

TABLE OF CONTENTS

Chapter 30 3D Concepts and Terminology

| | |
|--|-----|
| The 3D World | 744 |
| Introduction | 744 |
| The Coordinate System | 744 |
| Axes | 744 |
| Planes | 745 |
| Points | 746 |
| World Units | 747 |
| Local Axes | 747 |
| Rotation | 748 |
| 3D Vectors | 748 |
| Object Terminology | 749 |
| Textures | 750 |
| Images with an Alpha Channel | 750 |
| Cameras | 751 |
| Lights | 752 |
| Summary | 753 |

Chapter 31 3D Primitives

| | |
|--|-----|
| 3D Primitives | 756 |
| Introduction | 756 |
| Creating a Cube | 756 |
| The MAKE OBJECT CUBE Statement | 756 |
| Creating Other Primitives | 757 |
| The MAKE OBJECT BOX Statement | 757 |
| The MAKE OBJECT SPHERE Statement | 758 |
| The MAKE OBJECT CYLINDER Statement | 759 |
| The MAKE OBJECT CONE Statement | 760 |
| The MAKE OBJECT PLAIN Statement | 760 |
| The MAKE OBJECT TRIANGLE Statement | 761 |
| Positioning an Object | 762 |
| The POSITION OBJECT Statement | 762 |
| The MOVE OBJECT Statement | 764 |
| Rotating Objects - Absolute Rotation | 765 |
| The XROTATE OBJECT Statement | 766 |
| The YROTATE OBJECT Statement | 767 |
| The ZROTATE OBJECT Statement | 767 |
| The ROTATE OBJECT Statement | 768 |
| The SET OBJECT ROTATION Statement | 769 |
| Rotating Objects - Relative Rotation | 769 |
| The PITCH OBJECT Statement | 770 |

| | |
|--|-----|
| The TURN OBJECT Statement | 770 |
| The ROLL OBJECT Statement | 771 |
| The POINT OBJECT Statement | 771 |
| The MOVE OBJECT <i>distance</i> Statement | 772 |
| The FIX OBJECT PIVOT Statement | 773 |
| Resizing Objects | 775 |
| The SCALE OBJECT Statement | 775 |
| Showing and Hiding Objects | 776 |
| The HIDE OBJECT Statement | 776 |
| The SHOW OBJECT Statement | 776 |
| The DELETE OBJECT Statement | 777 |
| The DELETE OBJECTS Statement | 777 |
| Copying a 3D Object | 778 |
| The CLONE OBJECT Statement | 778 |
| The INSTANCE OBJECT Statement | 779 |
| Retrieving Data on 3D Objects | 779 |
| The OBJECT EXIST Statement | 779 |
| The OBJECT POSITION Statement | 780 |
| The OBJECT VISIBLE Statement | 780 |
| The OBJECT SIZE Statement | 781 |
| The OBJECT ANGLE Statement | 781 |
| Controlling an Object's Rotation Using the Mouse | 782 |
| Wireframe and Culling | 783 |
| The SET OBJECT WIREFRAME Statement | 783 |
| The SET OBJECT CULL Statement | 784 |
| Storage Methods | 785 |
| The SET GLOBAL OBJECT CREATION Statement | 785 |
| Summary | 786 |
| Merging Primitives..... | 788 |
| Introduction | 788 |
| The Statements | 788 |
| The PERFORM CSG UNION Statement | 788 |
| The PERFORM CSG DIFFERENCE Statement | 790 |
| The PERFORM CSG INTERSECTION Statement | 790 |
| Summary | 791 |
| Solutions..... | 792 |

Chapter 32

Texturing

| | |
|--|-----|
| Adding Texture..... | 798 |
| Introduction | 798 |
| Loading a Texture Image | 798 |
| Using the Image as a Texture | 798 |
| The TEXTURE OBJECT Statement | 798 |
| Mipmaps | 799 |
| The LOAD IMAGE Statement Again | 800 |

| | |
|---|-----|
| Tiling | 801 |
| The SCALE OBJECT TEXTURE Statement | 802 |
| Seamless Tiling | 804 |
| Video Texture | 805 |
| The PLAY ANIMATION TO IMAGE Statement | 805 |
| Other Texture Effects | 807 |
| The SET OBJECT TEXTURE Statement | 807 |
| The SCROLL OBJECT TEXTURE Statement | 808 |
| The SET OBJECT TRANSPARENCY Statement | 810 |
| The SET DETAIL MAPPING ON Statement | 811 |
| The SET OBJECT FILTER Statement | 813 |
| Summary | 814 |
| Other Visual Effects | 815 |
| Introduction | 815 |
| Changing Colour and Transparency | 815 |
| The COLOR OBJECT Statement | 815 |
| The GHOST OBJECT ON Statement | 816 |
| The GHOST OBJECT OFF Statement | 817 |
| The FADE OBJECT Statement | 817 |
| Summary | 819 |
| Images with an Alpha Channel | 820 |
| Introduction | 820 |
| Using Images with an Alpha Channel | 820 |
| Summary | 821 |
| Creating a Complex 3D Shape | 822 |
| Introduction | 822 |
| Designing the Castle | 822 |
| Gathering the Components | 823 |
| Creating the Code | 823 |
| The Code | 824 |
| Sky Spheres | 828 |
| Summary | 830 |
| Solutions..... | 831 |

