SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

RIAS Robotics & Intelligent Autonomous Systems

Introduction to Mobile Robotics

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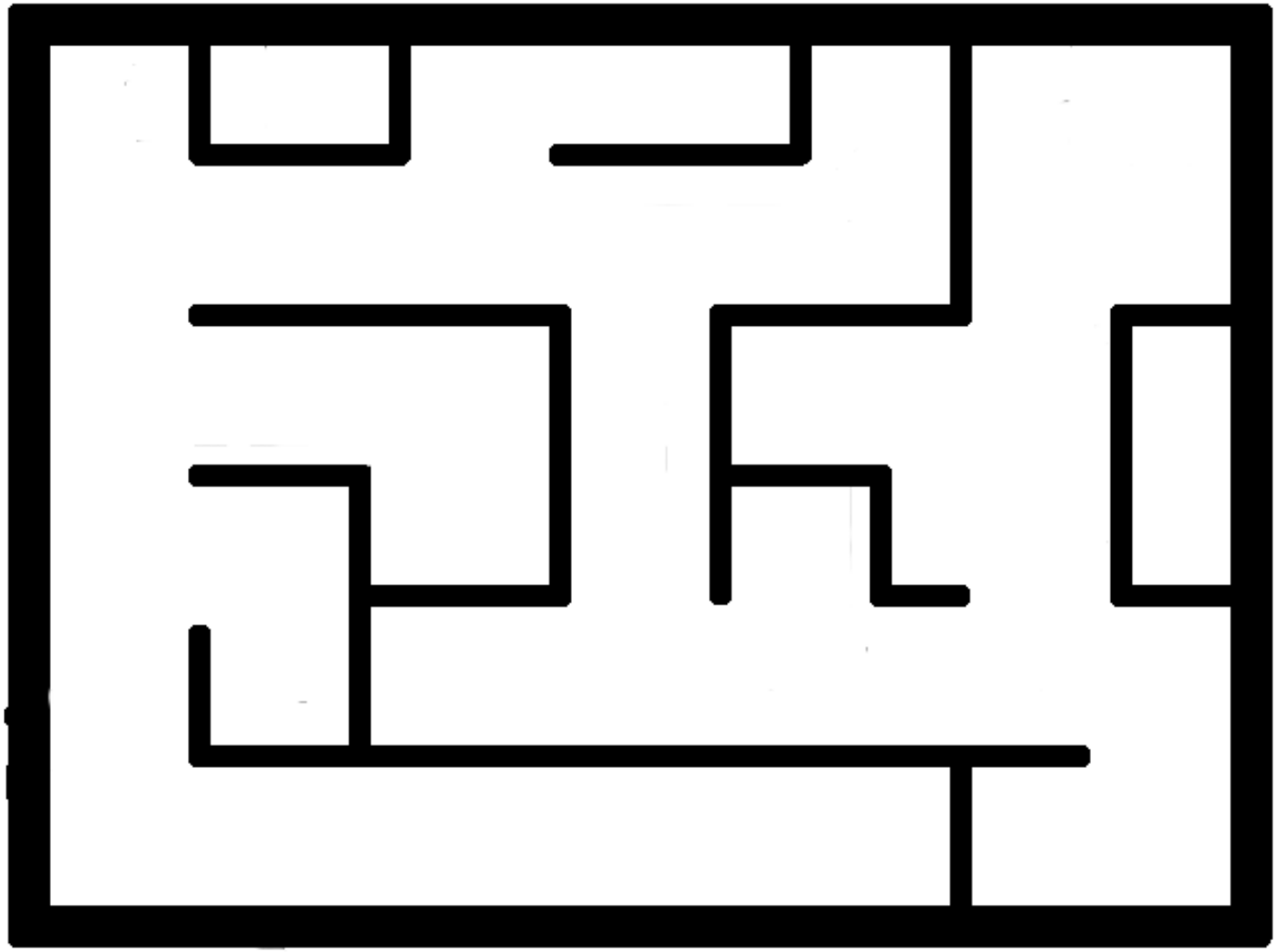
Stage

- Perspective camera
- Footprints
- Trails: rising arrows, fast
- Debug

XVidCap ...

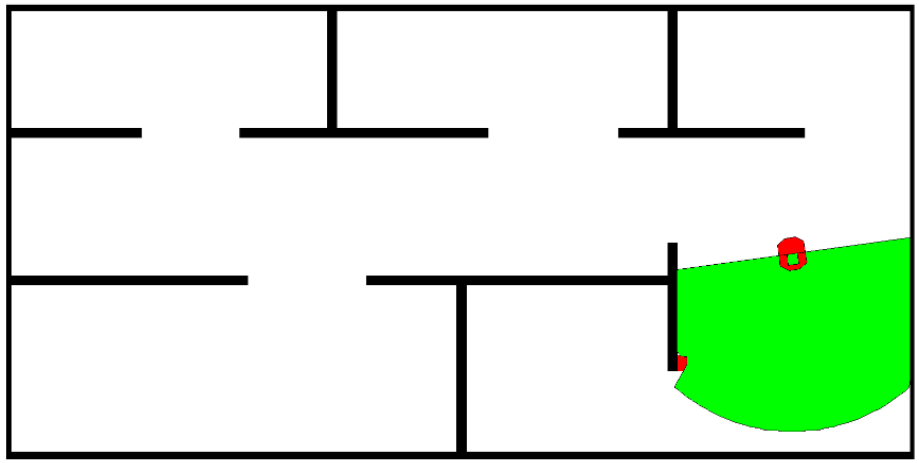
Examples

How does one get out of a Maze?



