The Return of the Utah Teapot

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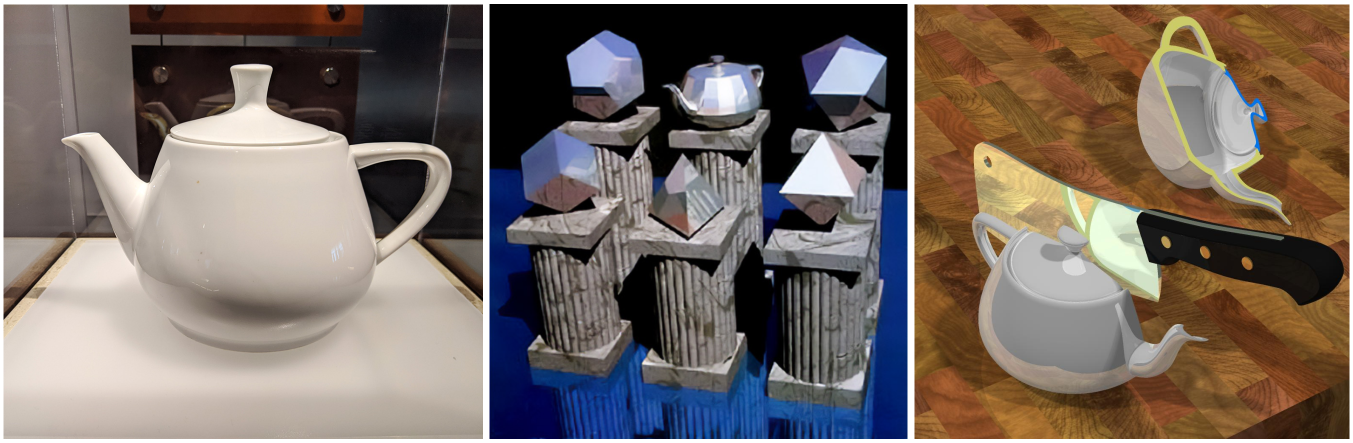

Figure 1: *The original teapot Martin Newell used for determining the proportions of the Utah Teapot model, displayed in the Computer History Museum in Mountain View, CA, USA; "The Six Platonic Solids" image by Arvo and Kirk [1987]; and the "Teapot Subdivision" image by Fish [2006].*

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1 Introduction

The Utah Teapot was one of the first models created using Bézier patches. It quickly rose to fame in the graphics community, following its first appearance at SIGGRAPH [Blinn and Newell 1976]. Its relatively simple but interesting shape, containing both positive and negative curvatures and parts that occlude and can cast shadows on each other, made it an excellent subject for testing various rendering algorithms.

Its widespread use in graphics led Arvo and Kirk [1987] to call it "Teapotahedron" and humorously declare it as the sixth Platonic solid (Figure 1). To this day, it is one of the standard models used for testing new computer graphics algorithms, frequently appearing in technical papers at SIGGRAPH and other graphics conferences. Beyond that, it also shows up in art installations, movies, video games, and various other graphics applications. A version of the Utah Teapot model is included in many rendering and modeling programs and graphics APIs, including 3ds Max, Direct3D, Houdini, Modo, OpenGL, POV-Ray, Quartz Composer, and RenderMan. The RenderMan Walking Teapot is another popular form of the Utah Teapot, coveted by many SIGGRAPH attendees for decades.

After the Utah Teapot was modeled in 1975, different versions of the Teapot were prepared and published by people from the University of Utah. We celebrate the 50th anniversary of Utah Teapot's first appearance at SIGGRAPH 1976 by presenting Version 2026!

2 Martin Newell – Version 1975

The original version of the Utah Teapot was prepared by Martin Newell, while he was a PhD student at the University of Utah, out of a need to have procedural models that would not require large numbers of triangles to store. One day, while Martin Newell was having tea with his wife, Sandra Newell, she suggested that the tea set they were using might be interesting to model. Liking this idea, Newell quickly drew a rough outline of the teapot on graph paper, naturally oblivious to the fact that it would quickly turn into an icon of computer graphics.

Martin Newell's Teapot is one of the first objects he modeled using bicubic Bézier patches. It is just one of the models he prepared and included in his PhD dissertation in 1975 (see Figure 2). Notably, Newell's Teapot model does not have a bottom or an interior. Also, the handle and the spout patches intersect the body patches. This was a helpful feature for testing hidden surface removal algorithms, which were still being developed at the time.

