

Contents

Preface	xv
1 Minigame Design Exercise	1
1.1 Design	2
1.2 Internal Playtest	3
1.3 Revision	4
1.4 Kleenex™ Playtest	4
1.5 Discussion	5
1.6 20-Minute Variation	6
1.7 Exploration	7
2 The Process of Development and Theory of Design	9
2.1 What Is a Game?	10
2.2 Levels of Abstraction	14
2.3 Emergence and Progression	16
2.4 Development Roles	18
2.5 Design as Theory	23
2.6 Industry Structure	24
2.7 Exercises	28
2.8 Resources	30
3 Managing Innovation	33
3.1 How Hard Can It Be?	34
3.2 Attitude	37
3.3 Organization Chart	42
3.4 Consistency	43
3.5 Inspiration	44

3.6	Brainstorming	45
3.7	Scheduling	46
3.8	Managing Risk	54
3.9	Exercises	56
3.10	Resources	57
4	Critique and Proposal	59
4.1	Critique	61
4.2	Generating Ideas	63
4.3	Format	64
4.4	Examples	78
4.5	Exercises	87
4.6	Resources	89
5	The Design Document	91
5.1	Title Page	93
5.2	Executive Summary	93
5.3	Overview	93
5.4	Related Games	94
5.5	Player Composites	94
5.6	World	96
5.7	Characters	96
5.8	Plot Graphs	97
5.9	Art Direction	99
5.10	User Interface Storyboards	100
5.11	Tags and Dialogue	101
5.12	Technology Plan	101
5.13	Software Architecture	102
5.14	Controls	104
5.15	Level Design	104
5.16	Mechanics Analysis	105
5.17	Schedule and Related Elements	106
5.18	Budget	108
5.19	Change Log	108
5.20	Exercises	109
5.21	Resources	110
6	Game Technology	111
6.1	Document Tools	112
6.2	Asset Management Tools	114
6.3	Art Tools	116
6.4	Runtime Technology for Video Games	119
6.5	Licensing	122

6.6	Exercises	136
7	Strategic Thought	139
7.1	State	141
7.2	Graphs	143
7.3	State Machine	146
7.4	Decision Trees	148
7.5	Algorithms	149
7.6	Search	154
7.7	Complexity	155
7.8	Heuristics	156
7.9	Game Theory	157
7.10	Exercises	158
8	Choice and Probability	161
8.1	Statistics and Probability	162
8.2	Random Variables	163
8.3	Generating Random Numbers	165
8.4	Cards and Dice	167
8.5	Outcome Tree	169
8.6	Combining Probabilities	172
8.7	Expected Value	173
8.8	Variance	175
8.9	Compound Expressions	176
8.10	Case Study: <i>Settlers of Catan</i>	177
8.11	Exercises	181
8.12	Resources	183
9	Balance	185
9.1	Our Methodology	186
9.2	Before Balance	187
9.3	Fairness	190
9.4	Stability	194
9.5	Engagement	202
9.6	The Role of Randomness	206
9.7	What Players Value	208
9.8	Optimizing for Real People	209
9.9	Exercises	211
9.10	Resources	213

10 Mechanics	215
10.1 Techniques for the First Move	216
10.2 Character Building	218
10.3 Action	220
10.4 Lock-and-Key	226
10.5 Geometry	227
10.6 Superunit	229
10.7 Rock-Paper-Scissors	229
10.8 Combat Simulation	230
10.9 Effect Distance	238
10.10 Rush Prevention	239
10.11 Dialogue Trees	239
10.12 Economy	240
10.13 Ensuring Entropy	244
10.14 Reward Cycles and Minigames	246
10.15 Resources	248
11 Creating a World	249
11.1 Setting	249
11.2 Motivations for Setting	254
11.3 Characters and Plot	263
11.4 Geography	267
11.5 Exercises	268
11.6 Resources	268
12 Art Direction	271
12.1 Visual Language	272
12.2 Reference Art	278
12.3 Concept Art	280
12.4 3D Art Roles	281
13 3D Modeling	287
13.1 Triangle Mesh	287
13.2 Particle System	292
13.3 Texture Map	292
13.4 Materials	299
13.5 Exercises	302
13.6 Resources	303
14 Real-Time Rendering	305
14.1 Graphics Processor (GPU)	306
14.2 Lighting	318
14.3 Exercises	323
14.4 Resources	324

15 Physical Simulation	325
15.1 Newtonian Mechanics	328
15.2 Newton's Laws of Motion for a Particle	330
15.3 Solving Equations of Motion	333
15.4 Verlet Integration	336
15.5 Rigid Body Dynamics	337
15.6 Collision Detection, Response, and Friction	341
15.7 Constraints and Articulated Bodies	345
15.8 Articulated Kinematics and Motion Control	348
15.9 Particle Systems and Natural Phenomena	351
15.10 Resources	353
15.11 Exercises	355
16 Network Programming	357
16.1 An Extended Analogy	358
16.2 Protocols	362
16.3 Ethernet	363
16.4 Routing	367
16.5 Transmission Protocols	369
16.6 Network Address Translation (NAT)	372
16.7 Lag	375
16.8 Synchronization and Topology	379
16.9 Matchmaking	389
16.10 Security	390
16.11 APIs	393
16.12 Exercises	394
16.13 Resources	396
17 User Input	397
17.1 Touch-Based Input	398
17.2 Optical Character Recognition	402
17.3 Mice	404
17.4 Inertial-Based Input and Global Positioning	404
17.5 Light and Positional Guns	411
17.6 Sound-Based Input	411
17.7 Camera-Based Input	415
17.8 Exercises	420
18 Artificial Intelligence	423
18.1 What Is AI?	423
18.2 How Smart Does My AI <i>Really</i> Need to Be?	426
18.3 Embodied Autonomous Agents	427
18.4 Decision Making: Reaction and Deliberation	434

18.5	Learning	443
18.6	Exercises	450
18.7	Resources	451
19	Social Issues	453
19.1	Ratings and Content	453
19.2	Industry Quality of Life	457
19.3	Real and Virtual Economies	459
19.4	Resources	461
	Appendices	465
A	Minigame Worksheet	467
B	Overview Worksheet	471
C	Technology Plan Worksheet	477
C.1	Common	478
C.2	Video Games	478
C.3	Board Games	480
D	Budget Worksheet	481
E	Schedule Worksheet	483
E.1	48-Hour Video Game Contest	484
E.2	3-Week Video Game	485
E.3	3-Week Board Game	486
E.4	12-Week Professional Video Game	487
E.5	2-Year Professional Video Game	488
F	The Games Canon	489
F.1	Minicanon	490
F.2	Card	492
F.3	Racing	494
F.4	Quest	495
F.5	Educational	497
F.6	Alternate Reality	498
F.7	Traditional Abstract Strategy	498
F.8	Stealth	500
F.9	Physics Games	501
F.10	German Board Games	502
F.11	American	503
F.12	<i>n</i> -in-a-Row	504

Contents

xiii

F.13	Games by Scientists	505
F.14	Game Books	506
F.15	Unique	507
F.16	Pen-and-Paper Role-Playing (RPG)	508
F.17	Computer Role-Playing (cRPG)	509
F.18	Computer Strategy	510
F.19	Classic Arcade	511
F.20	Rhythm Games	513
F.21	Massive Multiplayer	514
F.22	Sports	516
F.23	Fighting	518
F.24	First-Person Shooters	519
	Bibliography	521
	Index	530