TS-Insight: Visual Fingerprinting of Multi-Armed Bandits

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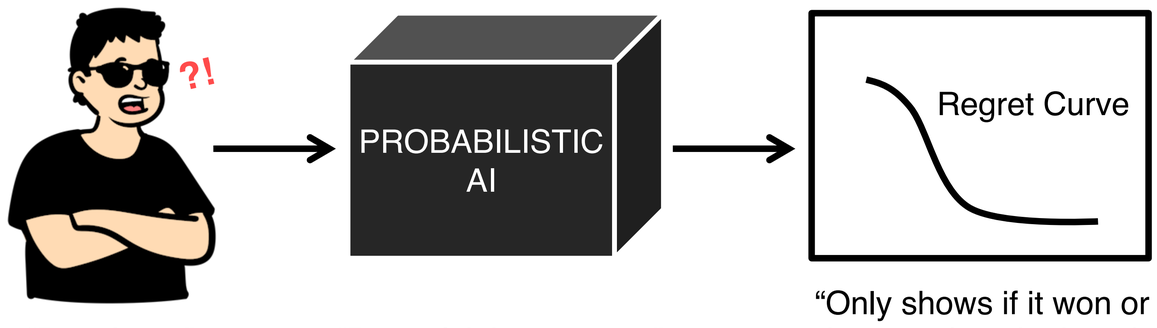
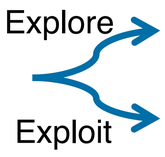
I. Beyond Regret Curves: How Can We Trust What We Can't See?



"Developer" | "Powerful, but opaque" | "Only shows if it won or lost, not how it played The game,"

II. A 60-Second Guide to Our 'Bandit'

The Goal:
Imagine multiple slot machines ("arms"), each with a hidden win rate. The goal is to find the best one and maximize winnings over time.