3 Jim Blinn – Version 1976

The Utah Teapot quickly rose to fame after its first appearance at SIGGRAPH'76 [Blinn and Newell 1976] (see Figure 3). Jim Blinn, when he was a PhD student, scaled the Teapot model down by 3/4

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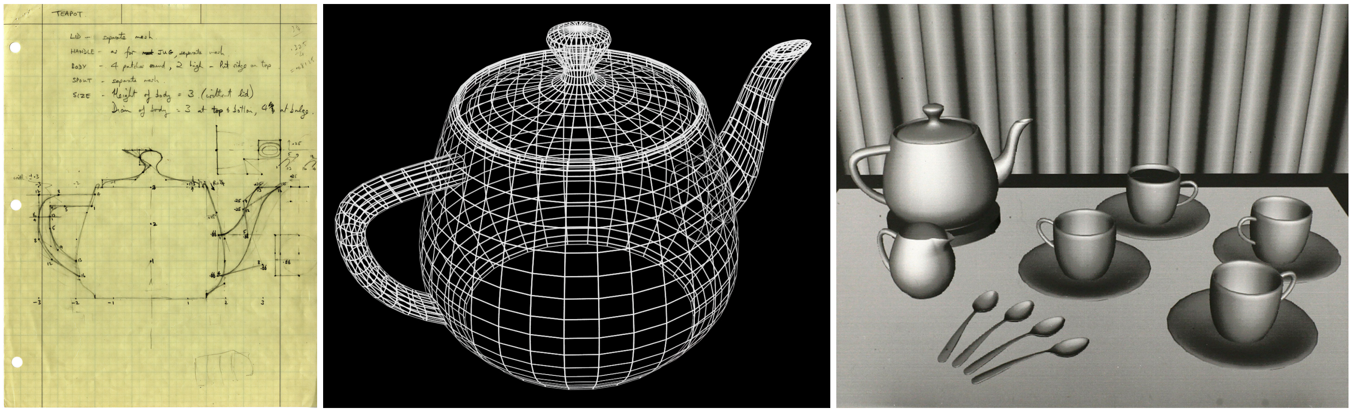

Figure 2: *Martin Newell's original sketch of the Utah Teapot, its wireframe rendering, and the image from Martin Newell's dissertation showing the Teapot with the entire tea set he modeled using bicubic Bézier patches, including the drapes in the background [Newell 1975].*

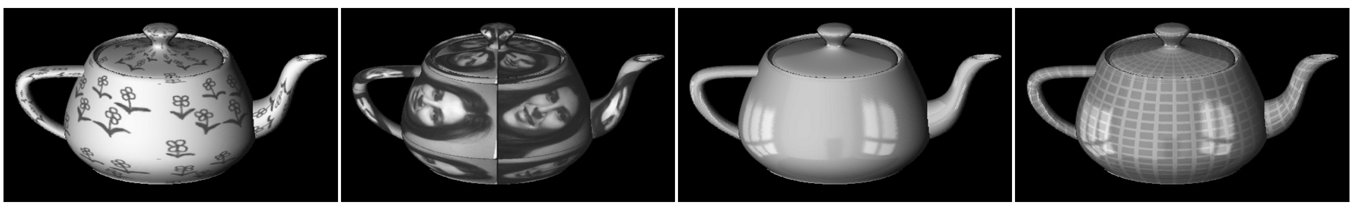

Figure 3: *Some of the first images of the Utah Teapot model that appeared at SIGGRAPH [Blinn and Newell 1976].*

during a demo to a visitor from a funding agency, showcasing the capabilities of the graphics system that was being developed at the University of Utah. Finding this shorter Teapot shape prettier, he kept these new proportions. This modified version of the Teapot was rendered numerous times, first by Blinn and then by many other researchers, turning it into a symbol of computer graphics.

A common rumor is that Blinn had squashed the Teapot because the display he was using had non-square pixels. This is false, and simply changing the vertical scaling of the model would not be a fix for all camera angles. Indeed, the pixels were rectangular, but Blinn had already compensated for that in his rendering algorithm without altering the Teapot model itself. Using the new proportions for the Teapot was a decision made for purely aesthetic reasons.

4 Frank Crow – Version 1987

The version of the Teapot that appears in numerous graphics applications and APIs is the one released by Frank Crow, who was another PhD graduate of the University of Utah. This Teapot has the same proportions as the one that Blinn popularized, but it also includes a curved bottom that Crow added. The common use of this particular version can be attributed to an article [Crow 1987] discussing the significant role that the Utah Teapot model had played in the earlier days of computer graphics. Crow [1987] lists 306 control point positions along with 16 indices for each of the 32 patches, including the additional 4 patches he introduced, together with Pascal code for displaying a wireframe model of the Teapot. Considering that the World Wide Web (commonly referred to as the "internet" today) came into being years later, the Teapot data included in a printed article [Crow 1987] likely played an important role in this version of the Teapot having widespread use.

As Blinn [1987] explains soon after, the Teapot model can be generated from much less data, and the bottom hole of the Teapot can be easily fixed by adding a flat disk.