Chapter 33

Cameras

| | |
|---|-----|
| Camera Basics | 836 |
| Introduction | 836 |
| Positioning the Camera | 836 |
| The POSITION CAMERA Statement | 836 |
| The MOVE CAMERA Statement | 837 |
| Changing the Viewpoint | 838 |
| The POINT CAMERA Statement | 838 |
| The ROTATE CAMERA Statement | 838 |
| The SET CAMERA ROTATION Statement | 840 |
| The XROTATE CAMERA Statement | 840 |

| | |
|--|-----|
| The YROTATE CAMERA Statement | 841 |
| The ZROTATE CAMERA Statement | 841 |
| The PITCH CAMERA Statement | 842 |
| The TURN CAMERA Statement | 842 |
| The ROLL CAMERA Statement | 843 |
| Retrieving Camera Data | 844 |
| The CAMERA POSITION Statement | 844 |
| The CAMERA ANGLE Statement | 844 |
| Modifying Camera Characteristics | 845 |
| The SET CAMERA VIEW Statement | 845 |
| The SET CAMERA ASPECT Statement | 846 |
| The SET CAMERA FOV Statement | 847 |
| The SET CAMERA RANGE Statement | 848 |
| Summary | 849 |
| Controlling Camera Movement..... | 851 |
| Introduction | 851 |
| Automatic Camera Placement | 851 |
| The AUTOCAM Statement | 851 |
| Following the Action | 852 |
| The SET CAMERA TO FOLLOW Statement | 853 |
| Giving the Player Control of the Camera | 856 |
| The CONTROL CAMERA USING ARROWKEYS Statement | 856 |
| The AUTOMATIC CAMERA COLLISION Statement | 858 |
| Controlling the Camera with the Mouse | 859 |
| Summary | 862 |
| Multiple Cameras | 863 |
| Introduction | 863 |
| Using Additional Cameras | 863 |
| The MAKE CAMERA Statement | 863 |
| The COLOR BACKDROP Statement | 864 |
| The BACKDROP Statement | 864 |
| The SET CURRENT CAMERA Statement | 865 |
| The DELETE CAMERA Statement | 866 |
| Switching Between Cameras | 866 |
| Multiple Camera Output | 868 |
| The CLEAR CAMERA VIEW Statement | 869 |
| Summary | 870 |
| Advanced Camera Techniques..... | 871 |
| Introduction | 871 |
| The Statements | 871 |
| The SET CAMERA TO IMAGE Statement | 871 |
| The SET CAMERA TO OBJECT ORIENTATION Statement | 873 |
| The SET OBJECT TO CAMERA ORIENTATION Statement | 873 |
| The LOCK OBJECT Statement | 874 |
| The SET VECTOR3 TO CAMERA POSITION Statement | 875 |
| The SET VECTOR3 TO CAMERA ROTATION Statement | 876 |

| | |
|-------------------|-----|
| Summary | 876 |
| Solutions..... | 878 |

| | |
|-------------------|-----------------|
| Chapter 34 | Lighting |
|-------------------|-----------------|

| | |
|---|-----|
| Lighting..... | 886 |
| Introduction | 886 |
| Types of Lighting | 886 |
| Ambient Lighting | 886 |
| Point Lighting | 886 |
| Spot Lighting | 886 |
| Directional Lighting | 886 |
| Lighting in DarkBASIC Pro | 887 |
| The HIDE LIGHT Statement | 887 |
| The SHOW LIGHT Statement | 888 |
| The SET AMBIENT LIGHT Statement | 888 |
| The COLOR AMBIENT LIGHT Statement | 889 |
| The MAKE LIGHT Statement | 889 |
| The DELETE LIGHT Statement | 890 |
| The COLOR LIGHT Statement | 890 |
| The POSITION LIGHT Statement | 891 |
| The SET LIGHT RANGE Statement | 891 |
| The SET SPOT LIGHT Statement | 892 |
| The SET DIRECTIONAL LIGHT Statement | 892 |
| The SET POINT LIGHT Statement | 893 |
| The POINT LIGHT Statement | 893 |
| The ROTATE LIGHT Statement | 895 |
| The SET LIGHT TO OBJECT POSITION Statement | 895 |
| The SET LIGHT TO OBJECT ORIENTATION Statement | 897 |
| Retrieving Light Data | 898 |
| The LIGHT EXIST Statement | 898 |
| The LIGHT VISIBLE Statement | 899 |
| The LIGHT RANGE Statement | 899 |
| The LIGHT TYPE Statement | 899 |
| The LIGHT POSITION Statement | 900 |
| The LIGHT DIRECTION Statement | 900 |
| Fog | 901 |
| The FOG Statement | 901 |
| The FOG COLOR Statement | 902 |
| The FOG DISTANCE Statement | 902 |
| The SET OBJECT FOG Statement | 903 |
| Summary | 904 |
| Solutions..... | 907 |

| | |
|--|-----|
| Meshes..... | 912 |
| Introduction | 912 |
| Handling Meshes | 912 |
| The MAKE MESH FROM OBJECT Statement | 912 |
| The SAVE MESH Statement | 913 |
| The LOAD MESH Statement | 914 |
| The MAKE OBJECT Statement | 914 |
| The DELETE MESH Statement | 915 |
| The MESH EXIST Statement | 915 |
| Summary | 916 |
| Limbs..... | 917 |
| Introduction | 917 |
| Getting Started | 917 |
| The ADD LIMB Statement | 917 |
| The MAKE OBJECT FROM LIMB Statement | 919 |
| The OFFSET LIMB Statement | 920 |
| The ROTATE LIMB Statement | 920 |
| The SCALE LIMB Statement | 922 |
| The COLOR LIMB Statement | 922 |
| The TEXTURE LIMB Statement | 923 |
| The SCALE LIMB TEXTURE Statement | 925 |
| The SCROLL LIMB TEXTURE Statement | 927 |
| The HIDE LIMB Statement | 927 |
| The SHOW LIMB Statement | 928 |
| The REMOVE LIMB Statement | 928 |
| The LINK LIMB Statement | 928 |
| The CHANGE MESH Statement | 931 |
| The GLUE OBJECT TO LIMB Statement | 931 |
| The UNGLUE OBJECT Statement | 934 |
| The SET LIMB SMOOTHING Statement | 934 |
| Creating Doors | 935 |
| Retrieving Limb Data | 936 |
| The LIMB EXIST Statement | 936 |
| The LIMB VISIBLE Statement | 937 |
| The LIMB OFFSET Statement | 937 |
| The LIMB SCALE Statement | 938 |
| The LIMB ANGLE Statement | 939 |
| The LIMB POSITION Statement | 939 |
| The LIMB DIRECTION Statement | 940 |
| The PERFORM CHECKLIST FOR OBJECT LIMBS Statement | 944 |
| The LIMB NAME\$ Statement | 945 |
| The LIMB TEXTURE Statement | 946 |
| The LIMB TEXTURE NAME Statement | 946 |
| The CHECK LIMB LINK Statement | 947 |

