INEL 4206 Spring 2002 Exámen II 4/8/02

Nombre: _____ **Sección:** _____

¡Anota tu nombre y número de sección en <u>todas las hojas</u> del examen AHORA! (penalidad de 5 puntos)

Tienes 2 horas para completar tres problemas. Lee cuidadosamente todo el examen antes de empezar a trabajar. Muestra todo el trabajo conducente a tu contestación. Podrás recibir crédito parcial por contestaciones parciales siempre y cuando muestres tu trabajo por escrito. Usa tu tiempo inteligentemente. Exito!

INEL 4206 Staff

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Nombre: _____ **Sección:** _____

1	35
2	30
3	25
4	10
Total	100

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Problema 1. (35 puntos) Control Structures

(a) **(10 points)** Write a segment of MIPS assembly code corresponding to the following high level language code.

```
// Assume variable a in register $s1
// Assume variable b in register $s2
// Assume result in register $s3
if (a == b) then result =  0
if (a  < b) then result =  1
if (a  > b) then result = -1
```

```
            bne  $s1, $s2, else1
            li   $s3, 0
            jump end
    else1:  bgt  $s1, $s2, else2
            li   $s3, 1
            jump end
    else2:  li   $s3, -1
```

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(b) Consider a procedure named *pairs* that takes an integer argument *n* and prints all the pairs of integers a, b in the interval [1,n] such that either a = 2b or 2a = b. For instance for the argument n = 3, pairs should generate output similar to the following:

a = 1 : b = 2
a = 2 : b = 1

(10 points) Provide a definition of the *pairs* function in the high level language of your choice.

```
void pairs(int n) {
  int a,b;
  for (a=0; a<n; a++) {
    for (b=0; b<n; b++) {
      if ((a==(2*b)) || (b==(2*a))) {
        printf("a=%d : b=%d", a, b);
      }
    }
  }
}
```

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(c) **(15 points)** Provide a MIPS assembly code implementation of the *pairs* function. Remember that the function must adhere to all the MIPS procedure linkage conventions.

```
          .data
space:    .asciiz   " "                 # space character
          .text
pairs:    addiu     $sp, $sp, -24
          sw        $a0, 20($sp)        # assume n in $a0
          sw        $ra, 16($sp)
          sw        $s1, 12($sp)
          sw        $s2, 8($sp)
          sw        $s3, 4($sp)
          sw        $s4, 0($sp)
          li        $s3, 2              # // constant 2 in $s3
          move      $s4, $a0            # // n in $s4
          li        $s1, 0              # // i in $s1
          bge       $s1, $a0, endfor1   # for(a=0; a<n; a++) {
for1:     li        $s2, 0              #   // j in $s2
          bge       $s2, $a0, endfor2   #   for(b=0; b<n; b++) {
for2:     multu     $s1, $s3
          mflo      $t0
          multu     $s2, $s3
          mflo      $t1
          bne       $t0, $s2, end       #     if((a==2b)||(b==2a)) {
          move      $a0, $s1            #       printf("a=%d:b=%d",
          li        $v0, 1                                 a,b);
          li        $v0, 1
          syscall
          la        $a0, space
          li        $v0, 4
          syscall
          move      $a0, $s2
          li        $v0, 1
          syscall
          addui     $s2, $s2, 1
          blt       $s2, $s4, for2
endfor2:
          addui     $s1, $s1, 1
          blt       $s1, $s4, for1
endfor1:
end:      lw        $a0, 20($sp)        # assume n in $a0
          lw        $ra, 16($sp)
          lw        $s1, 12($sp)
          lw        $s2, 8($sp)
          lw        $s3, 4($sp)
          lw        $s4, 0($sp)
          addiu     $sp, $sp, 20
          jr        $ra
```

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Problema 2. (30 points) Integer Representations

(a) (5 points) What is the largest positive integer that can be represented with n bits in two's complement ?

2 ^ (n –1) –1

(b) (5 points) What is the smallest negative integer that can be represented with n bits in two's complement ?

- 2 ^ (n – 1)

(c) (5 points) What is the smallest negative integer that can be represented with n bits in one's complement ?

- 2 ^ (n - 1) + 1

(d) (5 points each) Compute the following operations in 8-bit two's complement arithmetic. In each case indicate whether or not there was overflow. Also, verify your results by converting operands and results to decimal and computing the result using decimal arithmetic. SHOW ALL YOUR WORK.

0101011 + 1111111 = 00101010
43 + -1 = 42
NO OVERFLOW

11111110 + 11111111 = 11111101
-2 + -1 = -3
NO OVERFLOW

10000000 - 01110111 = 00000001 with 1 carry
-128 – 119 = -247
SI HAY OVERFLOW

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Problema 3 (25 points) MIPS Assemby Code

(a) (15 points) Add comments to the following MIPS code and describe in one sentence what it computes. Assume that $a0 is used for the input and initially contains n, a positive integer. Assume that $v0 is used for the output.

```
begin:    addi $t0, $zero, 0       # t0 = 0
          addi $t1, $zero, 1       # t1 = 1
loop:     slt  $t2, $a0, $t1       # while (t2 <= n) {
          bne  $t2, $zero, finish  #   t0 = t0 + t1
          add  $t0, $t0, $t1       #   t1 = t1 + 2
          addi $t1, $t1, 2         # }
          j    loop                #
finish:   add  $v0, $t0, $zero     # v0 = t0
```

The segment computes the sum of the odd numbers between 1 and n.

(b) (10 points) Provide the best equivalent sequence of MIPS instructions that could be used to implement the pseudo-instruction **bgt**, "branch on greater or equal". You may use register $at for temporary results.

```
slt     $at, $ry, $rx
bne     $at, target
```

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Problema 4 (10 points) Evaluación del curso

(a) Menciona los tres aspectos que mas te gustan de la clase INEL 4206 en orden decreciente de importancia.

a.

b.

c.

(b) Menciona los tres aspectos que menos te gustan de la clase INEL 4206 en orden decreciente de importancia.

a.

b.

c.

(c) En una escala de 0 (no mejoría) al 5 (mejoría excelente) como evaluarías la respuesta del professor a los comentarios que sugeriste durante el examen parcial 1. Explica brevemente.