

MATH GU4053: INTRODUCTION TO ALGEBRAIC TOPOLOGY

Homework 4

Due: 02/20/20 beginning of class

- (1) Hatcher 1.3.24 (if you did not submit it last week)
- (2) Hatcher 1.3.25
- (3) Hatcher 1.3.26
- (4) Hatcher 1.3.27
- (5) Hatcher 1.3.31
- (6) Hatcher 1.3.32

7). A covering space  $p : E \rightarrow X$  induces an action of  $\pi_1(X, x_0)$  on  $p^{-1}(x_0)$ ; hence if  $|p^{-1}(x_0)| = n$ , there is a group homomorphism  $\pi_1(X, x_0) \rightarrow S_n$ , the group of permutations of a set with  $n$  elements.

a) Find all group homomorphisms  $\mathbb{Z} \rightarrow S_n$  that are realized by connected covering spaces of  $X = S^1$ ; do the same for all covering spaces (not necessarily connected ones).

b) Repeat problem a) for group homomorphisms  $\mathbb{Z} \times \mathbb{Z} \rightarrow S_n$  for  $X = S^1 \times S^1$ .