| | |
|--|-----|
| Saving a Model in DBO Format | 947 |
| Introduction | 947 |
| The DBO File Format | 948 |
| Creating an Elevator Model | 948 |
| The SAVE OBJECT Statement | 949 |
| The LOAD OBJECT Statement | 950 |
| Summary | 951 |
| Solutions..... | 953 |

Chapter 36 **Importing 3D Objects**

| | |
|---|-----|
| Importing 3D Objects..... | 962 |
| Introduction | 962 |
| File Formats | 963 |
| Statements for Loading and Using 3D Objects | 963 |
| The LOAD OBJECT Statement Again | 963 |
| The PLAY OBJECT Statement | 965 |
| The LOOP OBJECT Statement | 966 |
| The TOTAL OBJECT FRAMES Statement | 966 |
| Moving the Alien | 967 |
| The SET OBJECT SPEED Statement | 967 |
| The STOP OBJECT Statement | 968 |
| The SET OBJECT FRAME Statement | 968 |
| The SET OBJECT INTERPOLATION Statement | 969 |
| The APPEND OBJECT Statement | 970 |
| Retrieving Animation Object Information | 971 |
| The OBJECT PLAYING Statement | 971 |
| The OBJECT LOOPING Statement | 971 |
| The OBJECT FRAME Statement | 972 |
| The OBJECT SPEED Statement | 972 |
| The OBJECT INTERPOLATION Statement | 972 |
| The OBJECT SIZE Statement | 973 |
| Limbs | 974 |
| Summary | 975 |
| Solutions..... | 977 |

Chapter 37 **Screen Control**

| | |
|---|-----|
| User Control | 980 |
| Introduction | 980 |
| Selecting an Object | 980 |
| The OBJECT SCREEN Statement | 982 |
| The PICK OBJECT Statement | 983 |
| The GET PICK DISTANCE Statement | 984 |
| The PICK VECTOR Statement | 985 |
| The PICK SCREEN Statement | 986 |

| | |
|---|-----|
| The OBJECT IN SCREEN Statement | 987 |
| Selecting Objects using the Mouse | 988 |
| Summary | 990 |
| Solutions..... | 991 |

Chapter 38

Solitaire

| | |
|---|------|
| Solitaire - The Board Game..... | 994 |
| Introduction | 994 |
| The Equipment | 994 |
| The Aim | 994 |
| The Rules | 994 |
| Creating a Computer Version of the Game | 994 |
| User Controls | 994 |
| Game Responses | 995 |
| Screen Layout | 995 |
| Media Used | 995 |
| Data Structures | 996 |
| Adding SetUpScreen() | 999 |
| Adding SetUpGame() | 1000 |
| Adding CreateBoard() | 1001 |
| Adding CreateInternalBoard() | 1001 |
| Adding CreateMarbles() | 1002 |
| Adding CreateSelector() | 1002 |
| Adding SetUpHelp() | 1003 |
| Adding GetPlayerMove() | 1004 |
| Adding MoveSelector() | 1006 |
| Adding SelectMarble() | 1007 |
| Adding SelectPit() | 1008 |
| Adding IsValidMove() | 1008 |
| Adding MoveMarble() | 1008 |
| Adding SelectHelpPage() | 1009 |
| Using the Mouse | 1009 |
| Introduction | 1009 |
| Updating the Program | 1010 |
| Suggested Enhancements | 1013 |
| Solutions..... | 1015 |

Chapter 39

Advanced Lighting and Texturing

| | |
|---|------|
| Advanced Lighting and Texturing..... | 1028 |
| Introduction | 1028 |
| Surface Reflection | 1028 |
| The SET OBJECT AMBIENT Statement | 1029 |
| The SET OBJECT DIFFUSE Statement | 1030 |
| The SET OBJECT SPECULAR Statement | 1030 |

| | |
|---|------|
| The SET OBJECT SPECULAR POWER Statement | 1031 |
| The SET OBJECT EMISSIVE Statement | 1031 |
| The SET OBJECT LIGHT Statement | 1034 |
| Mappings | 1035 |
| The SET LIGHT MAPPING ON Statement | 1035 |
| The SET BUMP MAPPING ON Statement | 1038 |
| The SET SPHERE MAPPING ON Statement | 1039 |
| The SET BLEND MAPPING ON Statement | 1041 |
| The SET CUBE MAPPING ON Statement | 1042 |
| The SET ALPHA MAPPING ON Statement | 1044 |
| Shadows | 1045 |
| The SET SHADOW SHADING ON Statement | 1045 |
| The SET SHADOW SHADING OFF Statement | 1048 |
| The SET GLOBAL SHADOWS Statement | 1048 |
| The SET GLOBAL SHADOW COLOR Statement | 1050 |
| The SET GLOBAL SHADOW SHADES Statement | 1050 |
| Positioning Shadows | 1051 |
| The SET SHADOW POSITION Statement | 1051 |
| Shadows and Models | 1052 |
| Other Shading Methods | 1054 |
| The SET CARTOON SHADING ON Statement | 1054 |
| The SET RAINBOW SHADING ON Statement | 1056 |
| The SET REFLECTION SHADING ON Statement | 1057 |
| The SET SHADING OFF Statement | 1058 |
| Summary | 1058 |
| Solutions..... | 1061 |

