

# Which bet would you take?

## A. Birthdays

- There are 36 students in the two groups taking Problem Solving
- I bet two of them share a birthday

## B. Coins

- I toss a fair coin
- I bet it will come up heads



# The Birthday Problem

- Try two people
- What are the chances they do not share a birthday?

$$\frac{364}{365} \approx 0.99726$$

- Add a third person

$$\frac{364}{365} \times \frac{363}{365} \approx 0.99176$$

$$1 - 0.99176 = 0.008204 = 0.82\%$$

- Now 36 people

$$\frac{364}{365} \times \frac{363}{365} \times \dots \times \frac{330}{365} \approx 0.832182$$

$$1 - 0.167818 = 0.832182 = 83.2\%$$

- So which bet would you take?  
50% or 83%?

# The Birthday Problem

- In fact, 23 people are sufficient for a greater than 50% chance
- With 57 people, there probability is greater than 99%

# **What do you think about the validity of this result?**

- What assumptions have been made?
- How realistic do you think this is?

# This process

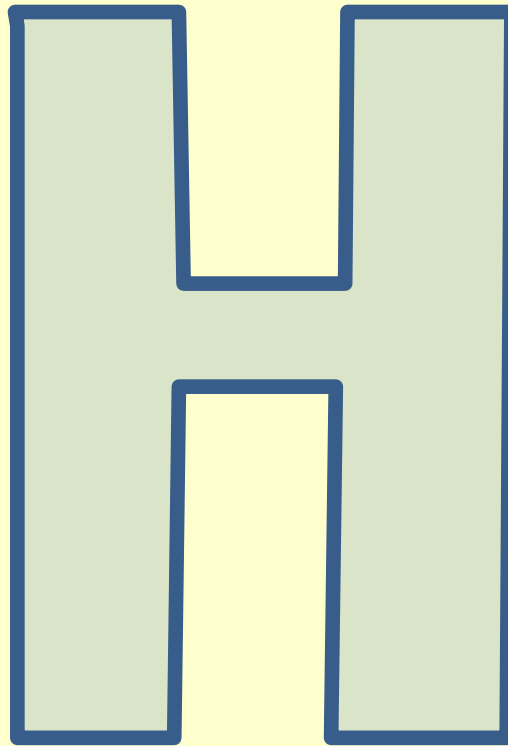
- We have:
  - Taken a real world scenario
  - Expressed it in mathematical language
  - Come up with a mathematical solution
  - Related that solution back to the problem
  - Critically examined the assumptions we made in arriving at our solution
- In this module, we are interested in the solution but we are particularly interested in the first 2 and last 2 steps

# Surveillance Problems

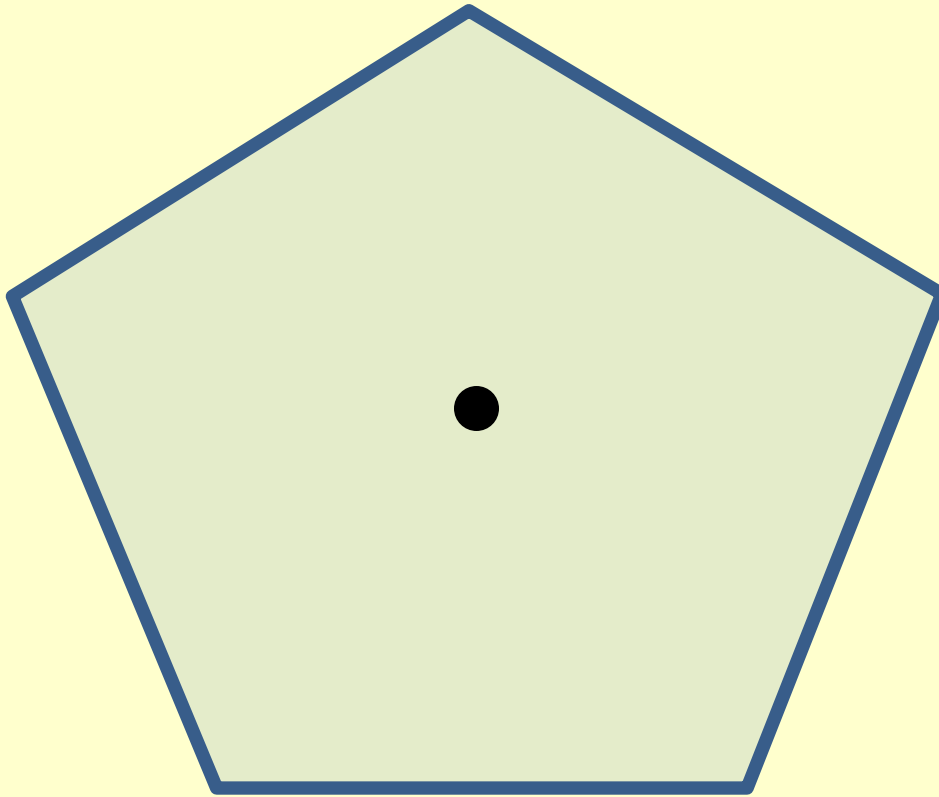
Or, Guard Problems

Or, Art Gallery Problems

Why is a H shaped prison a good design?



