



UCSB Capstone Project Proposal: Web-Based Tools for High-Fidelity Requirements Coverage Analysis

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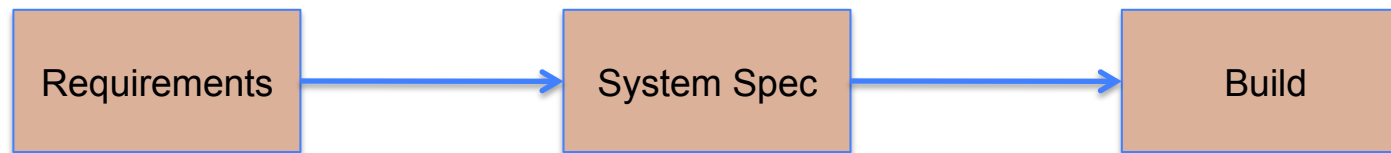
Project Goals

- Design and Implement a web-based framework for requirements management and analysis
 - Web-based user interface
 - Middleware that connects the user interface with existing and new components
 - Incorporate a document management database
 - Authenticate users
 - Achieve adequate performance through utilization of cloud technologies



Requirements Management

- The successful development of systems for National Security Space requires correct requirements development and management




- Large satellite systems will generate thousands of requirements against which the final build must be tested and verified
 - *Managing these requirements is tedious and very inefficient*
 - *It is difficult to assess if all system functions are included in the requirements*
- We propose to improve the requirements management process by employing modern CS concepts, such as language processing technologies used in Artificial Intelligence and web technologies



Project Outcomes

- Practical
 - Web-based requirements management tool that will be used by Aerospace and Air Force personnel for determining if a particular system functionality is adequately covered in a given requirements document
 - A report documenting the technologies used in developing the tool
- Pedagogical
 - Students will gain experience in developing an end-to-end application employing modern Web 2.0 technologies
 - Students will gain experience in integrating the application into an existing cloud infrastructure
 - Understand the challenges with resource utilization and parallelization
 - Students will gain experience with how modern language processing techniques and algorithms can be used in real-world applications





The Current Requirement Coverage Analysis Tool: **Induco**

Induco Usage Overview

Intended Use:

- Induco assists users by reducing the search space necessary to identify requirements related to a particular topic
 - *Note: this is different that simple key-word search*

Intended Users:

