

3D Graphics Module

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Abstract

- Project Areas: 3D Graphics, Modular design
- Purpose: to test data schemes for 3D rotations
- Four different test cases for data storage
- Graphing calculator program to perform tests

Abstract

- Scheme 1: Matrix expression trees, recalculate each time, column vectors
- Scheme 2: Matrix expression trees, recalculate each time, row vectors
- Scheme 3: Matrix expression trees, row vectors
- Scheme 4: Hard-coded rotation formulas

Abstract

- PGM format used to measure whitespace
- Graph used: $z=1/(x^2+y^2)$, $\theta=-.1$, $\phi=\pi/4$
- Scheme 1: plotted
- Scheme 2: triangles
- Scheme 3: Scheme 1+Scheme 2
- Scheme 4: gradients determine when to apply Schemes 1 & 2

Introduction

- Matrices used for rotations & stretches
- $A = \begin{bmatrix} \cos(a) & -\sin(a) \\ \sin(a) & \cos(a) \end{bmatrix}$
- Matrix above rotates points by an angle a
- Homogeneous coordinates: $(x, y, z, 1)$ so that translations become linear

Introduction

- Current programs in this area:
- Maple
- MatLab
- Mathematica
- Graphing programs built-in to calculators

Development & Construction

- Programs written in Java
- All programs run on 1.5 Ghz processor, 512 MB RAM
- No other processes running, except for IDE
- 10 million trials b/c of outliers
- First million trials ignored

Development & Construction

- Garbage collector run each iteration to avoid memory leaks
- Number of trials reduced to 10,000
- Runtime length outputted to text files for all versions
- Separate program used to calculate means, modes

Development & Construction

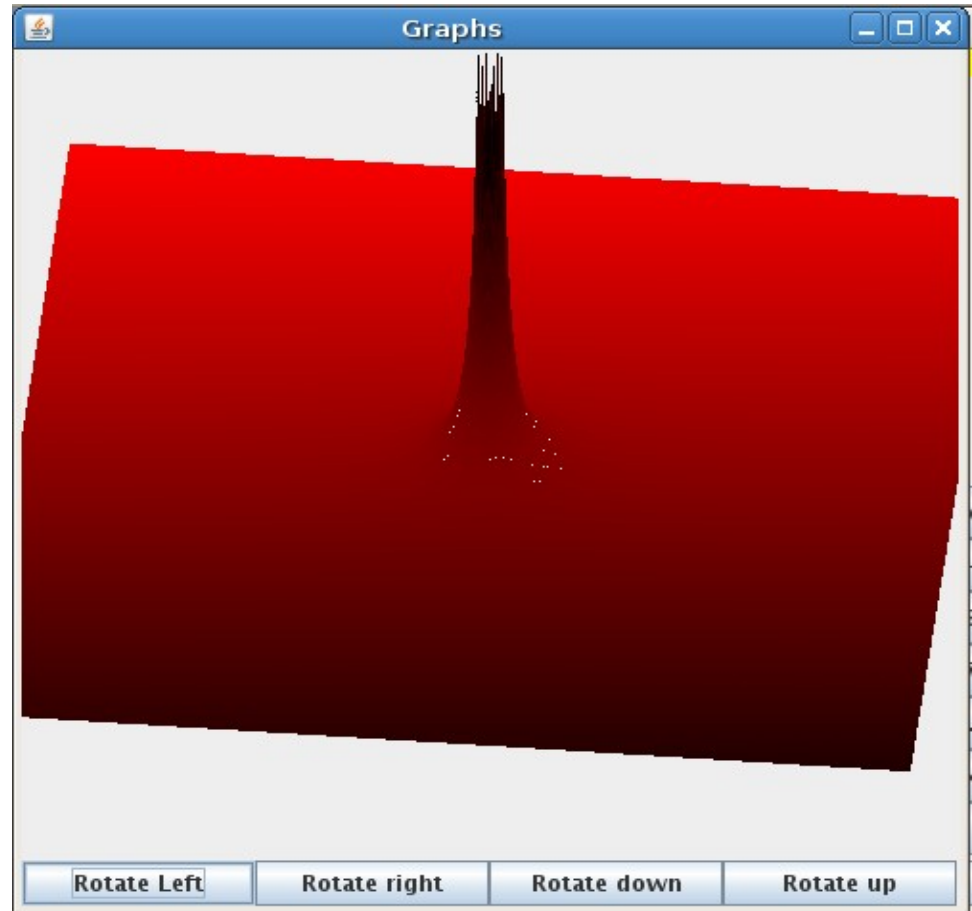
- Matrix editor module used to test matrix trees
- Calculator module used to test binary expression trees
- Graphing module used to test data storage scheme

Development & Construction

- Z-Buffer algorithm: different schemes work for different graphs
- Success determined by magnitude of gradient
- Combination fails when $|\nabla f| \approx 1$

