

AI/ML Applications for Scientific Review Assistance

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CENTER FOR DRUG EVALUATION & RESEARCH

Abstract

As the world's largest biomedical research agency, the National Institutes of Health (NIH) funds research performed across the country through thousands of competitive grants. To support NIH's rigorous scientific review process, scientists and reviewers have to sift through large volume of materials from various sources (e.g., grants, resumes, publications), often manually, Leidos has successfully implemented Artificial Intelligence (AI) and machine learning (ML) solutions to improve the efficiency and accuracy of every stage of the current review cycle—saving time and money for the NIH, freeing up scientists to focus on more creative and strategic work, and accelerating research and discovery.

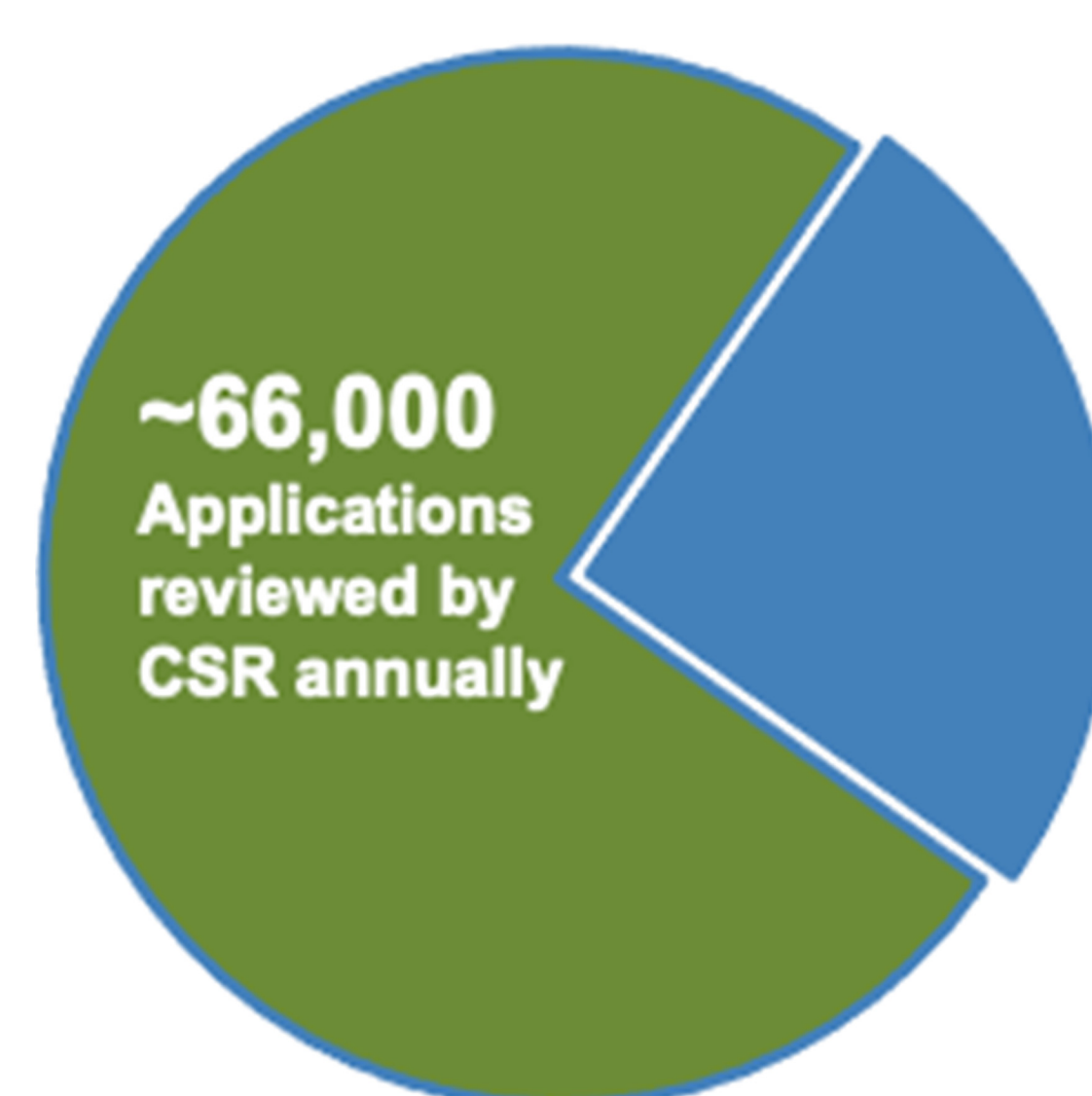
ART assists grant applicants with appropriate study sections recommendations based on the scientific content of their application text. Approximately 250 CSR study sections are represented in ART.

