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The Rise of Self Healing Software: A Vision for Autonomous Digital Systems

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Saba Naqvi*

MUFG Bank, USA

***Corresponding Author:** Saba Naqvi, MUFG Bank, USA.

The software systems that power today's enterprises are no longer static applications running in controlled environments. They are dynamic, distributed, and constantly evolving ecosystems spanning cloud infrastructure, microservices architectures, and AI-driven platforms. As complexity grows, so does fragility. Outages, cascading failures, configuration drift, and unforeseen runtime anomalies have become inevitable rather than exceptional. In this context, resilience can no longer rely solely on monitoring dashboards and human intervention. The future demands systems capable of diagnosing and correcting themselves. In their recent work, Mohammad Baqar, Rajat Khanda, and Saba Naqvi articulate a bold and forward-looking vision: software systems that emulate biological healing. In nature, living organisms continuously monitor their internal state. When damage occurs, sensory mechanisms detect the disruption, cognitive processes evaluate its severity, and adaptive repair mechanisms restore equilibrium. This process unfolds autonomously, intelligently, and in real time. The authors argue that modern observability platforms—rich with logs, metrics, traces, and event streams—represent the digital equivalent of biological sensory systems. What has been missing is a true cognitive layer capable of interpreting these signals and orchestrating intelligent recovery. Artificial intelligence now makes such a layer possible. Rather than relying on static rule-based automation, the proposed approach leverages machine learning models that can correlate telemetry signals, infer root causes, and propose corrective actions based on historical patterns. The system does not merely trigger alerts; it reasons. It does not simply restart services; it evaluates context and selects targeted interventions. In enterprise environments where downtime translates directly into financial loss and reputational risk, this shift from reactive automation to adaptive intelligence is profound. From an industry perspective, the implications are transformative. Self-healing capabilities can reduce mean time to recovery, alleviate operational fatigue among engineering teams, and enable organizations to scale infrastructure without proportionally increasing human oversight. As DevOps and SRE practices mature, the next frontier lies in autonomous remediation. Instead of engineers manually investigating incidents at 3 a.m., AI-driven agents could analyze anomalies, apply validated fixes, regenerate tests, adjust configurations, and document their actions—all within seconds. The significance of this paradigm extends beyond operational efficiency. It challenges how we conceptualize software ownership and reliability. Traditionally, resilience has been a property engineered into systems through redundancy and careful design. In the emerging model, resilience becomes an emergent property of continuous learning. Systems accumulate experience, adapt to evolving environments, and refine their corrective strategies over time. This mirrors biological evolution, where organisms grow stronger through exposure to stress. Of course, autonomy must be approached responsibly. Industry adoption will require safeguards, explainability mechanisms, and layered validation to ensure

that automated corrections do not introduce new risks. Trust in AI-driven remediation depends on transparency and rigorous testing. Yet the trajectory is clear. As AI models improve in reasoning over code, infrastructure states, and operational telemetry, the boundary between human-led debugging and machine-led recovery will continue to blur. The vision presented by Baqar, Khanda, and Naqvi signals a pivotal moment in software engineering. Observability has given systems the ability to sense. Artificial intelligence now provides the capacity to think. The final step—decisive and controlled action—positions self-healing architectures as the logical evolution of modern digital infrastructure. In an era defined by scale, speed, and complexity, the ability for systems to maintain their own health is not a luxury; it is an operational necessity. The coming decade may well see self-healing mechanisms become a standard layer of cloud-native stacks, much like CI/CD pipelines and container orchestration are today. Organizations that embrace this transition early will likely gain advantages in uptime, operational efficiency, and innovation velocity. More importantly, they will move toward a future where software systems are not merely reactive tools but adaptive partners in enterprise growth.