

## Homework # 3

### due February 15, 3:30 PM

## 1 Vectors

Mathematical vectors in  $n$ -dimensional Euclidean space can be represented by lists of real numbers. For this homework, you will define several operations on vectors:

- (a) Write a function `scale` that takes a real and a list of reals and returns a list which multiples the number to every element in the list. For example:

```
- scale (3.0, [1.0, 2.0, 3.0]) ;  
val it = [3.0, 6.0, 9.0] : real list
```

- (b) Write a function `dot` that takes two lists of real numbers of the same length and returns the “dot product” (the sum of the element-wise multiplication, also known as the “inner product”). For example:

```
- dot ([1.0, 2.0], [~3.0, 4.0, 6.0]) ;  
val it = 5.0 : real
```

As seen here, your program should assume a shorter vector is extended with zeros as necessary.

- (c) Write a function `magn` that takes a list of real numbers and returns the square root of the sum of the squares of the elements. Hint, you can use `dot` to do most of the work.

```
- magn [1.0, 1.0, 1.0, 2.0, 3.0] ;  
val it = 4.0 : real
```

(You will need to “open Math” to make the `sqrt` function available.)

- (d) Define an addition function for vectors:

```
- add ([1.0, 2.0], [~5.0, 0.0, 1.5]) ;  
val it = [~4.0, 2.0, 1.5] : real list
```

Put all your functions in a single file named `vector.sml` in your AFS volume under directory `homework3`.

## 2 Types

Do Exercises 1 and 2 of Chapter 6 (pages 101–102). Write your answers on paper.

## 3 Submitting Your Work

Turn in the first part in AFS, and the second part on paper at the beginning of lecture.