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der Freien Universität Berlin
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Bridging AI and Clinical Expertise: A Neuro-Symbolic System for Emergency Veterinary Triage Analysis

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Artificial Intelligence 4 Animal Science
EAAP conference, Zurich
June 4th – 6th, 2025

https://www.g2.com/glossary/machine-learning-operationalization-definition

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"When science meets technology..."

Background

- No definition of Veterinary Emergency
- Few studies and publications worldwide, leaving a gap in monitoring and detection of critical cases
- Limited number of animals included in epidemiological studies
- Increasing workload in human and veterinary emergency departments
- Use of triage-system in veterinary medicine less common, well-defined triage systems not available

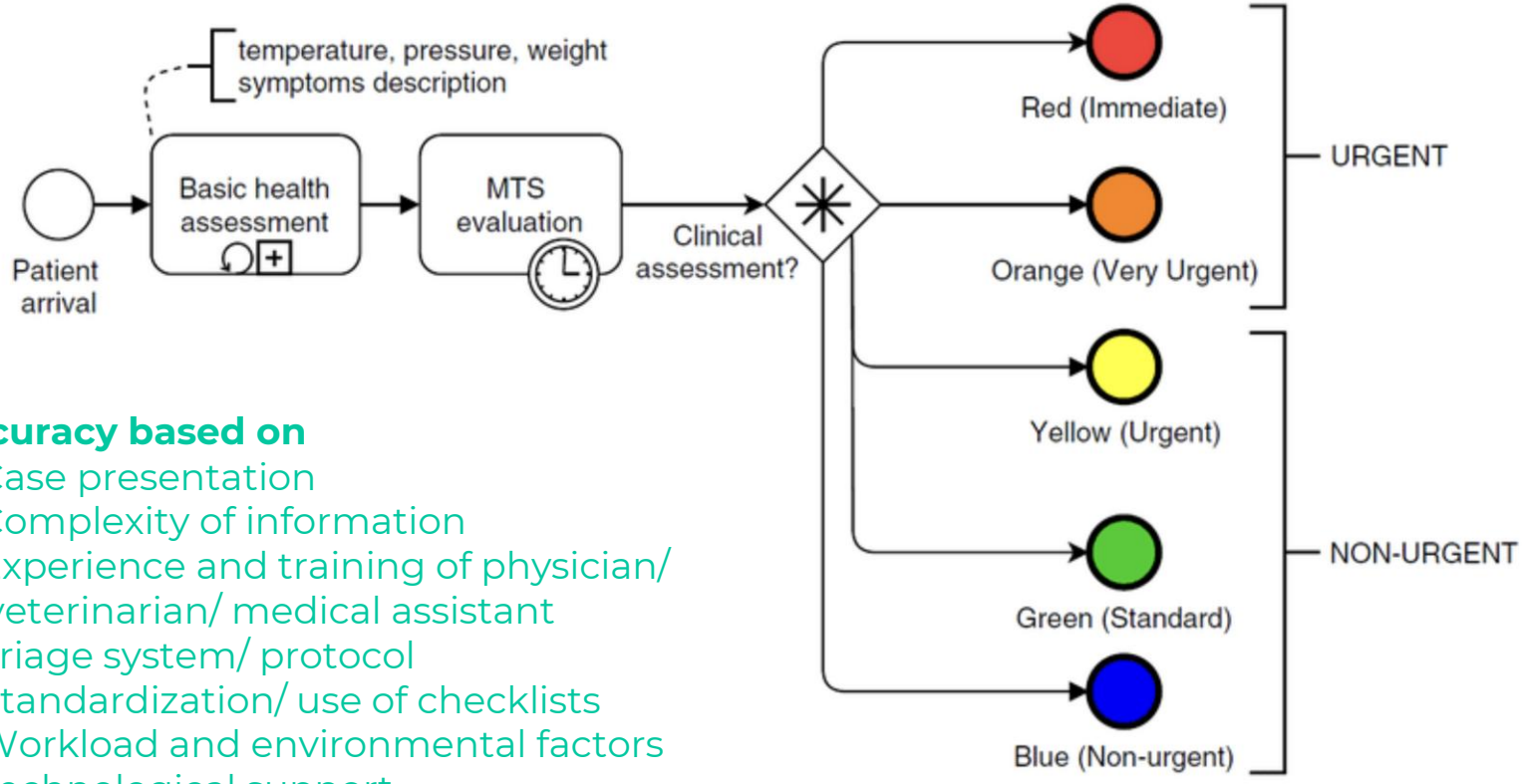
+ Guidelines for standardized veterinary triage list prioritization
+ Human studies provide extensive knowledge to facilitate initial treatment and diagnosis
+ Recognize seriously ill patients and prioritize the over less ill patients by using triage-systems
+ Use of AI-systems helpful for case analysis regarding triage classification

