

Parallel BVH Construction for Real-Time Ray Tracing

Aaron Lemmon

University of Minnesota, Morris

April 30, 2015

Ray Traced Scene

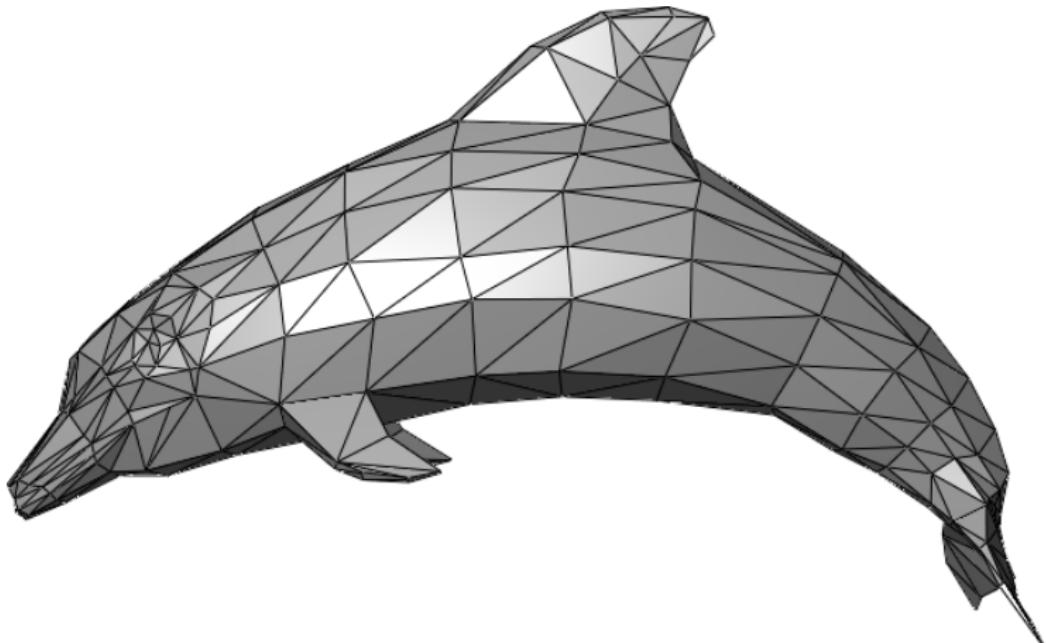


[https://en.wikipedia.org/wiki/Ray_tracing_\(graphics\)](https://en.wikipedia.org/wiki/Ray_tracing_(graphics))

Outline

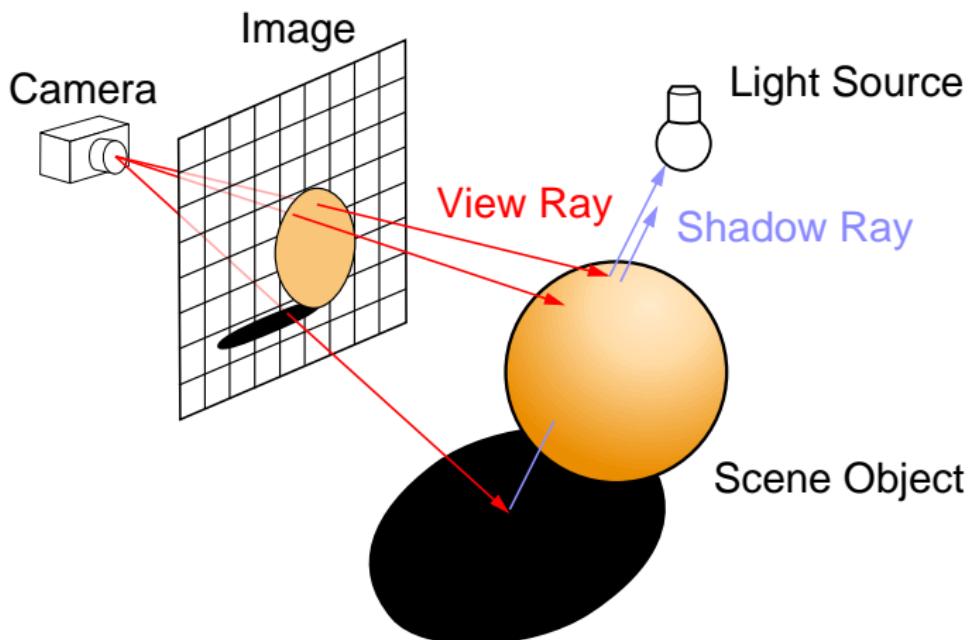
- 1 Ray Tracing Fundamentals
- 2 Grouping Primitives
- 3 Bounding Volume Hierarchy Construction
- 4 Results

Primitives



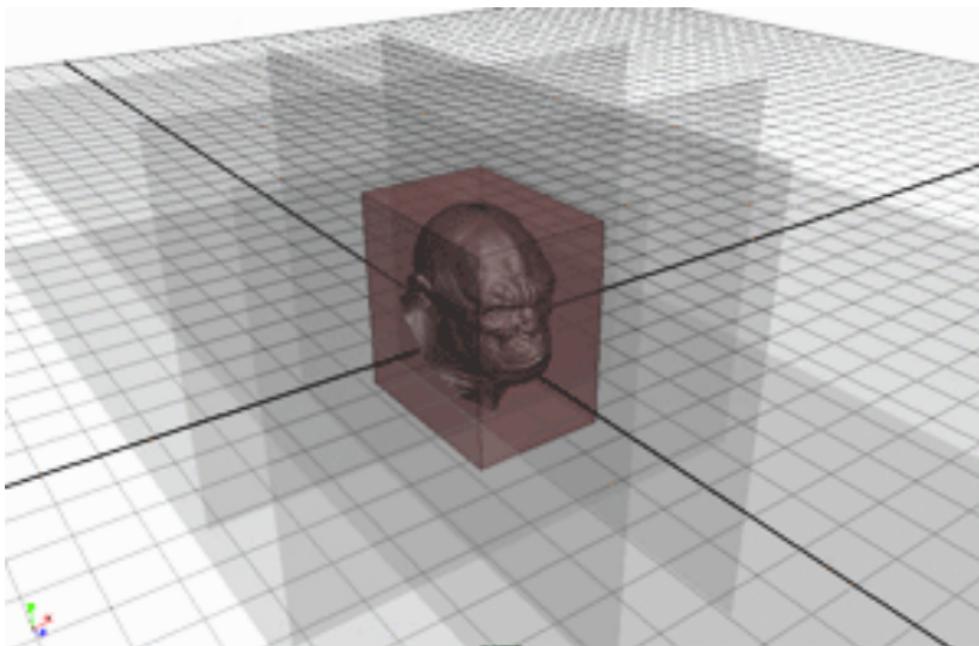
https://en.wikipedia.org/wiki/Triangle_mesh

Ray Tracing

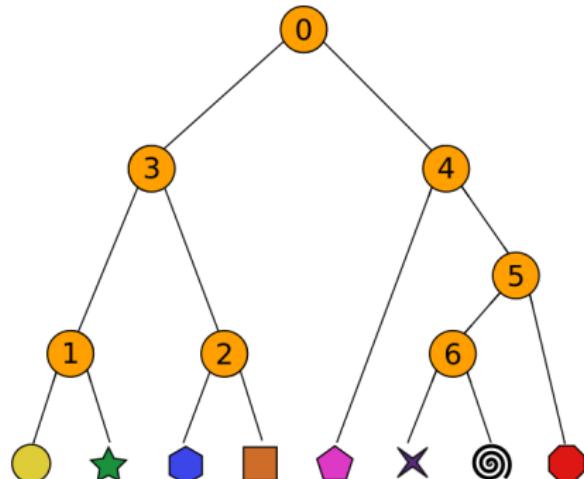
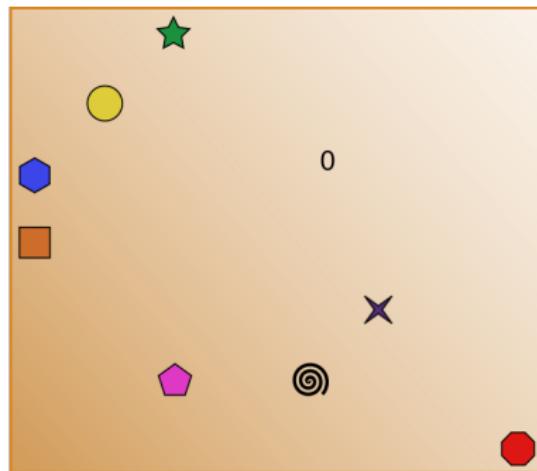


[https://en.wikipedia.org/wiki/Ray_tracing_\(graphics\)](https://en.wikipedia.org/wiki/Ray_tracing_(graphics))

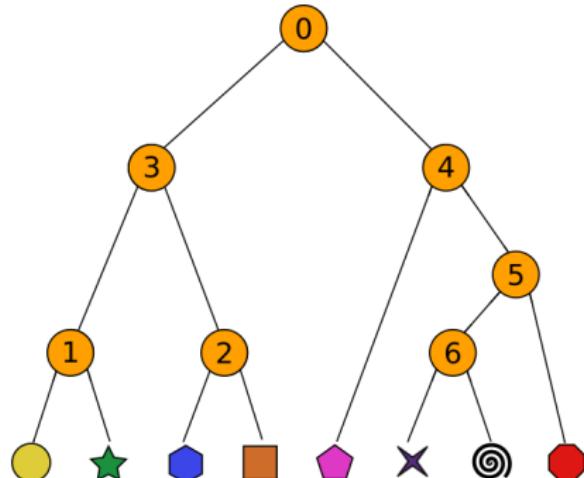
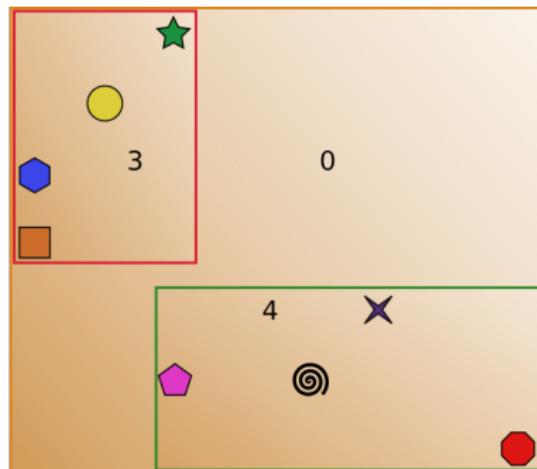
Axis-Aligned Bounding Boxes



