Master Thesis – Evaluate Fragmentation Effects of Different Heap Allocation Algorithms on Linux (30p)

Description
In any long-running, embedded software system, dynamic memory, i.e. heap, poses a challenge. While the speed of heap allocation is important, the real “killer” is external fragmentation. This is especially the case for highly utilised embedded systems with high-availability requirements. In the worst case, fragmentation is so severe that there are no large enough heap buffers available for allocation, causing the application to crash, and system availability to degrade.

If the embedded system is required to use heap, the problem essentially boils down to the right choice of heap allocation algorithm. This thesis aims at evaluating fragmentation effects of several different algorithms under Linux namely, ptmalloc2, ptmalloc3, tcmalloc, and TLSF. CPU time performance shall also be taken into account as part of the evaluation.

Task
As part of the thesis work, the student is required to complete the following:

- Create a test application in C that uses malloc/free library calls; it shall be possible to run different allocation “profiles”, i.e. allocations of different heap buffer sizes (e.g. small, large, mix)
- Run the test application with ptmalloc2, ptmalloc3, tcmalloc and TLSF allocation algorithms
- Monitor both the fragmentation and the CPU cycles for different allocation profiles and different allocation algorithms
- Provide a final evaluation of different allocation algorithms in regard to fragmentation, and CPU cycle penalties

Qualifications
This project aims at Master of Science (civilingenjör) students in electrical engineering, computer science, computer engineering or equivalent academic program. Typically skills required:

- Familiar with C, Linux and glibc
- Good communications skills in English
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