

# National University of Sciences and Technology

School of Electrical Engineering and Computer Science  
Faculty of Computing



## PhD Thesis Synopsis (Qualifier-B)

### [Placeholder: Full Thesis Title]

*Your title should identify the problem, the technical focus, and the constraint or setting where the contribution matters.*

**Candidate Name:** [Placeholder: Full Name]  
**Registration / ID:** [Placeholder: Student ID]  
**Degree Program:** [Placeholder: PhD in Computer Science / AI / SE / DS / Related Area]  
**Research Area:** [Placeholder: Machine Learning / Computer Vision / NLP / Systems / Cybersecurity / HCI / etc.]  
**Supervisor(s):** [Placeholder: Primary Supervisor Name(s)]  
**Co-Supervisor(s):** [Placeholder: If applicable]  
**Department:** [Placeholder: Department Name]  
**Date of Submission:** [Placeholder: Month Year]  
[Placeholder: City, Country]

## Declaration of Originality

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I, [Placeholder: Candidate Full Name], hereby declare that this PhD synopsis titled [Placeholder: Full Thesis Title] is my own original work, except where due acknowledgement has been made in the text through proper citation and referencing.

I further declare that this synopsis has been prepared for the purpose of PhD proposal defense / synopsis evaluation, that all claims and borrowed ideas from published or unpublished sources are properly cited, and that any overlap with my previous publications, technical reports, manuscripts, or ongoing collaborative projects is disclosed where relevant.

**Candidate Signature:**

\_\_\_\_\_

**Date:**

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# Abstract

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**Purpose** This section should allow the committee to understand the whole proposal in one reading. A strong abstract states the exact problem, explains why it matters in Computer Science, identifies the gap in existing work, outlines the proposed research direction, and indicates how the work will be validated.

**What to Include** Write one compact paragraph that introduces the problem context and one compact paragraph that states the gap, proposed solution direction, evaluation setting, and expected contribution. For a CS synopsis, the abstract should name the main research artifact, such as an algorithm, framework, system, benchmark, dataset, or theoretical result.

**Best Practices** Keep the language precise, technical, and evidence-oriented. Mention the evaluation logic explicitly rather than implying it. The best abstracts make the research problem, contribution, and validation strategy visible within a few sentences.

**What to Avoid** Avoid broad claims about technology trends, excessive detail, and vague statements such as “this research will improve AI.” If the abstract does not state the gap and the validation plan, the committee will likely assume that the study design is still underdeveloped.

**Recommended Length** Keep this section within 250–350 words.

**Weak vs. Strong Example** *Weak: This study aims to improve machine learning for many applications. Strong: This study investigates whether uncertainty-aware retrieval can improve answer faithfulness in retrieval-augmented language models under noisy and partially relevant evidence.*

# Chapter 1

## Introduction and Background

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### 1.1 Research Context

**Purpose** This section introduces the broader field and then narrows to the specific technical setting in which the research problem arises. It should help the committee understand where the work sits within Computer Science and why that area is currently significant.

**What to Include** Explain the broader domain, such as machine learning, software engineering, cybersecurity, HCI, systems, or computer vision, and then move quickly to the specific technical subproblem. Clarify why this area is active, difficult, or strategically important.

**Best Practices** Move from the broad area to the narrow problem efficiently. Use precise technical language rather than trend-driven language. Define the setting before making claims about importance.

**What to Avoid** Avoid opening with several paragraphs of generic history or hype. Do not rely on buzzwords without operational meaning.

**Recommended Length** About half a page to one page is usually sufficient.

### 1.2 Motivation

**Purpose** This section should persuade the committee that the problem is worth solving at PhD level. The motivation should connect scientific significance with technical difficulty and practical relevance.

**What to Include** Explain what remains unresolved scientifically, what fails technically under realistic conditions, and where the consequences of the unresolved problem become important in practice.

**Best Practices** Link the motivation to concrete research difficulty. Show why the work is more than an implementation exercise by emphasizing unresolved issues such as robustness, efficiency, privacy, fairness, interpretability, safety, reliability, or deployment constraints.

**What to Avoid** Avoid saying the topic is merely interesting or popular. Do not present industrial relevance as a substitute for research substance.

**Weak vs. Strong Example** *Weak: Deep learning is important and widely used. Strong: Despite strong benchmark performance, current deep models remain brittle under distribution shift, which limits trustworthy deployment in high-stakes settings.*

### 1.3 Scope of the Research

**Purpose** This section defines what the proposed research will cover and what it will not cover. A clear scope helps the committee judge whether the work is ambitious but still feasible.