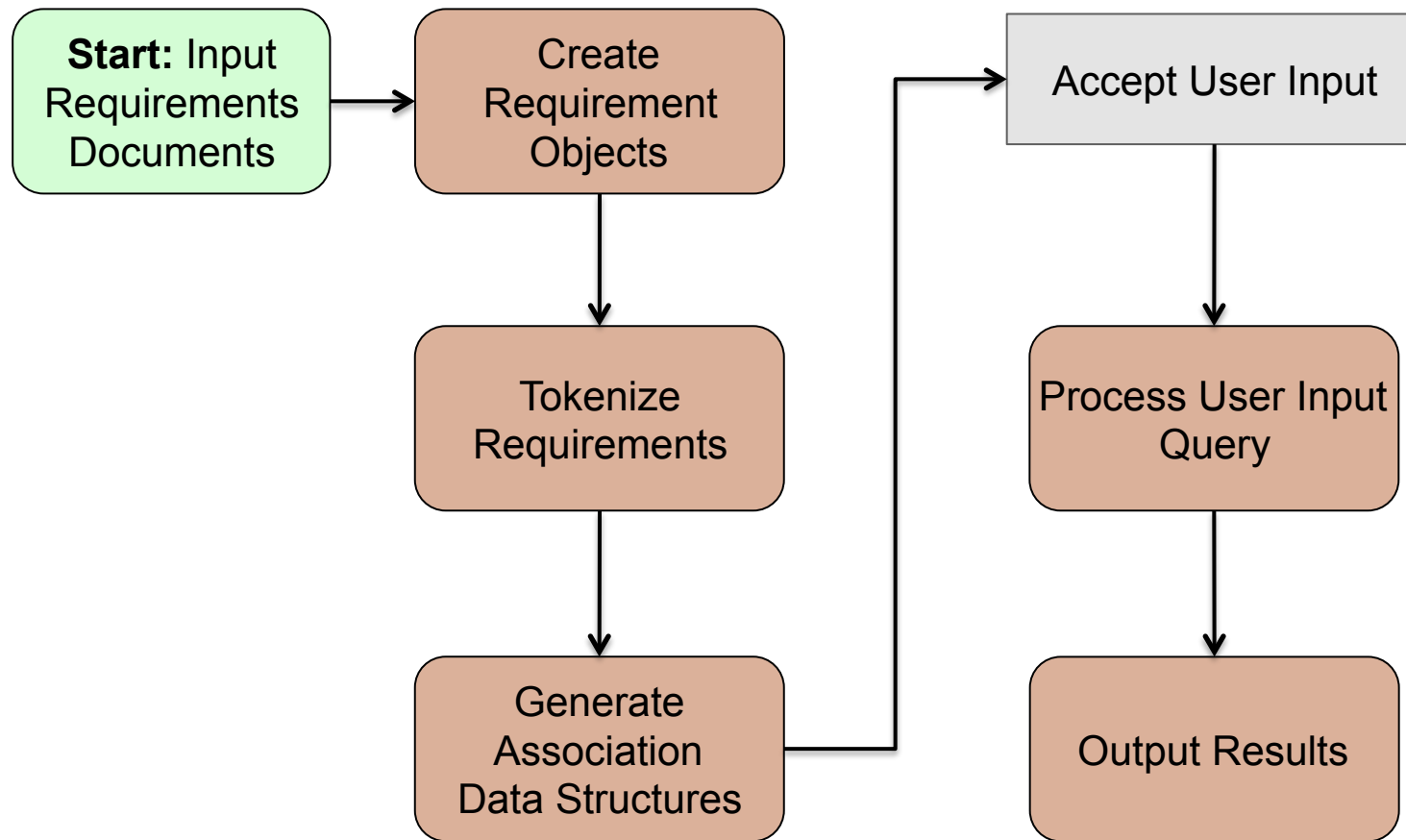
- Aerospace Engineers and Air Force Personnel reviewing or referencing requirements documents

Induco Capabilities Include:

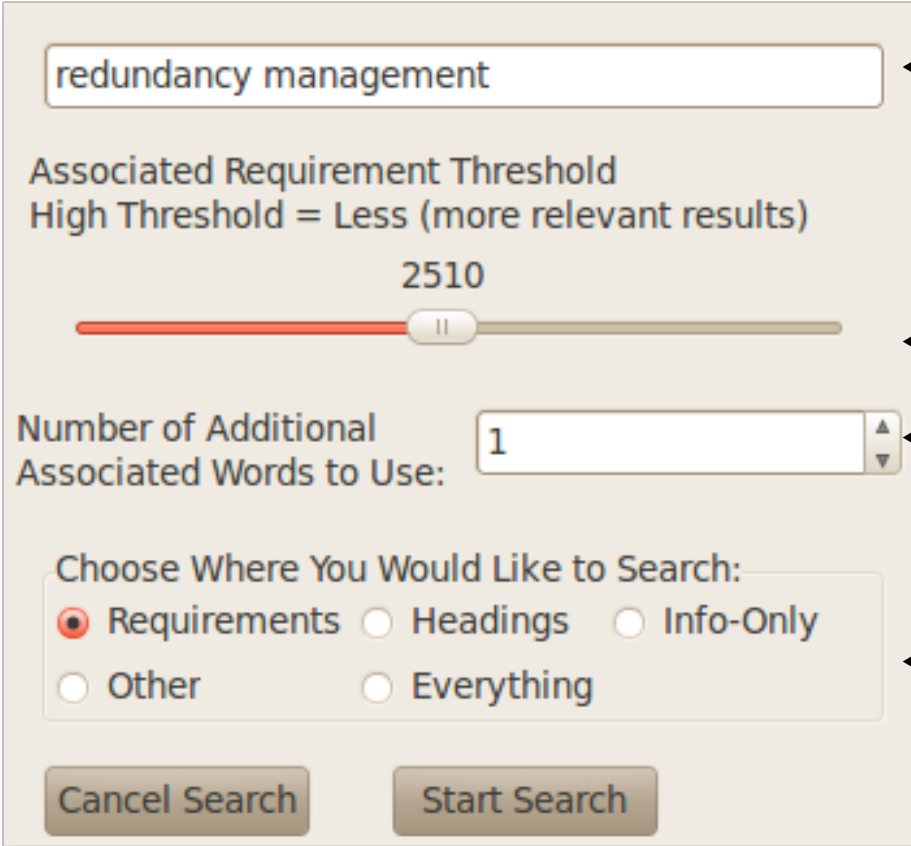
- User-Defined Related Requirements Threshold:
 - *lower threshold = more results but some are less relevant to user input*
 - *higher threshold = less results, but more directly related to the search string*
- Automatic Generation of Related Key Words:
 - *Induco automatically identifies key words that are directly related to the user input*



