

SkexGen

Autoregressive Generation of CAD Construction Sequences with Disentangled Codebooks

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Pradeep Kumar Jayaraman² Yasutaka Furukawa¹



¹Simon Fraser University



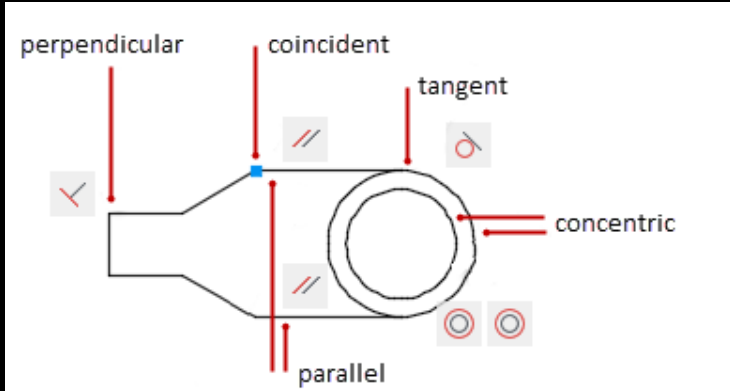
²Autodesk



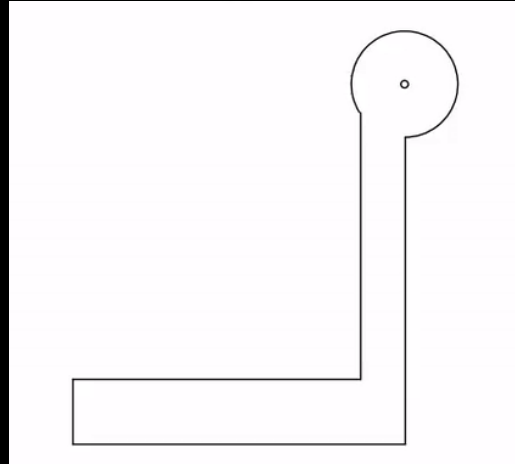
CAD enables the development, modification, and optimization of the design process.

