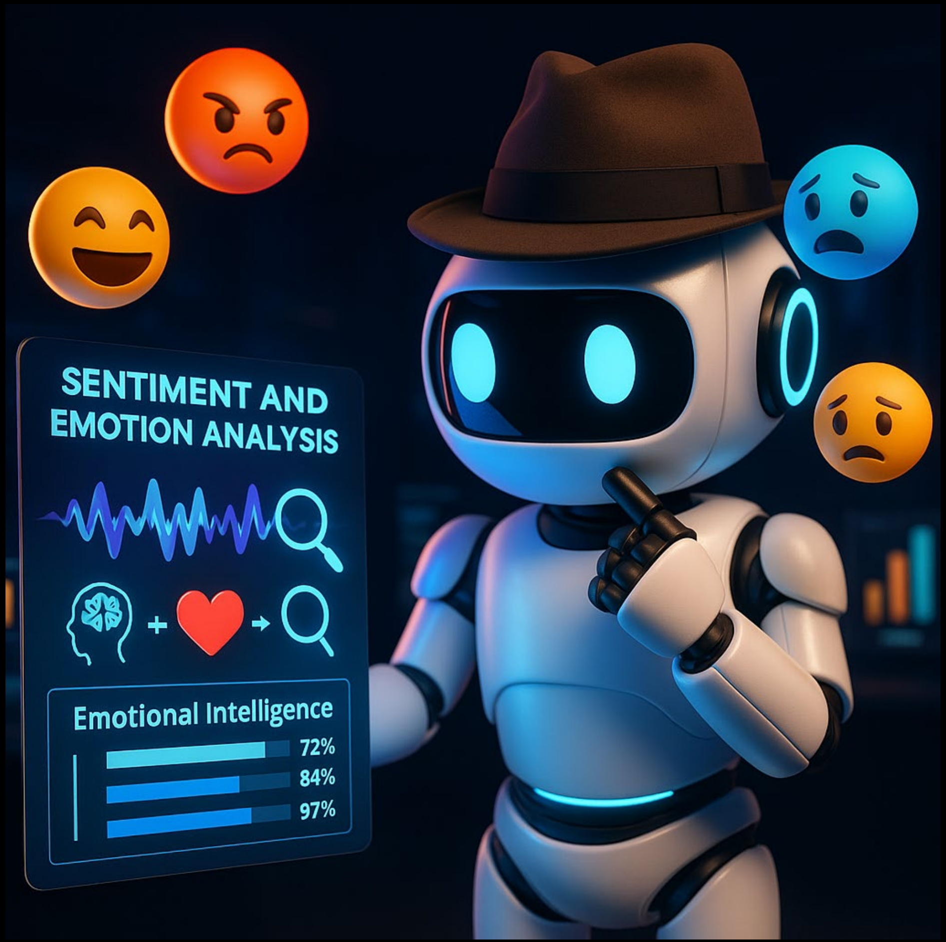

ITAI 2373 - Module 07

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By the end of this module, you will be able to:

- Distinguish between sentiment and emotion analysis
- Implement lexicon-based and machine learning approaches
- Apply sentiment analysis to both text and speech
- Evaluate bias and fairness in emotion detection systems

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- **Sentiment vs Emotion** - Understanding the Difference
- **Lexicon-Based Approaches** - Dictionary Detectives
- **Machine Learning Methods** - Pattern Recognition
- **Speech Emotion Analysis** - Beyond Words
- **Bias and Ethics** - Responsible Detection
- Lab Preview

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Module 6 gave us:

- Who did what to whom (relationships)
- Sentence structure understanding

Module 7 adds:

Ÿ How people feel about what they're saying

Ÿ Emotional targets and holders

The Science of Digital Emotions

Sentiment Analysis = Determining attitudes and opinions in text

Core question: ש this positive, negative, or neutral?

