

## Supplemental material: Visual Algebra (Math 4120), HW 14

#1: The additive Cayley table of the finite field  $\mathbb{F}_9 \cong \mathbb{F}_3[x]/(x^2 + x + 2)$ .

A Cartesian coordinate system with a horizontal x-axis and a vertical y-axis. The x-axis has tick marks labeled 0, 1, 2,  $x$ ,  $x+1$ ,  $x+2$ ,  $2x$ ,  $2x+1$ , and  $2x+2$ . The y-axis has tick marks labeled 0, 1, 2,  $x$ ,  $x+1$ ,  $x+2$ ,  $2x$ ,  $2x+1$ , and  $2x+2$ . A horizontal line passes through the point  $(2x+2, 2x+2)$ . A vertical line passes through the point  $(2x+2, 2x+2)$ .

#1: The multiplicative Cayley table of the finite field  $\mathbb{F}_9 \cong \mathbb{F}_3[x]/(x^2 + x + 2)$ .

$\times$	1	2	$x$	$x+1$	$x+2$	$2x$	$2x+1$	$2x+2$
1	1	2	$x$	$x+1$	$x+2$	$2x$	$2x+1$	$2x+2$
2	2	4	$x^2$	$x^2+x$	$x^2+2x$	$2x^2$	$2x^2+x$	$2x^2+2x$
$x$	$x$	$x^2$	$x^3$	$x^3+x^2$	$x^3+2x^2$	$2x^3$	$2x^3+x^2$	$2x^3+2x^2$
$x+1$	$x+1$	$x^2+x$	$x^3+x^2+x$	$x^3+2x^2+x$	$x^3+2x^2+2x$	$2x^3+x^2+x$	$2x^3+2x^2+x$	$2x^3+2x^2+2x$
$x+2$	$x+2$	$x^2+2x$	$x^3+2x^2+2x$	$x^3+2x^2+4x$	$x^3+2x^2+2x+2$	$2x^3+2x^2+2x$	$2x^3+2x^2+2x+2$	$2x^3+2x^2+4x+2$
$2x$	$2x$	$4x$	$x^3+4x^2$	$x^3+2x^2+4x$	$x^3+2x^2+2x+4$	$2x^3+4x^2$	$2x^3+2x^2+4x+2$	$2x^3+2x^2+2x+4$
$2x+1$	$2x+1$	$4x+1$	$x^3+4x^2+x$	$x^3+2x^2+4x+1$	$x^3+2x^2+2x+1$	$2x^3+4x^2+x$	$2x^3+2x^2+4x+1$	$2x^3+2x^2+2x+1$
$2x+2$	$2x+2$	$4x+2$	$x^3+4x^2+2x$	$x^3+2x^2+4x+2$	$x^3+2x^2+2x+2$	$2x^3+4x^2+2x$	$2x^3+2x^2+4x+2$	$2x^3+2x^2+2x+2$

#1: The additive Cayley table of the finite field  $\mathbb{F}_9 \cong \mathbb{F}_3[x]/(x^2 + x + 2)$ .

A Cartesian coordinate system with a horizontal x-axis and a vertical y-axis. The x-axis is labeled with values 0, 1, -1,  $x$ ,  $x+1$ ,  $x-1$ ,  $-x$ ,  $-x+1$ , and  $-x-1$ . The y-axis is labeled with values 0, 1, -1,  $x$ ,  $x+1$ ,  $x-1$ ,  $-x$ ,  $-x+1$ , and  $-x-1$ . The origin is marked with a plus sign (+). The graph of the function  $y = |x|$  is plotted as a V-shape opening upwards, passing through the points (0,0), (1,1), (-1,1), (x,x), (x+1,x+1), (x-1,x-1), (-x,-x), (-x+1,-x+1), and (-x-1,-x-1).

#1: The multiplicative Cayley table of the finite field  $\mathbb{F}_9 \cong \mathbb{F}_3[x]/(x^2 + x + 2)$ .

$\times$	1	-1	$x$	$x+1$	$x-1$	$-x$	$-x+1$	$-x-1$
1	1	-1	$x$	$x+1$	$x-1$	$-x$	$-x+1$	$-x-1$
-1	-1	1	$-x$	$-x-1$	$x$	$x+1$	$x-1$	$-x$
$x$	$x$	$-x$	1	-1	$x$	$x+1$	$x-1$	$-x$
$x+1$	$x+1$	$-x+1$	-1	1	$x$	$x-1$	$-x$	$-x+1$
$x-1$	$x-1$	$-x-1$	$x$	$-x$	1	-1	$x$	$x+1$
$-x$	$-x$	$x$	$x+1$	$x-1$	-1	1	$x+1$	$x-1$
$-x+1$	$-x+1$	$x+1$	$-x$	$x$	-1	1	$-x$	$x$
$-x-1$	$-x-1$	$x-1$	$x$	$-x$	$x+1$	$-x-1$	1	-1