**What to Include** Specify the exact subdomain, target setting, assumptions, and boundaries of the study. Indicate which closely related topics are intentionally excluded.

**Best Practices** Keep the scope tight enough for completion within a doctoral timeline while still broad enough to support an original contribution.

**Recommended Length** A short paragraph is usually enough.

### 1.4 Synopsis Roadmap

**Purpose** The roadmap helps the reader navigate the document and reinforces the internal logic of the synopsis.

**What to Include** Briefly explain what each chapter does and how the chapters build toward the proposed contribution.

**Recommended Length** One short paragraph is enough.

## Chapter 2

### Domain Related Concepts

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#### 2.1 Core Domain Concepts

**Purpose** This chapter equips the reader with the concepts needed to understand the problem, the proposed solution space, and the evaluation logic. Its role is not to theorize abstractly, but to define the domain-specific concepts that will recur throughout the synopsis.

**What to Include** Define the essential concepts, technical terms, representations, assumptions, and task notions used in the proposal. If the topic involves a particular type of model, system, architecture, data modality, user interaction, or infrastructure setting, define those ideas here in concise form.

**Best Practices** Include only concepts that the rest of the proposal genuinely depends on. Prefer operational definitions over philosophical ones. Where needed, support standard definitions with citations.

**What to Avoid** Avoid long textbook-style explanations and avoid repeating literature review content. This chapter should prepare the reader, not overwhelm them.

**Recommended Length** Roughly one page is often enough unless the field has specialized terminology that must be clarified early.

#### 2.2 Task Formulation and Operating Assumptions

**Purpose** This section clarifies what kind of problem is being solved and under what assumptions the study operates.

**What to Include** State the task view, operating assumptions, input-output perspective, constraints, and key conditions under which the problem is defined. If a compact formalization helps, include one.

**Best Practices** Keep notation minimal and readable. Only introduce mathematical formalization if it improves clarity.

$$[\textit{Placeholder : Optional : task formulation/objective/system equation}] \quad (2.1)$$

## 2.3 Domain Dimensions Relevant to Evaluation

**Purpose** This section prepares the reader for later methodological choices by identifying the domain dimensions that matter for evaluation, such as robustness, accuracy, efficiency, usability, fairness, safety, scalability, or interpretability.

**What to Include** Explain which dimensions are central in the domain and why they matter in judging whether a method or system is truly successful.

**Pro Tip** A strong synopsis defines domain concepts in a way that later makes the research gap and evaluation criteria feel inevitable rather than arbitrary.

## Chapter 3

# Problem Analysis, Existing Approaches, and Research Gap

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### 3.1 Identified Research Problem

**Purpose** This opening section states the exact research problem in precise and defensible form. It should tell the committee not merely what broad topic you are working in, but what specific technical difficulty remains unresolved.

**What to Include** Describe the operational or scientific setting in which the problem appears, the conditions under which it becomes difficult, and the specific inadequacy of current practice. The paragraph should make clear what is currently failing, what needs to be improved or understood, and why the problem matters.

**Best Practices** Make the problem testable and tightly connected to measurable evidence. The strongest problem statements are narrow enough to be solved and important enough to matter.

**What to Avoid** Avoid writing a broad topic description and calling it a problem statement. Avoid phrases such as “the problem is to study” or “current systems are not very good.”

**Weak vs. Strong Example** *Weak: The problem is that current systems are not very good. Strong: Current retrieval-augmented generation systems degrade sharply when evidence is noisy, stale, or only partially relevant, and existing ranking methods do not explicitly model evidence reliability under these conditions.*

## 3.2 How the Problem Has Been Addressed in Existing Work

**Purpose** This section explains how the field has attempted to deal with the identified problem so far. Rather than listing papers one by one, it should organize prior work into coherent lines of response.

**What to Include** Present the main families of existing approaches, their assumptions, and the specific mechanism through which they attempt to solve the problem. Depending on the field, these may be model-centric approaches, data-centric approaches, optimization strategies, architectural changes, retrieval strategies, systems engineering solutions, interaction design strategies, or theoretical treatments.

**Best Practices** Group prior work by technical logic rather than chronology. Show how each line of work tries to address the problem, what it improves, and under what assumptions it succeeds.

**Recommended Length** Devote enough space to show mastery, but keep the review selective and analytical rather than exhaustive.

### 3.2.1 Approach Family A

**Purpose** Explain one major line of prior work and the logic behind it. Describe what this family assumes, how it attempts to solve the problem, and where it performs well.

