Lecture 6-2: Metric Path Planning

***Introduction to AI Robotics* (Sec. 10.1 – 10.3)**

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Objectives:

- Define Cspace, path relaxation, digitization bias, subgoal obsession, termination condition
- Explain the difference between graph and wavefront planners
- Represent an indoor environment with a generalized Voronoi graph, a regular grid, or a quadtree, and create a graph suitable for path planning
- Apply wavefront propagation to a regular grid
- Explain the differences between continuous and event-driven replanning

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For metric path planning, a robot's environment can range from a continuous geometric description to a decomposition-based geometric map or a topological map.

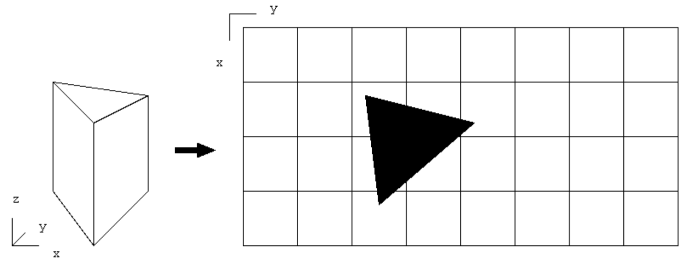
There are three general strategies for map decomposition:

- ___________________________ - identify a set of routes within the free space
- ___________________________ - discriminate between free and occupied cells
- ___________________________ - impose a mathematical function over the space

________________________________ (quantitative navigation) is the use of metric methods to produce an optimal path to a specified goal. A path may be decomposed into subgoals, or waypoints, instead of using landmarks or gateways like in topological navigation.

The representation of the world into salient features or navigationally relevant objects is called the _____________________________(Cspace).

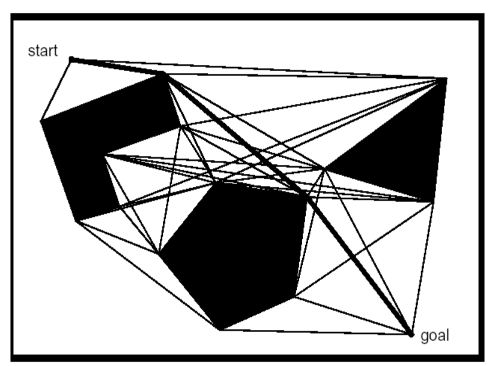
Cspace transforms three dimensional space into two dimensional space suitable for robots and simplifies storage in the computer and speeds of algorithms for path planning.



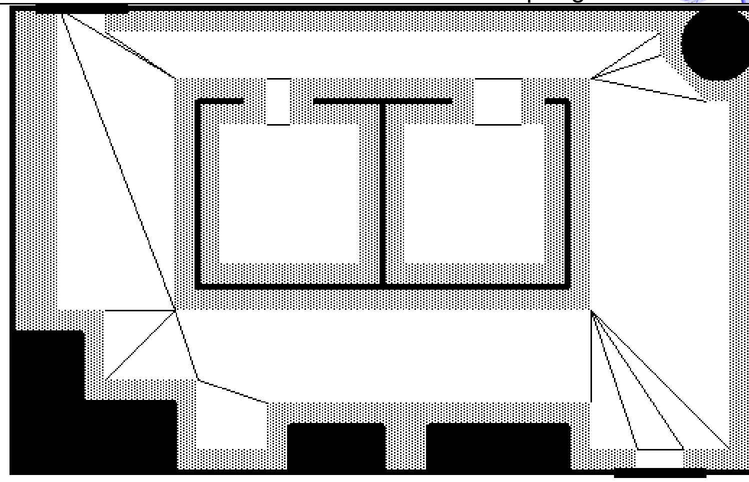
There are several types of Cpsace representations

- Voronoi diagrams
- Quadtrees and octrees
- Regular grids
- Vertex graps
- Visibility graphs (meadow maps)
- Hybrid free space/vertex graphs

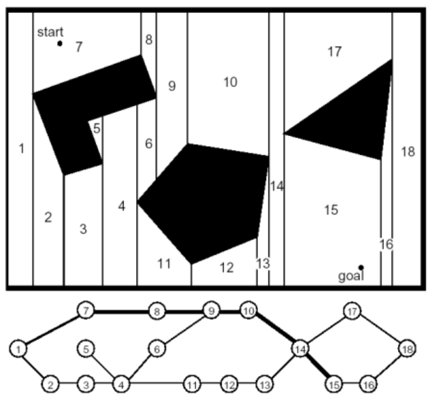
____________________ consists of all edges joining vertices that can see each other. Objects in the environment are polygons and the paths the robot take are in the polygons made by the lines that join the edges. One solution is to grow the obstacles by the robot's radius to avoid collisions



________________________ is a hybrid vertex-graph free-space model that transforms frees space to convex polygons. These polygons represent a safe region for the robot to traverse.

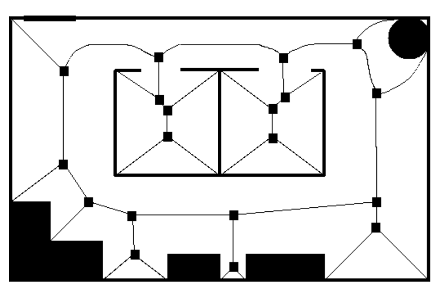


A ***connectivity graph*** is created using cell decomposition path planning. The space is divided into free and occupied cells. The trapezoidal decomposition of a space is shown below:

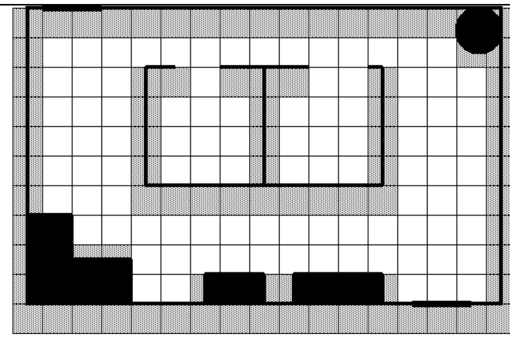


If the boundaries are placed as a function of the structure of the environment then this method is called ______________________________________otherwise it is ***approximate cell decomposition.***

A _____________________________ can be created as a robot enters a new region. A voronoi edge is equidistant from all points and the diagram is the ***road map*** method to maximize the distance between the robot and obstacles.



A ___________________ or exact cell decomposition superimposes a 2D Cartesian grid on the world space. This is also called an ***occupancy grid***, grids can be4-connected or 8-connected. This method suffers from digitization bias.



A ______________________ (adaptive cell decomposition) avoids wasted space because it is a recursive grid. It is one of the more popular techniques for mobile robot path planning. This is low computational complexity for path planning.