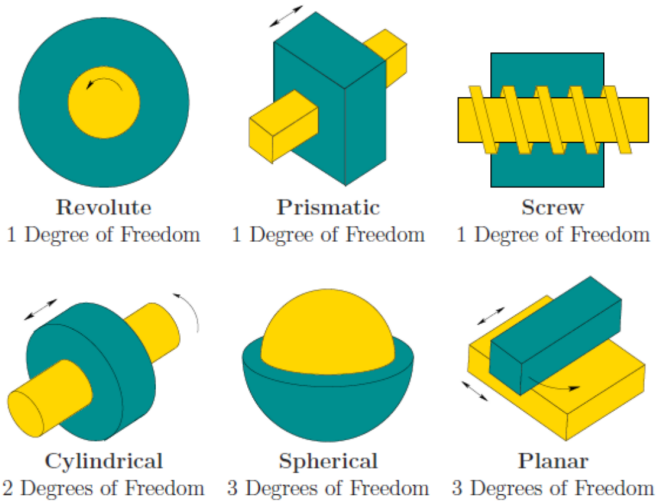
Motion Planning — Exercise 2

Wolfgang Hönig and Andreas Orthey, TU Berlin SS 2024

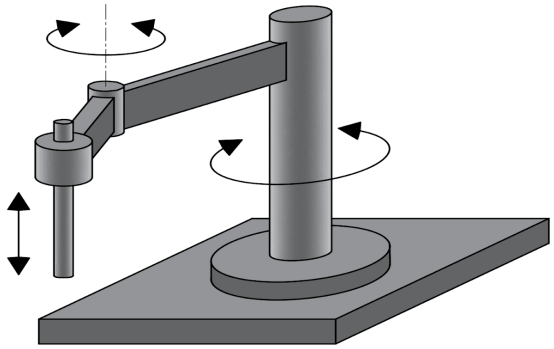
References: `https://en.wikipedia.org/wiki/Kinematic_pair`

Non-Programming

1. Write down the topological spaces corresponding to the depicted joints.
   (a) The six lower-pair joints (ignore joint limits)



   (b) Scara Robot. Assume that the base joint can rotate infinitely around its axis, but that both the upper revolute and the prismatic joint have joint limits.



2. Let (X, d_X), and (Y, d_Y) be two metric spaces. Show that (Z, d_Z) is a metric space whereby $Z = X \times Y$ and $d_Z = \max(d_X, d_Y)$.

Programming

3. Axis-aligned bounding boxes (AABBs) are frequently used for efficient, hierarchical collision checking.
   (a) Write a data structure that can represent an axis-aligned bounding box (AABB) in three dimensions.
   (b) Write a function `inAABB` that takes an AABB and a point as inputs and returns `True` if and only if the point is inside the volume described by the AABB.
   (c) Write a function `overlap` that takes two AABBs as inputs and returns `True` if and only if the two volumes described by the two AABBs intersect.
   (d) How many basic operations (additions, substractions, comparisons) are needed for the `overlap` computation?