

# Automated Verification of Network Function Binaries



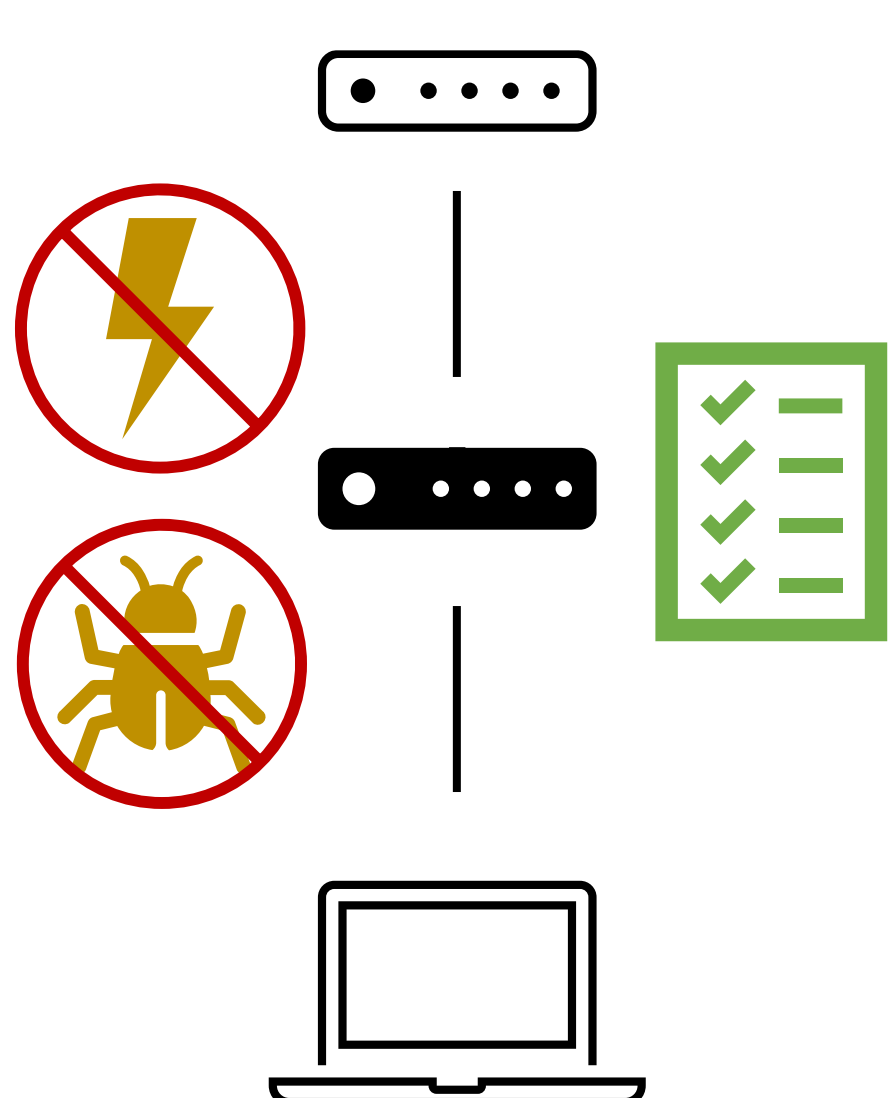
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Describing data structures with maps enables the automated verification of network function binaries