- Real-world examples:
  - Product reviews: "This phone is amazing!"
  - Social media: "Worst customer service ever"
  - News comments: "Great policy decision"

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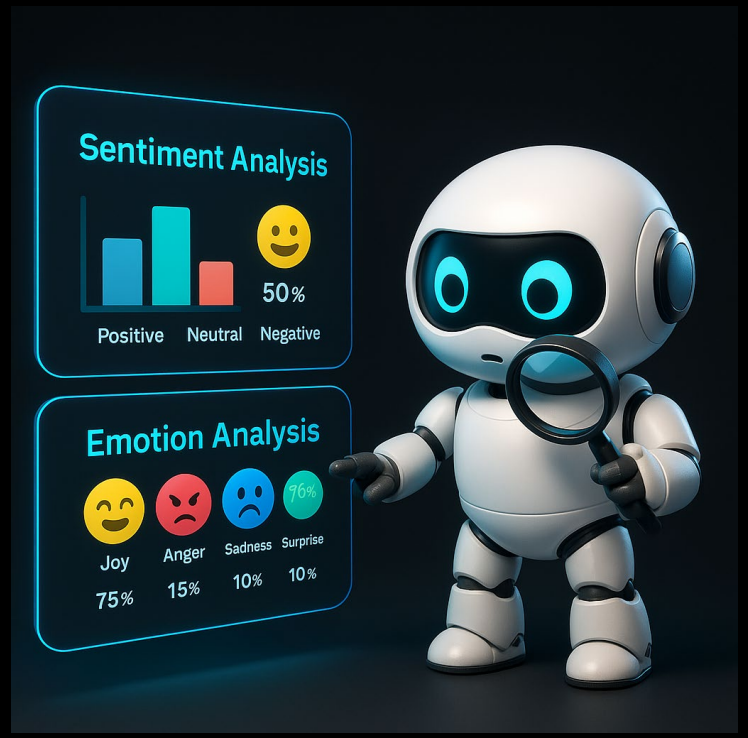
Understanding the Difference

Sentiment Analysis:

- Polarity: Positive, Negative, Neutral
- Attitude toward something
- "ىlike this movie" → Positive

Emotion Analysis:

- Specific emotions: Joy, Anger, Fear, Surprise
- Psychological states
- "ىm thrilled about this movie" → Joy



Why Emotion Detection Matters

Business Applications:

- Customer service: Detect frustrated customers
- Marketing: Understand emotional responses to ads
- Product development: Identify pain points

Social Applications:

- Mental health: Monitor emotional well-being
- Education: Adapt to student emotional states
- Social media: Detect cyberbullying or harassment

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Lexicon-Based Approaches

- **Core concept:** Use pre-built dictionaries of emotional words
- **How it works:**
  - Each word has an emotional score
  - Combine scores to get overall sentiment
  - Fast, interpretable, no training required
- **Popular tools:** VADER, TextBlob, SentiWordNet

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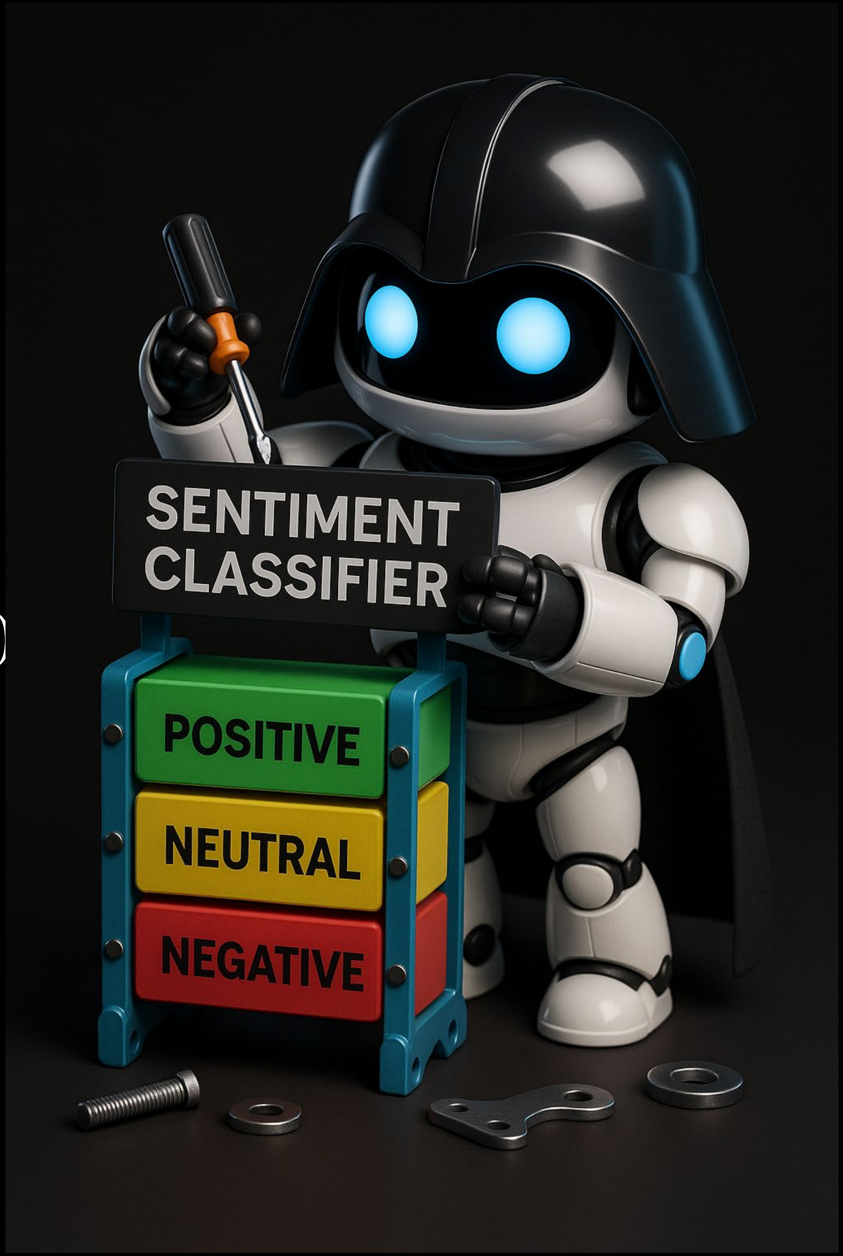
Social Media Sentiment Detective

