Possible CS428 Class Projects

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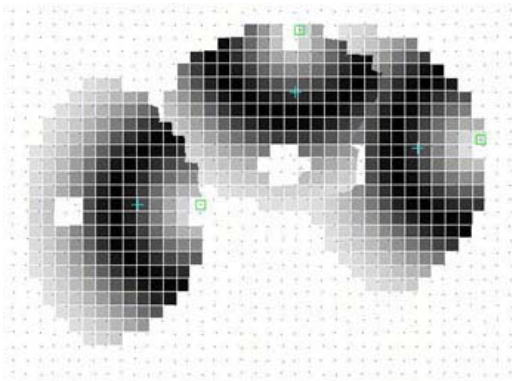
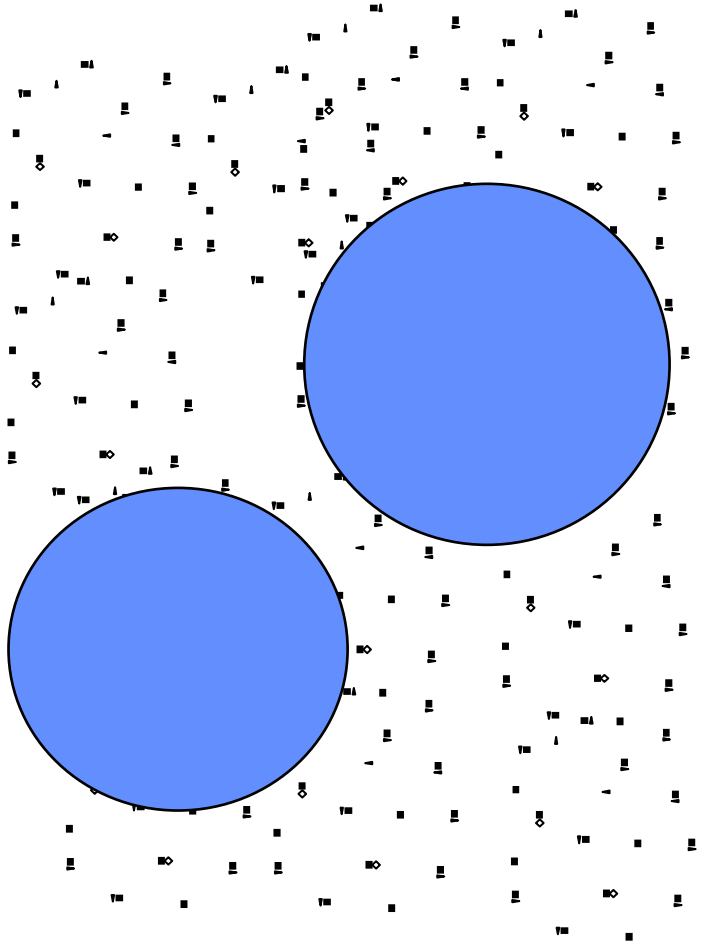


Project Types

- Design and implementation, using available networked iPAQs
  - 6 using Linux
  - 4 using Windows CE with NexiCam Cameras
  - Laser range finder also available to help with iPAQ localization
  - Time synchronization of iPAQs to better than 100ms seems difficult
- Sensor net algorithm design, validated using simulation
- Sensor net algorithms design, with theoretical performance analysis

