Subdivision for Line Drawings

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Overview

1. Introduction
2. Subdivision
3. Silhouette Propagation
4. Drawing by Subdivision
5. Results
6. Conclusion

Introduction

- Subdivision surfaces
  - general surfaces representation

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  - general surfaces representation

- Non-photorealistic rendering
  - here: line drawings

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  - general surfaces representation

- Non-photorealistic rendering
  - here: line drawings

- no explicit connection yet

Subdivision

- Geometry representation

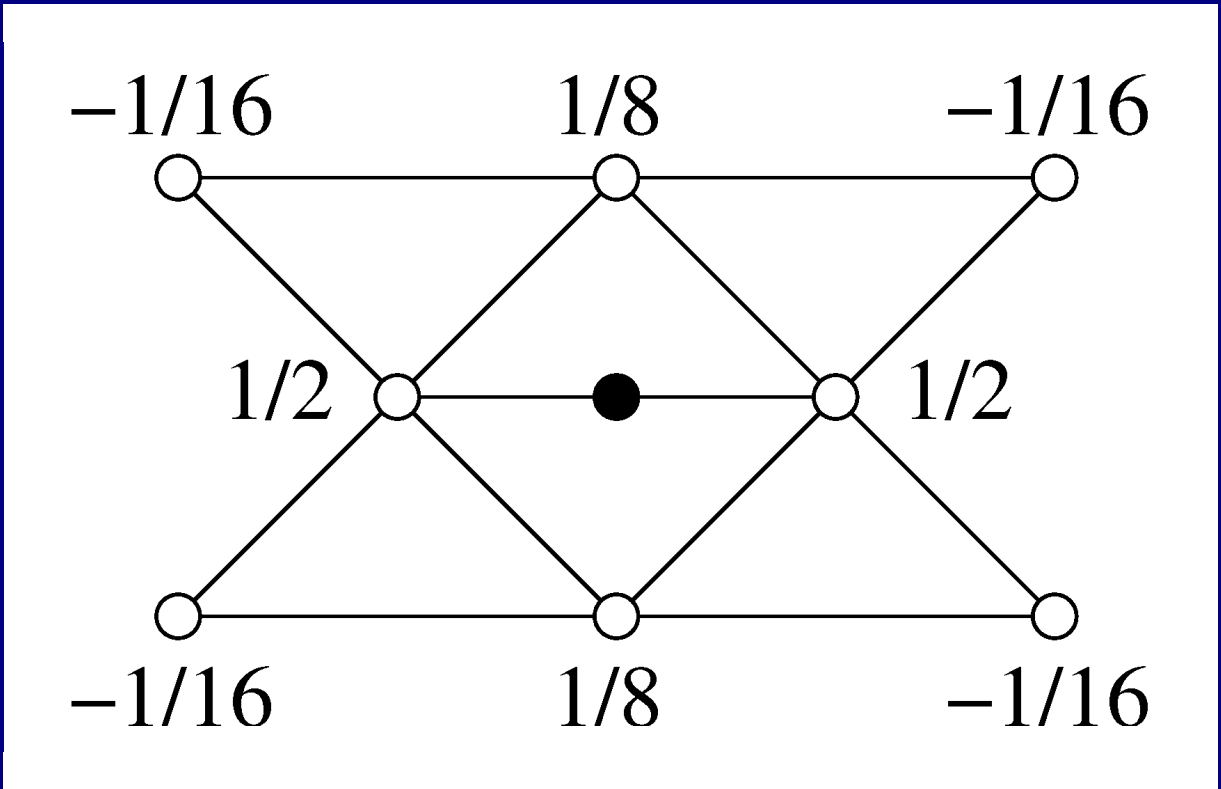
Subdivision

- Geometry representation
- Interpolating or approximating

Subdivision

- Geometry representation
- Interpolating or approximating
- Arbitrary mesh

Subdivision: Modified Butterfly



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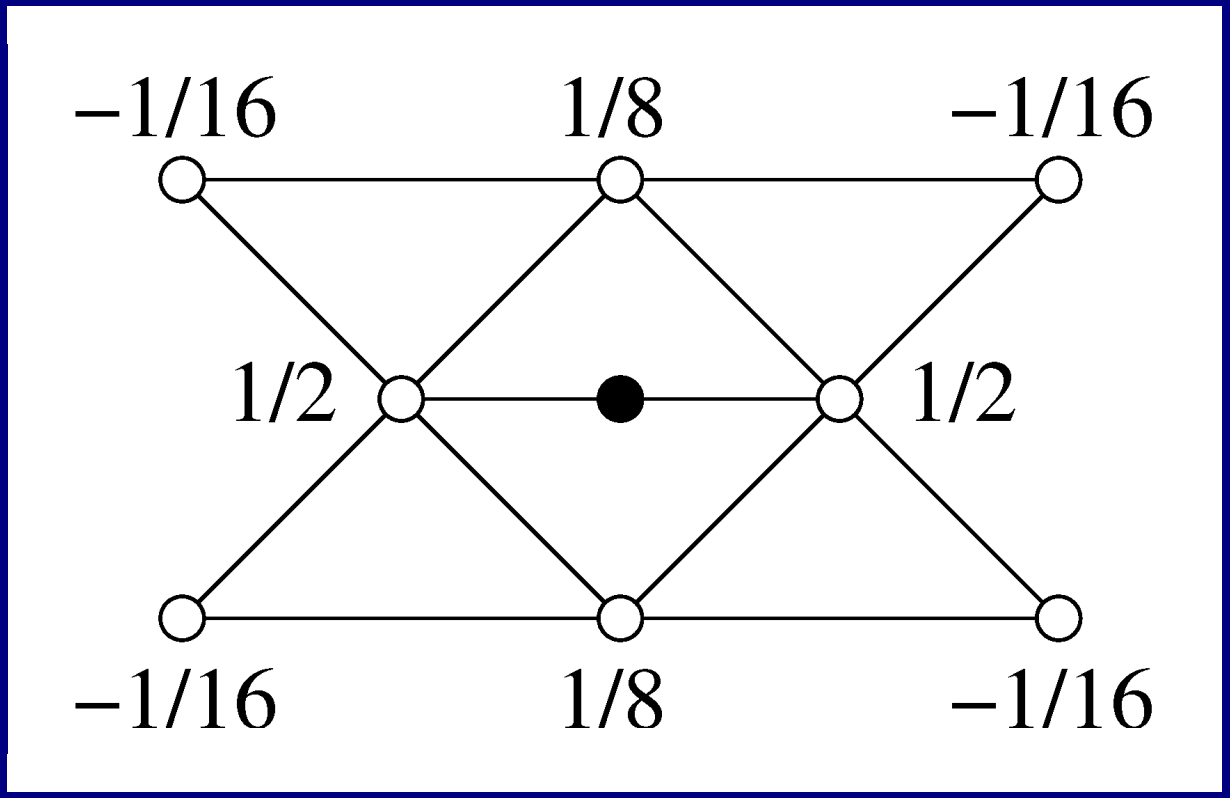
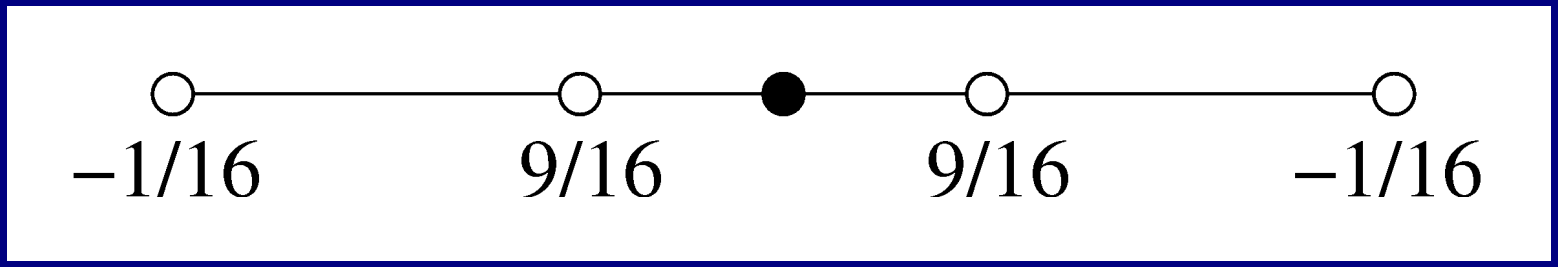
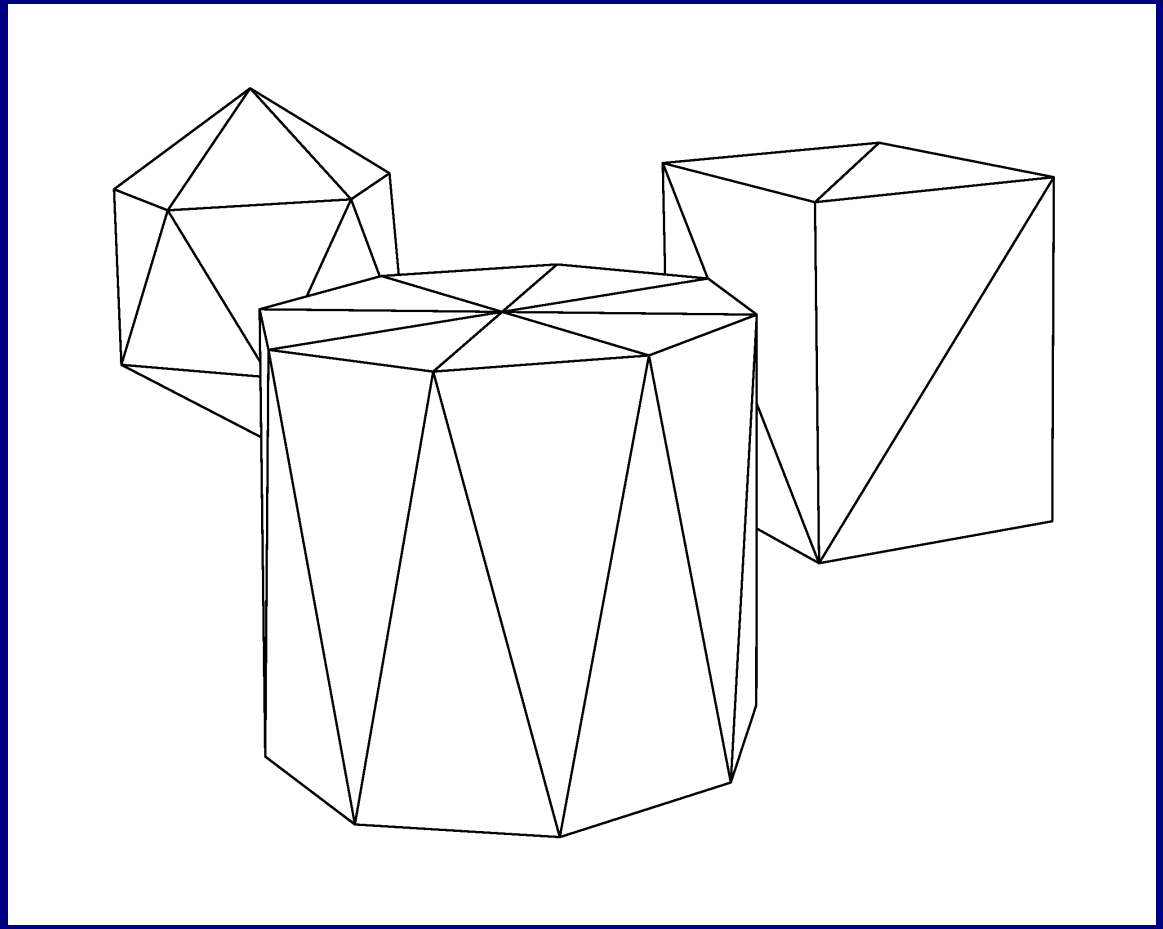
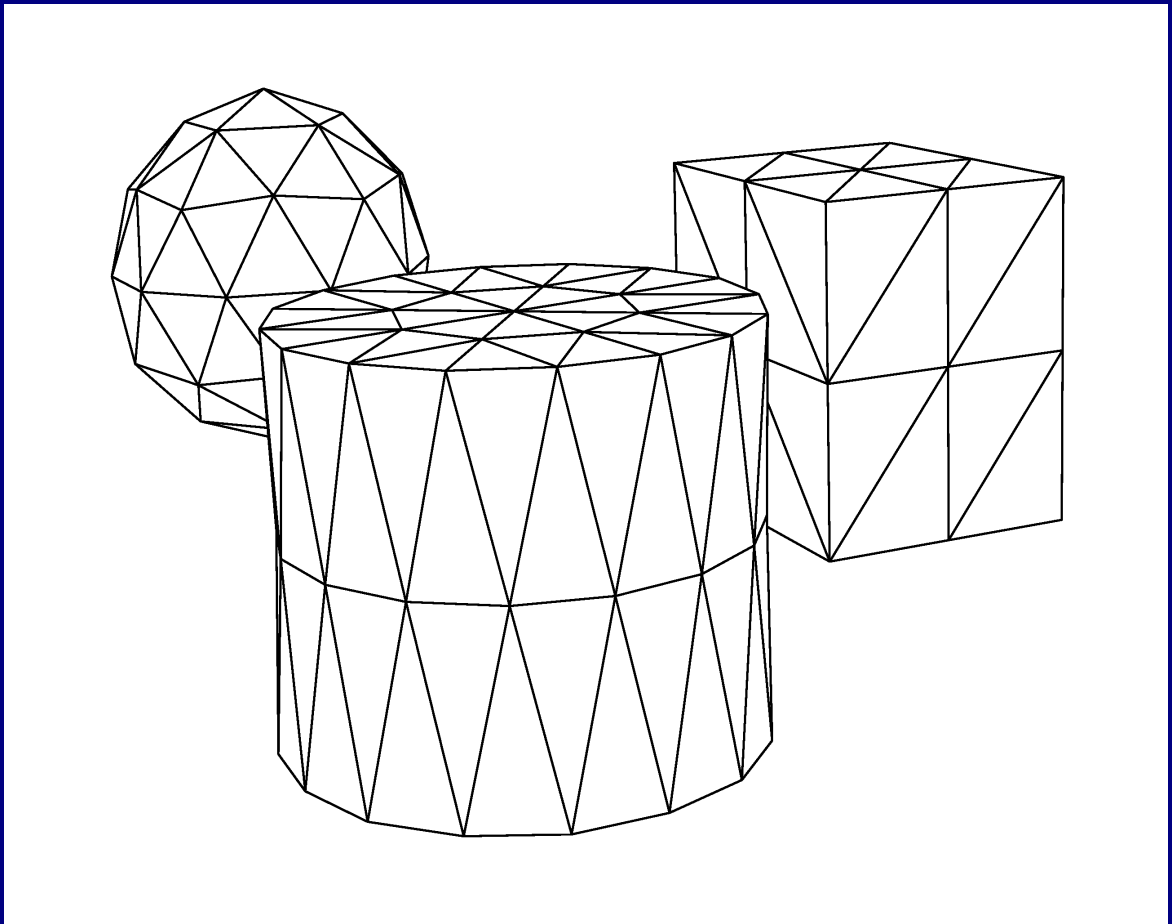