Generate Diverse CAD based on Design Intent

Parametric CAD Challenges



Manual Constraints



Limited Diversity



Limited Exploration

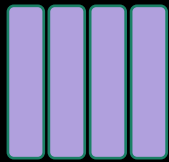
SkexGen Solutions



Topology

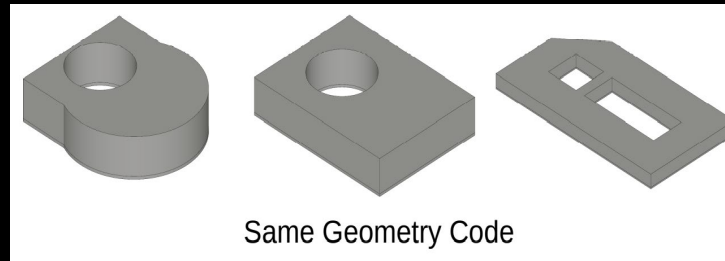


Geometry

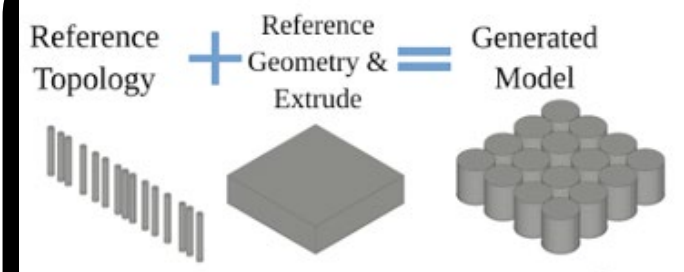


Extrude

Disentangled Codebooks

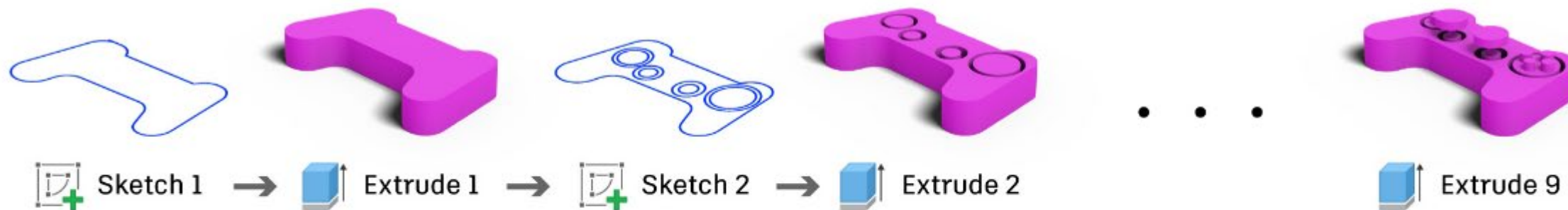


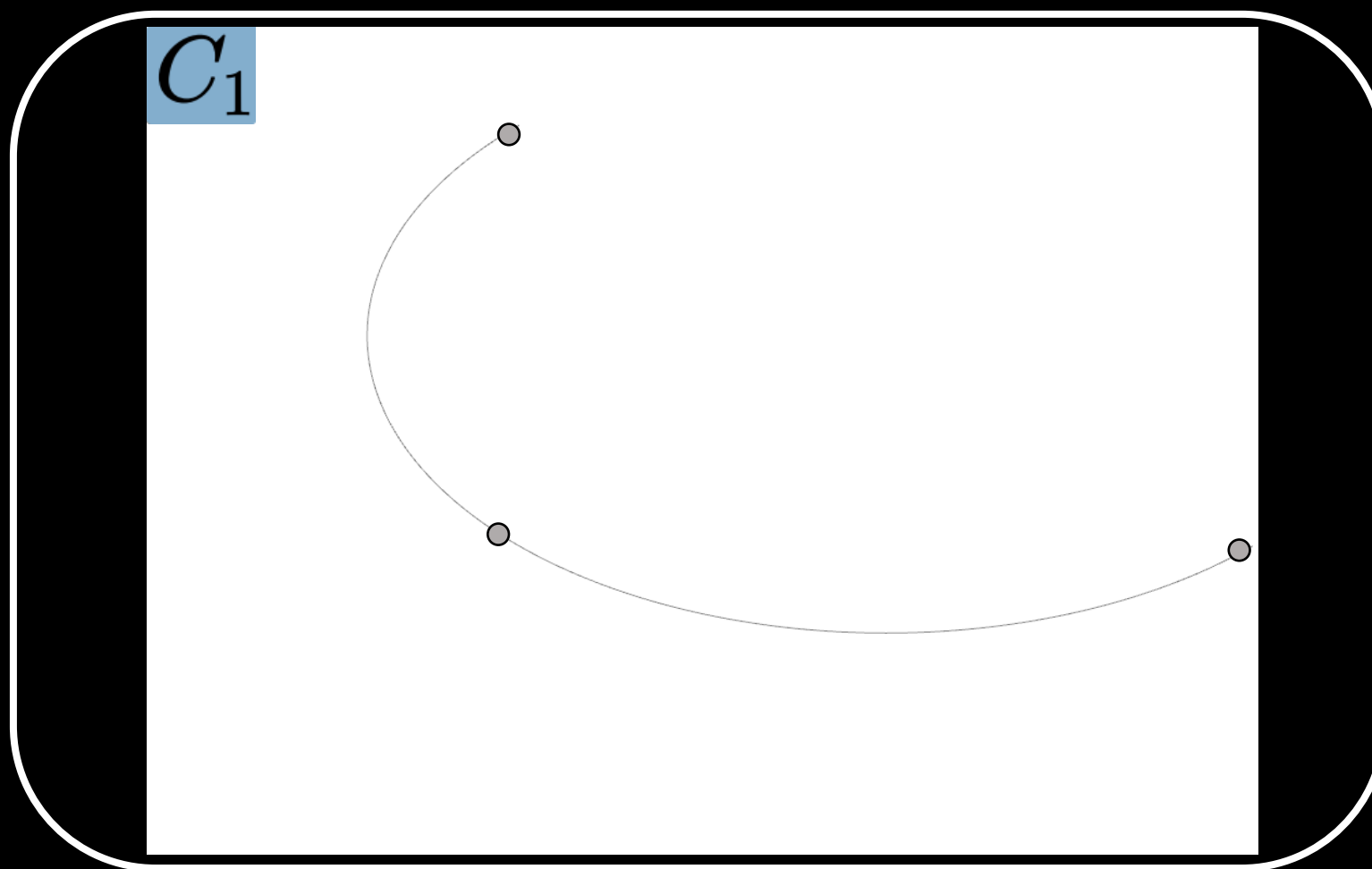
Diverse Generation



Efficient Exploration

Sketch-and-Extrude Construction Sequence

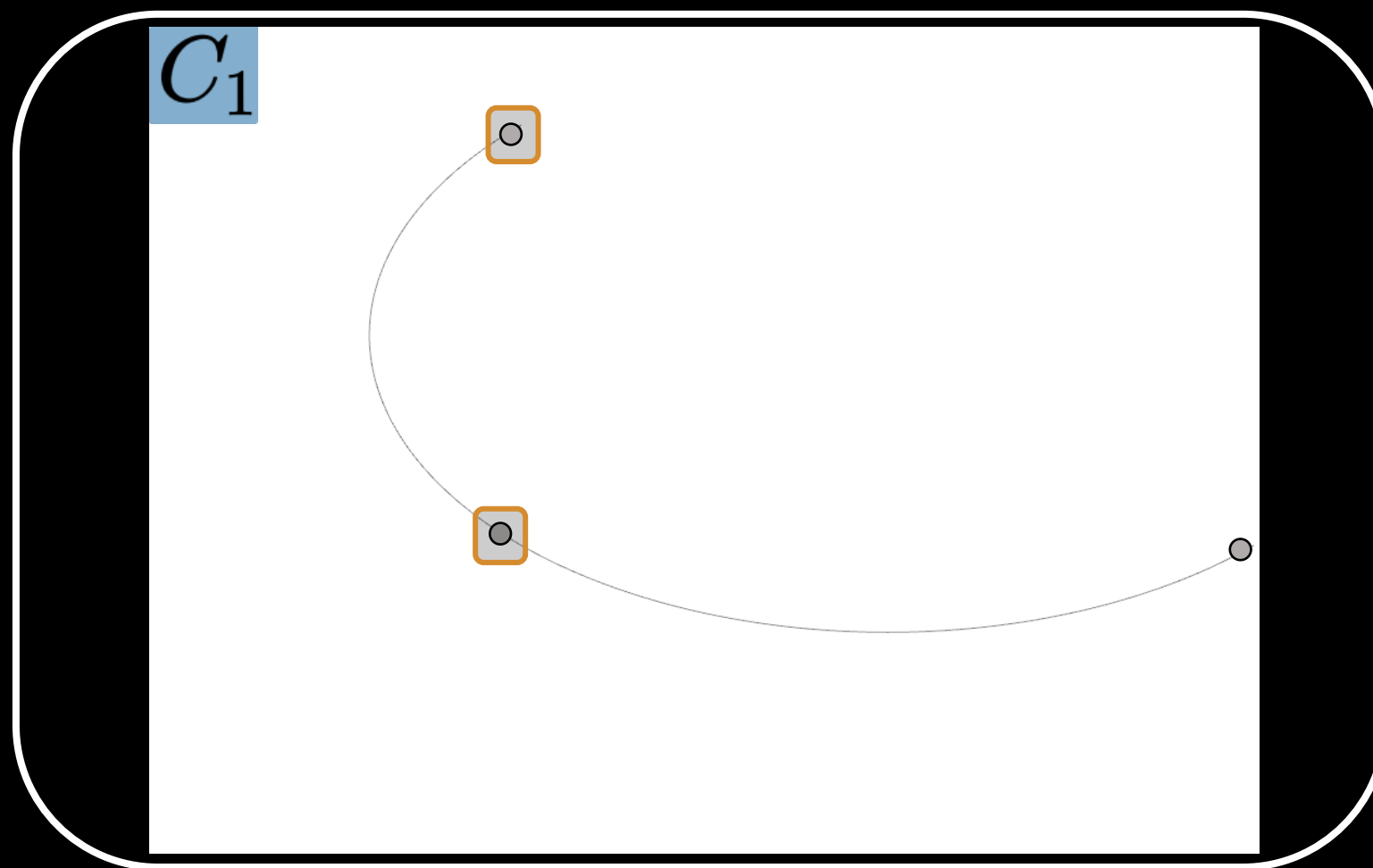




T_1 G_1 G_2 T_2 G_3 T_3 G_4 T_4 G_5 G_6 G_7 G_8 T_5 G_9 G_{10} G_{11} G_{12} H_1 R_1 O_1 S_1 B_1 T_6 G_{13} G_{14} G_{15} G_{16} H_2 R_2 O_2 S_2 B_2 END

line
 arc
 circle

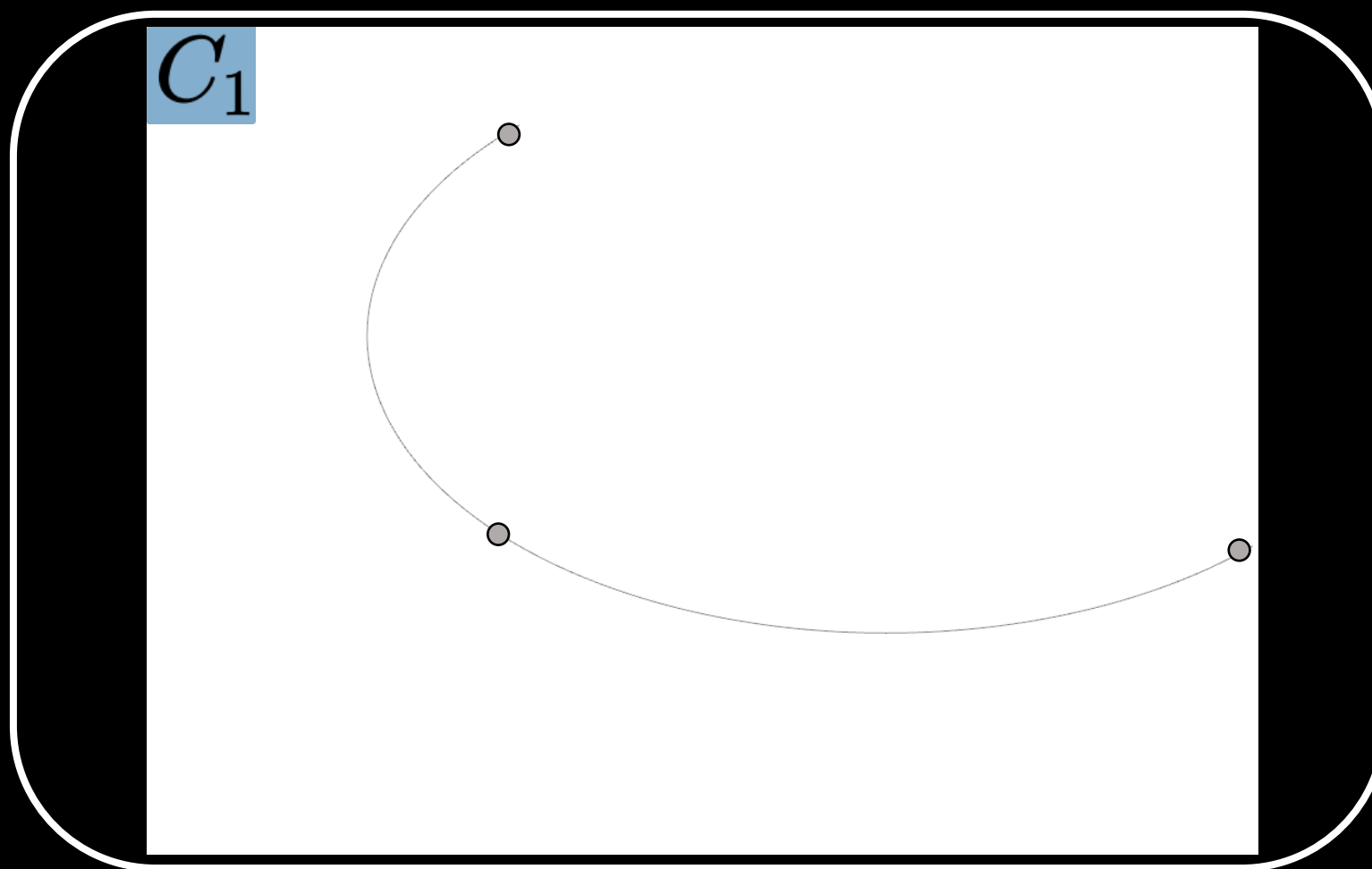
Topology Token



T_1 G_1 G_2 T_2 G_3 T_3 G_4 T_4 G_5 G_6 G_7 G_8 T_5 G_9 G_{10} G_{11} G_{12} H_1 R_1 O_1 S_1 B_1 T_6 G_{13} G_{14} G_{15} G_{16} H_2 R_2 O_2 S_2 B_2 END

$\begin{bmatrix} X=0.5 \\ Y=2.5 \end{bmatrix}$ $\begin{bmatrix} X=1.5 \\ Y=3.5 \end{bmatrix}$

