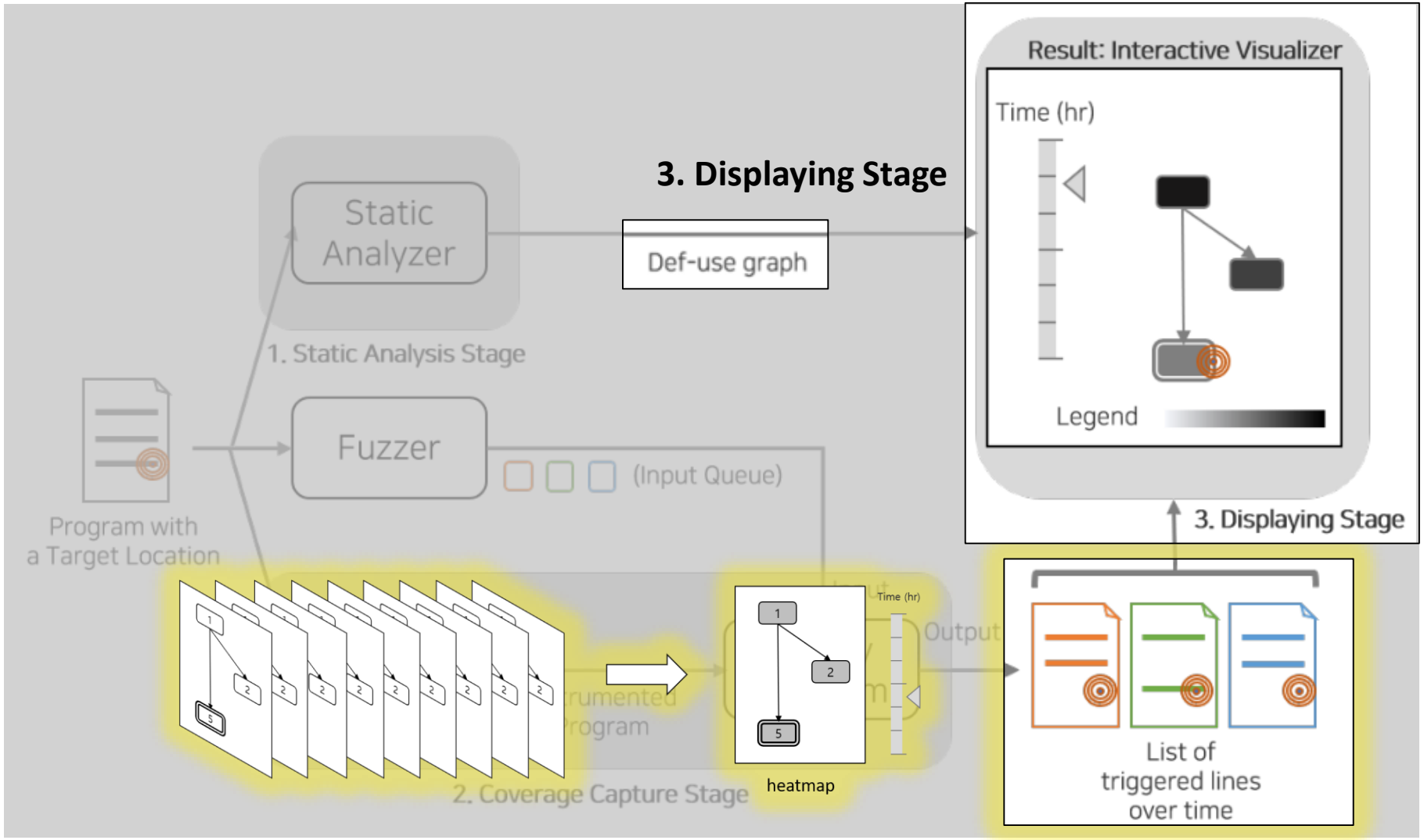
Visualizer Architecture



Visualizer Architecture

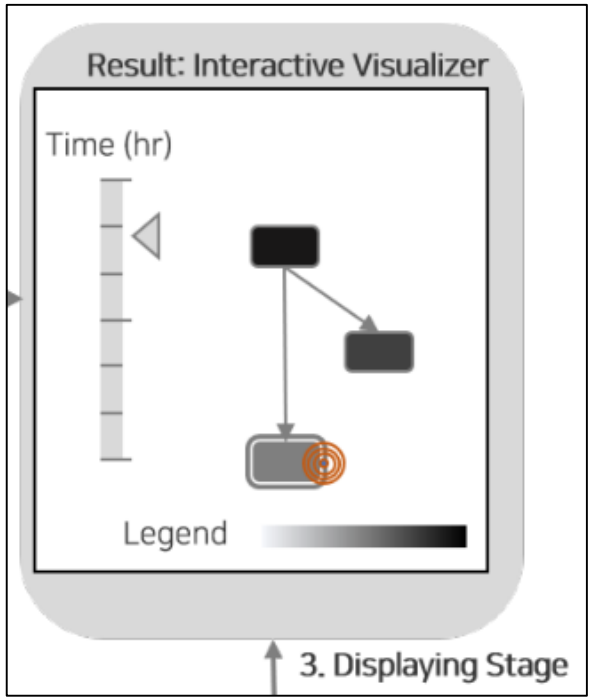


Visualizer Architecture

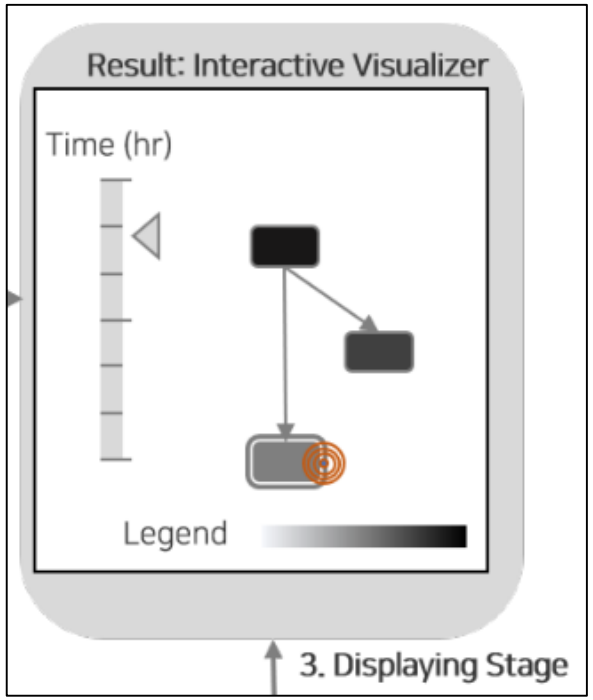


Visualizer Architecture

3. Displaying Stage

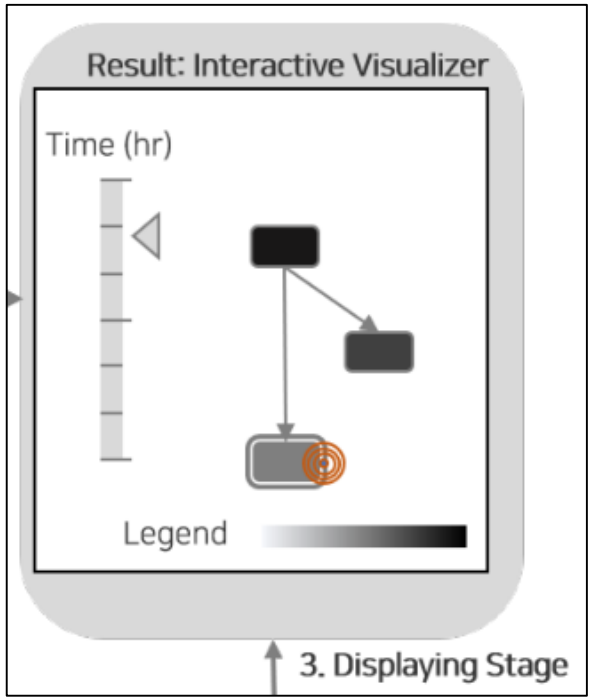


Visualizing more data



Visualizing more data

- More info becomes visible on click.



Visualizing more data

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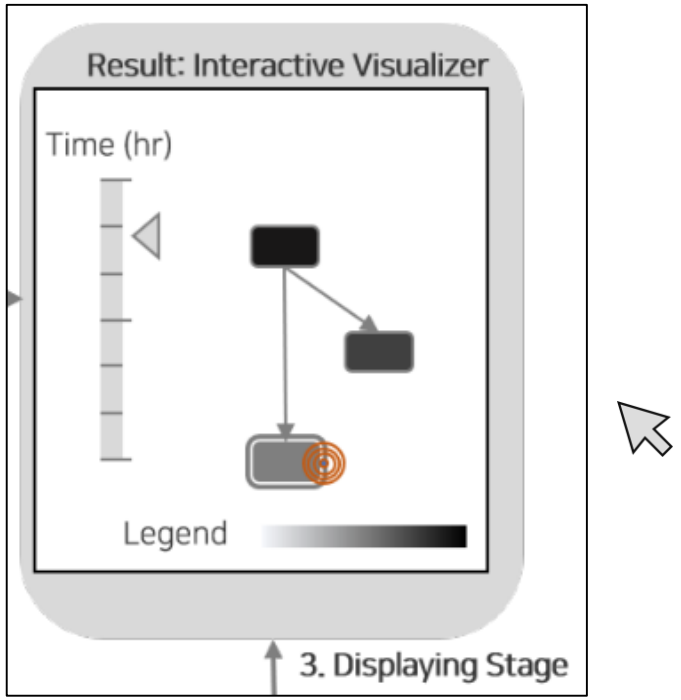