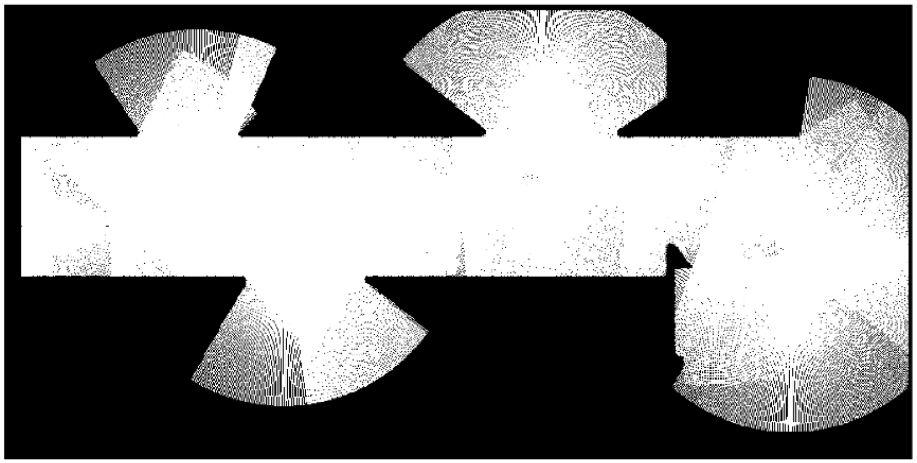
Examples

Use a LIDAR



Examples

LIDAR reconstruction:



Maze escape

Right hand rule:

Put your right hand on the wall.

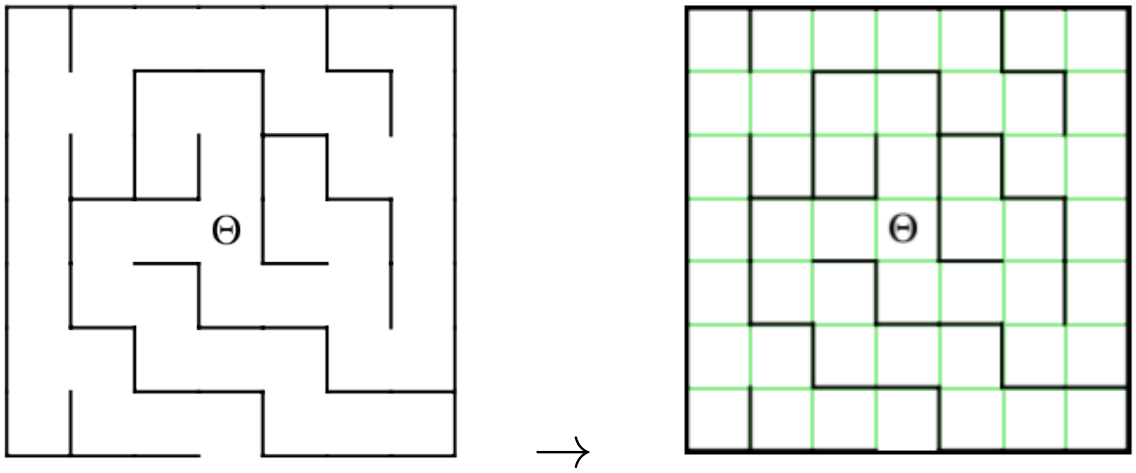
while(you have not escaped the maze) {

    Walk forward keeping your right hand on the wall.

}

Maze as a graph

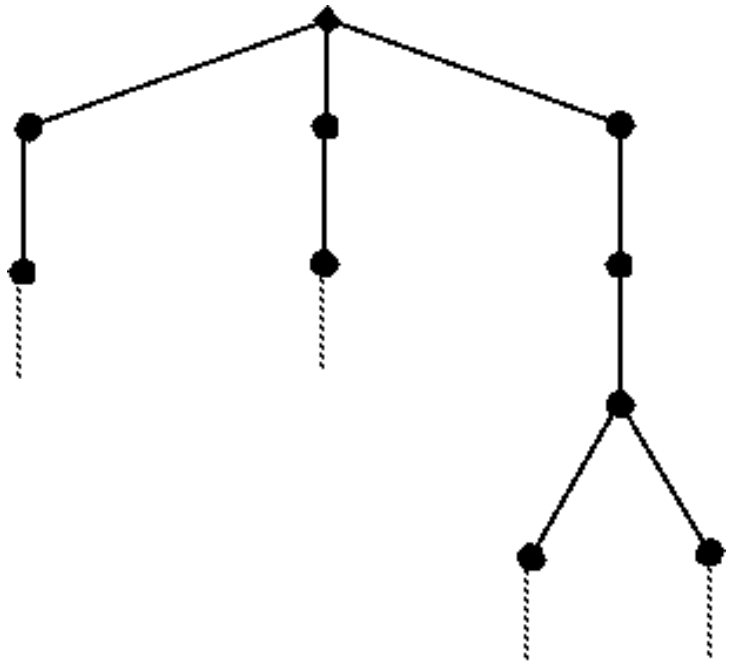
Assume that you have a maze and it is built on a grid.



