LAB 06: Integer Multiplication and Division

Saleh AlSaleh
salehs@kfupm.edu.sa

King Fahd University of Petroleum and Minerals
College of Computing and Mathematics
Computer Engineering Department

COE301: Computer Architecture
Term 222

Agenda

Integer Multiplication

- The result of multiplying n bit number by another n bit number is

Integer Multiplication

- The result of multiplying n bit number by another n bit number is n + n bits.
- Multiplication is done through addition and shifting operations.

Integer Multiplication

- The result of multiplying n bit number by another n bit number is n + n bits.
- Multiplication is done through addition and shifting operations.
- MIPS has two special register for the result of multiplication: HI, LO.

Integer Multiplication

- The result of multiplying n bit number by another n bit number is n + n bits.
- Multiplication is done through addition and shifting operations.
- MIPS has two special register for the result of multiplication: HI, LO.
- MIPS Multiplication Instructions:
  - mult $t0, $t1 # for signed multiplication
  - multu $t0, $t1 # for unsigned multiplication
  - mul $t2, $t0, $t1 # $t2 contains LO register value

Integer Division

- Binary division produces a quotient and a remainder.

Integer Division

- Binary division produces a quotient and a remainder.
- Division is done through subtraction and shifting operations.

Integer Division

- Binary division produces a quotient and a remainder.
- Division is done through subtraction and shifting operations.
- MIPS has two special register for the result of division: HI, LO.

Integer Division

- Binary division produces a quotient and a remainder.
- Division is done through subtraction and shifting operations.
- MIPS has two special register for the result of division: HI, LO.
  - HI register contains the remainder
  - LO register contains the quotient

Integer Division

- Binary division produces a quotient and a remainder.
- Division is done through subtraction and shifting operations.
- MIPS has two special register for the result of division: HI, LO.
  - HI register contains the remainder
  - LO register contains the quotient
- MIPS Division Instructions:
  - `div  $t0, $t1  # for signed division`
  - `divu $t0, $t1  # for unsigned division`

Special Instructions

MIPS has special instructions that allow copying the values from the special registers (HI, LO):

- mfhi $t0 # copy the contents of the HI register to $t0
- mflo $t0 # copy the contents of the LO register to $t0

Live Examples

Task #1

Write a MIPS assembly program that asks the user about the total amount of money he wishes to withdraw from the ATM. Then, calculate the minimum number of bank notes (500, 100, 50, 10, 5, 1) required for his withdrawal. Finally, print out the count of each banknote required. If a bank note is not required (i.e., its count is zero), do not print it out.

Sample Run

```
Enter withdrawal amount: 3243
500 Bank note: 6
100 Bank note: 2
10 Bank note: 4
1 Bank note: 3
```

Task #2

Write a MIPS assembly program that asks the user for an integer **n** that he wishes to compute the factorial of. Calculate **n!** based on the following code. Finally, print out the result.

Answer the following question in your report:

Q. What is the maximum value of **n** such that **n!** can fit in a 32-bit register?

```
int fact(int n){
  int result = 1;
  for (int i=1; i<=n; i++){
    result = result * i;
  }
  return result;
}
```

Iterative factorial function

Sample Run

```
Enter n: 7
n! = 5040
```