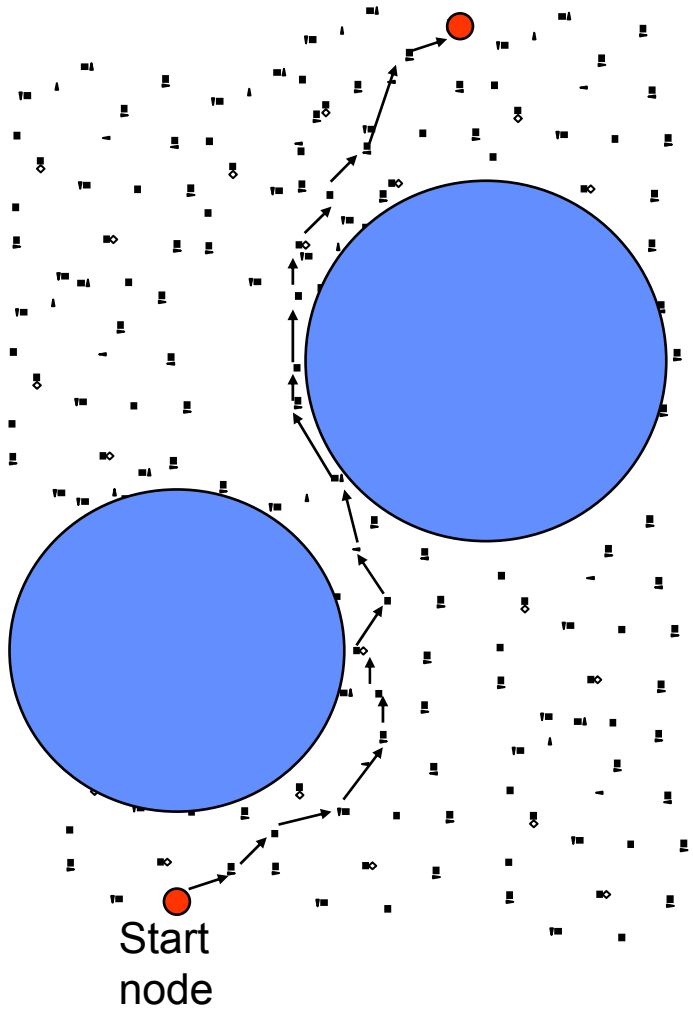
Routing: Hole Discovery

- Discover *holes*: areas of the network where greedy geographic routing algorithms will fail
- Mark the nodes on the boundary of these holes
- Study strategies for routing around such holes