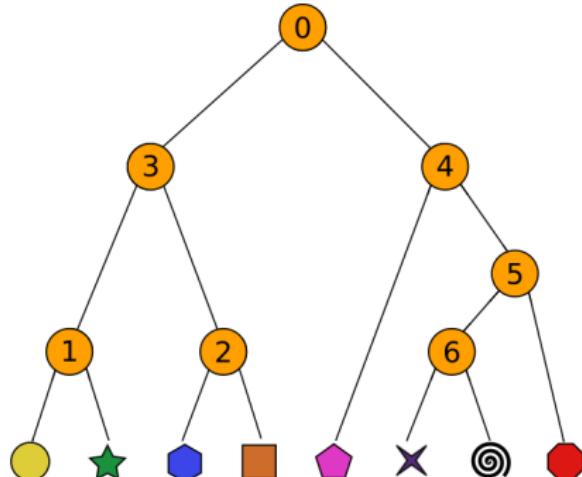
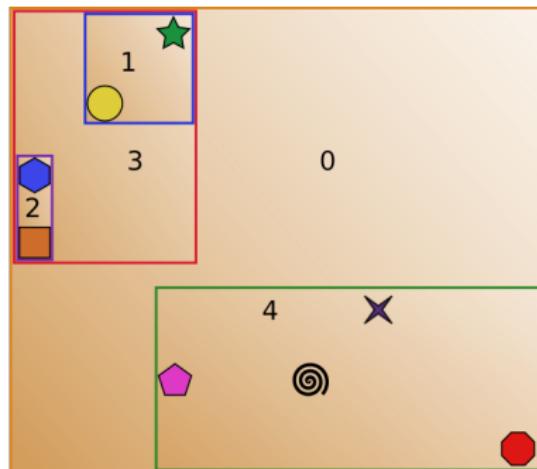
Bounding Volume Hierarchy



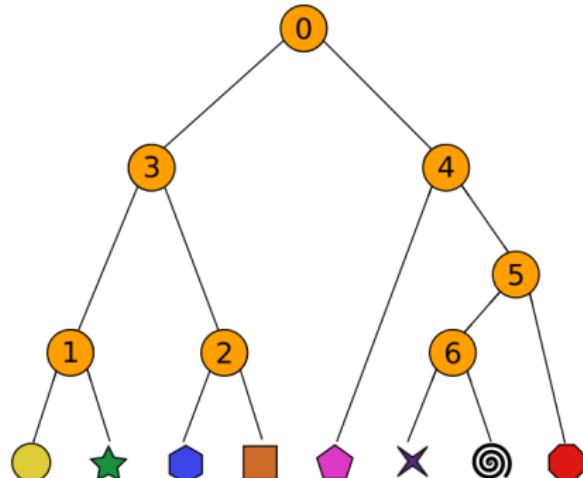
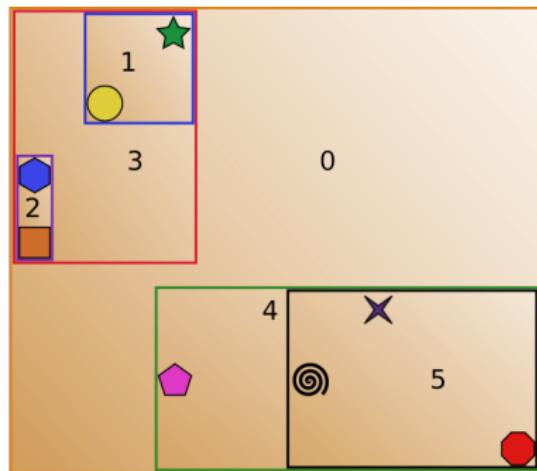
Bounding Volume Hierarchy



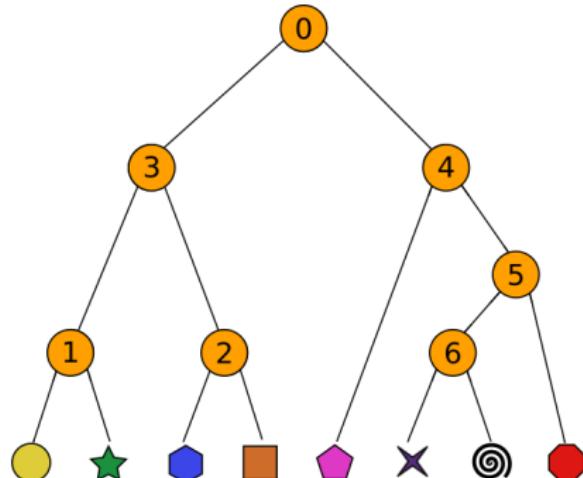
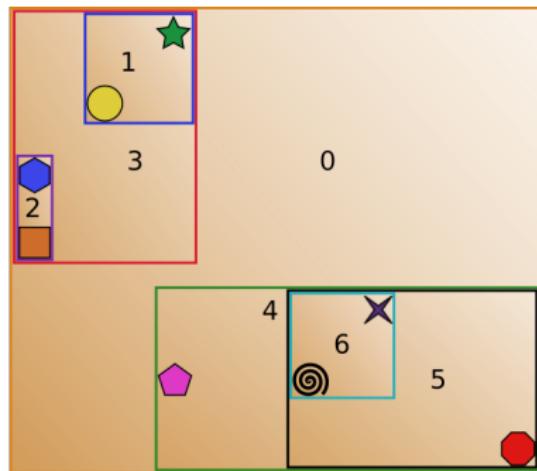
Bounding Volume Hierarchy



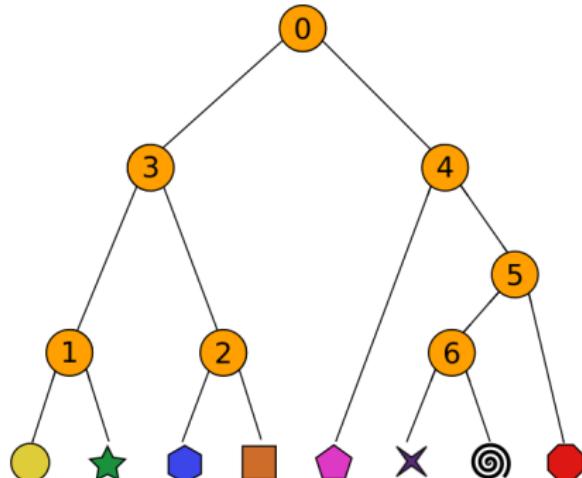
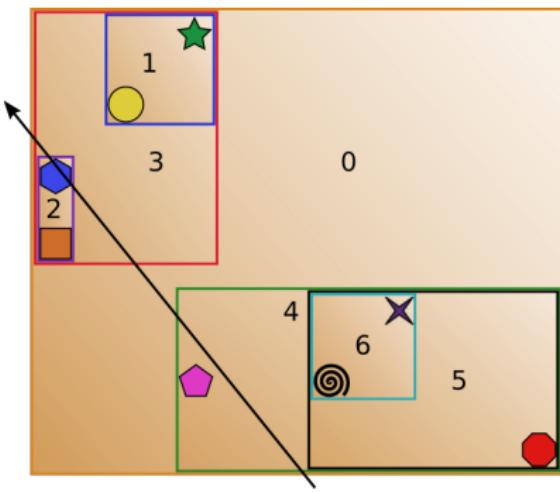
Bounding Volume Hierarchy



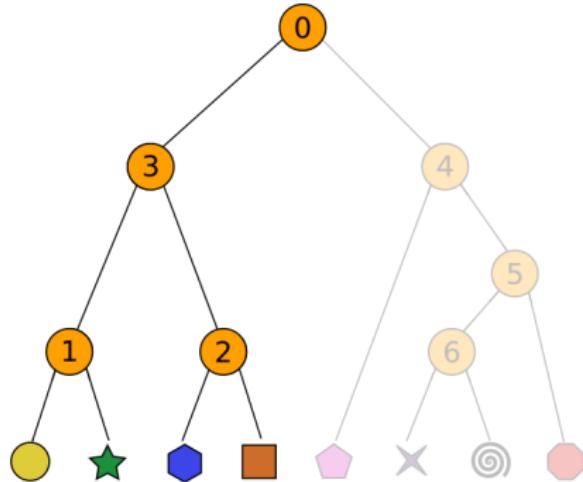
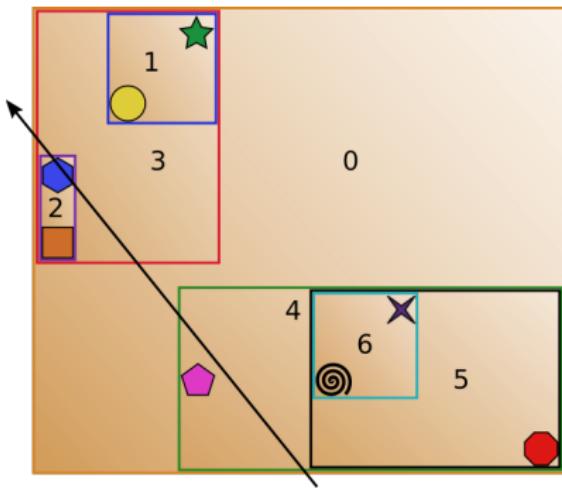
Bounding Volume Hierarchy



