Maximizing Usability and Performance in Numerical Software

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Abstract
Numerical software is constantly evolving and growing in functionality and complexity. Optimal toolkit and method selection can be challenging. Also, current software packages pose multiple usability challenges. Productivity and usability can be improved by organizing numerical packages into searchable taxonomies such as our Lighthouse framework [1].

Workflow

1. PETSc guided search: Interactive session presents a series of questions. Above, the first question in using PETSc sparse linear solvers or SLEPc eigensolvers.

2. PETSc guided search: Second question in the sparse linear solver series of questions.


4. At the end of the guided search, users can download a runnable program that can be customized for specific problems.

Approach
• Simple interactive interface to complex numerical software packages such as LAPACK [4], PETSc [2], SLEPc [5], and Trilinos [3].
• Guided (Q&A) and keyword searches.
• Context-sensitive help.
• Uses machine learning to build solver performance models [6].

Usability
With growing software capabilities, usability is typically decreasing.
• Reduce software learning curve.
• Identify solution methods that are likely to perform well for the user’s problem.
• Provide a runnable application template without any coding.

Summary
• Enable more effective use of complex numerical software.
• Simple interface to getting a template that can be integrated into larger applications.
• Improved performance modeling by using machine learning.

Motivation
• There are many numerical methods.
• Determining the best solution method for a given problem is challenging.
• Steep learning curves: documentation reading, significant background knowledge required.

References