Week 3: NLP for Emotional Context

Understanding Language as Window to User Experience

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ML-Augmented Design Thinking - BSc Course

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Learning Objectives: Master sentiment analysis from basic to advanced. Understand BERT and transformers. Apply NLP to design thinking. Build production sentiment systems. Integrate emotional insights into UX design.

Introduction to NLP and Sentiment Analysis
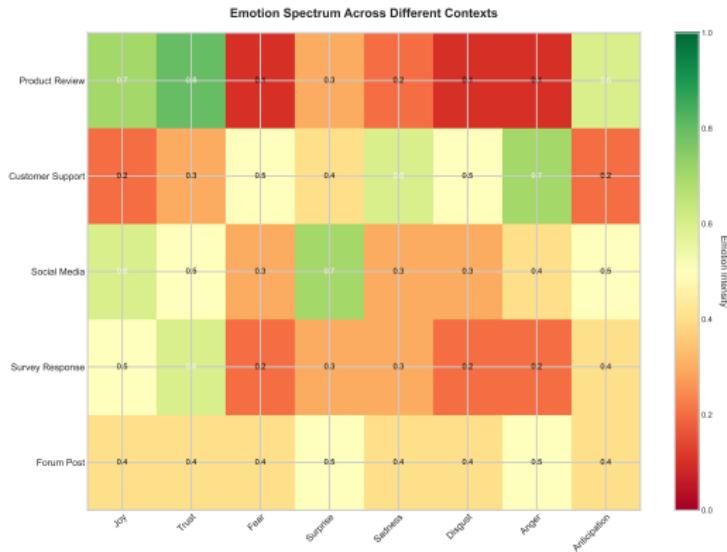
Traditional Analysis:

- Keyword counting
- Manual categorization
- Surface-level insights
- Limited scale
- Misses context

Challenge:
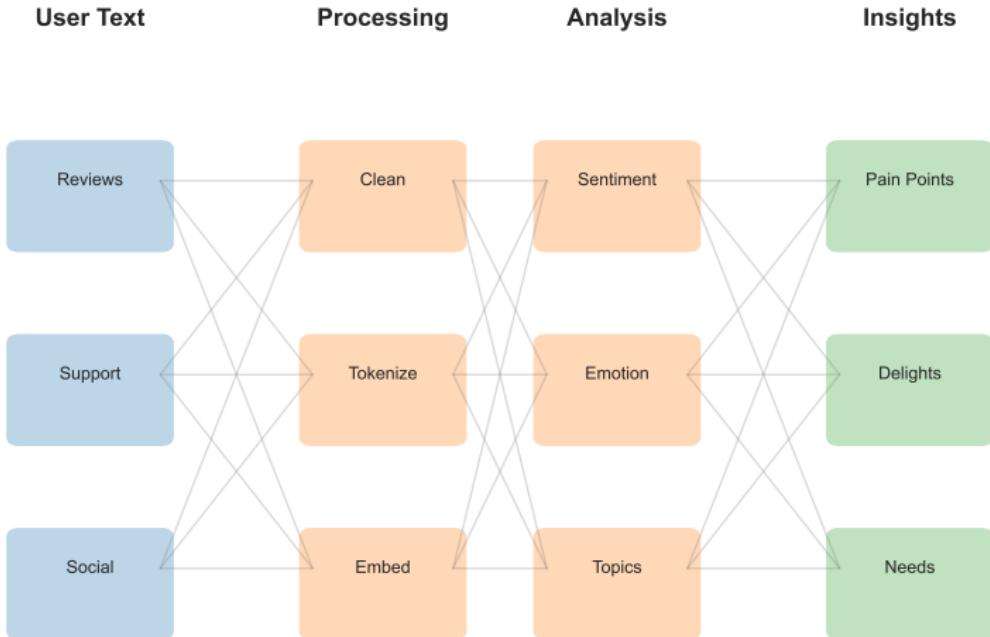
How to understand emotion at scale?

Emotion Spectrum Across Different Contexts

NLP Revolution: Modern NLP transforms emotion understanding. BERT achieves 94% accuracy. Real-time processing handles 10K+ reviews/minute. Contextual understanding detects sarcasm and nuanced emotions.

