

1 Powerful RISC-V Functions

1. Write a function `double` in RISC-V that, when given an integer x , returns $2x$.
2. Write a function `power` in RISC-V that takes in two numbers x and n , and returns x^n . You may assume that $n \geq 0$ and that multiplication will always result in a 32-bit number.

2 RISC-V with Arrays and Lists

Comment each snippet with what the snippet does. Assume that there is an array, `int arr[6] = {3, 1, 4, 1, 5, 9}`, which starts at memory address `0xBFFFFFF00`, and a linked list struct (as defined below), `struct ll* lst;`, whose first element is located at address `0xABCD0000`. `s0` then contains `arr`'s address, `0xBFFFFFF00`, and `s1` contains `lst`'s address, `0xABCD0000`. You may assume integers and pointers are 4 bytes and that structs are tightly packed.

```
struct ll {
    int val;
    struct ll* next;
}
```

1.


```
lw  t0, 0(s0)
lw  t1, 8(s0)
add t2, t0, t1
sw  t2, 4(s0)
```
2.


```
      add t0, x0, x0
loop: slti t1, t0, 6
      beq t1, x0, end
      slli t2, t0, 2
      add t3, s0, t2
      lw  t4, 0(t3)
      sub t4, x0, t4
      sw  t4, 0(t3)
      addi t0, t0, 1
      jal x0, loop
end:
```

```

3.      loop: beq  s1, x0, end
           lw   t0, 0(s1)
           addi t0, t0, 1
           sw   t0, 0(s1)
           lw   s1, 4(s1)
           jal  x0, loop
end:

```

3 Translating between C and RISC-V

Translate between the C and RISC-V code. You may want to use the RISC-V Green Card as a reference. We show you how the different variables map to registers – you don't have to worry about the stack or any memory-related issues.

C	RISC-V
<pre> // Nth_Fibonacci(n): // s0 -> n, s1 -> fib // t0 -> i, t1 -> j // Assume fib, i, j are already these values int fib = 1, i = 1, j = 1; if (n==0) return 0; else if (n==1) return 1; n -= 2; while (n != 0) { fib = i + j; j = i; i = fib; n--; } return fib; </pre>	

4 RISC-V Calling Conventions

1. How do we pass arguments into functions?
2. How are values returned by functions?
3. What is `sp` and how should it be used in the context of RISC-V functions?
4. Which values need to be saved before using `jal`?
5. Which values need to be restored before using `jr` to return from a function?

5 Writing RISC-V Functions

Write a function `sumSquare` in RISC-V that, when given an integer `n`, returns the summation below. If `n` is not positive, then the function returns 0.

$$n^2 + (n - 1)^2 + (n - 1)^2 + \dots + 1^2$$

For this problem, you are given a RISC-V function called `square` that takes in an integer and returns its square. Implement `sumSquare` using `square` as a subroutine.