Scenario Week 4

(comp203p)

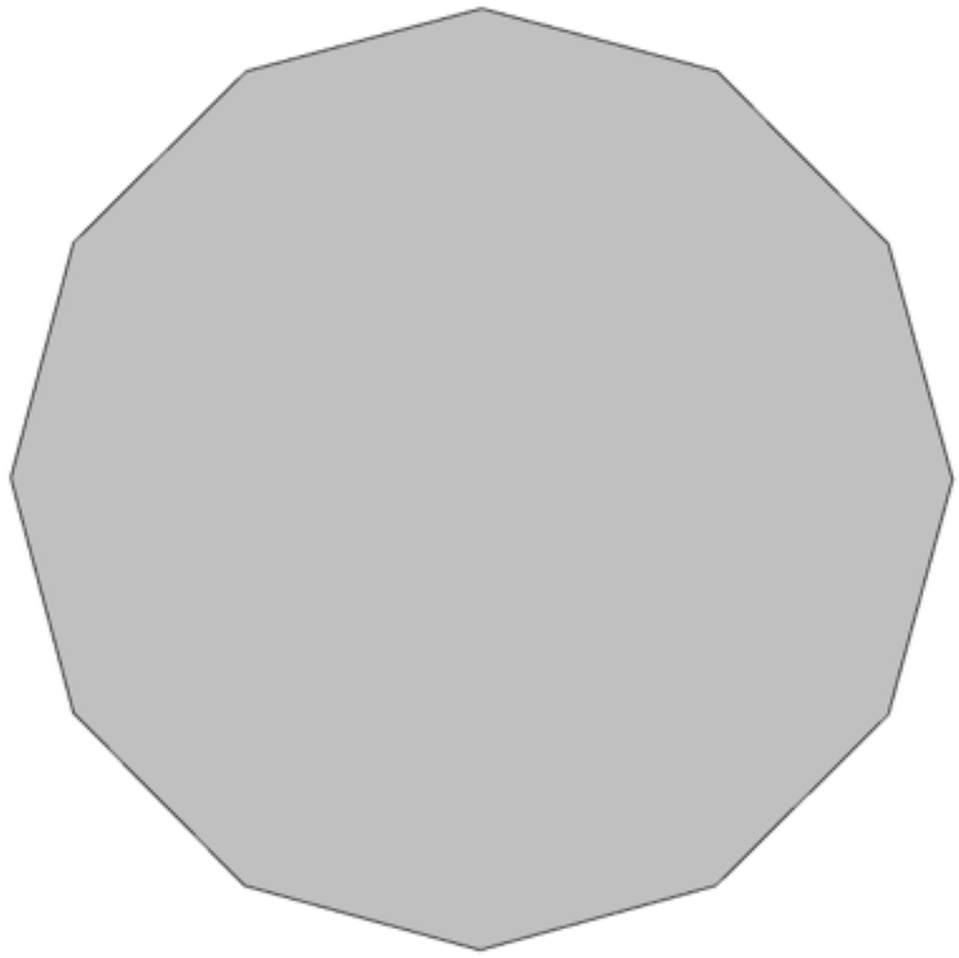
Ilya Sergey

scenario@cs.ucl.ac.uk

22-26 February 2016

How many guards do we *really* need?

The answer depends on the shape of the gallery.