- Example Analysis:
  - "I LOVE this phone!!!" → Very Positive (0.8)
  - "This phone is okay" → Slightly Positive (0.2)
  - "I hate this phone" → Negative (-0.6)
  - "This phone sucks!!!" → Very Negative (-0.8)
- VADER handles:
  - Capitalization intensity
  - Punctuation emphasis



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Lexicon Limitations

- Challenge 1: **Context matters**
  - "This movie is not bad" → Negative words, positive meaning
- Challenge 2: **Sarcasm and irony**
  - "Great, another meeting" → Positive words, negative feeling
- Challenge 3: **Domain-specific language**
  - "This stock is volatile" → Neutral in finance, negative elsewhere

Machine Learning Approaches

Pattern Recognition for Emotions

Core concept: Learn emotional patterns from labeled data

Advantages:

- Handles context and complexity
- Adapts to specific domains
- Can learn sarcasm and irony patterns

Common algorithms: Naive Bayes, SVM, Logistic Regression

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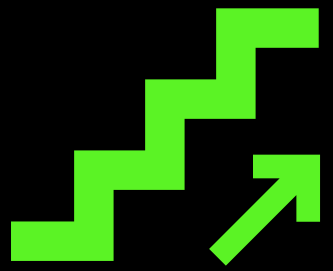


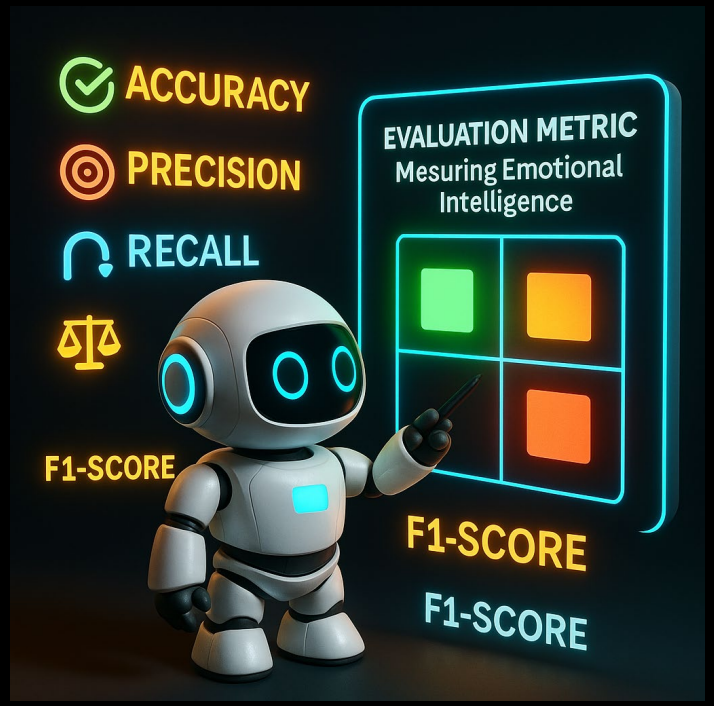
From Data to Decisions

- Step 1: Collect labeled training data
- Step 2: Preprocess and extract features
- Step 3: Train classification modeorml
- Step 4: Evaluate and tune perfance

