上机作业A1 讲评

2022/9/28

刘通宇

评分标准

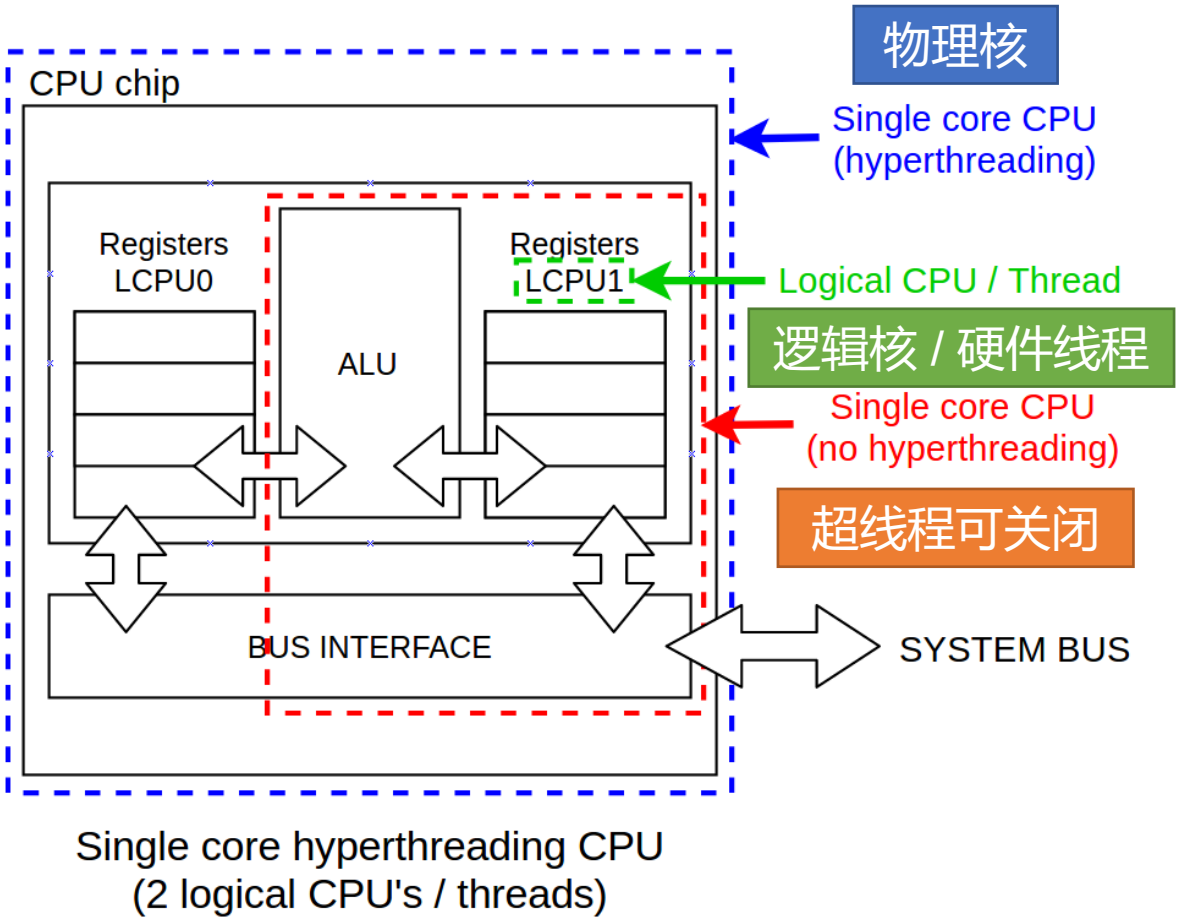
- 上机作业A1的分数分为2部分：基础分数80%，额外分数20%
  - 基础分数：作业共2大题，16小题，每题5%，按回答是否正确给予客观评分
  - 额外分数：视作业完成态度、分析详尽程度与深入程度给予主观评分，最高20%
- 提示
  - 认真对待每一次Assignment和Project，每一次分数都是总评的一部分
  - 按照要求，准时地、完整地提交作业
  - 禁止抄袭