Visualizing more data

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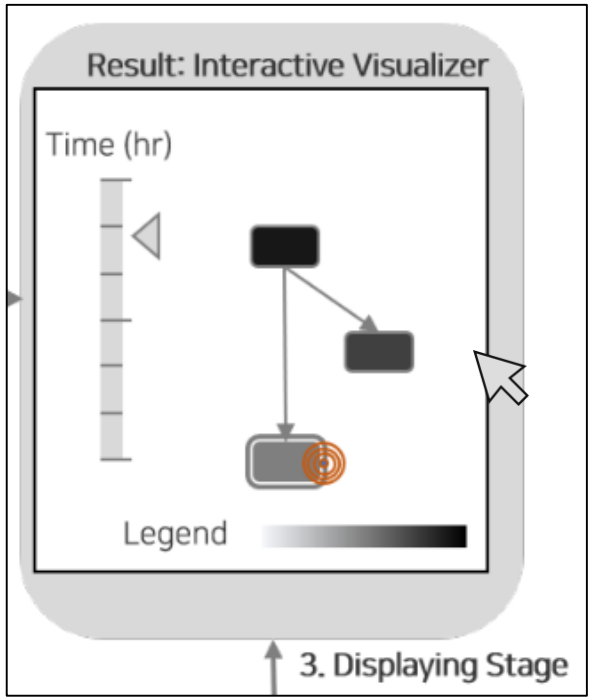

Visualizing more data

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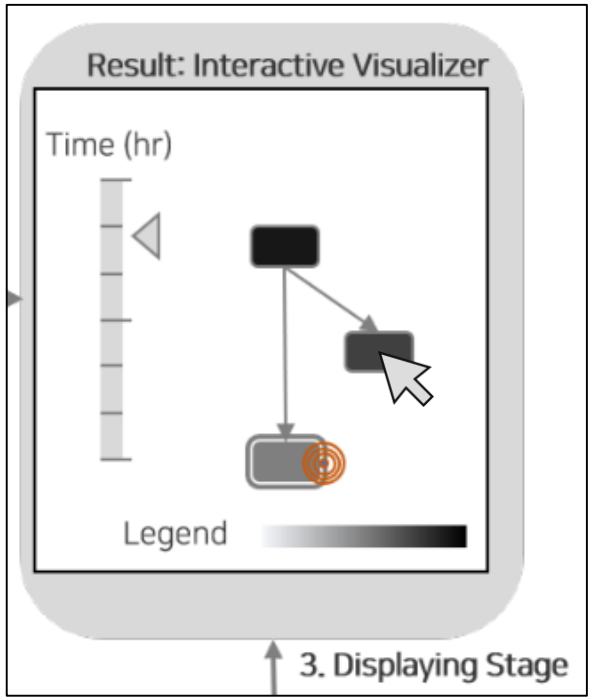

Visualizing more data

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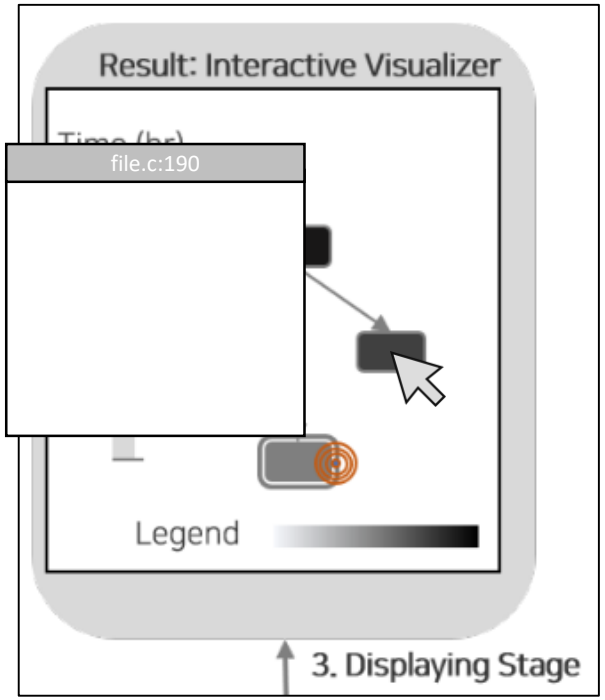

Visualizing more data

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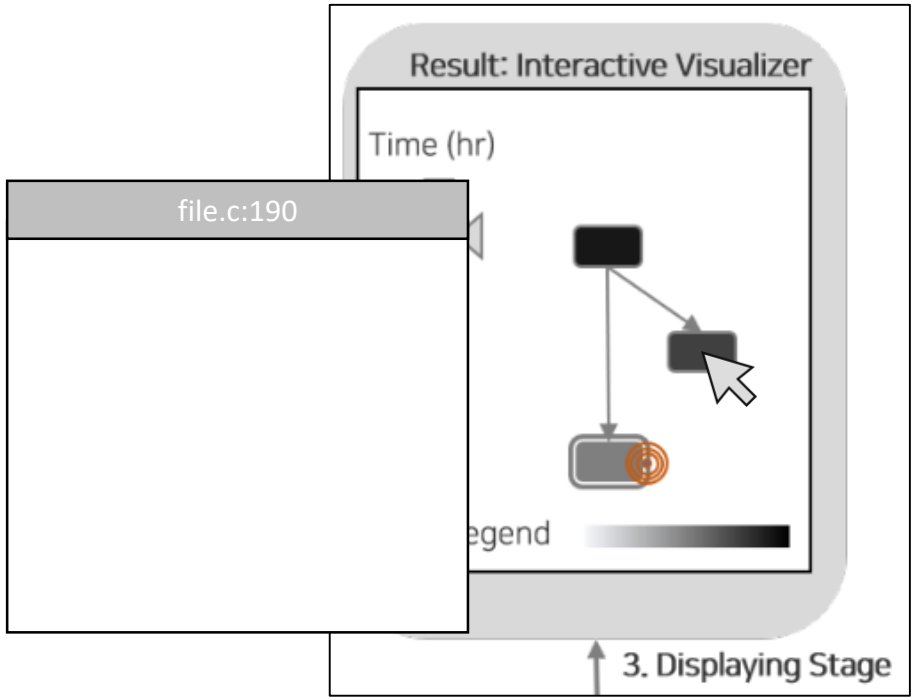

Visualizing more data

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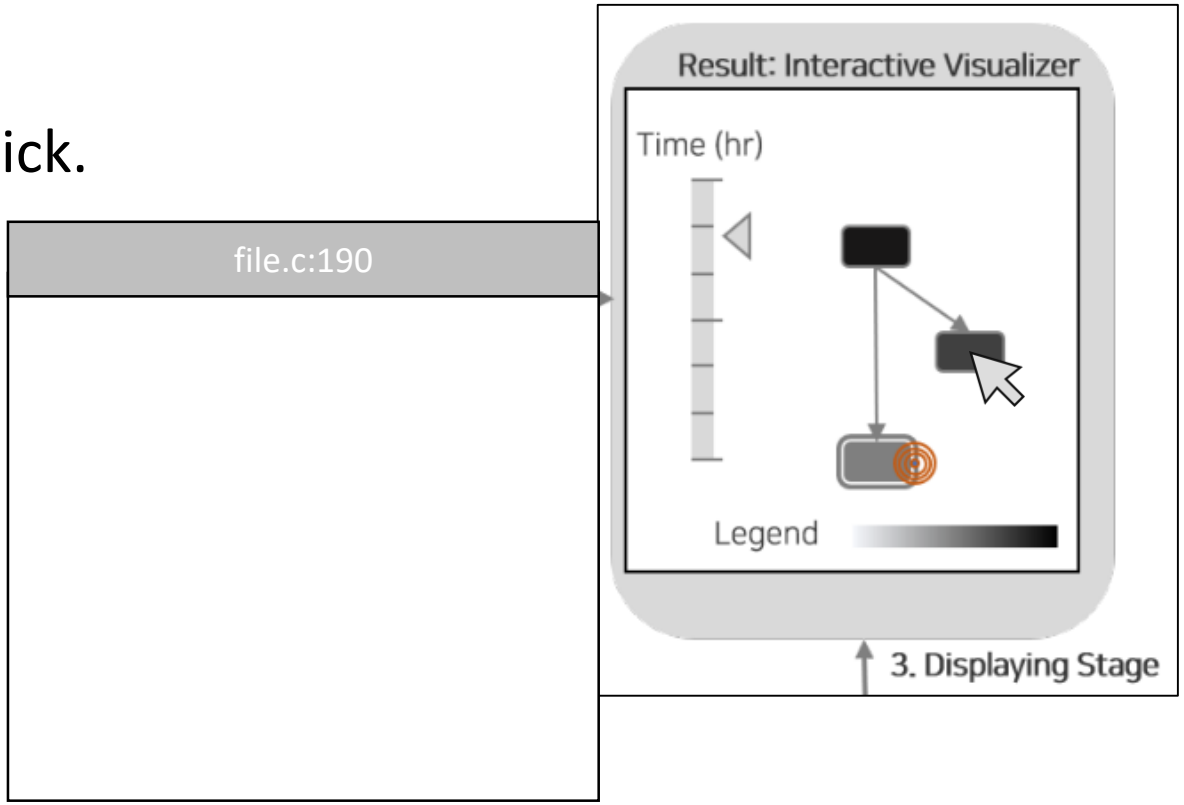

