Issues Concerning AI Transparency

Tom Dietterich

Why do we need transparency?

- Trust
- Effective human-machine interaction
- Effective machine-to-machine collaboration
- Software engineering

Goal: Trustable AI Systems

- Trustable AI in high-stakes applications
  - Self-driving cars
  - Autonomic power grid
  - Medical devices and surgical robots
  - Cyber defense
  - Weapons systems
  - etc.
- Trustable human augmentation
  - Trustable information source
  - Trustable personal assistant
  - Trustable augmented reality
- Trust that the system has not been compromised by cyberattack

Interaction and Collaboration

- In order for a human to interact successfully with an AI system…
  - human needs to understand
    - what the AI system knows and does not know
    - what the system can and cannot do
    - situations under which the system can and cannot be trusted
    - good predictive model of how the system will behave; when it will engage in clarifying dialogues
- In order for multiple AI systems to collaborate they need
  - models of each other: knowledge, capabilities, preferences, costs

Related Needs

- Software Engineering Tools
  - Training: building the software using machine learning
  - Testing: finding failure pathways
  - Debugging: fixing errors

Explanation Paradox

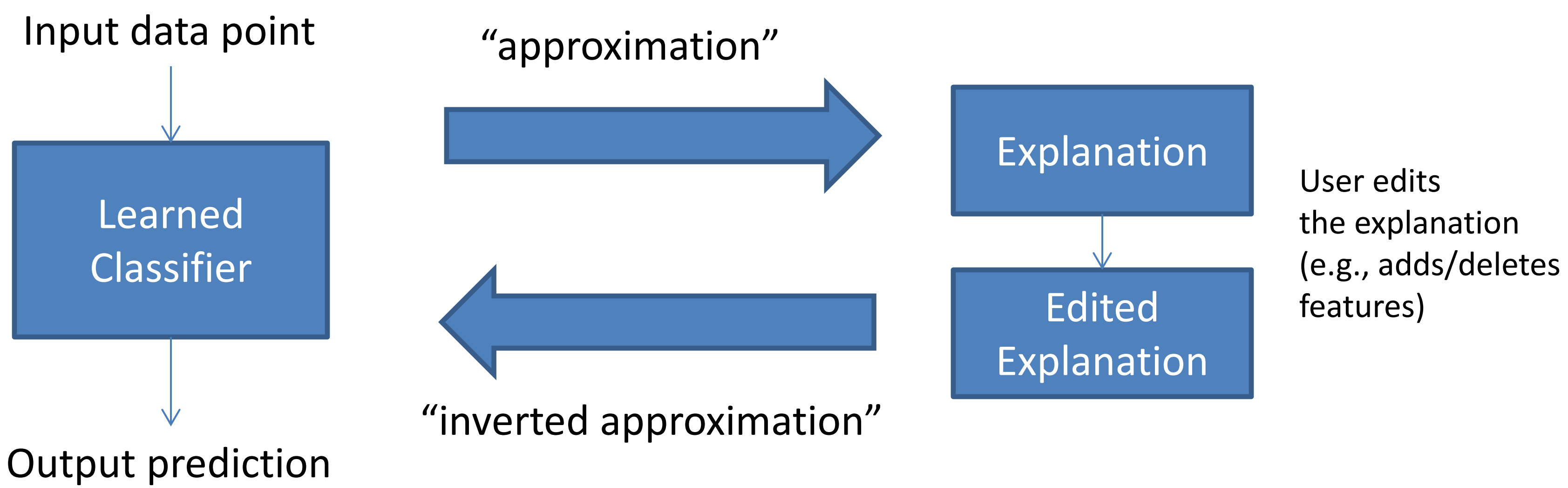
- In the 1980s, Expert Systems vendors found that the market demanded that there be an "Explanation Facility"
  - But no one ever used these in practice
- People are surprisingly willing to trust a system after only a small amount of experience with it
  - Over-estimate how general the system's knowledge is?
  - Assume that the system is based on broad fundamental principles rather than thousands of memorized cases?

Fundamental Issues

- Issue 1: Some AI knowledge or behaviors may not have short descriptions
  - Deep learning may produce a hierarchical cross product of local generalizations
  - Theorems may have no short proofs
    - many different information sources
    - many interlocking steps
    - Example: latest results on Pythagorean coloring and the Busy Beaver problem, Erdös discrepancy conjecture

- Issue 2: How do we ensure that explanations are faithful to the actual mechanism of the system?
  - What kinds of intervention or feedback are supported by the explanation?
    - Inserting a breakpoint at an inference step?
    - Manipulating a component (e.g., feature or parameter value) and observing its consequences?
    - Feedback on the explanation results in changes in the system behavior?

Example: End-User Feedback to Learning Systems



- Can the user edit the explanation and cause the “right” changes in the classifier?

- Issue 3: How do we validate “generality”?
  - Test that similar inputs always exercise similar components and produce similar outputs
    - Validate this formally?
    - Test experimentally? What is the smallest change that can produce an output difference greater than Δ?
  - Enforce “smoothness” of the input-output mapping
    - detect and remove fractal behavior?
    - ensure that the influence of every subcomponent is limited?
  - Ensure that there are no hidden back doors

- Issue 4: How can we easily test complex situations?
  – Need ways of generating complex scenarios
  – Need to ensure that there are no “tells” that are exploited by the AI system
    - “Tank in the trees” problem
    - UTF-16 ^@p^@r^@o^@b^@l^@e^@m
  – Need to be able to manage augmented reality tests
    - Real queries to the web?
    - Real sensor data with overlaid augmentations?
    - Example: simulated weapons in carry-on bags
  – Simulated Human-in-the-loop?

- Issue 5: How do we evaluate explanation quality?
  - What metrics?
    - User satisfaction (??)
    - User takes appropriate actions based on the explanations
    - User develops appropriate trust (knows when and when not to trust)
    - User can predict future behaviors
      - actions the system will take
      - when the system will ask for help
  - Human user studies are expensive
  - Cheaper proxies?

- Issue 6: Transparency for Multiple AI Collaboration
  – Metrics for successful collaboration?
  – Accuracy of each system’s model of the other systems?
    - probability that delegation succeeds?
    - probability that agent A proactively takes a step that will help agent B? Including warning B of potential trouble?

- Issue 7: Transparency for Software Engineering
  - Adversarial testing: Engineer defines bad outcomes and then applies AI search methods to find high probability paths to those outcomes
  - Debugging
    - Can the engineer easily find the cause of failures discovered through testing?
    - Can the cause be easily fixed?
    - Without introducing new failures?