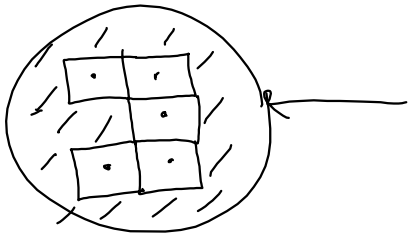


Unknown nvironment

Environment is one of several

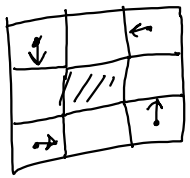
Let $E = \{e_1, e_2, \ldots, e_n\}$

$X = \mathbb{Z} \times \mathbb{Z} \times D \times E$

Here, $X(\eta_k)$ gives set of possible positions, directions, environments

Move while reducing the size of $X(\eta_k)$

Cannot distinguish between translated or rotated copies of the "same" environment



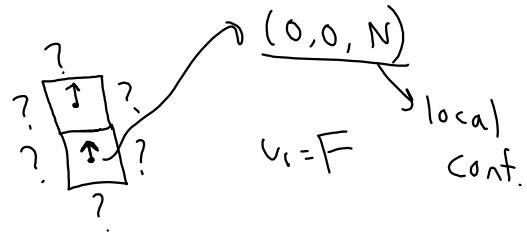
(no compass)

We can even let E be infinite

Example: E is the set of all finite, connected sets of white tiles

Problem: Mapping and localization at the same time (SLAM)

Let $I_{maps} = Pow(\underbrace{\mathbb{Z} \times \mathbb{Z} \times D}_{\text{configuration}} \times E)$



Represent a set in I_{maps} by recording the current local configuration, and the "status" of each tile in $\mathbb{Z} \times \mathbb{Z}$

white → name them
black → name them
unknown

Same state space

$$X = \mathbb{Z} \times \mathbb{Z} \times D \times E$$

Different task (Blum, Kozen, 1978)

There may be a treasure on one of the white tiles.

Additional sensor: Binary treasure ~~test~~ detector.

Need to visit every white tile

Systematic search: - Spiraling outward
- Breadth first
- Depth first

- Takes time and space linear in number of white tiles

$O(n)$ n = # of white tiles $|e|$

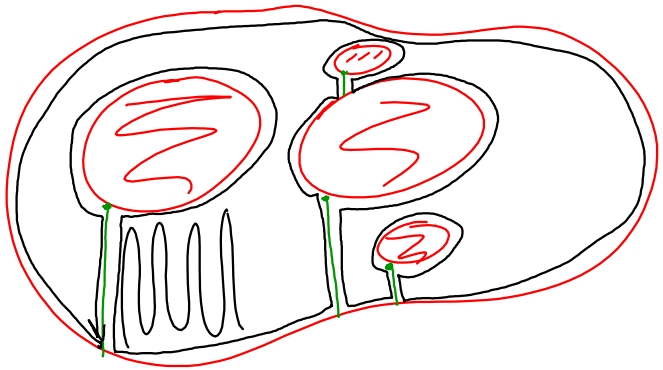
Can we solve the problem with less space?

Make a derived I-space that keeps track of

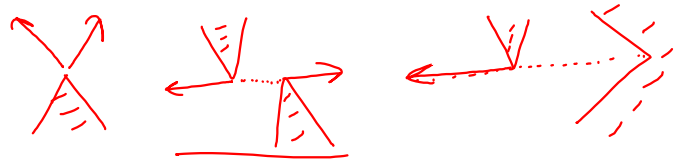
1) latitude - # of tilts in the local N direction (O(lgn) bits)

2) orientation (local) . (2 bits)

Sec. 12.3.1



Divide environment into convex regions



Ilcinkas TCS?

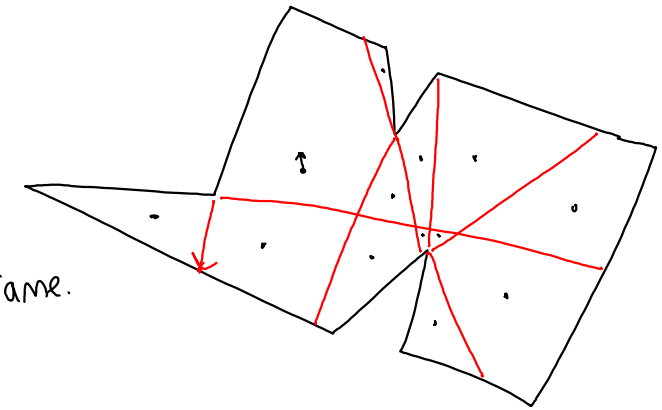
Localization in a Given Polygon

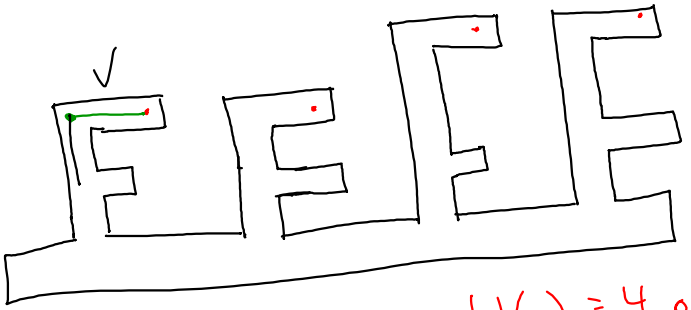
Sensors: Compass - no orientation problems

Visibility - perfect depth mapping sensor $\rightarrow y: S^1 \rightarrow [0, \infty)$

$X = \mathbb{R}^2$

Inside of each region, the set of visible edges (partial or full) remains the same.





Dudek
Whitesides

Ilcinkas

$H(y) = 4$ possible positions

$X(?_k)$?

$4 \to 2 \to 1$

Move left
Move down