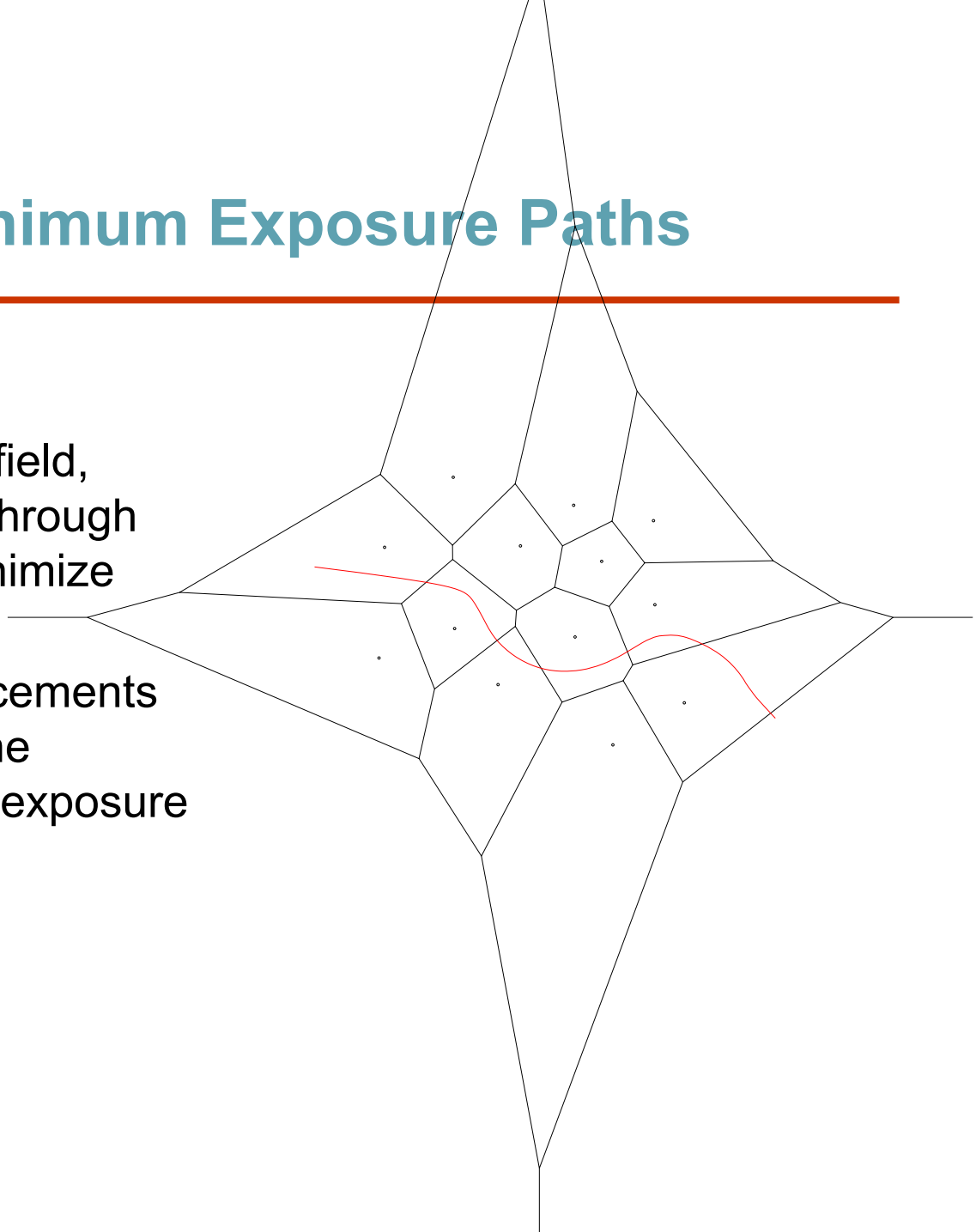
Routing: Path Migration and Improvement

- Study local methods for improving paths (path homotopy)
- Maintain good paths, as endpoints move (local heuristics)
- How can we discover that a path can be improved by jumping over a hole?



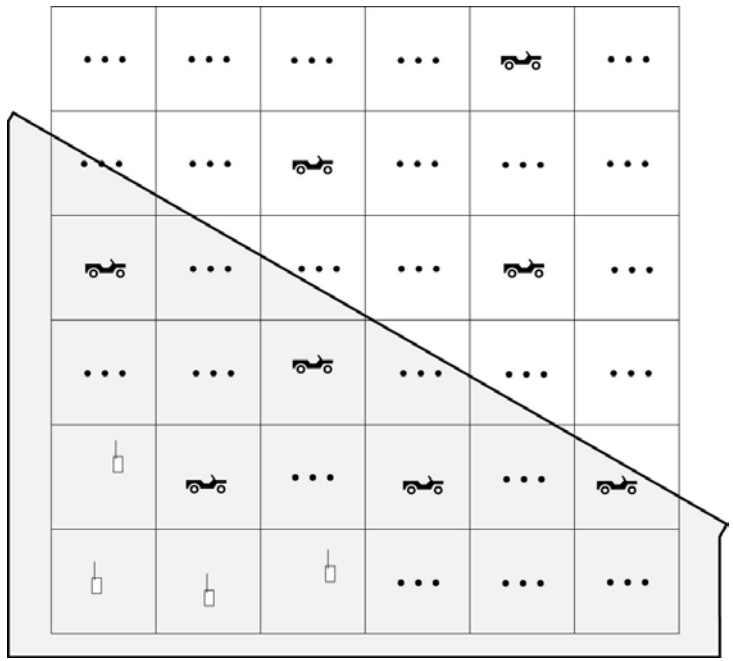
Computing Minimum Exposure Paths

- Given a sensor field, evaluate paths through the filed that minimize target exposure
- Find sensor placements that maximize the minimum target exposure

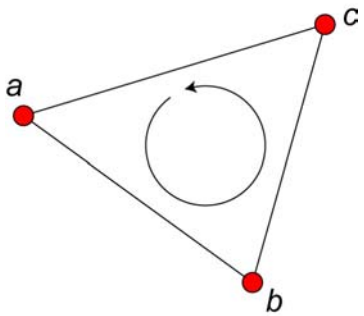


Counting Targets in a Region

- Efficiently determine the number of targets present in a given region
- What can you store to optimize the performance of repeated queries of the same type, but with different parameters?