Also assume that you always know which grid cell you are in ...

Maze as a graph

Representation of the path connectivity in the maze via a graph:



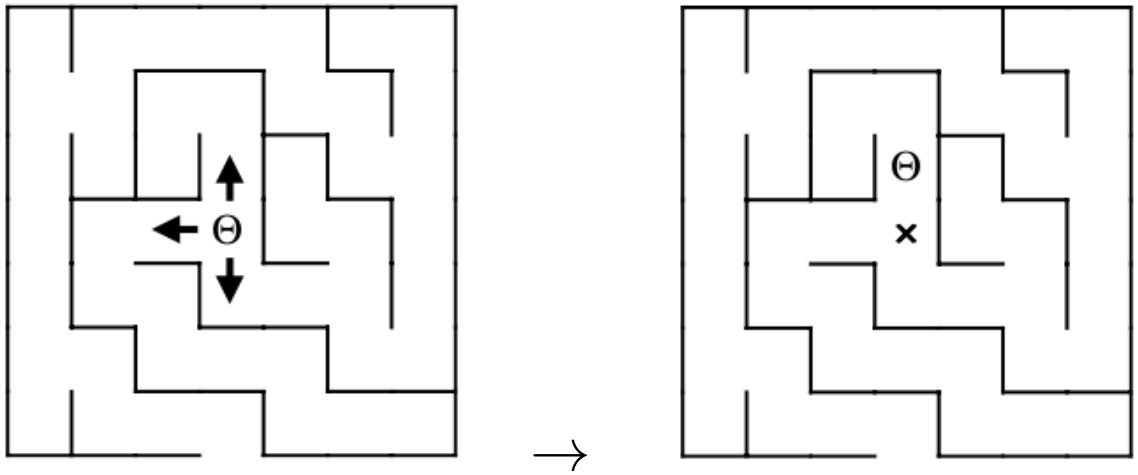
Thus we can just apply a graph (or tree) search approach.

Maze DFS algorithm

```
SolveMaze(location) {
  newlocation = location
  if (the current square is outside the maze)
      return (true) // to indicate that a solution has been found.
  if (the current square is marked)
      return (false) // to indicate that this path has already been tried.
  Mark the current square.
  for (each of the four compass directions) {
    if (this direction is not blocked by a wall) {
        update(newlocation) // Move one step in the indicated direction from the current square.
        if (SolveMaze (newlocation)) // Try to solve the maze from there by making a recursive call
           return (true) // to indicate the fact that the maze is solvable
    }
  }
  Unmark the current square.
  return (false) // to indicate that none of the four directions led to a solution.
}
```

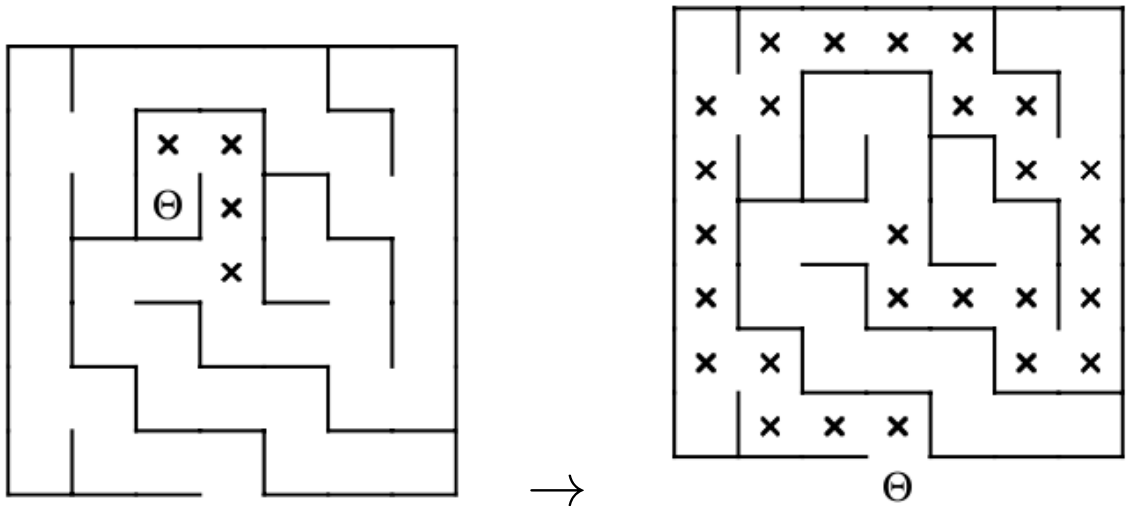
Maze as a graph

Recursive decomposition:



