Fault Impact and Fault Tolerance in Heterogeneous Architectures

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Monocultures are a major reason why infections in living organisms as well as in computer systems, like in the prevalent x86-based Windows platform, can spread rapidly. In contrast, heterogeneous architectures can restrain the proliferation of adverse effects on security and safety of systems. This heterogeneity can manifest itself in aspects like differing instruction sets, word widths, and the use of memory hierarchies with different properties.

We analyze how these different aspects of heterogeneity can benefit the fault tolerance of a system that is affected by transient and permanent faults. From this information, system designers can derive guidelines for building dependability-critical systems from heterogeneous components. The analysis of the impact of typical faults is demonstrated using different instruction sets as well as a method for exploiting the memory hierarchy of a system in order to avoid fatal errors that crash or hang a system.

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