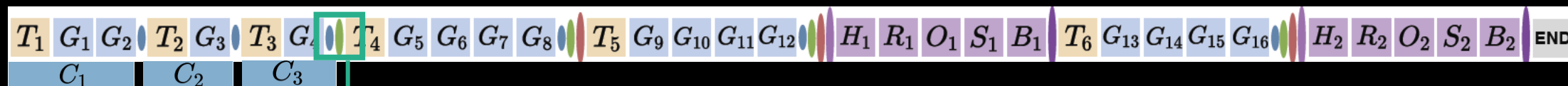
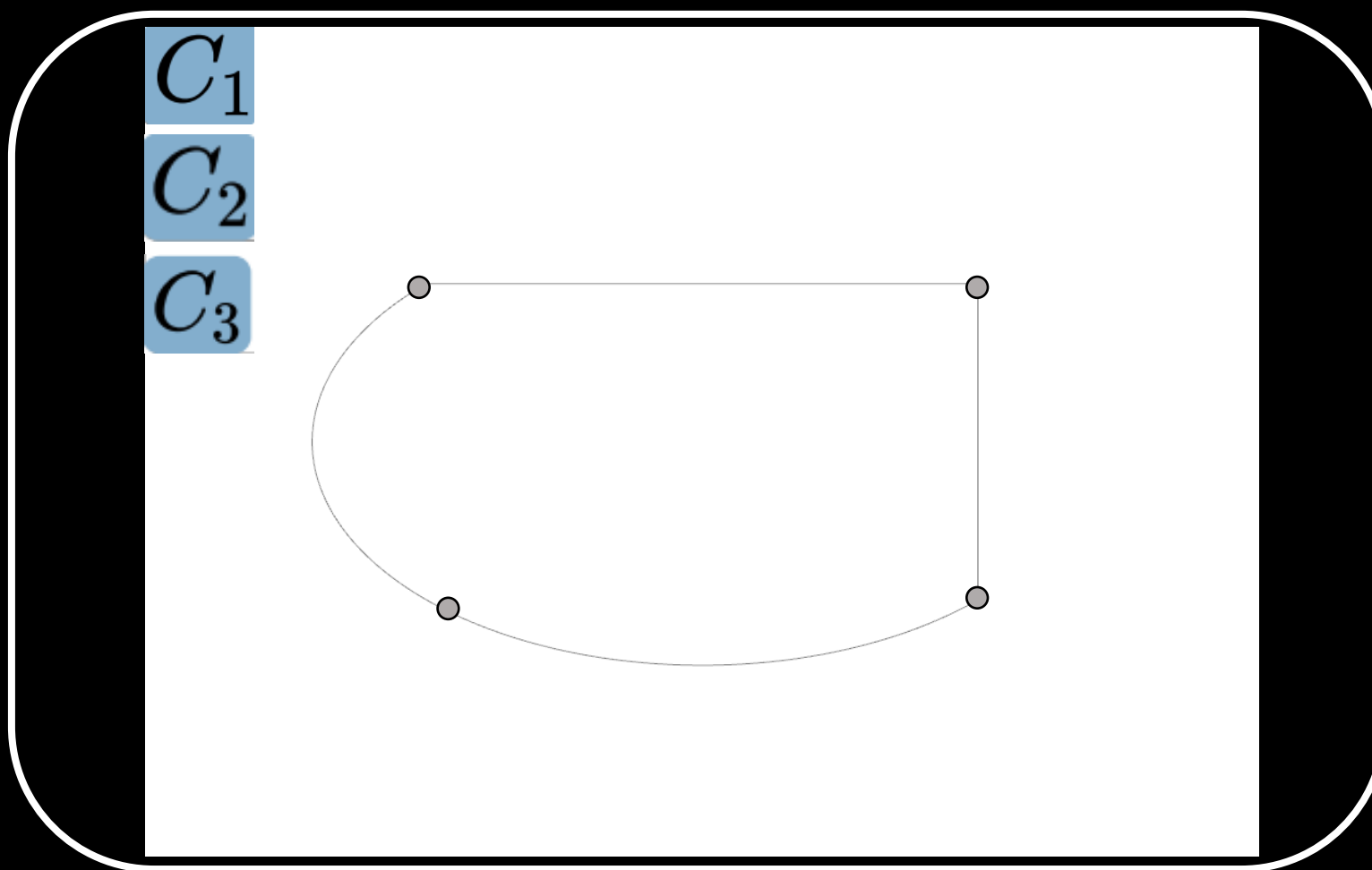
Geometry Token



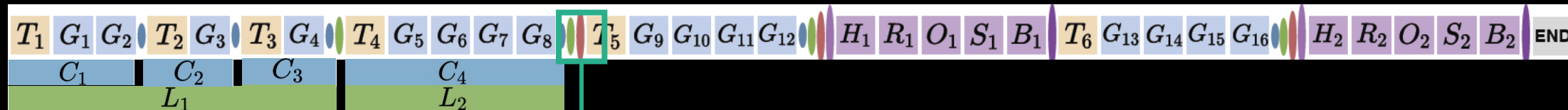
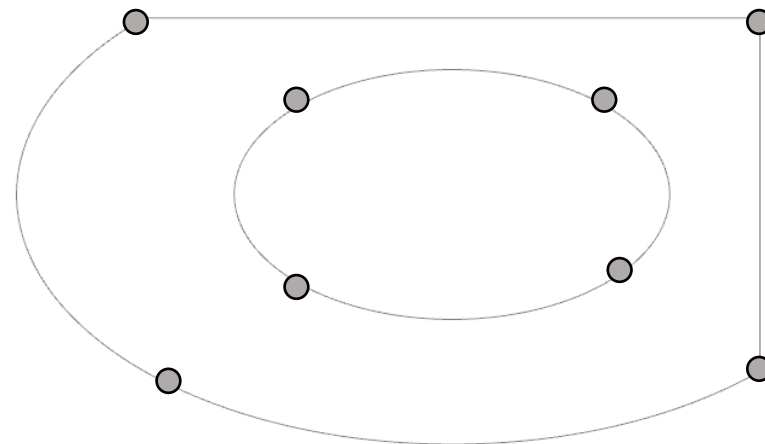
T_1 G_1 C_2 T_2 G_3 T_3 G_4 T_4 G_5 G_6 G_7 G_8 T_5 G_9 G_{10} G_{11} G_{12} H_1 R_1 O_1 S_1 B_1 T_6 G_{13} G_{14} G_{15} G_{16} H_2 R_2 O_2 S_2 B_2 END

End of a curve

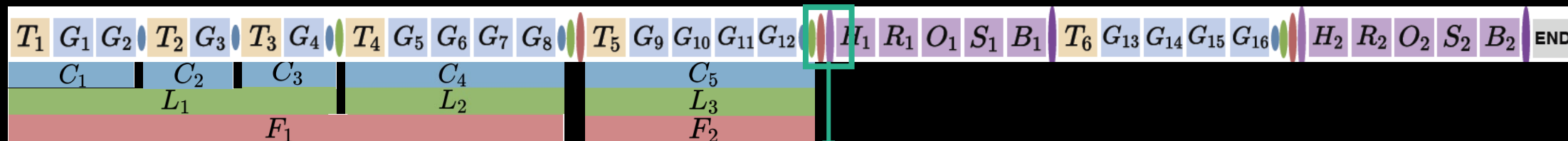
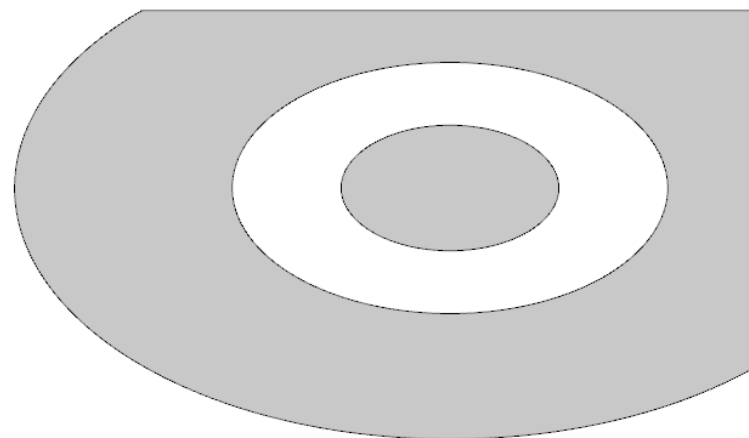
End-Primitive Token



End of a loop

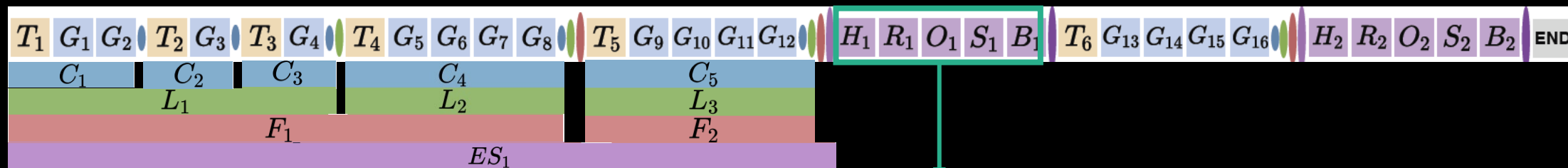
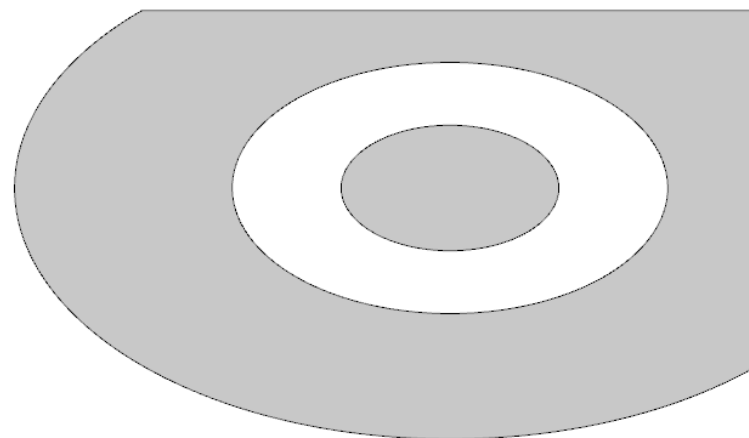
L_1 L_2 

