

Contents

1	Introduction to Linear Algebra	1
1.1	Systems of Linear Equations - Row Reduction	1
1.2	Matrices and Vectors	9
1.3	Inverses and Determinants	20
1.4	Vector Spaces: \mathbb{R}^2 and \mathbb{R}^3	28
1.5	Linear Independence, Span, Basis, Dimension	33
1.6	Change of Basis	40
1.7	Matrix Transformations	46
	Chapter 1 Project: Real-Time Collision Detection	56
2	Vectors and the Geometry of Space	59
2.1	Vectors in the Plane	59
2.2	Vectors in Space	67
2.3	The Dot Product	75
2.4	The Cross Product	83
2.5	Lines in 2D and 3D	88
2.6	Planes	97
2.7	Collision Detection and Response: Lines and Planes	107
	Chapter 2 Project: The Separating Axis Theorem	111
3	Vector-Valued Functions	117
3.1	Vector-Valued Functions and Curves	117
3.2	Differentiation of Vector-Valued Functions	123
3.3	Projectiles	129
3.4	Euler's Method	141
3.5	Bouncing Around in 2D	146
	Chapter 3 Project: Projectile Game in 2D	153
4	Multi-Variable Functions and Surfaces	155
4.1	Surfaces: $z = f(x, y)$	155
4.2	Partial Derivatives, Gradients, and Normal Vectors	160
4.3	Bouncing Around in 3D	166
	Chapter 4 Project: Projectile Game in 3D	172

A	Trigonometry Review	173
A.1	Triangle Trigonometry	174
A.2	Unit-Circle Trigonometry	175
A.3	Trigonometry as a Collection of Periodic Functions	176
A.4	Translations and Transformations of Trig Functions	177
A.5	Circles and Ellipses	178
A.6	The Tangent Function	179
A.7	Trigonometry Review - Problem Set	180
B	Review of Differentiation Rules	183
C	A Quick Guide to MATLAB[®]	185
C.1	Running MATLAB [®]	186
C.2	Creating your own functions	192
C.3	Graphing with MATLAB [®]	196
C.4	Input and Output with the Command Window	202
C.5	Input and Output with a Figure	204
C.6	Assignment	206
	Detailed Solutions to Worksheets	209
	Detailed Solutions to Selected Problems	215
	Index	263