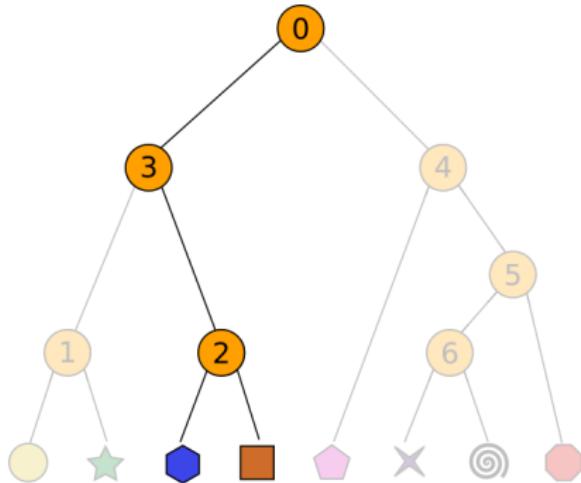
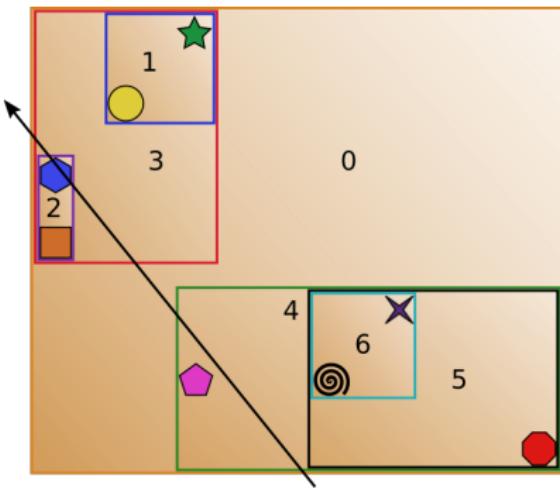
Bounding Volume Hierarchy



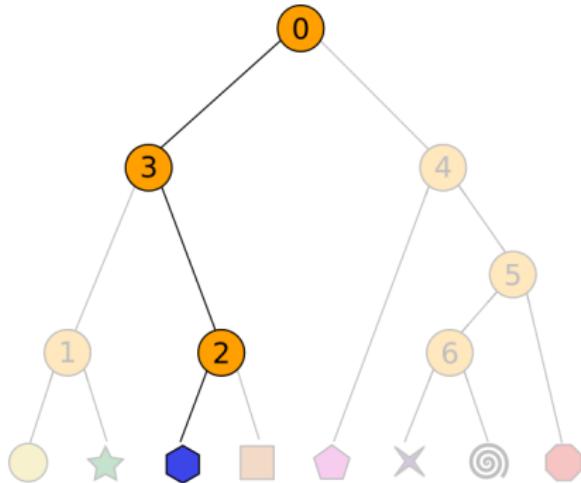
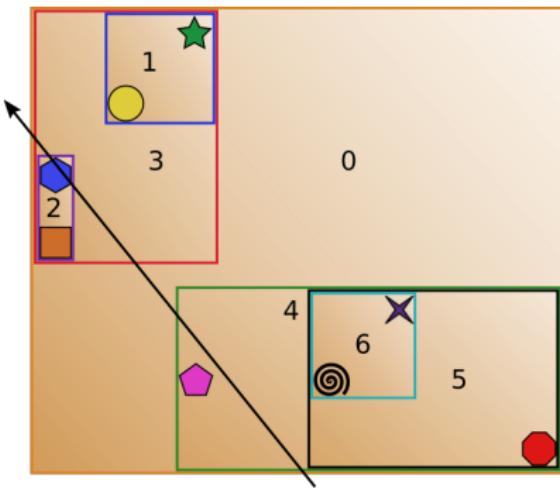
Bounding Volume Hierarchy



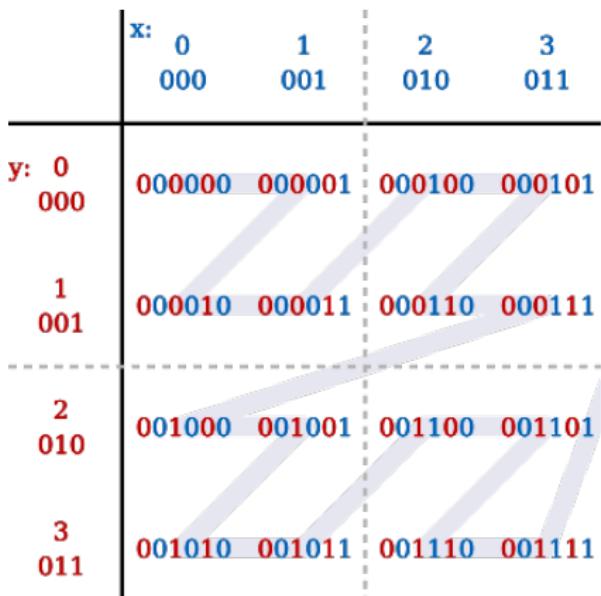
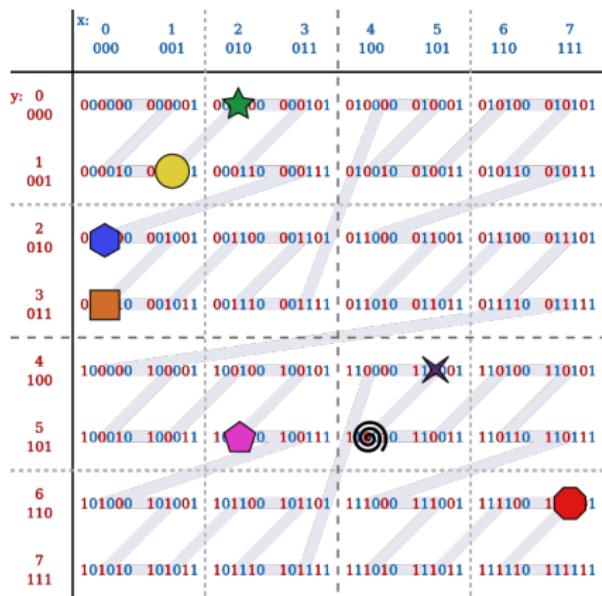
Bounding Volume Hierarchy