Visualizing more data

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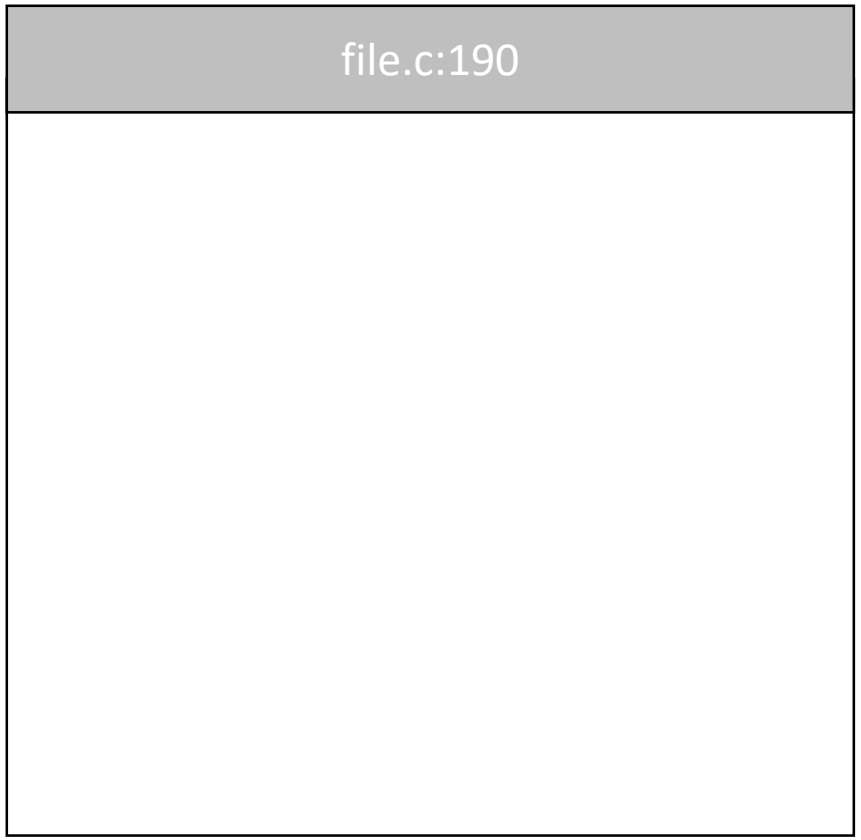
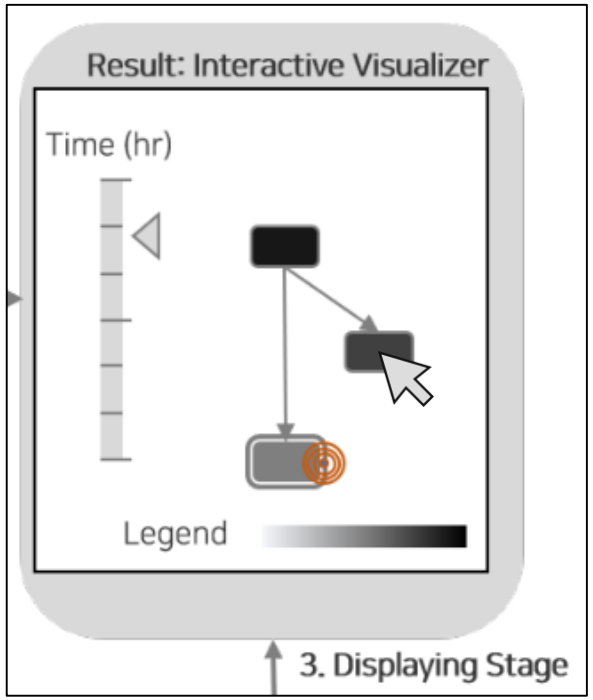
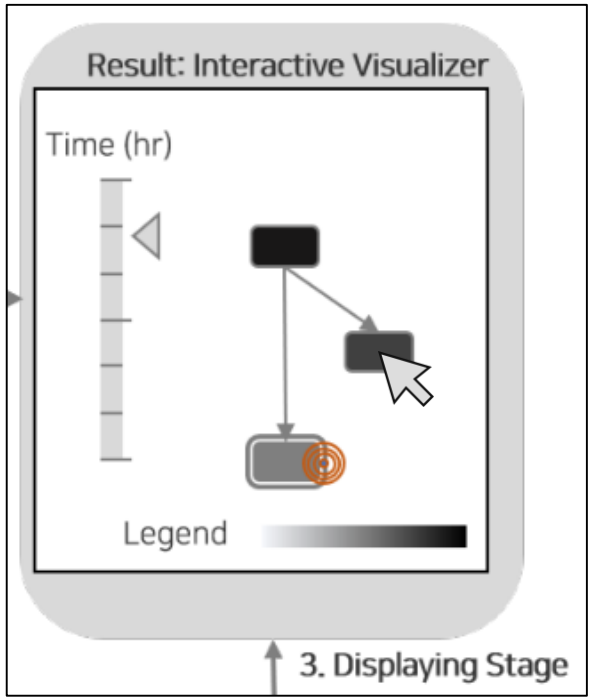




Visualizing more data

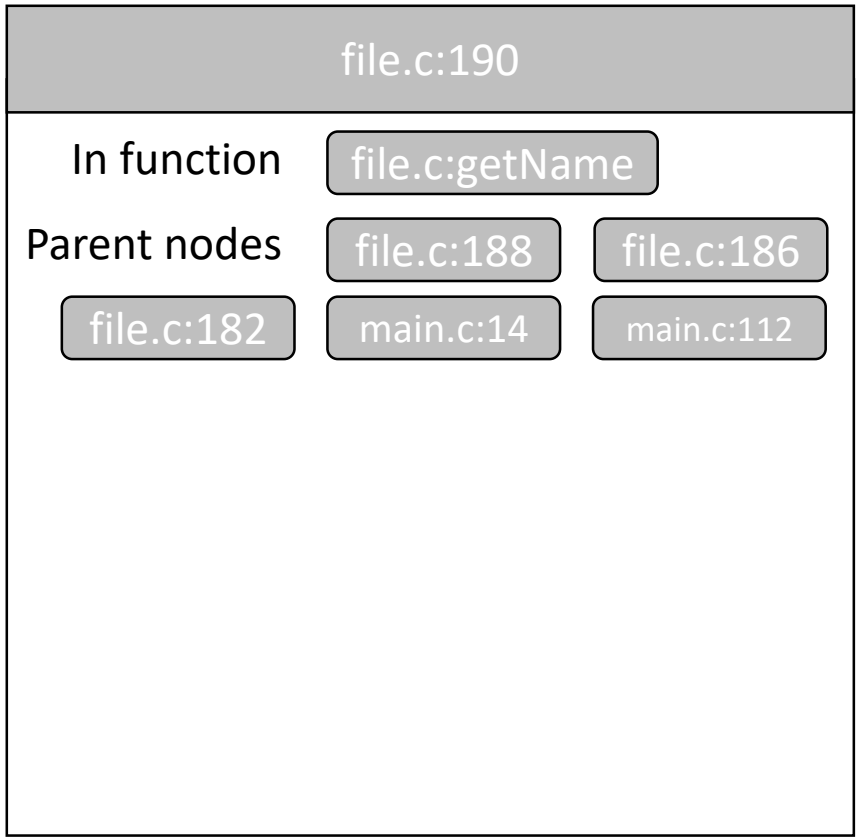
- More info becomes visible on click.
- Function name

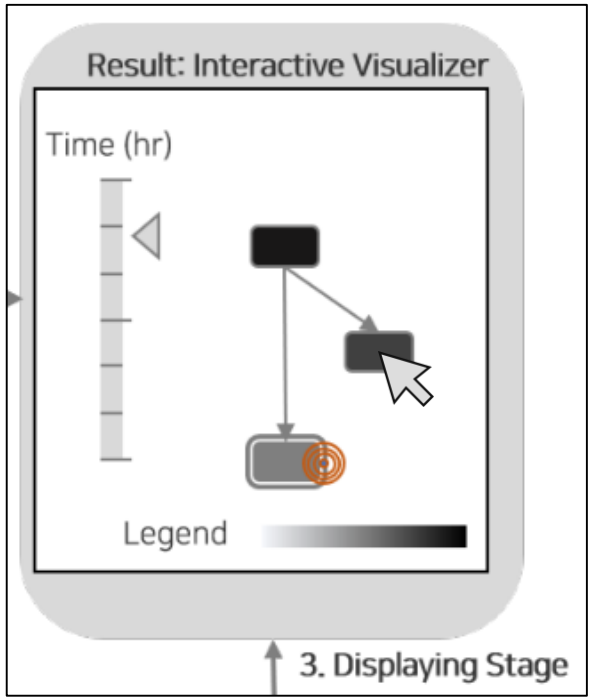


Visualizing more data

- More info becomes visible on click.