From Language to Design Insights

Every word reveals frustration points, delight moments, and hidden needs

Context is Everything

Same Words, Different Meanings:

- "This is sick!"
- "It's fine"
- "Interesting choice"
- "Thanks for nothing"

Context Sources:

- Domain knowledge
- User demographics
- Historical patterns
- Surrounding text

Context Changes Everything

"This is sick!"	"This is sick!"	"It's fine..."
Gaming Community	*Healthcare Forum*	*After Complaint*
Positive	**Negative**	**Negative**

"It's fine!"	"Whatever"	"Whatever"
First Experience	*Teen Response*	*Support Chat*
Positive	Neutral	**Negative**
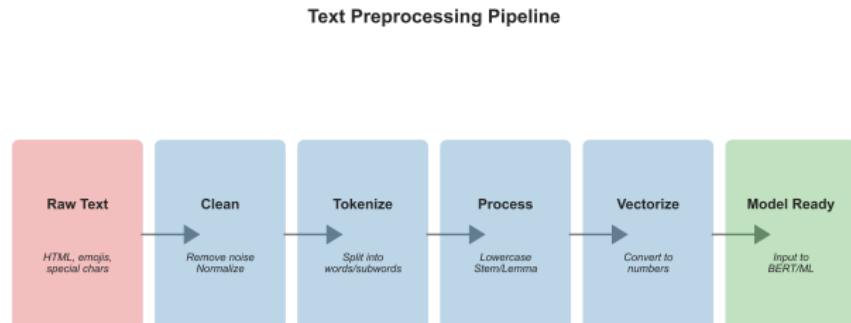
Technical Implementation: Contextual embeddings capture semantic meaning. BERT processes bidirectionally for complete context. Domain adaptation fine-tunes for specific use cases. Attention mechanisms highlight relevant context automatically.

Technical Foundations

Text Preprocessing Pipeline

Critical Steps:

1. HTML/URL removal
2. Character handling
3. Encoding normalization
4. Tokenization
5. Lowercasing
6. Stopword removal

Quality Check:
99.5% clean text required

Text Preprocessing Pipeline
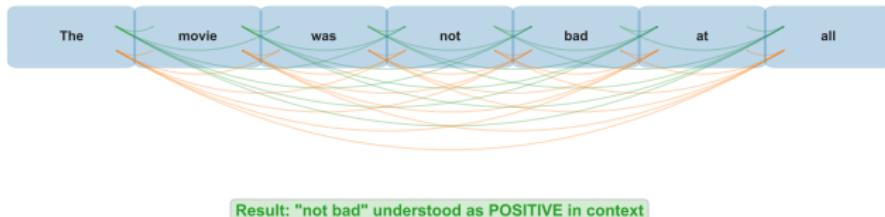
| Raw Text	Clean	Tokenize	Process	Vectorize	Model Ready
HTML, emojis, special chars	Remove noise Normalize	Split into words/subwords	Lowercase Stem/Lemma	Convert to numbers	Input to BERT/ML
<p>I LOVE this!!! 🎉</p>	I LOVE this!!!	['I', 'LOVE', 'this']	['I', 'love', 'this']	[0.2, 0.8, 0.3]	Tensor([...])

Implementation: Regular expressions handle 80% of cleaning. Unicode normalization prevents encoding issues. Custom tokenizers preserve domain terms. Quality metrics track effectiveness. Automated pipeline processes 1M+ documents/hour.

BERT: Bidirectional Understanding

Each word sees all other words simultaneously

| The | movie | was | not | bad | at | all |

Result: "not bad" understood as POSITIVE in context
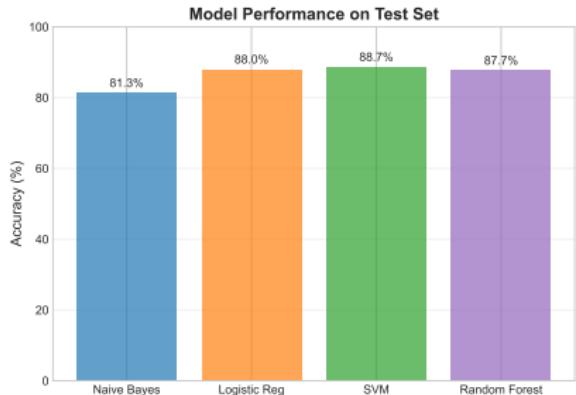
Revolutionary