To automate the document review process and create summaries, we designed and built an NLP application (Automated Referral Tool; ART) that employs ML. ART has been successfully used to automate the early steps of the NIH grant peer-review process. With ART, NIH Center for Scientific Review (CSR) staff no longer need to review each applications for accuracy of their assignment to specific study section; instead, a batch process at the backend recommends the strongest match and they only need to verify 4% of the applications which are exceptions. This process reduced CSR scientists' efforts by 80% and allowed them to focus on more complex tasks that require human decision-making and extensive subject matter expertise while still ensuring the NIH funds the most promising research. AI/ML is also used to identify new risks where scientific review compliance may be lacking. Leidos leverages large language model (LLM) based topic modeling and visualization techniques to help the NIH identify and fill the possible gaps between current biomedical research and reviewer expertise.

Introduction

- NIH receives ~88,000 research grant proposal applications annually, and 75% of them are reviewed by CSR
- Grant review processes were manual, but the documents come in a huge volume. A reduction of time and manual effort with scientific computing means are needed.
- We explored options to automate/speed-up the manual processes using AI/ML methods.

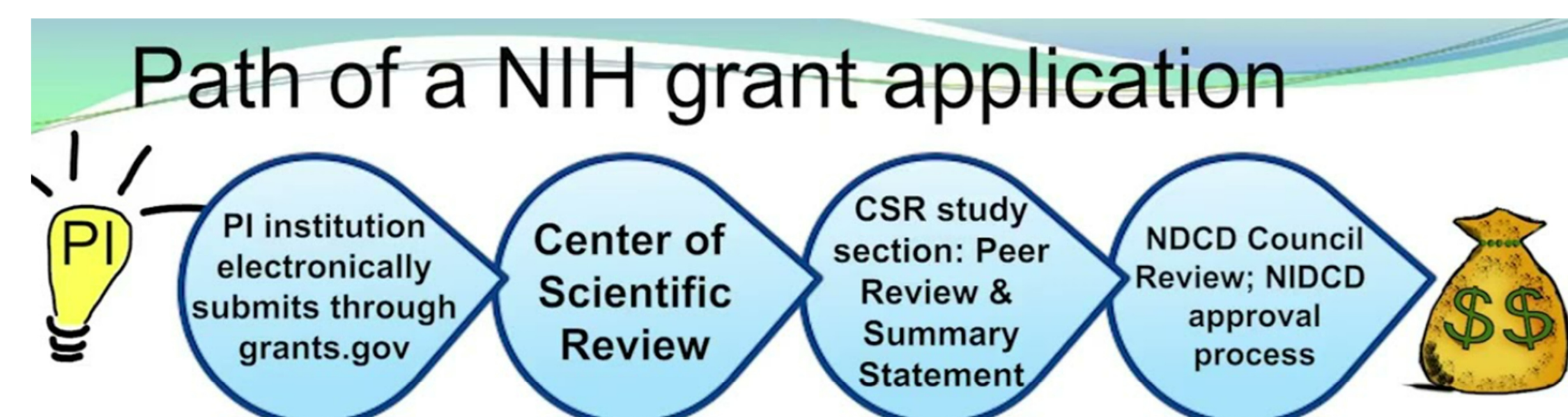
~88,000 NIH applications received annually
75% reviewed by CSR



92% Research Project Grants (R01)
95% Small Business (SBIR/STTR)
83% Fellowship

Center for Scientific Review
~20,000 Reviewers participate
~1,300 Meetings
~250 Scientific Review Officers

Leidos supports CSR (NIH) mission of ensuring NIH grant applications receive fair, independent, expert, and timely scientific reviews — free from inappropriate influences — so NIH can fund the most promising research.



