

- Which of the following are optimization techniques that can be employed by a computer program compiler ? (10 分)
 - (A) Common subexpression elimination
 - (B) Procedure inlining
 - (C) Expression strength reduction
 - (D) Global register allocation
 - (E) Pipeline scheduling for out-order-execution

- The following is the definition of some MIPS assembly instructions.

Instruction	Example	Meaning	Comments
Add registers	add \$s1, \$s2, \$s3	$\$s1 = \$s2 + \$s3$	$\$s0-\$s7$ are registers
Subtract registers	sub \$t1, \$t2, \$t3	$\$t1 = \$t2 - \$t3$	$\$t0-\$t9$ are also registers
Branch on equality	beq \$v1, \$v0, L	Branch to L if $\$v1 = \$v0$.	$\$v0-\$v1$ are also registers. L is an instruction label.
Add constant	addi \$t1, \$s1, 30	$\$t1 = \$s1 + 30$	

We have the following MIPS assembly program.

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L1: sub    $t0, $t2, $t2
L2: addi   $t1, $t0, 3
L3: add    $t2, $t0, $t0
L4: beq    $a1, $t0, L8
L5: add    $t2, $t2, $a1
L6: sub    $a1, $a1, $t1
L7: beq    $a1, $a1, L4
L8: addi   $t0, $t0, 10
L9: add    $t1, $t1, $t1
    
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Which of the following statements are true of the program ? (10 分)

- (A) The program stops only when $\$t2$ starts with a multiple of three.
 - (B) The program stops only when $\$t1$ starts with a multiple of three.
 - (C) When the program stops, $\$t0$ contains 13.
 - (D) When the program stops, $\$t1$ contains 6.
 - (E) When the program stops, $\$a1$ contains zero.
- Which of the following statements are true of 32-bit arithmetic? (10 分)
 - (A) Hexadecimal FFFF33A in 2's complement is -3260 in decimal.
 - (B) Hexadecimal 0000076 in 1's complement is 118 in decimal.
 - (C) Hexadecimals FFFF420 + 0000039 in 2's complement addition is -3063 in decimal.
 - (D) Hexadecimals FFFF420 * 0000039 in 2's complement multiplication is -115520 in decimal.
 - (E) Hexadecimals FFFF420 / 0000039 in 2's complement division is 77 in decimal.

見背面

4. Assume that we have three classes of instructions with the following CPI values.

Class A: CPI = 1, Class B: CPI = 2, Class C: CPI = 4

Now we have two programs, X and Y, fulfilling the same function. The counts of instructions in each class resulted respectively from the execution of X and Y are as follows.

Programs	Class A	Class B	Class C
X	100	200	100
Y	150	230	50

Assuming that all instructions are executed without temporal overlapping, which of the following statements are true? (10分)

- (A) Program X has 600 instructions.
 (B) Program Y has 430 instructions.
 (C) CPI of program X is 2.5.
 (D) CPI of program Y is 1.98.
 (E) The execution time of program X is 0.81 of the execution time of program Y.
5. Suppose that we have a memory system with 32-bit addresses and a 256 Kilobyte cache. The size of cache line (block) is 64 bytes. Which of the following statements are true of the system? (10分)
- (A) When the cache is 8-way associative, there are 4K cache lines.
 (B) When the cache is 8-way associative, the index field is 8 bits long.
 (C) When the cache is 32-way associative, the index field is 20 bits long.
 (D) When the cache is direct-mapped, the tag field is 14 bits long.
 (E) When the writing policy is 'write-back', the dirty data are written to the main memory only until the corresponding cache line becomes a victim in the replacement policy.
6. Consider a system uses Round-Robin scheduling policy and runs five I/O-bound tasks and three CPU-bound tasks with the following constraints.
- The I/O-bound tasks issue an I/O operation once for every 3 milliseconds of CPU computing.
 - Each I/O operation takes 50 milliseconds to complete.
 - The CPU-bound tasks always use up the time quantum allocated by the scheduler.
 - The context-switching overhead is 0.05 millisecond.
 - All tasks never terminate.
- Which of the following are true? (10分)
- (A) When the time quantum is 30 milliseconds, more than 99.6% of the CPU time is spent on the tasks.
 (B) When the time quantum is 5 milliseconds, less than 96% of the CPU time is spent on the tasks.
 (C) When the time quantum is 20 milliseconds and one CPU-bound task terminates, the CPU utilization by the tasks becomes less than 99.3%.

- (D) When the time quantum is 1 millisecond, the CPU utilization by the tasks is greater than 95%.
- (E) When the time quantum is 2 millisecond, the CPU utilization by the tasks is less than 93%.

7. Consider the following segment table of a process:

segment	base	length
0	305	1020
1	178	100
2	3200	3000
3	18000	200
4	9010	96

Which of the following are true of the process? (10 分)

- (A) Logical address 0,403 is illegal.
 - (B) Logical address 1,103 is illegal.
 - (C) The physical address of logical address 2,3000 is 6200.
 - (D) The physical address of logical address 3,180 is 18180.
 - (E) The physical address of logical address 4,0 is 9010.
8. Assume a demand-paging system with TLB access time = 1 nanosecond, memory access time = 20 nanoseconds, and disk backing store access and transfer time = 2 milliseconds. Which of the following are true of the system? (10 分)
- (A) When TLB miss ratio is 1% and the total page fault ratio is 0.01%, the effective memory access time is 211 nanoseconds.
 - (B) When TLB miss ratio is 0.1% and the total page fault ratio is 0.001%, the effective memory access time is 41.02 nanoseconds.
 - (C) When TLB miss ratio is 0.2% and the total page fault ratio is 0.002%, the effective memory access time is 52.6 nanoseconds.
 - (D) When TLB miss ratio is 0.4% and the total page fault ratio is 0.0005%, the effective memory access time is 30.08 nanoseconds.
 - (E) When TLB miss ratio is 0.3% and the total page fault ratio is 0.0009%, the effective memory access time is 36.06 nanoseconds.
9. To break a deadlock, which of the following are valid issues in selecting victim processes? (5 分)
- (A) The priority of the processes
 - (B) The resources allocated to the processes
 - (C) How many processes to kill
 - (D) Whether the process is locked in I/O
 - (E) Whether the process is CPU-bound

10. Which of the following are essential components of the log records in log-based recovery technique? (5 分)
- (A) Old value
 - (B) Data item name
 - (C) Operation
 - (D) New value
 - (E) Transaction name
11. Which of the following statements are true of process synchronization? (5 分)
- (A) To release a semaphore, a process executes the SIGNAL operation.
 - (B) The WAIT operation is originally called P.
 - (C) The SIGNAL operation can be implemented with spinlocks.
 - (D) Spinlocks is more suitable for single-processor systems than for multi-core systems.
 - (E) Semaphore operations on multiple resources may cause deadlocks.
12. Which of the following statements are true of interrupt handling? (5 分)
- (A) Interrupt indicates hardware or software failures.
 - (B) When interrupt locks the screen, operating system needs to wake up to remove the interrupt.
 - (C) Process context switching is caused by interrupt.
 - (D) Interrupt handling need preserve the register contents of the interrupted processes.
 - (E) Operating systems must forbid recursive Interrupts.

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