Subdivision: Control mesh



Subdivision: Subdivided once



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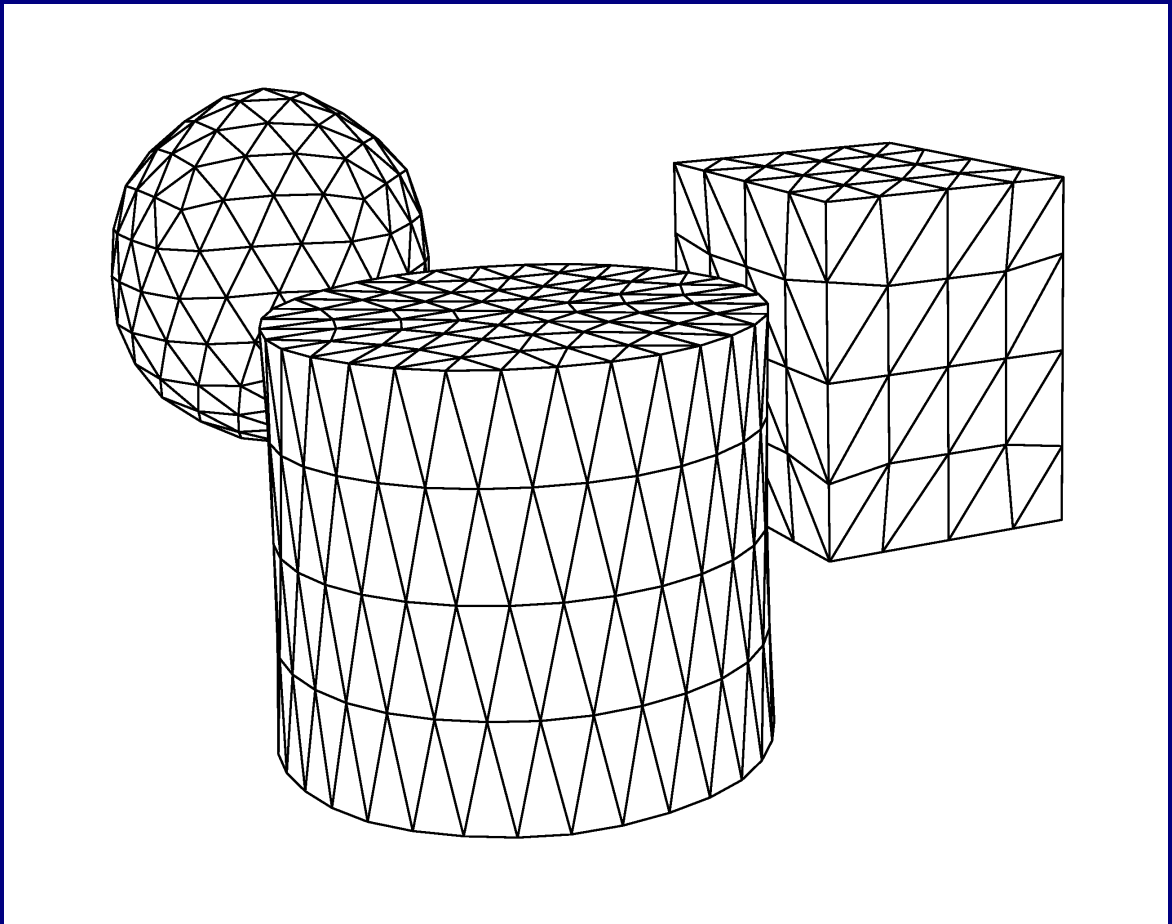
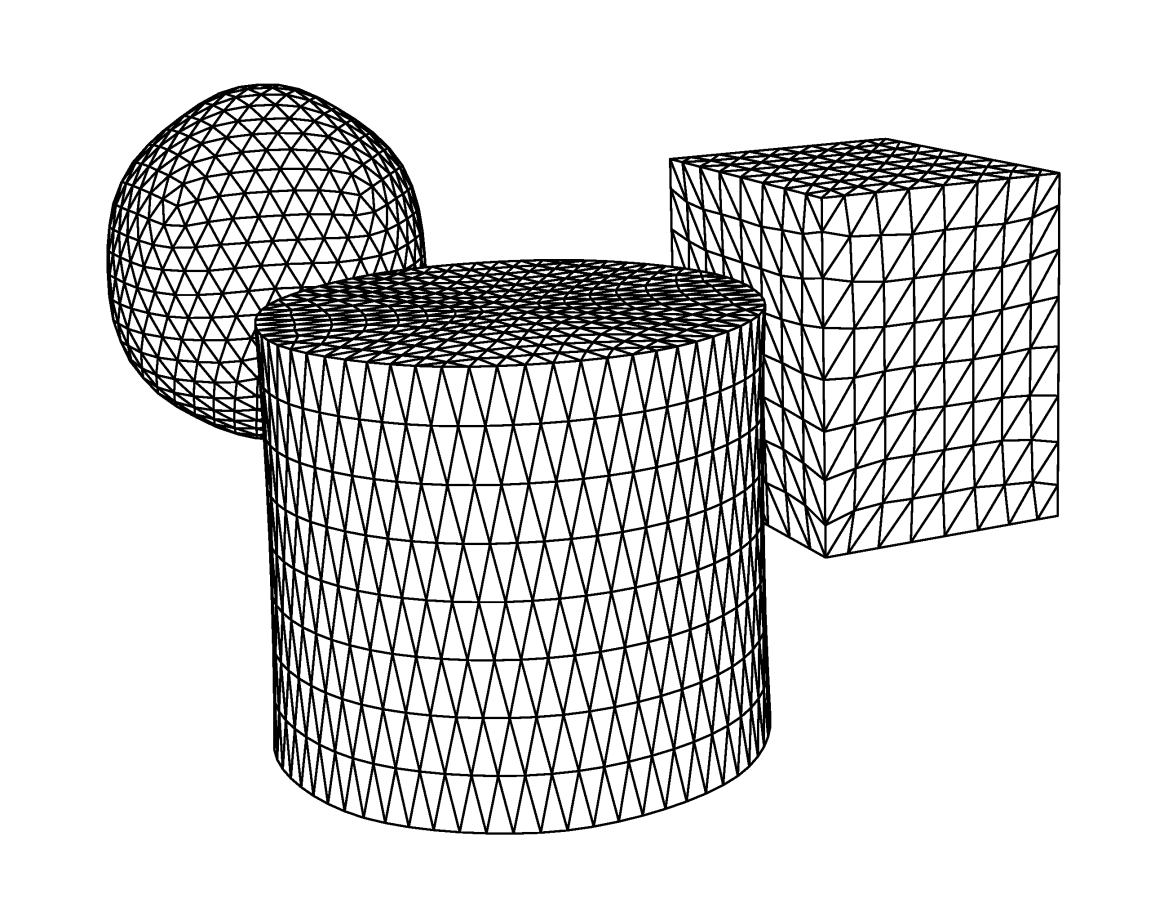


Subdivision: Subdivided three times



Subdivision: Line drawings

- Silhouettes
  - border from a specific viewpoint
  - adjacent to front-facing and back-facing polygon

