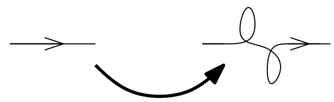
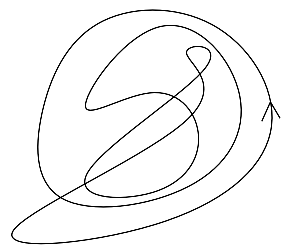
Comprehension questions

Problem 16.1. *Take an immersed loop, and modify it by inserting a curly piece somewhere, as in the picture below. How does that affect the rotation number?*

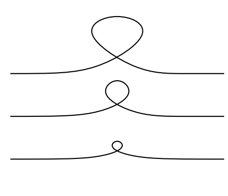


Problem 16.2. *Compute the rotation number of the immersed loop drawn below, in two ways: by counting tangencies; and by applying Whitney's formula.*



Problem 16.3. *Consider closed immersed curves which have exactly two simple selfintersection points. What are all possible rotation numbers? Draw examples for the rotation numbers that can occur.*

Problem 16.4. *The picture below looks like a deformation during which the rotation number changes by* 1*, contradicting the theorem from the lecture. What's wrong?*



If you prefer to think in terms of formulae, you could use $c_s(t) = (t + (1+s)\cos(t), s\,\sin(t))$*, in the region* $0 \leq t \leq \pi$ *(which is not itself a loop, but could be part of a loop). However, the insight is independent of any specific formula.*

Problem 16.5. *What is the rotation number of the anticlockwise circle with* $k \geq 0$ *outwards curls added to it, like this:*