

Exploring Domains for Configuration Synthesis

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Configuring complex systems is a challenge for administrators across domains. A small misconfiguration can result in performance degradation, security vulnerabilities, and crashes. Often configurations end up being composed of several hundred-line-long files. Currently, system administrators rely on forums and standard debuggers to resolve their configuration errors. This indicates the need for better tools to solve this class of problem.

One promising solution is automated configuration synthesis. Instead of relying on administrators to manually edit files, configuration synthesis takes as input a model of the system and a policy the administrator wants enforced, and it outputs the configuration files. Recent research has shown that configuration synthesis can generate provably correct configurations for networking protocols including OSPF and BGP.

The goal of this Capstone was to explore the potential application of configuration synthesis to a broader set of domains. We began by modelling several systems, including file systems, UNIX permissions, and a MySQL Server. In the end, we determined that a particularly promising application of configuration synthesis is access control for microservices.

Setting up access control in a microservice architecture typically requires configuration files for several distinct layers. This includes the control plane, the data plane, the networking stack, and the container orchestration platform. A configuration change at any layer can potentially result in policy violations elsewhere in the stack, so configuring access control properly requires understanding how a change will impact every other component of the architecture. This complexity has resulted in system administrators frequently struggling to implement access control policies in standard microservice architectures, as evidenced by our review of forum posts and bug reports. This work has set the stage for future synthesis research grounded in the problems facing the microservices domain.