Research Methods in Computer Science

An Introduction to Academic Presentations

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2026-02-03

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Introduction

Motivation

- Academic presentations communicate research findings effectively
- A consistent visual identity strengthens institutional recognition
- This template follows the TU Berlin corporate design guidelines

Motivation

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- This template follows the TU Berlin corporate design guidelines
- Built on **Touying**, a modern presentation framework for Typst
- Supports animations, multi-column layouts, and structured slides

Agenda

1. Introduction and motivation
2. Research methodology
3. Results and discussion
4. Conclusion and future work

Methodology

Research Approach

We employ a mixed-methods approach combining:

1. **Quantitative analysis** — statistical evaluation of experimental data
2. **Qualitative review** — expert assessment of design patterns
3. **Comparative study** — benchmarking against existing solutions

Research Approach

We employ a mixed-methods approach combining:

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The methodology follows established best practices in the field.

Comparison of Approaches

Traditional Methods

- Manual data collection
- Limited scalability
- High cost per sample
- Established validity

Modern Methods

- Automated pipelines
- Horizontally scalable
- Reduced marginal cost
- Requires validation

Results

Key Findings

Main Result: The proposed approach achieves a 35% improvement over the baseline while maintaining statistical significance ($p < 0.01$).

Supporting observations:

- Consistent performance across all test conditions
- Robust to variations in input parameters
- Generalizes well to unseen data distributions

Detailed Analysis

> **The combination of automated data collection and rigorous statistical testing enables reproducible research at scale.**

The analysis reveals three key factors:

1. **Data quality** has the strongest effect on outcomes
2. **Sample size** matters beyond $n = 100$
3. **Method selection** has diminishing returns after optimization

Mathematical Framework

The optimization objective[1] is defined as:

$$\min_{\theta} \mathcal{L}(\theta) = \frac{1}{N} \sum_{i=1}^{N} \ell(f_\theta(x_i), y_i) + \lambda \|\theta\|_2^2$$

where:

- f_θ is the parameterized model
- ℓ is the loss function
- λ controls regularization strength

[1] Boyd & Vandenberghe, *Convex Optimization*, Cambridge University Press, 2004.

Formal Definitions

Theorem

For any convex function $f : \mathbb{R}^n \to \mathbb{R}$, a local minimum is also a global minimum.

Definition

A function f is **convex** if for all $x, y \in \text{dom } f$ and $0 \leq \theta \leq 1$:

$$f(\theta x + (1-\theta)y) \leq \theta f(x) + (1-\theta)f(y)$$

Example

Formal Definitions

The function $f(x) = x^2$ is convex on $\mathbb{R}$, since $f''(x) = 2 > 0$ everywhere.

> *If we knew what it was we were doing, it would not be called research, would it?*
>
> — Albert Einstein

> *Premature optimization is the root of all evil.*
>
> — Donald Knuth

Conclusion

Summary

Contributions

- Novel methodology for data analysis
- Open-source implementation
- Reproducible experimental setup
- Comprehensive evaluation

Future Work

- Extension to larger datasets
- Cross-domain validation
- Real-time processing pipeline
- Community benchmarking

Thank You!

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Questions?