1 (Dehn twists) Consider a Dehn twist in a neighbourhood of a 2-sphere in M_n. Explain what happens in each slice perpendicular to the axis of rotation

2 (Star graphs) Explain how the star graph changes when you exchange a sphere A for a new sphere separating A from $\overline{A}$.

Outer space

2. Show that an inner automorphism acts trivially on the space of free actions of F_n on trees

3. Show that an action of F_n on T is minimal if and only if the quotient graph is finite and has no univalent vertices.

4. Compute the dimension of O_n

5 Draw a connected piece of O_2 containing 5 open 2-simplices. Then explain the picture of O_2 that I drew in the lecture.

6. Convince yourself that a sphere system is complete if and only if the dual graph has fundamental group F_n

7. Prove that the action of $Out(F_n)$ on $S(M_n)$
   is cocompact. Explain why it is not
   proper.

8. Prove that the action of $Out(F_n)$ on O_n is
   proper. Explain why it is not cocompact

$O_{n,s}$

9. Work out the space $O_{1,s}$ for any
   $s \geq 1$
   * Then determine the quotient
   $O_{1,s} / A_{1,s}$ and its homology.