CS57100: Artificial Intelligence
Takeaways from ICDM22
Prof. Chris Clifton
2 December, 2022

Announcements

• Final projects due this weekend
  – Writeup
  – Presentation materials
• Presentations next week
  – See course web page for (randomly assigned) schedule
  – Please let me know right away if you have a conflict
• Final exam 15 December, 1-3pm, BRNG 2290
Takeaways from ICDM’22

- ICDM’22 held November 28-December 1 in Orlando
  - World’s premier research conference in data mining
  - Annual conference running since 2001
  - 870 submissions, ~180 accepted

Observations

- Problems with graph-structured data are hot
  - “Specialized” graphs (e.g., recommender systems generalized as bipartite graphs)
- Active and Reinforcement Learning seem to be growing
  - Particularly novel models that tie well to real-world problems
Vipin Kumar (Minnesota)
Knowledge-Guided ML

- Long-standing leader in use of data mining for environmental challenges
- Competing approaches to climate modeling
  - Process-based models of dynamical systems
  - Machine learning
- Combining the two results in significantly better models
- Example: predicting lake temperature
  - Data collection too sparse for full physics-based models (e.g., energy input/output)
  - ML-based approaches don’t generalize well to unseen data
- Hybrid: Physics-based energy loss
  - even for days with no observation
  - See 43:55 in talk

Cynthia Rudin (Duke)
Simple Models

- ML moving towards complicated, uninterpretable models
- Simple models often do (nearly) as well
  - Interpretable
  - More likely to generalize
- Example at 13:00 in talk
- Have we forgotten a long-established principle?
Occam’s Razor

- Pluralitas non est ponenda sine necessitate
  - Plurality should not be posited without necessity
- Of competing theories, the simpler explanation is to be preferred
- William of Ockham, 1285-1347

Another Example: “Feature Creep”

- Too few radiologists
  - Can we use AI/Image Analysis?
- Problem: Does patient have pneumonia?
  - Many features – image, also metadata (patient characteristics, machine used, was image taken while patient standing or lying down, etc.)
- “Learned” classification
  - If patient lying down when x-ray taken, they have pneumonia
Erik Xing, CMU
“Standard Model” for learning

- \[ \min_{q, \theta} -\alpha H(q) + \beta D(q(x), p_{\theta}(x)) - E_{q(x,y)}[f(x, y)] \]

  - E – experiences term (data examples, rules, etc.)
  - D – Divergence (how good the model fits)
  - H – Uncertainty (e.g., Entropy)

- Application to classification obvious
  - But can also apply to learning other things – depending on how the model and fit of model to data is defined

Panel
Full Stack AI: The Missing Piece

- Raj Acharya, IU; Chris Clifton, Purdue; Lawrence Hall, USF; Cynthia Rudin, Duke

- Key takeaways:
  - HCI and AI – how does AI interact with humans?
    - Particularly explainability
  - Robustness
    - Can we ensure no catastrophic mistakes?
    - Can we have reliable confidence bounds on outcomes?
  - Applications
    - How do we apply AI to important problems?
What about the future?  
(My feelings based on what I heard)

• Leaderboard/benchmark-driven work isn't going to solve real problems
  – Data incorporates hidden assumptions that don’t address the real-world problems they are supposed to model
    • Hence, best on the leaderboard doesn't translate to real-world success
  – Optimization criteria too narrow, don’t address breadth of real-world constraints

• Generalized frameworks important
  – But must apply generally
  – Incorporate knowledge/reasoning, not just ML