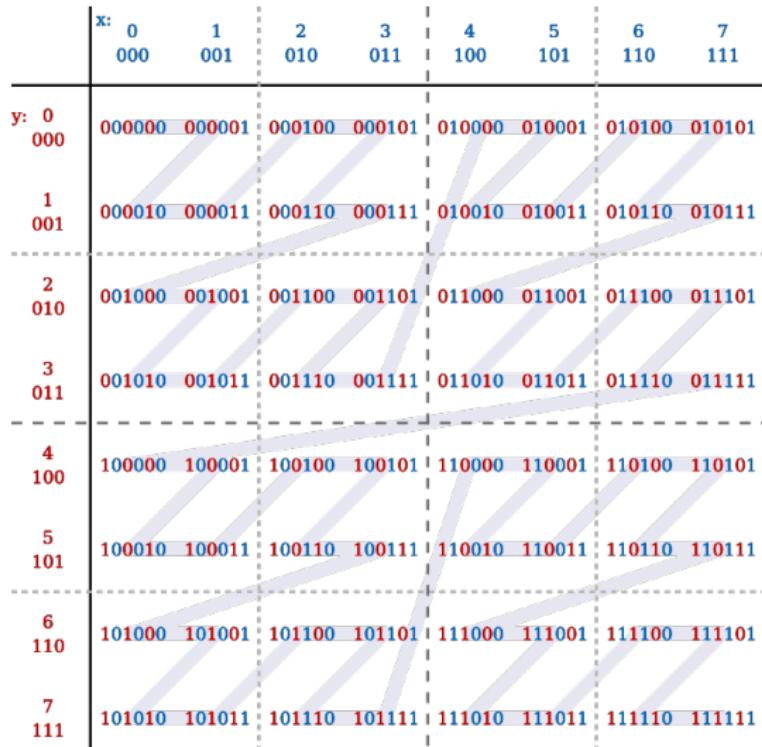
Bounding Volume Hierarchy



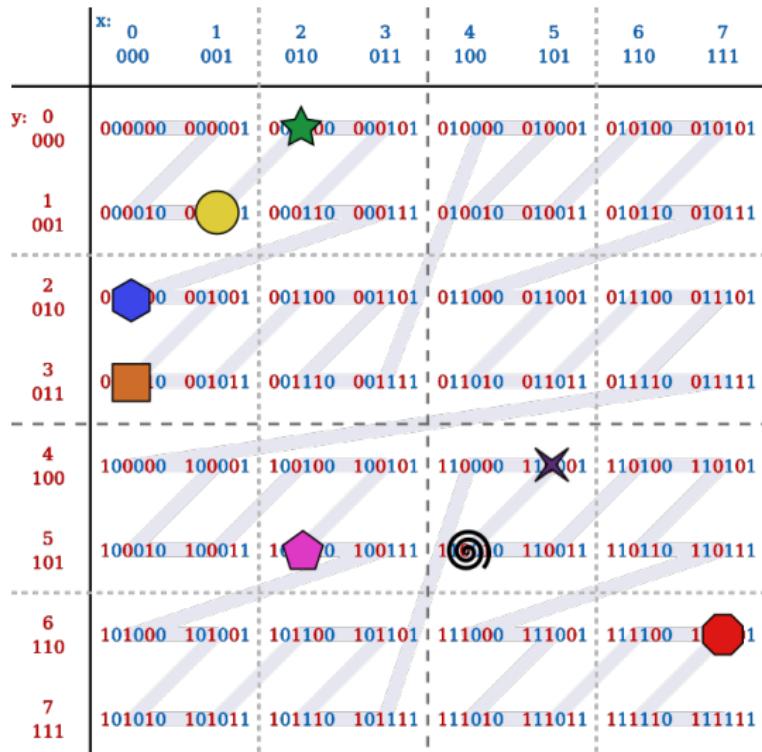
Morton Codes



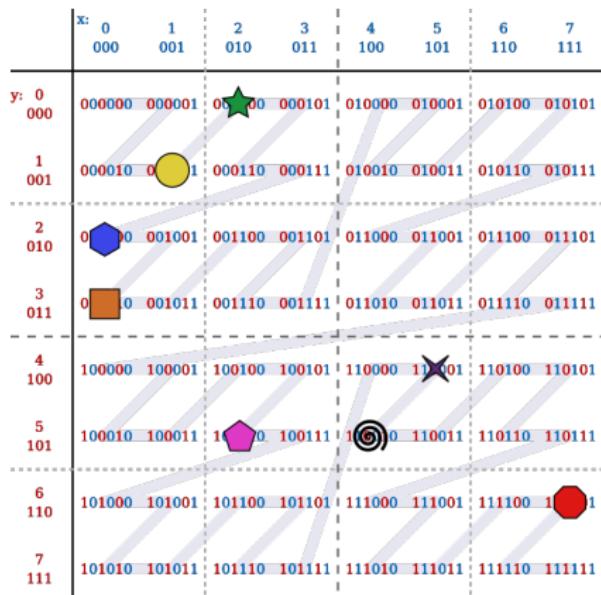
Morton Codes



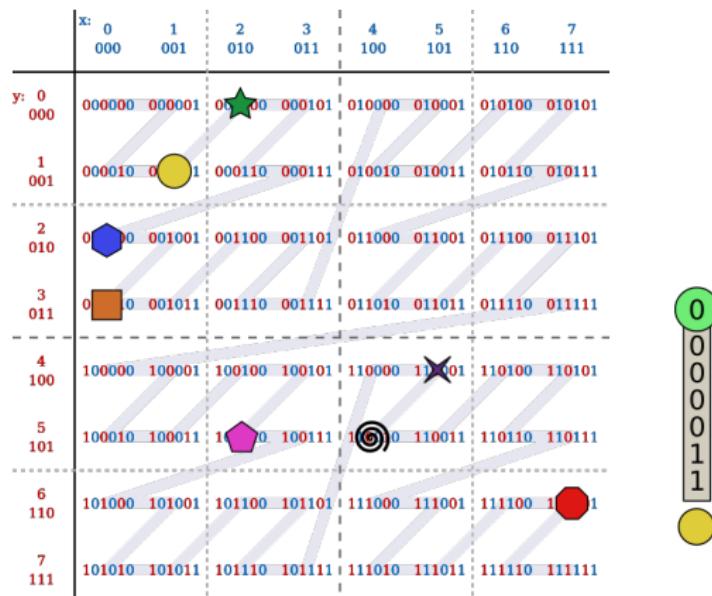
Morton Codes



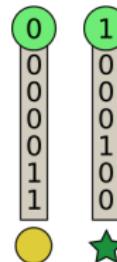
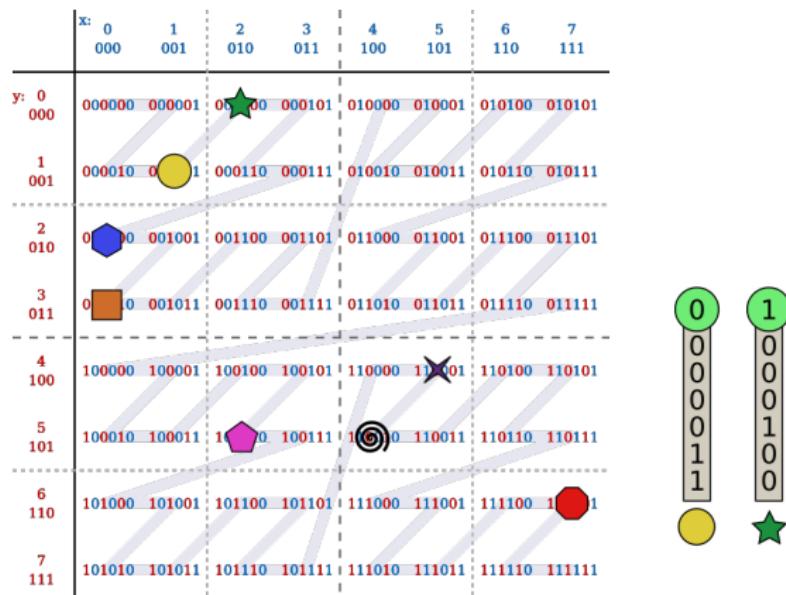
Morton Codes



