INDEX

Numbers

2001: A Space Odyssey, 142 2D graphics, 61–69 3D graphics, 69. See also rendering

A

acquire operation, 168, 170 adder circuit, 164 additive color mixing, 60 AES (Advanced Encryption Standard), 9-18,55block chaining, 15, 55 combining with RSA, 48-49 data organization under, 11 key expansion, 13-14 overview, 12 performance vs. RSA, 48 possible weaknesses, 17-18 S-box, 13, 14 security of, 16 aliasing, 66, 80, 99 all-pairs shortest path, 183. See also Floyd's algorithm alpha blending, 67-68, 82 alpha channel, 68, 78, 82 alpha level, 67 ambient lighting, 96-97 ambient occlusion, 96 American Standard Code for Information Interchange (ASCII), 12, 20-22, 119-120 AND (bitwise operation), 23, 25 angle of incidence, 74, 75 angle of reflectance, 74 animation cel, 59 ink and paint, 59, 65 interpolation, 63 anti-aliasing, 66-67 alpha blending, 67-68 full-screen, 80 FXAA, 111 multisampling, 111 post-process, 111

real-time, 108-113 supersampling, 109 ASCII (American Standard Code for Information Interchange), 12, 20-22, 119-120 atomic operation, 169 attacks, 2 brute-force, 5, 16, 20, 47 collision, 26 dictionary, 28 frequency analysis, 6, 9, 15, 17 known-plaintext, 6 man-in-the-middle, 52, 56 related-key, 17 timing, 17 authentication, 19, 26, 34. See also RSA authority, 51, 53 avalanche, 17, 21 Avatar, 69 axis, 61

B

best-first search. 178-181 marked points, 178, 179, 180 reusing results, 181-182 surplus information, 181 B-frame, 139 bidirectional frame, 139 bilinear filtering, 101 in FXAA, 112 binary, 10 ASCII, 12 bit. 10 byte, 10 search, 151 binary addition, 22 binary search, 151-152, 153 binary semaphore, 168 bit, 10 bitmap, 61, 116 alpha channel, 68, 78, 82 coordinate, 61 depth buffer, 91, 95, 96 display buffer, 61 height map, 106

bitmap (continued) mipmap, 102 origin, 61 resolution, 61 shadow map, 95 texture, 97 translucency, 68, 78 bitwise operations, 11 AND, 23, 25 binary addition, 22 NOT, 23, 25 OR, 23, 25 rotation, 14 XOR, 11, 14, 15 bitwise rotation, 14 Blair Witch Project, The, 142 block chaining, 15 blue difference (Cb), 124 Blu-ray, 116, 143 brute force attack, 5, 16, 20, 47 buffer, shared, 163 buffering, 143 bump mapping, 106, 107 byte, 10

C

Cb (blue difference), 124 cel animation, 59 central processing unit. See CPU (central processing unit) certificate, 53 CGI (computer-generated imagery), 57-59, 82-83. See also 3D graphics; rendering chain merging, 31 cipher key. See key (encryption) ciphertext, 2, 3, 8 circular wait, 172 clear reflection, 103 client, 52 Cloverfield, 142 code book, 9 coefficient, 126 collision, 20, 26 collision attack, 26 color additive, 60 RGB, 60, 116, 124 subtractive, 60, 76 YCbCr. 124 composite number, 40 compression, 116 deflate, 122 dictionary, 118-122

Huffman encoding, 120, 134 of JPEG pixel blocks, 132 lossless, 116 lossy, 116, 124 MPEG-2, 138 predictive encoding, 122 quantization, 123, 132 run-length encoding, 117, 123, 133, 142 sliding window, 122 temporal, 138 TGA file format, 117 .zip file format, 122 compression ratio, 118 dictionary compression, 120 **JPEG**, 135 MPEG-4, 143 TGA, 118 .*zip* file, 122 computer security. See security computer vision, 160 computer-generated imagery (CGI), 57-59, 82-83. See also 3D graphics; rendering concurrency, 161 atomic operation, 169 deadlock, 172 multitasking, 162-163, 174 multiuser environments, 162 performance, 162 print spooling, 162 problems of, 163-166 race condition, 165-169 read-only data, 166, 173 semaphore, 168-174 shared buffer, 163 starvation, 170, 172, 173 transaction, 166-167 control point, 62 coordinates, 61 axis, 61 control point, 62 conversion, 61, 71, 88, 96 interpolation, 63 local, 62 model, 62 origin, 61 projection, 71 scaling, 64 screen, 61, 88, 96 translation, 64 world, 70, 88 x, 61 y, 61 z, 69

coprime number, 40 core, 86, 162, 174 cost, 175, 178, 183, 184 computing route cost, 179, 182 defining per problem, 175 CPU (central processing unit), 86 adder, 164 core, 86, 162, 174 performance characteristics, 86 test-and-set, 169 updating data, 163, 165 Cr (red difference), 124 crack, 17 crib, 6, 9, 16 cut scene, 86