Feature types:

- Bag-of-words and TF-ЧDF
- N-grams and word sequences
- POS tags and syntactic features

Evaluation Metrics



Measuring Emotional Intelligence

Standard metrics:

- Accuracy: Overall correctness
- Precision: How many predicted positives are actually positive?
- Recall: How many actual positives did we find?
- F1-Score: Balanced precision and recall

- **Confusion Matrix:** Shows detailed error patterns

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Beyond Words to Voice

Audio adds new dimensions:

- **Tone of voice:** Happy vs sad speaking patterns
- **Speaking rate:** Fast (excited) vs slow (sad/tired)
- **Pitch variation:** Monotone vs expressive
- **Volume changes:** Loud (angry) vs quiet (sad)

Challenge: Combining text and audio features

Prosodic Features

The Music of Emotion

- Key acoustic features:
  - Fundamental frequency (F0): Pitch patterns
  - Energy/Intensity: Volume and emphasis
  - Duration: Timing and rhythm
  - Spectral features: Voice quality

Extraction tools: Librosa, Praat, OpenSMILE

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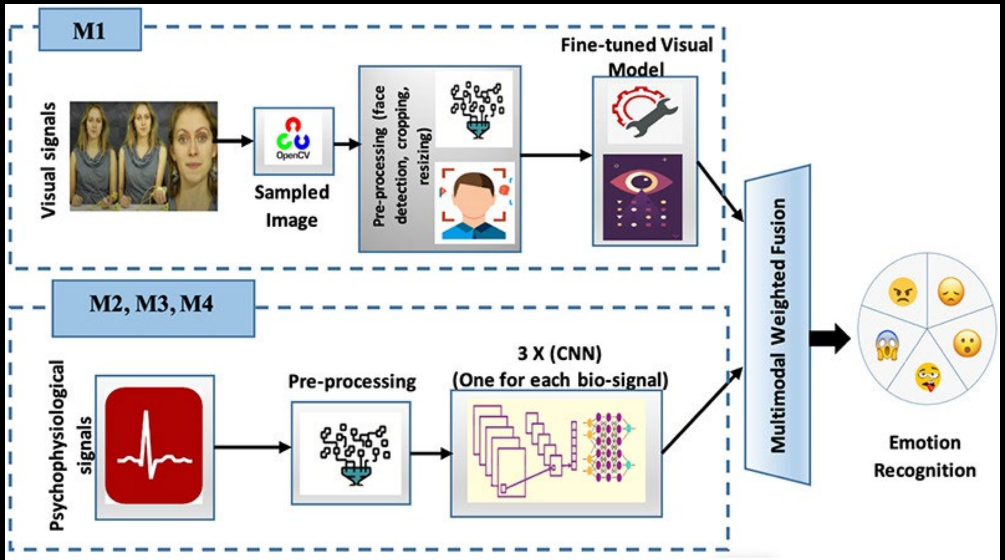
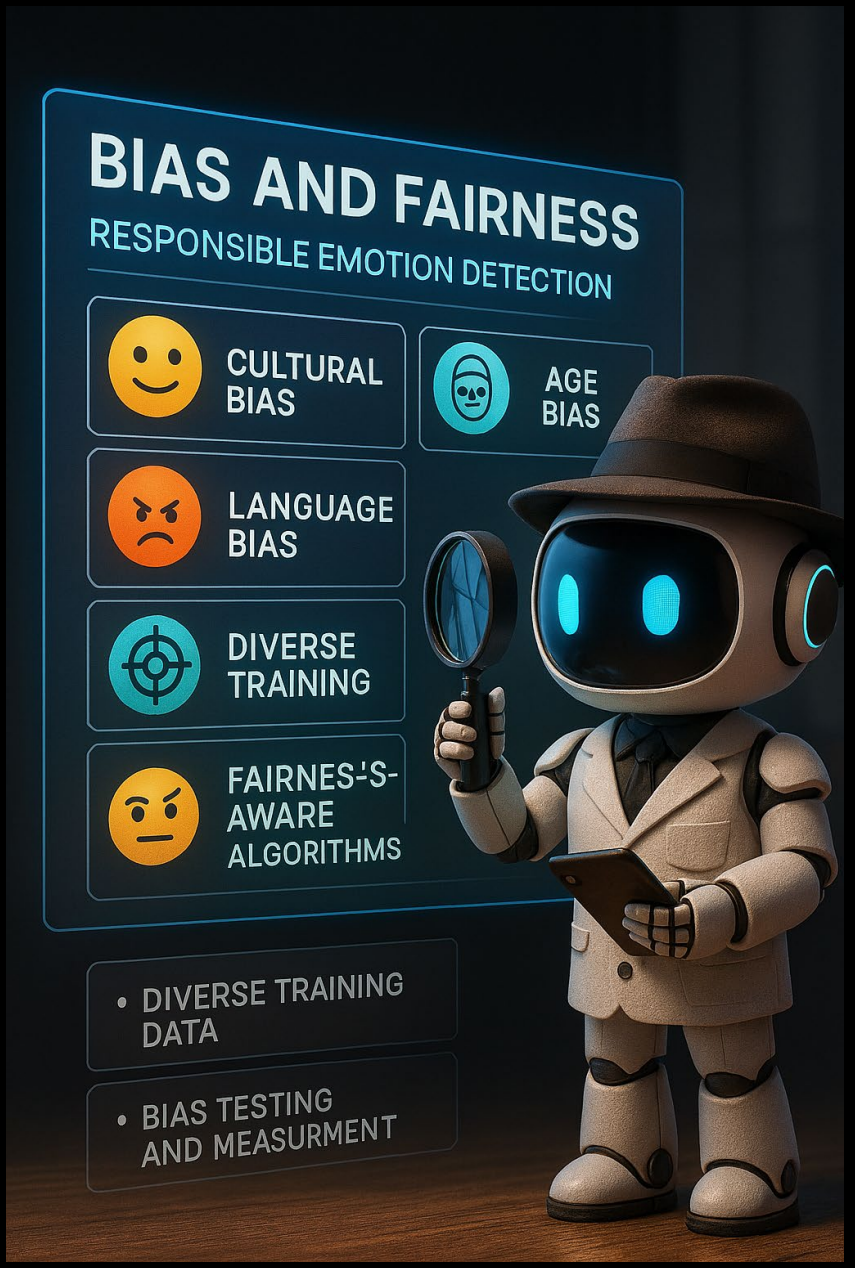
Combining Text and Speech