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- Silhouettes
  - border from a specific viewpoint
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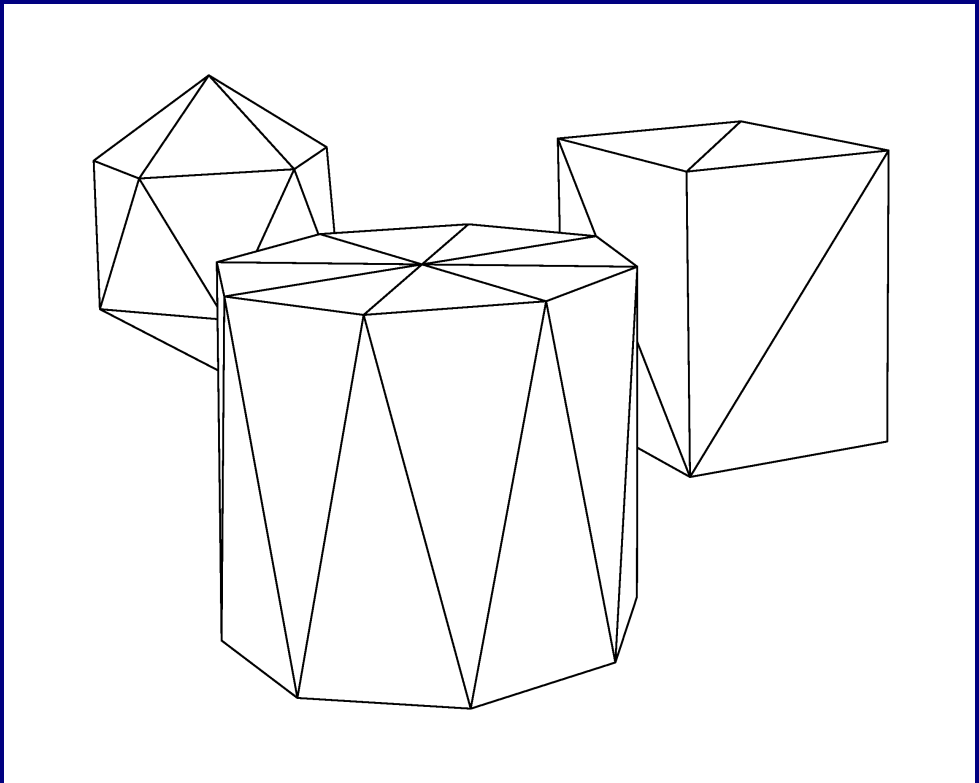
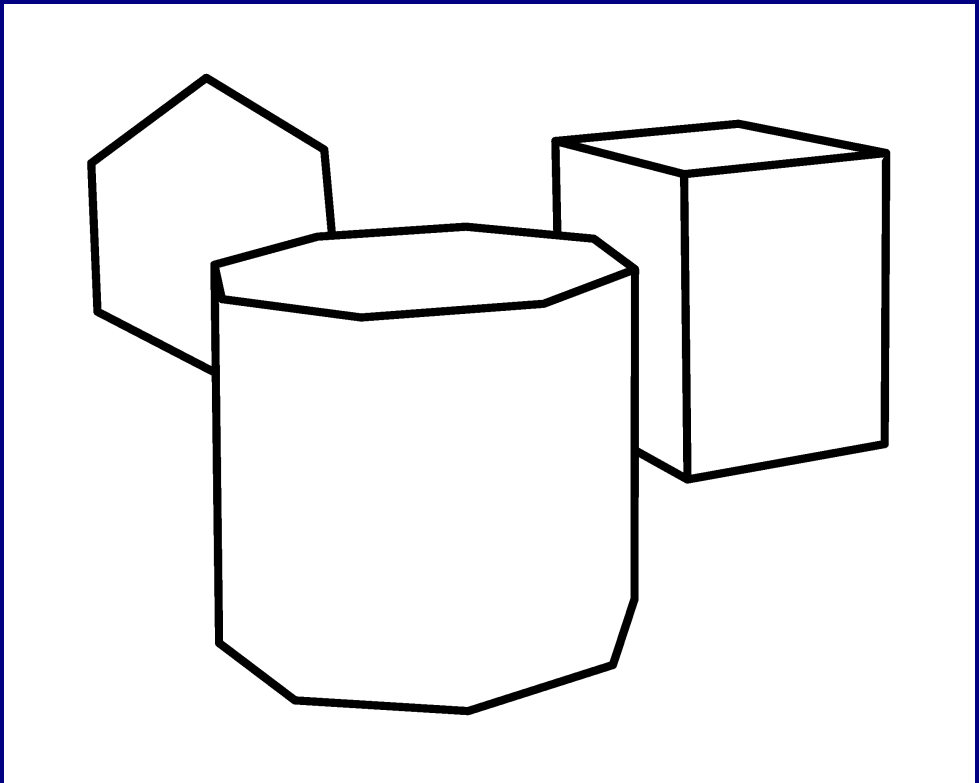
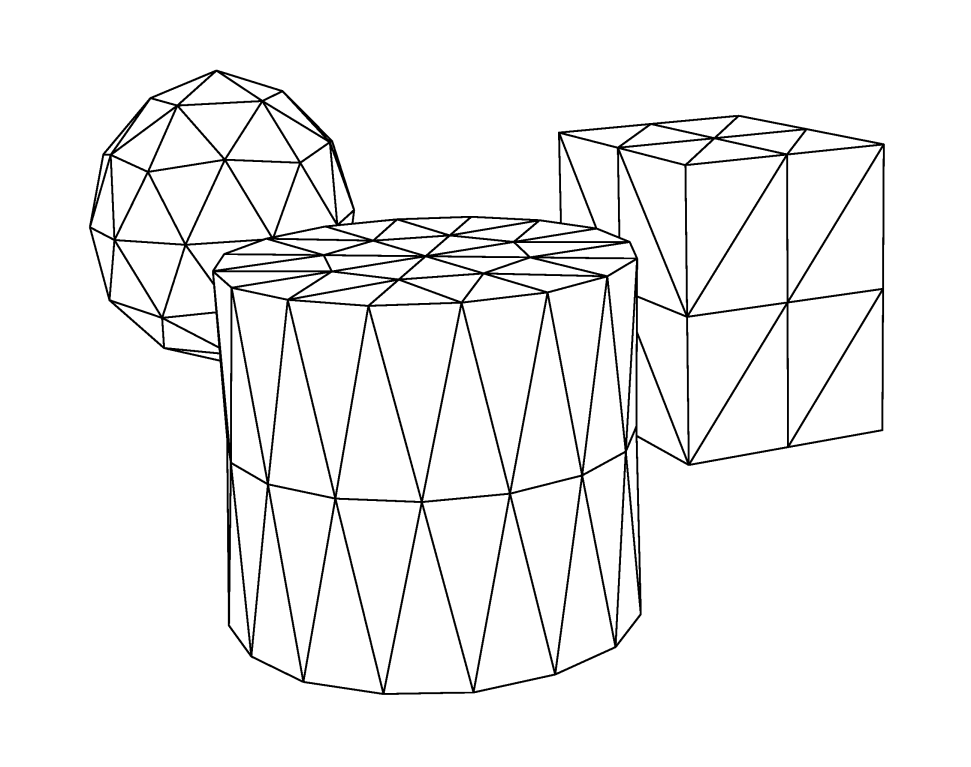
- Creases
  - sharp features on surface
  - inherent to subdivision model