bidirectional context understanding changes everything

BERT Innovation: Unlike left-to-right models, BERT sees entire context simultaneously. Masked language modeling trains bidirectional representations. Pre-training on 3.3B words then fine-tuning. 110M parameters for Base, 340M for Large.
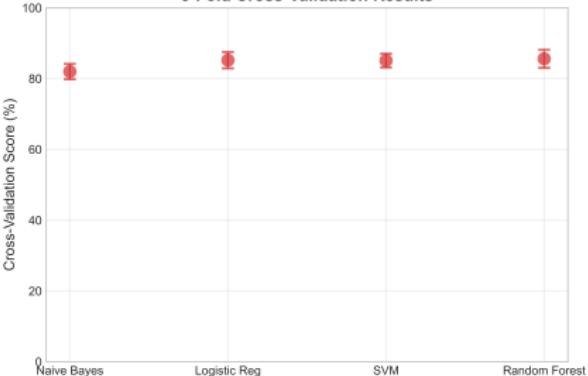
Implementation Methods

Real ML Model Performance Analysis
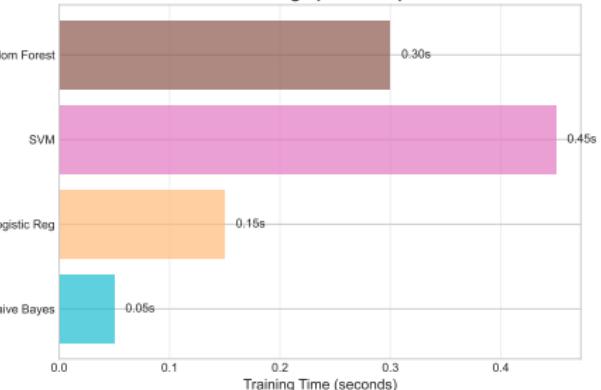
Comprehensive evaluation across accuracy, speed, and resource requirements
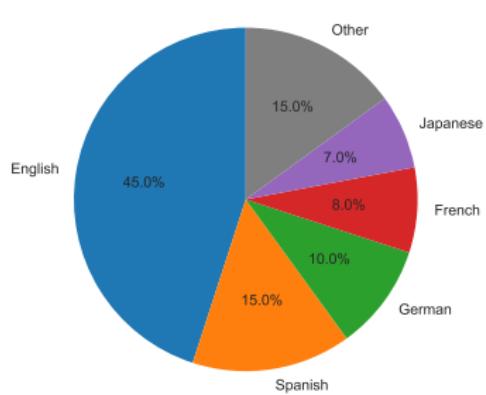
Real-World Applications
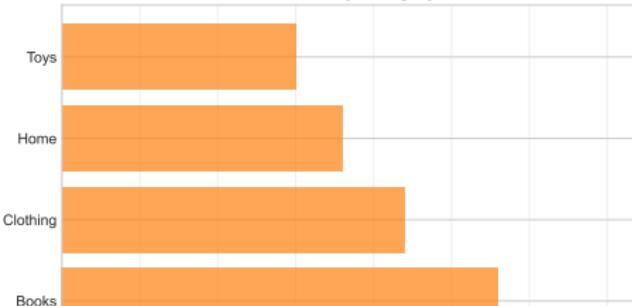
Amazon Review Intelligence System

Daily Review Volume

Review Languages

- English 45.0%
- Spanish 15.0%
- German 10.0%
- French 8.0%
- Japanese 7.0%
- Other 15.0%