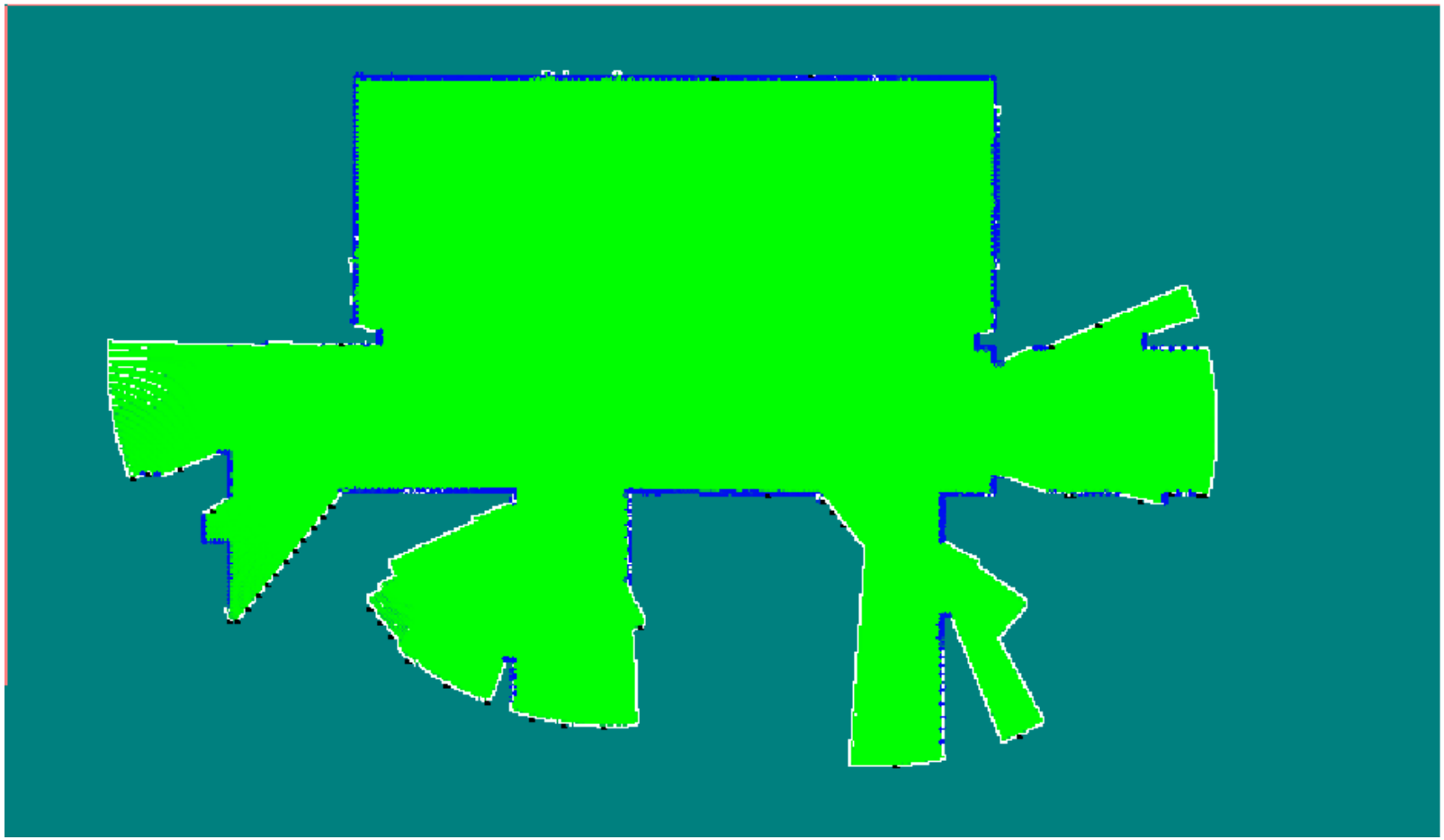
Maze graph cont.

Recursive decomposition:



Frontiers

The World According to LIDAR...