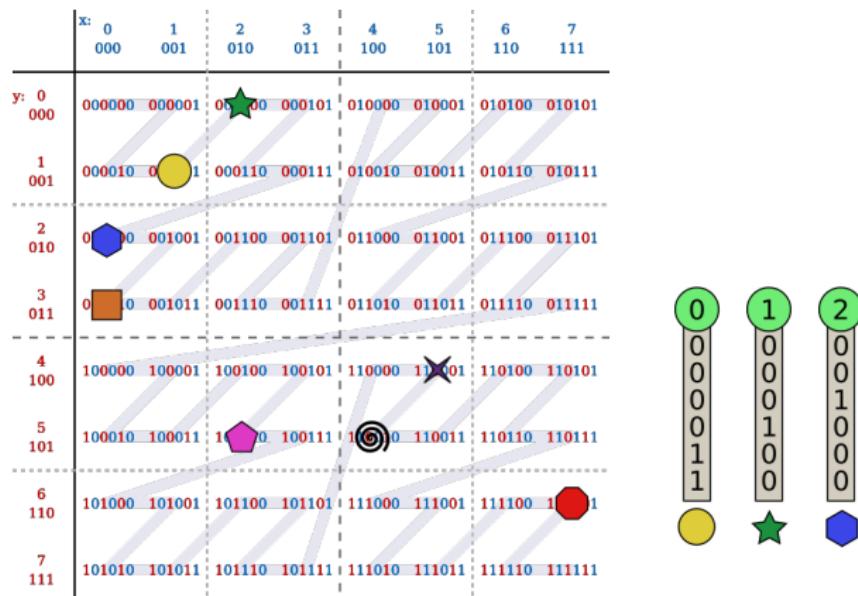
Morton Codes



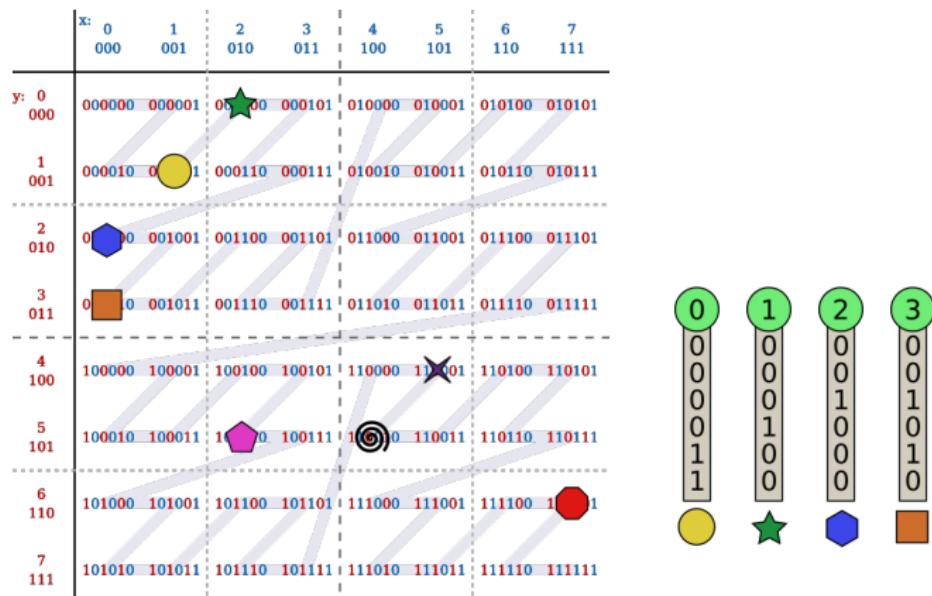
Morton Codes



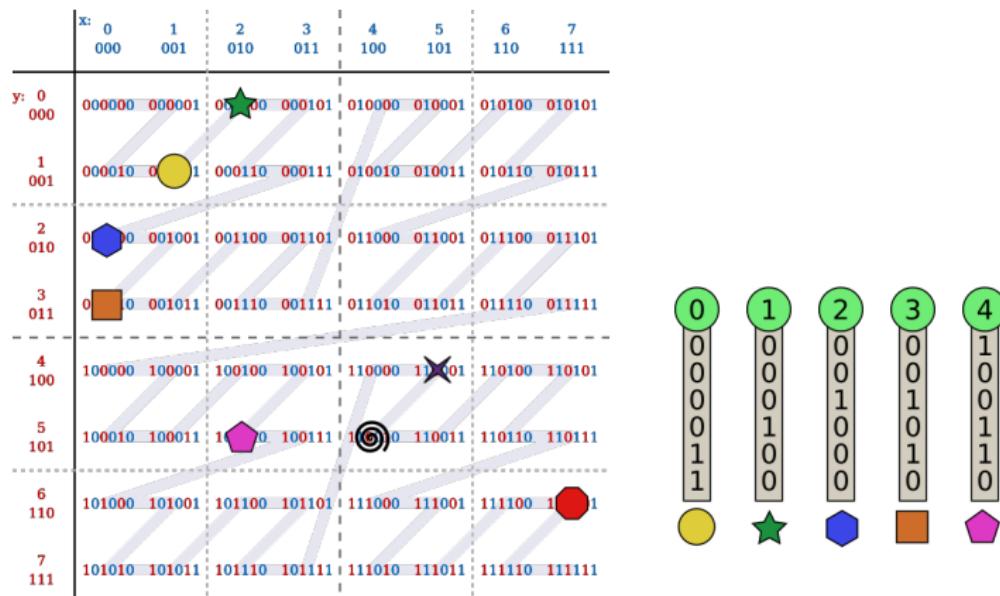
Morton Codes



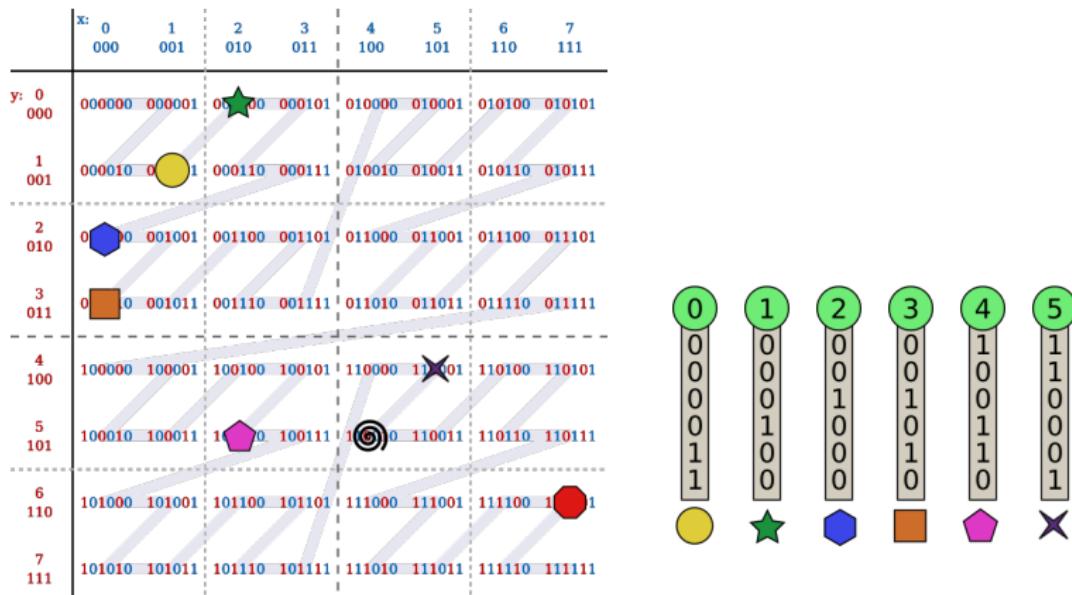
Morton Codes



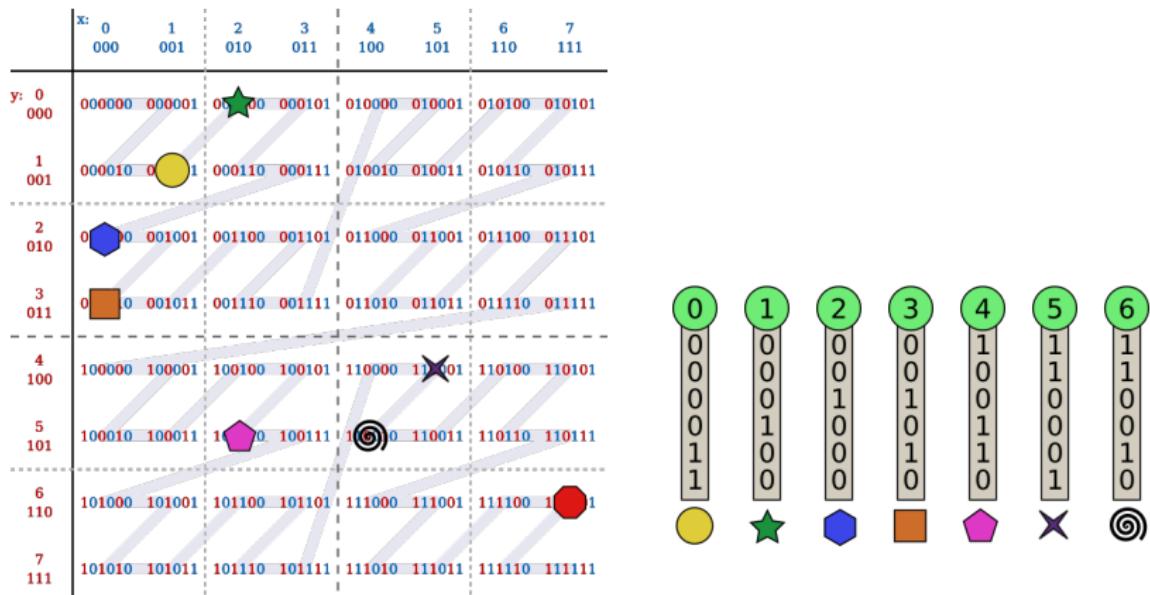
Morton Codes



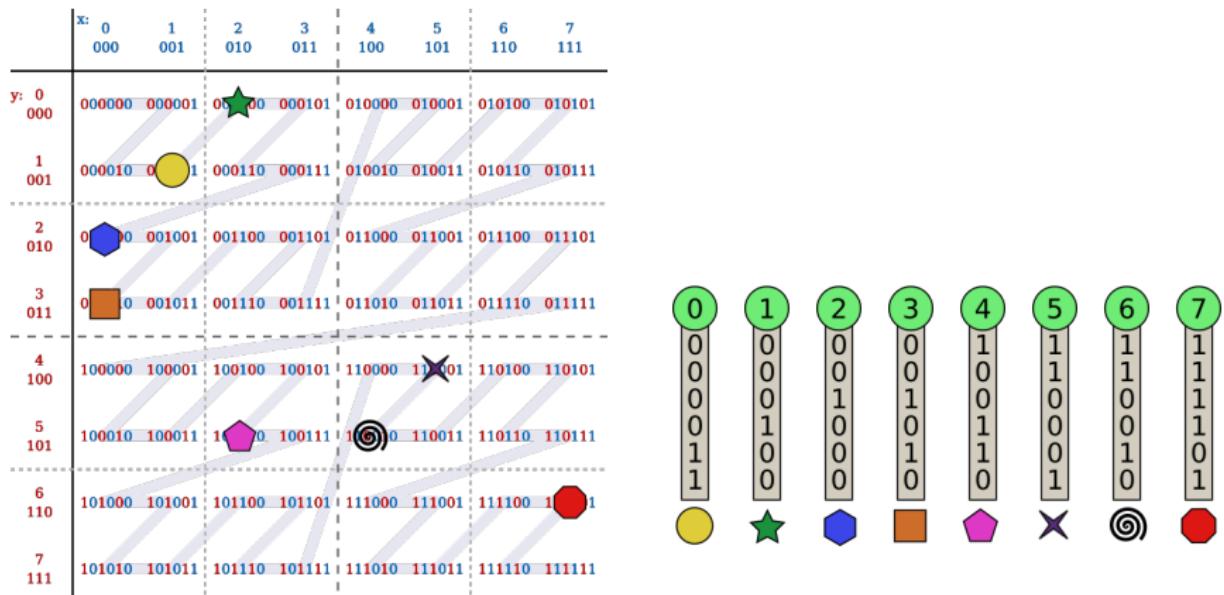
Morton Codes



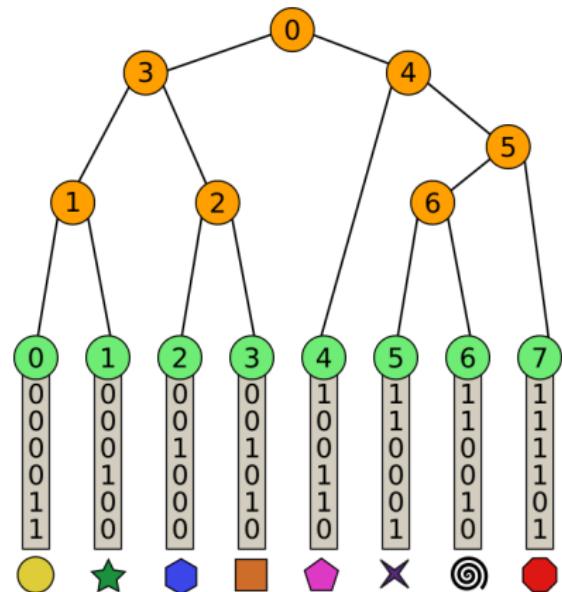
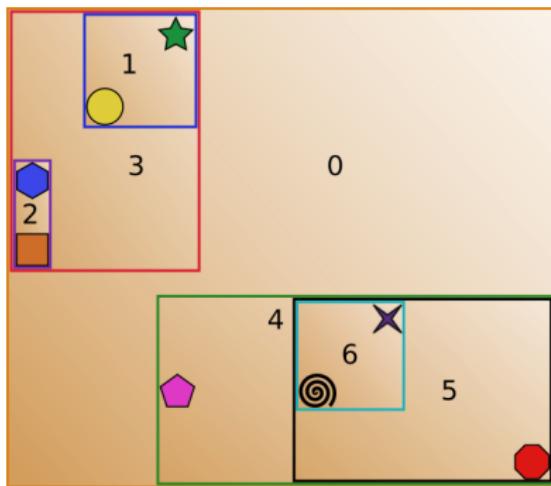
Morton Codes