概念：指令集架构与微架构

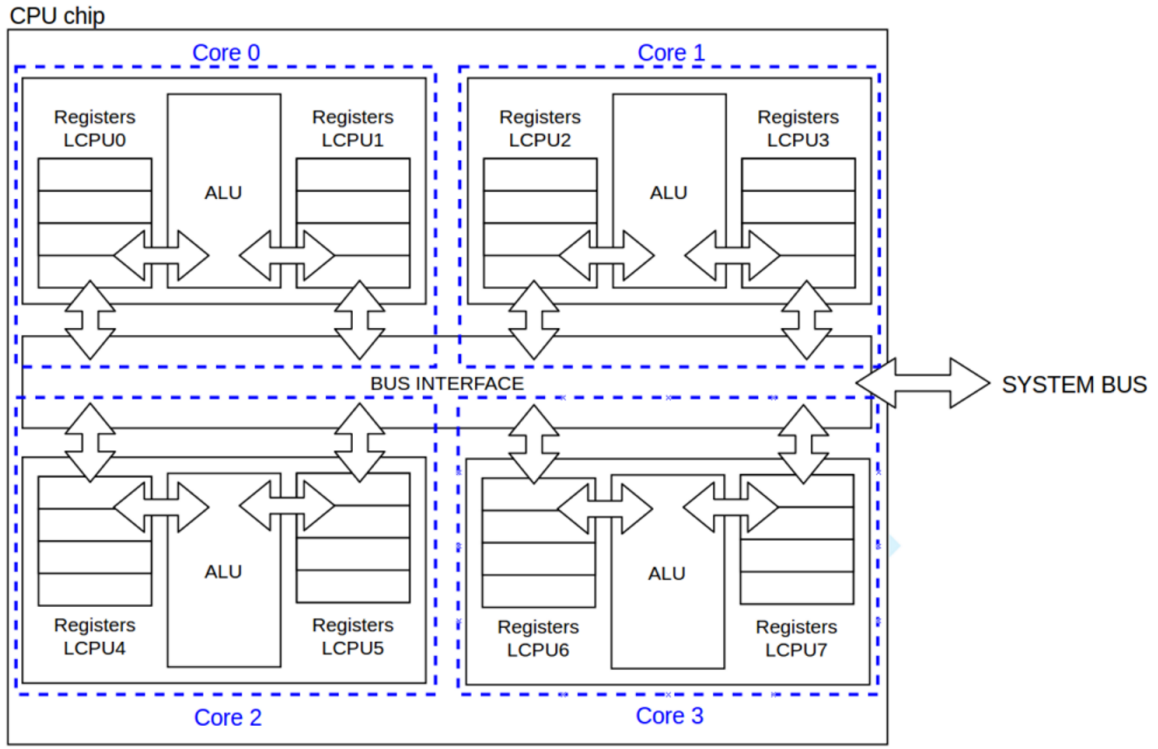
- **指令集架构（Instruction Set Architecture，ISA）**是计算机体系结构中与程序设计有关的部分，包含基本数据类型，指令集，寄存器，寻址模式，存储体系，中断，异常处理以及外部IO。
- **微架构（Micro-architecture）**指的是一套用于执行指令集的处理器设计方法，使得指令集架构可以在处理器上被执行。
- 不同微架构的处理器可以共享一种指令集，例：Intel处理器与AMD处理器都是属于x86-64的指令集架构，但是两者在处理器的内部设计上存在本质区别。
- 不同代际（generation）的处理器，即使使用相同指令集，微架构层面上是有区别的，例：Intel第2代Xeon服务器芯片微架构代号是CascadeLake，第3代是IceLake。