- Function name
- Parent nodes





Visualizing more data

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- Function name
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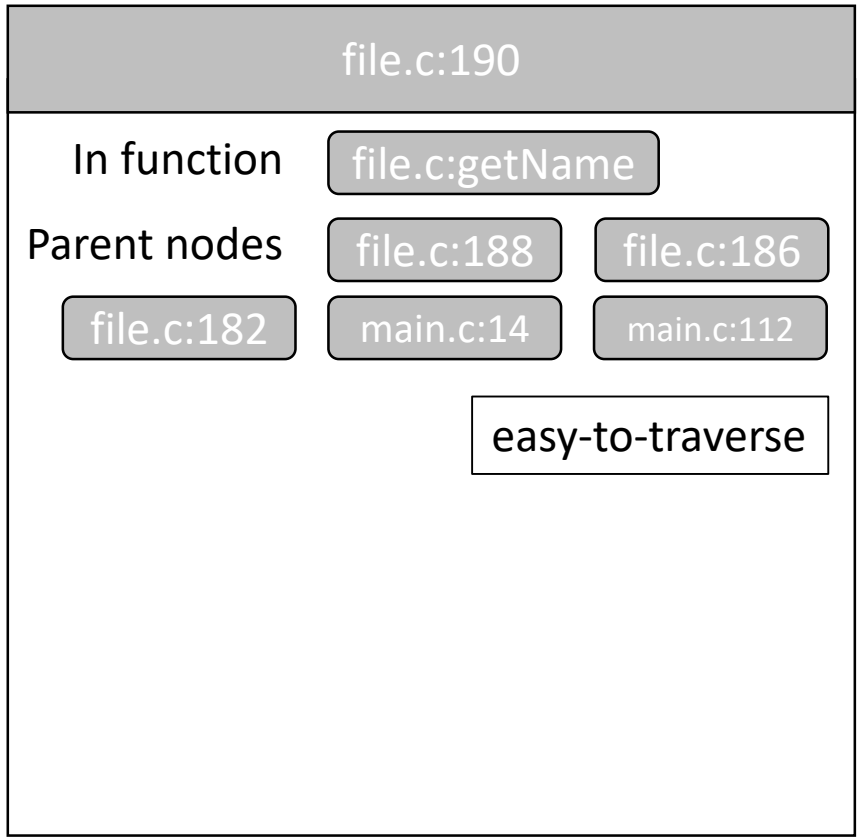
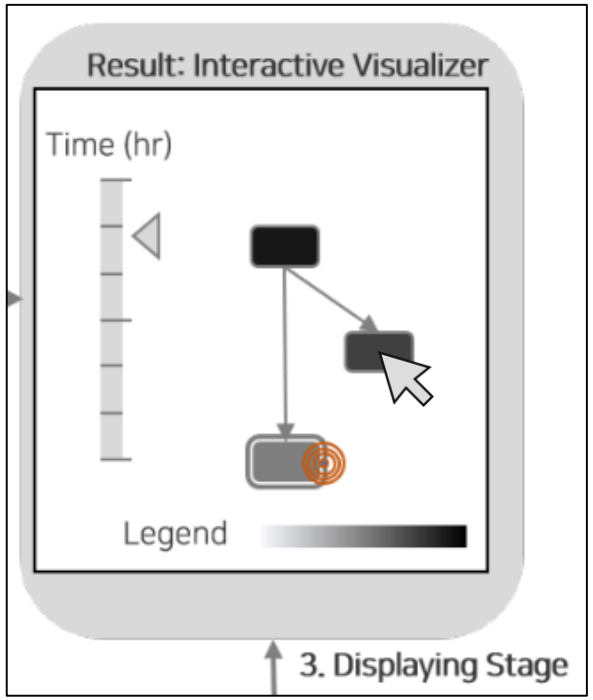
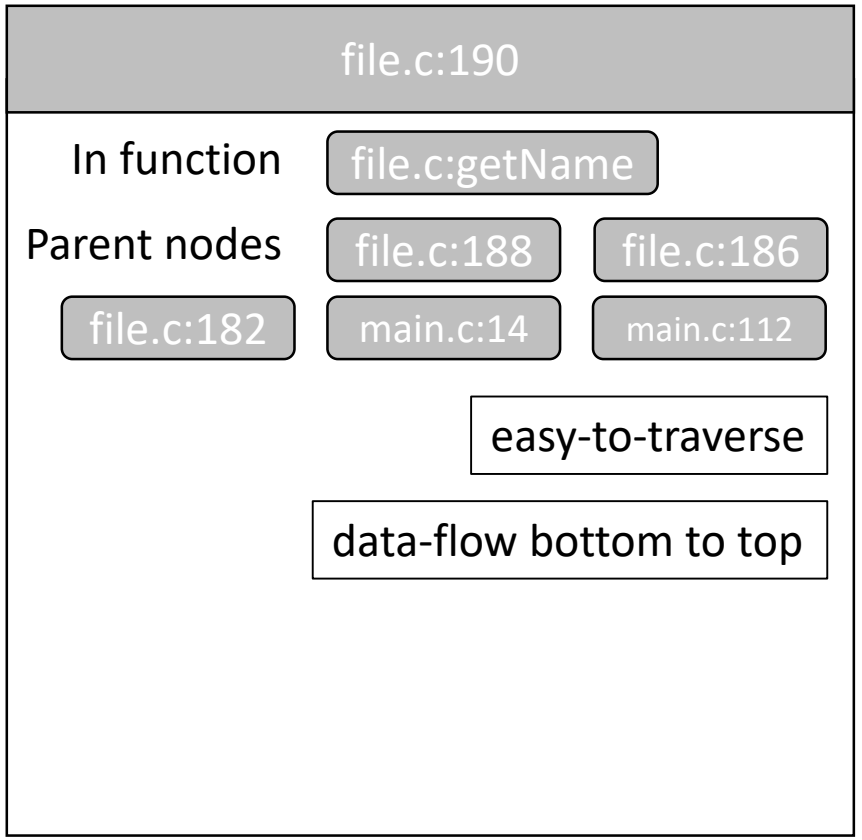


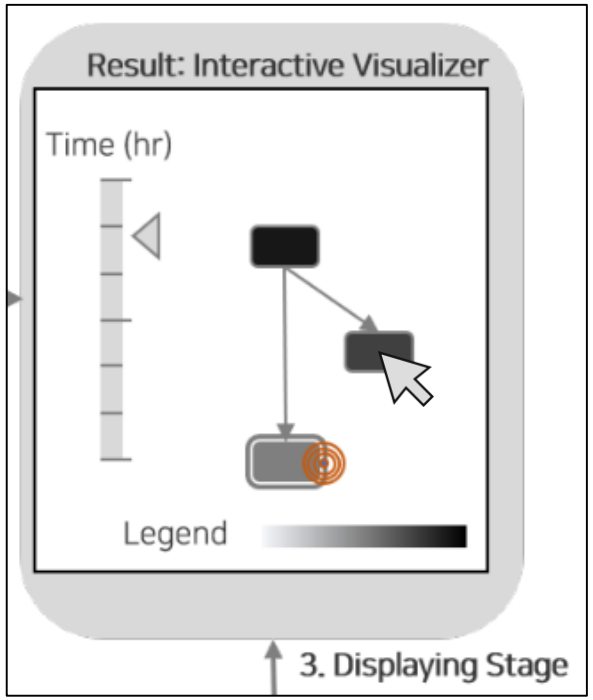


Visualizing more data

- More info becomes visible on click.

- Function name
- Parent nodes

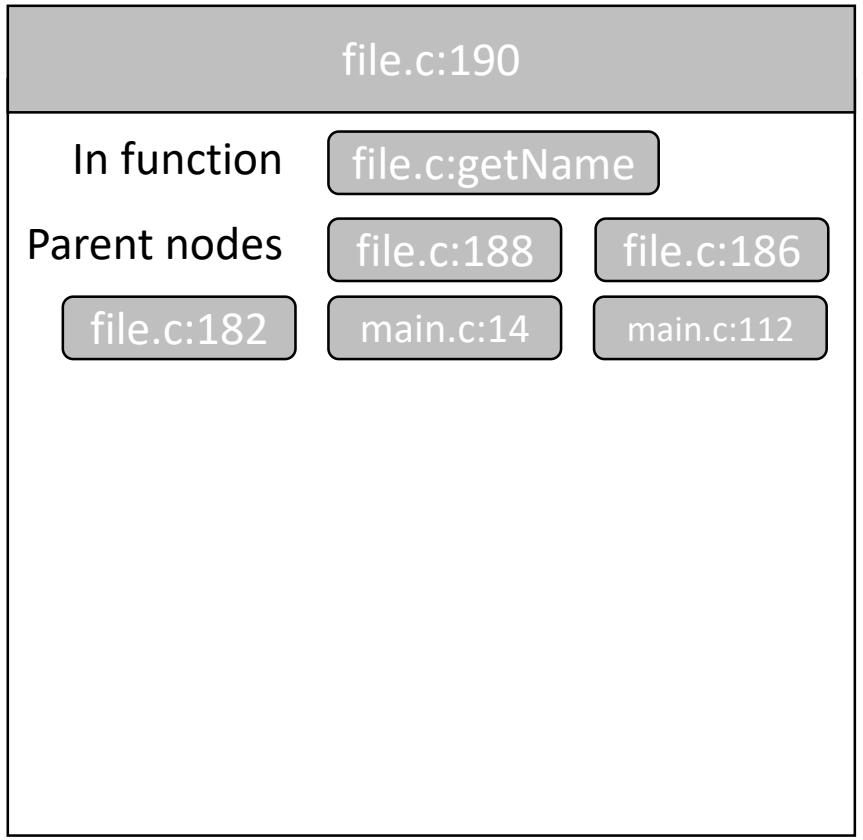


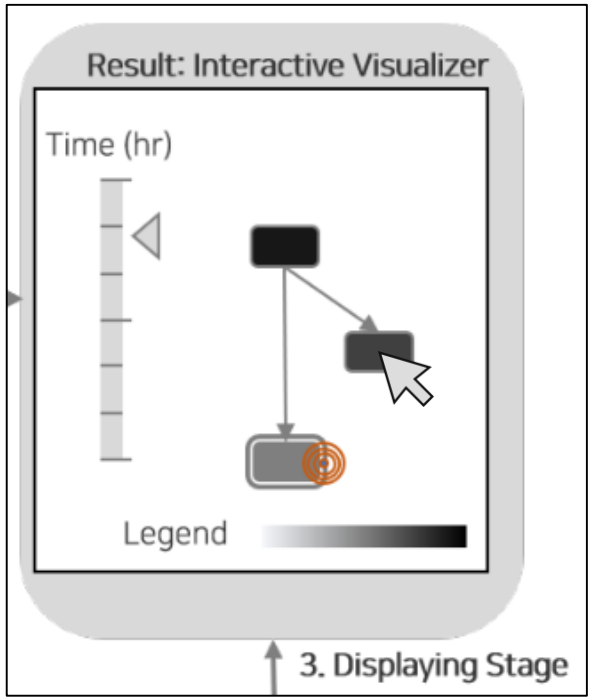


Visualizing more data

- More info becomes visible on click.