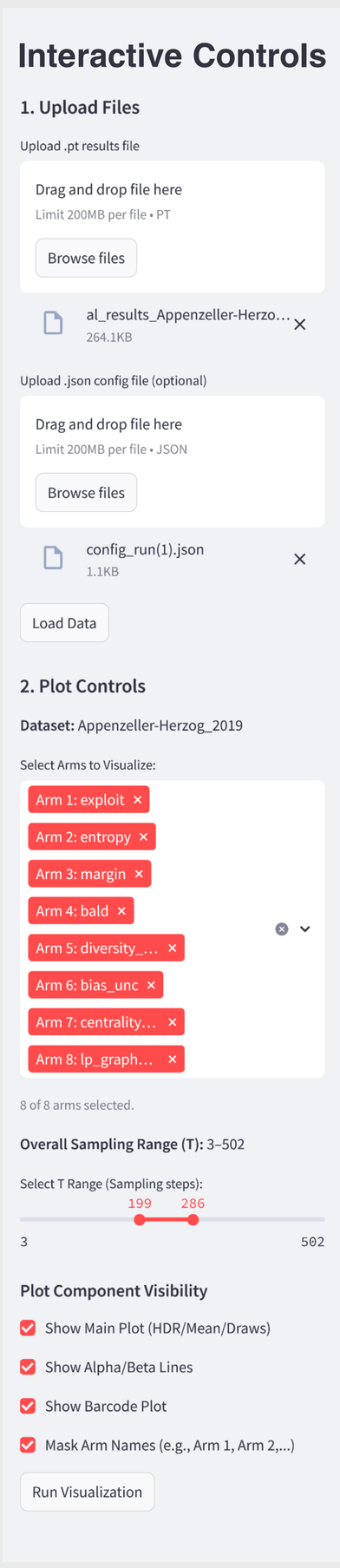


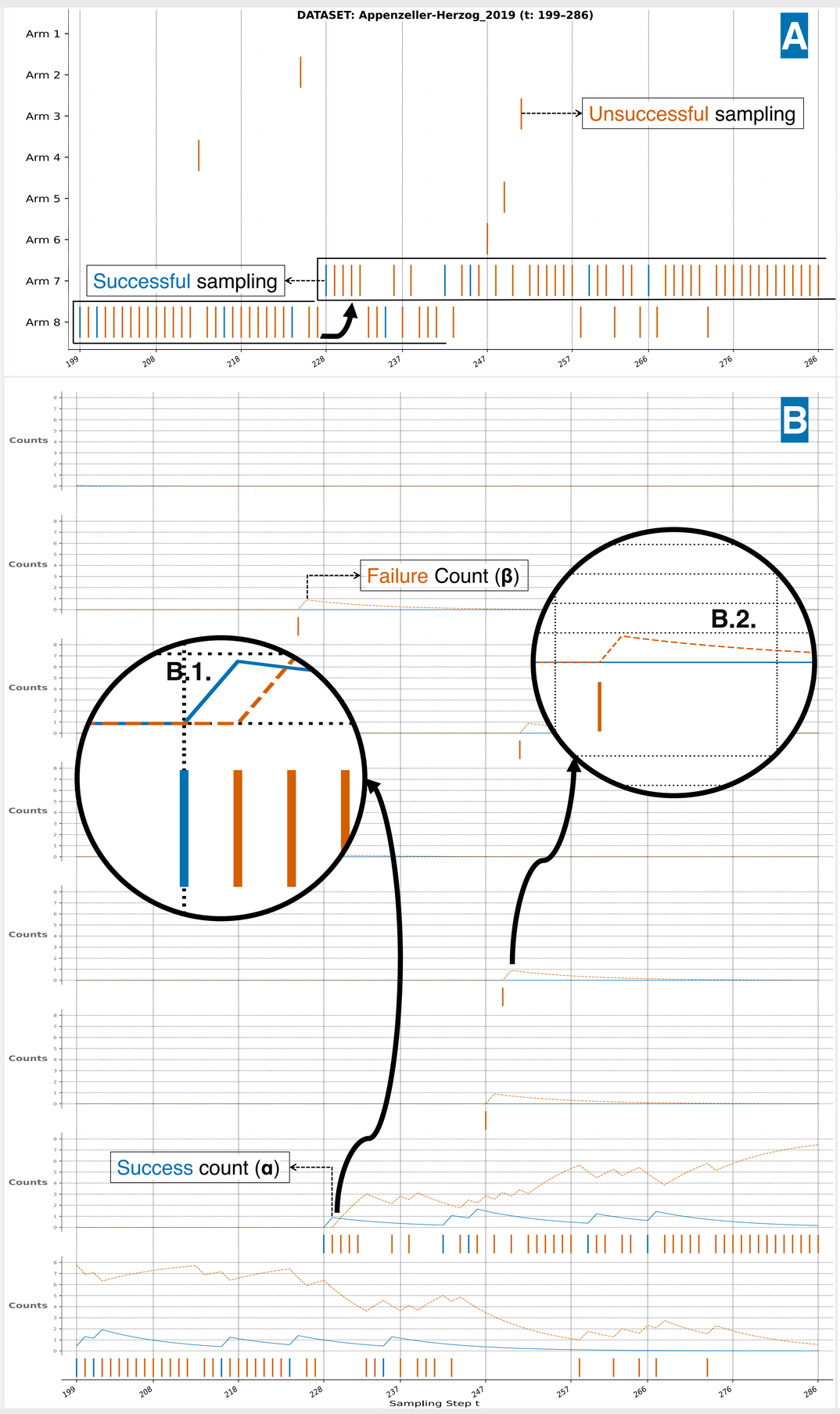
The Dilemma:
The algorithm must constantly balance *Exploitation* (pulling the arm it thinks is best) with *Exploration* (trying other arms to see if they might be better).