- Fusion strategies:
  - Early fusion: Combine features before classification
  - Late fusion: Combine predictions after classification
  - Hybrid fusion: Multiple combination points
- Benefits:
  - More robust emotion detection
  - Handles conflicting signals (sarcasm)
  - Better real-world performance





Bias and Fairness

Responsible Emotion Detection

- **Common biases:**
  - Cultural bias: Different emotional expression norms
  - Gender bias: Stereotypes about emotional expression
  - Age bias: Generational differences in communication
  - Language bias: Non-native speaker patterns
- **Mitigation strategies:**
  - Diverse training data
  - Bias testing and measurement
  - Fairness-aware algorithms

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Customer Service:

- Automatic escalation for frustrated customers
- Sentiment-aware response generation
- Quality monitoring and training

Healthcare:

Ÿ Mental health monitoring and early intervention
Ÿ Patient satisfaction analysis
Ÿ Therapy session analysis

Education:

- Adaptive learning based on student emotions
- Engagement monitoring in online classes
- Bullying detection in school communications

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- **When Emotion Detection Struggles**
- **Technical challenges:**
  - Context dependency and ambiguity
  - Sarcasm and irony detection
  - Cross-cultural emotional expression
  - Real-time processing requirements
- **Ethical challenges:**
  - Privacy and consent
  - Potential for manipulation
  - Bias and discrimination
  - Emotional surveillance concerns

Lab Preview

- **Building Your Emotion Detective System**
- **You'll build:**
  - Text sentiment analyzer using VADER and TextBlob
  - Machine learning classifier with scikit-learn
  - Speech emotion detector using audio features
  - Multimodal system combining text and speech
- **Real data**: Customer reviews, social media posts, audio recordings

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Your Emotional Intelligence Toolkit

Lexicon-based methods are fast and interpretable

Machine learning approaches handle complexity better

Speech analysis adds crucial emotional dimensions

Multimodal fusion provides the best performance

Bias and fairness require constant attention

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- **Module 8: Text Classification & Named Entity Recognition**

- **How today's skills connect:**
  - Sentiment analysis is a type of text classification
  - Emotion targets are named entities
  - Classification techniques apply broadly

- You're building a complete NLP toolkit!