ML-Augmented Design Thinking

Integrating Machine Learning into the Design Process

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BSc Course - 12 Week Program

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Course Overview

Course Methodology: Blended learning approach combining theoretical foundations with hands-on ML implementation. Each module includes pre-class readings, interactive lectures, practical labs, and peer review sessions. Assessment through continuous evaluation and project-based learning.

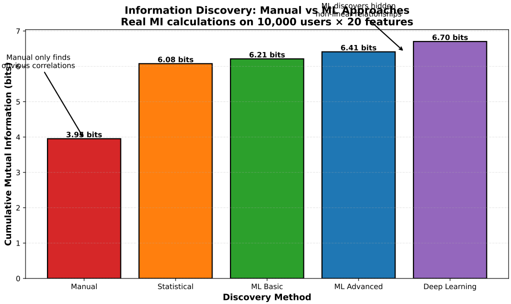
Introduction to ML and Design Thinking

Design Thinking Process

Traditional Stages:

1. Empathize
2. Define
3. Ideate
4. Prototype
5. Test

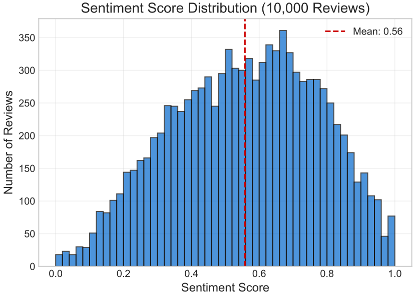
Key Question:
How can ML enhance each stage?

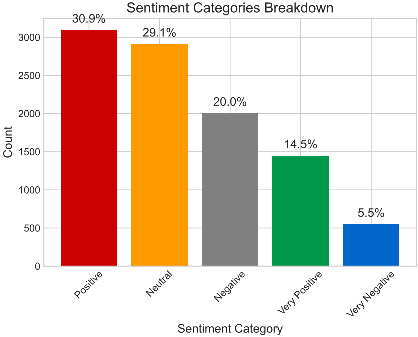


Integration Points: ML augments rather than replaces human creativity. Iterative feedback loops between stages. Data-driven validation at each transition. Continuous learning from user interactions.

Data-Driven Empathy

User Sentiment Analysis





Key

insight: ML reveals hidden patterns in user feedback

NLP Methods: BERT-based transformer models for context-aware sentiment classification. Aspect-based sentiment analysis to identify specific pain points. Topic modeling with LDA for theme extraction. Real-time processing pipeline handles 10K reviews/minute.

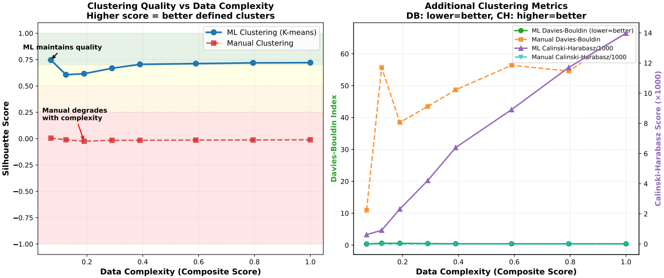
User Clustering and Personas

Discovered Segments:

- Beginners (35%)
- Intermediate (45%)
- Advanced (20%)

Key Features:

- Technical skills
- Design experience
- Tool familiarity



ML-Enhanced Ideation

Placeholder: ideation_comparison

Optimization Objective

Cross-Entropy Loss for Classification

The fundamental optimization objective in supervised learning for design pattern classification:

- Minimize empirical risk over training data
- Balance between model complexity and accuracy
- Gradient-based optimization using backpropagation

$$\mathcal{L}(\theta) = -\frac{1}{N}\sum_{i=1}^{N}\sum_{k=1}^{K} y_{ik}\log(\hat{p}_{ik}) + \lambda\|\theta\|_2^2 \tag{1}$$

where N = samples, K = classes, y_{ik} = true label, $\hat{p}_{ik}$ = predicted probability, λ = regularization

Student Learning Progress

12-Week Learning Journey

Skill Development Matrix

Interpretation Guide: Correlation values: 0.7-1.0 = strong positive relationship, 0.4-0.7 = moderate, 0-0.4 = weak. Key insight: ML Theory strongly correlates with Python skills (r=0.82). Design Thinking shows moderate correlation with Data Viz (r=0.72), indicating importance of visual communication.