D

data collection, 146 dynamic, 154 hash table, 154 static, 154 data compression. See compression DCT (discrete cosine transform), 125-131, 141 deadlock, 172 deblocking filter, 143 decimal, 10 decryption, 2 deep web, 157 deflate, 122 depth buffer, 91, 95, 96 depth buffering, 91-92 dictionary, 28 dictionary attack, 28 dictionary compression, 118-122 diffuse reflection, 74, 77, 92, 93, 107 diffusion, 16 digital composition, 82 digital image, 59 digital signature, 25-26, 53 validation. 53 weaknesses, 26 direct lighting, 76 directed graph, 176 coverting to table, 176 edge, 176 point, 176 discrete cosine transform (DCT), 125-131, 141 display buffer, 61 dissolve, 82 distance effect, 72-73, 92 distant impostor, 106, 108 dynamic data collection, 154

E

edge, 176 encryption, 2 avalanche, 17 crack, 17 diffusion, 16 key. See key (encryption) one-time pad, 9 public-key, 38 RSA. See RSA shared key problem, 18, 37 substitution, 6 symmetric key, 18 transposition, 2 environment mapping, 103–105 exclusive-or. See XOR

F

factor, 40, 41 fast approximate anti-aliasing (FXAA), 111 field of view, 89 finding the shortest path, 175 fixed-size storage, 152, 153 Floyd's algorithm, 183-189 connecting routes, 183, 187 grid, 183, 186 improving routes, 185 route directions, 186-189 focus, 79 fps (frames per second), 59, 116, 144 frame, 59, 116 buffering, 143 macroblock, 139 frame rate. 59 frames per second (fps), 59, 116, 144 frequency analysis, 6, 9, 15, 17 full-screen anti-aliasing, 80 functions, 39 hash, 20-21 invertible, 39-42 one-way, 39, 42 square, 39 square root, 39 trapdoor, 40 FXAA (fast approximate anti-aliasing), 111

G

geographic information systems (GIS), 189 global illumination model, 76 GPU (graphics processing unit), 87, 90 granularity, 173 graph, directed. *See* directed graph graphics accelerator, 86 graphics processing unit (GPU), 87, 90 group of pictures, 138

H

H.264 standard, 143 handshaking, 52-54 hash chaining, 29-31 chain merging, 31 reduction function, 29, 31 hash table, 29, 31 hashing, 20-23, 154-156 avalanche, 17, 21 collision, 20, 26 desirable properties, 20-21 digital signature. See digital signature encoded password, 21 irreversibility, 20, 25 iterative, 32-33 keyed, 55 MAC, 55 MD5. See MD5 reduction function, 29, 31 rehashing, 156 salt, 34, 35 slot, 154 tombstone, 156 height map, 106 HTTPS, 52-56 authority, 53 certificate, 53 handshaking, 52-54 issuer, 53 MAC, 55 master secret, 54 premaster secret, 53 security of, 55-56 session, 52 transmission, 54-56 Huffman encoding, 120, 142 code creation, 120 in JPEG, 134

I

IDCT (inverse discrete cosine transform), 127 I-frame, 138, 139 images digital, 51–60 searching for, 160 inbound link, 158 indexing, 152–154 indirect lighting, 76 ink and paint, 59, 65 interpolation, 63 intracoded frame, 138 inverse discrete cosine transform (IDCT), 127 issuer, 53 iterative hashing, 32–33

J

jaggies, 66, 80, 89, 109, 112 Joint Photography Experts Group, 123 JPEG, 123–136 adjusting quality, 135 compressing pixel blocks, 132 compression ratio, 135 DCT, 125 picture quality, 135–136 Jurassic Park, 57–58

K

Kerckhoffs's principle, 4, 5, 27, 33 key (encryption), 4 AES, 9-14 asymmetric, 38 code book, 9 expansion, 9 keyed hashing, 55 MAC, 55 private, 38, 44, 45, 50 public, 38, 43, 44, 45, 50 related-key attack, 17 shared key problem, 18, 37 size, 20, 47 symmetric, 18 key (search), 146, 151 key expansion, 9 keyframe, 59 known-plaintext attack, 6