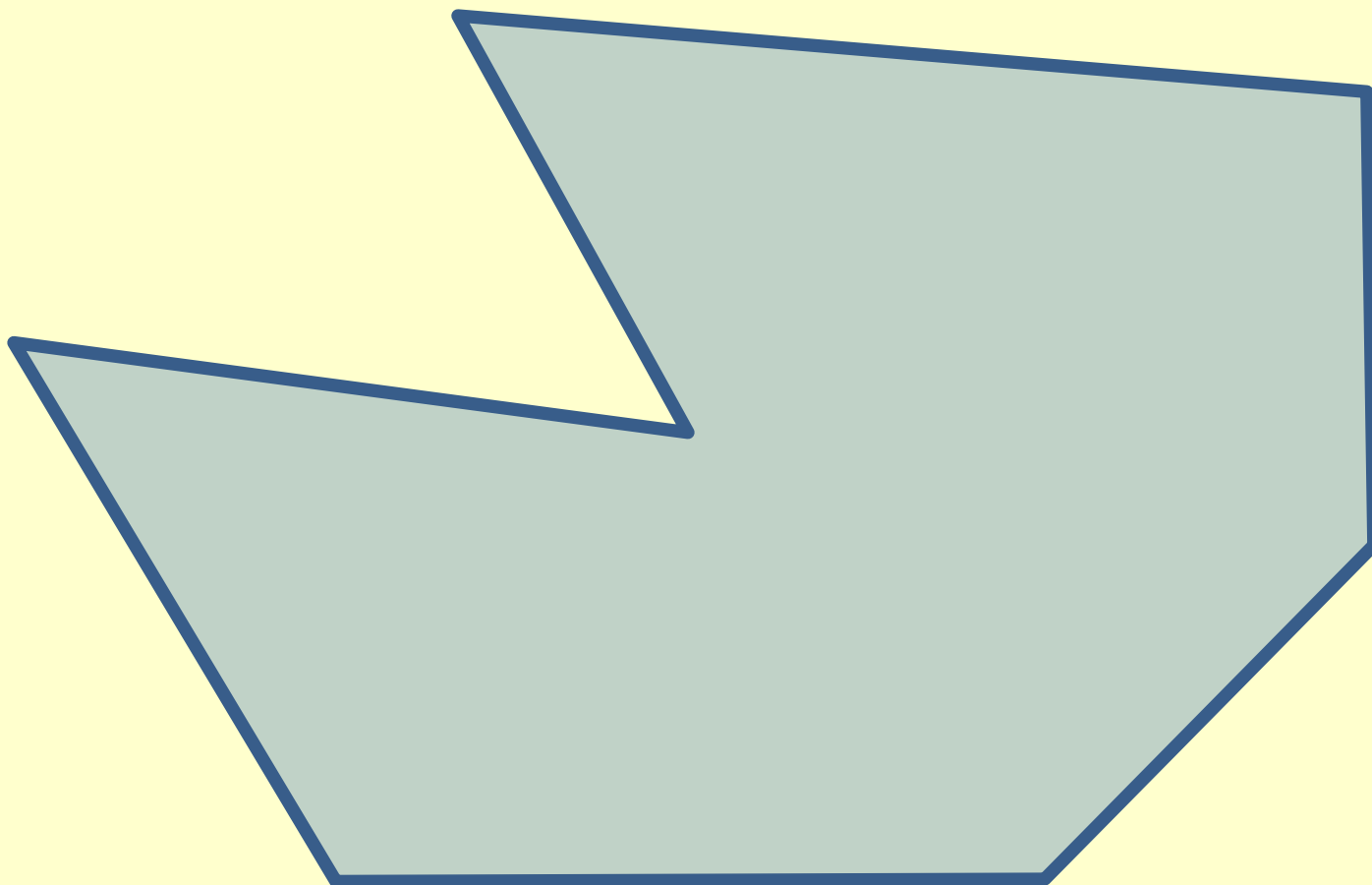
How many guards to guard a  
polygon?



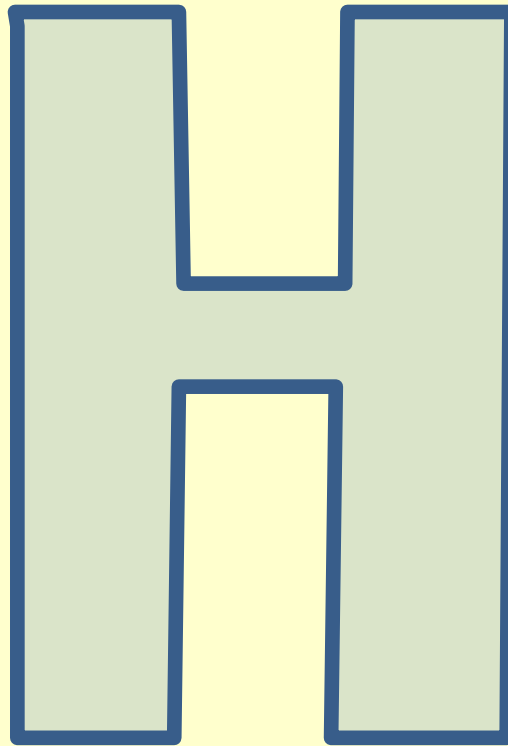
# Convex polygons

- Any convex polygon requires only one guard
- Proof is trivial – a convex polygon is one for which a line between any two points does not pass outside the polygon
- Therefore, a guard at any point has line of sight of every other point in the polygon

How about this one?



Why is a H shaped prison a good design?



# Task 3: Museum of mathematical curiosities

- You work for a mathematical consultant
- Your team is asked to work on the security arrangements for a series of museums
- You must write reports for the client (non-mathematical) and an internal company report (for mathematicians)
- Give a presentation to the client