Chapter 40

Collisions

| | |
|--|------|
| Object Collisions | 1068 |
| Introduction | 1068 |
| Object Collision | 1068 |
| The OBJECT HIT Statement | 1069 |
| The OBJECT COLLISION Statement | 1070 |
| The SET OBJECT COLLISION Statement | 1070 |
| The SET GLOBAL COLLISION Statement | 1071 |
| How Collision Detection Works | 1071 |
| The SHOW OBJECT BOUNDS Statement | 1072 |
| The HIDE OBJECT BOUNDS statement | 1072 |
| Modifying Collision Detection | 1074 |
| The SET OBJECT COLLISION TO SPHERES Statement | 1074 |
| The SET OBJECT RADIUS Statement | 1074 |
| The OBJECT COLLISION RADIUS Statement | 1075 |
| The OBJECT COLLISION CENTER Statement | 1075 |
| The SET OBJECT COLLISION TO BOXES Statement | 1076 |
| The SET OBJECT COLLISION TO POLYGONS Statement | 1076 |

| | |
|--|------|
| The MAKE OBJECT COLLISION BOX Statement | 1077 |
| The GET OBJECT COLLISION Statement | 1080 |
| The DELETE OBJECT COLLISION BOX Statement | 1082 |
| The AUTOMATIC OBJECT COLLISION Statement | 1082 |
| The INTERSECT OBJECT Statement | 1083 |
| Summary | 1085 |
| Static Collisions..... | 1087 |
| Introduction | 1087 |
| Creating and Using Static Collision Boxes | 1087 |
| The MAKE STATIC COLLISION BOX Statement | 1087 |
| The GET STATIC COLLISION HIT Statement | 1087 |
| The GET STATIC COLLISION Statement | 1089 |
| The STATIC LINE OF SIGHT Statement | 1093 |
| The STATIC LINE OF SIGHT Coordinates Statement | 1095 |
| Static Collision Boxes and the Camera | 1096 |
| Summary | 1096 |
| Solutions..... | 1098 |

Chapter 41

Particles

| | |
|---|------|
| Particles..... | 1102 |
| Introduction | 1102 |
| Creating Particles | 1102 |
| The MAKE PARTICLES Statement | 1102 |
| The HIDE PARTICLES Statement | 1103 |
| The SHOW PARTICLES Statement | 1104 |
| The DELETE PARTICLES Statement | 1104 |
| The POSITION PARTICLES Statement | 1104 |
| The POSITION PARTICLE EMISSIONS Statement | 1105 |
| The ROTATE PARTICLES Statement | 1106 |
| The COLOR PARTICLES Statement | 1107 |
| The SET PARTICLE EMISSIONS Statement | 1108 |
| The SET PARTICLE VELOCITY Statement | 1109 |
| The SET PARTICLE GRAVITY Statement | 1110 |
| The SET PARTICLE CHAOS Statement | 1110 |
| The SET PARTICLE SPEED Statement | 1111 |
| The SET PARTICLE FLOOR Statement | 1112 |
| The SET PARTICLE LIFE Statement | 1113 |
| The GHOST PARTICLES ON Statement | 1113 |
| The GHOST PARTICLES OFF Statement | 1114 |
| Retrieving Data on a Particles Object | 1114 |
| The PARTICLES EXIST Statement | 1114 |
| The PARTICLES POSITION Statement | 1115 |
| Particles Statements that use Vectors | 1116 |
| The SET VECTOR3 TO PARTICLES POSITION Statement | 1116 |
| The SET VECTOR3 TO PARTICLES ROTATION Statement | 1116 |

| | |
|---|------|
| Summary | 1116 |
| Other Types of Particles..... | 1118 |
| Introduction | 1118 |
| The Statements | 1118 |
| The MAKE SNOW PARTICLES Statement | 1118 |
| The MAKE FIRE PARTICLES Statement | 1119 |
| Summary | 1120 |
| Examples of Using Particles | 1121 |
| Introduction | 1121 |
| A Roman Candle | 1121 |
| A Spaceship | 1122 |
| A Dungeon Torch | 1122 |
| Solutions..... | 1124 |