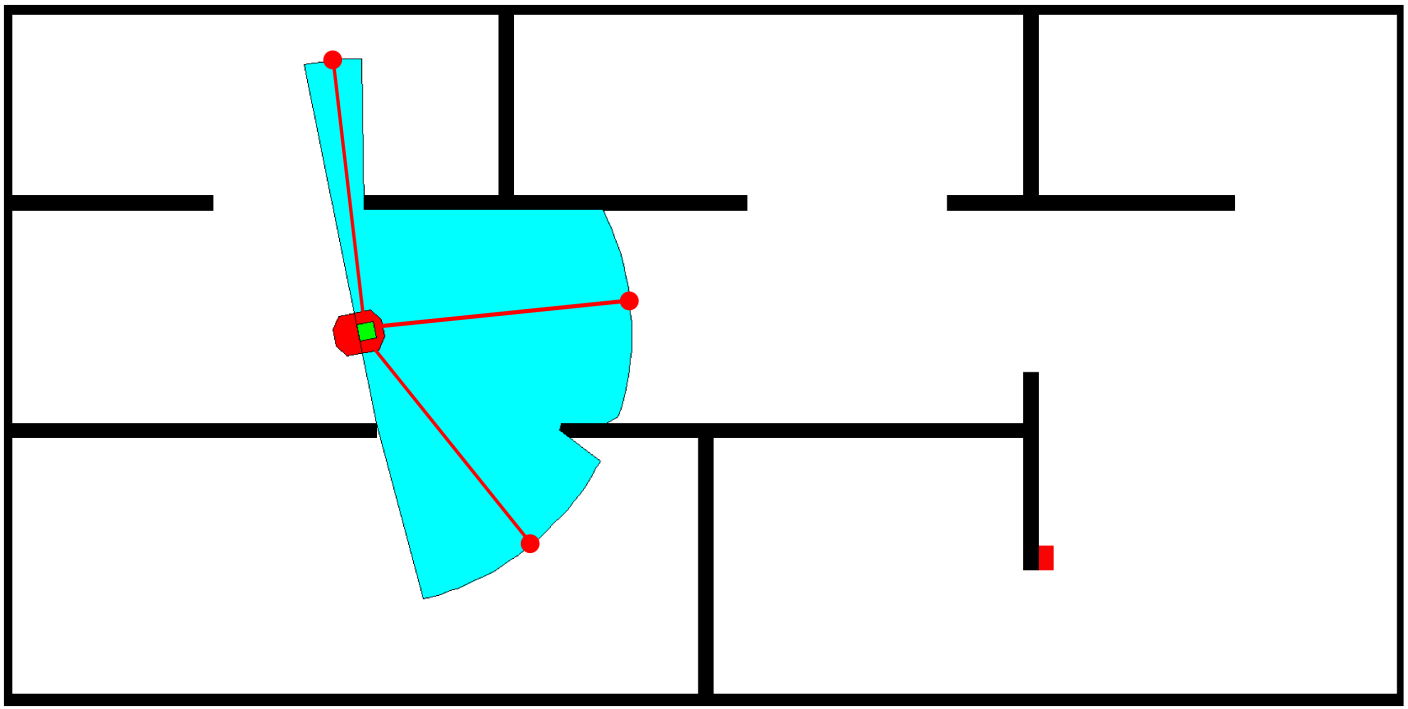


Frontiers ...