Leidos developed/deployed multiple AI/ML Technologies to support review process and principles:

Grant Application

- **Assisted Referral Tool** recommends areas of science for grant applications.
- **Science Similarity Detection** identifies redundant applications for withdrawal.

Review Panel

- **Evaluating Panel Quality in Review Clusters** to ensure no knowledge gap exists in emerging science.

Review and Reviewer

- **Quality assessment** on review text narratives using natural language processing (NLP).
- **Reviewer Network Analysis** detects reviewer network cabals.

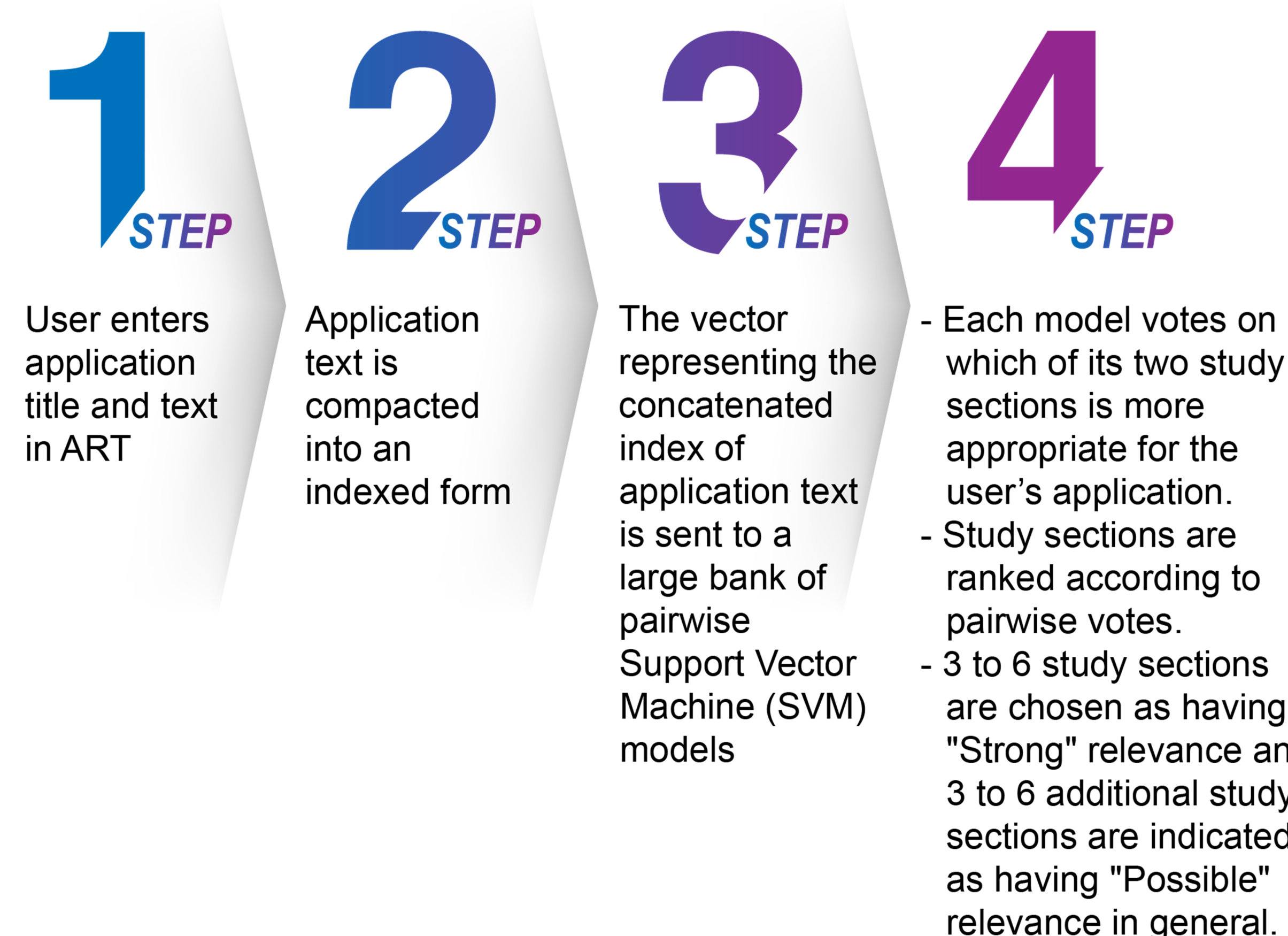
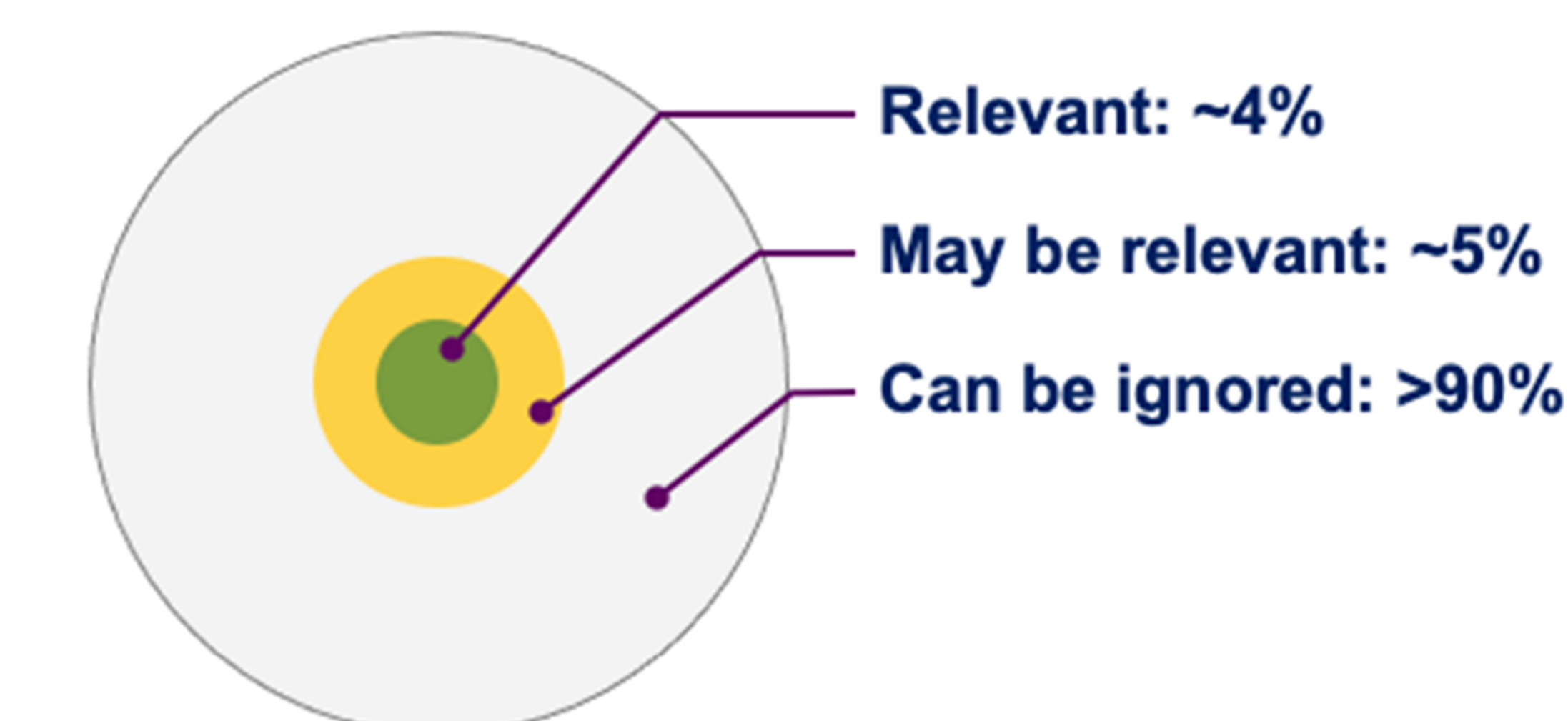
Application – ART (Assisted Referral Tool)

Goal: To recommend appropriate scientific study sections for reviewing a grant application, based on its scientific content.

