Advanced C Workshop Syllabus

Lecture 1: Alignment, Padding and Heap Allocation

Review: Stack and Pointer Lifetime
Endian (Little vs Big), Structure alignment and padding
Bitfields
Structure reordering
Readability and cache locality
Overriding alignment rules, C operators alignof and alignas
Review: Compiling and Assembly Code
Memory Segmentation, Code Segment, Data Segment, BSS Segment
Stack, Heap, CRT allocator (malloc, realloc, free), Pointer alignment

Lecture 2: Data Structures and Algorithms

Array,Hash Table
Linked List, Doubly Linked List
Binary Tree
Merge Sort
Time and Space Complexity

Lecture 3: Overview of the Computer Architecture

Review: Process Memory Segmentation
Multiprocessing System
Virtual Memory
Translation Lookaside Buffer
Cache (Instruction and Data)
SOA (struct of arrays) vs AOS (arrays of structs)
Multiprocessor
Threads
Context Switching

Lecture 4: Virtual Page allocation, Allocators and Scratchpad

Virtual Page Allocation System Calls (Allocate, Commit, Reserve, Free virtual pages)
More on CRT Generic Allocator
Stack Allocator
Bump Allocator (Memory Arenas)
Free List Allocator
Scratchpad memory, Temporary Allocation Region, Temporary String Allocation, Temporary Allocations inside Loop, Procedural Allocations, Reset Scratchpad

Lecture 5: Multithreading I

Threads (creating, wait, destruction, daemons)
Volatile and Atomic Operations
Memory Barriers
Mutex and Semaphores

Lecture 6: Multithreading II

Thread locals
Thread Pools
SIMD (Single Instruction Multiple Data)

Lecture 7: Neat C techniques

Function pointers, Callback Functions
Polymorphism with Void Pointer
Distributed Unions
Switch vs Function Dispatching