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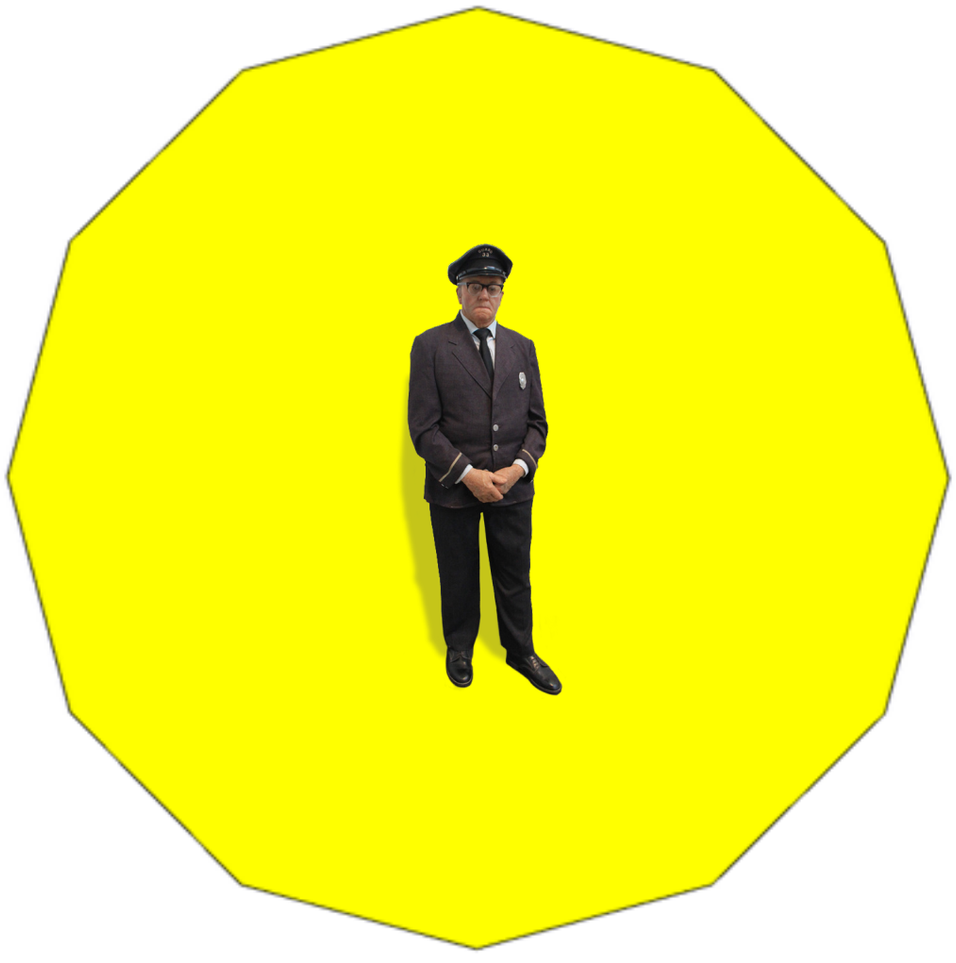
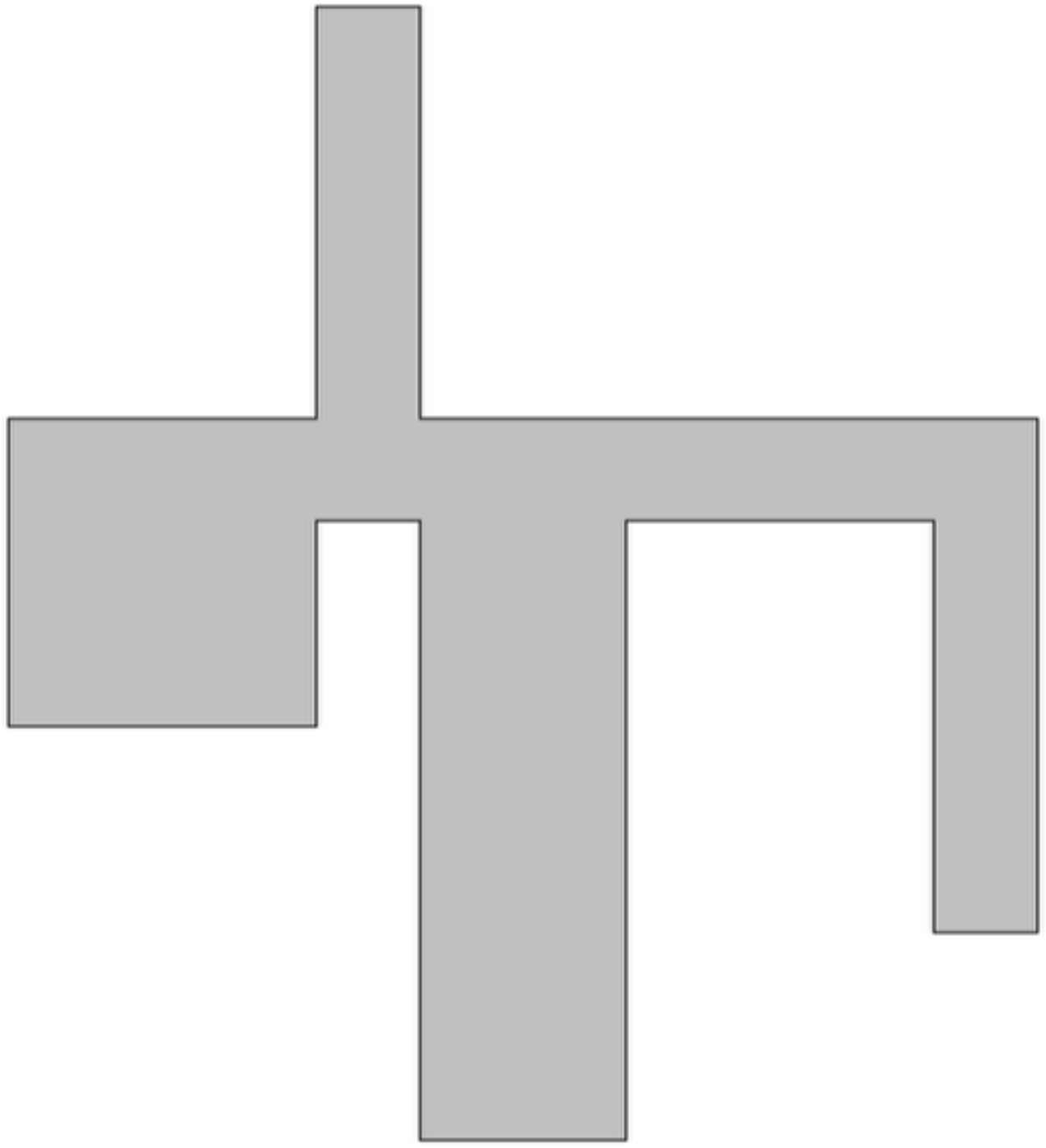


Here just 1 guard is okay.