Chapter 42

The Elevators Game

| | |
|---|------|
| Elevators | 1128 |
| Introduction | 1128 |
| The Equipment | 1128 |
| The Aim | 1128 |
| The Rules | 1128 |
| Creating a Computer version of the Game | 1128 |
| User Controls | 1128 |
| Game Responses | 1128 |
| Screen Layout | 1128 |
| The Board Design | 1129 |
| The Media Used | 1129 |
| Data Structures | 1130 |
| Game Logic | 1131 |
| Adding SetUpGame() | 1132 |
| Adding InitialiseData() | 1134 |
| Adding InitialiseLifts() | 1134 |
| Adding InitialiseBoard() | 1135 |
| Adding InitialiseVisuals() | 1136 |
| Loading Models and Texture Files | 1136 |
| Adding LoadBoard() | 1137 |
| Adding AddElevators() | 1137 |
| Adding LoadPlayerCharacter() | 1138 |
| Adding LoadDice() | 1138 |
| Adding PositionCameras() | 1138 |
| Adding RollDice() | 1142 |
| Adding MovePlayer() | 1143 |
| Adding UseElevator() | 1146 |
| Adding MovePlayerToElevator() | 1147 |
| Adding TurnPlayer() | 1148 |
| Adding MoveOntoPlatform() | 1148 |

| | |
|-------------------------------|------|
| Adding MoveElevator() | 1148 |
| Adding MoveOffPlatform() | 1149 |
| Adding ReturnElevator() | 1150 |
| Adding RepositionCamera() | 1150 |
| Fixing the Shortcomings | 1151 |
| Fixing RepositionCamera() | 1151 |
| Fixing MovePlayer() | 1152 |
| Fixing UseElevator() | 1153 |
| Fixing MovePlayerToElevator() | 1153 |
| Fixing MoveElevator() | 1153 |
| Adding EndGame() | 1154 |
| Game Review | 1154 |
| Solutions..... | 1155 |

Chapter 43

Handling BSP Models

| | |
|---|------|
| Binary Space Partitioning..... | 1164 |
| Introduction | 1164 |
| Creating a BSP File | 1165 |
| Using BSP Files | 1165 |
| The LOAD BSP Statement | 1165 |
| The SET BSP CAMERA COLLISION Statement | 1167 |
| The SET BSP OBJECT COLLISION Statement | 1167 |
| The SET BSP CAMERA COLLISION RADIUS Statement | 1169 |
| The SET BSP OBJECT COLLISION RADIUS Statement | 1169 |
| The SET BSP COLLISION HEIGHT ADJUSTMENT Statement | 1170 |
| The SET BSP COLLISION THRESHOLD Statement | 1171 |
| The PROCESS BSP COLLISION Statement | 1171 |
| The SET BSP COLLISION OFF Statement | 1171 |
| The BSP COLLISION HIT Statement | 1172 |
| The BSP COLLISION Statement | 1172 |
| The SET BSP CAMERA Statement | 1173 |
| The DELETE BSP Statement | 1173 |
| The SET BSP MULTITEXTURING Statement | 1173 |
| Summary | 1173 |
| Using a BSP Map..... | 1175 |
| Introduction | 1175 |
| The Program | 1175 |
| Solutions..... | 1178 |

Chapter 44

Creating Terrain

| | |
|---|------|
| Creating Terrain | 1180 |
| Introduction | 1180 |
| Documented Terrain Statements | 1180 |
| The MAKE TERRAIN Statement | 1180 |

| | |
|--|------|
| The DELETE TERRAIN Statement | 1181 |
| The POSITION TERRAIN Statement | 1182 |
| The TERRAIN POSITION Statement | 1183 |
| The TEXTURE TERRAIN Statement | 1183 |
| The GET TERRAIN HEIGHT Statement | 1184 |
| The GET TOTAL TERRAIN HEIGHT Statement | 1186 |
| The Advanced Terrain Statements | 1186 |
| The MAKE OBJECT TERRAIN Statement | 1186 |
| The SET TERRAIN HEIGHTMAP Statement | 1187 |
| The SET TERRAIN SCALE Statement | 1187 |
| The SET TERRAIN TEXTURE Statement | 1188 |
| The BUILD TERRAIN Statement | 1188 |
| The SET TERRAIN TILING Statement | 1189 |
| The SET TERRAIN LIGHT Statement | 1190 |
| The SET TERRAIN SPLIT Statement | 1191 |
| The GET TERRAIN GROUND HEIGHT Statement | 1191 |
| The GET TERRAIN SIZE Statement | 1193 |
| The SAVE TERRAIN Statement | 1193 |
| The LOAD TERRAIN Statement | 1194 |
| Terrains as Objects | 1195 |
| Summary | 1195 |
| Documented Statements | 1195 |
| Undocumented (Advanced Terrain) Statements | 1196 |
| Terrain Project..... | 1197 |
| Introduction | 1197 |
| Creating the Game | 1197 |
| Constants and Global Variables | 1198 |
| Adding StartUpGame() | 1198 |
| Adding PositionCamera() | 1199 |
| Adding CreateScene() | 1199 |
| Adding LoadTerrain() | 1199 |
| Adding CreateSkyBox() | 1200 |
| Adding LoadOcean() | 1200 |
| Adding PlaceOrb() | 1201 |
| Adding StartGame() | 1202 |
| Adding ControlPlayer() | 1202 |
| Adding EndGame() | 1203 |
| Adding Testing Features | 1204 |
| Solutions..... | 1206 |

Chapter 45

Using Matrices

| | |
|-------------------------------------|------|
| Matrices..... | 1212 |
| Introduction | 1212 |
| Creating a Matrix | 1213 |
| The MAKE MATRIX Statement | 1213 |

| | |
|--|------|
| The RANDOMIZE MATRIX Statement | 1214 |
| The UPDATE MATRIX Statement | 1214 |
| The SET MATRIX HEIGHT Statement | 1215 |
| The GET MATRIX HEIGHT Statement | 1217 |
| The GET GROUND HEIGHT Statement | 1218 |
| The SET MATRIX WIREFRAME Statement | 1219 |
| The MATRIX WIREFRAME STATE Statement | 1220 |
| Adding Texture to the Matrix | 1220 |
| The PREPARE MATRIX TEXTURE Statement | 1220 |
| The FILL MATRIX Statement | 1222 |
| The SET MATRIX TILE Statement | 1223 |
| The SET TEXTURE TRIM Statement | 1226 |
| The SHIFT MATRIX Statement | 1227 |
| The MATRIX TILE COUNT Statement | 1228 |
| The MATRIX TILES EXIST Statement | 1228 |
| Positioning the Matrix in 3D Space | 1229 |
| The POSITION MATRIX Statement | 1229 |
| The MATRIX POSITION Statement | 1230 |
| Matrix Transparency | 1231 |
| The GHOST MATRIX ON Statement | 1231 |
| The GHOST MATRIX OFF Statement | 1232 |
| The SET MATRIX PRIORITY Statement | 1232 |
| Lighting the Matrix | 1234 |
| The SET MATRIX NORMAL Statement | 1234 |
| The SET MATRIX Statement | 1235 |
| The MATRIX EXIST Statement | 1237 |
| Summary | 1238 |
| Solutions..... | 1240 |

