

Hardware-assisted Working Set Tracking

General information	Advisor Sebastian Reimers Email sebastian.reimers@tum.de Date 18.02.2022
Type	Master / Bachelor / Guided Research
Description	Efficient memory management requires tracking of an applications dynamic memory demand. Actively used pages, called an applications working set, should be kept in fast memory to ensure low-latency accesses. Tracking working sets with high accuracy avoids memory bloat and spilling of hot pages to slower memory tiers. However, accuracy comes at the cost of high overheads. Current tools, such as DAMON^[1] focus on page table entries, which combine temporal and spatial information needed to compute working sets. This also requires page table modifications and costly TLB flushes. Memory Protection Keys^[2] can help to record memory accesses, whilst reducing the number of TLB flushes. The goal of this thesis is to explore how memory protection keys can be efficiently utilized to track memory accesses, given their limited number.
Keywords	Working Set Tracking, Memory Protection Keys, eBPF, Profiling

Goals	Concrete outcomes 1. Analysis of different distribution algorithms, of protection keys to virtual pages 2. Extend the existing prototype using BPF[3] tracepoints 3. Analyze accuracy and overhead of the tracking mechanism
Prerequisites	Compulsory • Experience in systems programming • Experience in C/C++ Preferred • Knowledge in performance analysis (perf, BPF, ...) • Familiarity with Linux' memory management
References	1. DAMON: Data Access Monitor 2. Memory Protection Keys 3. libbpf
Application process	Please send an email to the advisor including the following: • Email subject: "Thesis application (DSE)" • CV • A copy of your transcript(s) • A motivation statement, please include samples of your work that you are proud of (e.g., major projects, open-source contributions, Github page, etc.) and/or writing samples (e.g., your technical blog, project reports, etc.)