### 3.2.2 Approach Family B

**Purpose** Explain a second major line of prior work, especially if it addresses the same problem from a different methodological or theoretical direction.

### 3.2.3 Approach Family C

**Purpose** Add a third line of prior work only if it is necessary to explain the state of the field and the space into which your proposal fits.

## 3.3 Why Existing Methods Fail or Remain Insufficient

**Purpose** This section is the analytical center of the chapter. It should show why current approaches do not fully resolve the identified problem, even if they improve part of it.

**What to Include** Explain the limitations of existing methods in terms of assumptions, evaluation design, benchmark coverage, generalization, efficiency, robustness, reproducibility, interpretability, deployment fit, or theoretical completeness. Make clear whether methods fail because they solve only part of the problem, solve it under unrealistic assumptions, or succeed only in narrow benchmark settings.

**Best Practices** Tie every criticism to evidence. A strong critique is not rhetorical; it is comparative, technical, and fair. Show not only that methods fail, but why they fail.

**What to Avoid** Avoid sweeping claims that all prior work is inadequate. Avoid dismissing prior methods without identifying their actual contribution and limitations.

Table 3.1: Comparative synthesis of representative prior work

Study Method	/ Problem Setting	Data Bench- mark	/ Metrics	Key Limitation / Gap
[Placeholder: Author et al., Year]	[Placeholder: setting]	[Placeholder: dataset]	[Placeholder: metric]	[Placeholder: technical limitation]
[Placeholder: Author et al., Year]	[Placeholder: setting]	[Placeholder: dataset]	[Placeholder: metric]	[Placeholder: technical limitation]
[Placeholder: Author et al., Year]	[Placeholder: setting]	[Placeholder: dataset]	[Placeholder: metric]	[Placeholder: technical limitation]

### 3.4 The Research Gap

**Purpose** The research gap should emerge naturally from the previous sections. It is the unresolved need that remains after examining both the problem and the field’s attempts to address it.

**What to Include** State clearly what is still missing in the literature and why that missing element matters. The gap may concern a methodological limitation, an unresolved trade-off, missing evidence across realistic settings, weak reproducibility, poor performance under a critical constraint, or the absence of a framework that integrates several needed capabilities.

**Best Practices** Keep the gap narrow, explicit, and defensible. The best gap statements identify a precise unresolved intersection rather than a broad call for more research.

**Weak vs. Strong Example** *Weak: More research is needed in this area. Strong: Although prior work improves average benchmark performance, no study jointly evaluates robustness, computational cost, and reproducibility under heterogeneous deployment settings, leaving the central trade-off unresolved.*

### 3.5 How the Proposed Research Addresses the Gap

**Purpose** This section closes the argumentative loop by explaining how the proposed work is designed to answer the unresolved question identified above.

**What to Include** Explain how your proposed solution direction responds directly to the limitations of prior work. Clarify what your approach adds that existing methods do not, and explain why that addition is expected to address the unresolved problem. This is not yet the full methodology; it is the conceptual positioning of your solution.

**Best Practices** Be explicit about the alignment between gap and solution. If the gap concerns realism, then explain how your proposal improves realism. If the gap concerns uncertainty, explain how your proposal models uncertainty. If the gap concerns trade-offs, explain how your design investigates or optimizes those trade-offs.

**Pro Tip** A strong combined problem-and-gap chapter reads like a single argument: here is the problem, here is how the field has tried to solve it, here is why that is still insufficient, here is the unresolved gap, and here is why the proposed research is the right next step.

## Chapter 4

# Research Objectives, Questions

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### 4.1 Overall Aim

**Purpose** State the single overarching aim of the research in one sentence. The aim should unify the entire study and make clear what the research is ultimately trying to achieve at the level of knowledge, method, system capability, theory, or evidence. A strong aim signals direction without collapsing into excessive detail.

**What to Include** Write one precise sentence that reflects the central problem, the proposed direction of inquiry, and the intended contribution. The aim should be broad enough to cover the full study, but specific enough that a reader can anticipate the kind of methodology and evaluation the research will require.

**Best Practices** Phrase the aim as a research ambition rather than an activity. It should show intellectual purpose, not workflow. In strong synopses, the aim usually connects three elements clearly: the unresolved problem, the intended intervention or analytical direction, and the expected form of contribution.

**What to Avoid** Avoid aims that are so broad they could describe an entire field, and avoid aims that merely restate the thesis title in less precise language. Do not write the aim as a task such as developing software, reviewing literature, or collecting data.