Induco Algorithm Overview and Execution Flow



Current Induco User Interface



The screenshot shows a search settings dialog box with the following elements:

- Search field:** A text input field containing the text "redundancy management".
- Associated Requirement Threshold:** A section with the text "Associated Requirement Threshold" and "High Threshold = Less (more relevant results)". Below this is a slider control with the value "2510" displayed above it.
- Additional Key Terms:** A section with the text "Number of Additional Associated Words to Use:" followed by a spin box containing the value "1".
- Search Type:** A section with the text "Choose Where You Would Like to Search:" and five radio button options: "Requirements" (selected), "Headings", "Info-Only", "Other", and "Everything".
- Buttons:** Two buttons at the bottom: "Cancel Search" and "Start Search".

Annotations with arrows point to the following elements:

- Search field
- Threshold Setting
- Additional Key Terms
- Search Type



Why Transition to a Web-Based Application?

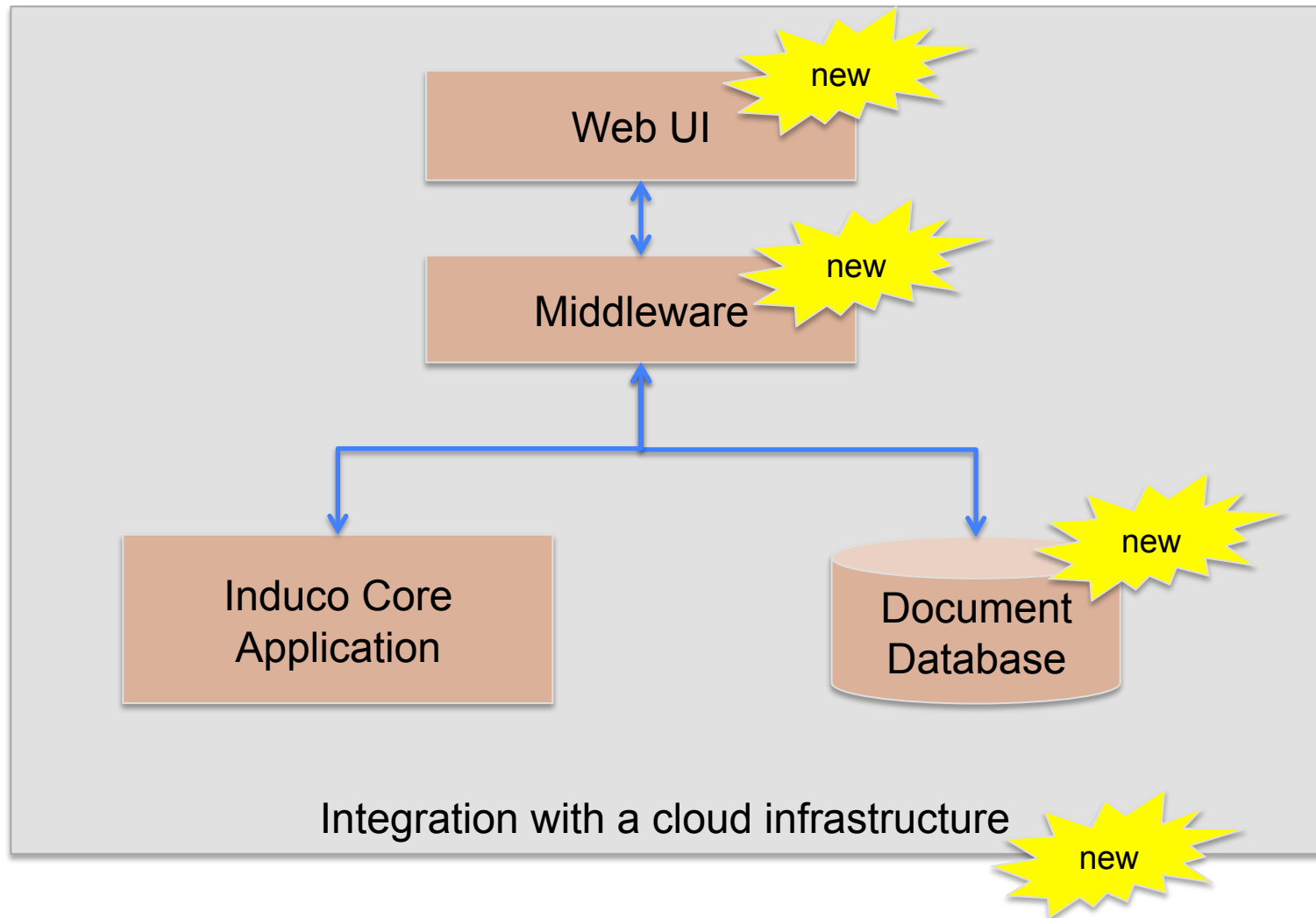
- Current Induco Implementation is inadequate for the following reasons:
 - A single-user desktop instance of the application does not provide sufficient computational resources for large sets of requirements documents
 - Scalability to large volumes of data is crucial to making requirements management easier, better, and less tedious
- Induco is an ideal application for the web
 - Induco has a simple set of interface requirements, ideal for a web browser
 - A web-based Induco can be made to work with an existing cloud infrastructure for improved performance
 - A web-based Induco can be designed to take advantage of multiple requirements sets within the same program with different user queries
 - *The availability large data sets allow well designed language processing algorithms to produce better results*
 - A centralized implementation is easier to maintain and deploy





Proposed Capstone Project: Migrating Induco onto the Web

Proposed System Architecture



Summary of Proposed Project Tasks

1. Design and Build Induco Middleware and User Interface (UI)

- The UI must allow the user to upload a requirements document, select a set of requirements documents to use, input the user query, and display the results to user
- The Middleware must connect the UI with existing Induco core application and other Induco components

2. Document Management Database

- Allows for management of multiple documents

3. Authentication and Security

- Proper access control of uploaded requirements documents is needed
- User authentication

4. Integration with an Existing Cloud Infrastructure

- Parallelization of the underlying language processing algorithms
- Dynamically assess required resources and interface with the cloud

5. Documentation



Proposed Schedule and Milestones

- Quarter 1
 - Familiarization with existing Induco application and underlying algorithms
 - Requirements analysis and basic design
 - Set up development and documentation environment
 - Design and implementation of web-based UI and middleware that is capable of utilizing existing Induco application
 - Setup local web servers, such as Apache, and test the web-based Induco application
 - Implementation of requirements document database
 - Allows management of multiple documents
 - Allows for the selection of subsets of documents for analysis
- Quarter 2
 - Implement the ability to authenticate users for the web-based Induco application
 - Integration of Induco application with existing cloud infrastructure
 - Document Everything
- Recommend that the team follows an agile development process

