2GA3 Tutorial #12

DATE: December 6th, 2021

TA: Jatin Chowdhary

Last Tutorial

- There are no tutorials on Friday
- The last-last tutorial is tomorrow, Tuesday
  - It's also a review tutorial
- Final exam is December 20th, 2021
  - Literally 2 weeks till D-Day
- Today's content is good practice for the final exam
  - Make sure you review it, at least once

Exam Review

- Tutorial 2, Q3 (2.7)
- Tutorial 3, Q1 (2.13)
- Tutorial 4, Q2 (2.31)
- Tutorial 7, Q4 (4.5)
- Tutorial 12, Q5
  - This is the only new content in today's tutorial
    - Everything else is review
      - We will start off with this

Tutorial 12, Q5

- **Question:** A machine has a 32-bit virtual address space and a 16KB page size. It has 1GB of physical memory. How many pages does a process have? How many bytes are needed for a page table, assuming 4 control bits and that disk addresses are stored elsewhere?
- **Precursor:**
  - Next slide

Tutorial 12, Q5

- **Precursor:**
  - The virtual address space is 32-bits
    - This is the size of the virtual memory
  - The page size is 16KB
    - KB = Kilobytes
  - The size of the physical memory is 1 GB
    - GB = Gigabyte
  - The stuff in the virtual address space maps to physical meory

Tutorial 12, Q5

- **Answer:**
  - To calculate the pages per process, or the number of pages, we need to divide the page size by the size of the virtual memory
    - i.e. Number Of Pages = Virtual Memory Size ÷ Page Size
  - But wait, there's a problem
    - The page size is given in KB, and we need B
      - KB = Kilobytes
      - B = Bytes

Tutorial 12, Q5

- **Answer:**
  - So, we convert 16 KB to ??? B
    - It's a simple calculation
      - Page size (Bytes) = 16×2^{10}
      - Page size (Bytes) = $2^4 \times 2^{10}$
      - Page size (Bytes) = 2^{10+4}
      - Page size (Bytes) = 2^{14}
  - Finally, we divide the new page size by the virtual memory size
    - Next slide

Tutorial 12, Q5

- **Answer:**
  - Number Of Pages = Virtual Memory Size ÷ Page Size
  - Number Of Pages = $2^{32} \div 2^{14}$
  - Number Of Pages = $2^{32 - 14}$
  - Number Of Pages = 2^{18} = 262144 = 256K
- Therefore, the number of pages per process is 2^{18}

Questions?
Comments?
Concerns?

Tutorial 2, Q3 (2.7)

Q3) 2.7

Translate the following C code to RISC-V.
Assume that the variables f, g, h, i, and j are assigned to registers x5, x6, x7, x28, and x29, respectively. Assume that the base address of the arrays A and B are in registers x10 and x11, respectively. Assume that the elements of the arrays A and B are 8-byte words:

```
B[8] = A[i] + A[j];
```

Questions?
Comments?
Concerns?

Tutorial 3, Q1 (2.13)

Question 1) 2.13

Provide the instruction type and hexadecimal representation of the following instruction:

```
sw x5, 32(x30)
```

THE END

Clarification

- Bytes Vs. Bits
  - Bytes are represented with a **BIG B**
    - *i.e. 4GB, 8GB, 16GB, etc.*
  - Bits are represented with a <u>small b</u>
    - *i.e. 150Mbps, 100 Mbps, 1024 Gb, etc.*

Corsair Vengeance RGB Pro 32GB (2 x 16GB) DDR4 3600MHz Desktop Memory (CMW32GX4M2D3600C18)

Corsair Vengeance LPX 16GB (2 x 8GB) DDR4 3600MHz Desktop Memory (CMK16GX4M2D3600C18)

Seagate One Touch 5TB USB 3.0 Portable External Hard Drive (STKC5000400) - Black

Samsung T5 1TB USB External Solid State Drive (MU-PA1T0B/AM)

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THE END