**Recommended Length** One sentence, or at most two tightly written sentences.

### 4.2 Specific Objectives

**Purpose** Objectives translate the overall aim into a small set of concrete research targets. They should describe what the study must establish, compare, design, validate, explain,

or demonstrate in order to answer the central research problem.

**What to Include** Include only the most important objectives needed to carry the research from gap to contribution. In a strong CS synopsis, each objective normally corresponds to one major part of the study, such as formalizing the problem, designing a method, evaluating it against baselines, analyzing trade-offs, or validating the approach under realistic constraints. The objectives should connect directly to later methodology and to the evidence the study will generate.

**Best Practices** Use action verbs that reflect research outcomes, such as evaluate, determine, design, compare, characterize, quantify, validate, formulate, or analyze. Arrange the objectives in a logical sequence so that they build toward the expected contribution. Keep the list focused; a synopsis usually becomes weaker when the objective list grows long and begins to resemble a project management checklist rather than a research agenda.

**What to Avoid** Avoid writing objectives such as “to review literature,” “to collect data,” “to implement a model,” or “to write a framework.” Those are activities that support research, not research outcomes. Also avoid objectives that are too vague to assess, such as “to improve the system” without specifying in what respect, under what conditions, or relative to what standard.

**Recommended Length** Usually 3–5 objectives are sufficient for a PhD synopsis.

O1. [Placeholder: Objective 1]

O2. [Placeholder: Objective 2]

O3. [Placeholder: Objective 3]

O4. [Placeholder: Objective 4]

**Weak vs. Strong Example** *Weak: To build a model for the problem. Strong: To design and evaluate a reliability-aware ranking mechanism that improves downstream answer faithfulness under noisy and partially relevant evidence.*

**Pro Tip** Each objective should imply a form of evidence. If an objective does not suggest how it would be assessed, it is probably still too vague.

### 4.3 Research Questions

**Purpose** Research questions convert the objectives into answerable questions that the study will resolve through evidence. They are important because they tell the committee exactly what the research is trying to find out, not just what it plans to do.

**What to Include** Formulate questions that arise naturally from the identified gap and that can be answered through the proposed methodology. Good research questions in Computer Science often focus on performance under specific conditions, trade-offs among desirable properties, causal or explanatory relationships between design choices and outcomes, or the comparative value of one approach against alternatives. The wording should make clear what counts as an answer and what type of evaluation or analysis will be required.

**Best Practices** Keep the number of questions manageable and ensure that each one is distinct. A strong question is precise, empirically or theoretically answerable, and closely linked to one or more objectives. In many successful synopses, the first question addresses overall effectiveness, the second addresses mechanisms, constraints, or trade-offs, and the third addresses robustness, generalizability, interpretability, or application relevance.

**What to Avoid** Avoid questions that are excessively broad, philosophical, or unbounded in scope. Avoid asking questions that cannot be answered within one doctoral project, or questions whose answers would amount only to personal opinion. Also avoid trivial questions that merely repeat what the methodology will do without addressing a meaningful uncertainty.

**Recommended Length** Usually 2–4 research questions are sufficient.

**RQ1.** [Placeholder: [Research Question 1](#)]

**RQ2.** [Placeholder: [Research Question 2](#)]

**RQ3.** [Placeholder: [Research Question 3](#)]

**Weak vs. Strong Example** *Weak: Which model works best? Strong: Under noisy, stale, and partially relevant evidence conditions, to what extent does a reliability-aware retrieval mechanism improve answer faithfulness relative to dense and hybrid retrieval baselines?*

**Pro Tip** If a research question can be answered with “it depends” and nothing more, refine it until the study can produce a clear analytical answer.

## 4.4 Target Audience, Users, and Direct Beneficiaries

**Purpose** This section identifies who will directly benefit from the research and who is likely to use its outputs. It helps the committee judge the proposal’s relevance, practical value, and likely pathway from contribution to impact.

**What to Include** Identify the primary scholarly audience first, such as researchers in a specific CS subfield who would build on the findings, benchmark, method, or theory. Then identify the technical users who might adopt the research outputs in practice, such as software engineers, system designers, data scientists, security analysts, clinicians using decision-support systems, educators working with intelligent tools, public institutions, or industrial research teams. Finally, where applicable, explain who may benefit indirectly through better reliability, safety, efficiency, accessibility, decision support, or reduced cost.

**Best Practices** Distinguish clearly between audience, users, and beneficiaries. The academic audience is usually the community that will cite and extend the work. The users are those who will directly employ the method, framework, benchmark, protocol, tool, or evidence. The beneficiaries are those who gain from improved outcomes even if they never interact with the technical artifact itself. The best versions of this section explain benefit in concrete, domain-specific terms rather than abstract social good.

