Shift Left with Generative AI
Automating Library Replacement

Information from the FY22 NDAA Section 835 Technical Debt Study and data from Department of Defense (DoD) programs reveal that out-of-date open source libraries—some of which are as much as dozens of versions behind—pose critical software risks for the DoD. Current resource-intensive manual processes for updating these libraries are error prone and progress too slowly to keep up with the DoD's upgrade needs.

Using Generative AI to Keep Software Libraries Updated

The Software Engineering Institute (SEI) is working to create a workflow and a prompting algorithm for a human-in-the-loop strategy that decomposes common changes in library replacement problems into smaller problems that can be more easily solved using large language models (LLMs), a form of generative AI trained on large amounts of text. This approach enables organizations like the DoD to address an open source library upgrade once and efficiently roll out automated changes to many projects.

AI-Augmented Software Engineering

Effective AI-augmented software engineering workflows pair generative AI with other technologies to achieve the best results. Our work decomposes the library upgrade (see Figure 1) problem into smaller tasks and applies appropriate techniques to each.

Integrating **LLMs in software supply chain workflows** offers a feasible solution to the DoD's difficulty in **keeping up with upgrades** to software libraries.
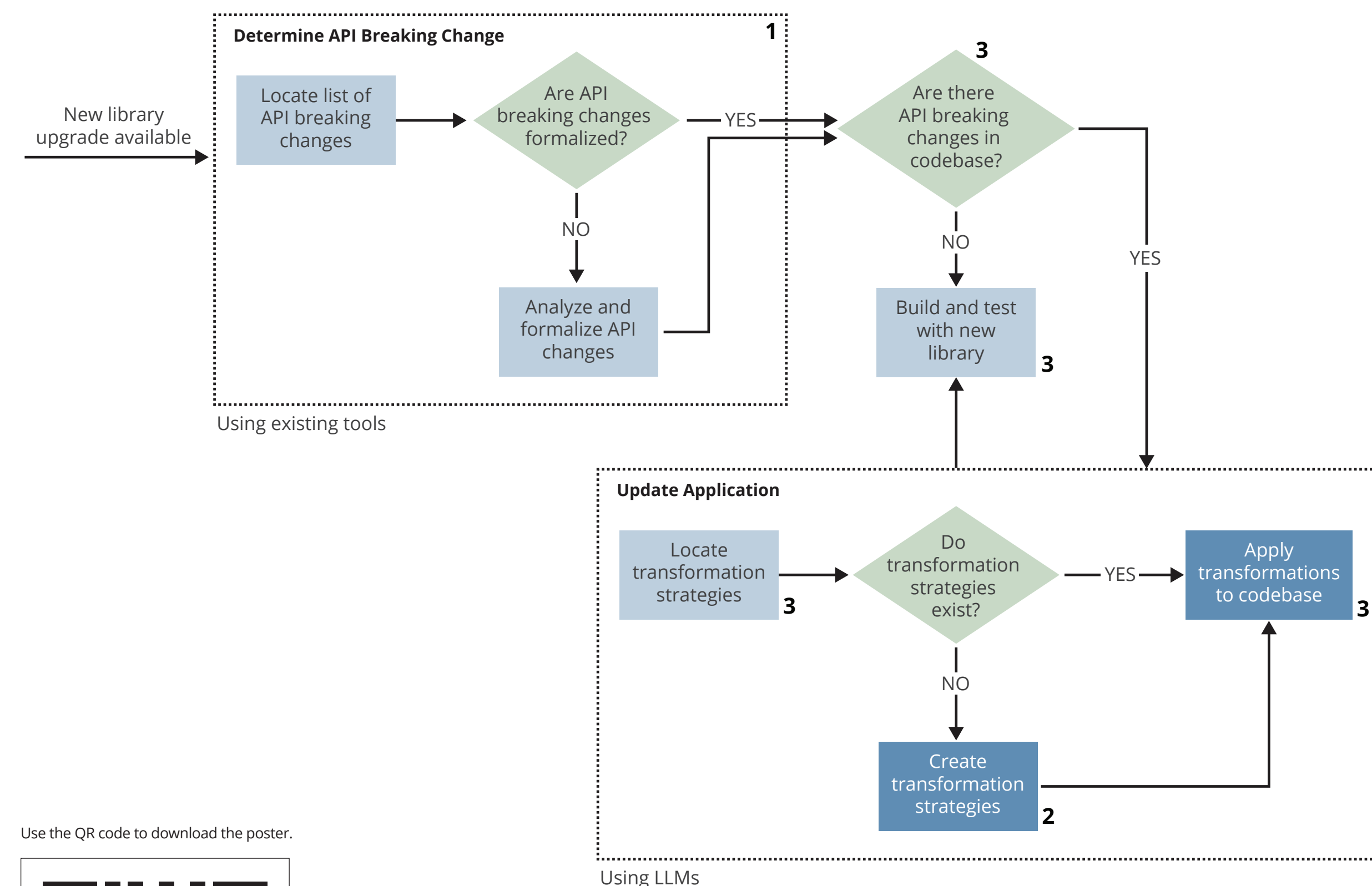
Use the QR code to download the poster.

KEY

- Decision
- Workflow step for LLMs
- Workflow step

1 Responsibilities of library providers or application developers
2 Responsibilities of library providers or sustainers in a new workflow
3 Responsibilities of application developers

Figure 1: Integrating LLMs In Software Supply Chain Workflows

Existing static analysis approaches identify API breaking changes more consistently and completely than LLMs for the same task. RevAPI* performs reasonably well in identifying these changes.

Version Type of Change	2.1	4.0	5.0
Total	280	120	14
removal	44 (51.42%)	45 (37.5%)	4 (28.57%)
signature change	2 (0.71%)	3 (2.5%)	5 (35.71%)
semantic change	24 (8.57%)	0 (0%)	3 (21.42%)
contract change	91 (32.5%)	44 (36.66%)	1 (7.14%)
visibility change	3 (1.07%)	0 (0%)	0 (0%)

Figure 2: Evolving Libraries Consist of Fewer and Easier Changes

LLMs are most effective in assisting with creating transformation strategies for the API breaking changes (See Figure 1). Transformations can be included with upgrade guidelines as recipes that can be automatically applied by existing code transformation tools.

Integrating LLMs in software supply chain workflows for library upgrades can shift how open source ecosystems operate and can help the DoD to stay up to date with its software on a timely basis.

Collaborate with Us!

We are looking for collaborators to help further the application of generative AI to address important software engineering challenges like library upgrades. Benefits to working with us include contributing to early research for improving the speed and accuracy of automation to address the DoD's software engineering challenges.

*RevAPI is an API analysis and change tracking tool written in Java. For more information, see https://revapi.org/.

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