Online Motion Planning
Problem Set 2
Universität Bonn, Institut für Informatik I

To be solved until the 8th of November

Problem 1:

Prove the following fact: Given two simple grid polygons, we have

$$E(P_1) + E(P_2) = E(P_1 \cup P_2) + E(P_1 \cap P_2).$$

Problem 2:

We showed that the ℓ–Offset of a simple grid polygon P has got 8ℓ edges less than P, if the ℓ–Offset is connected. Generalize this fact to arbitrary simple grid polygons!

Problem 3:

In the lecture it was shown that the piecemeal setting can be reduced to the tethered robot setting.

Formulate and prove the correctness of a reduction in the opposite direction. I.e. find a scheme that transforms a given piecemeal algorithm with $2(1+\alpha)r$ into a tethered-robot strategy with $(1+\beta)r$ and figure out its cost factor.

Problem 4:

Prove that an unknown graph with *unknown* radius r can be explored in $O(|E| + |V|/\alpha)$ steps by a tethered robot with cable length $(1+\alpha)r$.

Hint: Use the modification mentioned in the lecture. You basically will have to repeat the proofs of for the original algorithm. Notice that $d_{G^*}(s, s_i)$ could be 0. So replace $d_{G^*}(s, s_i)$ by $\max(d_{G^*}(s, s_i), c)$ for some constant $c > 0$ and prove the following instead of Claim 4:

After every iteration of the main loop in CFX, for every $T \in \mathcal{T}$,

$$|T| \geq \max(d_{G^*}(s, T), c)\alpha/4$$