**What to Avoid** Avoid claiming that the research benefits “everyone,” or naming audiences that are too broad to be credible. Avoid listing beneficiaries without explaining the mechanism of benefit. If the research is foundational, be honest about that and emphasize scholarly and technical users rather than forcing weak real-world claims.

**Recommended Length** One focused paragraph, or two short paragraphs if the research has both academic and applied stakeholders.

**Pro Tip** This section is strongest when the beneficiaries match the actual contribution. A benchmarking study should not be framed like a consumer product, and a systems contribution should not be justified only in abstract academic terms.

## 4.5 Alignment Between Objectives, Questions, and Evidence

**Purpose** This section demonstrates that the chapter is internally coherent. It shows the committee that every objective leads to one or more research questions and that each question can be answered through identifiable forms of evidence.

**What to Include** Use the alignment table to make the logic of the study visible. Each row should connect one objective to the most relevant question and to the evidence that will answer it, such as controlled experiments, formal proofs, simulations, user studies, benchmark evaluations, ablation studies, or comparative analyses. The table should reassure the committee that there are no disconnected objectives and no questions that lack an evidentiary path.

**Best Practices** Keep the wording in the table short but precise. Make sure the evidence

listed is appropriate for the question being asked. If a question is comparative, the evidence should involve strong baselines. If a question is explanatory, the evidence should include ablations, sensitivity analyses, or interpretive analysis. If a question concerns usability or deployment, the evidence may need user studies, systems evaluation, or field-informed analysis.

**What to Avoid** Avoid presenting the table as a formality. If the entries are vague, repetitive, or disconnected from the rest of the chapter, the table will expose conceptual weakness rather than strengthen the proposal.

Table 4.1: Alignment of objectives, research questions, and planned evidence

ID	Objective	Research Question	Evidence Required
O1	[Placeholder: Objective 1]	[Placeholder: RQ1]	[Placeholder: Experiment / theorem / simulation / user study / benchmark]
O2	[Placeholder: Objective 2]	[Placeholder: RQ2]	[Placeholder: Experiment / theorem / simulation / user study / benchmark]

**Pro Tip** If the alignment table looks clean, the proposal usually is. If it looks forced, the chapter likely needs conceptual revision.

## Chapter 5

# Research Methodology

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### 5.1 Research Design

**Purpose** This section states the overall design of the study and explains why it is appropriate for the research questions. It should indicate whether the work is experimental, quasi-experimental, simulation-based, proof-oriented, design science, systems evaluation, mixed-methods, or human-subject research.

**Best Practices** Name the design explicitly and justify it in relation to the objectives and hypotheses.

### 5.2 Study Setting and Scope

**Purpose** This section describes the environment in which the research will be conducted or evaluated. It should clarify the benchmark setting, deployment context, simulation environment, platform, or user setting relevant to the study.

### 5.3 Data Sources and Sampling Strategy

**Purpose** This section describes what evidence will be used and how it will be selected. The committee should be able to see that the evidence base is appropriate, sufficient, and feasible.

**What to Include** Describe the datasets, corpora, logs, repositories, simulation sources, participant pools, or benchmark suites that will be used. Explain the inclusion and exclusion logic, access conditions, and any sampling rationale.

### 5.3.1 Dataset Description Block

**Purpose** This table provides a compact summary of major datasets or evidence sources.

Table 5.1: Dataset / corpus / benchmark description

Name	Size	Type	Description / Domain	Access / License
[Placeholder: Dataset A]	[Placeholder: N]	[Placeholder: text / image / logs / code / sensor / tabular]	[Placeholder: brief description]	[Placeholder: domain / restricted / approved]
[Placeholder: Dataset B]	[Placeholder: N]	[Placeholder: type]	[Placeholder: description]	[Placeholder: domain / restricted / approved]

### 5.3.2 Data Annotation / Labeling Plan

**Purpose** If the work depends on labels or human judgments, explain how annotations will be generated and quality controlled. State who the annotators are, what instructions they will follow, and how consistency or agreement will be assessed.

## 5.4 Proposed Method / System / Algorithm

**Purpose** This section explains the proposed technical approach at a level appropriate for a proposal defense. The committee should understand the main idea, its components, and why it addresses the gap identified earlier.

### 5.4.1 Algorithmic Novelty Statement

**Purpose** State exactly what is new in the proposal. The novelty may lie in a new architecture, objective, representation, optimization strategy, inference mechanism, benchmark formulation, systems design, or theoretical insight.