L

Lady and the Tramp, 59 LaserDisc, 116 LCD (liquid crystal display), 60 light-emitting diode (LED), 60 lighting, 71–80 ambient, 96–97 angle of incidence, 74, 75 angle of reflectance, 74 bump mapping, 106, 107

diffuse reflection, 74, 77, 92, 93, 107 direct, 76 distance effect, 72-73, 92 indirect, 76 model, 72 normal, 92, 93, 107 ray tracing. See ray tracing real-time, 92-97 reflection, 80 clear, 103 environment mapping, 103-105 shadow. See shadow specular reflection, 75, 77, 92, 107 link farming, 159 links farming, 159 inbound, 158 pass-through, 159 liquid-crystal display (LCD), 60 local coordinate, 62 lossless compression, 116 lossy compression, 116, 124 luminance, 124

M

MAC, 55 macroblock, 139 deblocking filter, 143 man-in-the-middle attack, 52, 56 map converting to table, 176 directed graph, 176 routing. See routing massively multiplayer online game (MMO), 164 master secret, 54 matrix, 128 matrix multiplication, 126 MD5, 21-25 digital signature, 25-26 encoding password for, 21-22 quality of, 25 round, 24-25 message authentication code, 55 mipmap, 102 MMO (massively multiplayer online game), 164 model, 61-63, 70, 87 ambient light, 96 bump mapping, 106 control point, 62 distant impostor, 106 drawing, transforming into, 62, 88, 93.105

global illumination, 76 interpolation, 63 lighting, 72 line, 62 scaling, 64 tessellation, 107-108 translation, 64 Mortal Kombat, 85 movie-quality rendering, 70, 82-83 MPEG-2, 138-142 adjusting quality, 139 B-frame, 139 GOP, 138, 142 I-frame, 138, 139 macroblock, 139 P-frame, 139 MPEG-4, 143 multisample anti-aliasing (MSAA), 110 - 111vs. supersampling, 111 multitasking, 162-163, 174

N

nearest-neighbor sampling, 99–100, 101, 143 normal, 92, 93, 107 NOT (bitwise operation), 23, 25 numerical address, 153

0

offset, 139 one-time pad, 9 one-way function, 39, 42 optical printer, 82 OR (bitwise operation), 23, 25 origin, 61

P

packet, 118 painter's algorithm, 90 partition, 147 pass-through link, 159 password, 6, 19 common, 28, 29 encoding, 21–22 hashing, 20–23 salt, 34, 35 storage service, 35–36 table, 26, 27 performance scaling, 150 persistence of vision, 59 P-frame, 139

Phineas and Ferb, 69 pivot, 147 pixel, 59, 66 alpha channel, 68 alpha level, 67, 78, 82 bitmap, 61 contrast, 112 depth, 91, 95, 96 luminance, 124 raw, 117 run, 117 sampling, 97 shader, 92. See also lighting subpixel, 110 texel, 98 variation in photographs, 123 plaintext, 2, 3, 4, 8, 27, 28 known-plaintext attack, 6 polyalphabetic substitution, 7-9 polygon, 88. See also triangle post-process anti-aliasing, 111 precomputed hash table, 29, 31 predicted frame, 139 predictive encoding, 122 prefix code, 121 premaster secret, 53 prime number, 40 as factor, 41 coprime, 40 prime-product, 42, 44, 45 print spooling, 162 private key, 38, 44, 45, 50 process, 162 projection, 71, 88, 96 field of view, 89 ray tracing, 77 public key, 38, 43, 44, 45, 50

Q

quantization, 123, 132, 141 queue, 163, 170 quicksort, 147–150 partition, 147 pivot, 147 sublist, 149

R

race condition, 165–169 rasterization, 65–68, 89 raw pixel, 117 ray tracing, 77–81, 105 anti-aliasing, 80 focus, 79

