## Functional Requirements (FRs)

1. **FR1:** The system shall allow users to submit research queries and select the desired depth of research (e.g., surface, intermediate, advanced).

2. **FR2:** The system shall automatically crawl the web, extract relevant findings, and present them in structured sections.

3. **FR3:** The system shall display trust scores and fact-checking indicators for each extracted source.

4. **FR4:** The system shall provide real-time status updates of ongoing research tasks with progress indicators.

5. **FR5:** The system shall allow users to interact with an **editor interface** to compile research reports.

6. **FR6:** The system shall provide AI-generated feedback on reports, highlighting strengths, weaknesses, and suggestions for improvement.

7. **FR7:** The system shall generate accurate citations in multiple formats (IEEE, APA, MLA, etc.) for all sources used in the report.

8. **FR8:** The system shall support diagram creation inside the report editor (flowcharts, tables, and conceptual diagrams).

9. **FR9:** The system shall allow users to export reports in standard formats (PDF, DOCX, HTML) with embedded citations and diagrams.

10. **FR10:** The system shall allow users to filter, highlight, and organize extracted findings by relevance, date, or trust score.

11. **FR11:** The system shall allow users to select or skip specific sources or steps during research, providing manual control over AI automation.

12. **FR12:** The system shall integrate with APIs for external databases, news sources, and academic repositories.

13. **FR13:** The system shall maintain a history of research sessions and outputs in a **dashboard** with analytics and statistics.

14. **FR14:** The system shall allow the user to save the current state of a multi-step research query and reload it later to continue from the same point.

15. **FR15:** The system shall provide a step-by-step explanation of why the AI selected certain sources and how the trust scores were assigned for explainability.

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## Non-Functional Requirements (NFRs)

1. **NFR1:** The interface shall load the main page within 2 seconds on a standard broadband connection.
2. **NFR2:** The interface shall be responsive and usable on desktops, tablets, and mobile devices.
3. **NFR3:** The interface shall maintain consistent styling and layout across all pages.
4. **NFR4:** The interface shall provide accessibility features (e.g., keyboard navigation, ARIA labels).
5. **NFR5:** The interface shall update displayed data in real-time without requiring full page reloads.
6. **NFR6:** The interface shall secure all user input and prevent injection or XSS attacks.

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## Data Dictionary

| Term | Type | Description | Values / Example |
|---|---|---|---|
| **Query** | String | User-submitted research question or topic | `"Impact of AI on education"` |
| **Research Depth** | Enum | Level of research thoroughness, controlling how many sources or layers the AI explores | `Surface`, `Intermediate`, `Advanced` |
| **Surface** | Research Depth | Quick overview of topic; few sources, high-level summary | 3–5 sources, basic extraction |

| | | | |
|---|---|---|---|
| **Intermediate** | Research Depth | Moderate depth; more sources and some detailed analysis | 5–15 sources, multi-step extraction, summary + highlights |
| **Advanced** | Research Depth | Full-depth investigation; exhaustive sources, detailed summaries, cross-references, and citations | 15+ sources, deep extraction, fact-checking, trust scores, diagrams |
| **Source** | Object | An individual reference from web/API/database | `{title, url, author, trust_score, date, citation}` |
| **Trust Score** | Float (0–1) | AI-assigned reliability of a source | `0.92` |
| **Fact-Check Status** | Enum | Verification status of extracted info | `Verified`, `Unverified`, `Conflicting` |
| **Finding** | Object | Key insight or information extracted from a source | `{content, source_id, summary, importance_level}` |
| **Citation** | Object | Formatted reference for a source | `{format: "APA", text: "Author, Year, Title"}` |
| **Report** | Object | User-compiled research output | `{title, content, diagrams[], citations[], ai_feedback[]}` |
| **Diagram** | Object | Visual representation in report | `{type: "flowchart" |

| | | | |
|---|---|---|---|
| **Dashboard Metrics** | Object | Analytics of research or learning sessions | `{total_queries, avg_depth, avg_trust_score}` |