**What to Avoid** Avoid vague claims of novelty and avoid presenting dataset substitution or hyperparameter tuning as the main contribution.

**Weak vs. Strong Example** *Weak: The novelty is applying an existing model to a new dataset. Strong: The novelty lies in explicitly modeling evidence reliability during ranking, enabling downstream generation to condition on uncertainty rather than assuming all retrieved evidence is equally trustworthy.*

#### 5.4.2 High-Level Workflow

**Purpose** Use a workflow figure to give the reader a compact visual understanding of the proposed pipeline or system architecture.



Figure 5.1: High-level workflow / pipeline / system architecture of the proposed method

#### 5.4.3 Model / System Components

**Purpose** Break the proposed solution into its essential components and explain the role of each component.

- [Placeholder: Component 1: purpose and role]
- [Placeholder: Component 2: purpose and role]
- [Placeholder: Component 3: purpose and role]

#### 5.4.4 Training / Optimization / Implementation Details

**Purpose** Explain how the method will be built, trained, optimized, or executed. State the objective function, optimization or search procedure, hyperparameter logic, and key implementation constraints if these are central to feasibility.

## 5.5 Baseline Methods and Comparative Evaluation

**Purpose** This section states what the proposed method will be compared against and why those comparisons are fair and informative. In CS research, a proposal loses credibility if the baseline design is weak.

**Best Practices** Include strong current baselines and sensible conventional baselines where appropriate. Justify each one in terms of what comparison it enables.

Table 5.2: Baseline methods planned for comparison

Baseline	Category	Why Included	Expected Comparison Dimension
[Placeholder: Baseline 1]	[Placeholder: classical / deep / heuristic / system]	[Placeholder: reason]	[Placeholder: accuracy / latency / robustness / etc.]
[Placeholder: Baseline 2]	[Placeholder: category]	[Placeholder: reason]	[Placeholder: dimension]
[Placeholder: Baseline 3]	[Placeholder: category]	[Placeholder: reason]	[Placeholder: dimension]

## 5.6 Experimental Setup and Benchmark Protocol

**Purpose** This section shows exactly how the proposed work will be evaluated. It should specify benchmark tasks, train-validation-test protocol, ablations, stress tests, and statistical validation.

Table 5.3: Experimental setup and benchmark scaffold

Element	Planned Specification
Evaluation Benchmarks	[Placeholder: benchmark suites / datasets / tasks]
Train/Validation/Test Protocol	[Placeholder: fixed split / k-fold / temporal split / leave-one-group-out]
Ablation Studies	[Placeholder: which components will be removed or varied]
Sensitivity Analysis	[Placeholder: hyperparameters / perturbations / data regimes / hardware constraints]
Robustness Checks	[Placeholder: OOD shift / noise / adversarial / failure analysis / stress tests]
Statistical Validation	[Placeholder: confidence intervals / significance tests / effect sizes]

## 5.7 Evaluation Metrics

**Purpose** This section defines how success and failure will be measured. The metrics should map directly to the research claims.

- **Primary Metric(s):** [Placeholder: Accuracy, F1, AUROC, mAP, BLEU, NDCG, latency, throughput, memory, theorem tightness, etc.]
- **Secondary Metric(s):** [Placeholder: fairness, calibration, robustness, interpretability, energy, cost, sample efficiency]
- **Failure Analysis Indicators:** [Placeholder: error categories, stress tests, edge cases, qualitative breakdowns]

## 5.8 Reproducibility and Compute Environment

**Purpose** This section demonstrates that the work can be replicated and audited. It should describe frameworks, hardware, experiment tracking, code release plans, and randomness control.

Table 5.4: Reproducibility and compute environment

Aspect	Planned Practice
Programming Frameworks	[Placeholder: PyTorch / TensorFlow / JAX / C++ / Rust / Java / MATLAB / etc.]
Hardware	[Placeholder: CPU / GPU / TPU / cluster / embedded / cloud]
Experiment Tracking	[Placeholder: MLflow / Weights & Biases / versioned configs / logs]
Code Availability	[Placeholder: public repo / staged release / internal archive]
Data Availability	[Placeholder: public / restricted / synthetic pipeline]
Randomness Control	[Placeholder: seed management / repeated runs / deterministic settings]
Artifact Reproducibility	[Placeholder: scripts, configs, package versions, Docker/Conda]

**Pro Tip** In strong CS proposals, reproducibility is part of rigor, not an optional extra.

## 5.9 Ethical, Privacy, Security, and Risk Considerations

**Purpose** Address any ethical or risk issues tied to the study, including human subjects, sensitive data, privacy, bias, harmful misuse, environmental cost, or security implications if relevant.

