

BU CAS CS 320 (SUMMER I, 2009)
CONCEPTS OF PROGRAMMING LANGUAGES

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Assignment 5

Due: Tuesday, 16 June 2009

Total: 130 points

Exercise 1 (10 points) *The following is a well-known series:*

$$\ln 2 = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \dots$$

Please implement a stream consisting of all the partial sums of this series. Then compute an accurate approximation to $\ln 2$ by using Euler's transform.

Exercise 2 (10 points) *For each $i \geq 1$, we use P_i for the i^{th} prime number. For instance, P_1 is 2, P_2 is 3 and P_3 is 5. Please implement a stream consisting of all the sums of the form $\sum_{i=1}^n \frac{1}{P_i}$ for $n \geq 1$.*

Exercise 3 (30 points) *Implement a procedure that takes two matrices and returns their product. Note that two matrices can be multiplied only if they are of dimensions $p \times q$ and $q \times r$ for some natural numbers p, q, r .*

```
typedef matrix = list0 (list0 double)
fun mul_matrix_matrix (A: matrix, B: matrix): matrix
```

Exercise 4 (30 points) *A natural number n is a Ramanujan number if there exist two distinct pairs of natural numbers (i_1, j_1) and (i_2, j_2) such that $n = i_1^3 + j_1^3 = i_2^3 + j_2^3$. For instance, 1729 is a Ramanujan number as $1729 = 1^3 + 12^3 = 9^3 + 10^3$. Please construct a stream of all Ramanujan numbers and then use it to find the first twenty Ramanujan numbers.*

Exercise 5 (20 points) *Please find the description on-line.*

Exercise 6 (30 points) *Please find the description on-line.*