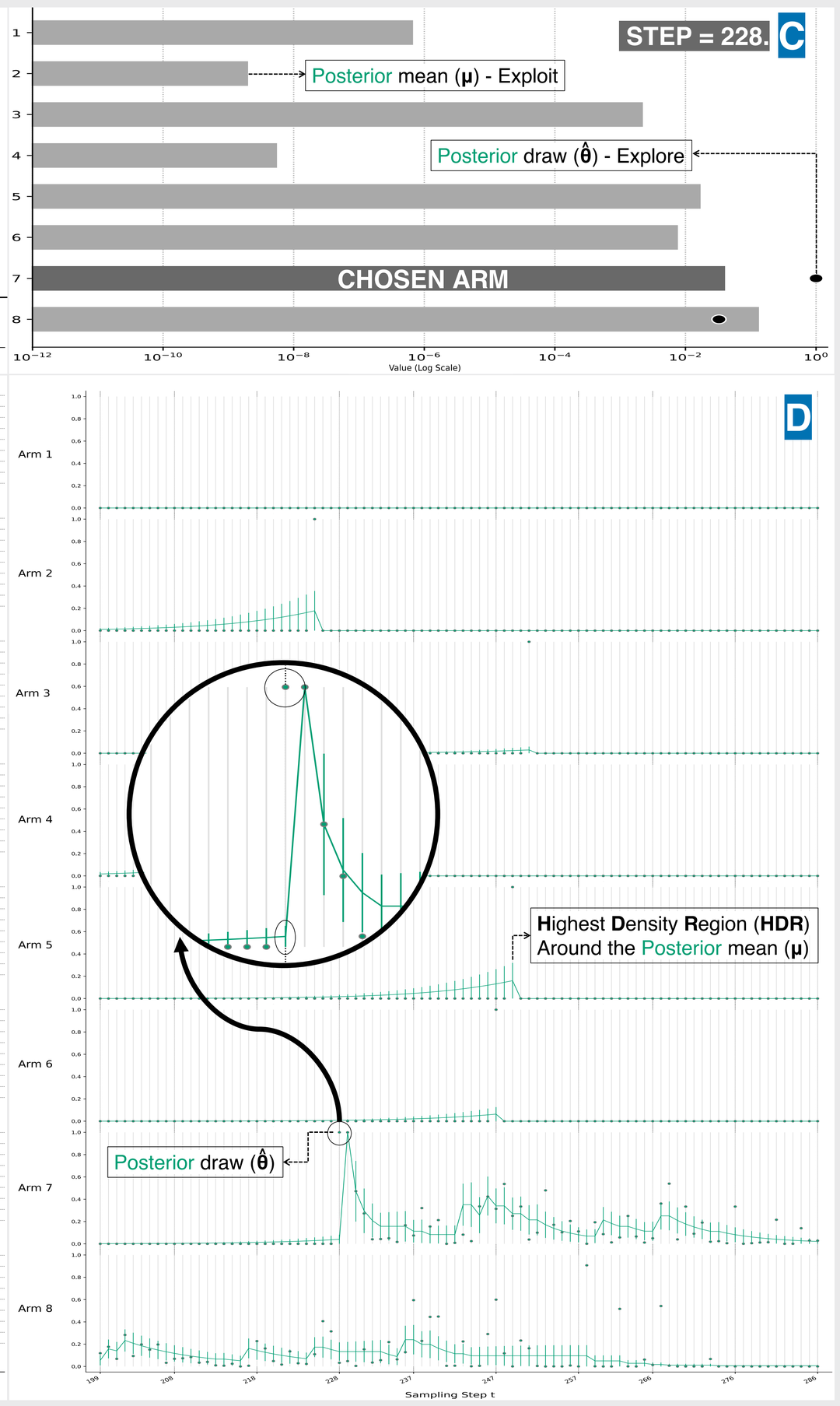
Thompson Sampling:
Instead of just tracking averages, TS maintains a full "belief" (a confidence level) about each arm. It makes choices based on both performance and its own uncertainty.

III. TS-Insight: Seeing is Believing in Multi-Armed Bandits

What visual design improves transparency and trustworthiness of the algorithm by "*Enabling developers to **verify** its mechanics, **explain** its choices, and assess the **reliability** of its decisions*"?







IV. Implications & Takeaway Messages

Key Question	What TS-Insight Reveals	Implication for Practice
A. What is the algorithm doing? (Diagnosis)	Shows arm selection and outcome over time using a barcode, surfacing behavior shifts and decision patterns.	Raises awareness of behavior shift, prompting deeper analysis.
B. Is it functioning as intended? (Verification)	Barcode + Alpha/Beta (evidence) counts reveal reward updates, forgetting, and feedback logic.	Aids and enables debugging[B.1.] and verification of algorithm variants mechanics[B.2.].
C. Why did it make that choice? (Explanation)	Decomposes each choice into its exploitation (mean) vs. exploration (draw) drivers (XAI).	Boosts interpretability and trust in individual decisions.
D. Was the decision confident? (Reliability)	A sample falling outside the HDR band signals a low-probability, uncertain choice.	Supports risk-aware analysis by highlighting decisions made under high epistemic uncertainty.

V. What's Missing?❖ Where We're Headed?

- ❖ Explicitly designed for Thompson Sampling and its variants.
- ➢ Online (real-time) Visualization.
- ➢ Formal user studies.
- ➢ Fully Interactive Coordinated Multiple Views.

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