- Function name
- Parent nodes

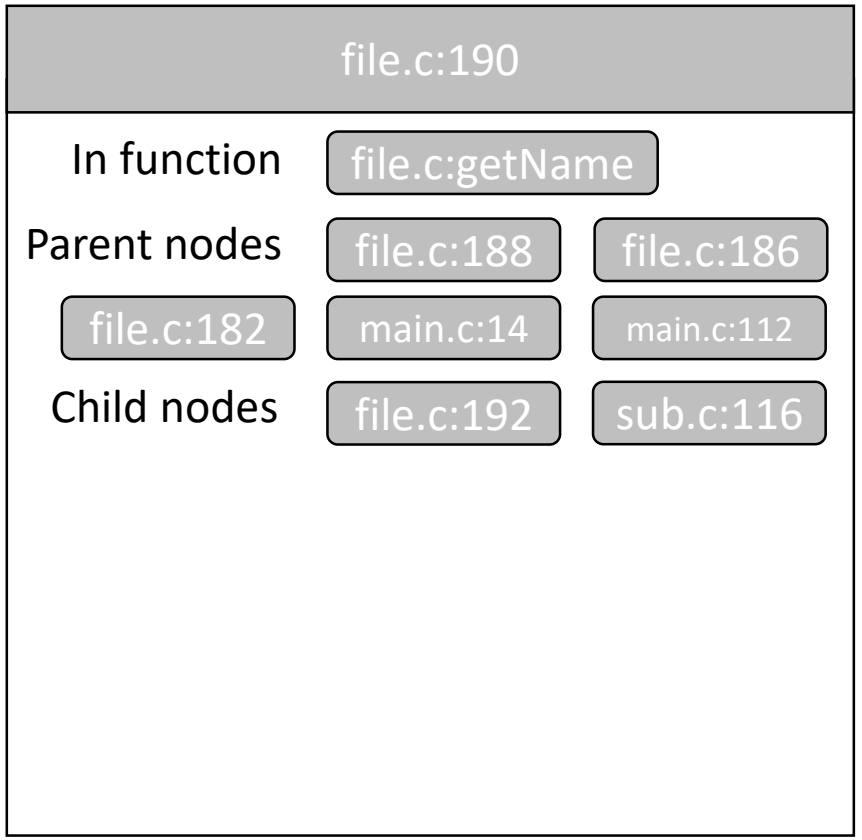


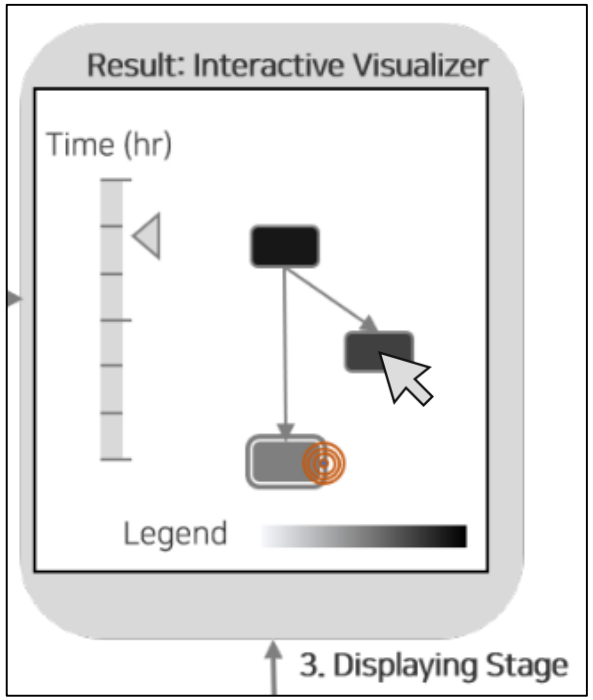


Visualizing more data

- More info becomes visible on click.

- Function name
- Parent nodes
- Child nodes

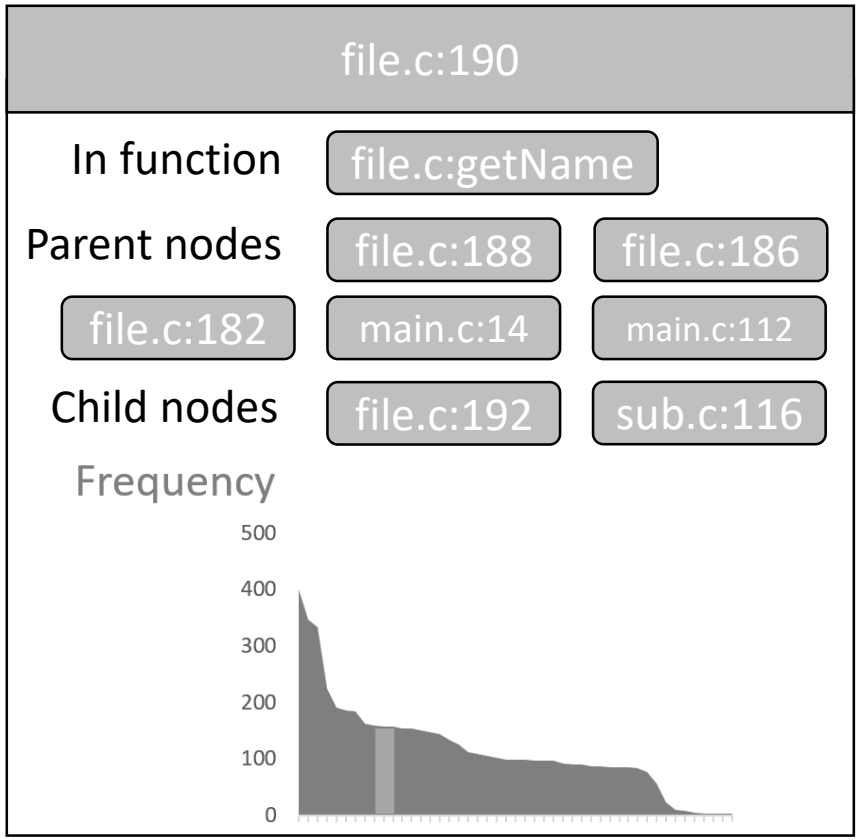


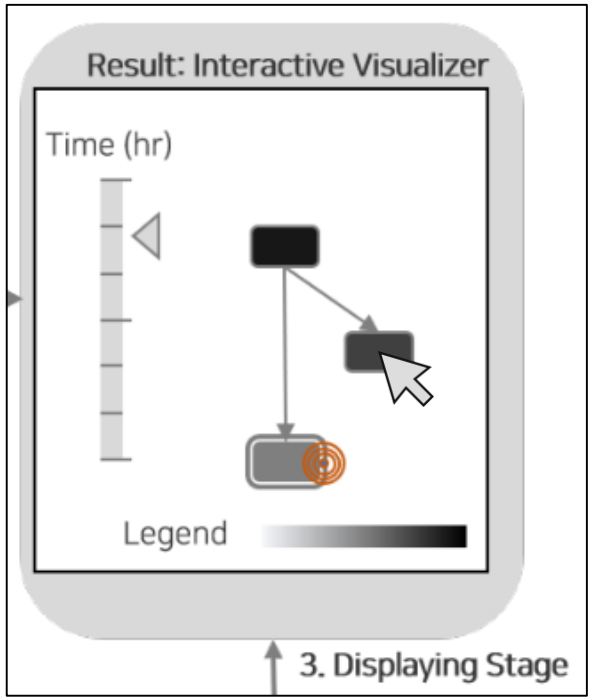


Visualizing more data

- More info becomes visible on click.

- Function name
- Parent nodes
- Child nodes
- Visit frequency





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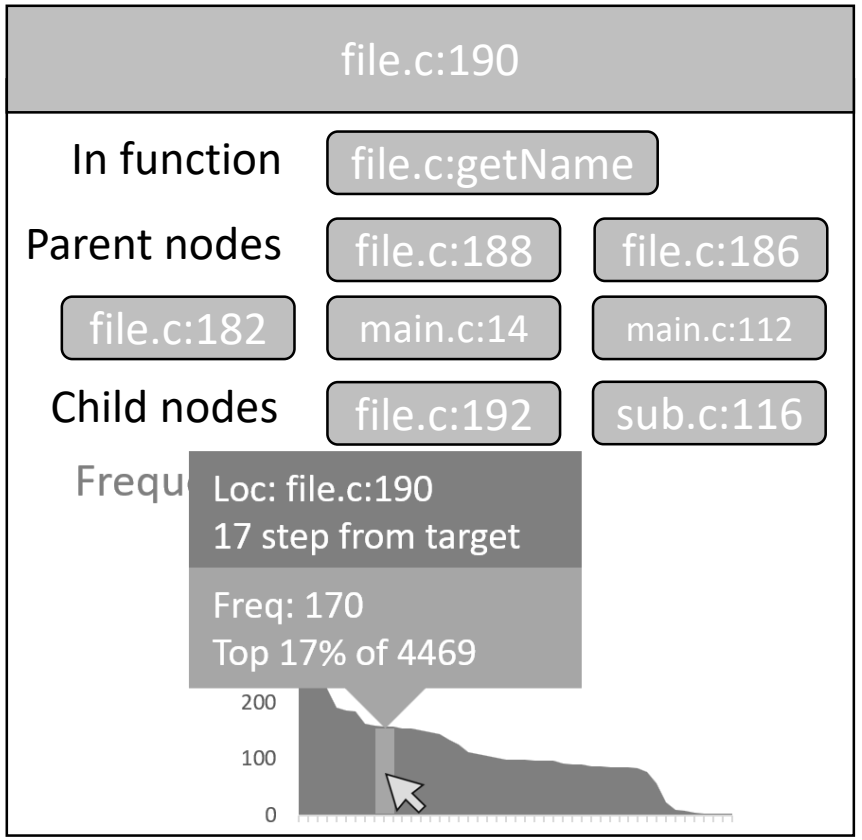

