CSE101 Review

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1. A central computer that holds collections of data and programs for many PCs, workstations and other computers is a
a) Supercomputer
b) Server
c) Microcontroller
d) Mainframe

Ans: b
服务器专门用来存数据的

2. A terminal that cannot do any processing by itself is a
a) Dependent terminal
b) Stand-alone terminal
c) Dumb terminal
d) Setup-box terminal

Ans: c
Dumb terminal 哑终端，一切程序处理交给主机做，自己不做。

3. What is the total number of bits contained in the following?
a) ASCII file containing the textual data - 1010 0100 0111 0010
b) binary file containing the data - 1010 0100 0111 0010

Ans:
a. 16 * 8 = 128 bits = 16 bytes
b. 16 * 1 = 16 bits = 2 bytes
1 byte(字节) = 8 bits
ASCII 一位 1 byte (8 bits)
二进制文件一位 1 bit

byte	1字节
boolean	至少1字节
short	2字节
char	2字节
int	4字节
float	4字节
long	8字节
double	8字节

4. How many microprocessors did you carry to XJTLU today?

Example Ans:
Microprocessors can be found in
- calculator, mobile phone, iPhone, notebook, iPad, PDA, watch, portable music player, camera, etc.

5. I have a block of 256 data bytes to be stored. Which of the following solution(s) is/are sufficient?
a) 8bit system with memory locations 0000 to 00FF
b) 16bit system with memory locations 0000 to 007F
c) 24bit system with memory locations 0000 to 0050

Ans :
(a) and (b)
F*16+F+1= 15*16+15+1 = 16*16 = 256
(7*16+F+1)*2= (7*16+16)*2=8*16*2=256
(5*16+1)*3=243
注意存的是 Byte

6. Why does computing benchmarks on application speed show that the Intel Centrino 1.4Ghz CPU runs faster than an Intel P4 mobile 2Ghz CPU?

Ans :
Clock speed is not always the deciding factor of computing speed in a system. Bottlenecks must be identified and improved, the system is as fast as its slowest component.
E.g. a much larger cache memory allows less switching of data.
E.g. faster system memory also reduces the system bottleneck
E.g. increase system bus speed
因为瓶颈的存在，即 CPU 的读取速度快于 memory 的读取速度，如果后者不快，前者再快也没用。

7. What is the decimal equivalent of the following binary addition? Identify problems in this computation. Assume only 8 bits available to hold the results.

```
    1010 1101
+   1100 0111
```

Ans :

```
     1010 1101     = 173
 +   1100 0111     = 199
     0111 0100     = 116
```

Why 173 + 199 = 116? Overflow

8. Why store data and communicate in digital format?
Ans :
Digital communication is used with the following benefits (reasons)

a) Analog representation is continuous, infinitely multi valued–leads to issues of precision.(模拟表示是连续的、无限多值的——导致精度问题。)

b) Resilience to error.(错误的恢复能力)

c) Digital representation is discrete, only two values 0 and 1. Let two voltage levels 0V and 5V denote values 0 and 1. E.g. any signal levels between 0 ~ 2.5V will be read as value 0.

9. A PC has a microprocessor which processes 16 instructions per microsecond. Each instruction is 64 bits long. Its memory can retrieve or store data/instructions at a rate of 32 bits per microsecond.

I. Mention 3 options to upgrade system performance. Which option gives most improved performance?

II. gives most improved performance.

Ans :
I.

a) upgrade processor to one with twice the speed
b) upgrade memory with one twice the speed
c) double clock speed

II.

Overcoming the bottleneck of a PC can improve the integrated(集成) performance.

10. Which component is used for temporary storage of data inside a CPU?

a) Main memory
b) ALU (Arithmetic Logical Unit)
c) Registers
d) Variables

Ans:
C

11. The main steps in a machine cycle are

a) Compile, link, execute instructions.
b) Interpret, translate to machine code, execute instructions.
c) Instruction fetch, decode instruction, data fetch, execute and store.
d) Data fetch, instruction fetch, decode instruction, execute and store.

Ans:
C (**Very Important**)

12. What controls how fast all the computer operations take place?
a) System buses
b) System Motherboard
c) System RAM
d) System Clock

Ans:
d

13.

(14 marks) Complete the following binary addition. What is the decimal equivalent of this addition? Identify problems in this computation. Assume the operands are prescribed in 2's complement format and only 7 bits are available. Suggest a solution in details for such a scenario.

```
  1001101
+ 1010111
  ???????
```

Ans：

```
    1001101
+   1010111
  01000100
```

This binary addition involves the addition of two operands: 1001101 (-51) and 1010111 (-41). The result (01000100) from this binary addition gives 36 in decimal, which is not what we expect from (-51)+(-41) = (-92). The problem arises because of this addition runs out of 7-bit capacity for the sum. (8 marks)
Solution: Use an 'overflow' flag mechanism to detect such an overflow, i.e. use the following simple rule to detect overflow: If both inputs to an addition have the same sign, and the output sign is different, overflow has occurred. (6 marks)
意思是如果两个以1开头的二进制数相加后结果变为0开头，那么就发生了溢出。
同样的如果两个以0开头的二进制数相加后结果变为1开头，那么就发生了溢出。

14. Given that a CDrom can store up to 70mins of audio file, can you calculate how many Mbytes of data a CDrom stores?
(Note : Audio file has these specifications, Stereo, sampling rate at 44.1KHz)

Ans:
(70 * 60 * 44.1 * 1000 * 2 * 16) / (1024 * 1024 * 8) ≈706 Mbytes
立体声(Stereo)有两个声轨，要乘 2

- CD quality Audio:
- 44.1 KHz sampling rate, 16 bits/sample →
  16 bits*44.1KHz = 705.6 Kbps
  (1 K = 1 Kilo = 2^{10})
- Stereo: 立体声
- 44.1 KHz, 32 bits/sample →

15. If we are going to store (320x240 pixel, 24bits/pixel, 30 frames/sec) video only (no audio), how many minutes can we store in a CDrom with a capacity of 700Mbytes?