How many guards do we *really* need?



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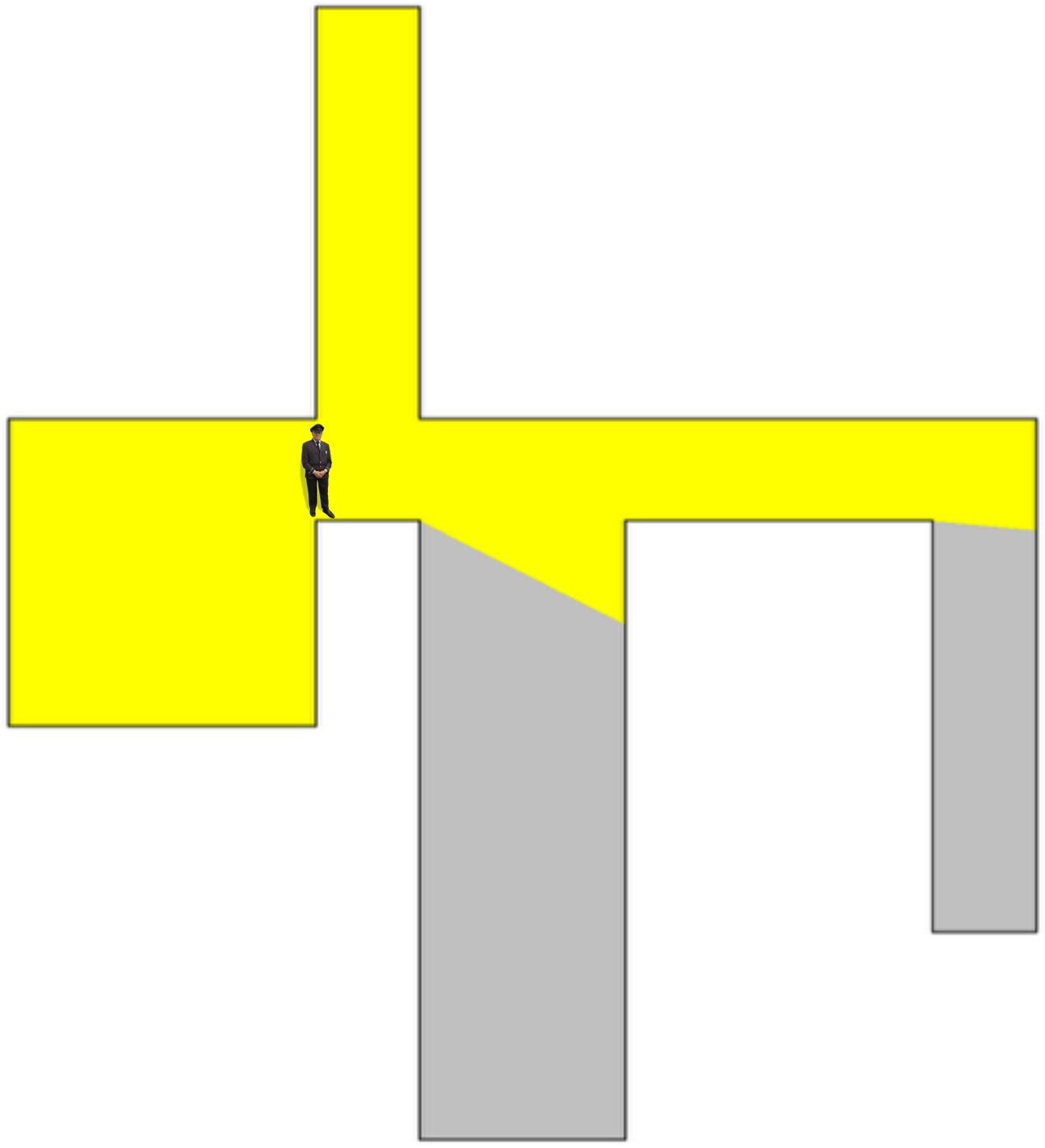

