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M676 Geometric Data Analysis
Problem Set One

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Due Thursday, February 9, 2006

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1 Theory

1. Text problem 1.5 (See page 346 for definitions of injective, surjective and bijective).

2. Text problem 2.4

3. Text problem 2.9

4. Text problem 2.12

5. Text problem 2.15

6. Text problem 2.16

7. Text problem 2.19

8. Reconsider problem 2.19. Find vectors such that $x = UU^T x$ and $x \neq UU^T x$ where the matrix U consists of the basis vectors from 2.19. Draw a picture to show the set of vectors for which UU^T acts as the identity.

2 Computing

Load the data set on the class web-site into matlab by typing

```
load datamatrix
```

To determine the size of this matrix enter

```
size(datamatrix)
```

Each column is a 64x64 pattern although it is stored as a vector of length 64^2. To unvec and look at the first pattern enter

```
P1 = reshape(Y(:,1),64,64);
imagesc(P1)
colormap(gray)
```

The first 99 columns of Y belong to class 1 and the second 99 columns belong to class 2.

1. Using the Gram-Schmidt orthogonalization procedure compute an orthonormal basis for class one using the first 98 patterns. Show the projection of the 99th pattern (also in class one) onto the first 98 members of class 1. Find the patterns in class 2 that are closest and most distant from class 1.

2. Text problem 2.32