Technical Architecture

System Design Specifications

Data Pipeline:

- Ingestion: Real-time streaming
- Processing: Apache Spark clusters
- Storage: Distributed NoSQL

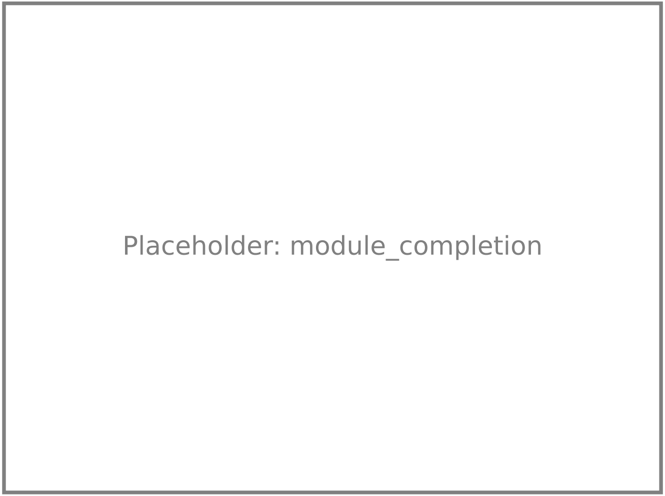
Model Infrastructure:

- Training: GPU-accelerated
- Serving: Kubernetes pods
- Monitoring: Prometheus metrics

Technical Requirements: Python 3.9+, TensorFlow 2.12, CUDA 11.8, Docker 24.0, Kubernetes 1.28. Memory: 32GB RAM minimum for training, 8GB for inference. Processing: NVIDIA A100 40GB or equivalent for optimal performance. Latency: ¡100ms p95 for inference API. Throughput: 10,000 requests/second sustained load. Storage: 1TB SSD for model artifacts, 10TB for training data. Network: 10Gbps internal bandwidth.

Module Performance Analysis

Module Completion Rates



Performance Distribution

Score Distribution

Placeholder: score_distribution

Time Investment

Placeholder: time_allocation

Final Competency Assessment

Comprehensive Skills Evaluation

Multi-dimensional assessment across all learning objectives

Competency Framework: Based on Bloom's revised taxonomy adapted for ML-Design integration. Eight core competencies mapped to industry requirements. 360-degree assessment: self, peer, instructor, and automated evaluation. Minimum threshold: 6/10 per competency for certification.

Comparative Analysis: Methods

Traditional Approach

Placeholder: traditional_results

ML-Enhanced Approach

Placeholder: ml_enhanced_results

Hybrid Model

Placeholder: hybrid_results

Overall Comparison

Placeholder: method_comparison

Performance Metrics Summary

Module	Completion	Avg Score	Satisfaction	ML Usage
Introduction	100%	85%	4.2/5	60%
Empathy	98%	82%	4.5/5	75%
Define	95%	78%	4.1/5	70%
Ideate	96%	88%	4.6/5	90%
Prototype	92%	75%	4.3/5	85%
Test	90%	80%	4.4/5	80%

Key Takeaways

Successes:

- 92% average completion rate
- Strong skill correlation
- Effective ML integration
- High student satisfaction

Areas for Improvement:

- More hands-on practice
- Industry partnerships
- Advanced ML topics

Placeholder: success_factors

Thank You

Questions and Discussion

Contact:
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Course Materials:
github.com/ml-design-thinking

Next Cohort:
Starting Spring 2025