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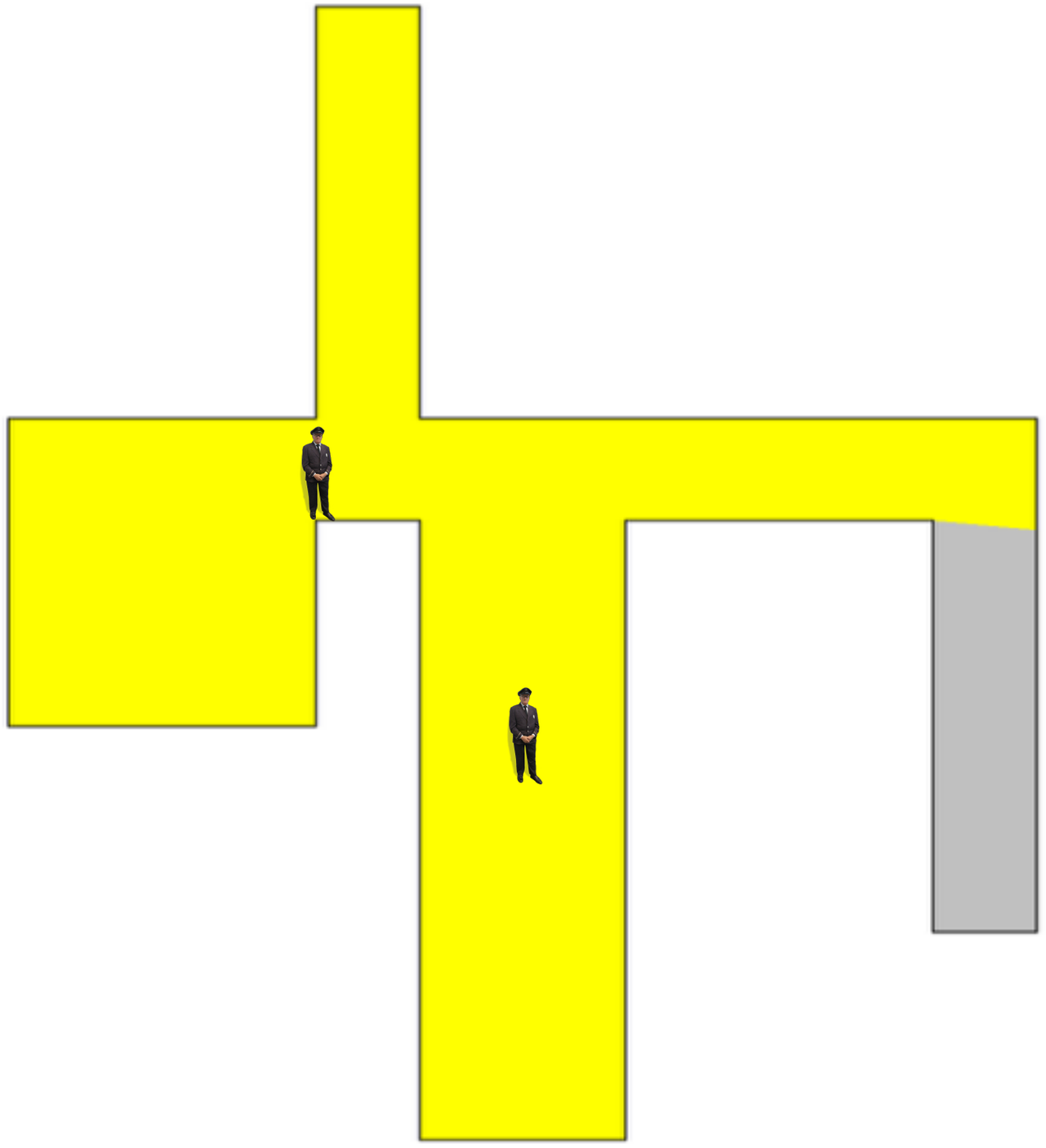

