BRIGHT: A Bayesian Reinforcement Learning Framework for Intelligent Traffic Monitoring and Measurement

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***Abstract*—Recent deployments of software-defined networking (SDN), especially OpenFlow, have enabled fine-grained traffic monitoring and traffic matrix (TM) estimation, yet existing methods still struggle under tight monitoring budgets in large networks due to three limitations: (1) lack of reasoning-driven adaptive monitoring plans that adjust intensity to traffic dynamics; (2) weak coupling between monitoring and inference, with little explicit per-flow uncertainty modeling for TM optimization; and (3) coarse spatio-temporal scheduling that ignores heterogeneous switch and link costs, causing excessive overhead and unbalanced loads. To address this, we propose BRIGHT, a Bayesian reinforcement-learning framework for intelligent traffic monitoring in OpenFlow networks. BRIGHT maintains lightweight Gaussian posteriors for per-flow rates and their uncertainty, uses stability and entropy indicators to categorize flows, and employs a linear contextual bandit with Bayesian Thompson sampling to adaptively select monitoring templates and per-slot measurement quotas. A spatio-temporal scheduler then maps each template to concrete probing intervals and low-overhead polling points along flow paths, achieving an online trade-off between monitoring cost and estimation accuracy. We implement BRIGHT as a Ryu controller application and evaluate it on a Mininet testbed with the GEANT backbone topology, comparing against LCM, AdaptMon, and OpenTM under stationary and bursty traffic. Experiments show that BRIGHT substantially reduces monitoring messages and control-plane load, improves effective link utilization, and still maintains or even improves TM estimation accuracy.**

***Keyword*—Software-Defined Networking (SDN), Traffic Monitoring, Bayesian Reinforcement Learning, Contextual Bandits**

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