Method/Process: The documents are encoded to feature vectors, which are input to the ML model that assigns scores for each study sections of the document.

Achievement and Impact: Automates a largely manual process, freeing scientists for complex work.

Strong	84.7%
Strong + Possible	92.6%



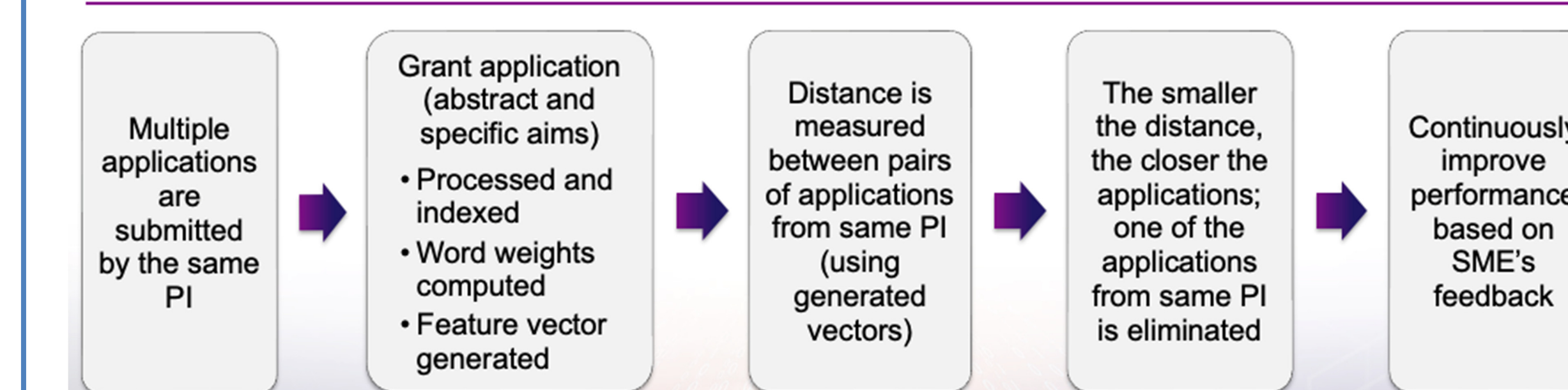
Goal: To reduce manual effort going through grant applications to identify and withdraw redundant applications.

Method/Process: The documents are encoded into vectors, and distance scores between all pairs of all applications from the same PI are calculated.

Achievement and Impact

- Reduced burden on staff by eliminating efforts to manually check grant applications for overlap/duplicate.
- Expanded the scope of applications for checking duplications
- Automated and facilitated efficient and easier way for staff to identify similar applications quickly.
- It handles 50 new incoming applications daily on average.

Distance Score Calculation
(high level overview – feedback required for continuous improvement)



Conclusion

- Automated Referral Tool (ART), an ML-based application automates the early steps of the peer-review process. With ART, CSR staff no longer need to review each study section; instead, they upload the document to ART and need to review only 4% of the study sections. ART processed 9,400 grant applications monthly and reduced labor by 80%.
- Our team is also developing AI/ML technologies for sentiment analysis on review narratives (a proof of concept), scientific similarity detection (SSD), Evaluating Panel Quality in Review Clusters and Reviewer Network to support the grant application revision process.
- Our AI/ML solutions for assisting the scientific review life cycle are general capabilities that can be applied to the FDA to assist review and knowledge discovery of submitted regulatory review (drug/biologics) applications.
- Our solutions facilitate the identification of required reviewer expertise, speed-up of applications' review assignments, and informed decision-making based on the understanding of the research landscape from diverse regulatory and scientific data sources.
- To further improve review quality, ensure fairness, and reduce bias, we are exploring LLMs, advanced document representations, and network analysis to bring further efficiencies to scientific reviews.