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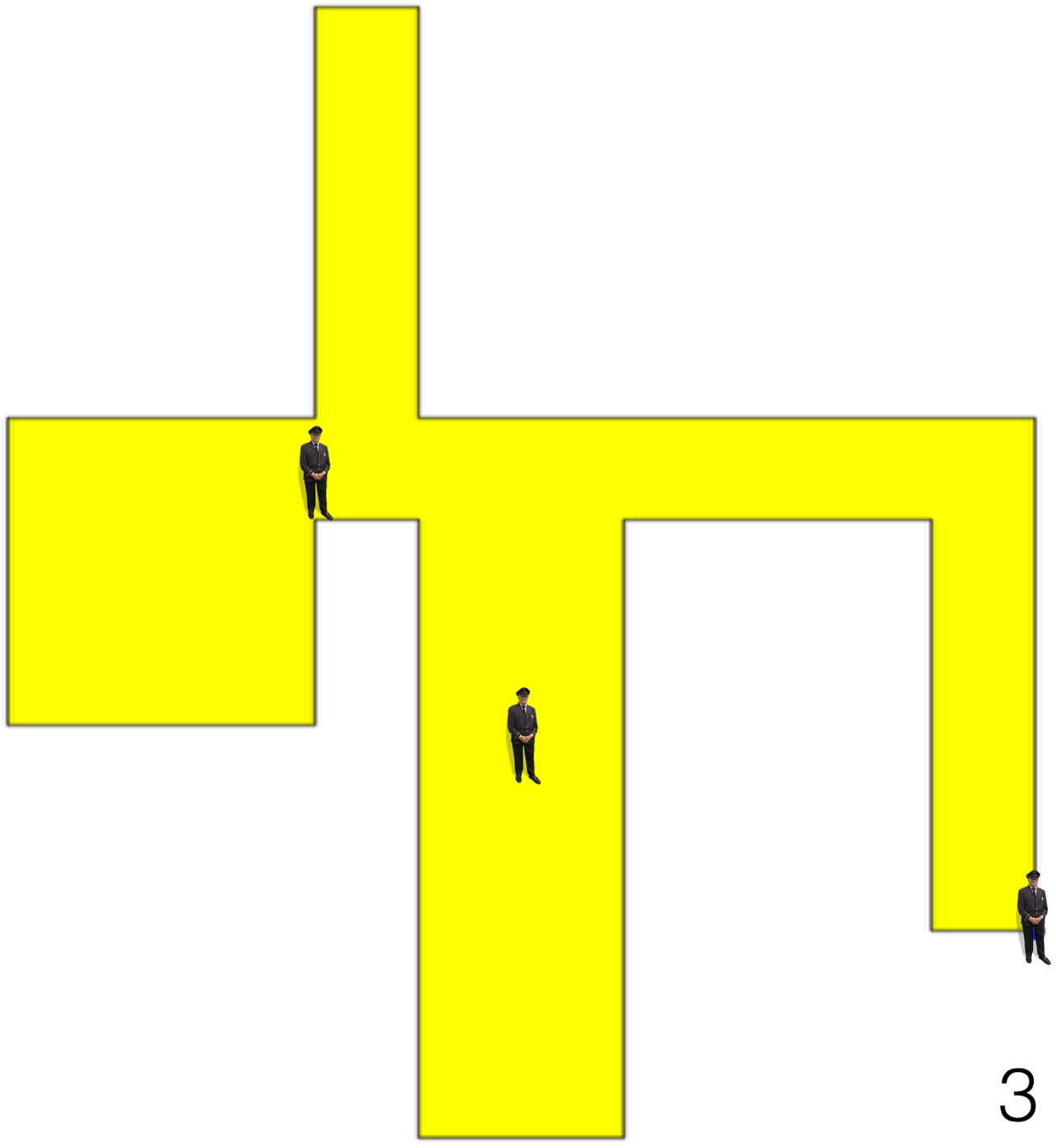
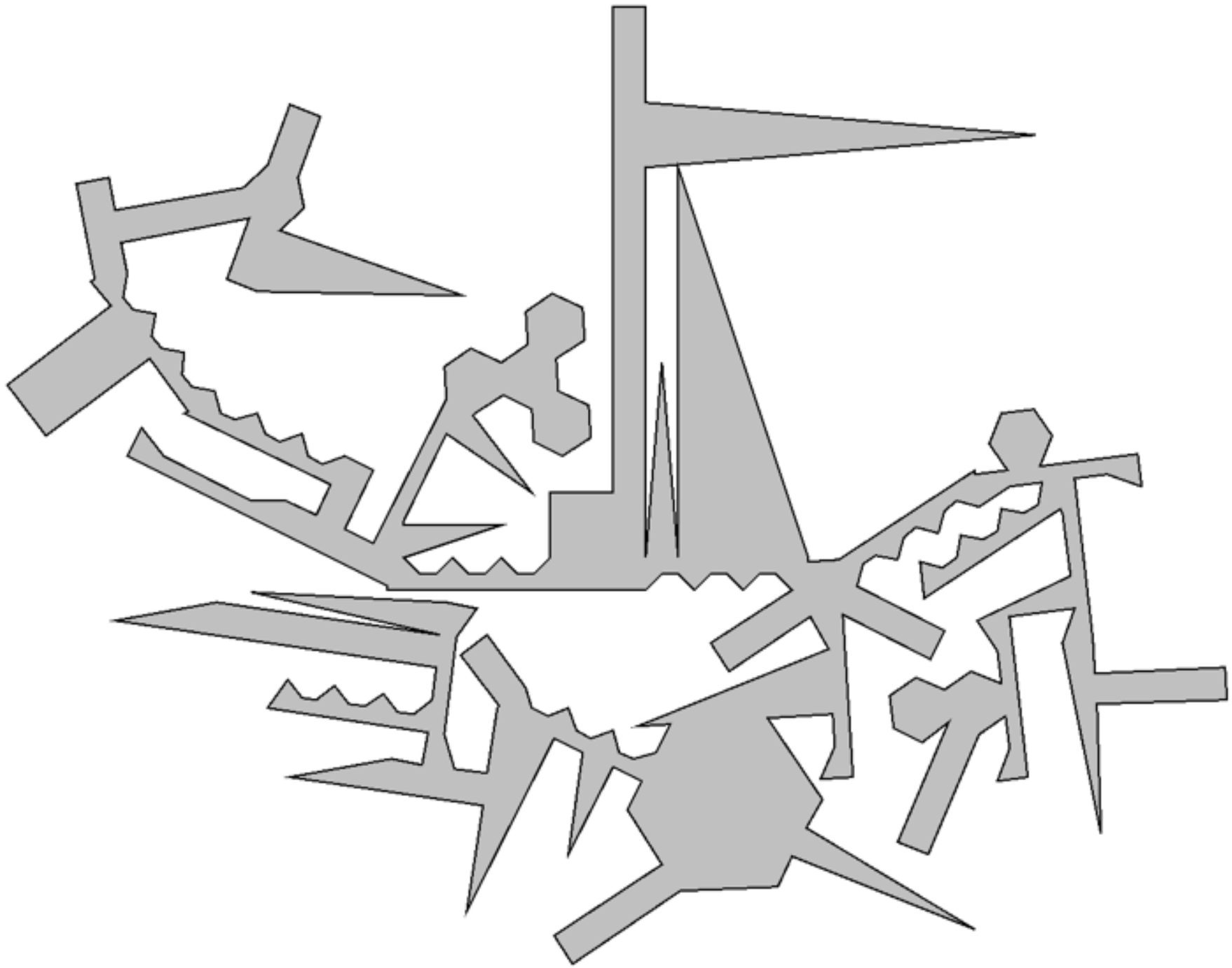