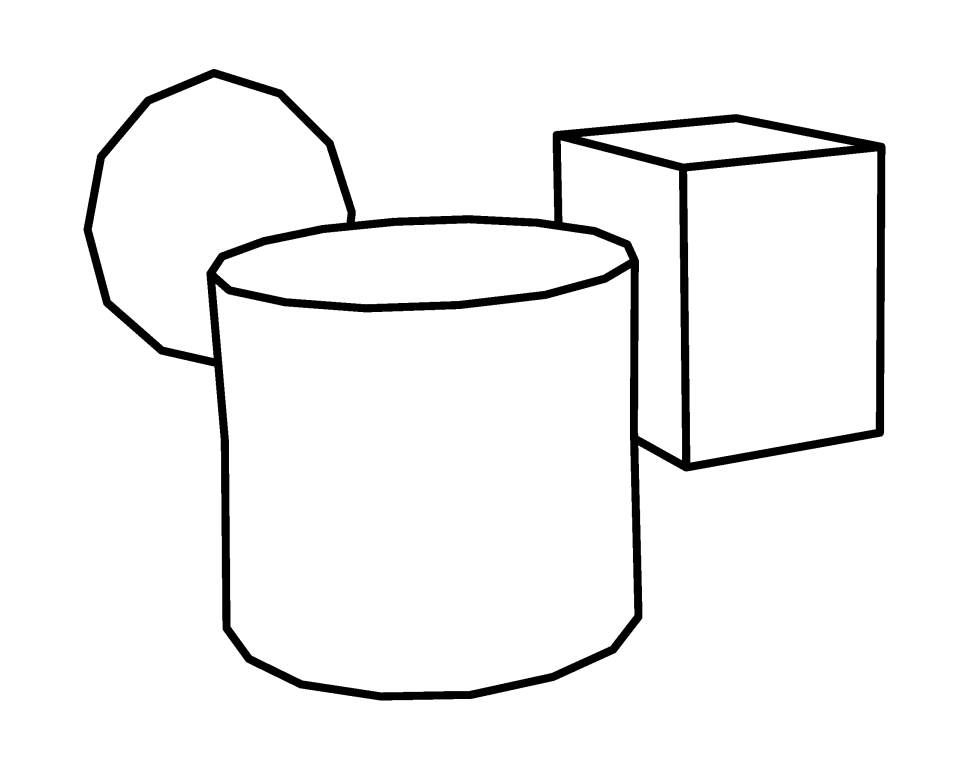
Subdivision: Level 0



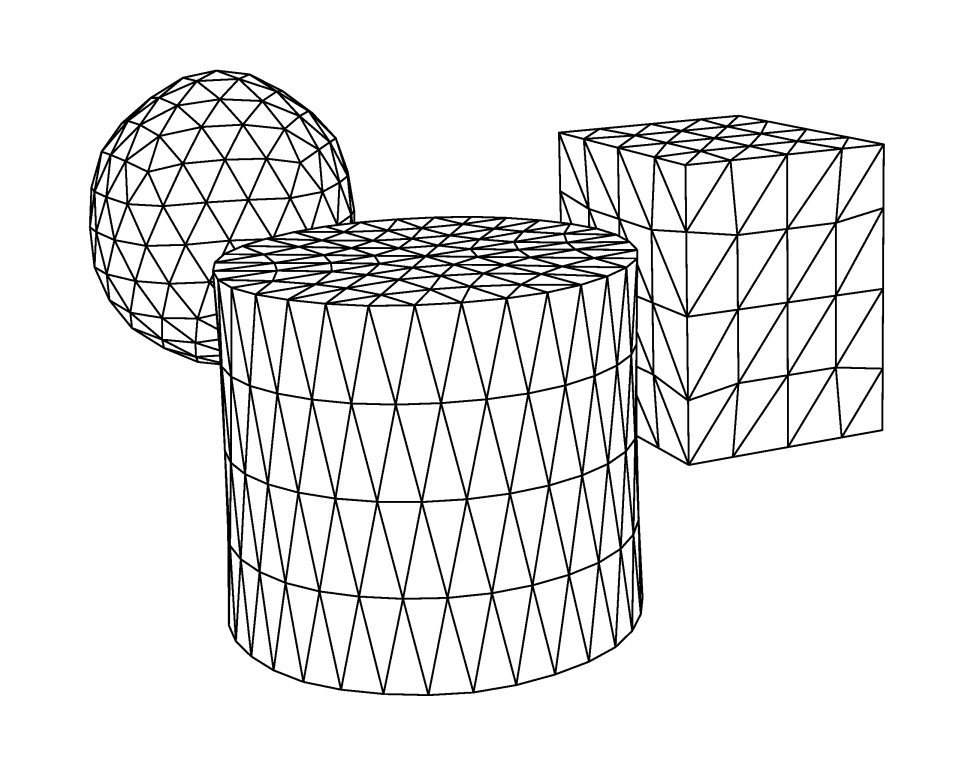


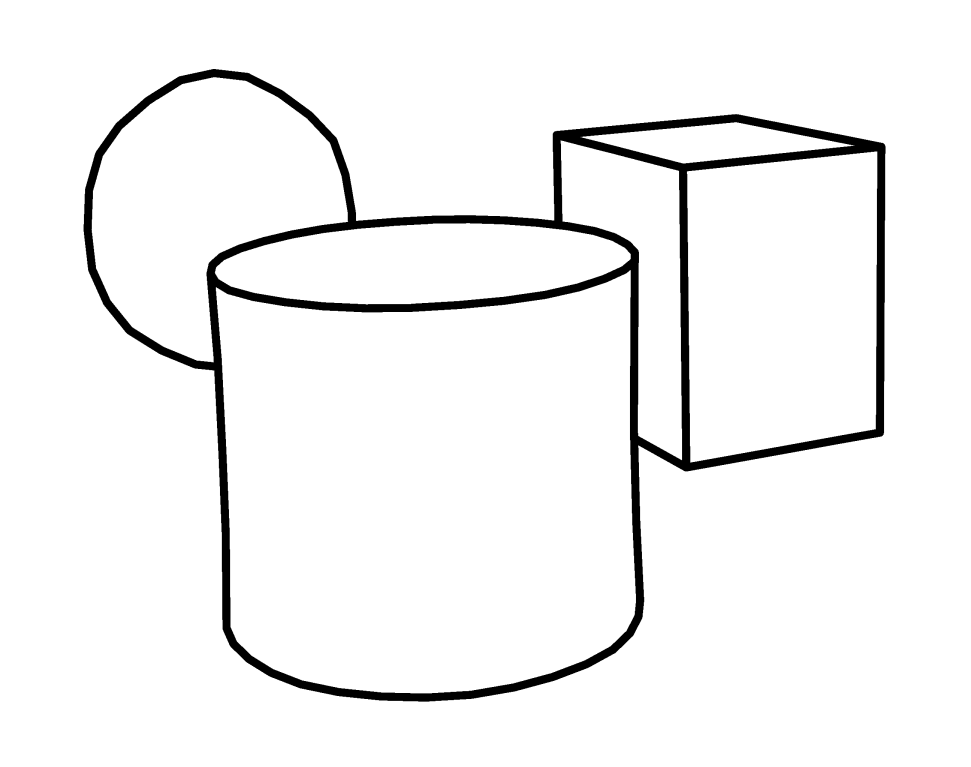
Subdivision: Level 1



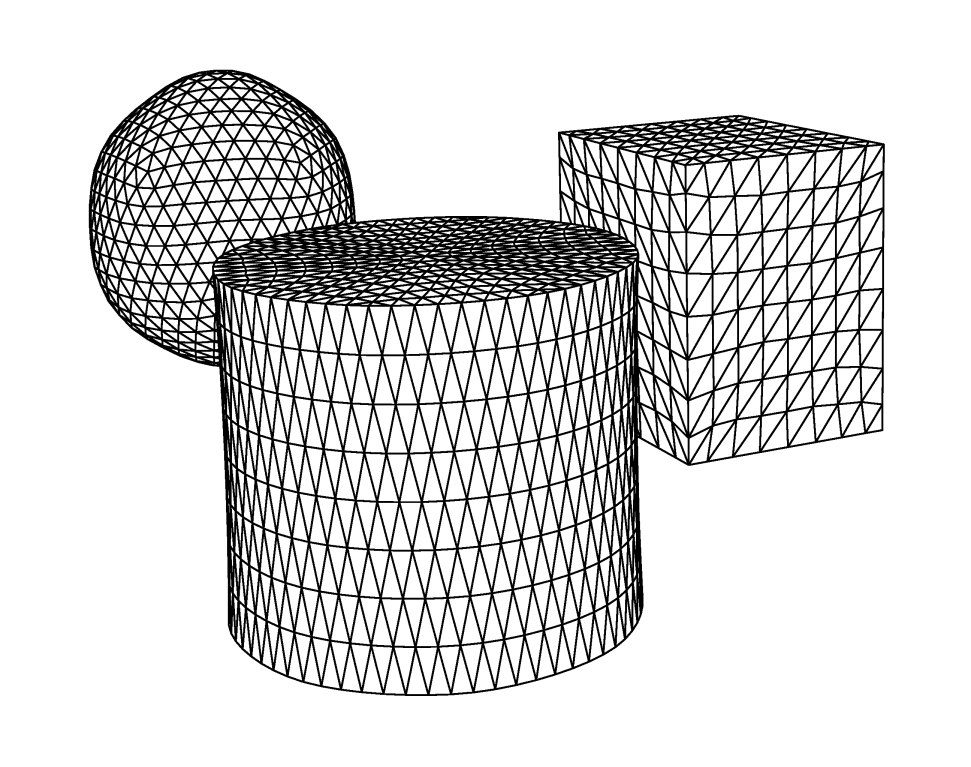


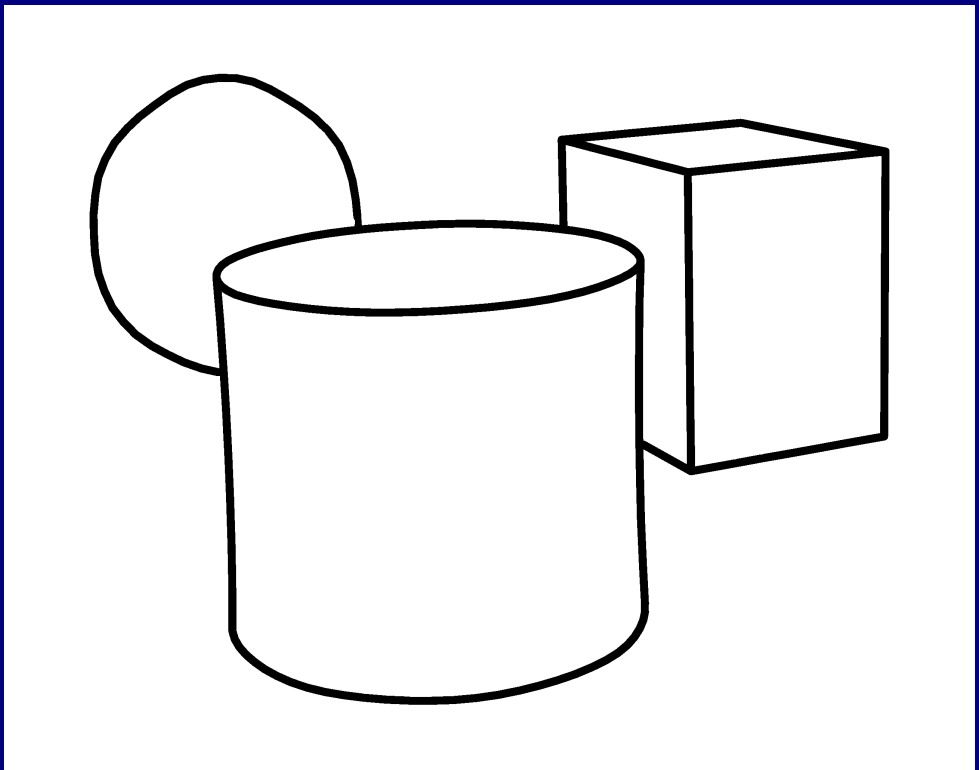
Subdivision: Level 2





Subdivision: Level 3





Subdivision: Line drawings

Problem: triangle count quadruples in each refinement step

- Rapid determination of silhouettes
- Fast drawing of silhouettes and creases

Silhouette Propagation

- New method for determining silhouettes

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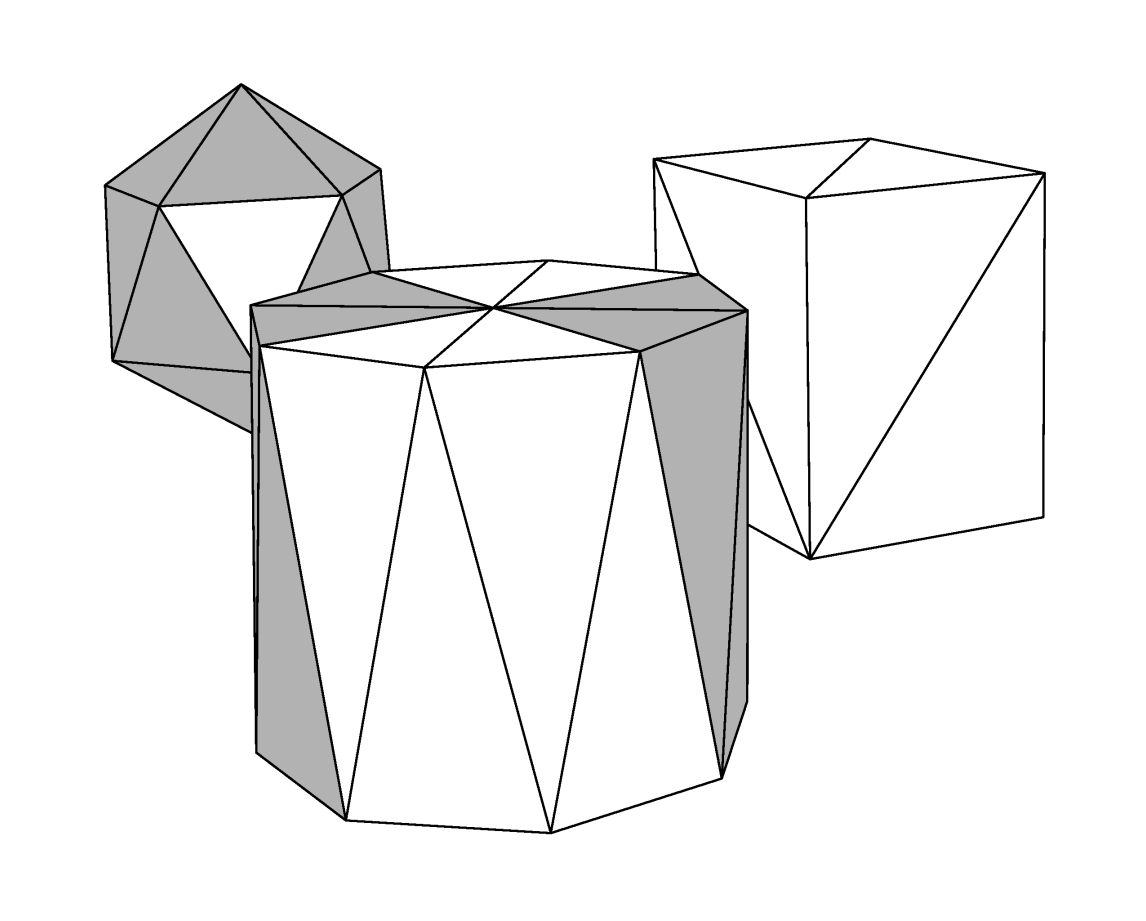
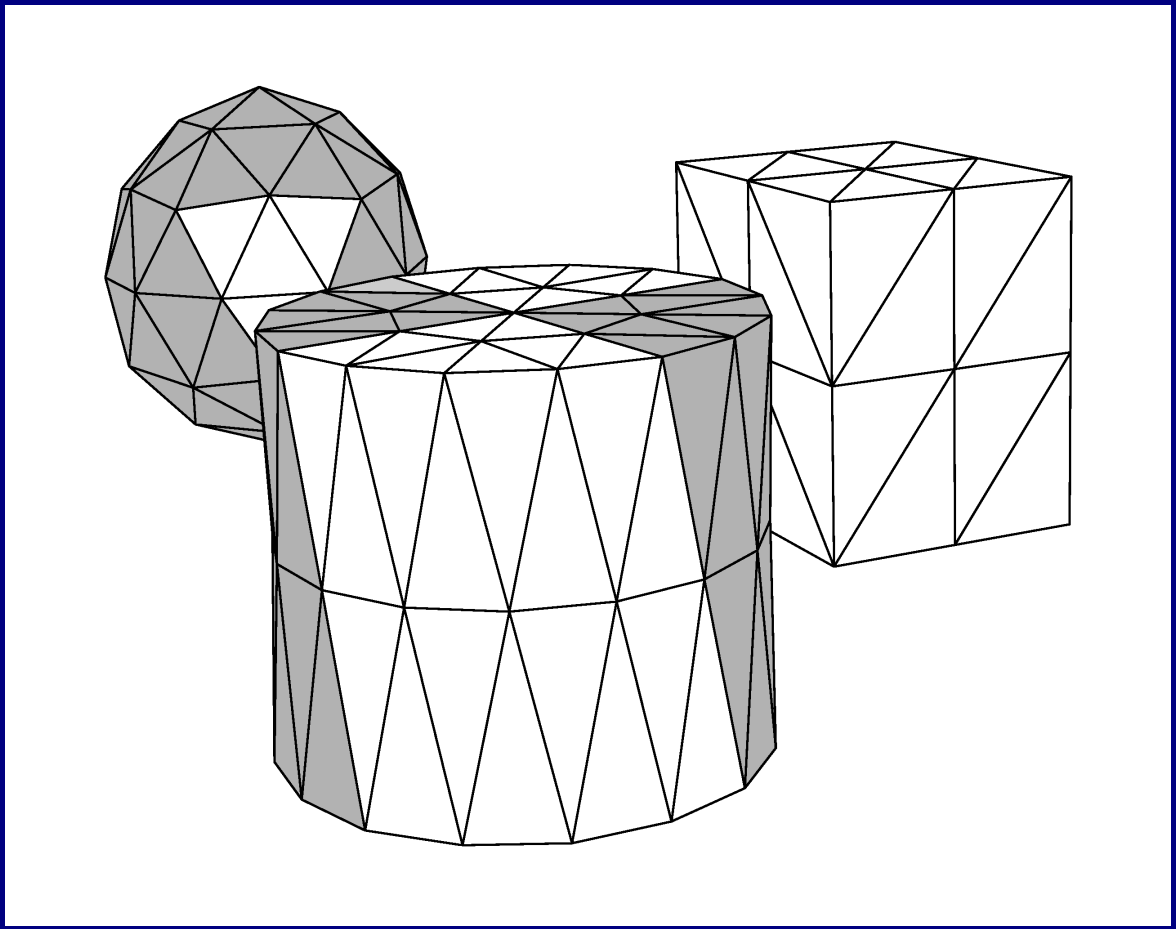
- Idea: propagate silhouettes while refining the mesh

