

hw1

Coding the Matrix, Summer 2013

Please fill out the stencil file named “hw1.py”. While we encourage you to complete the Ungraded Problems, they do not require any entry into your stencil file.

Vector Addition Practice

Problem 1: For vectors $v = [-1, 3]$ and $u = [0, 4]$, find the vectors $v + u$, $v - u$, and $3v - 2u$.

Problem 2: Given the vectors $v = [2, -1, 5]$ and $u = [-1, 1, 1]$, find the vectors $v + u$, $v - u$, $2v - u$, and $v + 2u$.

Problem 3: For the vectors $v = 011$ and $u = 111$ over $GF(2)$, find $v + u$ and $v + u + u$.

Expressing one $GF(2)$ vector as a sum of others

Problem 4: Here are six 7-vectors over $GF(2)$:

$\mathbf{a} =$	1100000	$\mathbf{d} =$	0001100
$\mathbf{b} =$	0110000	$\mathbf{e} =$	0000110
$\mathbf{c} =$	0011000	$\mathbf{f} =$	0000011

For each of the following vectors u , find a subset of the above vectors whose sum is u , or report that no such subset exists.

1. $u = 0010010$
2. $u = 0100010$

Problem 5: Here are six 7-vectors over $GF(2)$:

$\mathbf{a} =$	1110000	$\mathbf{d} =$	0001110
$\mathbf{b} =$	0111000	$\mathbf{e} =$	0000111
$\mathbf{c} =$	0011100	$\mathbf{f} =$	0000011

For each of the following vectors u , find a subset of the above vectors whose sum is u , or report that no such subset exists.

1. $u = 0010010$
2. $u = 0100010$

Practice with Dot-Product

Problem 6: For each of the following pairs of vectors \mathbf{u} and \mathbf{v} over \mathbb{R} , evaluate the expression $\mathbf{u} \cdot \mathbf{v}$:

(a) $\mathbf{u} = [1, 0], \mathbf{v} = [5, 4321]$

(b) $\mathbf{u} = [0, 1], \mathbf{v} = [12345, 6]$

(c) $\mathbf{u} = [-1, 3], \mathbf{v} = [5, 7]$

(d) $\mathbf{u} = [-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}], \mathbf{v} = [\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}]$

Solving Linear Equations over GF(2)

Problem 7: Find a vector $\mathbf{x} = x_1x_2x_3x_4$ over $GF(2)$ satisfying the following linear equations:

$$1100 \cdot \mathbf{x} = 1$$

$$1010 \cdot \mathbf{x} = 1$$

$$1111 \cdot \mathbf{x} = 1$$

Ungraded: Show that $\mathbf{x} + 1111$ also satisfies the equations.

Formulating Equations using Dot-Product

Problem 8: Consider the equations

$$2x_0 + 3x_1 - 4x_2 + x_3 = 10$$

$$x_0 - 5x_1 + 2x_2 + 0x_3 = 35$$

$$4x_0 + x_1 - x_2 - x_3 = 8$$

Your job is not to solve these equations but to formulate them using dot-product. In particular, come up with three vectors $\mathbf{v}_1, \mathbf{v}_2,$ and \mathbf{v}_3 represented as lists so that the above equations are equivalent to

$$\mathbf{v}_1 * \mathbf{x} = 10$$

$$\mathbf{v}_2 * \mathbf{x} = 35$$

$$\mathbf{v}_3 * \mathbf{x} = 8$$

where \mathbf{x} is a 4-vector.

Plotting Lines and Line Segments

Ungraded Problem: Use the `plot` module to plot

(a) a substantial portion of the line through $[-1.5, 2]$ and $[3, 0]$, and

(b) the line segment between $[2, 1]$ and $[-2, 2]$.

For each, provide the Python statements you used and the plot obtained.