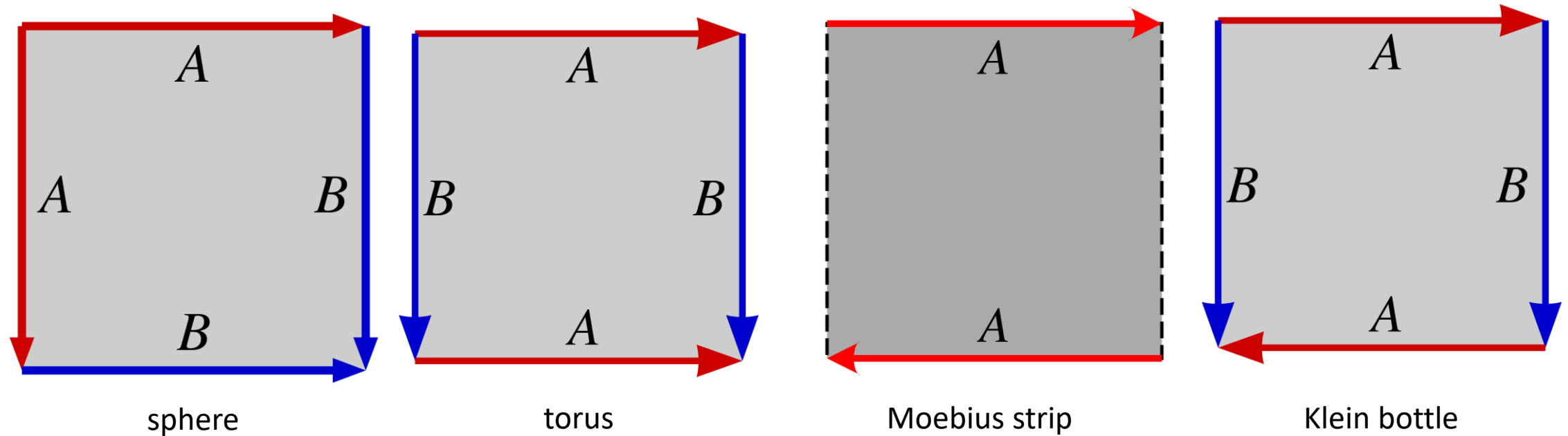


MODELLING AND RENDERING TECHNIQUES

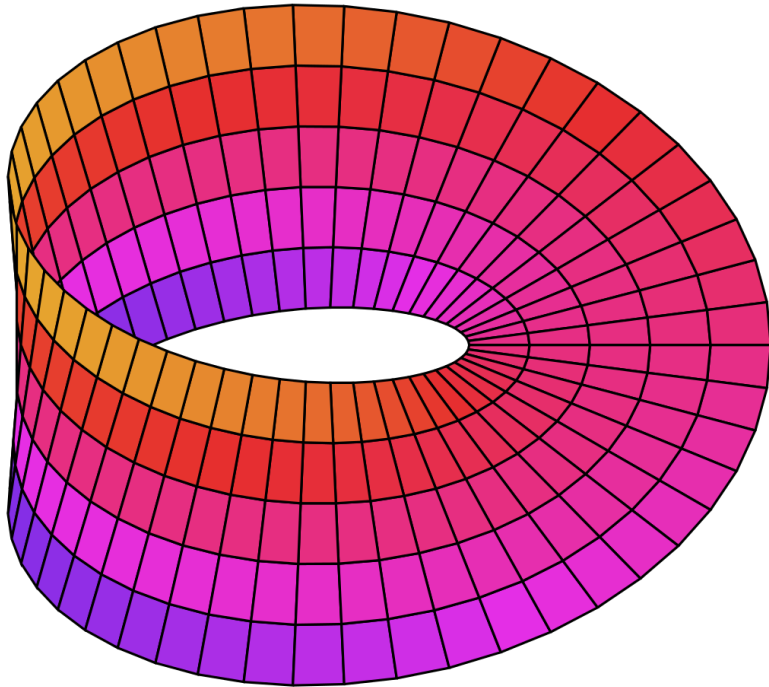
TOPOLOGICAL SURGERY

Construction from polygons

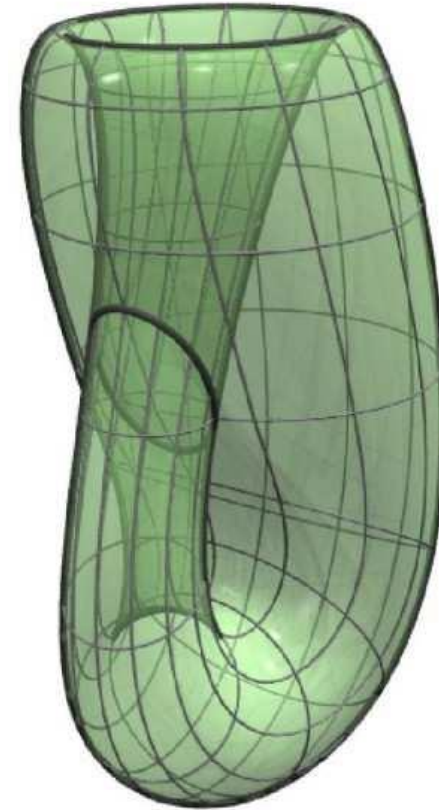
- Each closed surface can be constructed from an oriented polygon with an even number of sides, called a fundamental polygon