Frontier Determination

Circular arc

- Midpoint of arcs

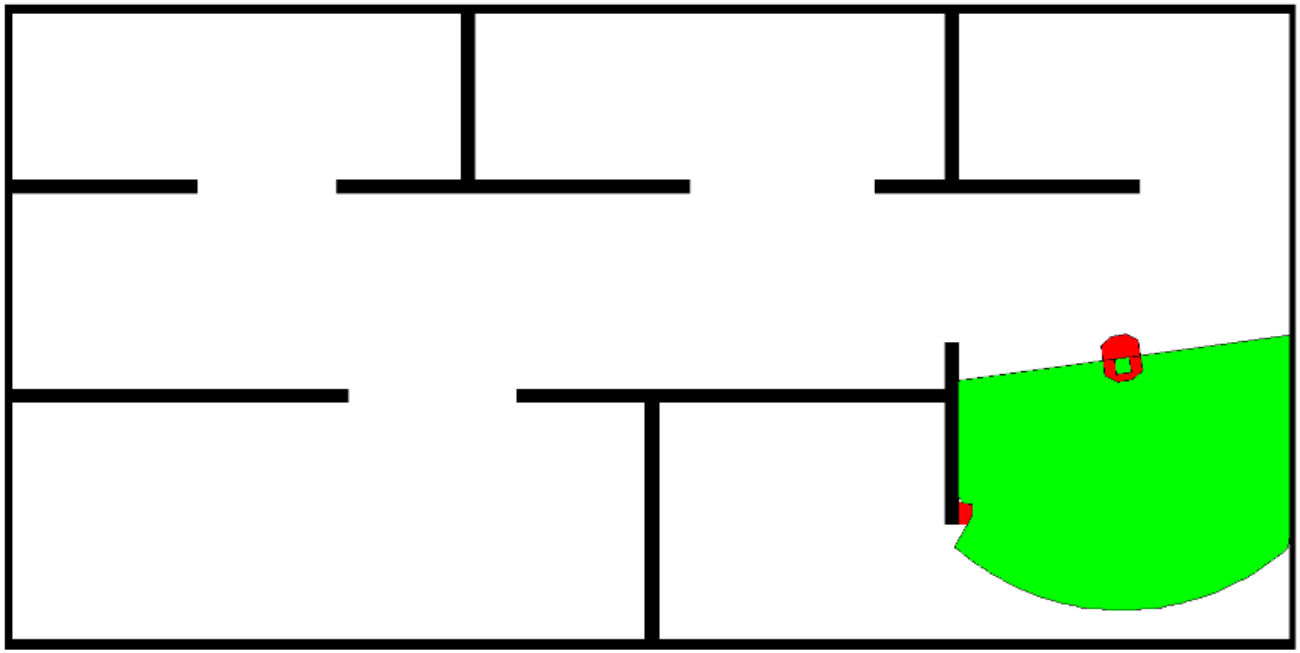


Multiple arcs - selection process

- Largest arc
- Momentum arc

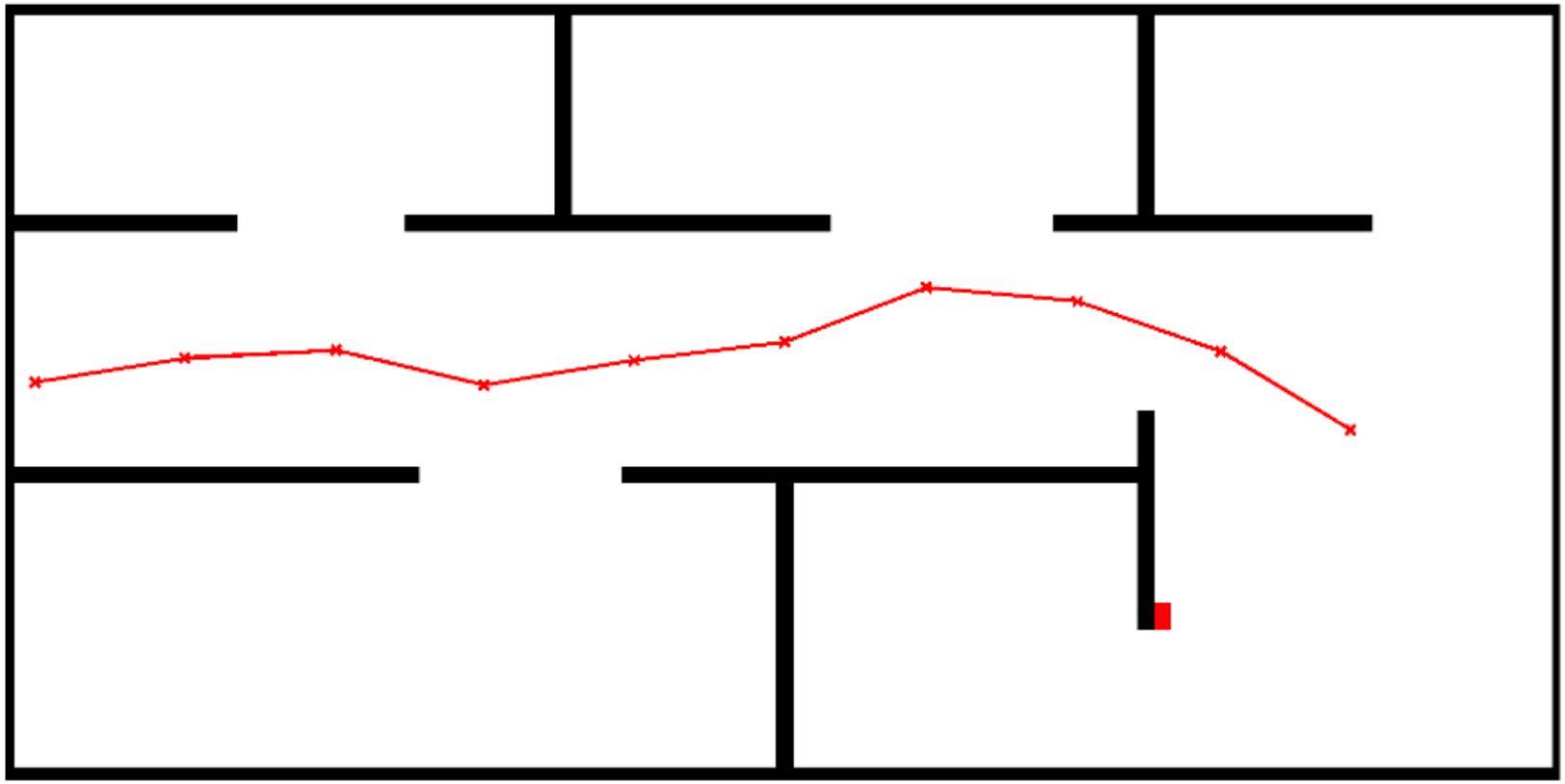
Path Generation via LIDAR

Region exploration and target location.