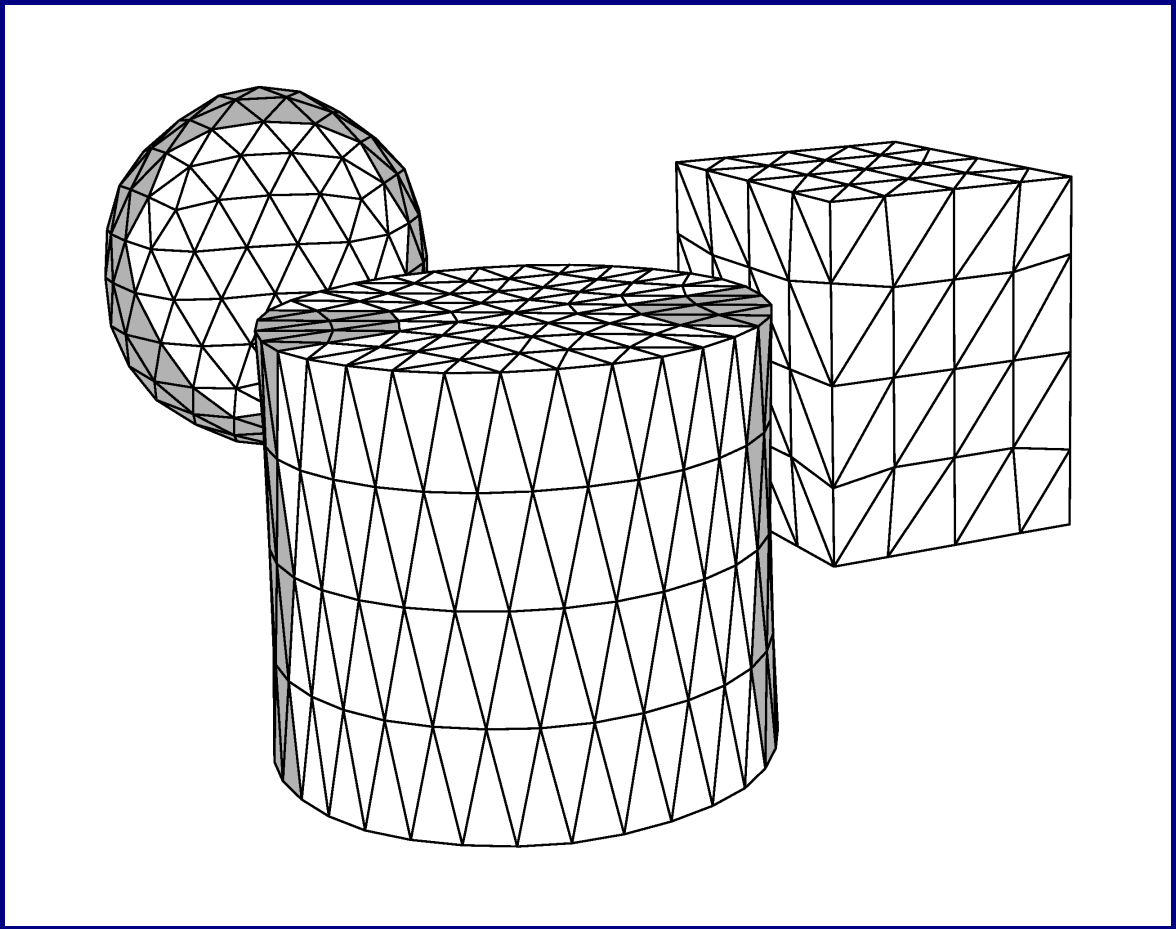
Silhouette Propagation: silhouette triangles



Silhouette Propagation: triangles refined



Silhouette Propagation: refined again



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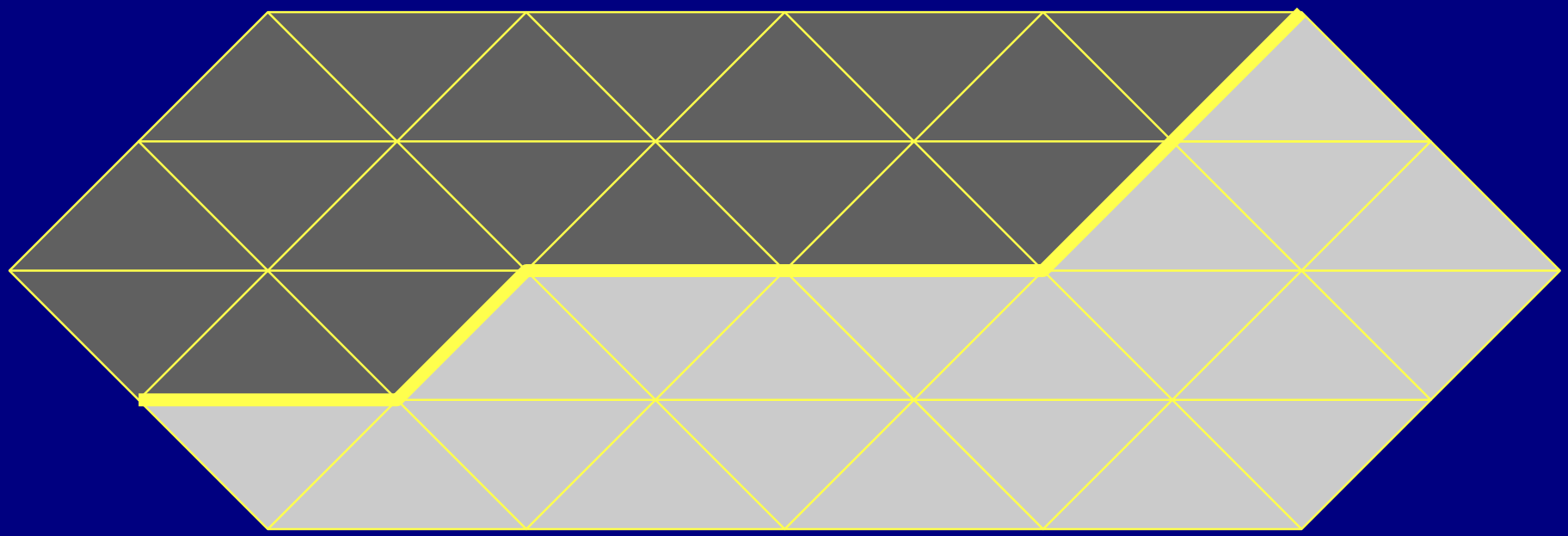
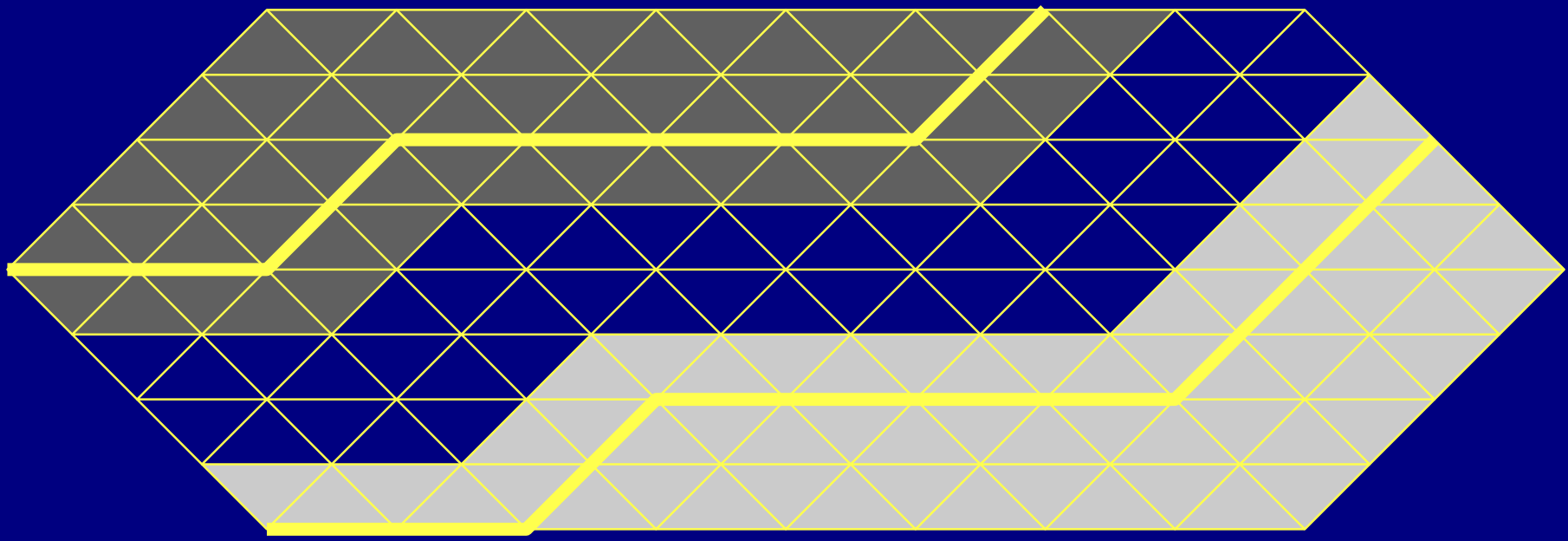
  - update while subdividing

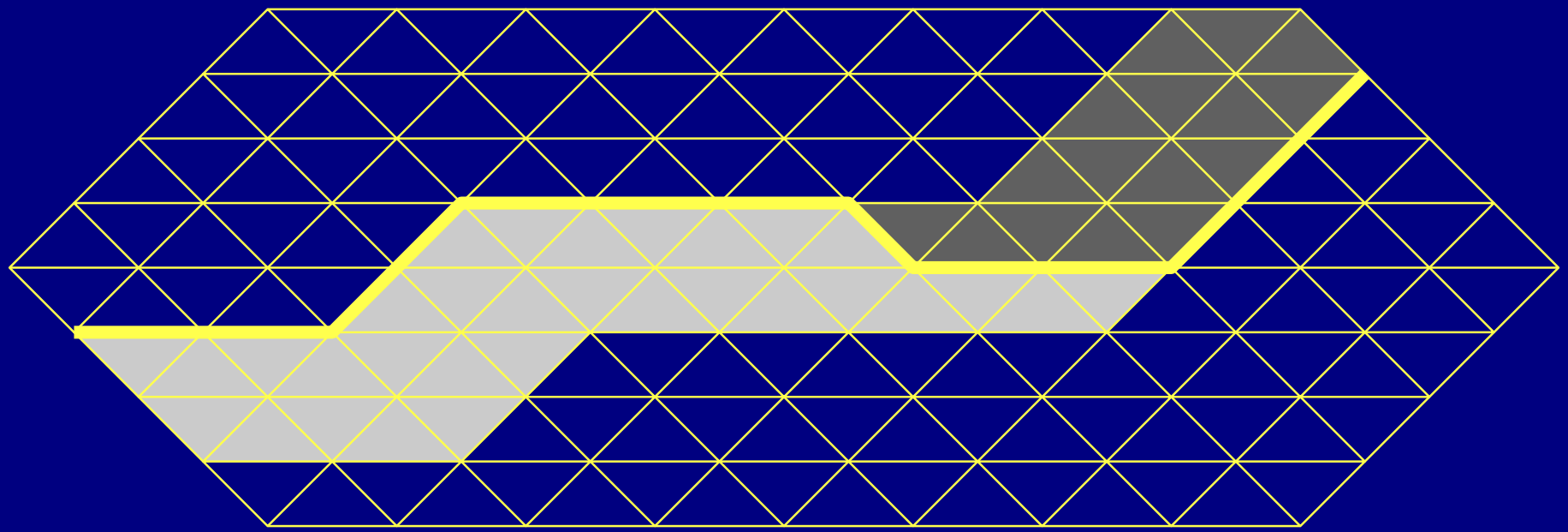
Silhouette Propagation: before subdivision