Question: Can an AI system be trained for case analysis and triage classification?

https://www.petkonnect.in/blogs/health-and-care/pet-first-aid-kit-essentials

Manchester Triage System (MTS)

- used in human medicine -



Accuracy based on

- ✓ Case presentation
- ✓ Complexity of information
- ✓ Experience and training of physician/ veterinarian/ medical assistant
- ✓ Triage system/ protocol
- ✓ Standardization/ use of checklists
- ✓ Workload and environmental factors
- ✓ Technological support
- ✓ Evaluation (outcome analysis)

✓ **Immediate action!**

Treatment needed ..

✓ **within 10 minutes**

✓ **within 30 minutes**

✓ **within 90 minutes**

✓ **within 120 minutes**

A Simulation Study on Demand Disruptions and Limited Resources for Healthcare Provision - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Manchester-Triage-System-MTS-process-performed-by-trained-nurse_fig3_349811502

Dataset

✓ **Patients presented in emergency service in small animal practice**

✓ **12-month period (2021)**

✓ **4.579 cases of dogs and cats**

✓ **Date and time of presentation**

✓ **Patient profile**

✓ **Clinical problem & medical history**

✓ **Diagnostics and received medical care**

✓ **Classification into categories:**

1) REASON FOR PRESENTATION
2) VETERINARY CARE

✓ **Application of 5-point-MTS retrospectively**

Manually done by veterinarian experienced in emergency care

Classification of cases

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REASON FOR PRESENTATION

1. No medical problem
2. Gastrointestinal tract
3. Respiratory tract
4. Poisoning
5. Ear-, nose-, throat-diseases including eyes
6. Trauma and shock including bleeding disorders
7. Kidney and urinary tract diseases
8. Seizures
9. Musculoskeletal system including lameness
10. Cardiovascular diseases
11. Metabolic diseases and allergies
12. Euthanasia
13. Other

MEDICAL CARE

1. Delivery and sale
2. Refusal of veterinary advice
3. Symptomatic therapy including medication
4. Diagnostics
5. Outpatient infusion therapy
6. Inpatient admission
7. Referral to veterinary clinic
8. Euthanasia or death
9. Wound care or surgery
10. Home visit

https://brightcarevet.com/emergency/why-call-an-emergency-vet/

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Machine learning

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✓ **3 different machine learning models:**

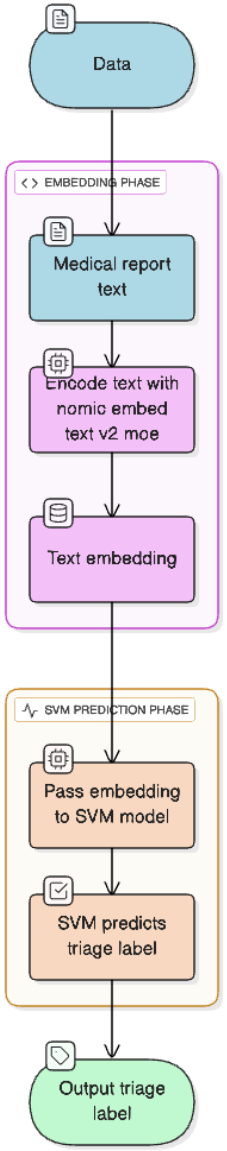
- **SVM (Support Vector Machine)**
- **MLP (Multilayer Perceptron)**
- **BERT (Encoder-only Transformer)**

