

Assignment 1 – Exploring Programming Language Concepts

- 1. Provide a common definition of functional programming. (2 marks)
- 2. Haskell is considered by many to be a pure functional programming language. Explain the following piece of Haskell code and discuss its relationship with the definition in Q. 1.

- 3. "Immutability is preferable over mutability". Explain why this is normally considered correct.
- 4. Consider the following (pseudo-) machine code:

```
mov R1, $y
mov R2, $z
add R3, R1, R2
mov $x, R3
```

- a. Write the equivalent code in C.
- b. Write the equivalent code in Haskell.
- c. Since this code is mutable, what does it imply for ALL languages?
- 5. Consider the following code in F#:

```
let sqrtx x = x * x
let imperativefun list =
    let mutable total = 0
    for i in list do
        let x = sqrtx i
        total <- total + x
        total
let functionalfun list =
    list
    |> Seq.map sqrtx
    |> Seq.sum
```

a. What does each function do in the previous code?



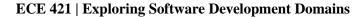
- b. Consider a subset of ISO 9126
- Reliability
- Efficiency
- Maintainability
- Portability

Argue about the impact, if any, of the two different implementations (imperativefun and functionalfun) on these characteristics.

- c. Utilize the sqrtx function in Q5 to write a function which raises its argument to the 4th power.
- 6. *Pure functions:* A pure function is a function that, given the same input, will always return the same output and does not have any observable side effect. Functional programming likes pure functions; which of the following are pure functions:
 - changing the file system
 - inserting a record into a database
 - making an http call
 - mutations
 - printing to the screen / logging
 - obtaining user input
 - querying the DOM
 - accessing system state
 - Math.random()
- 7. Based on the definition of *functionalfun* presented in Q5, write a function in Rust that takes a number x and returns $\sum_{i=1}^{x} i^2 + 2$.
- 8. Write a Rust function that computes the volume of a sphere, given its radius.
- 9. What does the following Scheme function do?

- 10. Total functions state that, for every valid input value, there is a valid, terminating output value. In contrast to a total function, a partial function may result in an infinite loop, program crash, or runtime exception for some input.
 - a. Explain what happens when you present the following Haskell code to its compiler

```
data Colour = Red | Yellow | Blue
sayColour colour =
  case colour of
   Red -> "red"
```





```
Yellow -> "yellow"
main = putStrLn (sayColour Blue)
```

b. Explain what happens when you present the following Rust code to its compiler

```
enum Colour {
    Red,
    Yellow,
    Blue,
}

fn say_colour(colour: &Colour) -> &'static str {
    match colour {
        Colour::Red => "red",
        Colour::Yellow => "yellow",
    }
}

fn main() {
    println!("{}", say_colour(&Colour::Blue));
}
```