Chapter 46

Manipulating Vertices

| | |
|---|------|
| Manipulating Vertices | 1246 |
| Introduction | 1246 |
| The Statements | 1246 |
| The LOCK VERTEXDATA FOR MESH Statement | 1246 |
| The GET VERTEXDATA VERTEX COUNT Statement | 1247 |
| The GET VERTEXDATA POSITION Statement | 1248 |
| The SET VERTEXDATA POSITION Statement | 1250 |
| The UNLOCK VERTEXDATA Statement | 1250 |
| The LOCK VERTEXDATA FOR LIMB Statement | 1251 |
| The GET VERTEXDATA NORMALS Statement | 1253 |
| The SET VERTEXDATA NORMALS Statement | 1254 |
| The GET VERTEXDATA Statement | 1255 |
| The SET VERTEXDATA UV Statement | 1256 |
| The SET VERTEXDATA DIFFUSE Statement | 1257 |
| The GET VERTEXDATA DIFFUSE Statement | 1258 |

| | |
|---|------|
| Handling More Complex Shapes | 1258 |
| The ADD MESH TO VERTEXDATA Statement | 1265 |
| More About the Vertex Data Buffer's Structure | 1266 |
| The GET VERTEXDATA INDEX COUNT Statement | 1267 |
| The GET INDEXDATA Statement | 1268 |
| The SET INDEXDATA Statement | 1270 |
| The DELETE MESH FROM VERTEXDATA Statement | 1271 |
| Summary | 1272 |
| Solutions..... | 1274 |

Chapter 47

Accessing Memory

| | |
|---|------|
| Accessing Memory | 1282 |
| Introduction | 1282 |
| Pointers | 1282 |
| Creating Pointers in DarkBASIC Pro | 1283 |
| Assigning a Value to a Pointer | 1283 |
| The MAKE MEMBLOCK Statement | 1283 |
| The GET MEMBLOCK PTR Statement | 1283 |
| Using a Pointer | 1284 |
| Using a Pointer to Return Values from a Function | 1285 |
| Larger Memory Blocks | 1286 |
| The WRITE MEMBLOCK Statement | 1286 |
| The MEMBLOCK Statement | 1287 |
| The GET MEMBLOCK SIZE Statement | 1288 |
| The DELETE MEMBLOCK Statement | 1288 |
| The MEMBLOCK EXIST Statement | 1288 |
| The COPY MEMBLOCK Statement | 1289 |
| Strings and Memory Blocks | 1290 |
| The WRITE MEMBLOCK (to file) Statement | 1292 |
| The MAKE FILE FROM MEMBLOCK Statement | 1294 |
| The READ MEMBLOCK (from file) Statement | 1294 |
| The MAKE MEMBLOCK FROM FILE Statement | 1296 |
| Adding a New Top Score to our List | 1296 |
| Summary | 1297 |
| Media Contents and Memory Blocks | 1299 |
| Introduction | 1299 |
| Bitmaps and Memory Blocks | 1299 |
| The MAKE MEMBLOCK FROM BITMAP Statement | 1299 |
| The MAKE BITMAP FROM MEMBLOCK Statement | 1301 |
| Mapping a Screen Position to a Memory Block Location | 1302 |
| Mapping the Mouse Position to a Memory Block Location | 1303 |
| Images and Memory Blocks | 1304 |
| The MAKE MEMBLOCK FROM IMAGE Statement | 1304 |
| The MAKE IMAGE FROM MEMBLOCK Statement | 1304 |
| Sounds and Memory Blocks | 1305 |

| | |
|---|------|
| The MAKE MEMBLOCK FROM SOUND Statement | 1305 |
| The MAKE SOUND FROM MEMBLOCK Statement | 1307 |
| 3D Objects and Memory Blocks | 1308 |
| The MAKE MEMBLOCK FROM MESH Statement | 1308 |
| The MAKE MESH FROM MEMBLOCK Statement | 1311 |
| The CHANGE MESH FROM MEMBLOCK Statement | 1312 |
| Summary | 1313 |
| Solutions..... | 1314 |