laws of optics, 79 performance, 87 projection, 77 reflection, 80 shadow, 79 read semaphore, 173 read-only data, 166, 173 real-time lighting, 92-97 record, 146 red difference (Cr), 124 reduction function, 29, 31 reflection, 80 clear, 103 environment mapping, 103-105 rehashing, 156 related-key attack, 17 release operation, 168 renderer, 69 rendering, 69 2D, 61-69 budget, 113 depth buffering, 91-92 depth ordering, 89-92 field of view, 89 focus, 79 lighting, 71-80 movie-quality, 70, 82-83 pixel shader, 92 polygon, 88 projection, 71 rasterization, 89 ray tracing, 77-81 realism, 72, 79, 94, 96, 105 reflection, 80 translucency, 78 triangle, 88, 90 viewpoint, 71 resolution, 61 RGB color system, 60, 124 vs. YCbCr, 124 Rivest, Shamir, and Adleman method. See RSA (Rivest, Shamir, and Adleman method) robot, 157, 160 rotation, 14 routing cost, 175, 178, 179, 182, 183, 184 directed graph, 176 finding the shortest path, 175 using real-time data, 189 RSA (Rivest, Shamir, and Adleman method), 42-51 authentication, 49-51 authority, 51

bidirectional transmission, 47 combining with AES, 48–49 effectiveness, 45–47 encryption process, 44–45 key creation, 42–44 key size, 47 performance, 47–48 prime-product, 42, 44, 45 real-world use, 47–49 totient, 43, 45 run of pixels, 117 run-length encoding, 117, 123, 133, 142

S

salt method, 34, 35 sampling, 97 bilinear filtering, 101, 112 mipmap, 102 nearest-neighbor, 99-100, 101, 143 trilinear filtering, 102-103 S-box, 13, 14 scaling, 64, 150 screen coordinate, 61, 88, 96 screen space ambient occlusion (SSAO), 96 - 97search, 29, 145 all-pairs shortest path, 183 best-first, 178-181 binary, 151-152, 153 engine, 157 images, 160 location use, 160 page ranking, 158-159 robot, 157, 160 sequential, 146, 153 Sitemap, 157 storage requirements, 153 term, 159-160 Web, 157-160 security, 1, 17, 19, 35 of AES, 16 best practices, 6, 27, 29, 34, 56 single point of defense, 27 Web. 52-56 selection sort, 146 performance scaling, 150 semaphore, 168-174 acquire, 168, 170 binary, 168 circular wait, 172 granularity, 173 implementation, 169 performance, 172-174

read, 173 release, 168 spin lock, 169 test-and-set, 169 wait list, 170 write, 173 sequential search, 146, 153 server, 52 session, 52 shadow, 79, 94-97 ambient occlusion, 96 mapping, 94-95 quality, 95 shadow map, 95 shared buffer, 163 shared key problem, 18, 37 signature. See digital signature simple substitution, 6 Simpsons, The, 69 single point of defense, 27 Sitemap, 157 sliding window, 122 slot, 154 sort, 146 quicksort, 147 selection sort, 146 specular reflection, 75, 77, 92, 107 spin lock, 169 square function, 39 square root function, 39 SSAA (supersampling anti-aliasing), 109 - 110vs. multisampling, 111 SSAO (screen space ambient occlusion), 96 - 97starting variable, 15 starvation, 170, 172, 173 static data collection, 154 storage address, 153 fixed-size, 152, 153 requirements for search, 153 variable-size, 152, 153 subpixel, 110 substitution, 6-9 polyalphabetic, 7 S-box, 13 simple, 6 tabula recta, 7 subtractive color mixing, 60, 76 supersampling anti-aliasing (SSAA), 109 - 110vs. multisampling, 111 surface normal. See normal symmetric key, 18

T

tabula recta, 7 temporal compression, 138 temporal redundancy, 138, 142 tessellation, 107-108 test-and-set, 169 texel, 98 texture mapping, 97-103, 143 bump mapping, 106 sampling, 97 TGA file format, 117 compression ratio, 118 packet, 118 Theora, 143 timing attack, 17 tombstone, 156 Toon Boom, 69 Toonz. 69 totient, 43, 45 transaction, 164, 166-167 translation, 64 translucency, 68, 78 transposition, 2-6 rotation, 14 trapdoor function, 40 triangle, 88, 90, 107 trilinear filtering, 102-103, 143 trivial factor, 40 tweening, 59 automatic, 63-64

U

ultra high definition video (UHD), 144

V

variable-size storage, 152, 153 vector, 126 video streaming, 116 videocassette, 115 view angle, 74 viewpoint, 71 virtual camera, 71

W

War and Peace, 122 web search, 157–160 web session, 52 world coordinate, 70, 88 write semaphore, 173

X

x-axis, 61 x-coordinate, 61 XOR (bitwise operation), 11, 14, 15

Y

y-axis, 61 YCbCr color system, 124 vs. RGB, 124 y-coordinate, 61 Y (luminance), 124

Z

z-coordinate, 69 .*zip* file format, 122