

### 159.202 Assignment 3-updated 26 Aug

<b>Deadline:</b>	<b>Anytime before Saturday 12 Sept 2015</b> , time: mid night
<b>Evaluation:</b>	10 marks – which is 3% of your final grade
<b>Late Submission:</b>	5% per hour (or fraction of hour) it is late
<b>Team:</b>	The assignment can be done individually or in pairs.
<b>Purpose:</b>	Practice with Haskell functions, guards and if statements

This assignment consists of four exercises and is meant to help you practice with writing Haskell functions. You are expected to submit a single file named *a3.hs* (use Notepad or WordPad to create it), consisting of

- All authors name(s) and ID(s) (as comments at the top of the file)
- Definitions, including types and good comments**, for all functions require in the following exercises.

#### Exercise 1 (2 marks). Answers to this question should be written as comments.

Find out, using expressions entered at the GHCi or WinGHCi' prompt:

- the last eight digits of the number given by 3 to the power 234
- the number of digits of 600! (600 factorial)
- the value of  $(5 \% 8 - \text{div } 13 \ 4, \text{"FUN"} ++ \text{"THOMAS"}, 1 + 5/7 == 12/7)$
- the values<sup>1</sup> of `chr 100` and `ord 'Q'`

#### Exercise 2 (4 marks).

Define a function to compute the sum:  $\sum_{i=1}^n i^3$  using

- The formula:  $\sum_{i=1}^n i^3 = [n(n+1)/2]^2$ , call the function **sum2a**
- Guards and recursion, call the function **sum2b**
- Patterns and recursion, call the function **sum2c**
- Which of the solutions above is the most run-time efficient?-Write your answer as a comment and explain in one sentence how you reached your conclusion.

#### Exercise 3 (2 marks).

a) Write a function `f :: Char -> Int` that converts a hexadecimal digit to its decimal value. Upper and lower case letters have the same value. For example,

```
f '0' == 0 f 'a' == 10 f 'A' == 10
f '1' == 1 f 'b' == 11 f 'B' == 11
f '9' == 9 f 'f' == 15 f 'F' == 15
```

For any character that is not a hexadecimal digit, `f` should display an error message.

b) Write a Haskell function, `netEarning`, to compute the income of a person in New Zealand in 2014-2015 after deducting the income tax. You will consider only the initial earning value and the corresponding IRD tax to be deducted as per table

<sup>1</sup> First type at the prompt `:m Data.Char` (to access the Char module); the prompt will change from `Prelude>` to `Prelude Data.Char>`

presented in Figure 1; you should ignore other deductions like ACC levy, etc... For example netEarning 65238.00 is 52646.6

Income tax rates for tax year 2014-2015	
Taxable income	Income tax rates for every \$1 of taxable income (excl ACC earners' levy)
up to \$14,000	10.5 cents
from \$14,001 to \$48,000	17.5 cents
from \$48,001 to \$70,000	30 cents
\$70,001 and over	33 cents
No-notification - see "Note 2 below"	45 cents

Figure 1. Income tax rates (from <http://www.ird.govt.nz/how-to/taxrates-codes/itaxsalaryandwage-incometaxrates.html>)

#### Exercise 4 (2 marks).

a) Write a recursive function, **gcdD** to compute the gcd of two positive integers **using patterns or guards** and Dijkstra's algorithm.

Here is a C-program using Dijkstra algorithm:

```
int gcd(int x, int y) {
    if(x == y) {return x;}
    else if (x > y){return gcd(x-y, y);}
    else {return gcd(x, y-x);}
}
```

b) Write a recursive function **pow n k**, to calculate the k-th power of n, using patterns or guards and the following algorithm:

If k is even,  $n^k = (n * n)^{k/2}$   
 If k is odd,  $n^k = n * (n^{k-1})$

**If you have any questions about this assignment, please ask the lecturer before its due time!**

Submit your solution electronically using 159.202 Stream.

#### Important:

1. You can define and use other functions in order to solve a problem that asks you to define a function to perform a specific task.
2. Use only the material covered in lectures or in Notes (Stream); solutions using material not covered in lectures or in the above mentioned Notes will get 0 marks.
3. The assignment can be done individually or in teams of at most 2 students- **send one solution file per team**. All assignments authored by 3 or more students will get 0 marks.

4. Run your final version of *a3.hs* file on Albany computer labs and make sure it has no errors. **Please note that if we cannot run your a3.hs script you will get 0 marks.**
5. As sample solutions will be presented in lectures no extension will be possible.