✓ **Input:**

- **textual data (concatenation):**

jahreszeit	*(season)*
tag	*(day)*
dienstzeit	*(shift time)*
tageszeit	*(time of day)*
tier_art	*(animal species)*
tier_rasse	*(animal breed)*
tier_geschlecht	(animal sex)
tier_altersgruppe	*(animal age group)*
vorstellung_grund	*(reason for presentation)*

Machine learning: SVM



embedding length = 768

			precision	recall	f1-score
blue	-	blau	1.00	0.27	0.42
yellow	-	gelb	0.74	0.40	0.52
green	-	grün	0.62	0.96	0.75
orange	-	orange	0.83	0.21	0.34
red	-	rot	0.89	0.56	0.69
		accuracy			0.67
		macro avg	0.82	0.48	0.54
		weighted avg	0.73	0.67	0.63

Machine learning: MLP

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MLP_triage

```python
# Feature extractor
        self.feature_extractor = nn.Sequential(
            nn.Linear(input_dim, hidden_dim),
            nn.BatchNorm1d(hidden_dim),
            nn.ReLU(),
            nn.Dropout(0.3),

            nn.Linear(hidden_dim, hidden_dim // 2),
            nn.BatchNorm1d(hidden_dim // 2),
            nn.ReLU(),
            nn.Dropout(0.3),

            nn.Linear(hidden_dim // 2, hidden_dim // 4),
            nn.BatchNorm1d(hidden_dim // 4),
            nn.ReLU(),
            nn.Dropout(0.2)
        )

        # Classifier
        self.classifier = nn.Linear(hidden_dim // 4, num_classes)
```

Classification Report:

	precision	recall	f1-score
blau	0.40	0.61	0.48
gelb	0.56	0.46	0.50
grün	0.78	0.67	0.72
orange	0.27	0.47	0.34
rot	0.72	0.72	0.72
accuracy			0.60
macro avg	0.54	0.59	0.55
weighted avg	0.64	0.60	0.62

Machine learning: MLP

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Machine learning: VetTriageBERTModel

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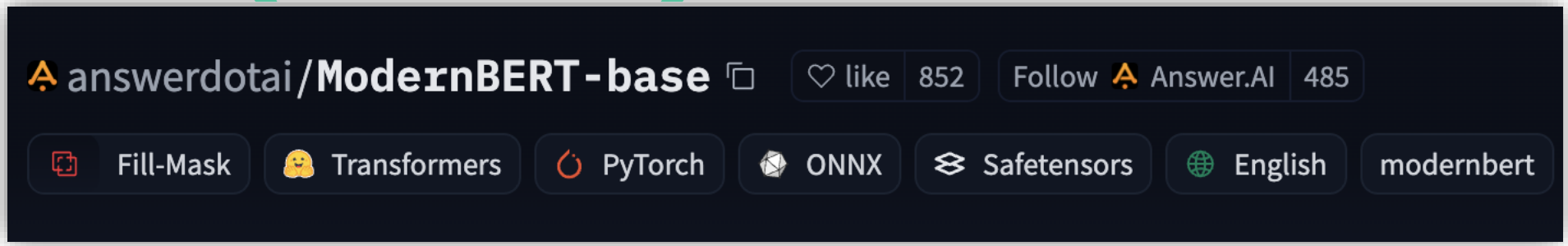
Base model (encoder):



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Machine learning: VetTriageBERTModel

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📋 Detailed Classification Report:

	precision	recall	f1-score	support
gelb	0.8182	0.5806	0.6792	31
grün	0.5391	0.6571	0.5923	105
rot	0.7948	0.8311	0.8125	219
blau	0.4722	0.3778	0.4198	45
orange	0.9302	0.6897	0.7921	58
accuracy			0.7118	458
macro avg	0.7109	0.6273	0.6592	458
weighted avg	0.7232	0.7118	0.7118	458