of the surface, by pairwise identification of its edges



Non-orientable objects



Moebius strip



Klein bottle

Rules

1) $Xabc^{-1}Yabc^{-1}Z \rightarrow XdYdZ$

2) $XaYa^{-1}Z \rightarrow XaYaZ$

3) $XaYaZ \rightarrow XY^{-1}aaZ$

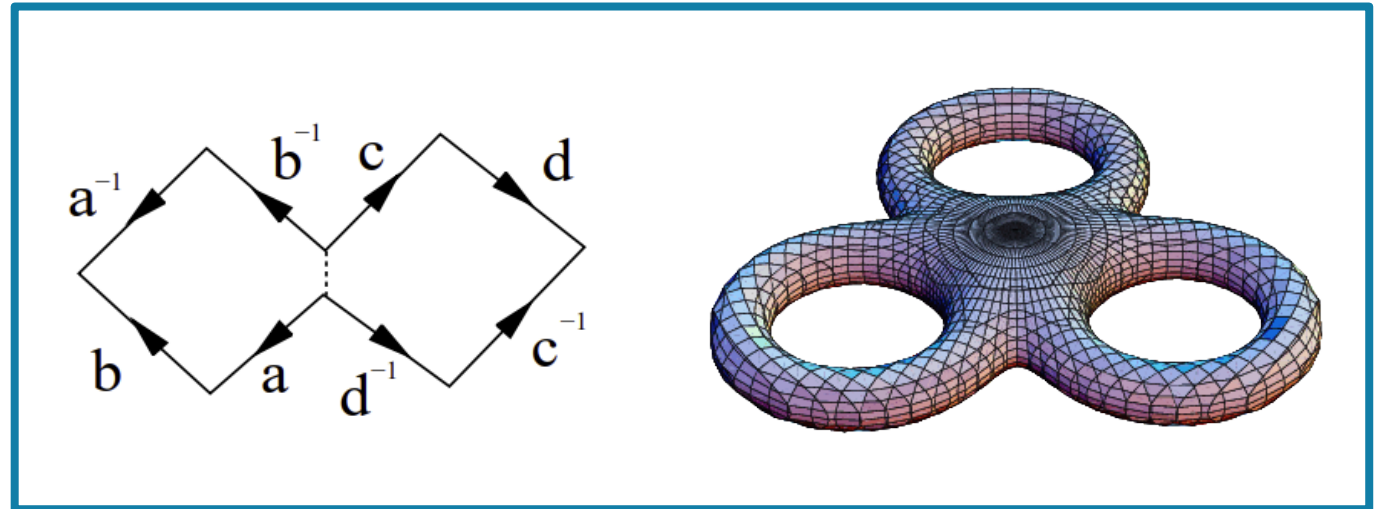
4) $XbYaZb^{-1}Sa^{-1} \rightarrow aba^{-1}b^{-1}YXSZ$