Chapter 48

Open Dynamics Engine

| | |
|--|------|
| Using ODE | 1318 |
| Introduction | 1318 |
| Basic ODE Statements | 1318 |
| The ODE CREATE DYNAMIC BOX Statement | 1318 |
| The ODE START Statement | 1319 |
| The ODE END Statement | 1319 |
| The ODE UPDATE Statement | 1319 |
| The ODE SET WORLD GRAVITY Statement | 1320 |
| The ODE CREATE STATIC BOX Statement | 1321 |
| The ODE MAKE DYNAMIC SPHERE Statement | 1322 |
| The ODE CREATE DYNAMIC CYLINDER Statement | 1322 |
| The ODE CREATE DYNAMIC TRIANGLE MESH Statement | 1324 |
| The ODE SET WORLD STEP | 1325 |
| The ODE CREATE STATIC TRIANGLE MESH Statement | 1325 |
| The ODE SET WORLD ERP Statement | 1326 |
| The ODE SET WORLD CFM Statement | 1327 |
| The ODE SET CONTACT FDIR1 Statement | 1328 |
| The ODE SET LINEAR VELOCITY Statement | 1328 |
| The ODE SET ANGULAR VELOCITY Statement | 1331 |
| The ODE SET BODY ROTATION Statement | 1332 |
| The ODE SET BODY MASS Statement | 1332 |
| The ODE DESTROY OBJECT Statement | 1334 |
| The ODE GET BODY LINEAR VELOCITY Statement | 1335 |
| The ODE GET BODY HEIGHT Statement | 1335 |
| The ODE COLLISION MESSAGE EXISTS Statement | 1336 |
| The ODE COLLISION GET MESSAGE Statement | 1336 |
| The ODE GET OBJECT Statement | 1336 |
| The ODE GET OBJECT VELOCITY Statement | 1337 |
| The ODE GET OBJECT ANGULAR VELOCITY Statement | 1338 |
| The ODE ADD FORCE Statement | 1338 |
| Surface Contact Statements | 1340 |
| Summary | 1343 |
| Solutions..... | 1345 |

| | |
|--|------|
| 3D Vectors..... | 1350 |
| Introduction | 1350 |
| A Mathematical Description of 3D Vectors | 1350 |
| What is a 3D Vector in DarkBASIC Pro? | 1351 |
| Why do we need 3D Vectors? | 1351 |
| 3D Vector Statements | 1351 |
| The MAKE VECTOR3 Statement | 1351 |
| The SET VECTOR3 Statement | 1352 |
| Retrieving Data from a 3D Vector | 1352 |
| The DELETE VECTOR3 Statement | 1353 |
| The COPY VECTOR3 Statement | 1353 |
| The MULTIPLY VECTOR3 Statement | 1354 |
| The SCALE VECTOR3 Statement | 1354 |
| The DIVIDE VECTOR3 Statement | 1355 |
| The LENGTH VECTOR3 Statement | 1355 |
| The SQUARED LENGTH VECTOR3 Statement | 1356 |
| The ADD VECTOR3 Statement | 1356 |
| The SUBTRACT VECTOR3 Statement | 1357 |
| The DOT PRODUCT VECTOR3 Statement | 1357 |
| The NORMALIZE VECTOR3 Statement | 1358 |
| The IS EQUAL VECTOR3 Statement | 1359 |
| The MAXIMIZE VECTOR3 Statement | 1359 |
| The MINIMIZE VECTOR3 Statement | 1360 |
| The CROSS PRODUCT VECTOR3 Statement | 1360 |
| Summary | 1361 |
| 4D Vectors..... | 1363 |
| Introduction | 1363 |
| Matrices..... | 1365 |
| Introduction | 1365 |
| Matrix Statements | 1365 |
| The MAKE MATRIX4 Statement | 1365 |
| The SET IDENTITY MATRIX4 Statement | 1366 |
| The IS IDENTITY MATRIX4 Statement | 1366 |
| Other Matrix Assignment Statements | 1367 |
| The COPY MATRIX4 Statement | 1367 |
| The IS EQUAL MATRIX4 Statement | 1367 |
| The ADD MATRIX4 Statement | 1368 |
| The SUBTRACT MATRIX4 Statement | 1368 |
| The DIVIDE MATRIX4 Statement | 1368 |
| The MULTIPLY MATRIX4 Statement | 1369 |
| The INVERSE MATRIX4 Statement | 1370 |
| The SCALE MATRIX4 Statement | 1370 |
| The TRANSLATE MATRIX4 Statement | 1371 |
| The ROTATE MATRIX4 Statement | 1371 |

| | |
|---|------|
| The TRANSPOSE MATRIX4 Statement | 1372 |
| The DELETE MATRIX4 Statement | 1372 |
| Summary | 1372 |
| Solutions..... | 1374 |

Chapter 50

Shaders

| | |
|---|------|
| Shaders and FX Files..... | 1376 |
| Introduction | 1376 |
| Vertex Shader | 1376 |
| Pixel Shader | 1376 |
| FX Files | 1377 |
| Graphics Card Check Statements | 1377 |
| The GET MAXIMUM VERTEX SHADER VERSION Statement . | 1377 |
| The GET MAXIMUM PIXEL SHADER VERSION Statement . . | 1377 |
| FX Statements | 1378 |
| The LOAD EFFECT Statement | 1378 |
| The EFFECT EXIST Statement | 1378 |
| The PERFORM CHECKLIST FOR EFFECT ERRORS Statement . . . | 1379 |
| The SET OBJECT EFFECT Statement | 1379 |
| The SET EFFECT ON Statement | 1380 |
| The DELETE EFFECT Statement | 1381 |
| The SET LIMB EFFECT Statement | 1381 |
| The PERFORM CHECKLIST FOR EFFECT VALUES Statement | 1382 |
| The SET EFFECT CONSTANT Statement | 1383 |
| The SET EFFECT TECHNIQUE Statement | 1383 |
| The SET EFFECT TRANSPOSE Statement | 1384 |
| Vertex Shader Statements | 1383 |
| The CREATE VERTEX SHADER FROM FILE Statement . . . | 1383 |
| The SET VERTEX SHADER ON Statement | 1385 |
| The SET VERTEX SHADER OFF Statement | 1385 |
| The DELETE VERTEX SHADER Statement | 1385 |
| Other Vertex Shader Statements | 1386 |
| Pixel Shader Statements | 1386 |
| Summary | 1386 |
| FX Files | 1386 |
| Shader Files | 1387 |
| Solutions..... | 1388 |