5 The Problems of the Earlier Teapot Versions

As popular and useful as the Utah Teapot model was, it was not flawless. First of all, the spout and the handle patches intersected the body. This was unavoidable, using a small number of bicubic Bézier patches to model the Teapot.

The intersection of the spout also meant that the Teapot could not have an interior. The intersections of the handle with the body could be easily hidden within the thickness of the model, as in the case of the tea cups (see Figure 2). The spout, however, needed a hole through the body for pouring the liquid, without which the spout would not appear functional.

Not having an interior, the lid had to be kept on. Yet, the lid did not perfectly fit the body, leaving a fairly visible gap, through which the missing interior of the Teapot could be seen from most viewing angles. This gap is due to the fact that the lid is supposed to rest on a gallery that is a part of the Teapot's interior, which was not modeled. Yet, this gap not only limited how the Teapot could be viewed, but it also caused problems with shadow computation, as light could enter the interior of the Teapot from the gap around the lid, and, for some shadow casting methods, could even pass through the Teapot, forming a corresponding gap in its shadow.

Finally, the Teapot's body and its lid did not have a perfectly circular profile, because non-rational cubic polynomials of bicubic Bézier patches cannot form circular shapes. Yet, this was not an important problem, since Newell's patches very closely approximate a circular shape (with a max. error of less than 0.41% of the radius).

Figure 4: *The latest version of the Utah Teapot model by Cem Yuksel. The cross-section visualization shows its interior design, closely following the contours of its exterior. It has smooth reflections on its exterior due to its new curvature-continuous shape.*

6 Hank Driskill – Version 1992

Hank Driskill, another PhD student at the University of Utah, addressed all these problems with the earlier versions of the Teapot. He used the Alpha_1 software, which was being developed at the University of Utah, and he converted the Utah Teapot into a trimmed NURBS representation, which can form holes via Boolean operations. NURBS can also have perfectly circular shapes. As a result, Driskill's Teapot could have a circular shape and cut-outs on the body for the handle and the spout patches. He also modeled an interior for the Teapot's body and lid. Finally, he cut a path through the spout via Boolean operations using a circular profile following a curve. Its bottom was flat, as suggested by Jim Blinn, instead of the round bottom that was added by Frank Crow.

Hank Driskill's design, titled "Utah, the Next Generation," featuring this new Utah Teapot (with additional warp nacelles), won the SIGGRAPH 1992 T-Shirt Contest.

7 Russ Fish – Version 2006

Russ Fish, a co-founder and technical lead of the Alpha_1 project at the University of Utah, improved upon the version by Hank Driskill. He modeled a new interior for the body and the lid, more closely following the outer contours of Teapot's exterior surface. In addition, he came up with an elegant solution for the interior of the spout, reflecting the control points of the original spout patches modeled by Martin Newell. This version of the Utah Teapot is also represented as trimmed NURBS surfaces and requires Alpha_1.

He presented his "third-generation" teapot at SIGGRAPH 2006 with the title "Teapot Subdivision" [Fish 2006] (Figure 1).

8 Cem Yuksel – Version 2026

Recently, Prof. Cem Yuksel of the University of Utah developed a web software to regenerate the Second and Third Generation Teapot models as polygonal meshes of any desired resolution, along with its earlier versions. He also prepared a new version of the Utah Teapot, improving upon the previous version by Russ Fish.

The lid of Yuksel's Teapot has a solid knob, as opposed to the hollow knob of the earlier versions. The spout's interior is slightly modified to ensure that the surface normals are continuous where the tip of the spout meets the interior surface. The new interior design even more closely follows the outer contours and it works with either the round bottom of Frank Crow or a flat bottom.

Yuksel's Teapot also includes small chamfers where the spout and the handle meet the Teapot's body, ensuring that the Teapot's surface normal is continuous over the exterior surface. Finally, the exterior shape is slightly modified to make it curvature-continuous, using a new method for enhancing the continuity of Bézier curves, presented at SIGGRAPH 2026 [Yuksel 2026]. This ensures that reflections on the Teapot appear smooth, eliminating the sharp discontinuities of the earlier versions (Figure 4).

9 Conclusion

The original Teapot that used to sit on Martin Newell's desk at the University of Utah has been prominently displayed in the Computer History Museum in Mountain View, CA, USA (see Figure 1). It was previously presented in the Computer Museum in Boston, Massachusetts, USA, since Martin Newell donated it at SIGGRAPH 1982, alongside Jim Blinn's renderings of its digital version using the bicubic Bézier patches, as they appeared at SIGGRAPH 1976. While many visitors of the museum might be puzzled to see a teapot in an exhibition about computer history, we all know the significant role it has played in the computer graphics community.

All versions of the Utah Teapot, with many options for customization and mesh resolution, can be downloaded from the official Utah Teapot page of the University of Utah:
https://graphics.cs.utah.edu/teapot/

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