5) $Xaa^{-1}Y \rightarrow XY$

$$W_1 = aa^{-1}$$

$$W_2 = a_1b_1a_1^{-1}b_1^{-1}a_2b_2a_2^{-1}b_2^{-1} \dots a_kb_ka_k^{-1}b_k^{-1}$$

$$W_3 = c_1c_1c_2c_2 \dots c_nc_n,$$



W2 – sphere with k handles

Exercise

$$abcdec^{-1}da^{-1}b^{-1}e^{-1}$$

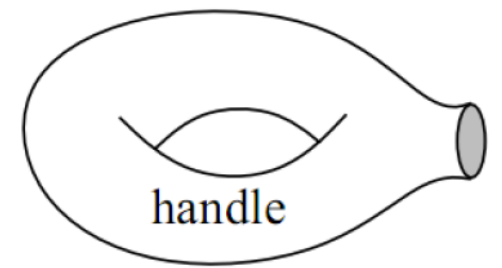
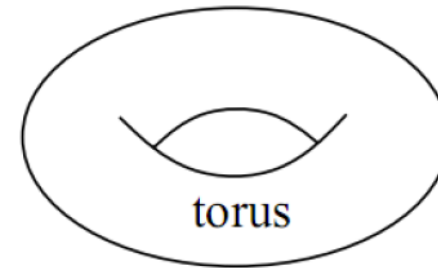
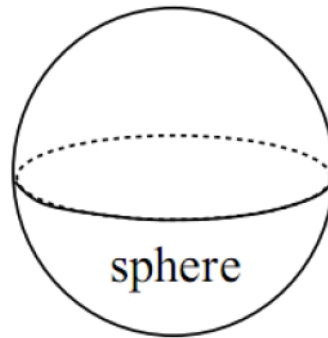
$$ae^{-1}a^{-1}bdb^{-1}ced^{-1}c^{-1}$$