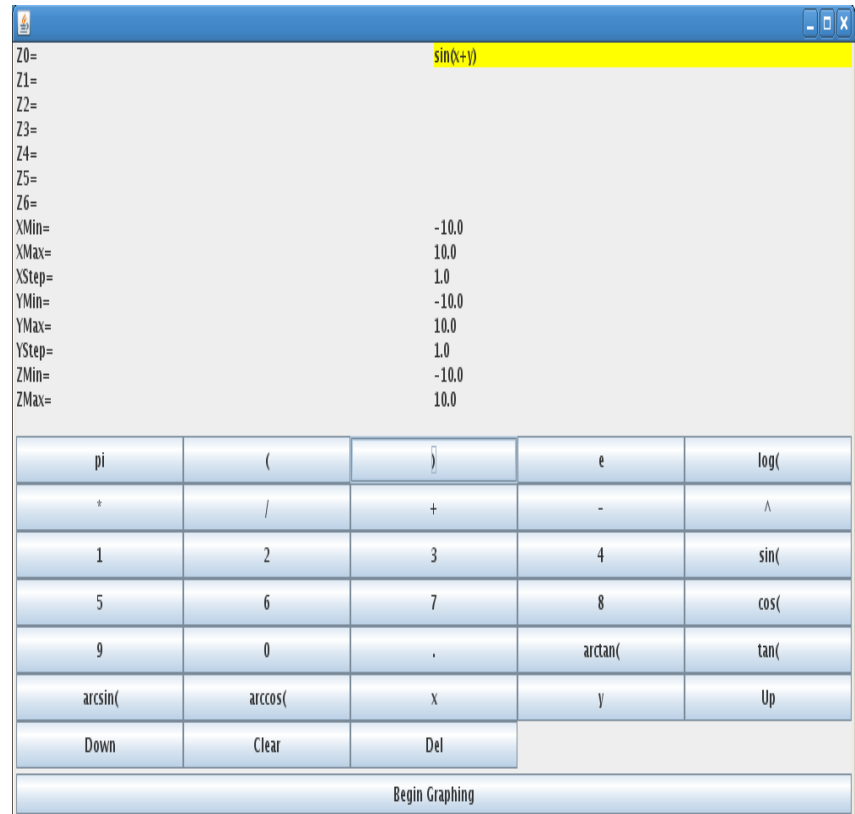
Results & Conclusion

- 40 million data points
- 240 MB of data collected
- Symmetric differences: too costly



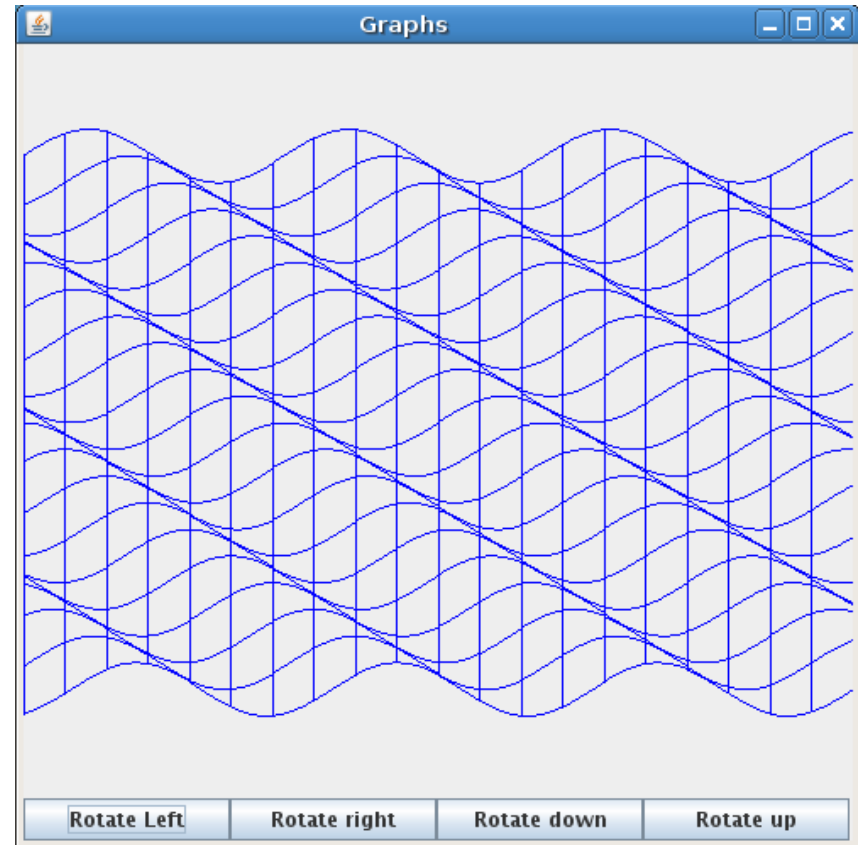
Memory Leaks

- Scheme 1: 2685
- Scheme 2: 2513
- Scheme 3: 2592
- Scheme 4: 2440
- Steady-state reached after ~20K trials



Garbage Collect

- Scheme 1: 42558
- Scheme 2: 45343
- Scheme 3: 44679
- Scheme 4: 50457
- Absence of “spike-and-plateau” pattern



Z-Buffering

- Scheme 1: 73%
- Scheme 2: 89%
- Scheme 3: 66%
- Scheme 4: 67%
- Gradients: not significantly compromise