End of a face

F_1 F_2 

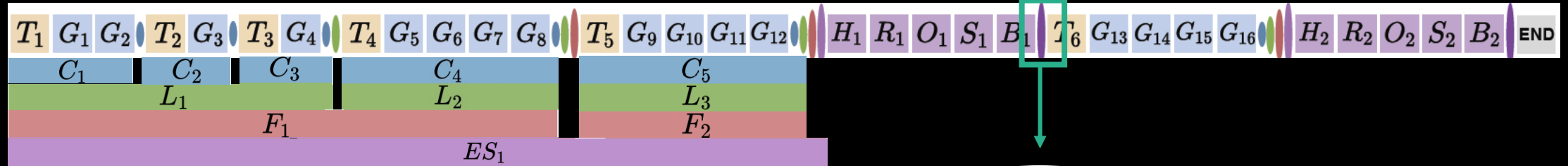
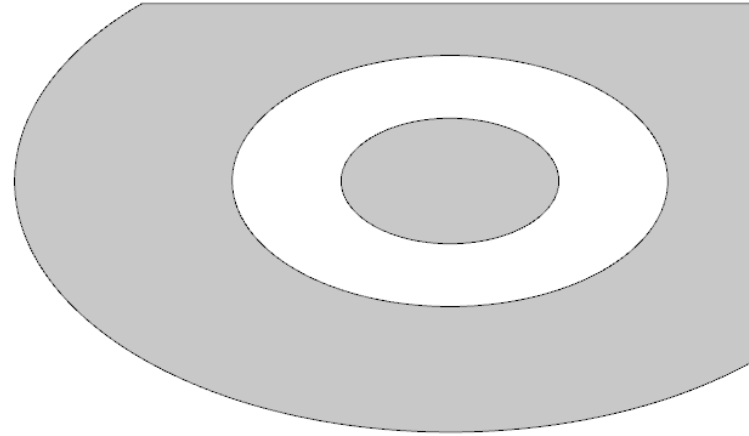
End of a sketch

ES_1



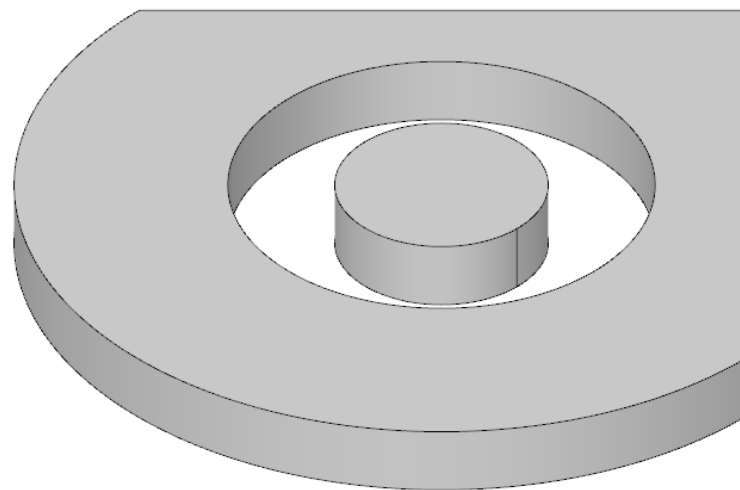
Extrude Token

ES_1

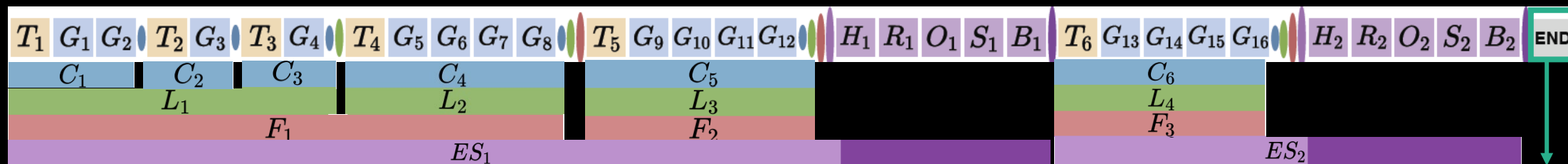


End of an
extruded sketch

ES_1

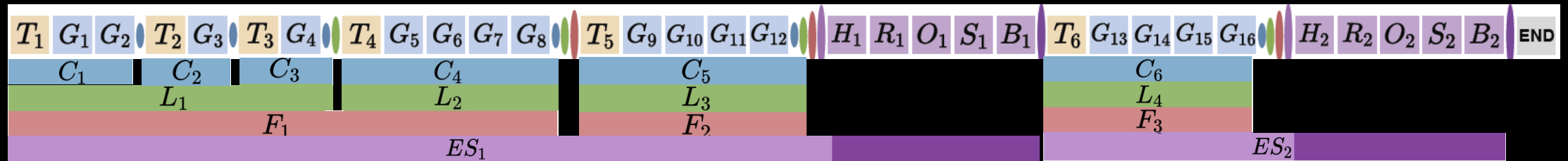
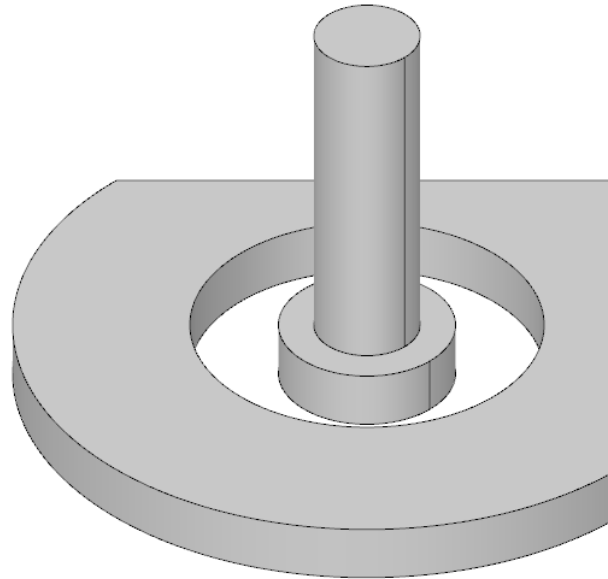