Reference: Instruction set architecture - Wikipedia https://en.wikipedia.org/wiki/Instruction_set_architecture
指令集架构知识汇总 - 知乎 (zhihu.com)

Hyper-Threading 超线程



Single core hyperthreading CPU
(2 logical CPU's / threads)



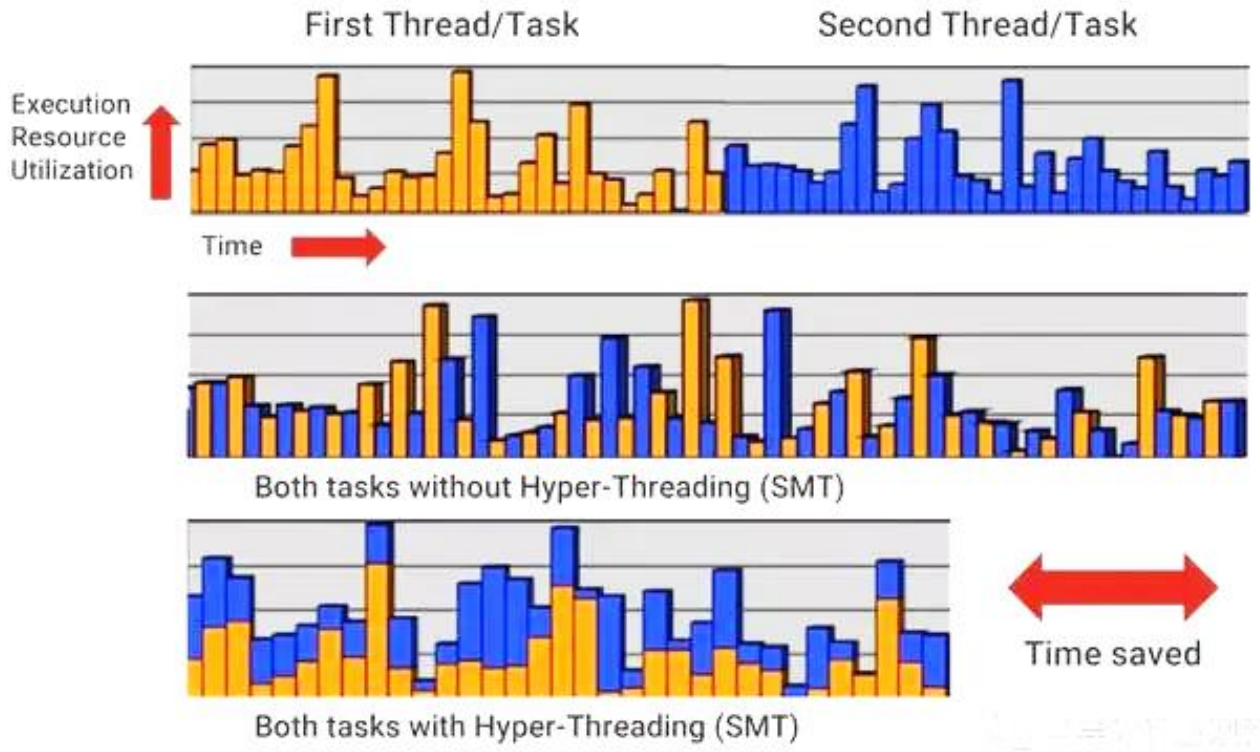
Quad-core hyperthreading CPU

- Intel “四核八线程处理器”
  - 物理核：4个，逻辑核：8个
  - 操作系统能看到8个处理器供调度

Reference: [Differences between physical CPU vs logical CPU vs Core vs Thread vs Socket | daniloaz.com]

类似Intel “超线程” 的技术

- 相似的技术
  - Intel® Hyper-Threading，超线程，简称HT
  - AMD® Simultaneous Multithreading，同步多线程，简称SMT
- 思考：HT或SMT带来的性能提升?