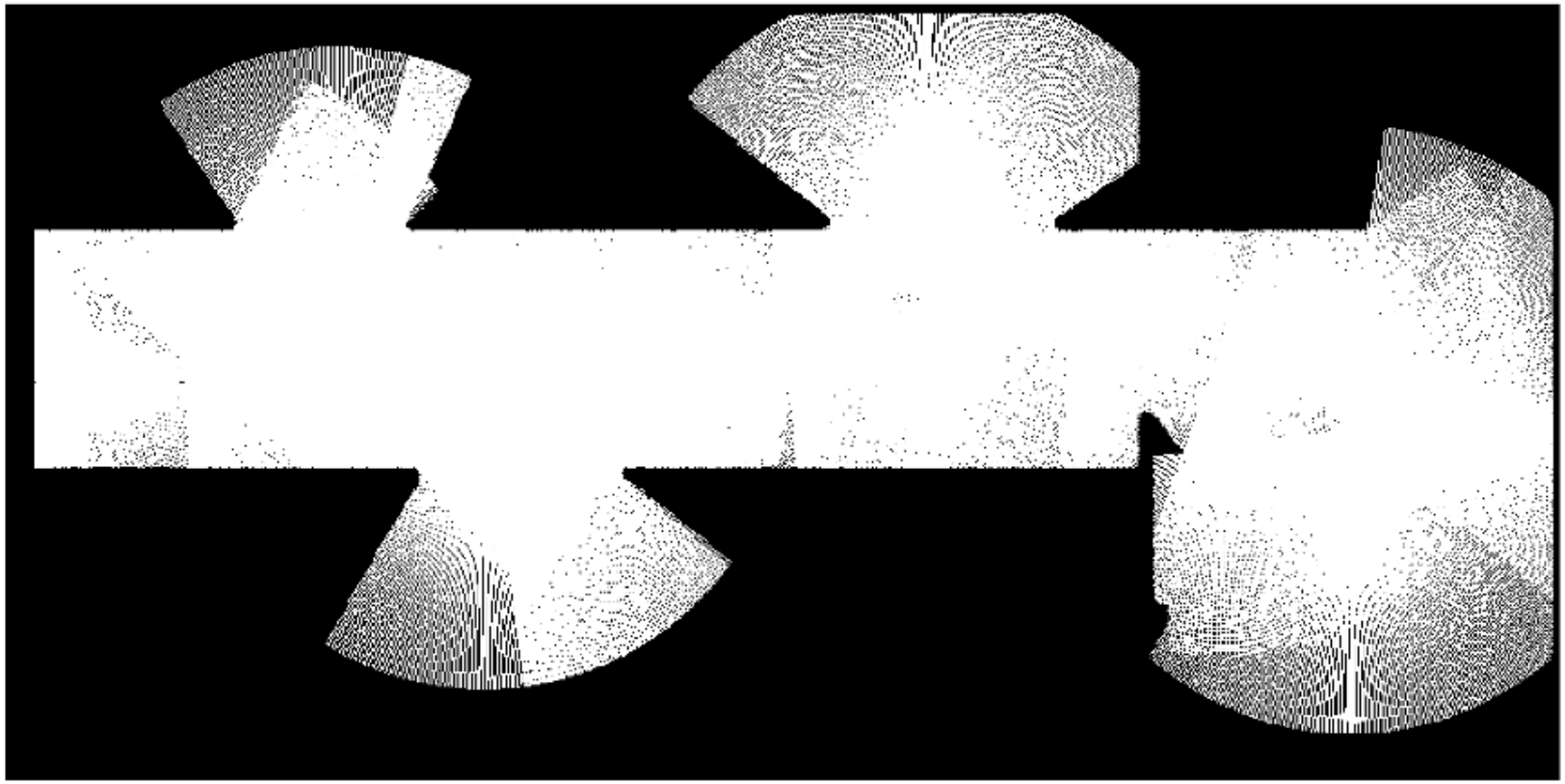
Path Generation

Sequence of safe path points generated along the search path.



LIDAR Map Generation

The global map generated by the frontier exploration:



Latex

LaTeX is the best system to produce documents that are mathematically rich.

You create a source file, run it through the latex formatter and a PDF is produced.

1. Edit foo.tex
2. pdflatex foo.tex
3. View foo.pdf

Latex Elements

```
\documentclass[11pt]{article}  % Specifies the document style.

\begin{document}

Hello World!

\end{document}
```

Latex header

```
\documentclass[11pt]{article}    % Specifies the document style.

                                 % The preamble begins here.
\title{A Sample Document}        % Declares the document's title.
\author{Leslie Lamport}          % Declares the author's name.
\date{December 12, 1984}         % Deleting this command produces today's
                                    date.
\begin{document}                 % End of preamble and beginning of text.

\maketitle                       % Produces the title.
```

Latex body

```
 \section{Ordinary Text}  % Produces section heading.
                          % Lower-level sections are begun with similar
                          % \subsection and \subsubsection commands.

The ends  of words and sentences are marked
  by   spaces. It  doesn't matter how many
spaces    you type; one is as good as 100.  The
end of   a line counts as a space.

One   or more   blank lines denote the  end
of  a paragraph.

Since any number of consecutive spaces are treated like a single
one, the formatting of the input file makes no difference to
      \TeX,          % The \TeX command generates the TeX logo.
but it makes a difference to you.
```

Latex reserved characters

```
 \TeX\ interprets some common characters as commands,
so you must type
special commands to generate them.
These characters include the
following:
       \$ \& \% \# \{ and \}.

\end{document}                  % End of document.
```

```
pdflatex samplev3.tex
```

Latex lists

```
\begin{itemize}
 \item b = baseline, distance between ...
\item f = focal length
\item v-v' = disparity
\end{itemize}
```