Euler characteristics

- Euler formula for sphere topology

$$V - E + F = 2$$

- V – number of vertices
- E – number of edges
- F – number of faces



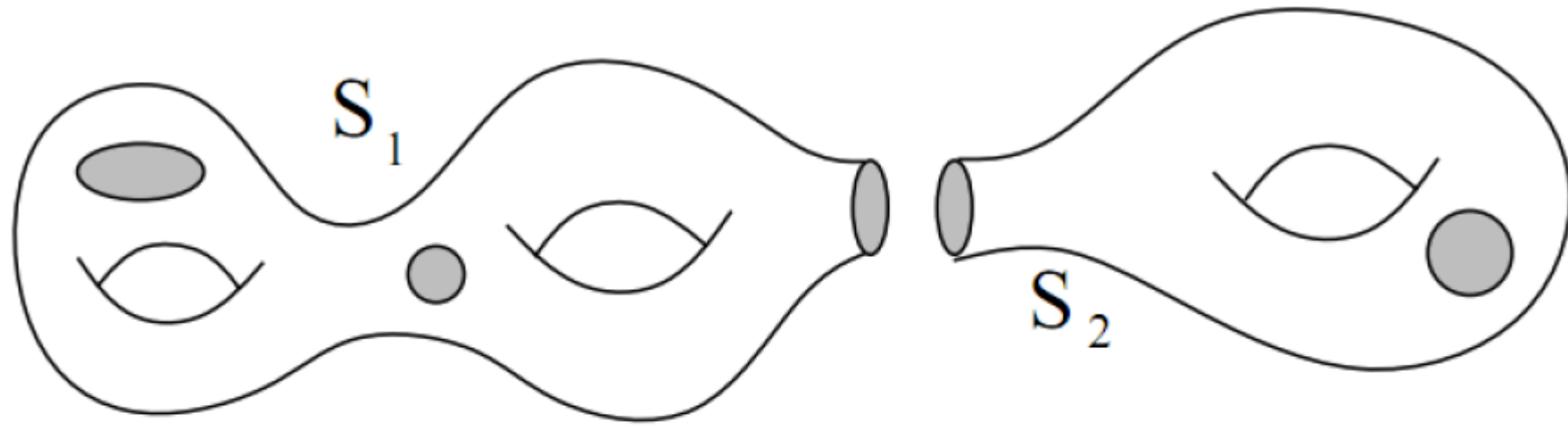
- General Euler formula

$$\chi(K) = V - E + F$$

$$\chi(\textit{sphere}) = 2$$

$$\chi(\textit{torus}) = 0$$

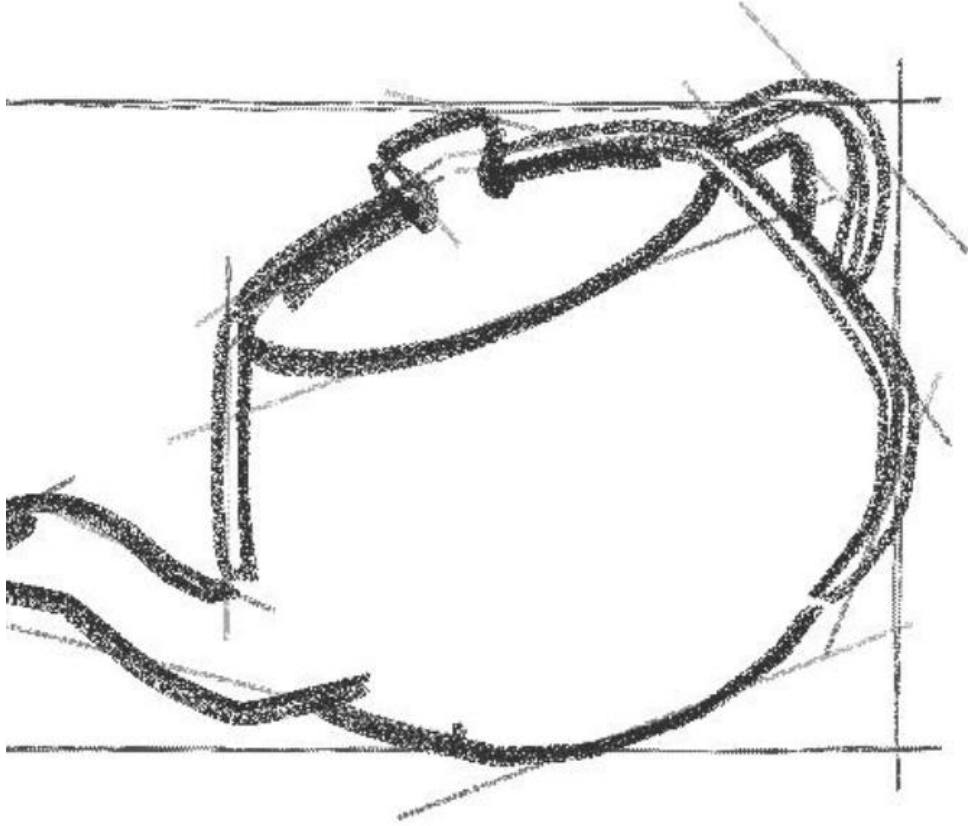
$$\chi(\textit{handle}) = -1$$



$$\chi = 2 - 2p - q$$

p – number of handles

q – number of holes



Questions ??