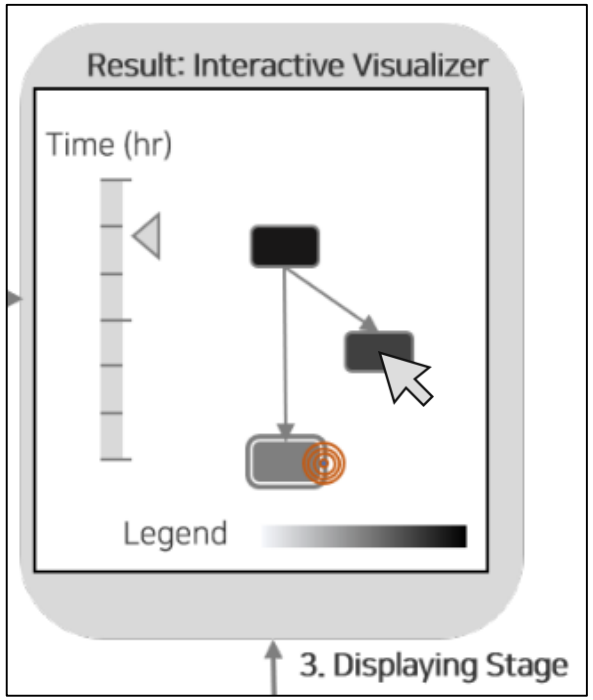

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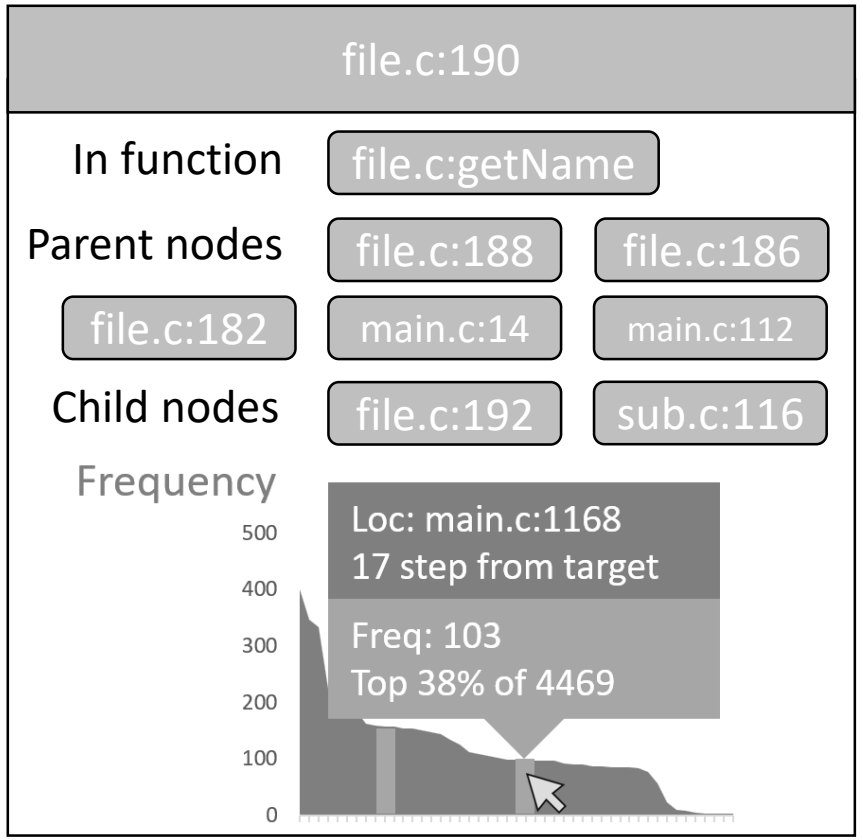
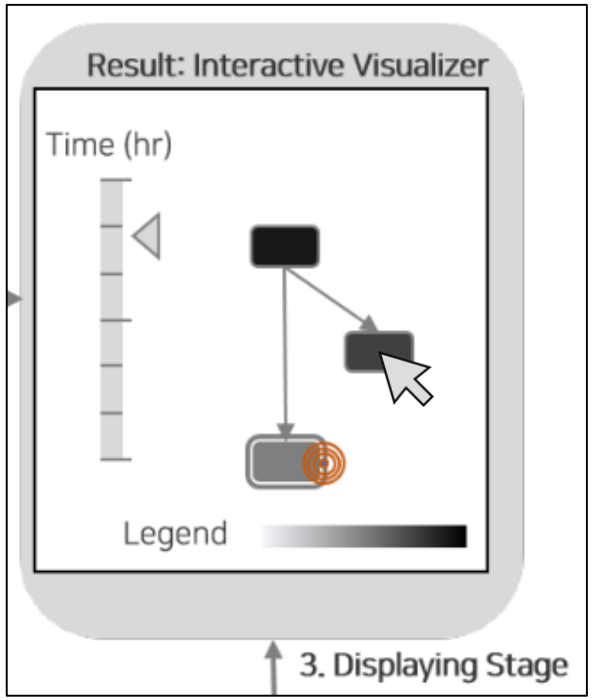
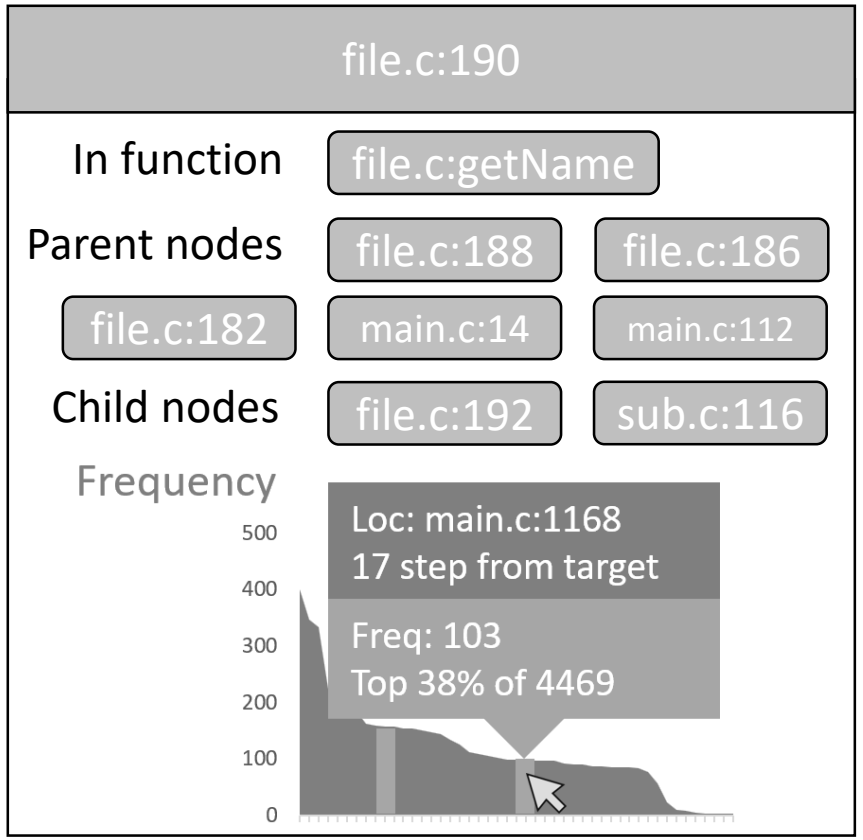


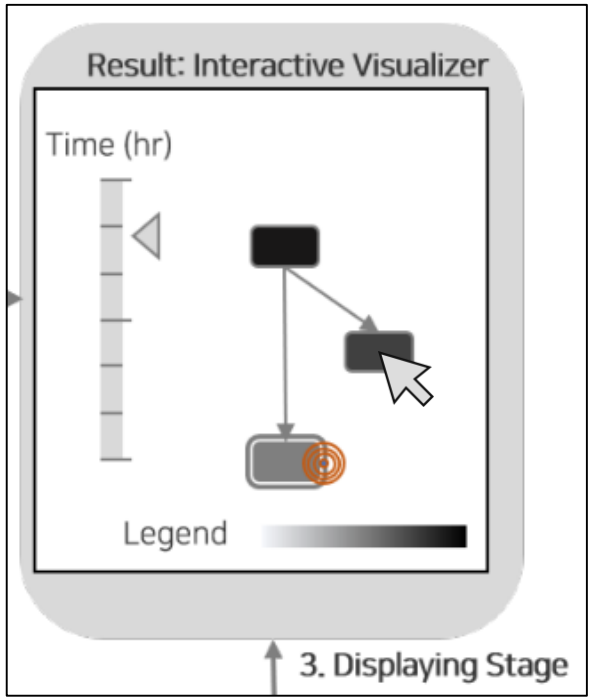


Visualizing more data

- More info becomes visible on click.

- Function name
- Parent nodes
- Child nodes
- Visit frequency
- Time-to-reach





Visualizing more data

- More info becomes visible on click.

