Memory Management

Marius Müller

Universität Tübingen

Procedure

- We will have weekly meetings on Thursday 12-14.
  The first presentation is on May 07 (three weeks from the first meeting).
- The speaker gives a presentation of about 30-35 min and leads the discussion of about 10 min afterwards.
- Everybody will be the speaker one time.

Speaker

As the speaker you prepare your presentation and prepare for the ensuing discussion. In particular, you

- read (a proper selection of) the resources given to you
- potentially collect and read some more resources
- develop a detailed knowledge of your topic
- prepare slides for your presentation
- briefly discuss your presentation with me prior to giving it (e.g., right before or after the seminar of the previous week, or via zoom)

AI Usage:

- you *can* use AI as a helper to understand concepts, but don't rely on it!
- read and understand your resources
- if you use AI to generate images, say so, and check the details for correctness
- think about your slides, don't just let an AI generate them for you

Registration

If possible, register on alma. In addition, register with me via mail! Please send an e-mail (to mari.mueller@uni-tuebingen.de) with the following information

- Matrikelnummer
- name
- Studiengang + Abschluss
- Fachsemester
- your student e-mail address

Seminar Details

- Proseminar, 3 ECTS
- Grading components
  - presentation
  - discussion afterwards (active participation in discussion is expected)
  - term paper

Term Paper

At the end of the seminar, you hand in a term paper on the topic you presented. The term paper should

- have around 3-4 pages
- summarize your topic
- properly cite resources
- use the template linked on the website
- be sent to mari.mueller@uni-tuebingen.de

AI Usage:

- you *can* use AI as a helper to improve your writing, but not to generate the contents: write the paper yourself!
- if you use AI to generate images, say so, and check the details for correctness

The deadline is September 29.

Topics

We will have 8-10 presentations. The core topics (that will definitely be presented) are

- Operating System & Virtual Memory (address translation, paging, TLB, swapping)
- Manual Memory Management (á la C (C++)) & Allocators (stack vs. heap, memory safety, memory leak, malloc/free)
- Garbage Collectors: Basics & Mark-Sweep (basic terminology, tri-colour abstraction)
- Moving Garbage Collectors (mark-compact, semi-space)
- Reference Counting (deferred, coalesced, lazy, cycles)
- Heap Partitioning for GC (generational GC, large-object spaces, topological collectors)
- Linearity, Ownership, Borrowing (á la Rust) (lifetimes, move semantics, RAII, smart pointers)

Topics

Further possible topics are

- Comparing & Unifying Tracing and RC (common framework for GC)
- Implementation-Related Issues for GC (finding pointers, GC-safe points, read/write barriers)
- (Concurrent GC)
- Specific Sophisticated GC Algorithms (Garbage-First, Immix)
- Garbage-Free Reference Counting with Reuse (Perceus)
- Mutable Value Semantics (mutable values but second class references, copy-on-write)
- Region-Based Memory Management (inferred vs explicit, stack of regions, arenas)
- Generational References (references have generations for safety)

Please send an e-mail with your preferences for the topics to present to mari.mueller@uni-tuebingen.de.