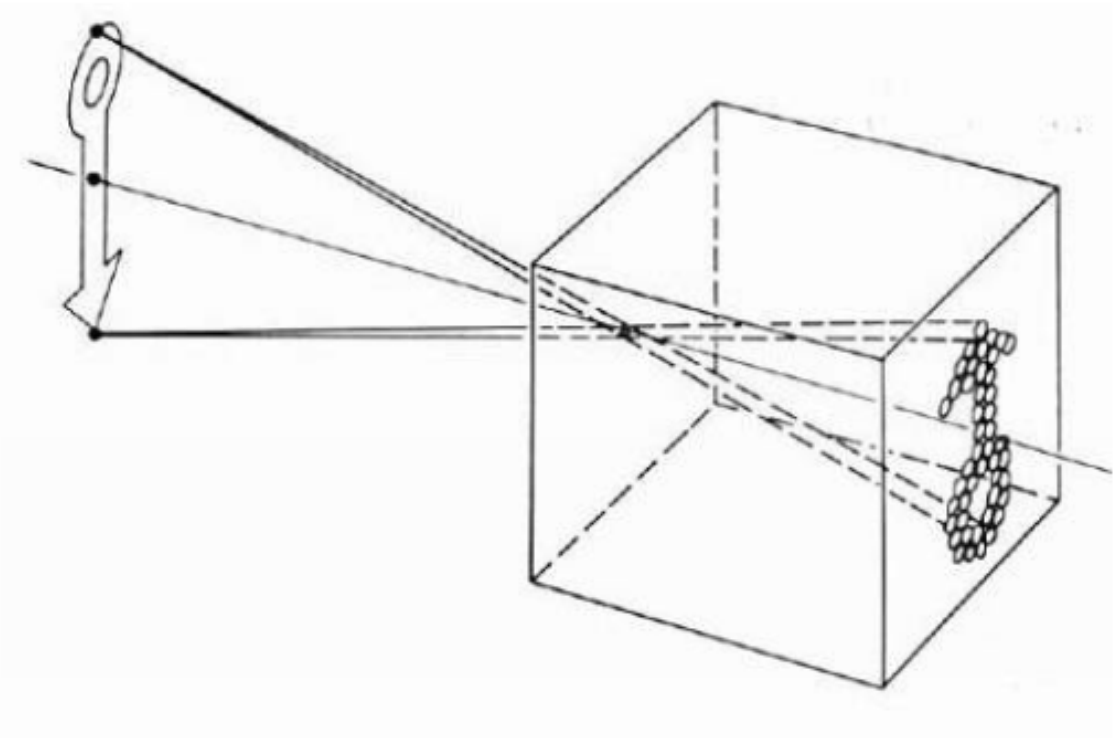
- b = baseline, distance between ...
- f = focal length
- v-v' = disparity

```
\begin{enumerate}
 \item Edit foo.tex
 \item pdflatex foo.tex
 \item View foo.pdf
\end{enumerate}
```

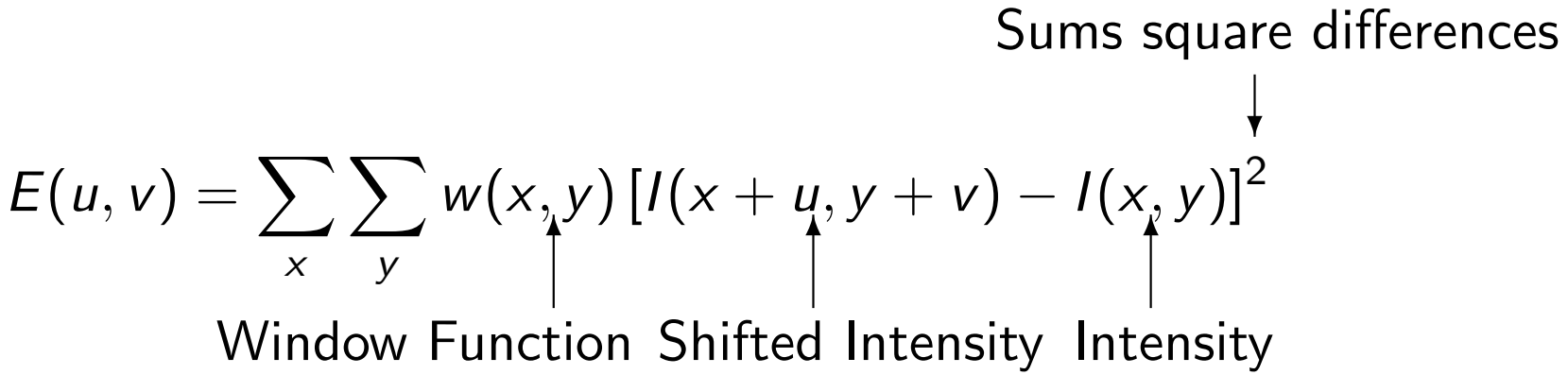
1. Edit foo.tex
2. pdflatex foo.tex
3. View foo.pdf

Latex Images

```
\begin{center}
 \includegraphics[scale=0.4]{./Figures/vision/simplecamera3.png}
\end{center}
```



Latex Images




```
$$E(u,v) = \sum_x\sum_{y} w(x,y)\left[I(x+u,y+v)-I(x,y)\right]^2$$
\begin{picture}(1,1)
 \put(155,5){\vector(0,1){18}}
 \put(90,-5){Window Function}
 \put(205,5){\vector(0,1){18}}
 \put(175,-5){Shifted Intensity}
 \put(270,5){\vector(0,1){18}}
 \put(255,-5){Intensity}
 \put(290,55){\vector(0,-1){12}}
 \put(240, 60){Sums square differences}
\end{picture}
```