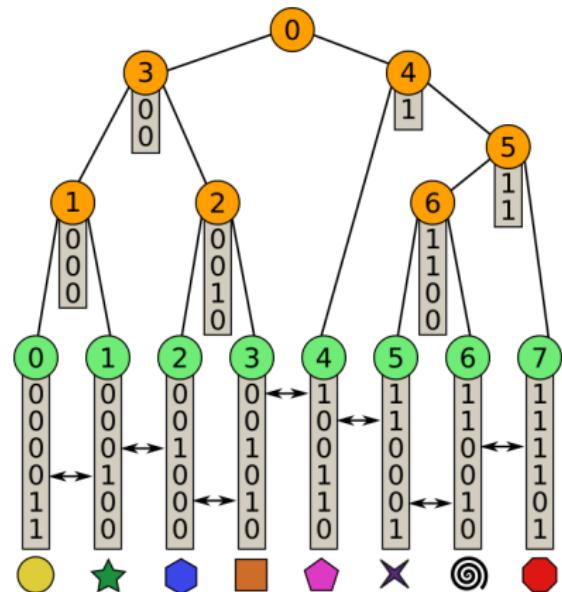
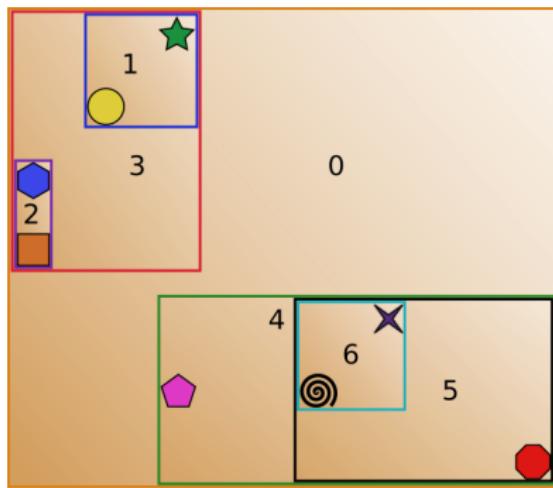
Morton Codes



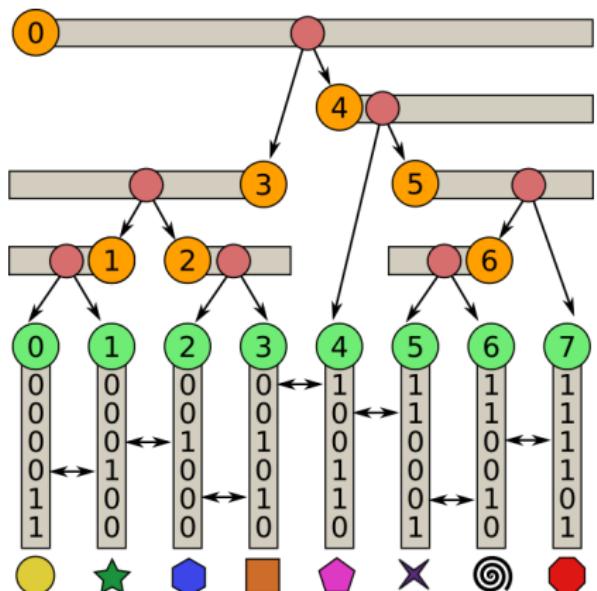
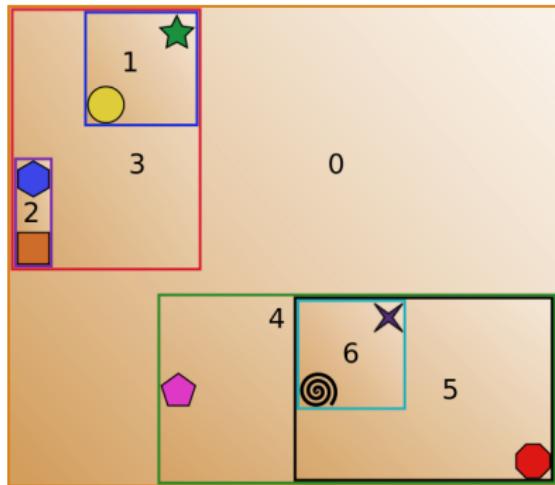
Goal



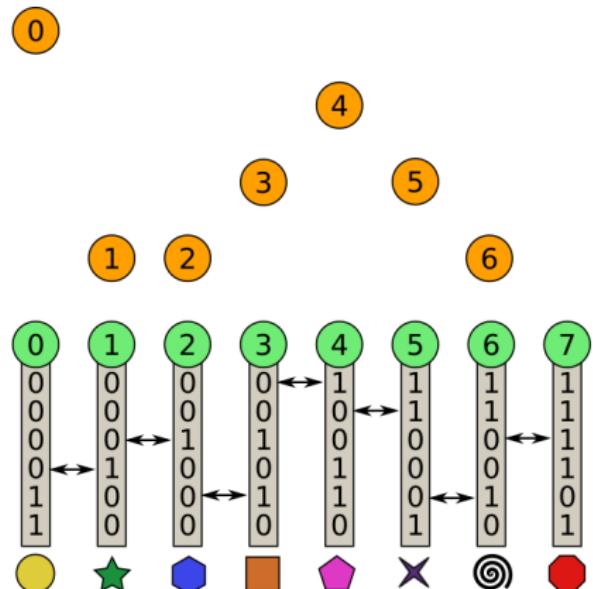
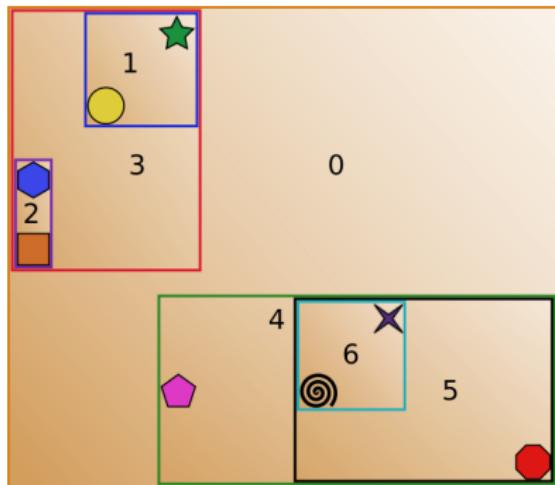
Binary Radix Tree



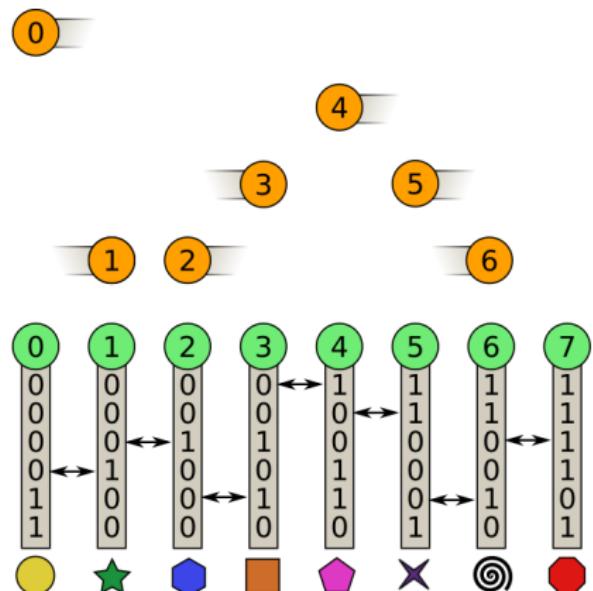
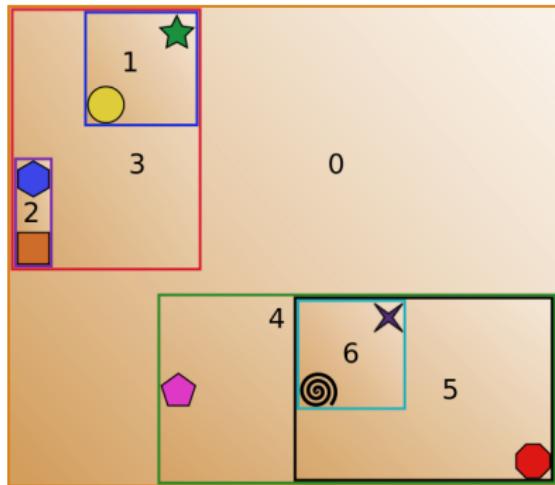
Internal Node Array



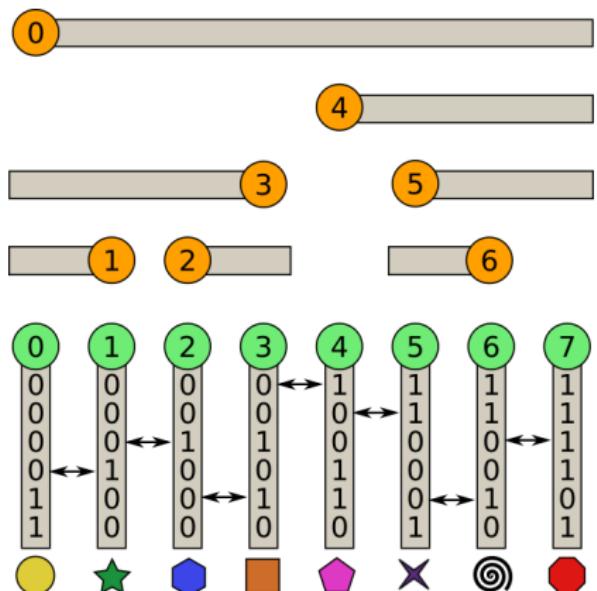
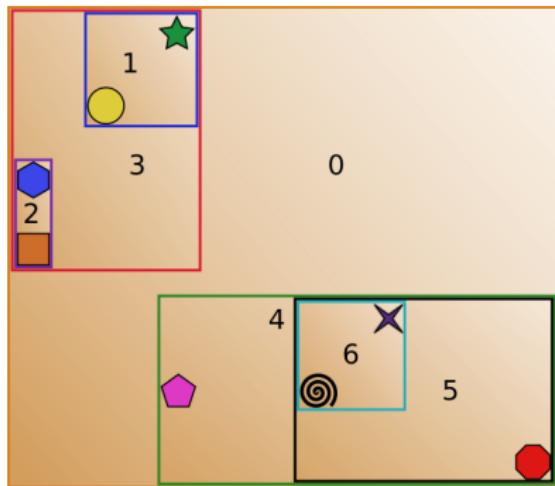
Internal Nodes