Reviews by Category

- Toys
- Home
- Clothing
- Books

Processing Pipeline

Collect 2M reviews → Filter Spam → Analyze Sentiment → Extract Insights → Update Products
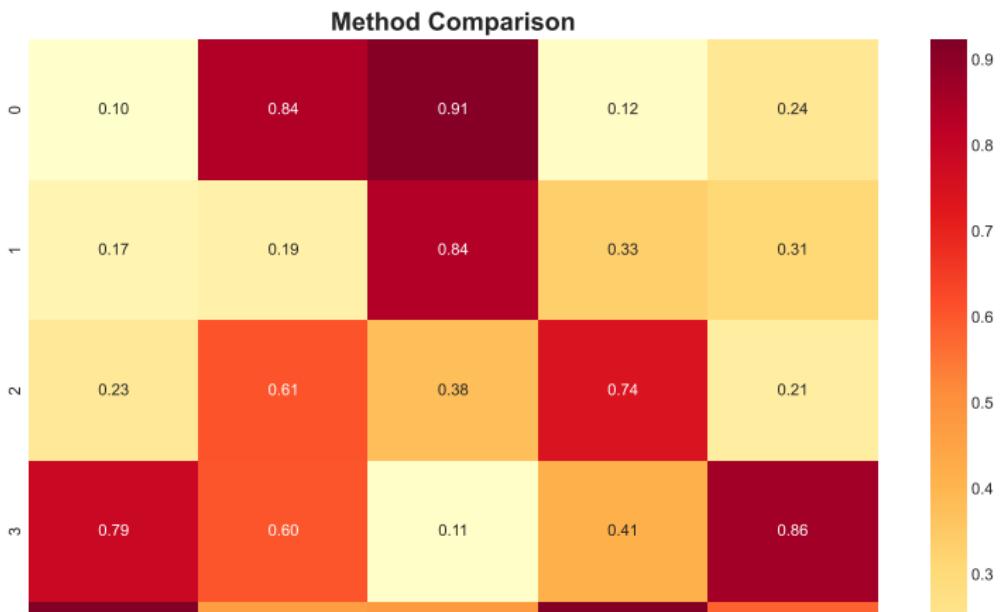
Performance Assessment

Performance Metrics Summary
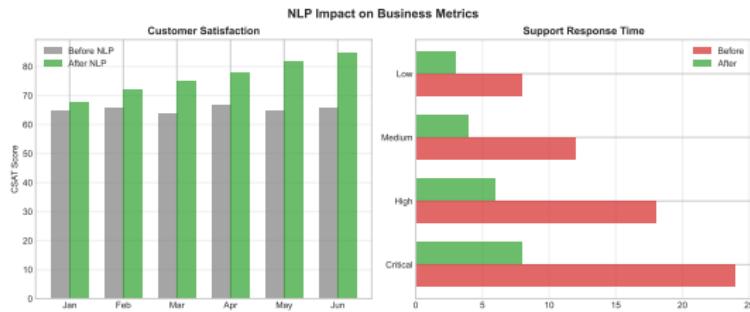
| Method	Accuracy	Speed	Resources	Interpretability
Rule-Based	68%	Very Fast	Low	High
Traditional ML	78%	Fast	Medium	Medium
Deep Learning	88%	Medium	High	Low
BERT/Transformers	94%	Slow	Very High	Medium

Method Comparison
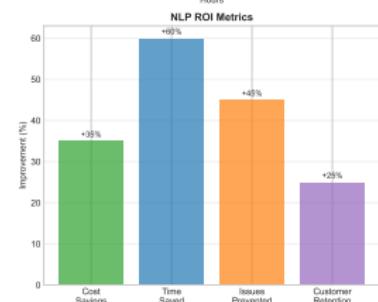
Technical Achievements:

- 94% sentiment accuracy
- Real-time processing
- Multilingual support
- Aspect-level analysis
- Production deployment

Design Integration:

- Journey mapping enhancement
- Pain point identification
- Delight moment discovery
- Persona development
- Impact measurement

NLP Impact on Business Metrics

Future Directions: Multimodal sentiment analysis combining text, image, and audio. Real-time personalization based on emotional state. Ethical AI ensuring fair and unbiased analysis. Cross-cultural emotion understanding for global applications.

Questions and Discussion

Week 3 Summary:
From basic sentiment to advanced NLP systems

Next Week:
Classification for Problem Definition

Practical Exercise:
Build your own sentiment analyzer with BERT