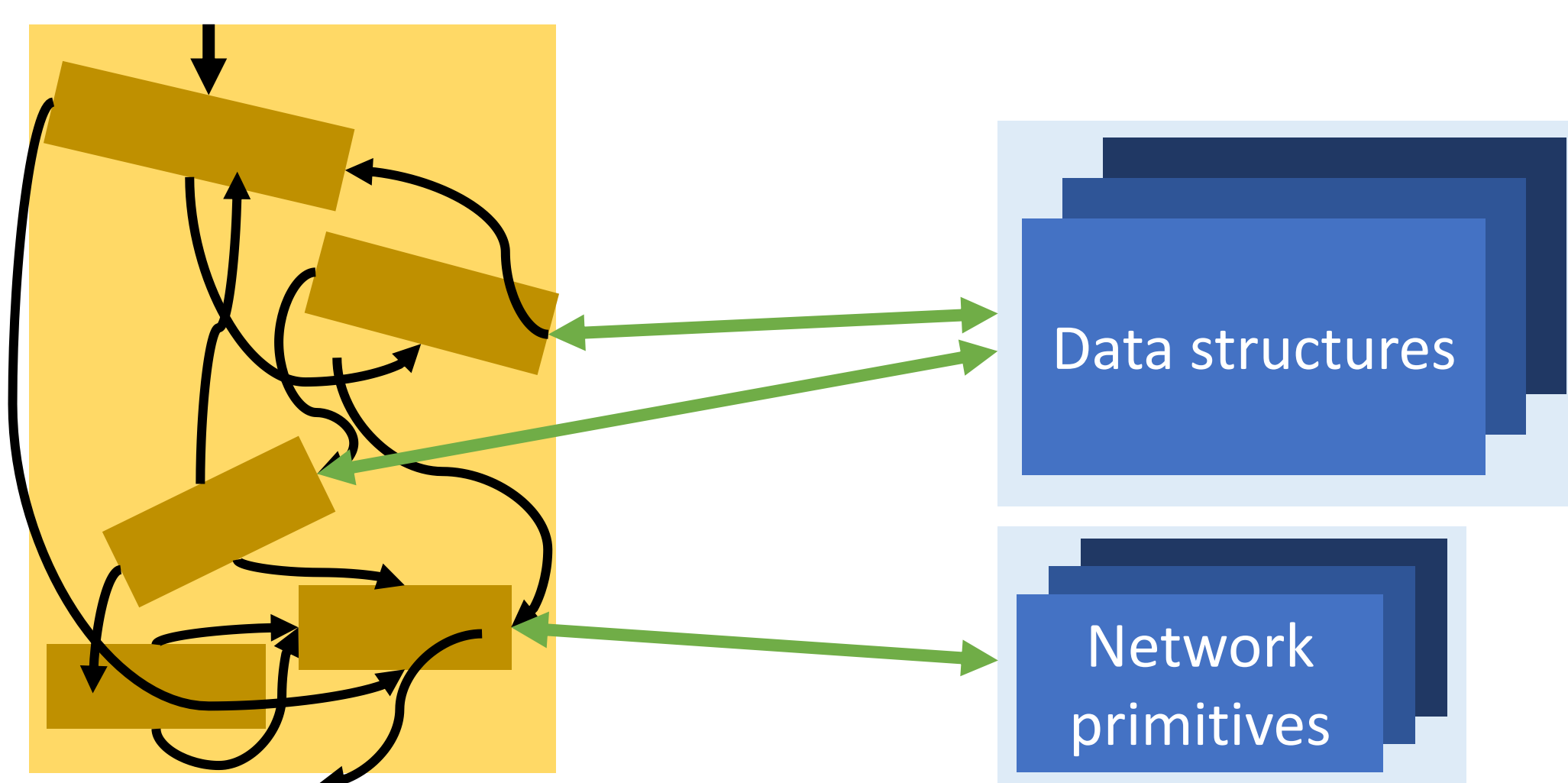
Previous automated network function verification efforts:

- Require operators to have access to source code
- Require developers to use specific data structures
- Require experts to write invariants for the known data structures

We remove these requirements, and only require map-based contracts to use any data structure



Goals:  
Crash freedom,  
memory safety,  
spec compliance (e.g., RFC)



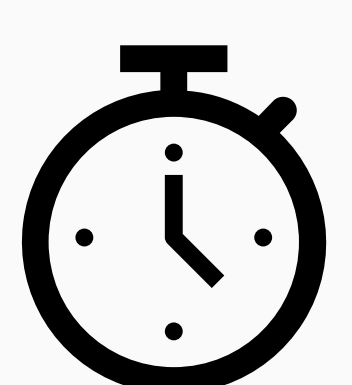
Key idea to verify binaries:  
Observe interactions (= calls)  
with the environment, i.e.,  
data structures + network

*State:* map  $M$  (value  $\rightarrow$  age)

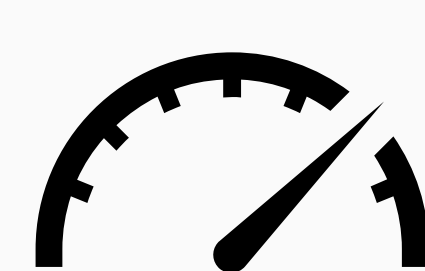
*Precondition:*  
 $\text{length}(M) > 0$

*Postcondition:*  
 $\text{contains}(M, \text{result}) \wedge$   
 $M' = \text{remove}(M, \text{result}) \wedge$   
 $\forall (v,a) \in M: a \leq \text{get}(M, \text{result})$

Example contract for  
a least-recently-used cache  
“evict” operation



Individual network functions  
verify in <2min on a laptop



Prototyping is now easy,  
our performance beats Click

Paper and code: [dslab.epfl.ch/research/klint](https://dslab.epfl.ch/research/klint)