Combinatorial Methods for Artificial Intelligence

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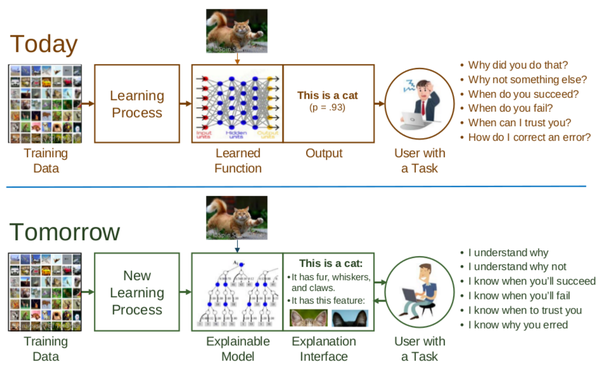
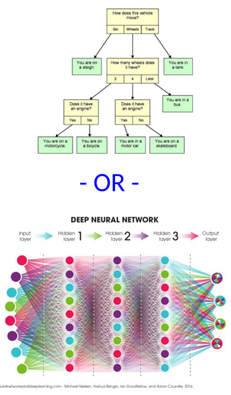
MATRIS

Combinatorial Methods for Explainable Artificial Intelligence (XAI)

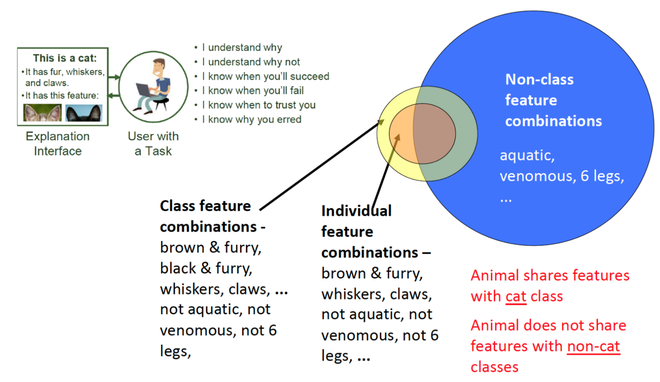




Expert system:
Good for explanations,
not so good for accuracy

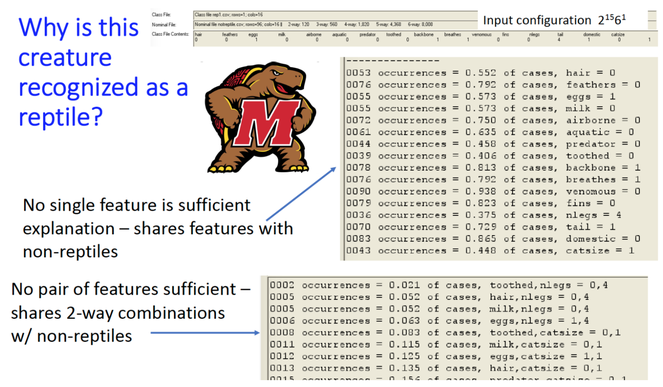
Neural nets:
Good for accuracy,
not so good for explanations

How do we get the best of both worlds?



Combinatorics for XAI

Why is this creature recognized as a reptile?

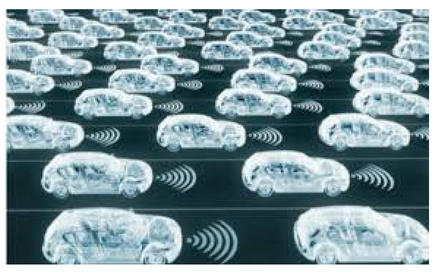


- Only reptiles have these 3-way combinations of features:
  - not aquatic AND not toothed AND four legs
  - egg-laying AND not aquatic AND four legs
  - not hairy AND four legs AND cat size
  - not milk-producing AND not aquatic AND four legs
  - not milk-producing AND four legs AND cat size
  - not predator AND not toothed AND four legs

Intelligent Virtual Assistants (IVAs)

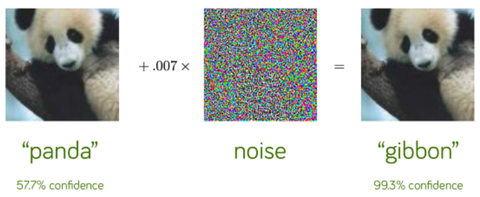
- Vulnerabilities and exploits demonstrated against available IVA platforms.
- Exhibit large new attack surface due to functionality.
- Need all-embracing novel security and reliability testing (e.g., explainable AI).

Autonomous Vehicles



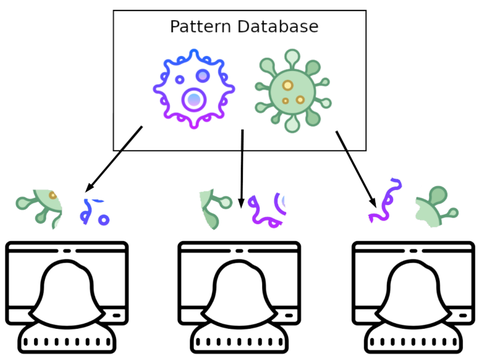
- Connected, intelligent, and autonomous vehicles pose new safety and security challenges.
- Systematic and holistic safety and security approach required to test networked computers on wheels.
- Guaranteeing the reliability and robustness is a major challenge.

Generative Adversial Networks (GANs)



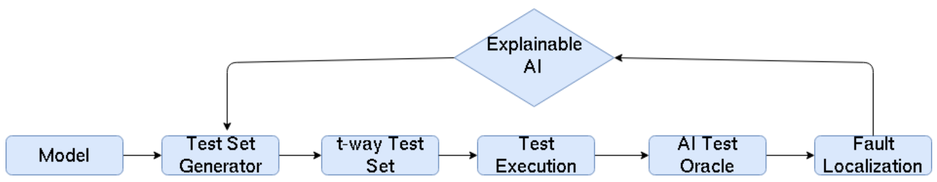
- Combinatorial methods to reduce number of queries to targeted classifier.
- Generating inputs that get misclassified by different classification networks.

AI-based Combinatorial Computer Virology



- Most anti-virus scan patterns can easily be extracted from anti-virus software.
- Using balanced incomplete block designs and AI to generate effective subsets of malware patterns.
- Prevent black-box analysis by only using specific subset per user for malware detection.
- Single user cannot learn full detection pattern.

Analyzing AI-based Test Oracles



- Software and security testing scenarios.
- Test oracles can contain and use AI-systems.
- Approach finds the root cause of security vulnerabilities.
- Provides transparency and explanations for test outcomes.

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FFG Forschung wirkt.
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FWF Der Wissenschaftsfonds.
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