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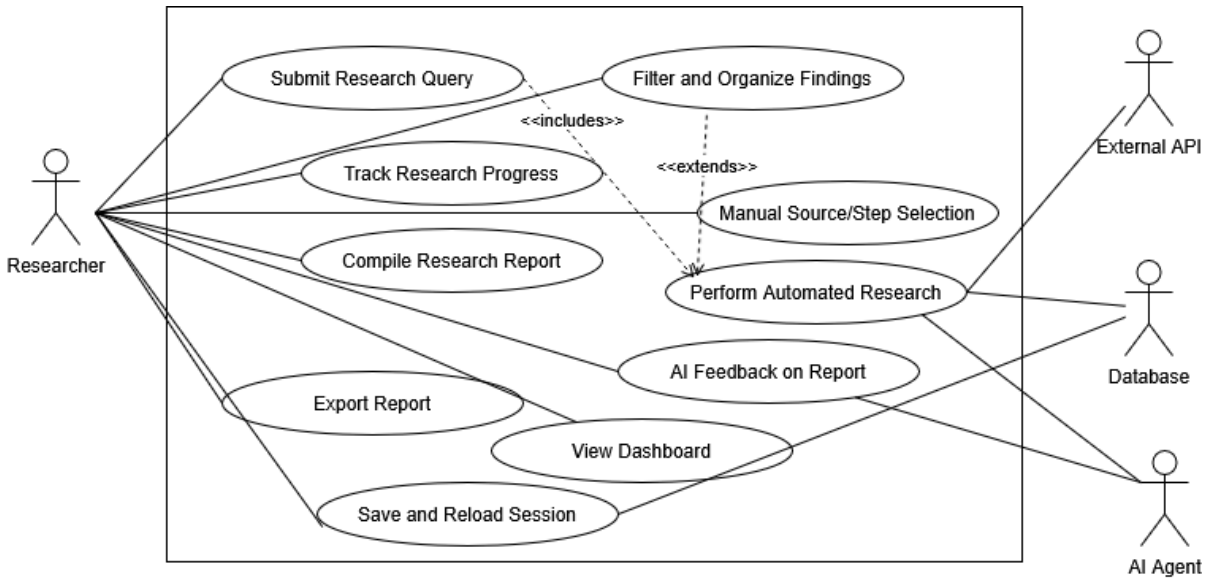
## Use Case Diagram

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## Use Case Descriptions

- **Use Case 1:** Submit Research Query (UC1)
- **Actor:** User
- **Description:** User submits a research topic and selects the desired research depth (surface, intermediate, advanced).
- **Pre-Condition:** User must be logged in.
- **Flow of Events:**
  - **Basic Flow:**
    1. User opens research interface.
    2. User enters a research query.
    3. User selects research depth.
    4. User submits query.
  - **Alternate Flow:** User cancels submission → query is not processed.
  - **Exception Flow:** Query is empty or invalid → system prompts user to enter a valid query.
- **Post-Condition:** Query is queued for AI processing.

- **FR Covered:** FR1

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- **Use Case 2:** Perform Automated Research (UC2)
- **Actor:** AI Research Agent, External APIs/Databases (secondary)
- **Description:** System crawls the web and external databases to extract relevant findings, assigns trust scores, and fact-checks sources.
- **Pre-Condition:** UC1 completed; system is running and APIs accessible.
- **Flow of Events:**
    - **Basic Flow:**
        1. AI agent starts research process.
        2. System fetches data from external APIs and databases.
        3. AI extracts findings from sources.
        4. AI assigns trust scores and fact-checks each source.
    - **Alternate Flow:** Some sources unavailable → system continues with remaining sources.
    - **Exception Flow:** No sources found → system notifies user of failure.
- **Post-Condition:** Structured findings stored with trust scores and fact-checking status.
- **FR Covered:** FR2, FR3, FR12