Ans:
(700 * 1024 *1024) / (320 * 240 * 24 * 30 *60 / 8) = 1.77 minutes

16. To store (320x240 pixel, 24bits/pixel, 30 frames/sec) video only (no audio) for 60 minutes using a CDrom with a capacity of 700Mbytes, how much compression ratio needs to be achieved?

Ans:
The original size of video is:
320 * 240 * 24 * 30 * 60 * 60 / 8 = 24883200000bytes
So the compression should achieve:
(700 * 1024 * 1024) / (320 * 240 * 24 * 30 * 60 * 60 / 8) = 0.0295 = 2.95%

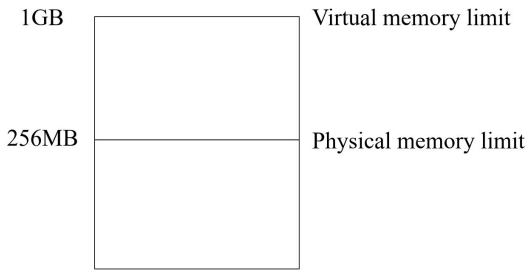
17. What are the main resources consumed(消耗) by the file system in performing its task?

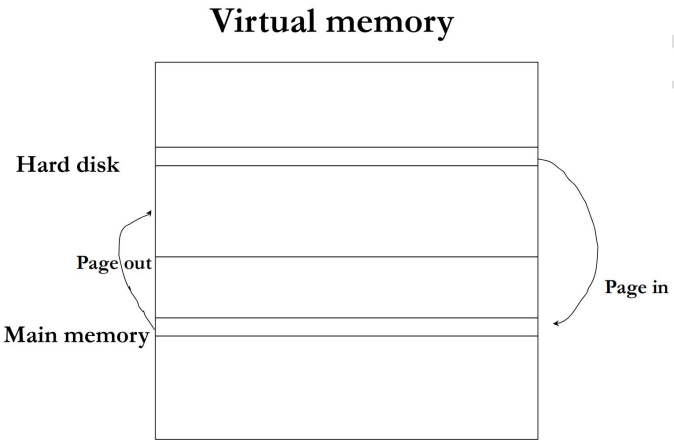
Ans:
CPU time,
memory,
disk space.

Memory Management

- Virtual memory
  - hard disk space
  - when processor needs more RAM space, swaps data onto designated hard disk space
  - improves flexibility but is slower than RAM to which the processor has direct access

Virtual Memory





18. Assume Process A needs 5 pages of memory. When the CPU runs the process, it requests data from each of the 5 pages with equal probability. Assume that the average time to read a word of data from main memory is 5 ns. Assume the average time to read/write a page from hard disk from/into main memory is 8000ns. Assume no caching and all pages in memory are dirty. What is the average access time to read a word of data if

a) All 5 pages of process A are stored in main memory?

b) 3 pages of process A are stored in main memory at one time (the content of the other 2 are on hard disk)?

c) 1 page of process A is stored in main memory at one time (the content of the other 4 are on hard disk) ?

Ans:
a) 5 ns
b) 5 ns * 3/5 + (5ns + 8000ns + 8000ns)(2/5)
c) 5 ns * 1/5 + (5ns + 8000ns + 8000ns)(4/5)
8000 加两遍是因为不仅要读到数据，还要写入主存

19. All conditions and assumptions being the same as given in Q18 except that not all pages in main memory are dirty – the probability of a page being dirty is 0.6. What is the average access time to read a word of data if
a) All 5 pages of process A are stored in main memory?
b) 3 pages of process A are stored in main memory at one time (the content of the other 2 are on hard disk)?
c) 1 page of process A is stored in main memory at one time (the content of the other 4 are on hard disk) ?

Ans:
b) 5 ns * 0.6 + (5ns + 8000ns + 8000ns) * 0.4
b) 5 ns * 3/5 * 0.6 + (5ns + 8000ns + 8000ns) * 3/5 * 0.4 + (5ns + 8000ns + 8000ns)(2/5)
c) 5 ns * 1/5 * 0.6 + (5ns + 8000ns + 8000ns) * 1/5 * 0.4+ (5ns + 8000ns + 8000ns)(4/5)

20. Design and then implement a voting circuit with three inputs and one output, where the output is 1 if the number of inputs in 1 is in majority, otherwise, the output is 0. Follow the following steps:
• Build a Truth Table to derive the above mentioned Boolean function and write down the corresponding logic expression in Sum-of-Products form. (6 marks)
• Lay out in Sum-of-Products form the corresponding Boolean circuit for this function using only AND, OR and NOT gates. (8 marks)

Ans:
Truth table:
i1 i2 i3 O
0 0 0 0
0 0 1 0
0 1 0 0
1 0 0 0
0 1 1 1
1 0 1 1
1 1 0 1
1 1 1 1

O = (not i1 and i2 and i3) or (i1 and not i2 and i3) or (i1 and i2 and not i3) or (i1 and i2 and i3)