3 guards will do.

How many guards do we *really* need?



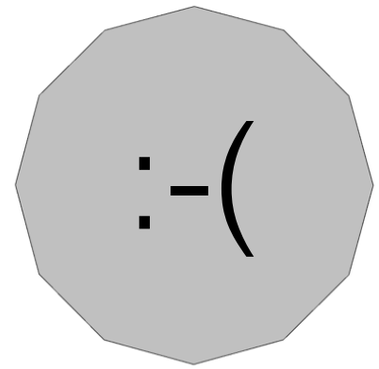
Art Gallery Problem

For a given gallery (polygon),
find the *minimal* set of guards' positions,
so together the guards can "see" the *whole* interior.

- *Complexity*-wise, *harder* than
  - SAT
  - Travelling salesman
  - Hamiltonian paths
  - Knapsack problem

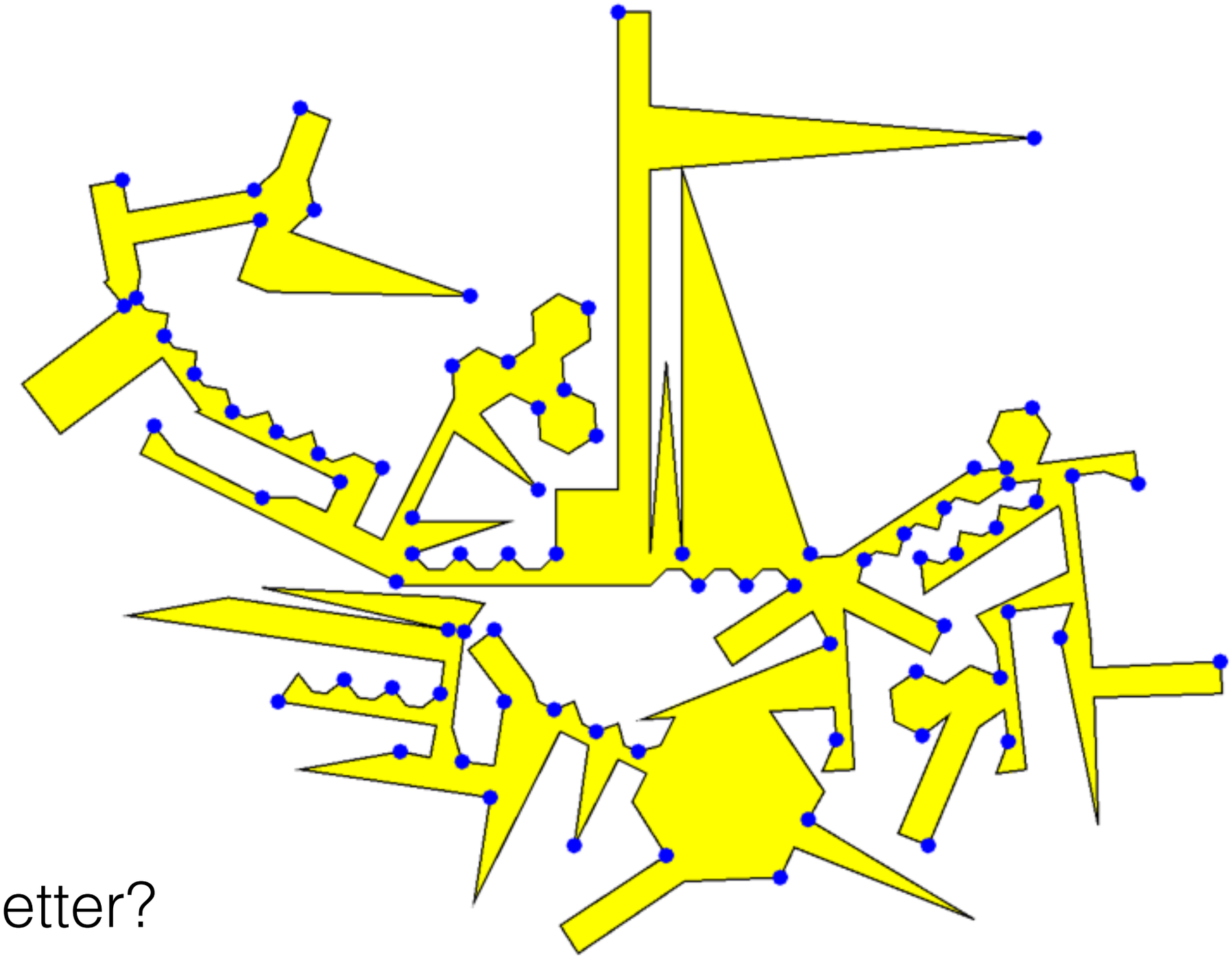
Cheap-and-cheerful "almost" solutions

- Putting guard in *each* vertex