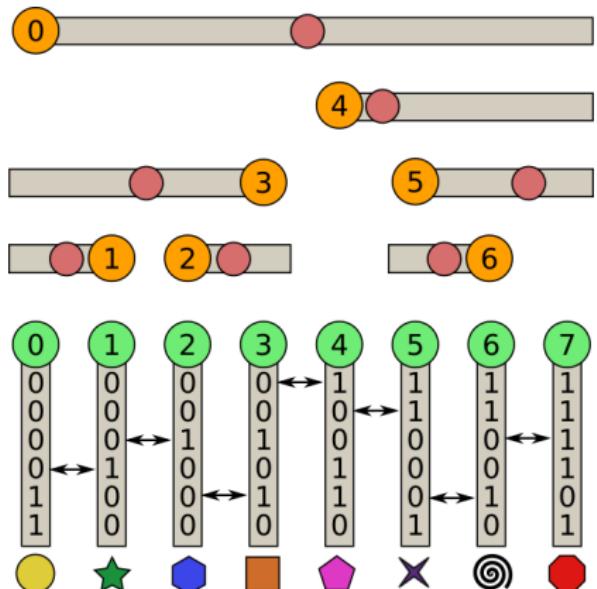
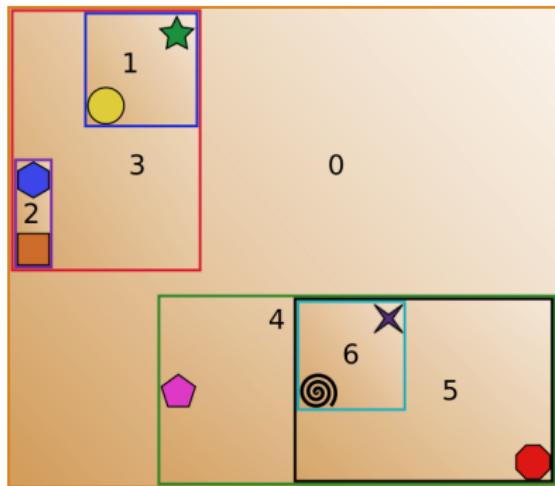
Determine Range Direction



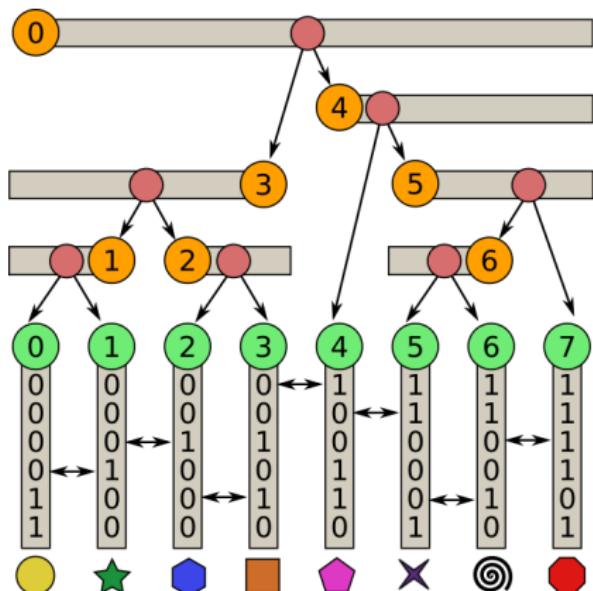
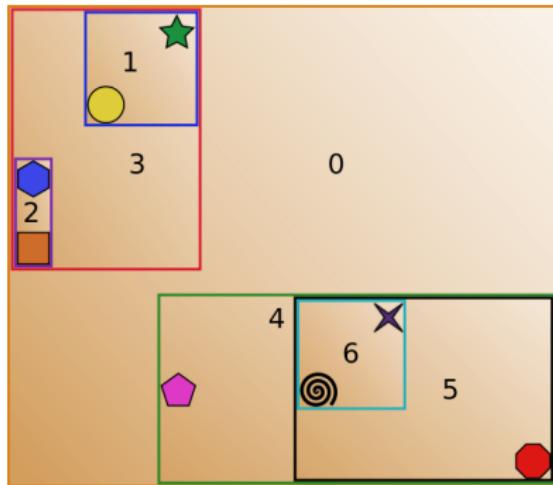
Determine Full Range



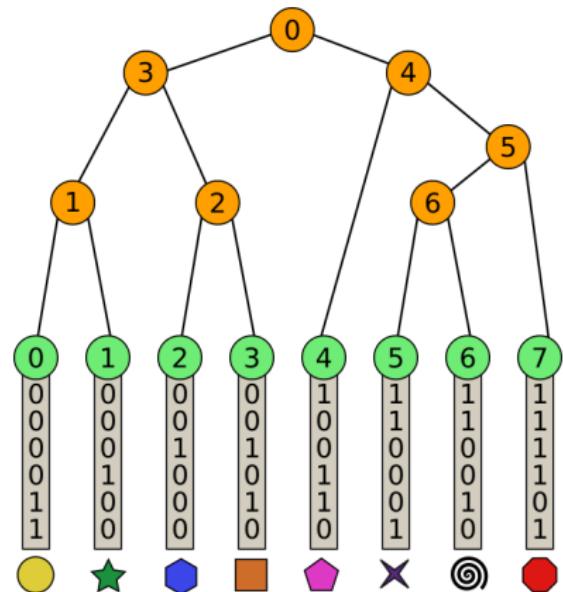
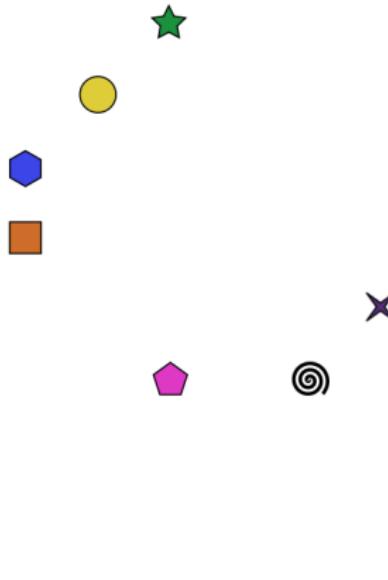
Determine Split Location



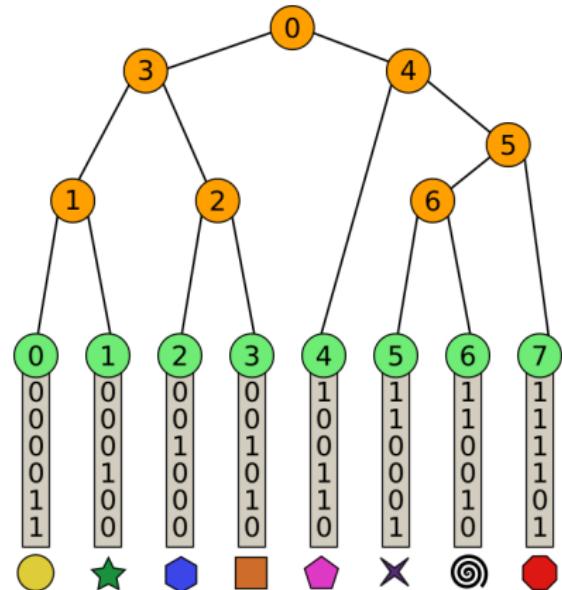
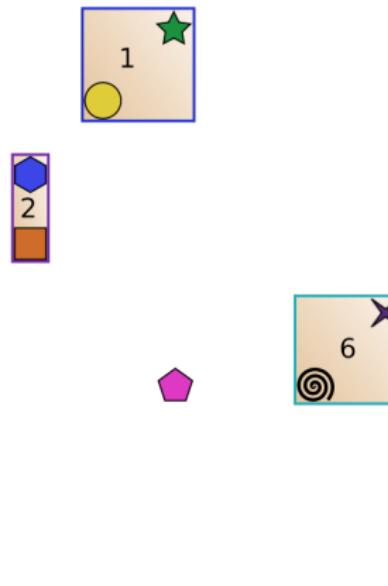
Determine Children



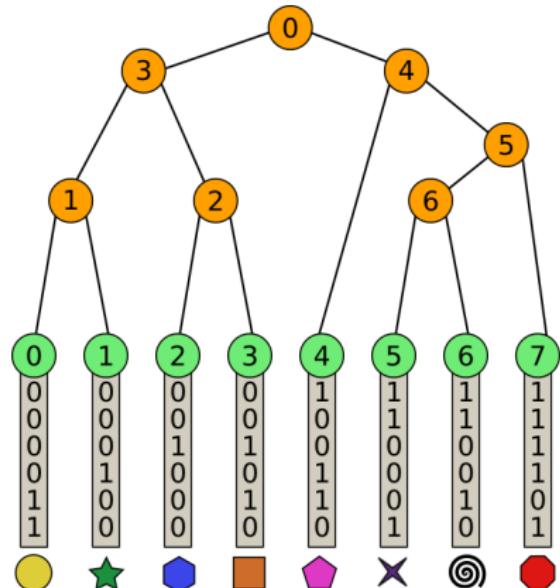
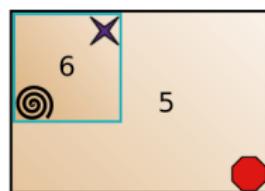
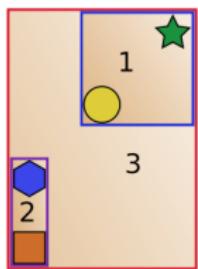
Fitting Boxes



