Noises
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Noise

Noise is a function:

\[ noise(\text{coordinate}) \rightarrow \text{value} \]

**Pseudo-random:** gives the appearance of randomness

**Determinism:** same input gives the same result every time
White noise

? Dimensions

? Dimensions
Better noise
Combination of noises

http://www.blendswap.com/blends/view/80871
Value noise

x3  x9  x27
Perlin noise

- **Author:** Ken Perlin
- **Idea:** 1-st Tron movie
- **Complexity:** $O(2^n)$
Perlin Implementation

1. Define n-dimensional grid
2. Assign a gradient vector to each grid coordinate
   ○ Lookup table / texture
3. Find dot product between the gradient vector and distance vector (2D - 4 x dot, 3D - 8 x dot)
4. Interpolate between the dot product values
Perlin Implementation

yellow - positive
blue - negative
Pseudocode

// Compute Perlin noise at coordinates x, y
def perlin(float x, float y) {

    // Determine grid cell coordinates
    int x0 = (x > 0.0 ? (int)x : (int)x - 1);
    int x1 = x0 + 1;
    int y0 = (y > 0.0 ? (int)y : (int)y - 1);
    int y1 = y0 + 1;

    // Determine interpolation weights
    // Could also use higher order polynomial/s-curve here
    float sx = x - (double)x0;
    float sy = y - (double)y0;

    // Interpolate between grid point gradients
    float n0, n1, ix0, ix1, value;
    n0 = dotGridGradient(x0, y0, x, y);
    n1 = dotGridGradient(x1, y0, x, y);
    ix0 = lerp(n0, n1, sx);
    n0 = dotGridGradient(x0, y1, x, y);
    n1 = dotGridGradient(x1, y1, x, y);
    ix1 = lerp(n0, n1, sx);
    value = lerp(ix0, ix1, sy);

    return value;
}
Simplex noise

- **Author:** Ken Perlin
- **Complexity:** $O(n^2)$
  - Scales well on high dimensions.

Uses simplicial grid

*(triangles* instead of squares, *tetrahedron* instead of cubes)*
Applications - textures
Creating textures

\[
\text{simplex}(p) \quad \text{abs}(\text{simplex}(p))
\]

\[
1 - (\text{abs} (\text{simplex}(p)))
\]

billow

ridged
Creating textures
Creating textures

Another simplex noise for distortion

Or use ridged noise instead
Terrain
Level
Animations

3D animated noise:
https://www.youtube.com/watch?v=4KOJiQ4jZhY

3D clouds:
https://www.shadertoy.com/view/XslGRr