Silhouette Propagation: subdivided



Silhouette Propagation: new silhouette



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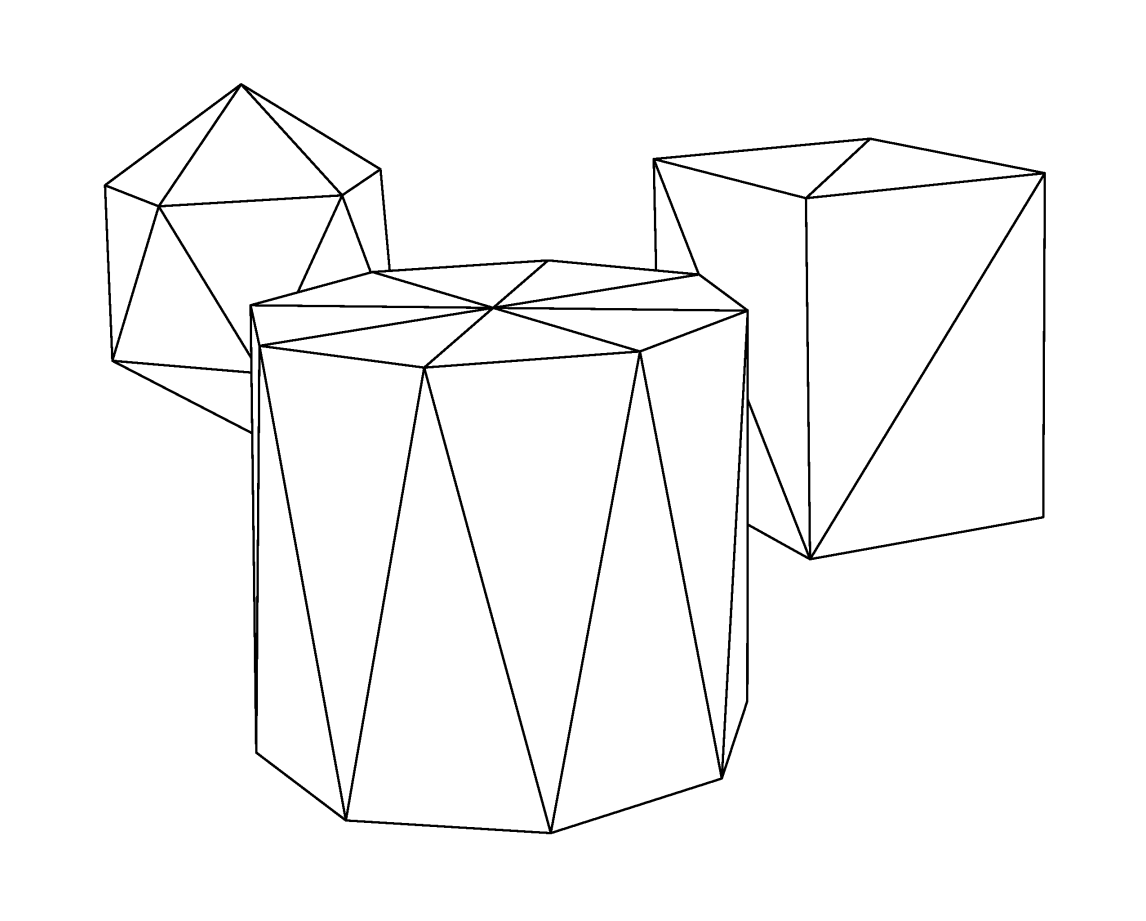
- Problem: subdivision itself is expensive
- Applications:
  - dynamic subdivision
  - off-line rendering

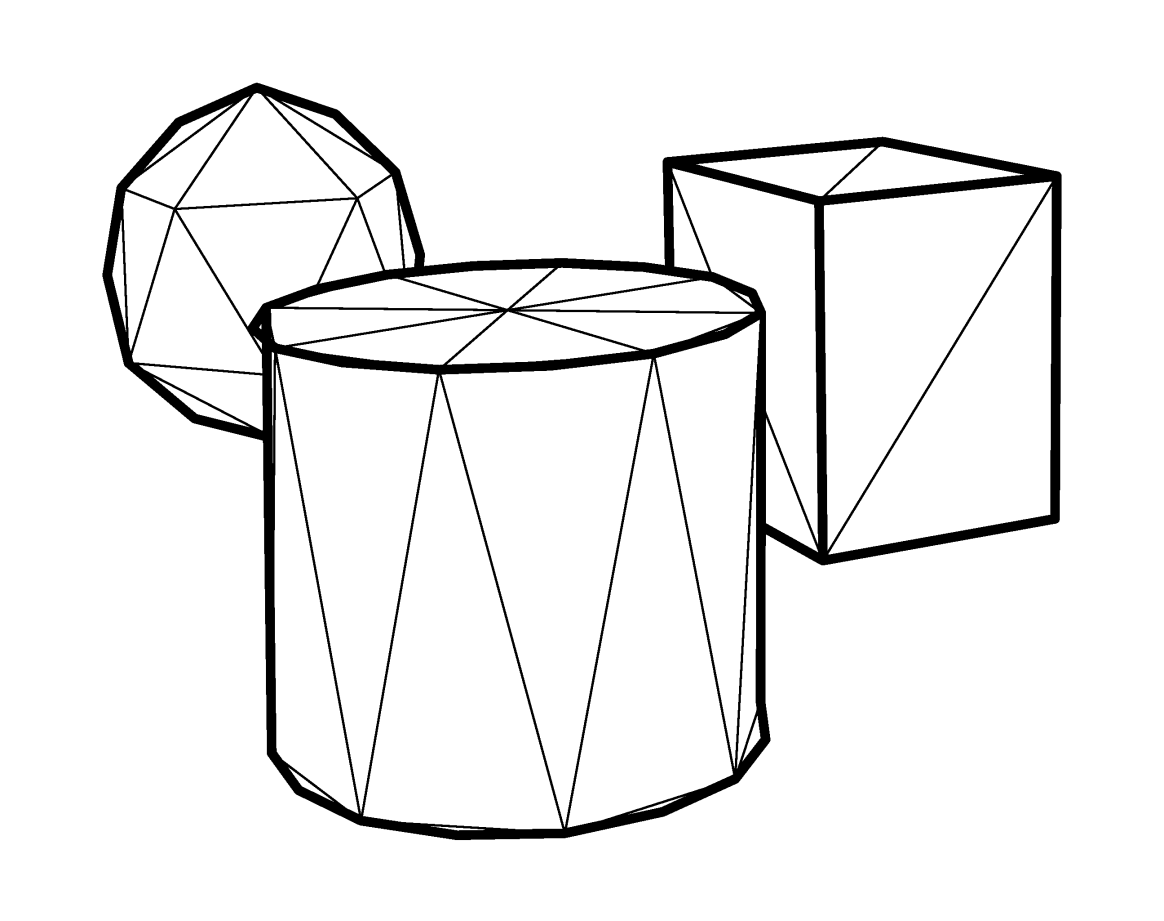
Drawing by Subdivision

- New method for accelerating drawing
- Idea: subdivide in 2D instead of 3D

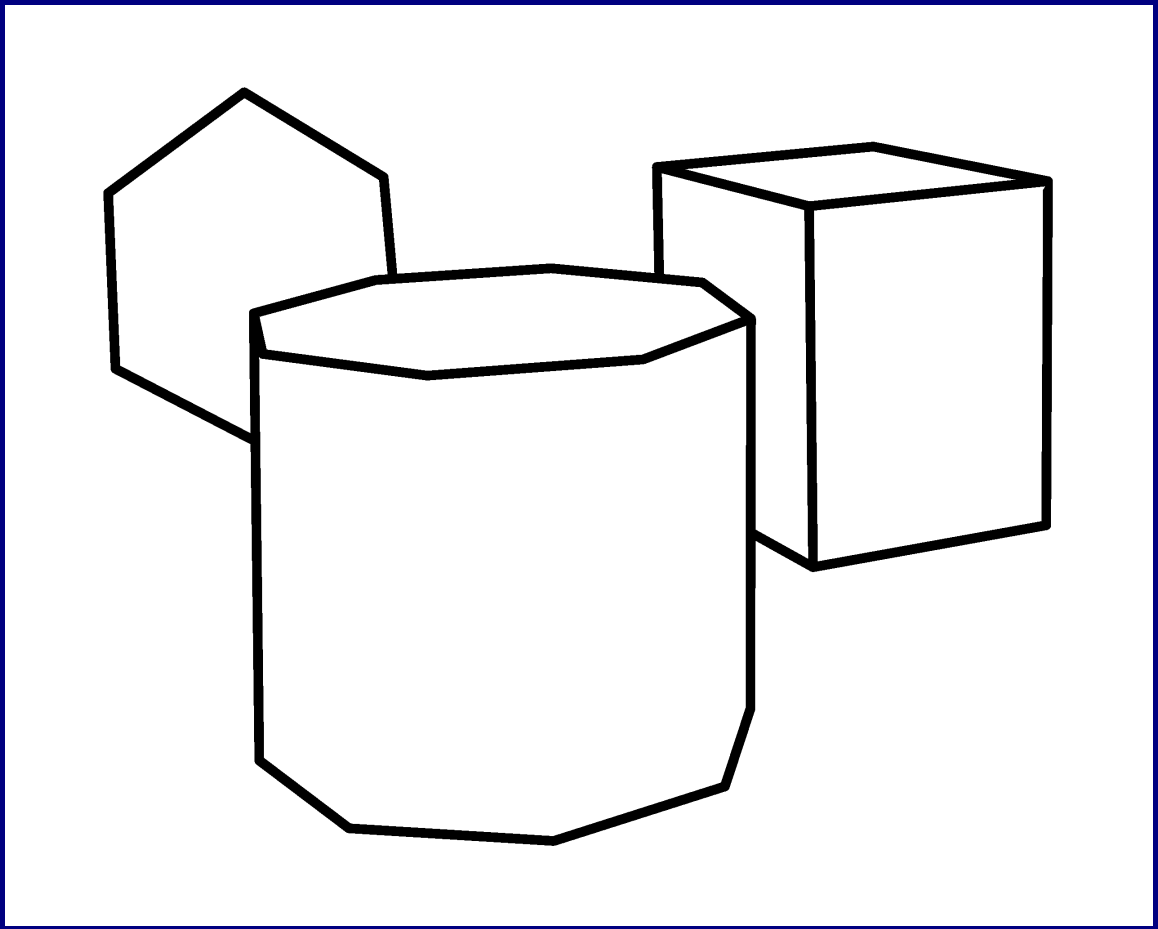
Drawing by Subdivision: Mesh



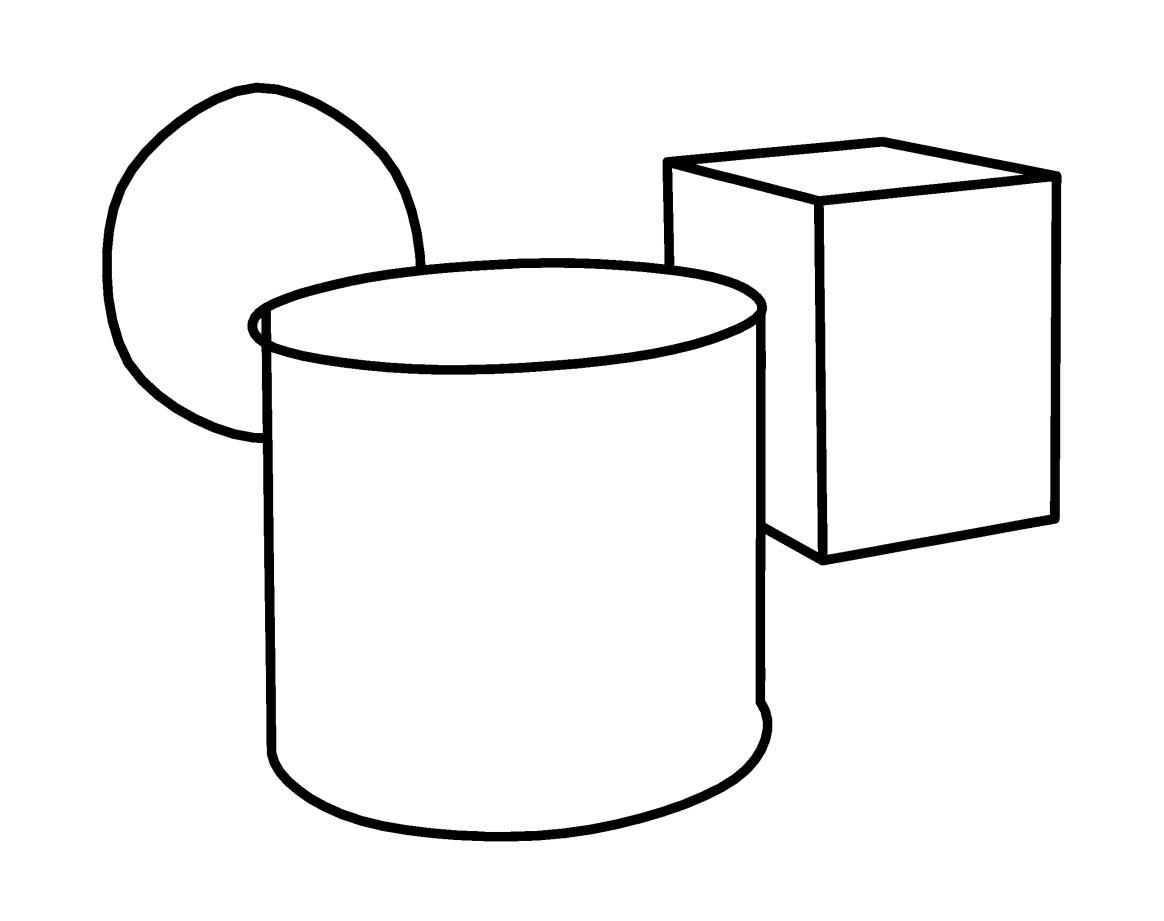
Drawing by Subdivision: One 2D subdivision