- Function name
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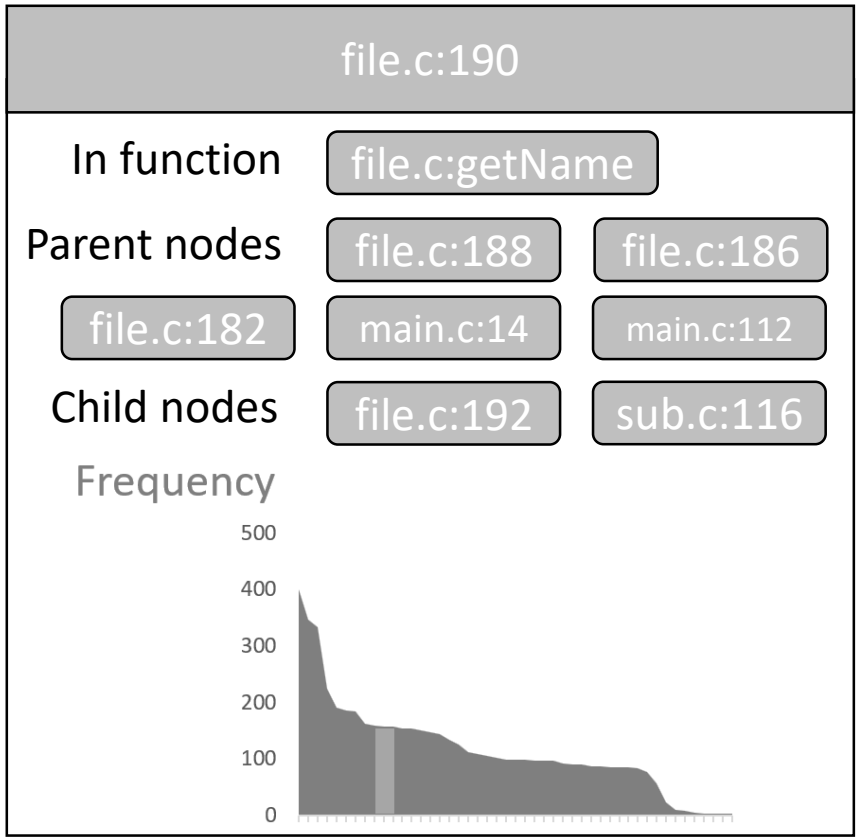
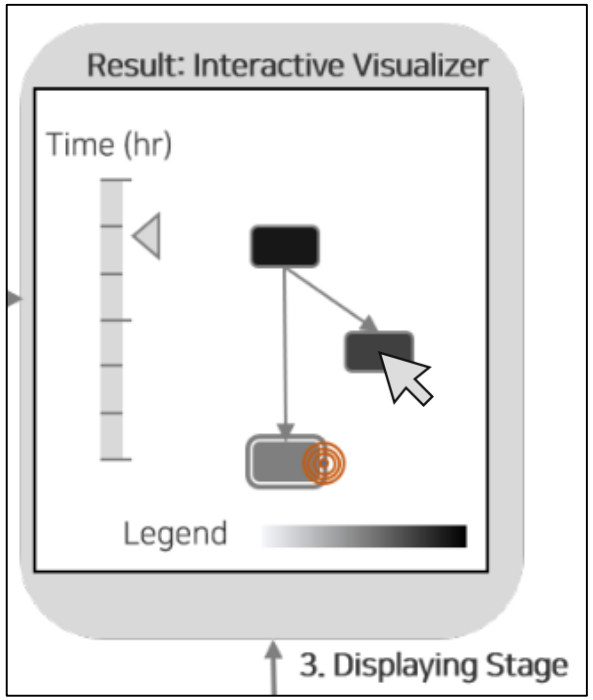
…





Impact

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- TopViz **helps developing** directed fuzzing by..
  - tracking data-flow to target location.

Impact

- TopViz **helps developing** directed fuzzing by..
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Impact

- TopViz **helps developing** directed fuzzing by..
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- TopViz is **first** to aid directed fuzzing research.

Impact

- TopViz **helps developing** directed fuzzing by..
  - tracking data-flow to target location.
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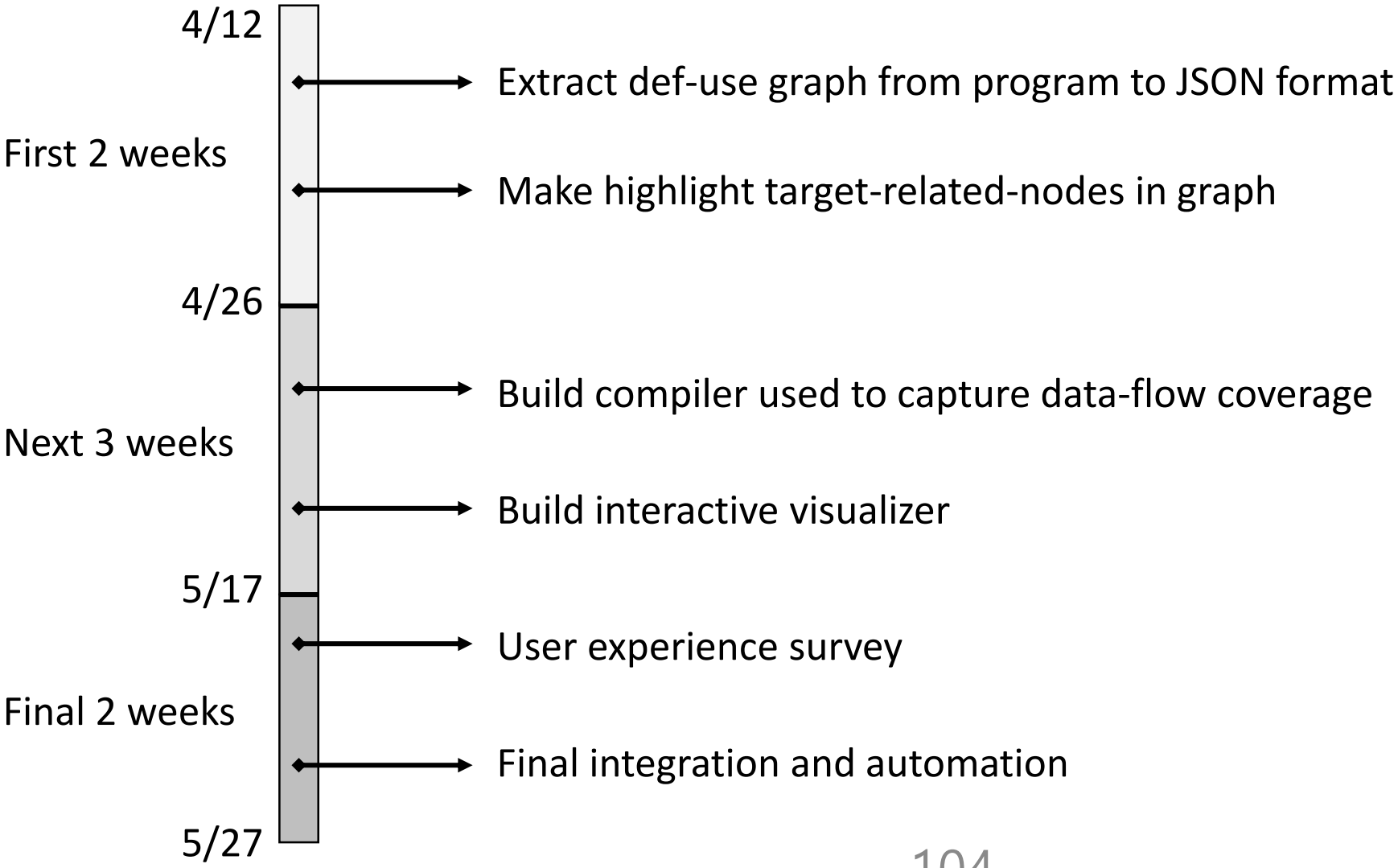
- TopViz is **first** to aid directed fuzzing research.
- TopViz is compatible with..
  - **any** fuzzing tools.

Impact

- TopViz **helps developing** directed fuzzing by..
  - tracking data-flow to target location.
  - **clear**, interactive frequency chart and parent/child buttons.
- TopViz is **first** to aid directed fuzzing research.
- TopViz is compatible with..
  - **any** fuzzing tools.
  - **any** target programs with open source code.