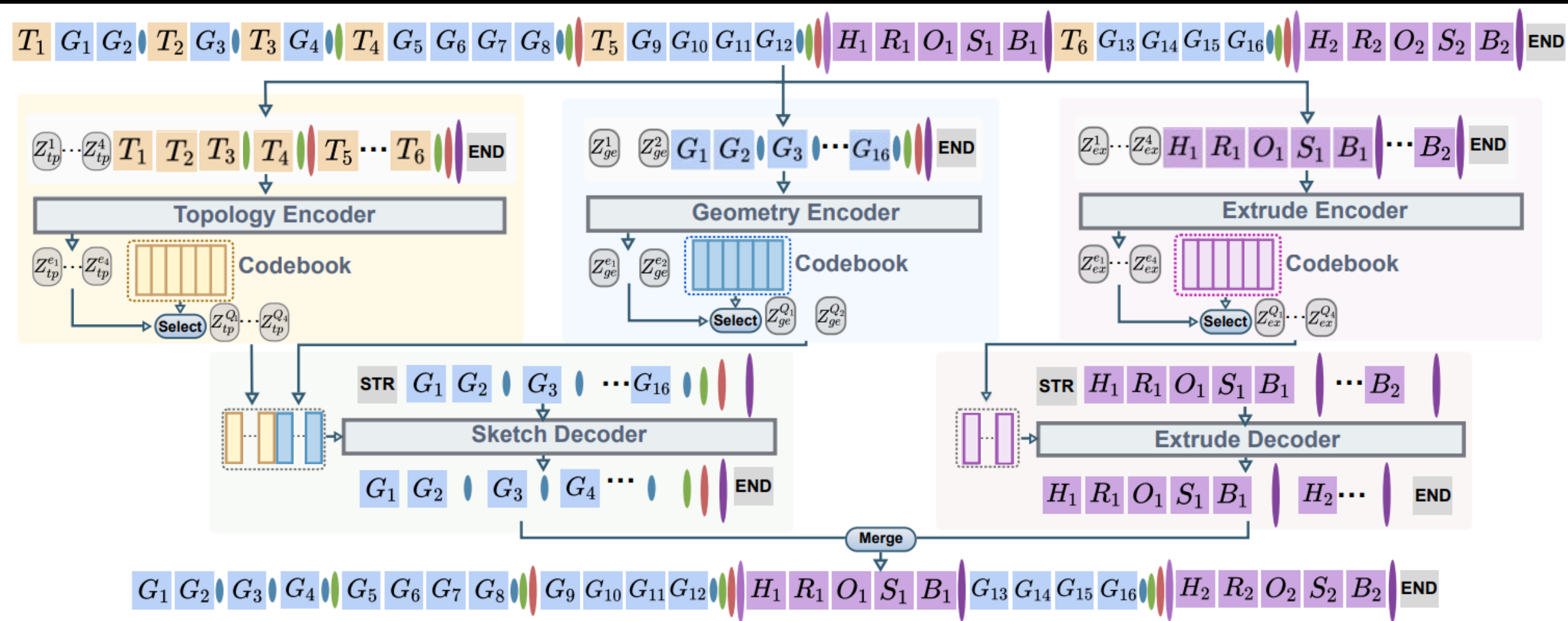
ES_2



End-seq Token

Sketch & Extrude CAD Model



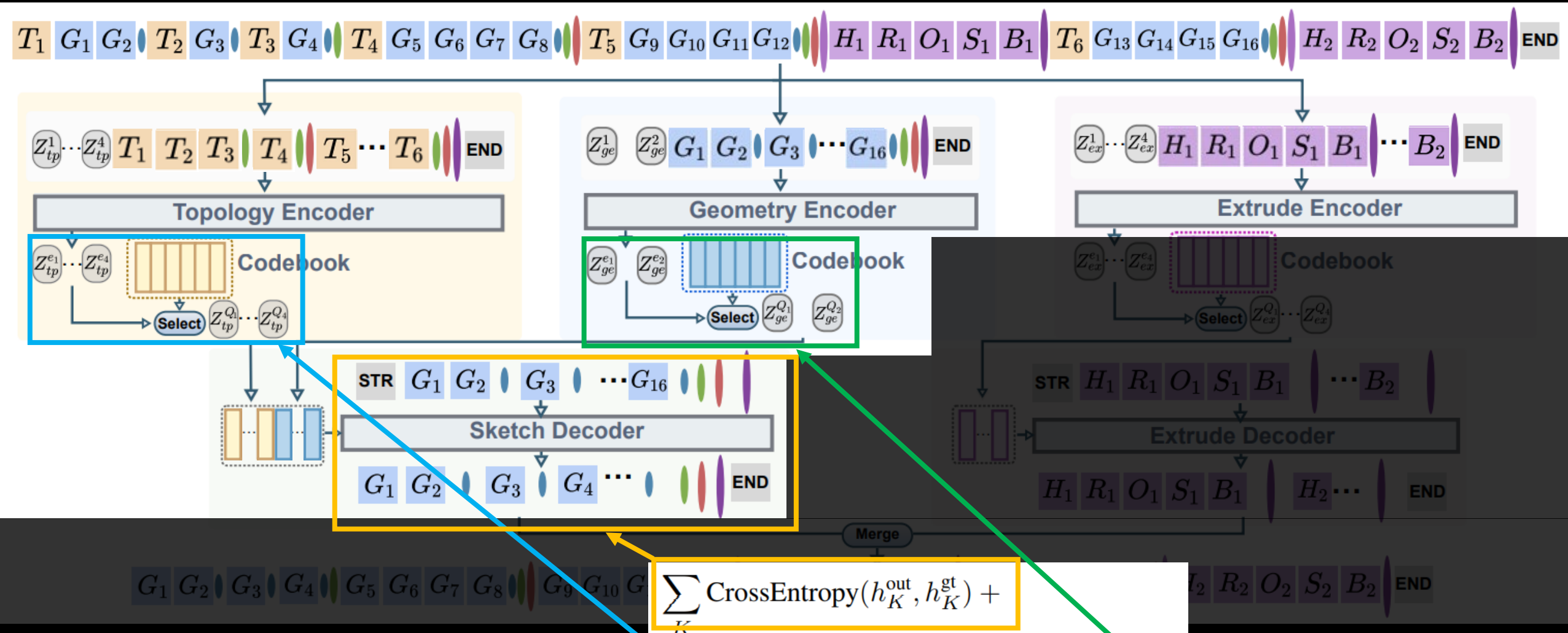


Sketch Branch

- Topology Encoder
- Geometry Encoder
- Sketch Decoder

Extrude Branch

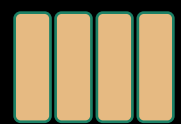
- Extrude Encoder
- Extrude Decoder



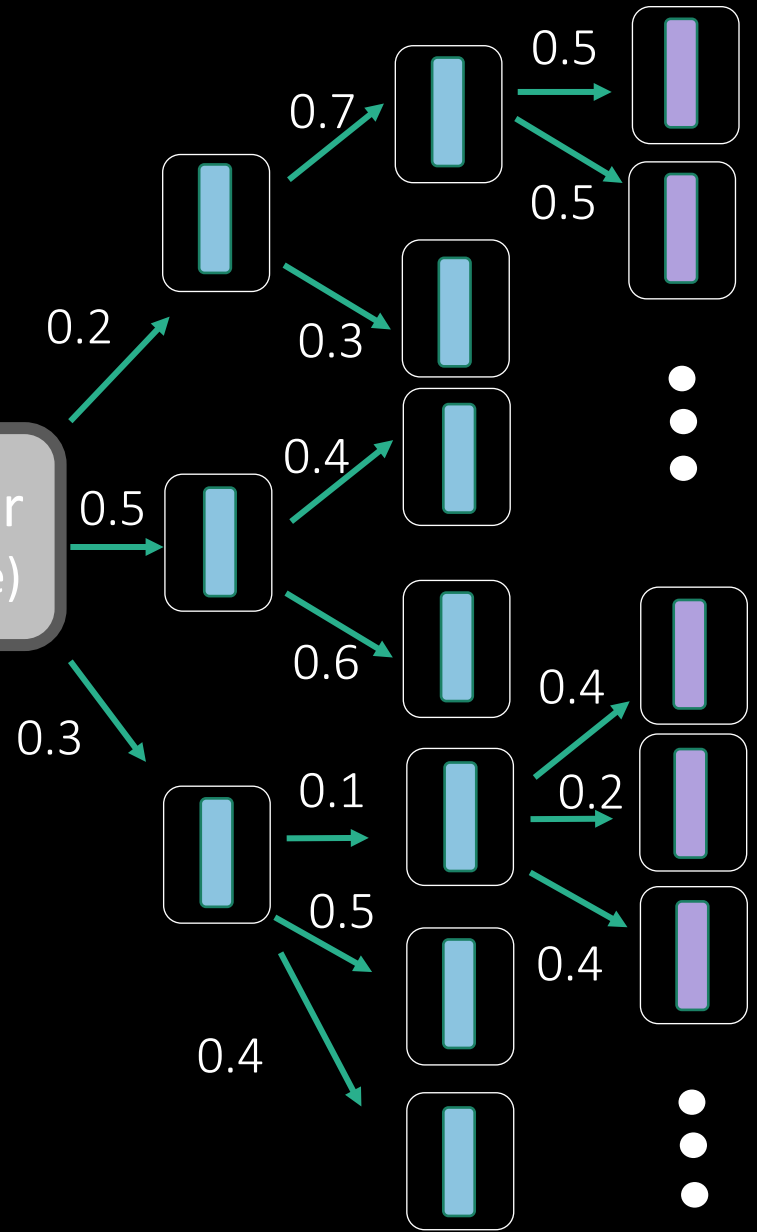
Sketch Branch Loss :

Generation

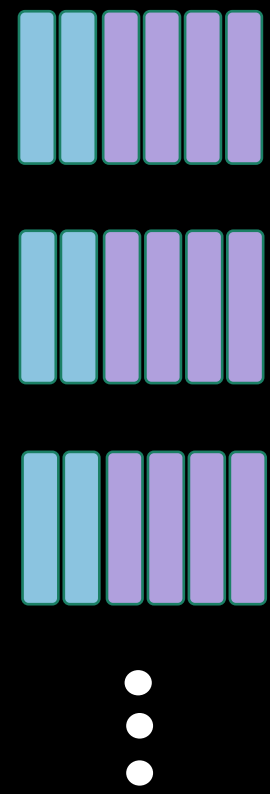
Topology Code



Code Selector
(Autoregressive)