## 5.10 Validity Threats and Mitigation Plan

**Purpose** Show awareness of what could weaken the findings. Discuss internal validity, external validity, construct validity, and statistical conclusion validity where relevant, and explain how the design mitigates these risks.

## Chapter 6

### Expected Results and Significance

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#### 6.1 Expected Technical Outcomes

**Purpose** This section states what outputs the research is likely to generate, such as an algorithm, framework, benchmark, system, dataset, tool, or theoretical result.

#### 6.2 Expected Empirical / Theoretical Findings

**Purpose** Explain the kind of patterns, comparisons, or insights that the study is expected to reveal. State expected findings cautiously and in relation to the hypotheses or questions.

#### 6.3 Academic and Practical Significance

**Purpose** Explain why the field should care if the study succeeds. This section should show the scientific significance of the work and, where relevant, its practical value to downstream users or institutions.

**What to Avoid** Avoid exaggerated claims such as “this will revolutionize the field.” Significance should be linked to the identified problem and the contribution.

**Weak vs. Strong Example** *Weak: The research will help the field a lot. Strong: If successful, the proposed work will provide a validated method for improving reliability under noisy evidence without unacceptable computational overhead, addressing a practical barrier to trustworthy deployment.*

## Chapter 7

# Original Contribution to Knowledge

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### 7.1 Primary Original Contribution

**Purpose** State the single most important original contribution of the proposed research. Phrase it as an advance in knowledge rather than as a task or activity.

### 7.2 Secondary Contributions

**Purpose** List additional contributions in ranked order. These may be methodological, theoretical, empirical, systems-oriented, benchmark-related, or evidence-related.

C1. [Placeholder: Contribution 1]

C2. [Placeholder: Contribution 2]

C3. [Placeholder: Contribution 3]

### 7.3 Contribution Type Classification

**Purpose** This table helps the candidate distinguish types of originality clearly.

Table 7.1: Planned contribution types

Contribution	Type	How it Advances Knowledge
[Placeholder: Contribution 1]	[Placeholder: method / theory / benchmark / dataset / system / evidence]	[Placeholder: advance explanation]
[Placeholder: Contribution 2]	[Placeholder: type]	[Placeholder: advance explanation]

## 7.4 Publication and Dissemination Plan

**Purpose** Explain how the work will be communicated and validated by the field. Identify plausible conference, journal, or artifact dissemination targets aligned with the topic.

- **Conference Target(s):** [Placeholder: NeurIPS / ICML / CVPR / ACL / KDD / CHI / SIGCOMM / IEEE / ACM venue]
- **Journal Target(s):** [Placeholder: IEEE / ACM / JMLR / domain-specific journal]
- **Artifact Outputs:** [Placeholder: code, benchmark, dataset card, model card, replication package]

## Chapter 8

### Work Plan and Timeline

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#### 8.1 Work Packages

**Purpose** This section breaks the research into manageable phases and shows how the work will progress from formulation to validation, publication, and thesis completion.

Table 8.1: Work packages, tasks, and deliverables

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WP	Phase	Major Task(s)	Deliverable(s)	Planned Duration
WP1	[Placeholder: Phase Name]	[Placeholder: task description]	[Placeholder: deliverable]	[Placeholder: Months 1–6]
WP2	[Placeholder: Phase Name]	[Placeholder: task description]	[Placeholder: deliverable]	[Placeholder: Months 7–12]
WP3	[Placeholder: Phase Name]	[Placeholder: task description]	[Placeholder: deliverable]	[Placeholder: Months 13–18]
WP4	[Placeholder: Phase Name]	[Placeholder: task description]	[Placeholder: deliverable]	[Placeholder: Months 19–24]
WP5	[Placeholder: Phase Name]	[Placeholder: task description]	[Placeholder: deliverable]	[Placeholder: Months 25–36]

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## 8.2 Milestones

**Purpose** Milestones identify clear checkpoints by which the committee can judge progress. They should be measurable and tied to deliverables.