Time table and Milestones



Time table and Milestones

4/12

Extract def-use graph from program to JSON format

First 2 weeks

Make highlight target-related-nodes in graph

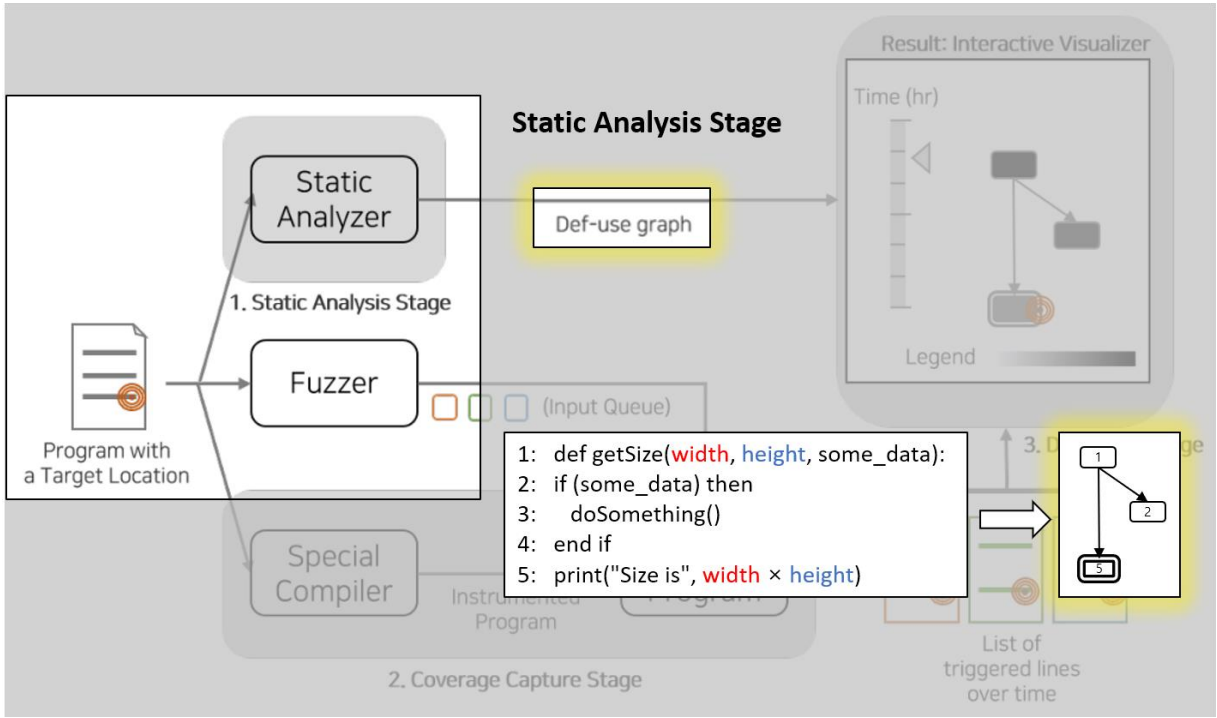
4/26

Next 3 weeks

5/17

Final 2 weeks

5/27



Time table and Milestones

4/26

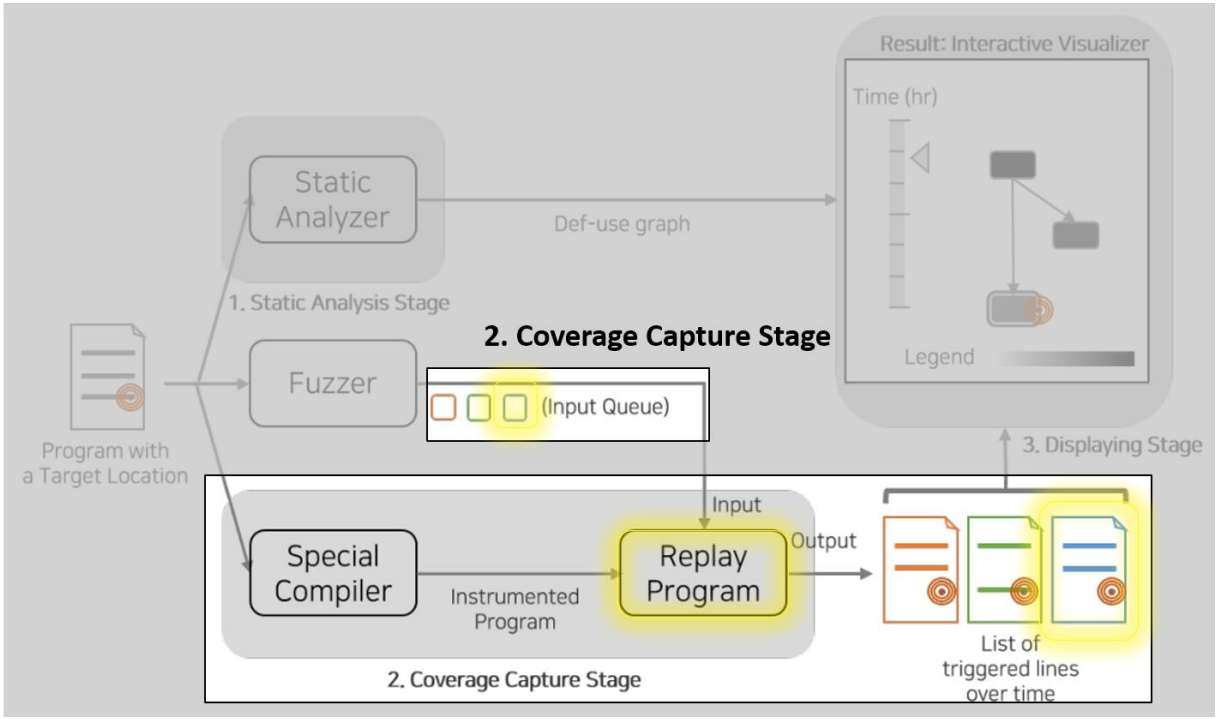
Build compiler used to capture data-flow coverage

Next 3 weeks

5/17

Final 2 weeks

5/27



Time table and Milestones

4/26

Build compiler used to capture data-flow coverage

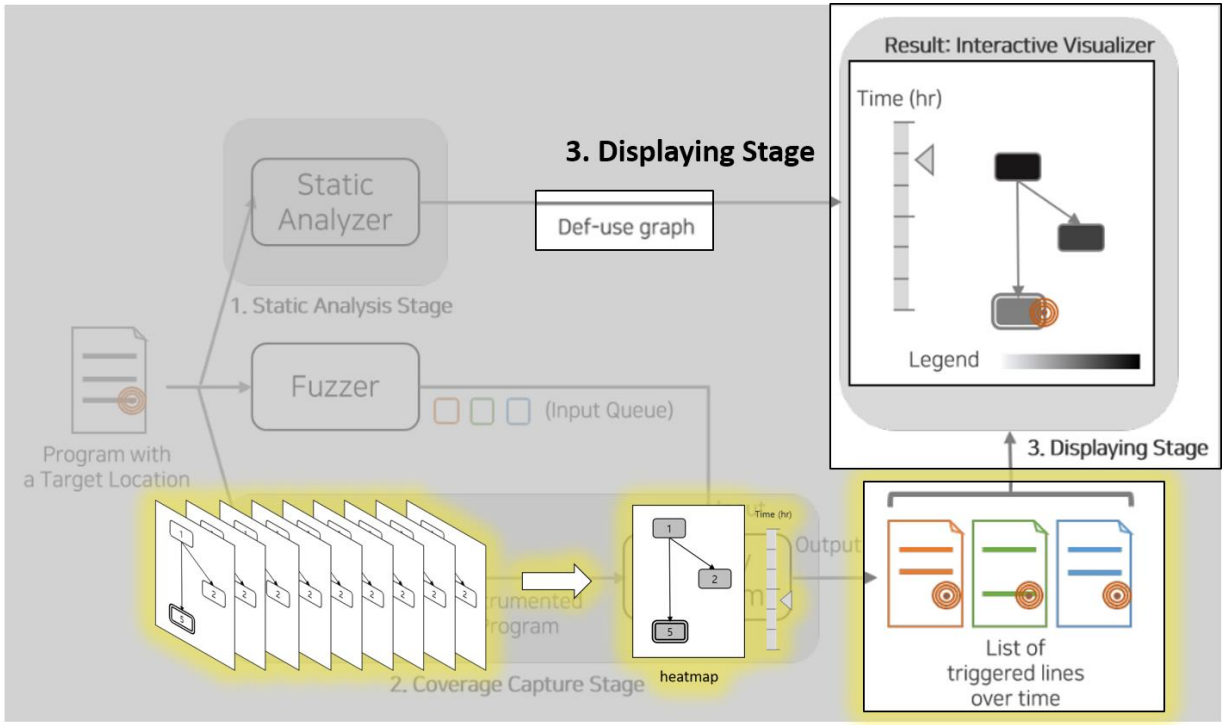
Next 3 weeks

Build interactive visualizer

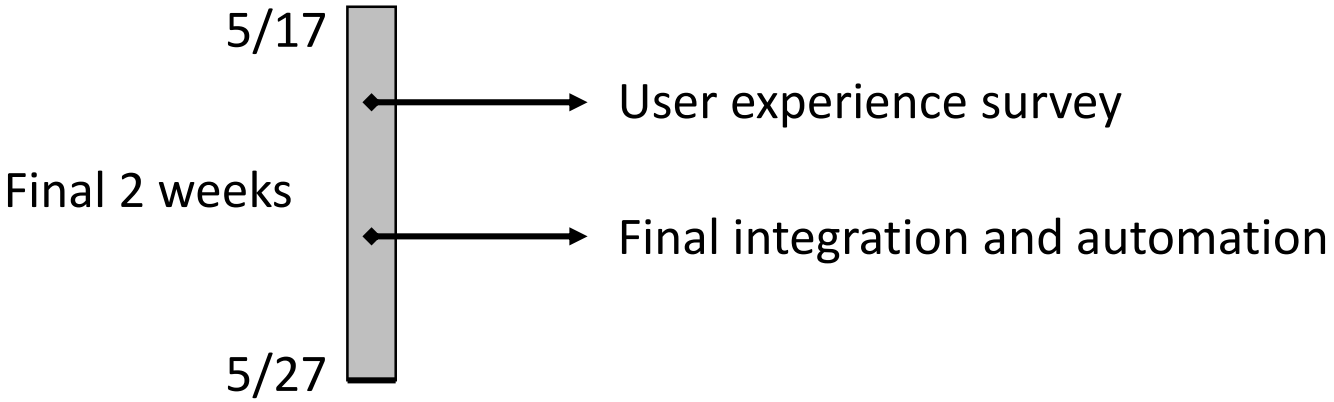
5/17

Final 2 weeks

5/27



Time table and Milestones



Conclusion

- This research builds a brand-new visualization tool, **TopViz**.
- TopViz **helps developing** directed fuzzing by..
  - tracking data-flow to target location.
  - **clear**, interactive frequency chart and parent/child buttons.
- TopViz is **first** to aid directed fuzzing research.
- TopViz is compatible with..
  - **any** fuzzing tools.
  - **any** target programs with open source code.
- TopViz's development will spend 7 weeks, with **user experience survey**.