Final words and test questions examples

NSWI170 Computer Systems

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Refreshing course contents

- C++
  - Will not be tested directly, but you may need it to understand some questions

- CPUs
  - Principles of instruction encoding and execution
    - Basic instruction types (arithmetic, conditions, jumps, memory operations, …)
  - Representing higher-language constructs in assembly
  - Registers, memory operations
  - Hardware architectures fundamentals

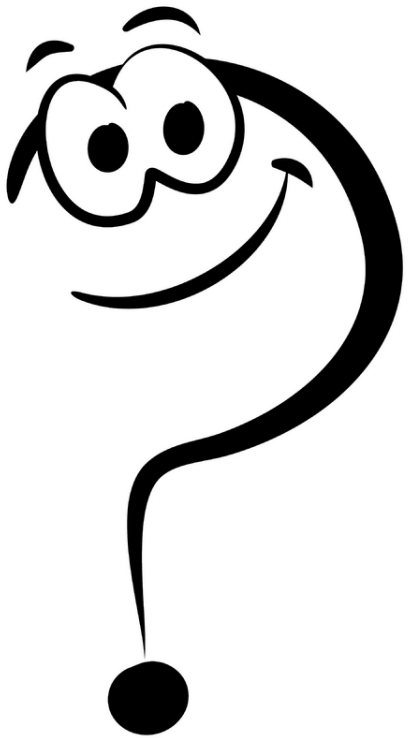
Refreshing course contents

- Memory
  - Fundamentals (addressing, endianness)
  - Representing data structure (alignment)
  - Memory allocation (principles, algorithms)
  - Hardware details (caches, NUMA)
- Programming languages
  - Compilation, linking, dynamic linking, loading for execution
  - Memory organization (globals, constants, heap, …), relocations
  - Calling conventions
  - Portability, virtual machines, garbage collector

Refreshing course contents

- Operating systems
  - Fundamentals, architectures
  - Devices (controller, driver, communication), interrupts
  - Process, thread, scheduling (principles, multitasking , algorithms)
  - File systems (files, directories, FS representation)
    - Hardware-related issues of HDD and SSD (request scheduling, wear leveling, RAID)
  - Virtual memory (principles, segmentation, paging)
    - Including page replacement algorithms, file memory mapping, and shared memory
- Parallel processing and synchronization
  - Race condition, deadlock, sync. primitives, basic sync. problems

Consultation



Exams

- General information
  - Dates are in SIS (will become available 18.5., after some reduction)
    - There will be no other dates, unless we detect a major global problem
  - The credit is not required for the test
    - Since lectures and labs were separated
  - Exam is focusing on understanding, not memorizing low-level details
    - Slides are not a complete reference of knowledge
    - Memorizing the slides/lecture will probably not help you
    - Some questions will require you to apply the knowledge from the lectures
      - E.g., to compute something, apply an algorithm and report the result, …
    - Prior knowledge from NSWI120 (Principles of computers) may be required!

Exams

- Test structure
  - In the labs using online application (still experimental)
    - Strict rules, no materials, no other applications may be running, …
  - 10 questions, 20 points, 65 minutes (soft deadline)
  - Grading
    - 17-20 points = mark 1 (Excellent)
    - 14-16 points = mark 2 (Well done)
    - 11-13 points = mark 3 (OK)
    - < 11 points = fail

Exams

- Question types
  - Single best answer (radio select)
    - Multiple answers may technically correct, but you need to select the best one
    - The best one is the most precise and the most complete one
  - Multi-choice (checkboxes)
    - Multiple answers may be correct, you need to select all of them
    - There may be no correct answers (not checking anything may be correct)
  - Fill in number(s)
    - The answer is a number or sequence of numbers (e.g., a result of a calculation)
  - New types may be added
    - E.g., put given tokens in the right order

Exams

- Quiz questions
  - 8 questions, 1 point each
  - Example (single best answer question)
    “Instruction set architecture (ISA) defines:”
    - Instructions semantics and registers
    - Instruction op-codes, memory management, and I/O model
    - Registers, ALUs, decoding units, caches, and memory controllers
    - Instruction mapping to micro-instructions and ALU operations
    - Instructions semantics, op-codes, registers, memory management, and I/O model
    - Instructions semantics, op-codes, ALUs, decoding units, registers, memory management, caches, and I/O model

Exams

- Practical questions
  - A scenario, where a problem is given and you need to solve it
    - Calculate something, decode a data structure, understand a piece of code, …
  - 4 questions, 3 points each
  - Example (numeric question)
    “How many page faults (at most) may occur when you copy 2KiB of memory in user space?”
    - Assume 32-bit address space, 4 KiB pages, and 2-level paging
    - There is enough physical memory (each page may fault at most once)
    - OS is “simple”, it can allocate only one physical frame at each fault
    - Ignore possible page faults caused by instruction fetching

Exams

- Practical questions
  - Example (numeric question)

```
struct S {
   char type;
   double deviation;
   int count;
}
S[20] sa;
```

“What is the offset (in bytes) of **sa[3].count** from the beginning of **sa** array? (**double** is 64bit, **int** is 32bit)?”

Exams

- Practical questions
  - Example (numeric question)
    - FAT16 file system with 2 KiB clusters
    - File **a.txt** directory entry has properties
      - firstCluster = 3
      - size = 7654
    - An user performs
      - Seek to offset 3210
      - Read of 1000 bytes

FAT

2	0	3	10	4	0	5	-1
6	0	7	0	8	5	9	0
10	15	11	0	12	0	13	8
14	-1	15	14	16	0	17	0

    - “Write indices of all clusters which will be loaded to satisfy this operation. (assume the FAT table is cached in main memory).”

Exams

- Practical questions
  - Example (single best answer)
    "Select a C code that was compiled into the given assembly fragment."

    - **if (x < y) ++x;**
    - **s += (a-b) * (a-b)**
    - **a + b + c - d**
    - **(a+b) - (c+d)**
    - **(x >= y) ? 0 : x+1**
    - **return x * x**
    - **while (j > 0) --j;**

```
add $t0, $a0, $a2 // addition
add $t1, $a1, $a3
sub $r0, $t0, $t1 // subtraction
```

Discussion