- **M1:** [Placeholder: final problem formulation and benchmark selection]
- **M2:** [Placeholder: baseline implementation and pilot evaluation]
- **M3:** [Placeholder: proposed method validated]
- **M4:** [Placeholder: paper submission(s)]
- **M5:** [Placeholder: thesis writing and defense preparation]

## 8.3 Illustrative Gantt Chart

**Purpose** This chart provides a compact visual overview of sequencing and timing.

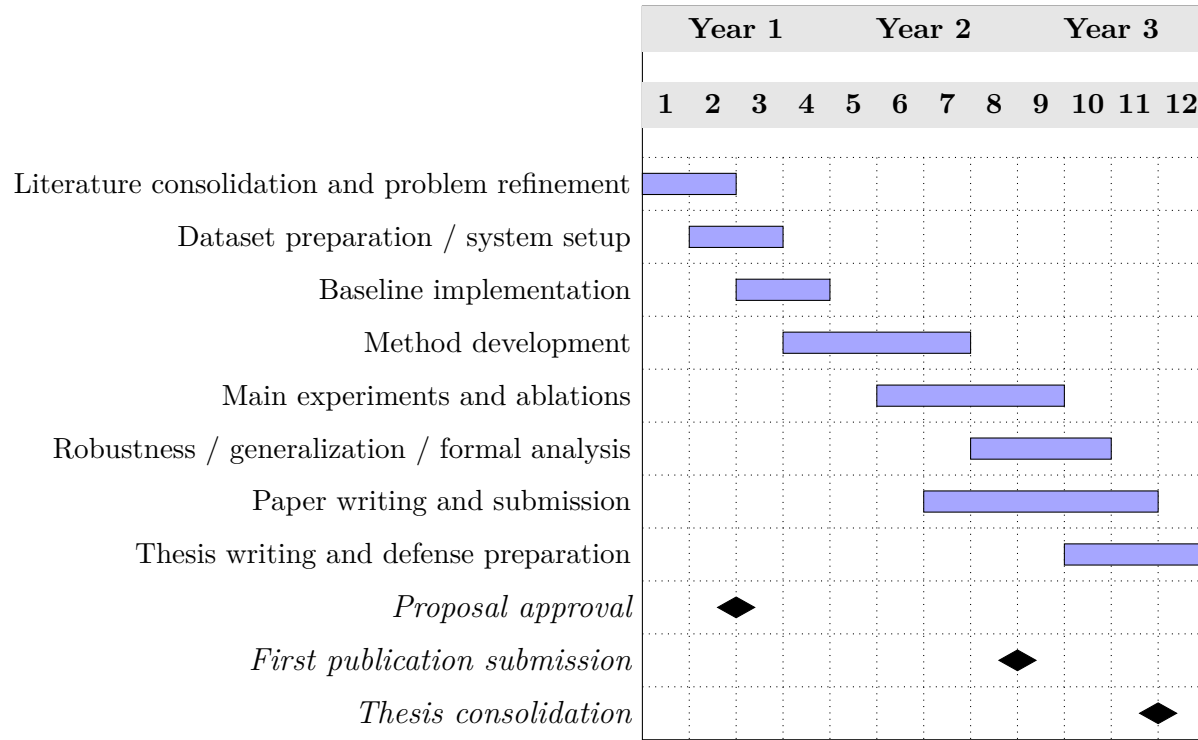


Figure 8.1: Illustrative timeline for the proposed PhD research

## 8.4 Contingency Planning

**Purpose** This section shows that the project remains viable even if constraints arise. Mention backup datasets, alternative benchmarks, or fallback evaluation plans where appropriate.

## Chapter 9

# Limitations and Delimitations

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### 9.1 Delimitations

**Purpose** Delimitations are the boundaries that the study intentionally sets. This section should explain what the research will not cover and why those boundaries are appropriate.

### 9.2 Limitations

**Purpose** Limitations are constraints that may affect execution, generalization, or inference. This section should identify them honestly and in relation to the evidence base, benchmark design, compute budget, data access, or deployment realism.

### 9.3 Mitigation Measures

**Purpose** Explain how the design reduces the effect of major limitations. Mitigation strategies demonstrate planning discipline and research maturity.

**Weak vs. Strong Example** *Weak: One limitation is that the study may have some limitations due to time and data. Strong: A key limitation is that public benchmarks may not fully capture deployment-specific edge cases; this will be mitigated through stress testing, sensitivity analyses, and structured error categorization.*

## Chapter 10

### Conclusion

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#### 10.1 Concluding Synthesis

**Purpose** This chapter brings the full proposal together in one concise closing argument. It should restate the central problem, the gap, the proposed research direction, the expected contribution, and the overall feasibility of the study.

**Best Practices** Be brief, confident, and coherent. The conclusion should leave the committee with a clear sense that the proposal is logically integrated and appropriately scoped.

## Bibliography

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