

# Math 220 Assignment

October 31, 2001

## Due Friday, November 2

1. Let  $g$  be the linear function from  $\mathbf{R}^4$  to  $\mathbf{R}^5$  that is defined by  $g(x) = Mx$  where  $M$  is the  $5 \times 4$  matrix

$$\begin{pmatrix} -1 & 1 & 5 & 1 \\ 2 & -1 & 2 & 1 \\ 1 & 0 & -2 & 2 \\ -2 & 2 & 1 & 2 \\ -4 & 3 & 8 & 1 \end{pmatrix} .$$

Find the following:

- (a) A basis for the kernel of  $g$ .
  - (b) A non-redundant list of linear equations that characterize the image of  $g$  as a subset of  $\mathbf{R}^5$ .
  - (c) A basis for the image of  $g$ .
2. Let  $\mathcal{P}_2$  denote the vector space of polynomials of degree 2 or less. If  $f$  is an element of  $\mathcal{P}_2$ , let  $T_f$  be the polynomial given by the formula

$$T_f(x) = \frac{d}{dx}xf(x) .$$

- (a) Show that the function  $T$  that is defined by

$$T(f) = T_f$$

is an abstractly linear map from  $\mathcal{P}_2$  to  $\mathcal{P}_2$ .

- (b) What is the dimension of  $\mathcal{P}_2$ ?
- (c) Find a basis of the kernel of  $T$ .
- (d) Find a basis of the image of  $T$ .

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