The Tale of Monty Hall & The Procrustes Problem

Sanjiban Choudhury
Foundations

Probabilistic Inference

Linear Algebra
Tale 1
The Monty Hall Problem
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The Monty Hall Problem
Activity!
Think-Pair-Share

Think (30 sec): Will you stick with door 1? Or switch to door 2? Justify your decision!

Pair: Find a partner

Share (45 sec): Partners exchange ideas
How is any of this related to robotics?
Robots are fundamentally uncertain
Uncertainty in perception
Localizing object states as an inference problem
The Blindfolded Robot: A Bayesian Approach to Planning with Contact Feedback
An overview of experiments

Brad Saund, Sanjiban Choudhury, Siddhartha Srinivasa, Dmitry Berenson
Uncertainty in decision making
What did the robot do wrong?
What did the robot do wrong?
Back to the problem
What if there are a 100 doors?
What if Monty is blindfolded?
Tale 2
Procrustes Problem
Rotation? Translation?
Rotation? Translation?

\( x_1, y_1 \)

\( x_2, y_2 \)

\( x_3, y_3 \)

\( x_4, y_4 \)

\( x'_1, y'_1 \)

\( x'_2, y'_2 \)

\( x'_3, y'_3 \)

\( x'_4, y'_4 \)
Activity!
Think-Pair-Share

Think (30 sec): How can we solve for the unknown rotation?

Pair: Find a partner

Share (45 sec): Partners exchange ideas

Rotation?
Gimbal Lock!

Gimbal locked airplane. When the pitch (green) and yaw (magenta) gimbals become aligned, changes to roll (blue) and yaw apply the same rotation to the airplane.

A real problem in Apollo 13!
How is any of this related to robotics?
Robots fundamentally reason about 3D relationships
3D Surface Reconstruction

Planning + Controls

**Optimization** with over 50 objectives at 500 iterations/sec
3D Surface Reconstruction

3D Scan Workflow

Explore

Capture
3D Grasp Pose Estimation
Back to the problem
\[ M = \begin{bmatrix} M_{1,1} & M_{1,2} \\ M_{2,1} & M_{2,2} \end{bmatrix} \]
tl;dr

The Monty Hall Problem

The Procrustes Problem