Conversational Toxicity Detection

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Problem Statement and objectives

Key Challenges:

- Online platforms harbor toxic interactions
- Limited work on Italian language toxicity
- Need for real-time detection capabilities

Main Objective

Developing systems for:

- Toxic conversation detection
- Personality classification (28 types)
- Real-time toxicity detection

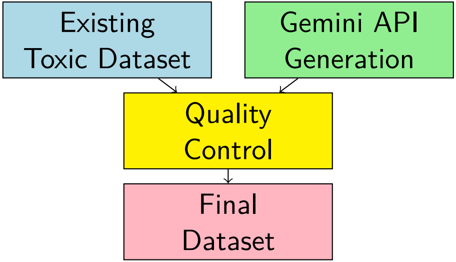
Dataset Construction Pipeline

Existing Toxic Dataset IDaToC:

- Annotated Italian conversations
- Various toxicity types
- Emotional manipulation
- Psychological violence

Generated Non-Toxic Dataset:

- Google Gemini API
- Healthy conversations
- 4 positive relationship types
- Corpus balancing



Existing Toxic Dataset

Gemini API Generation

Quality Control

Final Dataset

Figure: Dataset generation pipeline

Dataset Generation Parameters

- **Model**: Gemini-2.0-flash-lite - Fast inference with quality generation
- **Temperature**: 1.8 - High creativity for diverse conversation styles
- **Top-p**: 0.95 - Nucleus sampling for coherent text generation
- **Top-k**: 40 - Limits vocabulary to most probable tokens
- **Max tokens**: 2048 - Maximum conversation length per generation

Overall Approach

Three Main Components

1. **Binary Classification**: Traditional ML baseline
2. **Personality Classification**: Zero-shot + Fine-tuning
3. **Real-Time Detection**: Personality-based system

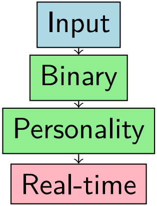


Figure: Processing Pipeline

BERT Model

`BERT-base-italian-xxl-cased` with 28 personality tokens

Binary Classification

Compared Approaches:

- **Approach 1**: Raw text + TF-IDF
- **Approach 2**: Italian preprocessing + TF-IDF

Italian Preprocessing Pipeline:

- SpaCy (it_core_news_sm)
- Lemmatization
- Stop words removal
- Italian-specific tokenization

Model Configuration:

- Logistic Regression
- Nested Cross-Validation (5-fold)
- Hyperparameter grid search

Personality Classification with BERT

BERT Model Enhancement

- Base model: `dbmdz/bert-base-italian-xxl-cased`
- Added 28 personality tokens: `[NARCISISTA]`, `[MANIPOLATORE]`, etc.
- Extended vocabulary and embedding matrix
- Context-aware personality detection

Two Approaches Comparison

Zero-Shot Learning:

- No training required
- Similarity-based classification
- Uses personality descriptions
- Cosine similarity matching

Fine-Tuning:

- Task-specific training
- Custom classifier head

CLS token representation

- Dropout regularization (0.3)

Real-Time Detection System

Detection Mechanism

- Message-by-message analysis
- Context-aware predictions
- Weighted confidence scoring
- Adaptive threshold: 0.3
- Immediate toxicity alerts

Weighted Scoring Formula

$$\text{toxic\_score} = \sum_{i=1}^{n} w_i \times \text{confidence}_i \tag{1}$$

$$\text{avg\_score} = \frac{\text{toxic\_score}}{n} \tag{2}$$

$$\text{is\_toxic} = \text{avg\_score} > 0.3 \tag{3}$$

Binary Classification Results

Table: Binary Classification Performance

Approach	Accuracy	F1	Precision	Recall
Raw Text	1.0000	1.0000	1.0000	1.0000
Preprocessed	1.0000	1.0000	1.0000	1.0000

Important Insight

Preprocessing requires 20x more computational time without performance benefits

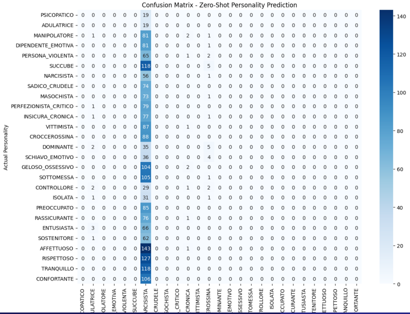
Personality Classification - Zero-Shot vs Fine-Tuned

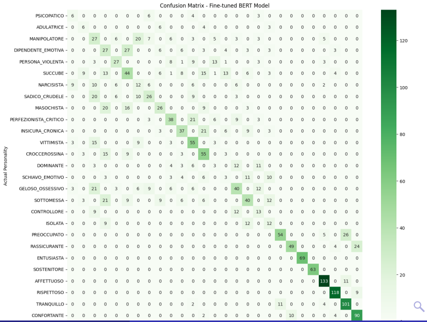
Table: Zero-Shot Performance

Metric	Score
Accuracy	0.0268
Macro Precision	0.0010
Macro Recall	0.0364
Macro F1-Score	0.0020

Table: Fine-Tuned Performance

Metric	Score
Accuracy	0.5628
Macro Precision	0.5093
Macro Recall	0.5043
Macro F1-Score	0.5015





Training Progress Analysis

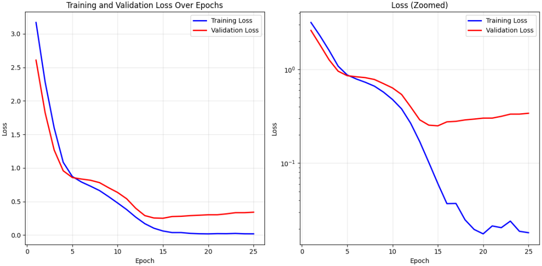


Figure: Training and Validation Loss Over Epochs

Training Details:

- Early stopping after 15 epochs
- Best validation loss: 0.2504
- Dropout rate: 0.3
- Learning rate: 1e-5
- Patience: 10 epochs

Performance Improvement:

- Zero-shot: 2.68%
- Fine-tuned: 56.28%
- **21x improvement!**

Real-Time Toxicity Detection

Table: Real-Time System Performance

Metric	Score
Accuracy	0.9884
Precision	0.9943
Recall	0.8889
F1-Score	0.9915

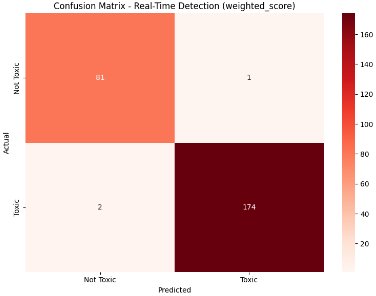


Figure: Real-Time Detection Confusion Matrix

Main Contributions

Key Results

- **Binary Classification**: Perfect performance without preprocessing
- **Personality**: Fine-tuning significantly outperforms zero-shot
- **Real-Time**: 98.84% accuracy in toxicity detection

Innovations

- First BERT-based system for Italian toxicity detection
- Integration of personality classification + toxicity detection
- Automatic pipeline for non-toxic data generation
- Adaptive system with weighted scoring

Limitations and Future Work

Current Limitations:

- Specific to Italian language
- 28 personality framework
- Limited context window (512 tokens)
- Domain-specific dataset

Future Directions:

- Multilingual extension
- Larger datasets
- GPT-based architectures
- Real-world deployment
- Extended context windows

Availability

Code and dataset available on GitHub: `https://github.com/Fonty02/NLP/tree/main/Exam`

Thank You for Your Attention

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