

# AI-Enhanced Cybersecurity Training: Learning Analytics in Action

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**Abstract:** *Cybersecurity is growing increasingly intricate due to the rapid expansion of interconnected systems and the global landscape of threats. To address these challenges effectively, a proficient cybersecurity workforce capable of making complex decisions in the ever-changing cyberspace is essential. While Artificial Intelligence (AI) is being quickly integrated into cybersecurity operations, it is crucial to comprehend the foundational learning theory and ecosystems to adequately train human operators and AI-assisted cyber defense teams. Cybersecurity exercises (CSXs) serve as popular instructional tools for cyber preparedness. Nevertheless, the utilization of learning analytics (LA) techniques and AI-driven approaches in exercise development and implementation is still nascent. We advocate for a comprehensive model of human-AI interaction within the context of LA and CSX. This model unifies aspects of human-AI interaction, cyber ranges, cybersecurity practices, LA tools, multimodal learning analytics, exercise life cycles, and pedagogical strategies. We also explore the potential and obstacles for implementing LA and AI in cybersecurity training. By examining the role of AI through a lens of learning, instruction, and administration in cybersecurity training, particularly within exercises, we seek to prompt further discourse on the future of collaboration between humans and AI and how to enhance cybersecurity training through innovative LA and AI capabilities.*

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