Machine learning: VetTriageBERTModel

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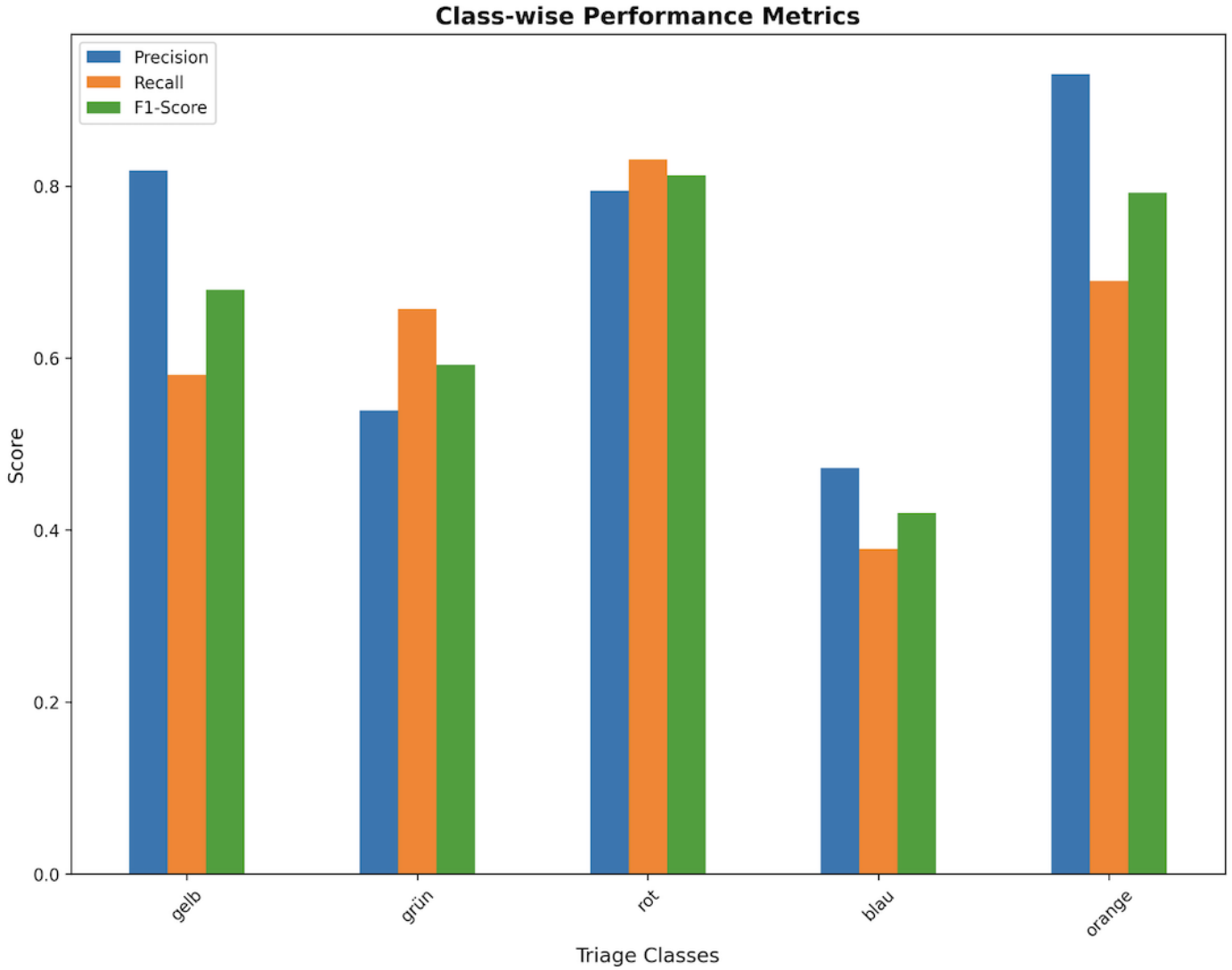

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Machine learning: VetTriageBERTModel