Chapter 51

Network Programming

| | |
|---|------|
| Networked Games..... | 1390 |
| Introduction | 1390 |
| Hardware Requirements | 1390 |
| Getting Started | 1390 |
| The PERFORM CHECKLIST FOR NET CONNECTIONS Statement . | 1391 |

| | |
|--|------|
| TCP/IP | 1392 |
| The SET NET CONNECTION Statement | 1392 |
| The CREATE NET GAME Statement | 1394 |
| Writing Code for the Client Machine | 1395 |
| The PERFORM CHECKLIST FOR NET SESSIONS Statement | 1395 |
| The JOIN NET GAME Statement | 1396 |
| The PERFORM CHECKLIST FOR NET PLAYERS Statement | 1397 |
| Using a Single Machine as Both Host and Client | 1498 |
| Combining the Host/Client Requirements | 1499 |
| Communicating | 1401 |
| The SEND NET MESSAGE Statement (Version 1) | 1401 |
| The GET NET MESSAGE Statement | 1401 |
| The NET MESSAGE EXISTS Statement | 1402 |
| The NET MESSAGE Statement (Version 1) | 1402 |
| The NET MESSAGE PLAYER FROM Statement | 1403 |
| The NET MESSAGE PLAYER TO Statement | 1403 |
| The SEND NET MESSAGE Statement (Version 2) | 1404 |
| The NET MESSAGE Statement (Version 2) | 1405 |
| The NET MESSAGE TYPE Statement | 1406 |
| The NET BUFFER SIZE Statement | 1408 |
| Session Dynamics | 1409 |
| The NET PLAYER CREATED Statement | 1409 |
| The NET PLAYER DESTROYED Statement | 1409 |
| The NET GAME NOW HOSTING Statement | 1411 |
| The FREE NET GAME Statement | 1411 |
| The CREATE NET PLAYER Statement | 1412 |
| The FREE NET PLAYER Statement | 1412 |
| The NET GAME EXISTS Statement | 1413 |
| The NET GAME LOST Statement | 1413 |
| Summary | 1413 |
| A Networked Game | 1415 |
| Introduction | 1415 |
| A Non-Networked Version | 1415 |
| Program Data | 1415 |
| Game Logic | 1416 |
| Adding SetUpPlayerDetails() | 1417 |
| Adding SetUpScreen() | 1417 |
| Adding SetUpBoard() | 1417 |
| Adding GetMove() | 1417 |
| Adding GetMyMove() | 1418 |
| Adding GetSquare() | 1418 |
| Adding InRange() | 1418 |
| Adding GetOpponentsMove() | 1419 |
| Adding CheckForWin() | 1419 |
| Adding the Other Search Routines | 1420 |
| Adding EndGame() | 1422 |

| | |
|--|------|
| Networking the Game | 1423 |
| Updating the main section | 1423 |
| Adding WaitForSecondPlayer() | 1423 |
| Adding NumberOfPlayers() | 1423 |
| Modifying the Call to SetUpPlayerDetails() | 1424 |
| Modifying GetMyMove() | 1424 |
| Modifying GetOpponentsMove() | 1424 |
| Modifying EndGame() | 1425 |
| A Complete Listing | 1425 |
| Solutions | 1431 |

Chapter 52 **Using File Transfer Protocol**

| | |
|---|------|
| Internet File Transfers | 1436 |
| Introduction | 1436 |
| The Instructions | 1436 |
| The FTP CONNECT Statement | 1436 |
| The GET FTP FAILURE Statement | 1436 |
| The GET FTP ERROR\$ Statement | 1437 |
| The GET FTP STATUS Statement | 1437 |
| The FTP SET DIR Statement | 1438 |
| The GET FTP DIR\$ Statement | 1438 |
| The FTP FIND FIRST Statement | 1438 |
| The FTP FIND NEXT Statement | 1439 |
| The GET FTP FILE TYPE Statement | 1439 |
| The GET FTP FILE NAME\$ Statement | 1439 |
| The GET FTP FILE SIZE Statement | 1439 |
| The FTP DISCONNECT Statement | 1440 |
| The FTP GET FILE Statement | 1440 |
| The FTP PROCEED Statement | 1441 |
| The GET FTP PROGRESS Statement | 1442 |
| The FTP TERMINATE Statement | 1442 |
| The FTP DELETE FILE statement | 1442 |
| The FTP PUT FILE Statement | 1443 |
| Summary | 1443 |

Chapter 53 **Dynamic Link Libraries**

| | |
|--|------|
| Creating New DBPro Statements..... | 1446 |
| Introduction | 1446 |
| A Dynamic Link Library (DLL) | 1446 |
| Creating a DLL | 1446 |
| Starting Up Visual Studio | 1446 |
| Adding the Code for New Statements | 1448 |
| Adding a String Table | 1449 |
| Constructing the Caption | 1450 |

| | |
|--|------|
| Adding the New Statements to DarkBASIC Pro | 1451 |
| Adding Help | 1452 |
| Adding More New Commands | 1456 |
| Functions that Return Real Values | 1456 |
| Functions that Return Strings | 1456 |
| More String Handling Functions | 1459 |
| Summary | 1460 |
| Using Standard DLLs | 1462 |
| Introduction | 1462 |
| The LOAD DLL Statement | 1463 |
| The DLL EXIST Statement | 1463 |
| The CALL DLL Statement | 1463 |
| The DLL CALL EXIST Statement | 1464 |
| The DELETE DLL Statement | 1464 |
| Summary | 1465 |
| Solutions..... | 1467 |