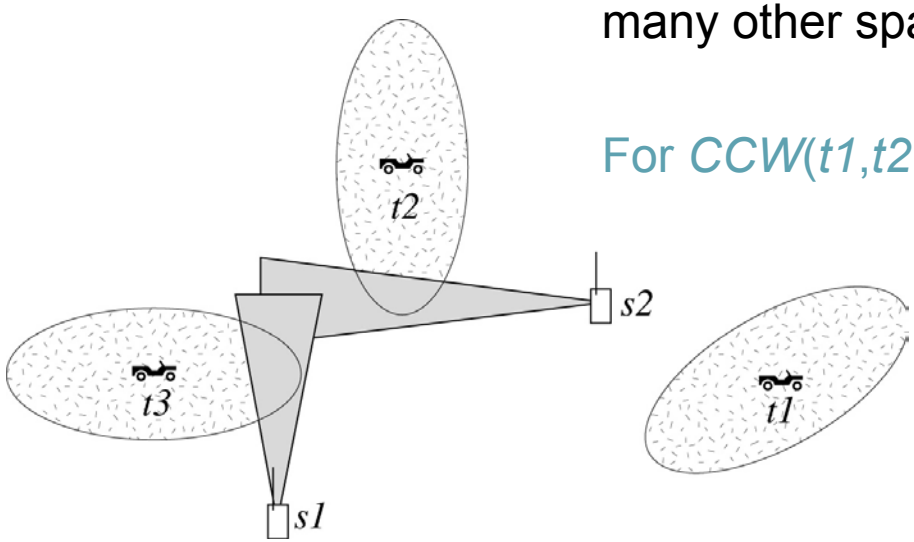
Optimal Evaluation of CCW Relations



CCW(*a*,*b*,*c*) asserts that the triangle defined by *a*, *b*, and *c* is counterclockwise oriented.

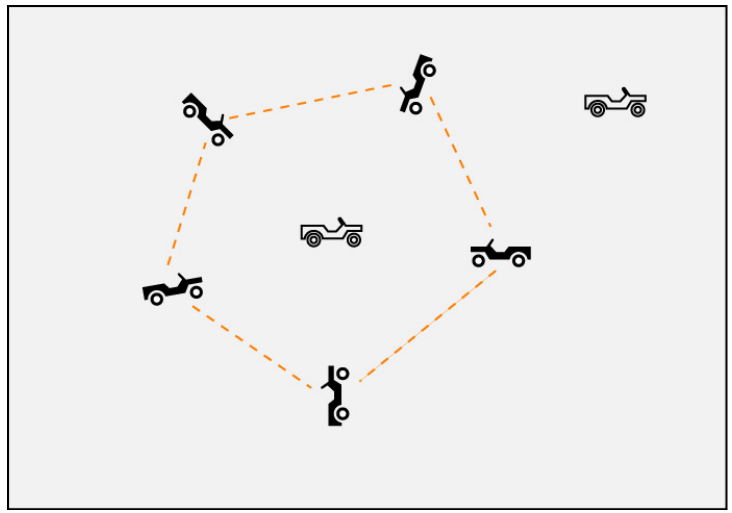
CCW predicates can capture the notion of the convex hull of a set of points, the notion of inclusion in a convex polygon or triangle, and many other spatial predicates.

For *CCW*(*t1*,*t2*,*t3*), *s2* is more valuable than *s1*.



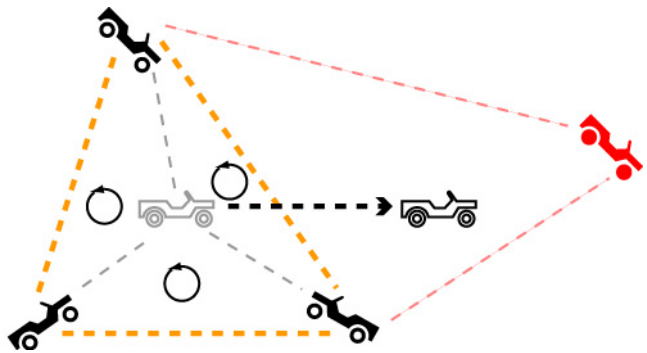
Evaluating the "Am I Surrounded" Relation

- Say the white vehicle is surrounded by the black vehicles, if it is inside the convex hull of those vehicles
- Can we decide this predicate without localizing all black vehicles? In general very few black vehicles should suffice (3)



