### ML Competitions and their Design Problems

- Improper payout structure: prize money for a single benchmark, but no bonus for further improvement.
- Competition is anti-collaborative: competitors have no incentive to reveal their strategies or predictions.
- Winner-take-all discourages team diversity, leading instead to team merging.

### Crowdsourced Learning Mechanism (CLM)!

**Loss function**

$$L(w; X)$$

**Test data**

**Hypothesis**

**PHASE 1:**
- For each $$t$$ while market open
  - Market posts $$w_t$$
  - Trader "bets" on $$(w_t \rightarrow w_{t+1})$$
  - Trader pays Cost($$w_t \rightarrow w_{t+1}$$)
- Market updates to $$w_{t+1}$$

**PHASE 2:** Test data $$X$$ is revealed

**PHASE 3:** For every $$t$$, trader $$t$$ earns

$$\text{Payout}(w_t \rightarrow w_{t+1}; X) = L(w_t; X) - L(w_{t+1}; X)$$

**Participant gets paid by the amount they improved the hypothesis on the test data:**

**Intro to Prediction Markets**

- **Contract:**
  - Pays $1 if outcome is Perry
  - Pays $1 if outcome is Cookiemonster
  - Pays $1 if outcome is Cain

- **Price vector**
  - $$r_C(q) := \exp(\langle \phi, q \rangle)$$

**Prediction Markets as CLMs**

- **When is CLM \( \Leftrightarrow \) Prediction Market?**
  - You can use an "share-based" market to implement a CLM iff the loss function can be written as a divergence:

$$L(w; X) \equiv D_P(p(X), \psi(w)) + f(X)$$

- **The cost function is just the dual**
  - $$C(q) = \max_p p \cdot q - R(p)$$

**Benefits of share-based CLMs**

- Tractable budgeted betting
- Ability to neutralize risk
- Simple betting language

**Examples**

- Netflix: $$L(w; X) = ||w - y||^2$$
- Huffman codes: $$L(p; q) = KL(q || p) + H(q)$$

**CLM = Better incentives!**

- Offers aligned incentives, with payout proportional to contribution
- Mechanism has built-in aggregation
- Incentives encourage diversity, rewarding partial knowledge

**Future considerations**

- Too much risk?
- Use vouchers
- Insufficient feedback?
- Several rounds of test data
- Overly restricted model?
- Allow additions to feature space