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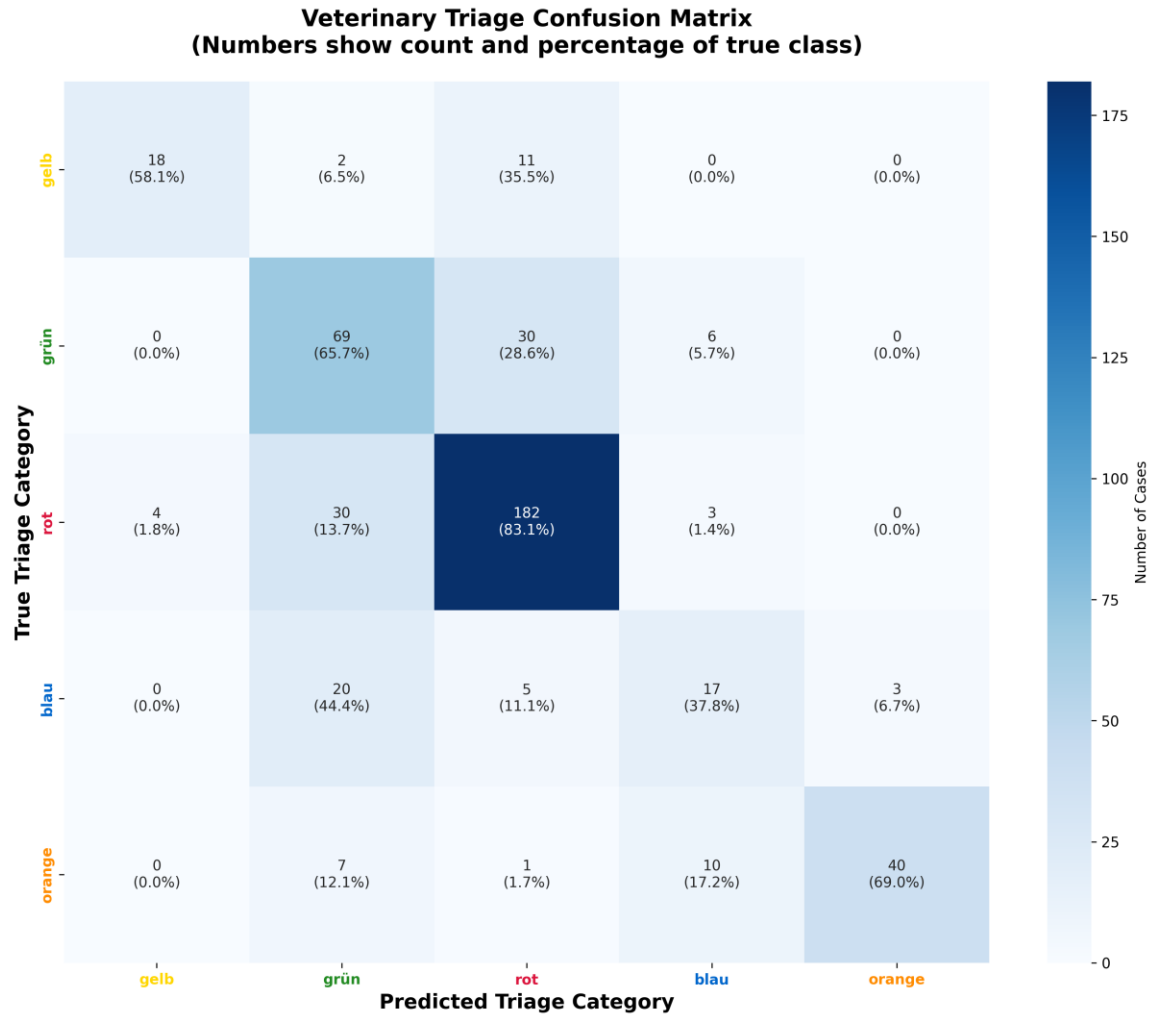

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Conclusion

FUTURE RESEARCH:

- Experiments with different BERT base models (PetBERT).
- Use the support of neuro-symbolic engine.
- Mapping to another triage system (only 3 classes?).
- Adding a synthetic data to the dataset.

Thank You!