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- **Use Case 3:** Track Research Progress (UC3)
- **Actor:** User
- **Description:** User monitors real-time status of ongoing research tasks.
- **Pre-Condition:** Research query is in progress.
- **Flow of Events:**
    - **Basic Flow:**
        1. User opens dashboard or progress panel.
        2. System displays ongoing tasks and progress indicators.
    - **Alternate Flow:** Network failure → system shows last known status.
- **Post-Condition:** User can see current progress and estimated completion time.
- **FR Covered:** FR4

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- **Use Case 4:** Compile Research Report (UC4)
- **Actor:** User
- **Description:** User organizes extracted findings, adds diagrams, and generates citations in the report editor.
- **Pre-Condition:** Research findings are available.
- **Flow of Events:**
    - **Basic Flow:**
        1. User opens report editor.
        2. User drags and drops findings into sections.

3. User makes text edits.
4. User creates diagrams (flowcharts, tables, conceptual).
5. System generates citations in selected format.

- **Alternate Flow:** User skips optional diagrams → system only generates text and citations.

- **Post-Condition:** Draft report prepared with findings, diagrams, and citations.
- **FR Covered:** FR5, FR7, FR8

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- **Use Case 5:** AI Feedback on Report (UC5)
- **Actor:** User, AI Research Agent (secondary)
- **Description:** AI evaluates the report and provides feedback on strengths, weaknesses, and suggestions.
- **Pre-Condition:** Report draft exists.
- **Flow of Events:**
  - **Basic Flow:**
    1. User submits report for feedback.
    2. AI analyzes content, diagrams, and citations.
    3. AI provides step-by-step reasoning and recommendations.
  - **Alternate Flow:** Partial analysis if report incomplete → feedback provided for completed sections only.
- **Post-Condition:** User receives detailed feedback and reasoning.
- **FR Covered:** FR6, FR15

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- **Use Case 6:** Export Report (UC6)
- **Actor:** User
- **Description:** User exports the report in PDF, DOCX, or HTML formats with embedded citations and diagrams.
- **Pre-Condition:** Report draft exists.
- **Flow of Events:**
  - **Basic Flow:**
    1. User clicks “Export.”
    2. User selects format.
    3. System generates export file.
  - **Alternate Flow:** Export fails → system shows error and allows retry.
- **Post-Condition:** Report is saved/exported with all content intact.
- **FR Covered:** FR9

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- **Use Case 7:** Filter and Organize Findings (UC7)
- **Actor:** User
- **Description:** User filters, highlights, and sorts findings by relevance, date, or trust score.

- **Pre-Condition:** Findings are available from UC2.
- **Flow of Events:**
    - **Basic Flow:**
        1. User opens findings panel.
        2. User applies filters or highlights.
        3. System updates view accordingly.
- **Post-Condition:** Findings displayed according to user preferences.
- **FR Covered:** FR10

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- **Use Case 8:** Manual Source/Step Selection (UC8)
- **Actor:** User
- **Description:** User selects or skips sources or research steps to customize AI workflow.
- **Pre-Condition:** Research in progress.
- **Flow of Events:**
    - **Basic Flow:**
        1. User views suggested sources or steps.
        2. User selects or skips items.
        3. AI adjusts workflow based on selections.
- **Post-Condition:** Research continues according to user-controlled workflow.
- **FR Covered:** FR11

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- **Use Case 9:** Save and Reload Session (UC9)
- **Actor:** User, Database
- **Description:** User can save the state of a multi-step research session and reload it later.
- **Pre-Condition:** Research session in progress.
- **Flow of Events:**
    - **Basic Flow:**
        1. User clicks “Save Session.”
        2. System stores current state in database.
        3. User later reloads session → system restores state and progress.
- **Post-Condition:** User resumes session without losing progress.
- **FR Covered:** FR14

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- **Use Case Name:** View Dashboard (UC10)
- **Actor:** User
- **Description:** User views analytics and history of past research sessions.
- **Pre-Condition:** At least one research session exists.
- **Flow of Events:**
    - **Basic Flow:**

1. User opens dashboard.
2. System displays metrics: number of sessions, average trust scores, progress trends.

- **Post-Condition:** User gains insights into past research performance.
- **FR Covered:** FR13