  - n guards for a polygon with n vertices



- Václav Chvátal's solution (1975)
  - based on *triangulation*, $\lfloor n/3 \rfloor$ guards;
  - ***Chvátal's theorem***: this number is *always sufficient* and is in some cases *necessary*.

Chvátal's solution in practice



- 246 vertices
- 79 guards

Can we do better?

Scenario Week 4

(comp203p)

Art Gallery Competition

scenario@cs.ucl.ac.uk

22-26 February 2016

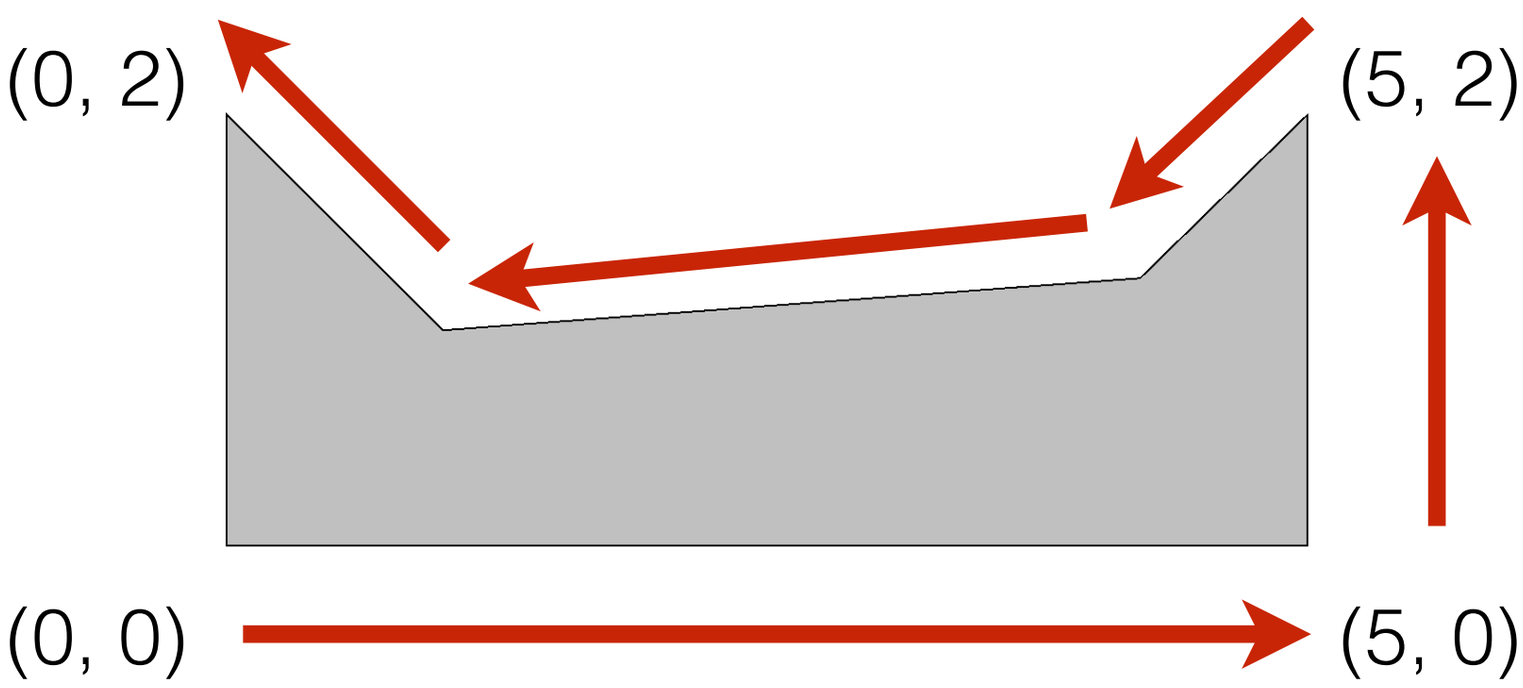
Part 1: Computing "good enough" set of guards