[Reference: What Is Hyper-Threading? - Intel]

lscpu的输出

Server with Intel processors

```
(base) tongyu@solesystem:~$ lscpu
Architecture:            x86_64
CPU op-mode(s):          32-bit, 64-bit
Byte Order:              Little Endian
Address sizes:           46 bits physical, 48 bits virtual
CPU(s):                  80
On-line CPU(s) list:     0-79
Thread(s) per core:      2
Core(s) per socket:      20
Socket(s):               2
NUMA node(s):            2
Vendor ID:               GenuineIntel
CPU family:              6
Model:                   85
Model name:              Intel(R) Xeon(R) Gold 5218R CPU @ 2.10GHz
Stepping:                7
……
```

Server with Kunpeng processors

```
(base) tongyu@taishan-200:~$ lscpu
Architecture:            aarch64
  CPU op-mode(s):        64-bit
  Byte Order:            Little Endian
CPU(s):                  96
  On-line CPU(s) list:   0-95
Vendor ID:               HiSilicon
  Model name:            Kunpeng-920
    Model:               0
    Thread(s) per core:  1
    Core(s) per socket:  48
    Socket(s):           2
    Stepping:            0x1
……
```

这里的“Architecture”指的是指令集架构

“Thread(s) per core”每一个物理核对应的硬件线程个数

信息来源于处理器厂商提供的信息，这里的“Model”是厂商内部的型号标识，具体含义需要参考相应的架构文档。

http://www.intel.com/content/www/us/en/processors/architectures-software-developer-manuals.html

CPUID命令

- 对于x86-64指令集架构，CPUID是其指令集下的一条机器指令，这条指令通过EAX的取值，判断需要取得的信息，再通过EAX、EBX、ECX、EDX作为返回值，得到相应信息，这些取值和返回信息需要参考硬件生产商的相关文档。
- 对Intel的处理器按照DisplayFamily_DisplayModel的模式查找，06_9EH所在的条目

[CPUID - Wikipedia]

man cpuid： [cpuid(1): Dump CPUID info for each CPU - Linux man page (die.net)]

Intel® 64 and IA-32 Architectures Software Developer's Manuals Volume 4 Chapter 2 Model Specific Registers (MSRs)

```
CPU 0:
   vendor_id = "GenuineIntel"
   version information (1/eax):
      processor type  = primary processor (0)
      family          = 0x6 (6)
      model           = 0xe (14)
      stepping id     = 0x9 (9)
      extended family = 0x0 (0)
      extended model  = 0x9 (9)
      (family synth)  = 0x6 (6)
      (model synth)   = 0x9e (158)
      (simple synth)  = Intel Core (unknown type) (Kaby Lake /
Coffee Lake) [Kaby Lake] {Skylake}, 14nm
......
```

Table 2-1. CPUID Signature Values of DisplayFamily_DisplayModel

DisplayFamily_DisplayModel	Processor Families/Processor Number Series
06_85H	Intel® Xeon Phi™ Processor 7215, 7285, 7295 Series based on Knights Mill microarchitecture
06_57H	Intel® Xeon Phi™ Processor 3200, 5200, 7200 Series based on Knights Landing microarchitecture
06_8CH, 06_8DH	11th generation Intel® Core™ processors based on Tiger Lake microarchitecture
06_7DH, 06_7EH	10th generation Intel® Core™ processors based on Ice Lake microarchitecture
06_A5H, 06_A6H	10th generation Intel® Core™ processors based on Comet Lake microarchitecture
06_66H	Intel® Core™ processors based on Cannon Lake microarchitecture
06_8EH, 06_9EH	7th generation Intel® Core™ processors based on Kaby Lake microarchitecture, 8th and 9th generation Intel® Core™ processors based on Coffee Lake microarchitecture, Intel® Xeon® E processors based on Coffee Lake microarchitecture
06_6AH, 06_6CH	3rd generation Intel® Xeon® Processor Scalable Family based on Ice Lake microarchitecture
06_55H	Intel® Xeon® Processor Scalable Family based on Skylake microarchitecture, 2nd generation Intel® Xeon® Processor Scalable Family based on Cascade Lake product, and 3rd generation Intel® Xeon® Processor Scalable Family based on Cooper Lake product
06_4EH, 06_5EH	6th generation Intel Core processors and Intel Xeon processor E3-1500m v5 product family and E3-1200 v5 product family based on Skylake microarchitecture
06_56H	Intel Xeon processor D-1500 product family based on Broadwell microarchitecture

