We can use shift instructions along with either addition or subtraction instructions to multiply the content of a register by a constant. Shift-left (**`sll`**) instruction can be used to perform multiplication when the multiplier is a power of **`2`**. You can factor any binary number into powers of **`2`**. For example, to multiply `$s1` by **`36`**, factor **`36`** into **`(4 + 32)`** and use distributive property of multiplication **`$s2 = $s1*36 = $s1*(4 + 32) = $s1*4 + $s1*32`**. Thus, this can be achieved by the following instructions:

```
sll    $t0, $s1, 2        # $t0 = $s1 * 4
sll    $t1, $s1, 5        # $t1 = $s1 * 32
addu   $s2, $t0, $t1      # $s2 = $s1 * 36
```

As another example, let us multiply the content of **`$s1`** by **`31`**. We can do that using the following instructions noting that **`31=32-1`**:

```
sll    $s2, $s1, 5        # $s2 = $s1 * 32
subu   $s2, $s2, $s1      # $s2 = $s1 * 31
```

We can also use the shift right instructions (**`srl`** and **`sra`**) to divide a number by a power of **`2`** constant. Shifting register **`$s0`** right by **`n`** bits divides its content by 2^n. For example, to divide an unsigned number in register **`$s0`** by **`8`**, we use the instruction **`srl $s0, 3`**. However, to divide a signed number in register **`$s0`** by **`8`**, we use the instruction **`sra $s0, 3`**.

3.5 Exercise

1. Write a program to ask the user to enter two integers **`A`** and **`B`** and then display the result of computing the expression: **`A + 2B - 5`**.
2. Assume that **`$s1 = 0x12345678`** and **`$s2 = 0xffff9a00`**. Determine the content of registers **`$s3`** to **`$s6`** after executing the following instructions:

```
and $s3,$s1,$s2          # $s3 =
or  $s4,$s1,$s2          # $s4 =
xor $s5,$s1,$s2          # $s5 =
nor $s6,$s1,$s2          # $s6 =
```

Write a program to execute these instructions and verify the content of registers **`$s3`** to **`$s6`**.

3. Assume that **`$s1 = 0x87654321`**. Determine the content of registers **`$s2`** to **`$s4`** after executing the following instructions:

   ```
   sll $s2,$s1, 16                # $s2 =
   srl $s3,$s1, 8                 # $s3 =
   sra $s4,$s1, 12                # $s4 =
   ```

   Write a program to execute these instructions and verify the content of registers **`$s2`** to **`$s4`**.

4. Write a program that asks the user to enter an alphabetic character (either lower or upper case) and change the case of the character from lower to upper and from upper to lower and display it.

5. Write a program that asks the user to enter and integer number and read it. Then ask him to enter a bit position (between 0 and 31) and display the value of that bit.

6. Write a program that asks the user to enter a signed number and read it. Then display the content of multiplying this number by **`24.5`**.

7. Write a program that asks the user to enter an unsigned number and read it. Then swap the bits at odd positions with those at even positions and display the resulting number. For example, if the user enters the number **`9`**, which has binary representation of **`1001`**, then bit **`0`** is swapped with bit **`1`**, and bit **`2`** is swapped with bit **`3`**, resulting in the binary number **`0110`**. Thus, the program should display **`6`**.