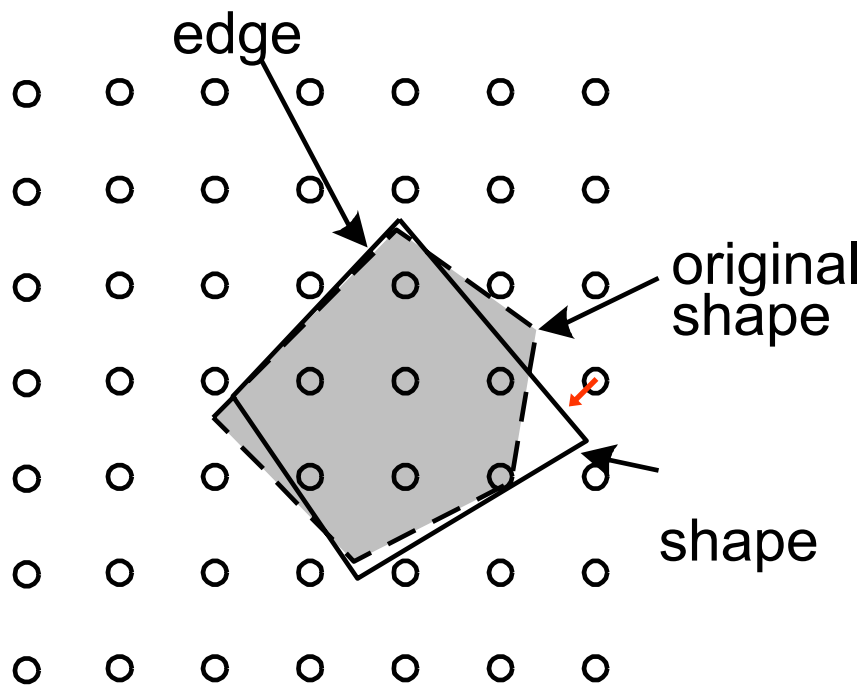
Tracking the "Surrounded" Relation

- When the white vehicle escapes the surrounding triangle, the sensor net searches for a new black vehicle that can still establish containment
- What are good strategies for finding such a new vehicle (pivoting step)?



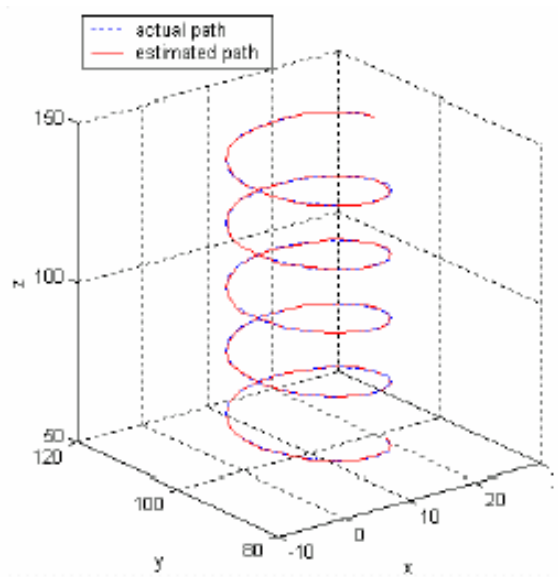
Tracking a Shadow over a Sensor Field

- How can we best track the position and orientation of a shape moving over a fixed sensor field
- Which sensors need to be active when?
- What if some sensors could move to help better estimate the shape?



Localization Using Total Least Squares

- Use combination of distance (amplitude) and bearing (DoA) sensors
- Quantify the errors introduced by different sensor mixtures and placements



iPAQ Localization in Gates

- Use base base station IDs and wireless signal signatures
- Assume map of building is given
- Construct topological building map, using similarity measures on signatures

Leader-to-Leader Handoff

- Restrict each iPAQ to talk only to a few neighbors
- As in the warm up project, the iPAQ hearing the loudest target signal is to be elected leader
- However, to save power, the current leader *alerts only a small number of neighbors to participate in the next leader election*

Multicamera Tracking

- Use the camera equipped iPAQs to track a moving object in a large space; assume iPAQ positions are known
- A subset of the camera iPAQs transmit images a central computer where background subtraction and silhouettes intersection is used to localize the object
- Different subsets of the iPAQs need to be selected for this computation, depending to the location of the object.

Project Deadlines

- Project proposal due in class, on Thursday, May 1, 2003
- Final project due in class, on Thursday, May 29, 2003