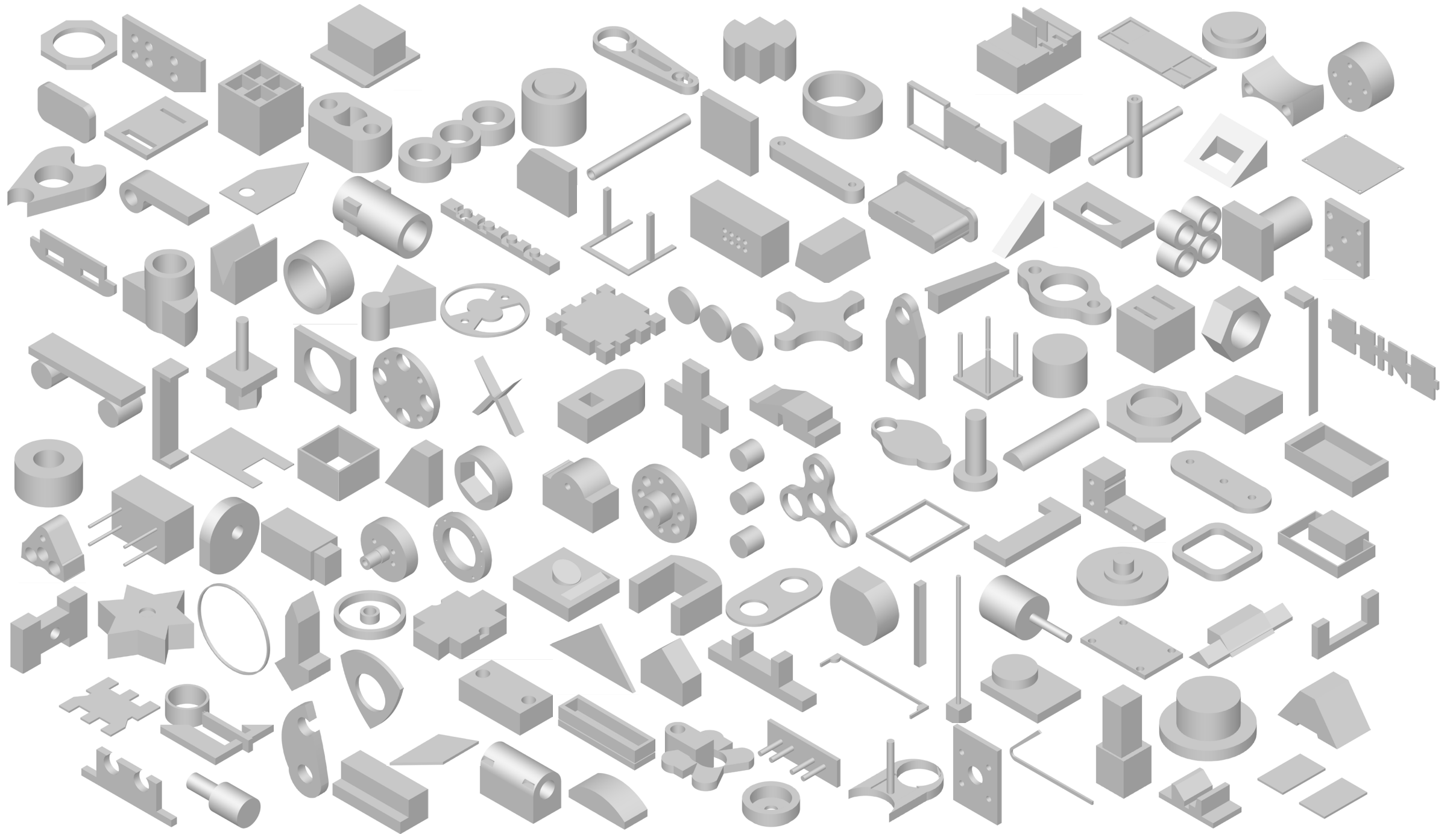


Geometry & Extrude code

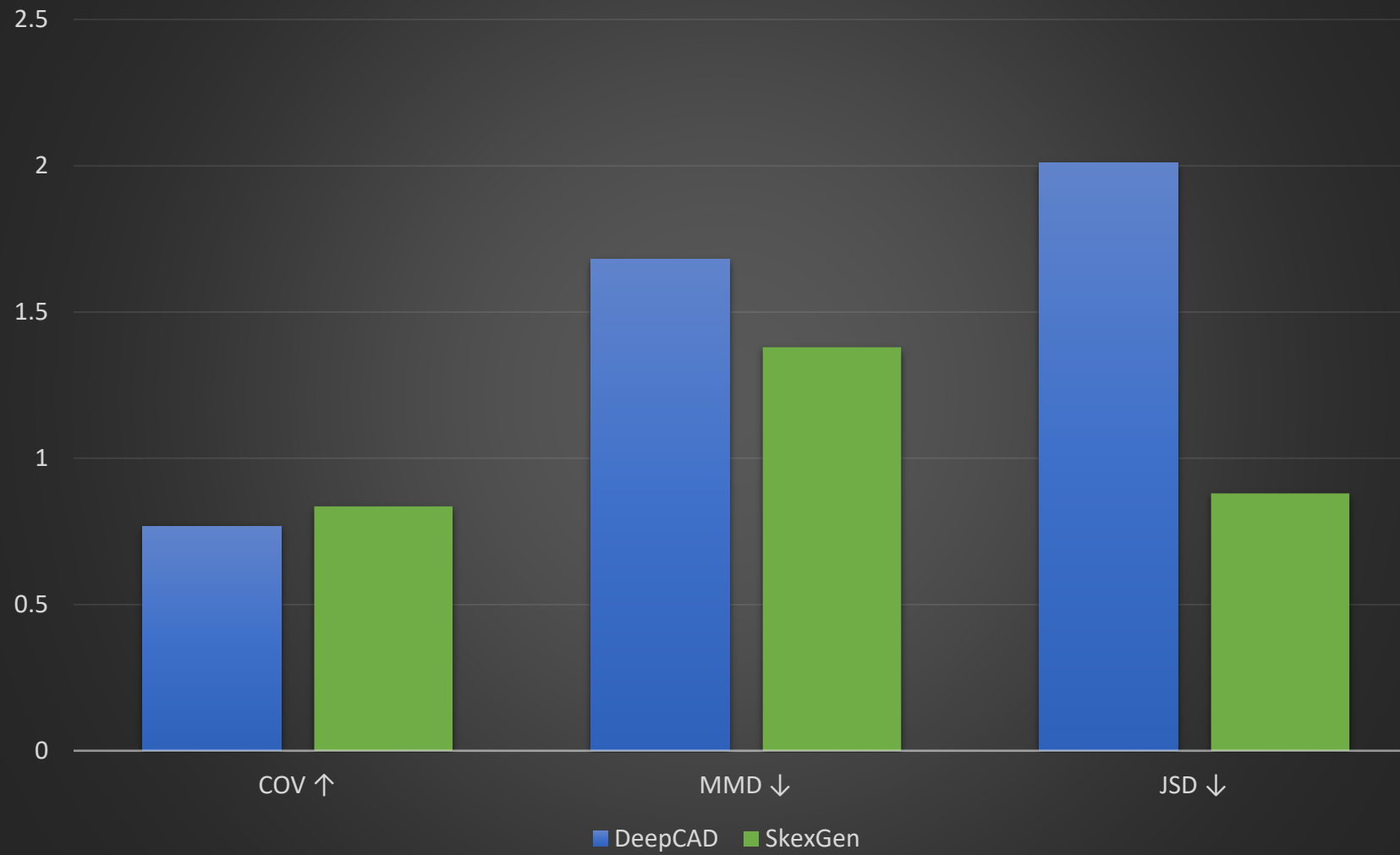


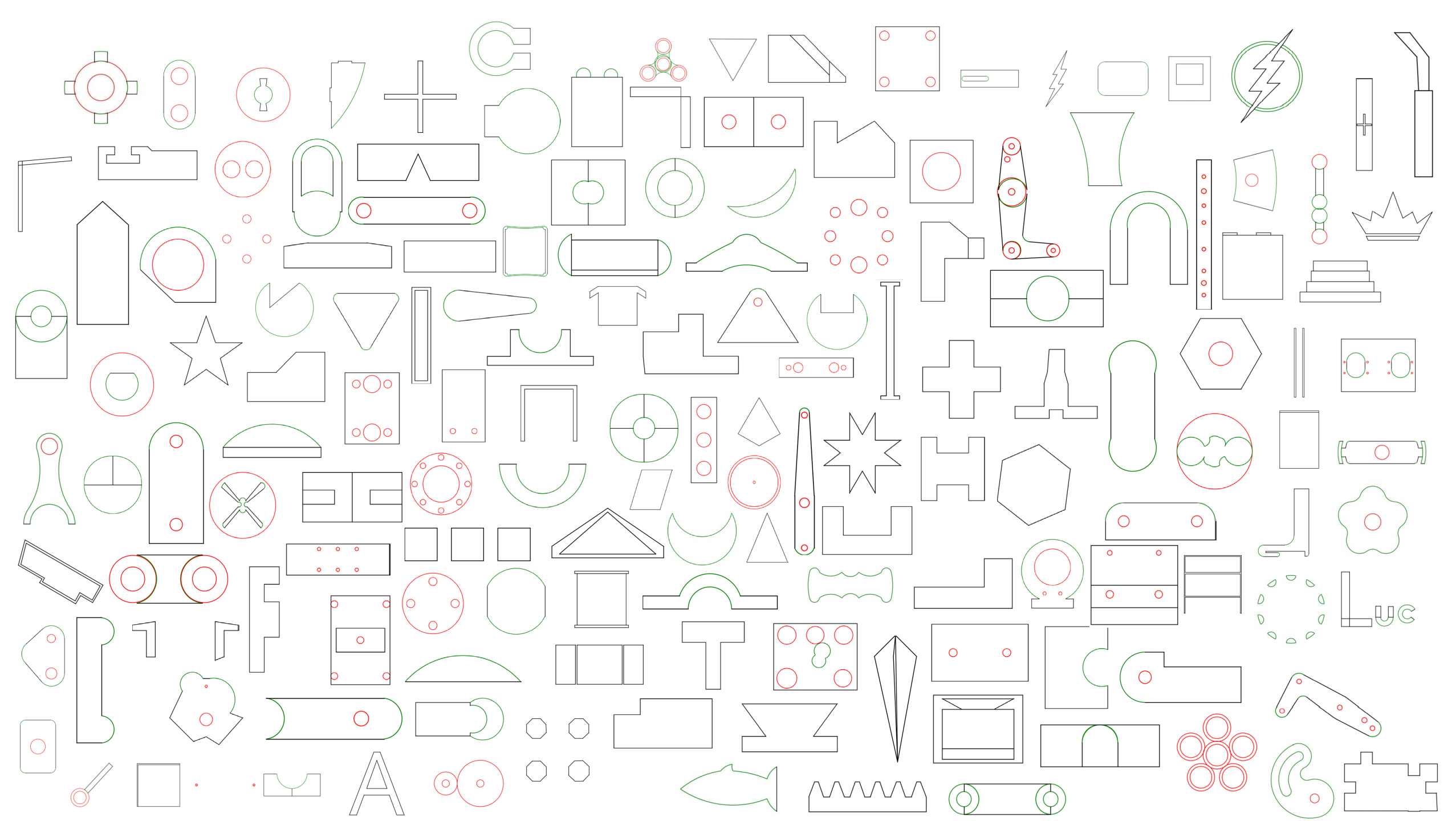
SkexGen Decoders
(Autoregressive)