Drawing by Subdivision: No 2D subdivision



Drawing by Subdivision: Three 2D subdivisions



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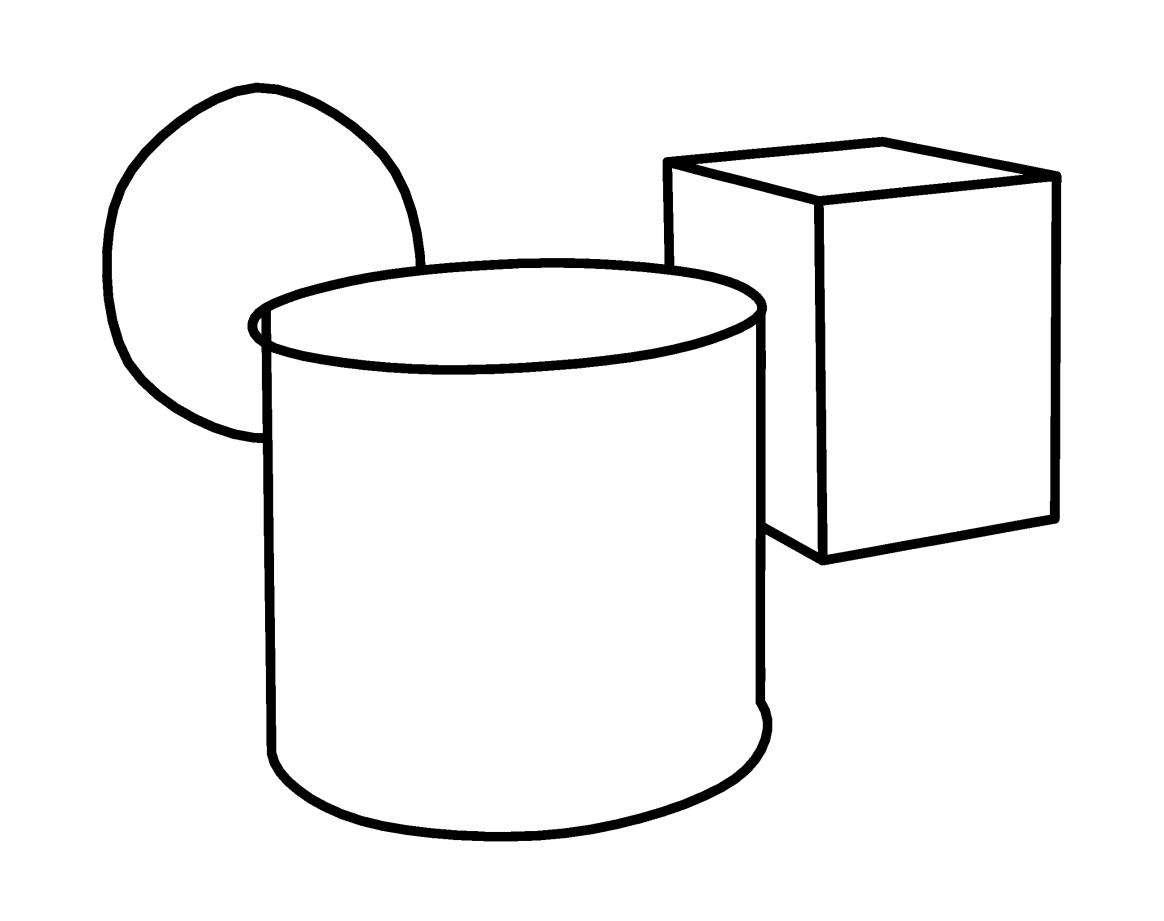
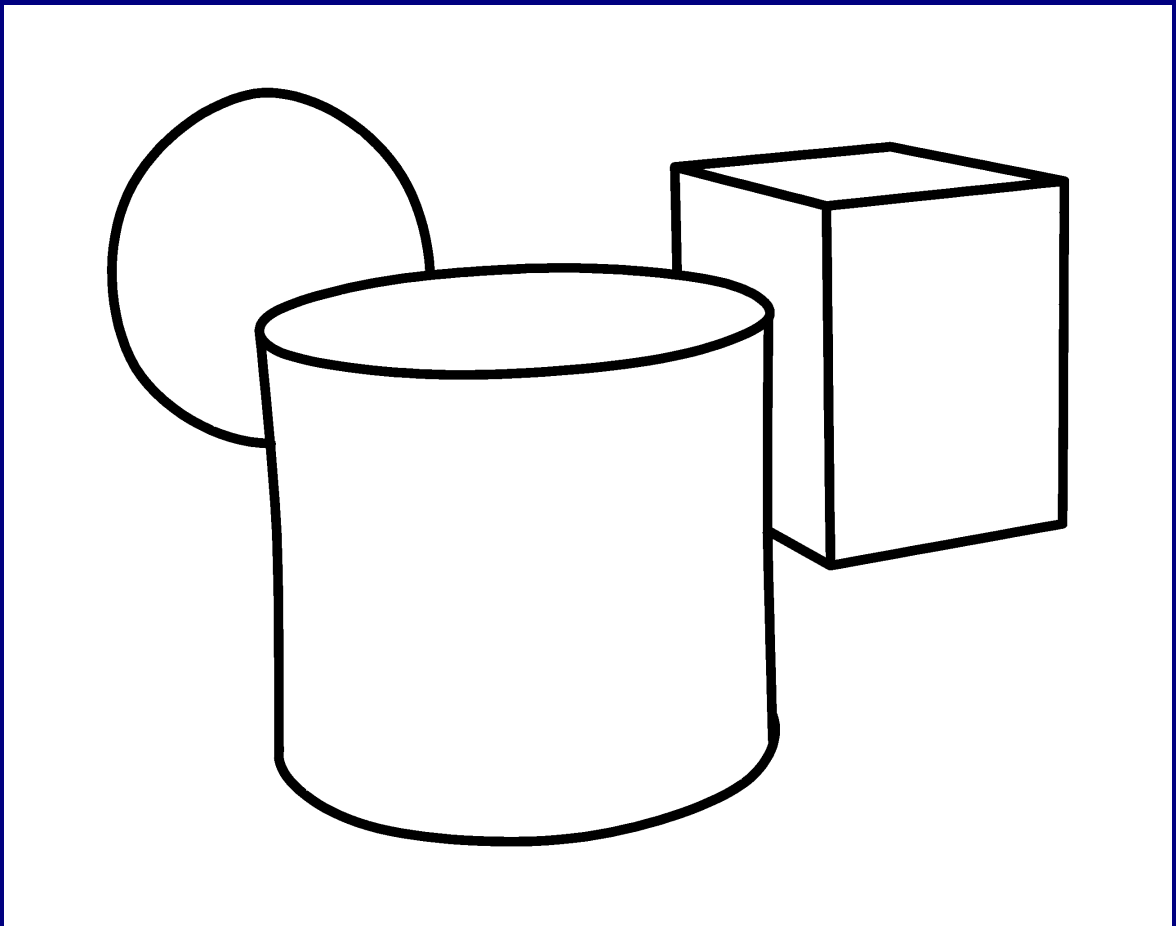
- Problem: accuracy
- Solution: perform a few 3D refinement steps first

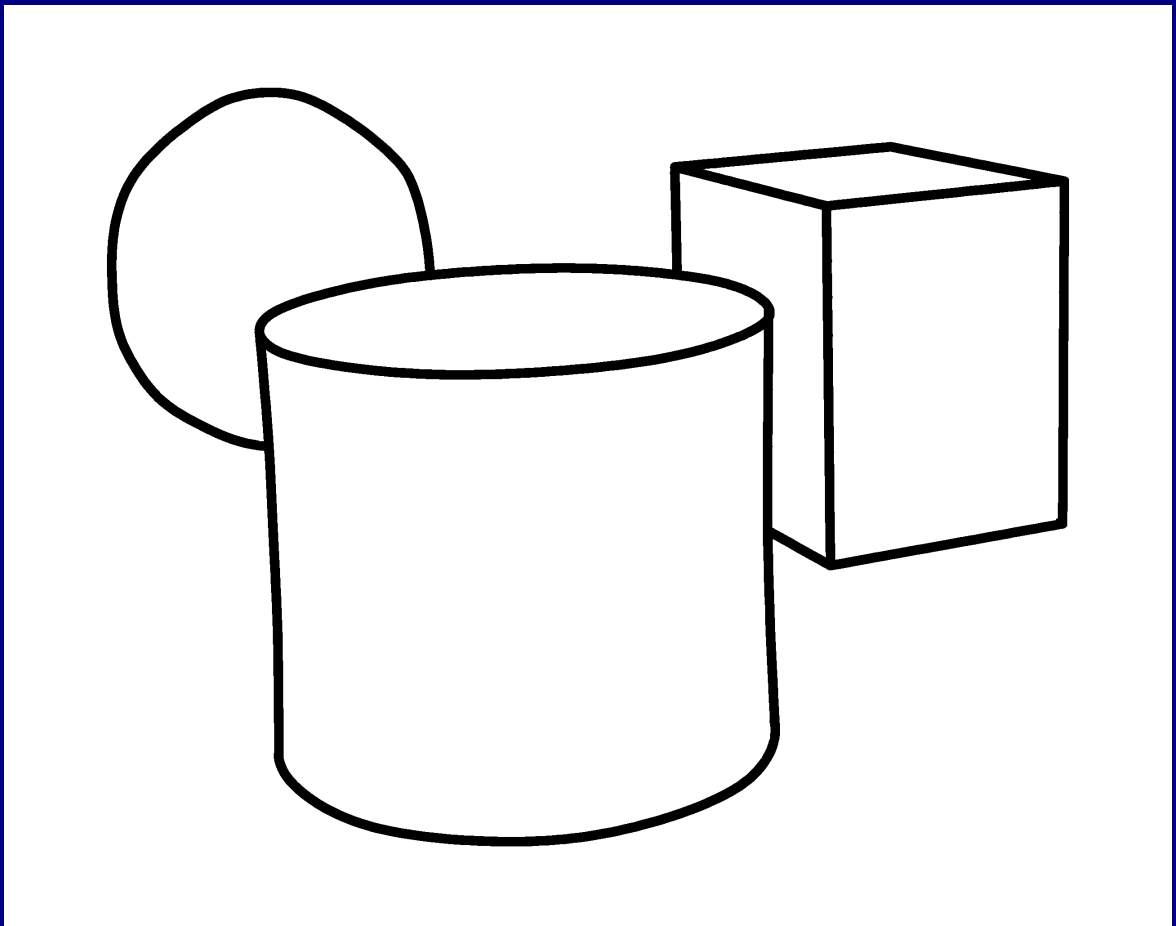
Drawing by Subdivision: No 3D subdivision



