COMP3400
Assignment 3 Written

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In addition to this written work there are *three* coding questions. The written work is worth 25 points and the coding questions are worth 60 points totalling 85 points.

Either

The Functor and Applicative for the `Either` data-type is as follows:

```
instance Functor (Either a) where
    fmap f (Right x) = Right (f x)
    fmap f (Left x)  = Left x

instance Applicative (Either e) where
    pure             =  Right
    Left  e  <*>  _  =  Left e
    Right f  <*>  r  =  fmap f r
```

Question 1. [4 MARKS]

Show `Either` satisfies the *second* functor law:

```
fmap (g . h) = fmap g . fmap h
```

Question 2. [6 MARKS]

Show `Either` satisfies the *third* applicative law:

```
x <*> pure y = pure (\g -> g y) <*> x
```

ZipWith

Recall the alternate definition for a list applicative given in tutorial 8.

```
1 instance Functor [] where
2     fmap _ []     = []
3     fmap g (x:xs) = g x : (fmap g xs)
4
5 instance Applicative [] where
6     pure f = repeat f
7     [] <*> _ = []
8     _ <*> [] = []
9     (f:fs) <*> (x:xs) = (f x) : (fs <*> xs)
```

When writing your proofs *use the line numbers given above* when justifying your steps.

Question 3. [7 MARKS]

Show your Applicative satisfies the *second* applicative law:

```
pure (g x) = pure g <*> pure x
```

Question 4. [8 MARKS]

Show your Applicative satisfies the *forth* applicative law:

```
x <*> (y <*> z) = (pure (.) <*> x <*> y) <*> z
```