Random CAD Generation





Random Sketch Generation

120

100

80

60

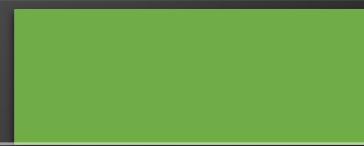
40

20

0

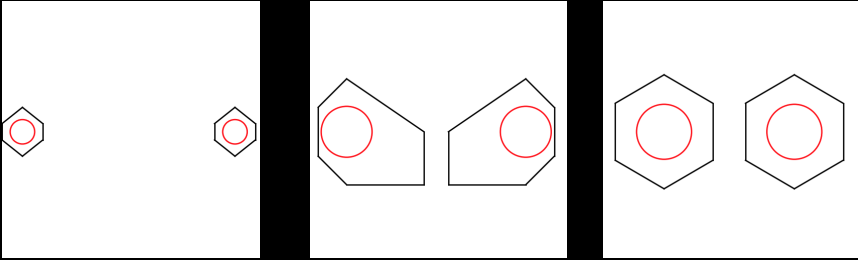
FID Score ↓

CurveGen DeepCAD SkexGen

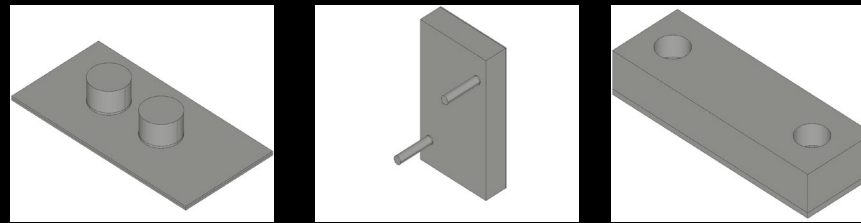


Conditional Generation

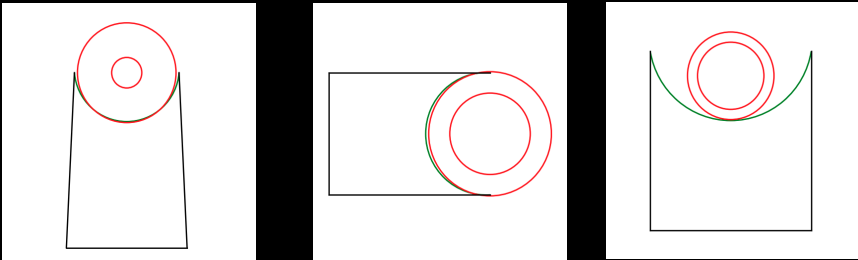
Same Topology Code



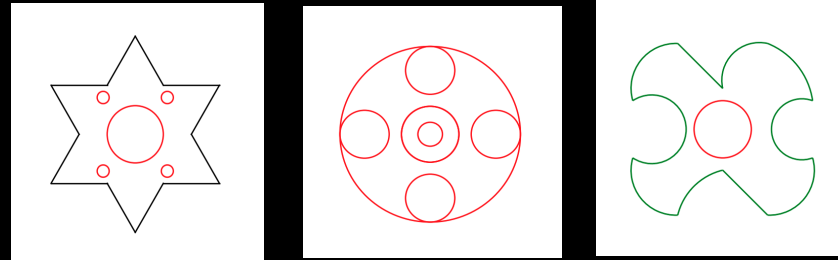
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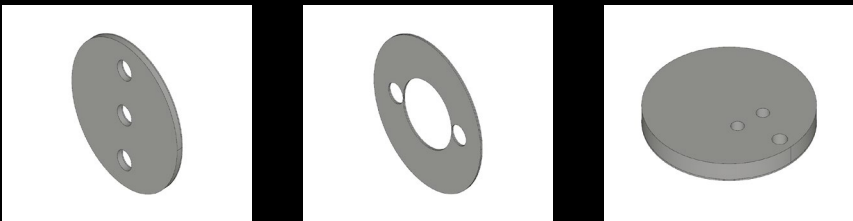
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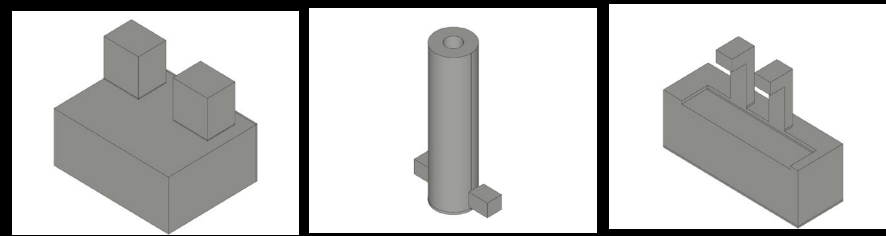
Same Geometry Code



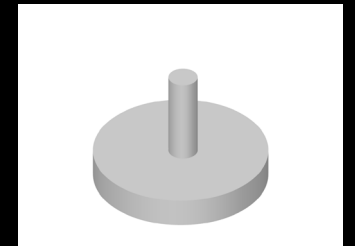
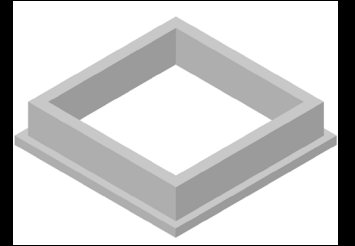
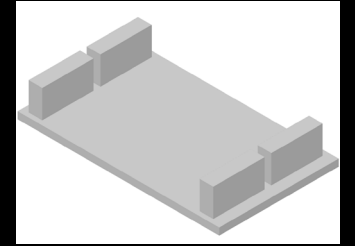
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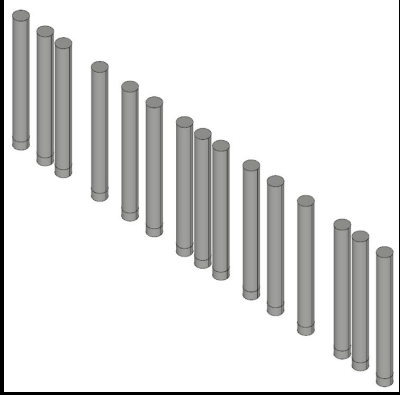
Same Geometry Code



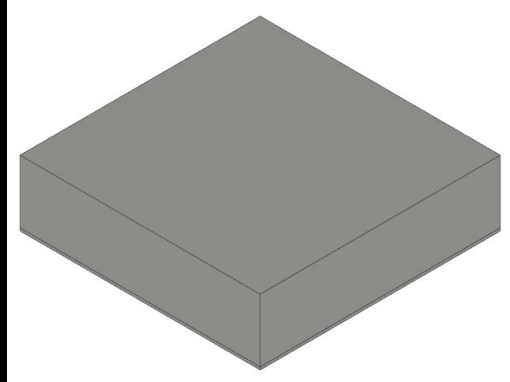
Same Extrude Code



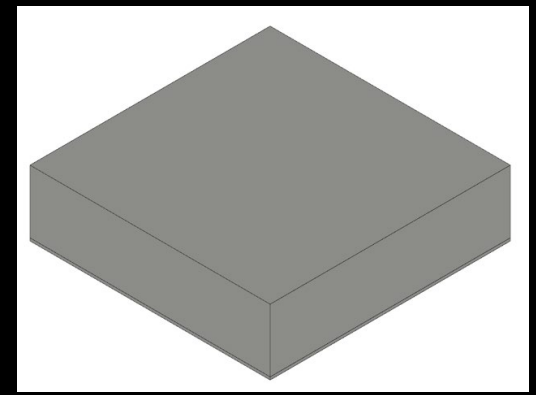
Code Mixing



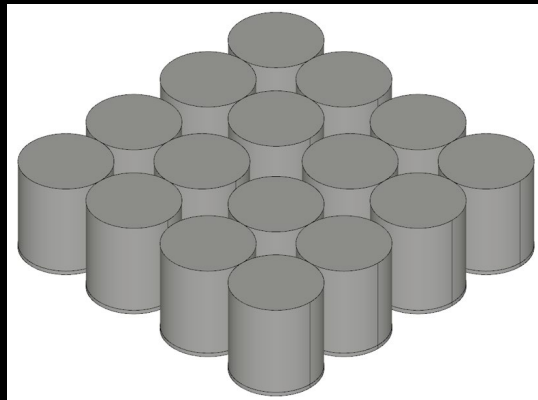
Topology Encoder



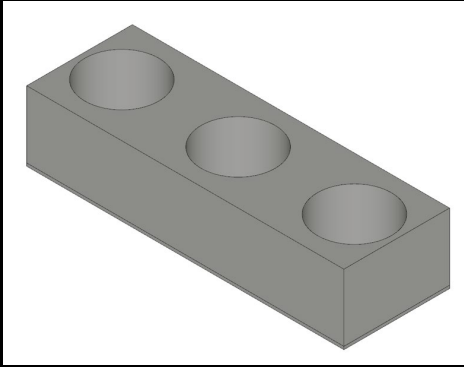
Geometry Encoder



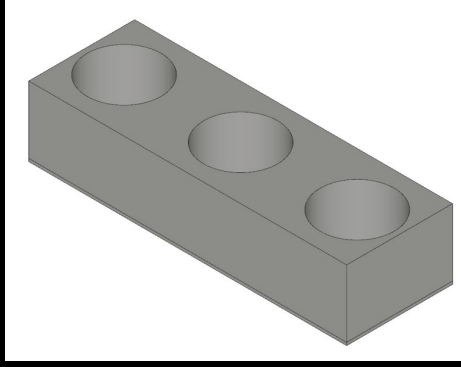
Extrude Encoder



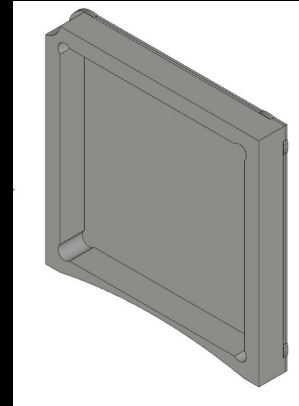
Code Mixing



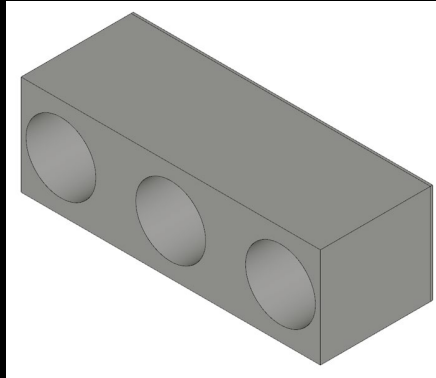
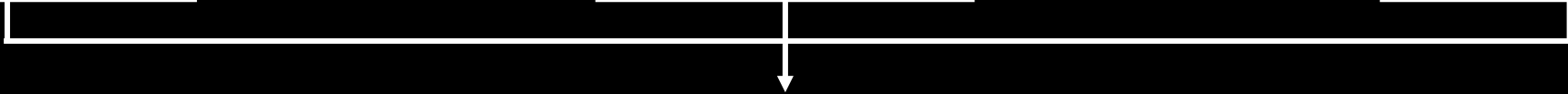
Topology Encoder



