FIT1008 Introduction to Computer Science
Practical Session 5
Semester 2, 2014

Objectives of this practical session

To be able to write MIPS programs involving lists, local variables, and functions.

Task 1 *[3 marks]*

(i) Write a Python program `reverse.py`, which does the following:

- Reads in the size of the `the_list`.

- Reads in all the items of `the_list`.

- Prints `the_list` out in reverse order.

(ii) Write a MIPS program which implements `reverse.py` faithfully.
Note: Local variables must be stored on the runtime stack.

Task 2 *[3 marks]*

Suppose $e = 12$, then the binary representation of `e` would be `1100` and the list of integers containing the binary representation in reverse order would be `[0, 0, 1, 1]`.

(i) Write a Python program `binary.py`, which does the following:

- Reads in a positive integer, `n`.

- Constructs a list `rev_binary` of integers, initialized to zero, of size `n` (where `n` is the integer you read in).

- Stores in the list the binary representation of `n` in reverse order, starting at position `0`.

- Set the size of the list to be the length of the binary representation of `n`.

- Prints `rev_binary` out in reverse order. *So, this means the binary representation of* `n` *should be printed.*

(ii) Write a MIPS program which implements `binary.py` faithfully.
Note: Local variables must be stored on the runtime stack.

Task 3 *[4 marks]*

Suppose `rev_binary` is a list of integers that contains the binary representation of `e` in reverse order. Then the following algorithm uses the list `rev_binary` to compute $result = b^e$.

```
1   result <- 1
2   idx <- len(rev_binary)-1
3   while idx >= 0:
4       result = result*result
5
6       if rev_binary[idx]:
7           result = result*b
8
9       idx <- idx - 1
```

(i) Modify the function `power(b, e)`, given in lectures so that it implements the above algorithm.

(ii) Write a Python program `new_power.py` to test the modified function `power(b, e)`.

(iii) Write a MIPS program to implement `new_power.py` faithfully. *Note this means that you will need implement the modified function power(b,e) and use the runtime stack for any local variables.*

Advanced Question *[Bonus 2 marks]*

Integers are represented as binary numbers in Python. So, rather than constructing a list as you did in Task 3, in this task you will access the bits in the binary representation of the numbers.

(i) Using the bitwise operators in Python to access the bits in the binary representation of `e`, implement the above algorithm given in Task 3.

(ii) Write a MIPS program that faithfully implements the function your wrote in part (i).

Hall of Fame

Write a MIPS program that reads in a list of integers, sort the list into increasing order, and then prints the sorted list.