Linux操作系统的内核版本与发行版本

- 内核（Kernel）：Linux的底层和核心部分，是硬件与软件之间的中间层，充当底层的驱动程序，负责将可用的资源分配到各个进程。
- 发行版本（Distribution）：在内核的基础上，开发不同应用程序，组成的一个完整的操作系统，用户可以直接使用，例如RedHat，Debian，Ubuntu等。

`uname -a`的输出

```
(base) tongyu@taishan-200:~$ uname -a
Linux taishan-200 5.15.0-41-generic #44-Ubuntu
SMP Thu Jun 23 11:20:13 UTC 2022 aarch64
aarch64 aarch64 GNU/Linux
```

- 操作系统名称（-s选项）
- 计算机名称（-n选项）
- **操作系统内核版本（-r选项）**
- 发行版版本与时间（-v选项）
- 指令集架构（-m选项）

* SMP: Symmetric Multi-Processor 对称多处理器

numactl -H与demidecode的输出

Note: 在最新的WSL2上，这两条命令无法导出机器的信息

```
(base) tongyu@taishan-200:~$ numactl -H
available: 4 nodes (0-3)
node 0 cpus: 0 1 2 3 4 5 6 7 8 9 10 11 12 13
14 15 16 17 18 19 20 21 22 23
node 0 size: 47883 MB
node 0 free: 257 MB
……
node distances:
node   0   1   2   3
  0:  10  16  32  33
  1:  16  10  25  32
  2:  32  25  10  16
  3:  33  32  16  10
......
```

```
(base) root@taishan-200:~# dmidecode | grep -A16 "Memory Device"
Memory Device
        Array Handle: 0x0006
        Error Information Handle: Not Provided
        Total Width: 72 bits
        Data Width: 64 bits
        Size: 16 GB
        Form Factor: DIMM
        Set: None
        Locator: DIMM000 J27
        Bank Locator: SOCKET 0 CHANNEL 0 DIMM 0
        Type: DDR4
        Type Detail: Synchronous Registered (Buffered)
        Speed: 2933 MT/s
        Manufacturer: Hynix
        Serial Number: 20E7B5EE
        Asset Tag: 2011
        Part Number: HMA82GR7CJR4N-WM
```

Question: 这里的GB，指的是2^{20} Byte还是10^6 Byte?

通常规定：1 GiB = 1024 MiB　　1 MiB = 1024 B
　　1 GB = 1000 MB　　1 MB = 1000 B

Python2和Python3

- Python3在设计的时候没有考虑向下兼容，因此使用Python2的程序无法直接使用Python3的解释器执行。

```
Python2: print “Hello, world”
Python3: print(“Hello, world”)
```

- 我已经安装了Python3了，怎么办?

1. Download source code

$ wget https://www.python.org/ftp/python/2.7.9/Python-2.7.9.tgz

2. Unzip, compile to install

$ tar -zxvf Python-2.7.9.tgz
$ cd Python-2.7.9
$ ./configure --prefix=~/local/python-2.7.9
$ make
$ make install
3. Create a symbolic link
$ ln -s ~/local/python-2.7.9/bin/python ~/local/python27
4. Add to $PATH
export PATH="~/local/bin:$PATH“
5. Run
$ python27 helloword.py