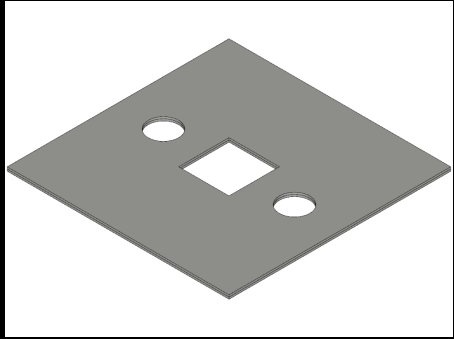
Geometry Encoder



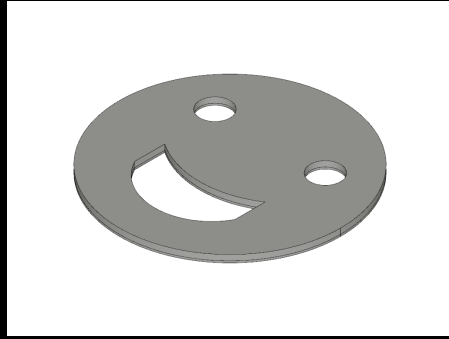
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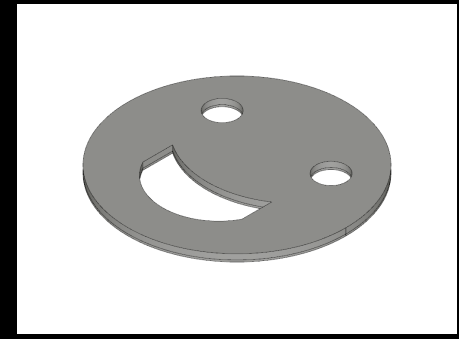
Code Mixing



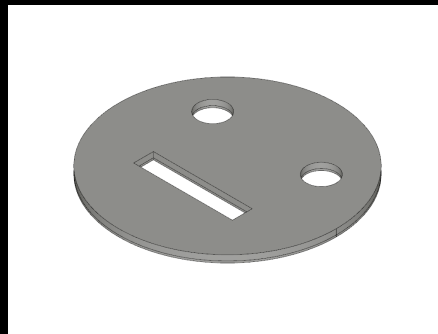
Topology Encoder



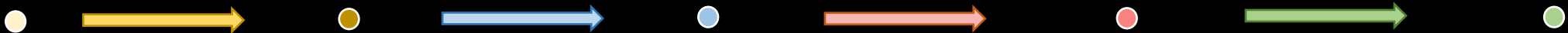
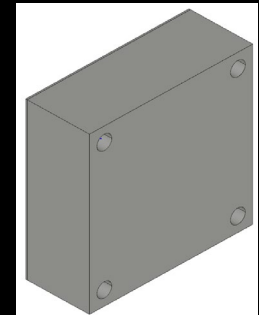
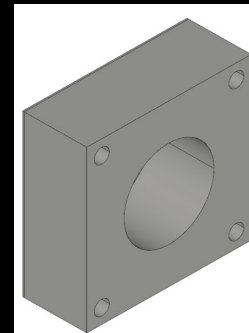
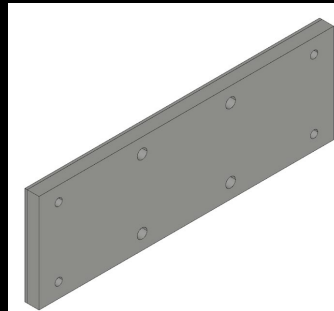
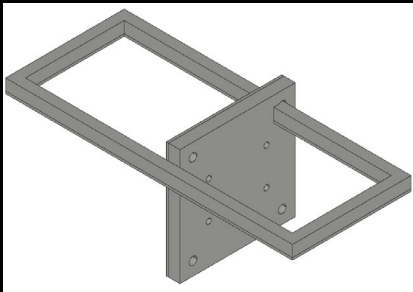
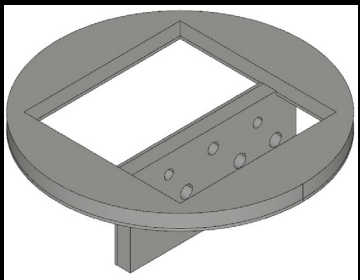
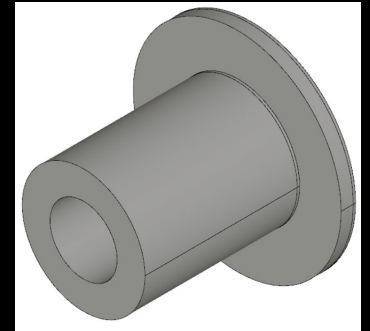
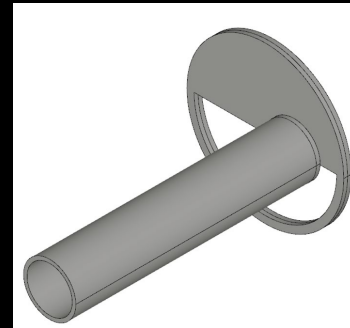
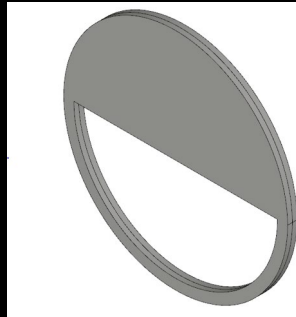
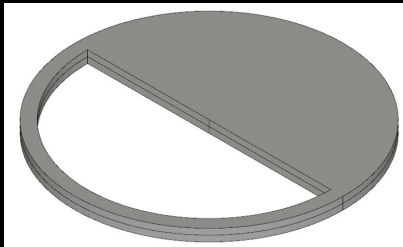
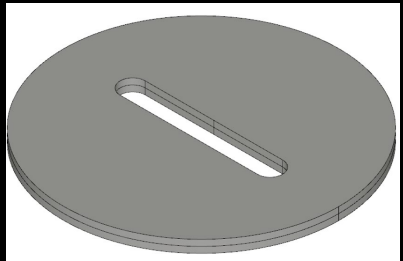
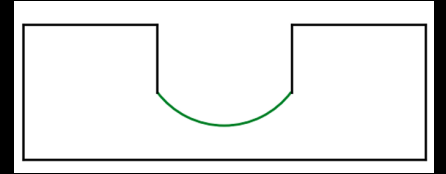
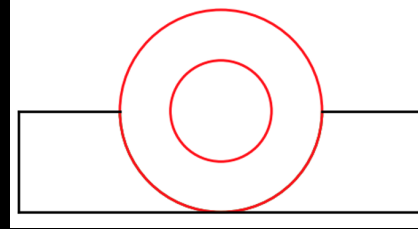
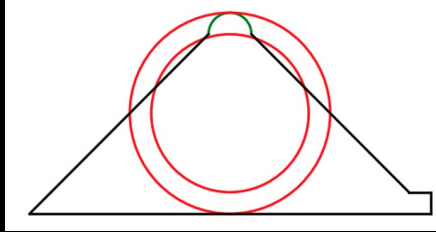
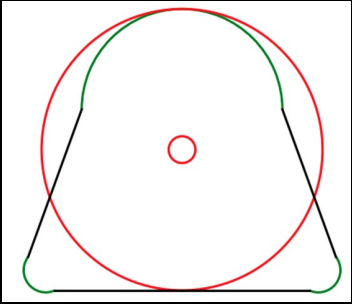
Geometry Encoder



Extrude Encoder

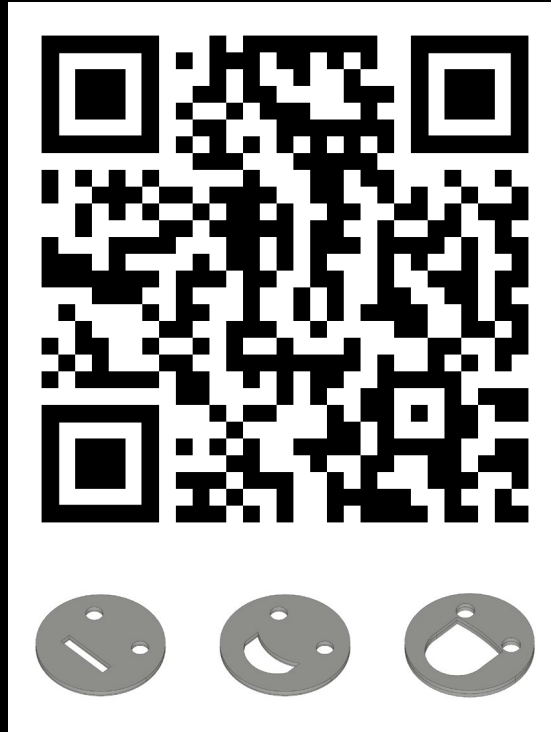


Code Latent Interpolation



SkexGen

Project website: <https://samxuxiang.github.io/skexgen>



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