Drawing by Subdivision: One 3D subdivision



Drawing by Subdivision: Two 3D subdivisions



Results

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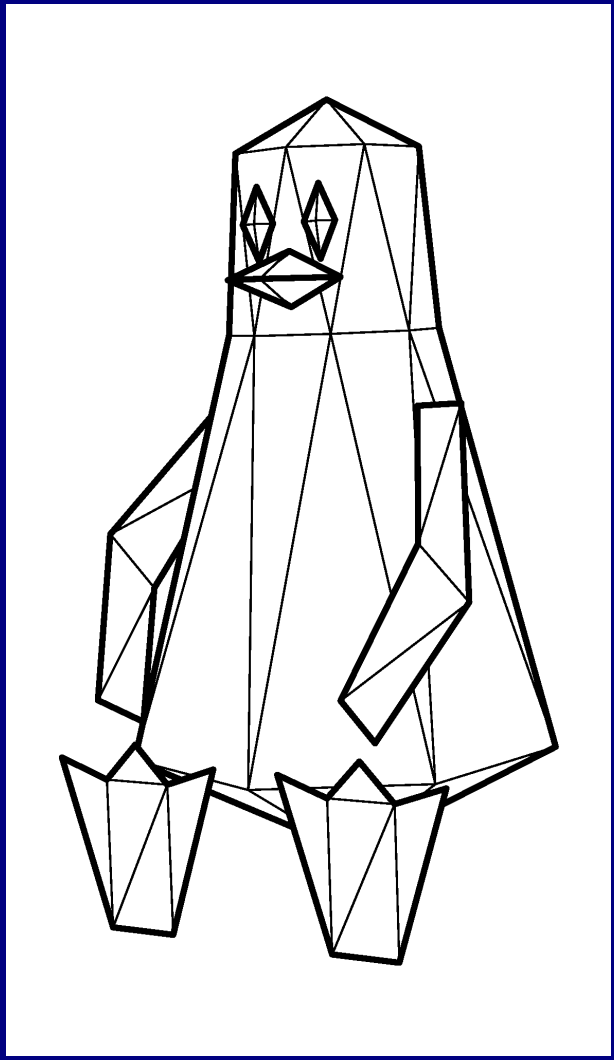
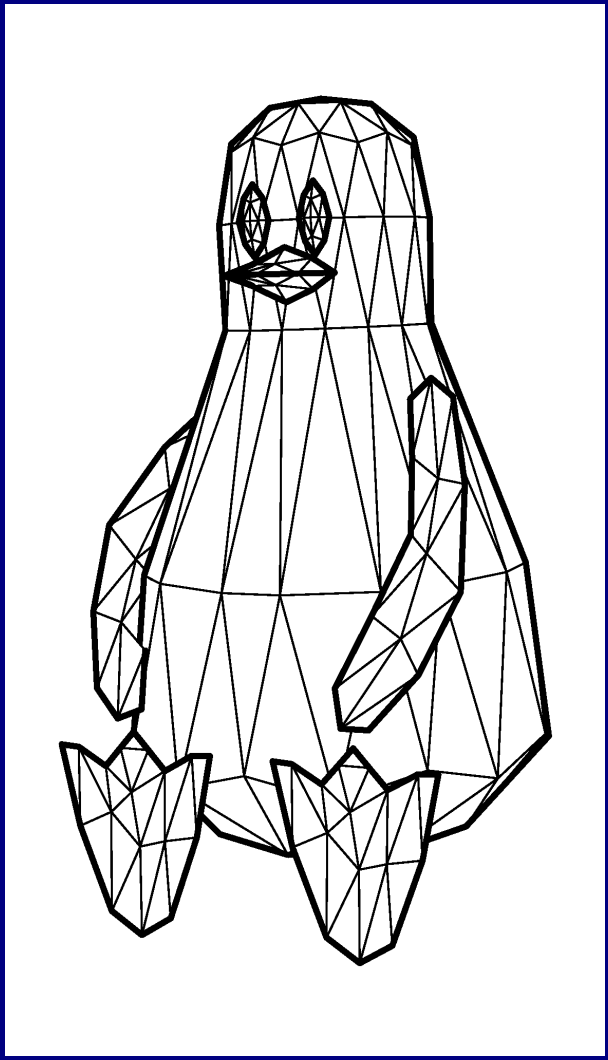
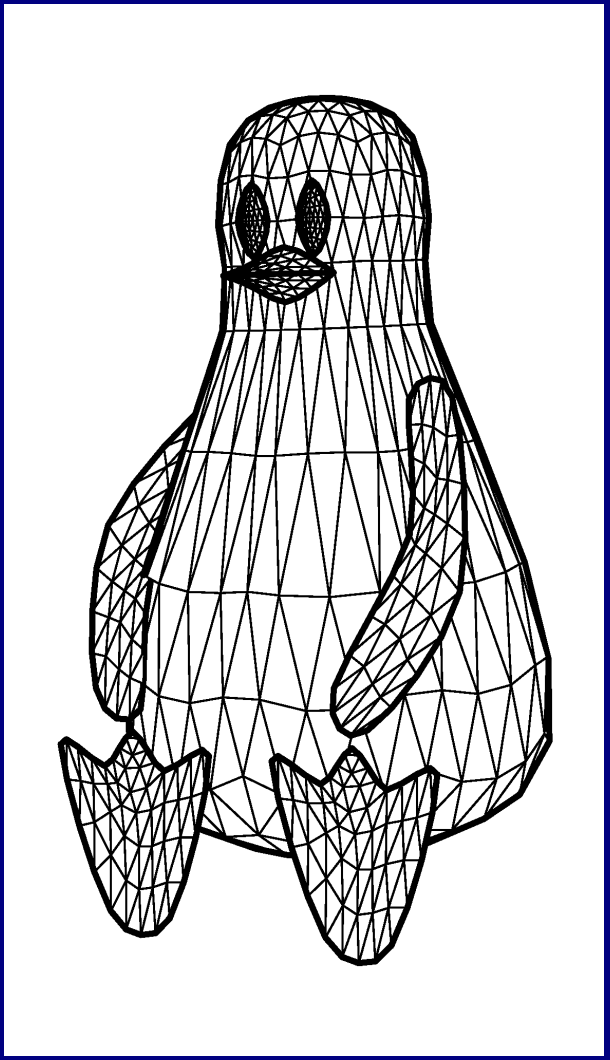
- factor 10 speedup for 2D over 3D subdivision

Results







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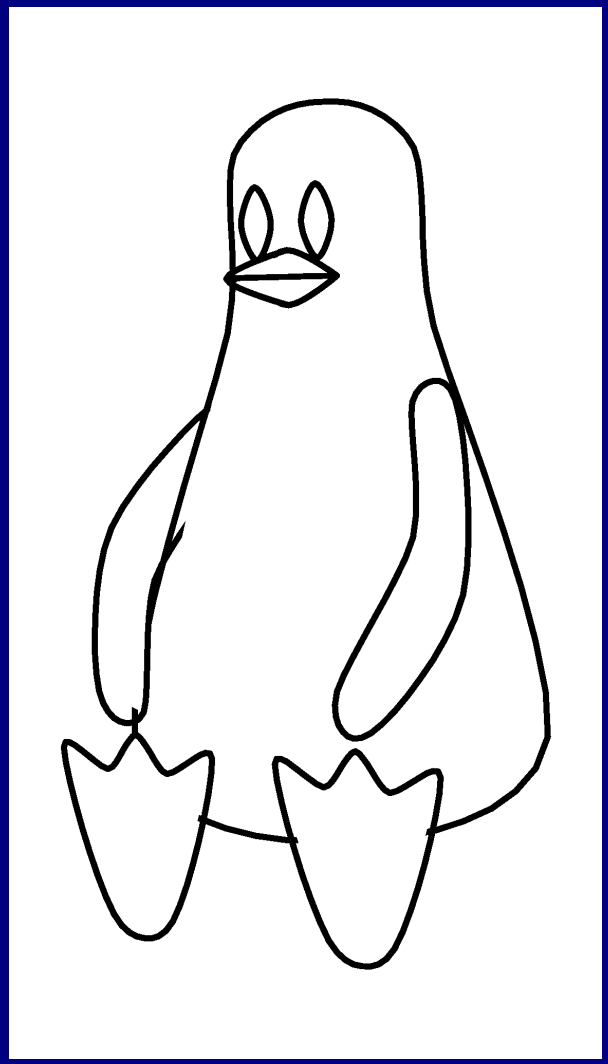

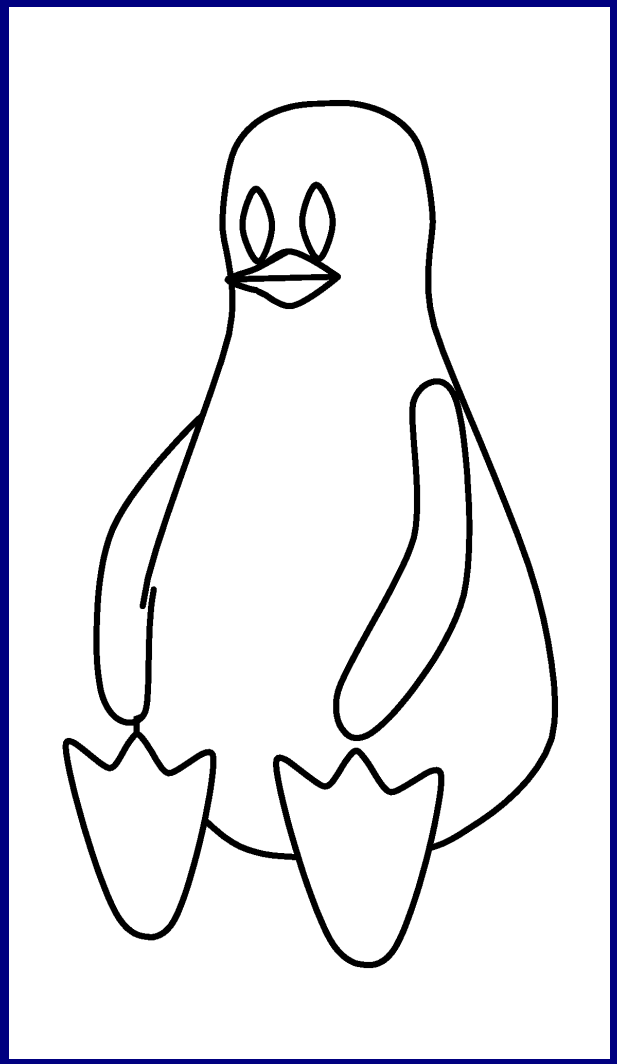

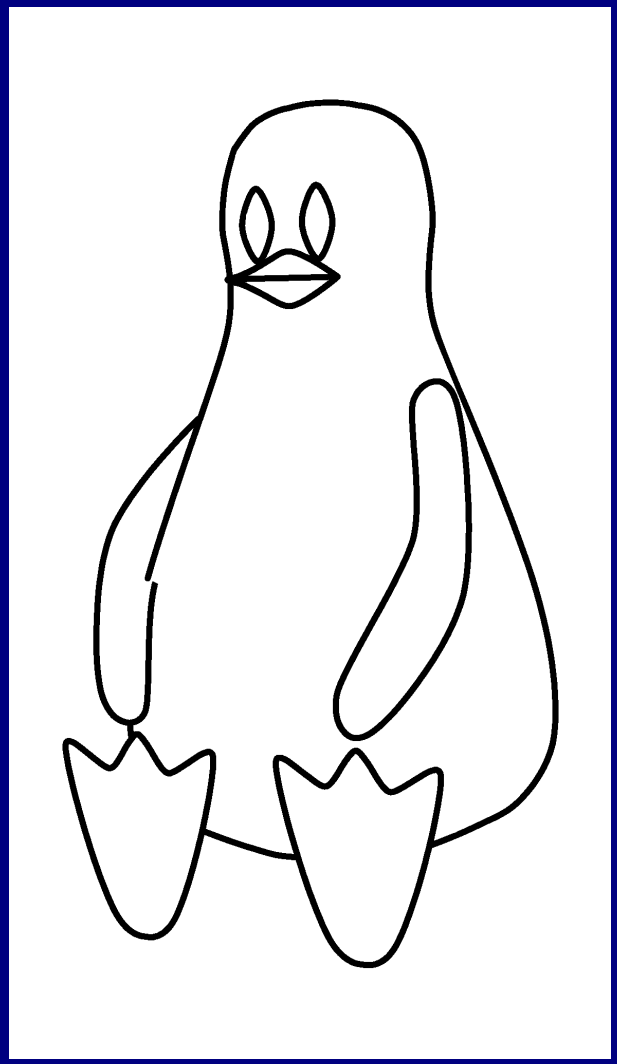

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  $\Rightarrow$ silhouette propagation

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- Exploit features of surface representations
  $\Rightarrow$ silhouette propagation
- Simplify where possible
  $\Rightarrow$ 2D subdivision for drawing

Extensions

- hidden line removal
  $\Rightarrow$ visibility propagation

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- hidden line removal
  $\Rightarrow$ visibility propagation
- overshooting when drawing
  $\Rightarrow$ chordal parametrization of curves

The End

Questions?