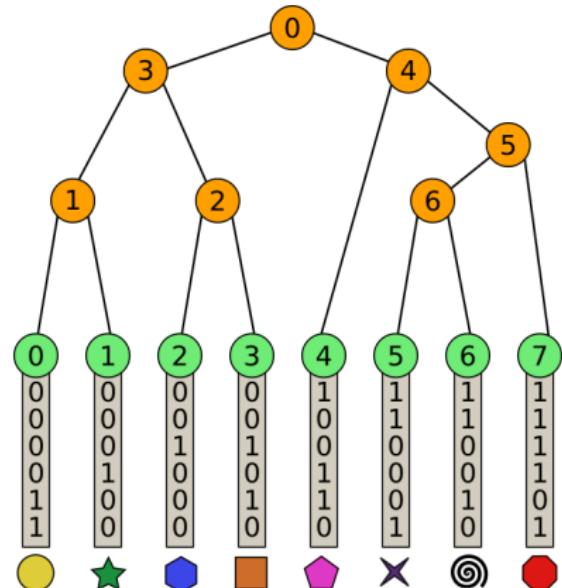
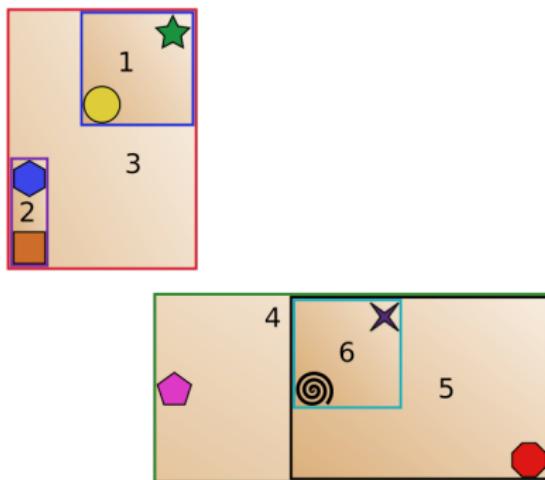
Fitting Boxes



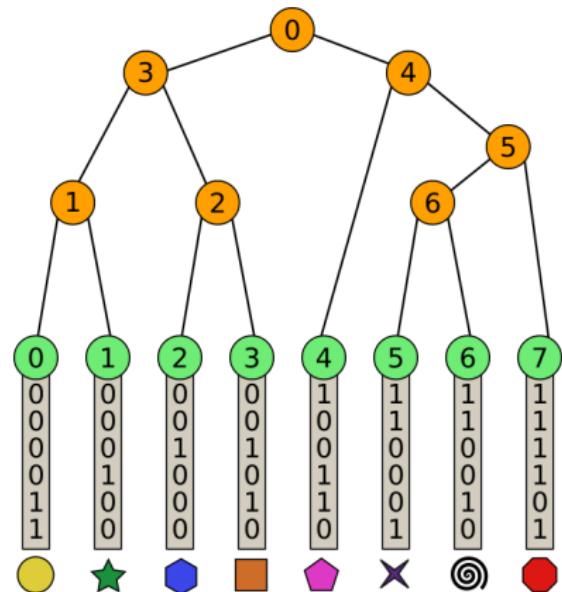
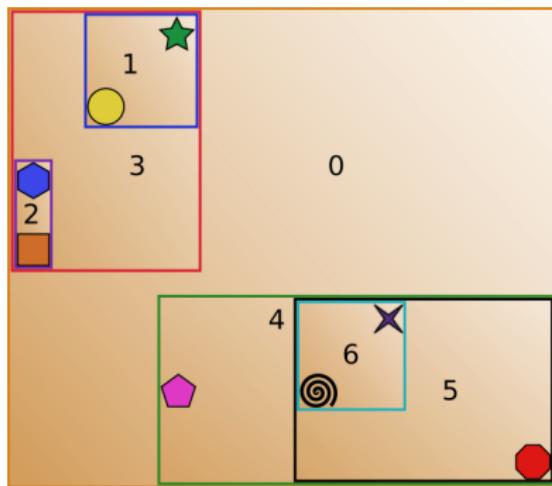
Fitting Boxes



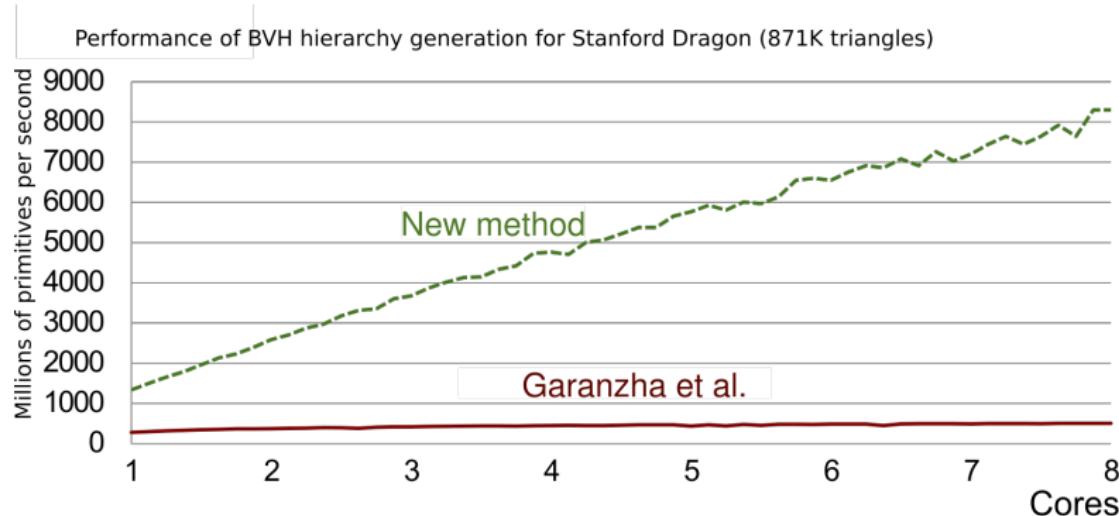
Fitting Boxes



Fitting Boxes

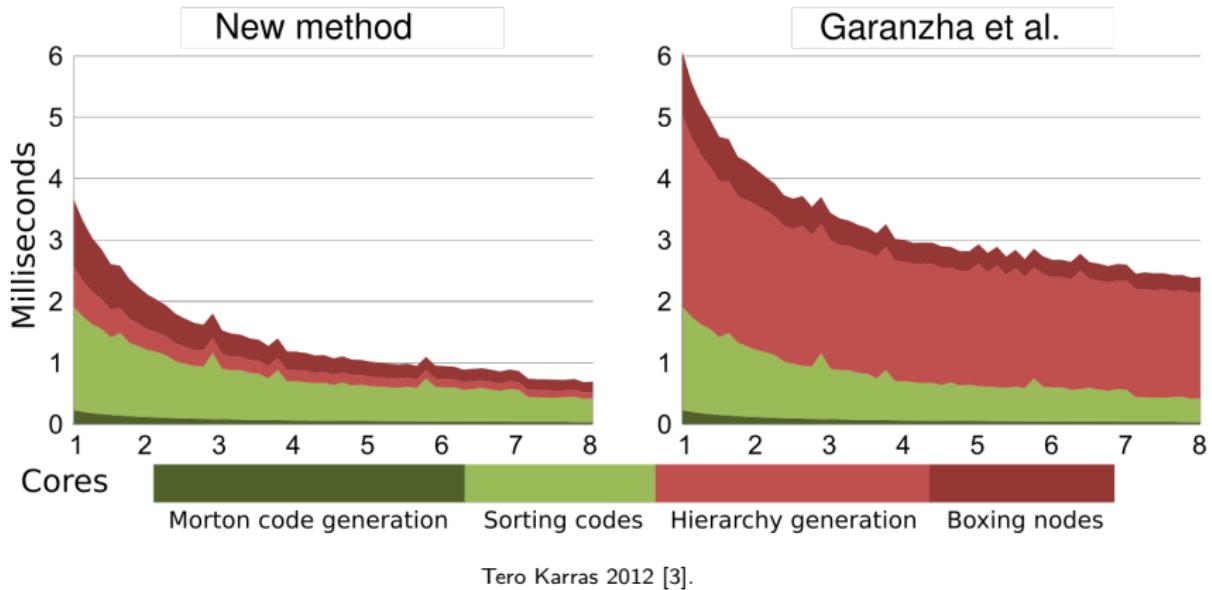


Results



Tero Karras 2012 [3].

Results



Questions?



Bibliography

- ① Kirill Garanzha, Jacopo Pantaleoni, and David McAllister. 2011. Simpler and faster HLBVH with work queues. In Proceedings of the ACM SIGGRAPH Symposium on High Performance Graphics (HPG '11), Stephen N. Spencer (Ed.). ACM, New York, NY, USA, 59-64.
DOI=<http://dx.doi.org.ezproxy.morris.umn.edu/10.1145/2018323.2018333>
- ② Christian Gribble, Jeremy Fisher, Daniel Eby, Ed Quigley, and Gideon Ludwig. 2012. Ray tracing visualization toolkit. In Proceedings of the ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games (I3D '12), Stephen N. Spencer (Ed.). ACM, New York, NY, USA, 71-78.
DOI=<http://dx.doi.org.ezproxy.morris.umn.edu/10.1145/2159616.2159628>
- ③ Tero Karras. 2012. Maximizing parallelism in the construction of BVHs, octrees, and k-d trees. In Proceedings of the Fourth ACM SIGGRAPH / Eurographics conference on High-Performance Graphics (EGGH-HPG'12), Carsten Dachsbacher, Jacob Munkberg, and Jacopo Pantaleoni (Eds.). Eurographics Association, Aire-la-Ville, Switzerland, Switzerland, 33-37.
DOI=<http://dx.doi.org.ezproxy.morris.umn.edu/10.2312/EGGH/HPG12/033-037>
- ④ Timo Viitanen, Matias Koskela, Pekka Jskelinen, Heikki Kultala, and Jarmo Takala. 2015. MergeTree: a HLBVH constructor for mobile systems. In SIGGRAPH Asia 2015 Technical Briefs (SA '15). ACM, New York, NY, USA, , Article 12 , 4 pages.
DOI=<http://dx.doi.org.ezproxy.morris.umn.edu/10.1145/2820903.2820916>
- ⑤ Ingo Wald. 2007. On fast Construction of SAH-based Bounding Volume Hierarchies. In Proceedings of the 2007 IEEE Symposium on Interactive Ray Tracing (RT '07). IEEE Computer Society, Washington, DC, USA, 33-40. DOI=<http://dx.doi.org/10.1109/RT.2007.4342588>
- ⑥ Turner Whitted. 1980. An improved illumination model for shaded display. Commun. ACM 23, 6 (June 1980), 343-349. DOI=<http://dx.doi.org/10.1145/358876.358882>