**Unit 11: Future trends in Secure Software Development**

# Required Reading

DiBona, C. & Ockman, S. (1999) Open Sources. 1st ed. Sebastapol: O’Reilly Media, Inc.

**Summary**
The Tanenbaum-Torvalds debate, as documented in this appendix, centers on the fundamental differences in operating system design between microkernels and monolithic kernels. It originated in 1992 when Andrew Tanenbaum, a professor and creator of MINIX, criticized Linux as an "obsolete" monolithic system, arguing that microkernels were the future due to their modularity and portability. Linus Torvalds, the creator of Linux, defended his design choices, emphasizing that Linux was practical, performant, and immediately available, unlike microkernel-based systems such as GNU Hurd, which remained unfinished. The debate sparked wider discussion in the computing community, with notable figures such as Ken Thompson weighing in, acknowledging the advantages of microkernels but also the practicality and efficiency of monolithic systems. Ultimately, while Tanenbaum advocated for academic purity and future-proofing, Torvalds focused on real-world usability and immediate functionality.
**Reflection**
Reflecting on this debate, it is fascinating to see how a disagreement over operating system design in the early '90s foreshadowed the trajectory of modern computing. While microkernels have gained traction in certain areas, Linux's monolithic architecture has become the foundation of countless systems, proving its resilience and adaptability. Tanenbaum's concerns about portability and hardware evolution were valid, but Linux's open-source model and widespread adoption allowed it to evolve and address those challenges over time. This debate highlights the tension between theoretical ideals and practical implementation, demonstrating that sometimes, what works in the moment can shape the future more profoundly than what is deemed "correct" in theory.

Fritzsch J., Bogner J., Zimmermann A. & Wagner S. (2019) From Monolith to Microservices: A Classification of Refactoring Approaches. In: Bruel JM., Mazzara M., Meyer B. (eds) Software Engineering Aspects of Continuous Development and New Paradigms of Software Production and Deployment. DEVOPS 2018. Lecture Notes in Computer Science, vol 11350. Springer.

**Summary**
The study explores the challenges and methodologies involved in transitioning legacy monolithic applications to microservices. The authors highlight the growing trend of cloud adoption and the need for flexible, loosely coupled service architectures. They examine ten existing academic approaches to refactoring monoliths, classifying them based on decomposition techniques such as static code analysis, metadata-driven methods, workload-based strategies, and dynamic microservice composition. The study presents a

decision guide to help software architects choose the most appropriate refactoring method based on specific requirements. However, the findings indicate a lack of universally applicable techniques, limited tool support, and the need for further empirical validation.

**Reflection**

Reflecting on this study, it is evident that while microservices offer significant benefits such as scalability and maintainability, the process of migrating from monolithic architectures remains complex and resource-intensive. The study highlights that there is no one-size-fits-all approach, as different methods require varying levels of input data and impose different constraints. The paper underscores the importance of balancing service granularity, as poorly executed refactoring can lead to architectures that inherit the disadvantages of both monoliths and microservices. Future research should focus on automation, empirical validation, and the development of more adaptable refactoring strategies to bridge the gap between theoretical models and real-world applications.

Roman, R. Lopez, J. & Mambo, M. (2016) Mobile Edge Computing, Fog et al.: A Survey and Analysis of Security Threats and Challenges. Future Generation Computer Systems 78(1): 680 - 698.

**Summary**

The paper explores the limitations of cloud computing in meeting low-latency, context-aware, and mobility-supported applications, leading to the emergence of edge paradigms such as fog computing, mobile edge computing (MEC), and mobile cloud computing (MCC). It provides a holistic analysis of the security challenges, threats, and potential synergies among these paradigms. The authors emphasize that security research in these fields is often compartmentalized, failing to leverage advancements across different edge paradigms. The study identifies various threats to edge computing infrastructures, including denial-of-service attacks, privacy breaches, privilege escalation, and rogue data centers. It also discusses the importance of security mechanisms such as authentication, trust management, intrusion detection, and virtualization security.

**Reflection**

Reflecting on the paper, it is evident that while edge computing presents a promising solution to cloud computing's shortcomings, its distributed and decentralized nature introduces significant security challenges. The lack of a centralized perimeter makes edge infrastructures more vulnerable to attacks, requiring robust and adaptive security frameworks. The study highlights the need for interdisciplinary research that bridges the gaps between different edge paradigms, allowing security solutions to be shared and adapted across various architectures. Additionally, the paper underscores the trade-off between security and performance, as stringent security measures may introduce latency, which edge computing aims to minimize. Moving forward, developing unified security standards and frameworks that cater to the unique needs of edge paradigms will be crucial in ensuring their widespread adoption and reliability.

## Additional Reading

Seshia, S., Hu, S., Li, W. & Zhu, Q.,(2017) Design Automation of Cyber-Physical Systems: Challenges, Advances, and Opportunities. IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems 36(9):1421-1434. DOI: 10.1109/TCAD.2016.2633961.

Bonomi, F., Milito, R., Zhu, J. & Addepalli, S. (2012) Fog computing and its role in the internet of things. Proceedings of the first edition of the MCC workshop on Mobile cloud computing - MCC 12 1(1): 13-16.