- **30** galleries of different shapes;
  - File with galleries: **`guards.pol`** (see Moodle page);
    - sizes of problems: small (<10) to large (~300);
- Compute a *complete* set of guards for *each one* of them;
- *Baseline* — Chvátal's boundary (cannot get worse than that);
- Grading: ***30 points***, *one per gallery*, for *any* solution, which is not worse than the baseline.

Encoding of the problems (Part 1)

guards.pol

```
1:  (0, 0), (2, 0), (2, 1), (1, 1), (1, 3), (0, 3)
2:  (0, 0), (5, 0), (5, 2), (4.2312351, 1.234), (1, 1), (0, 2)
```



- Polygon is "on the left"
- No holes inside

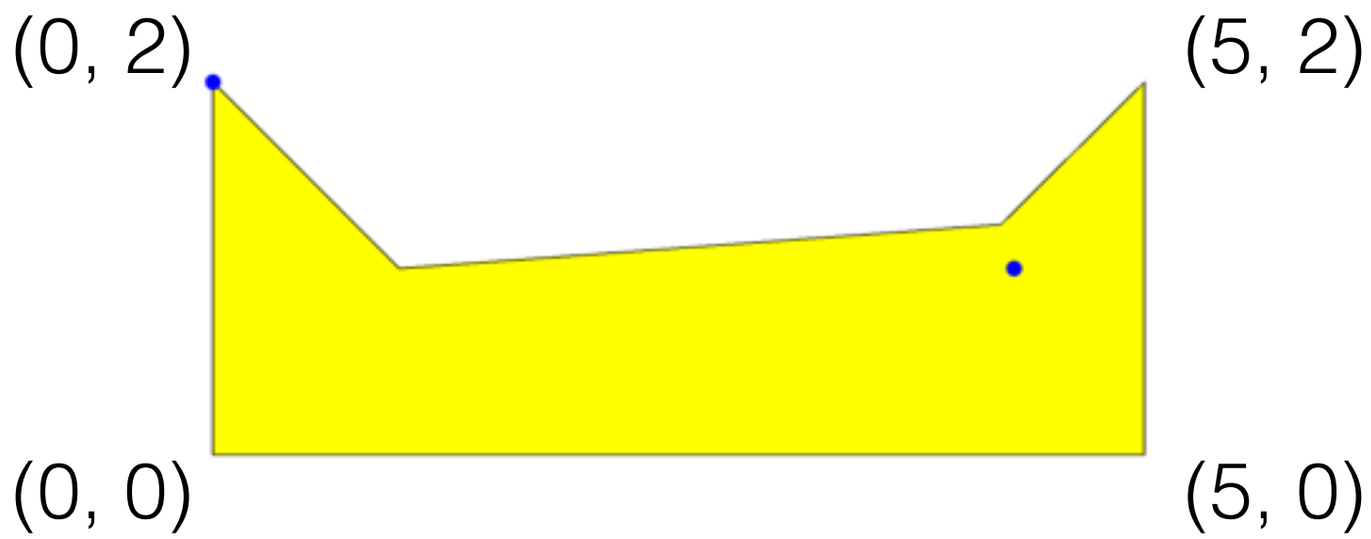
Encoding your solutions (Part 1)

Solution file:

team name →
team's password →

```
tiger
lt671vecrskq
2:  (0, 2), (4.3, 1)
1:  (0.2, 2.5), (2, 0.5)
```

per-polygon guards →



Checking and submitting solutions

- **Warning:** *double-precision floating-point* arithmetic
  - all equalities are up to $\varepsilon = 0.000{,}000{,}000{,}1$
- Details on acceptance criteria are in the *specification* (on Moodle)

- Submit your solutions here (under Part 1):

`http://artgallery.cs.ucl.ac.uk`

Solutions are accepted until **14:00 GMT 26/02/2016**

Part 2: Checking a (flawed) set of guards

- **20** galleries of different shapes *with* sets of guards;
  - File with problems: **`check.pol`** (see Moodle page);
    - sizes of problems: small (<10) to gigantic (~500);
- Find a *refutation* (a point within a polygon, not visible from the given guards) for *each* problem in the set;
- *Any* refutation will do.
- Grading: ***20 points***, *one per problem/refutation.*

Encoding of the problems (Part 2)

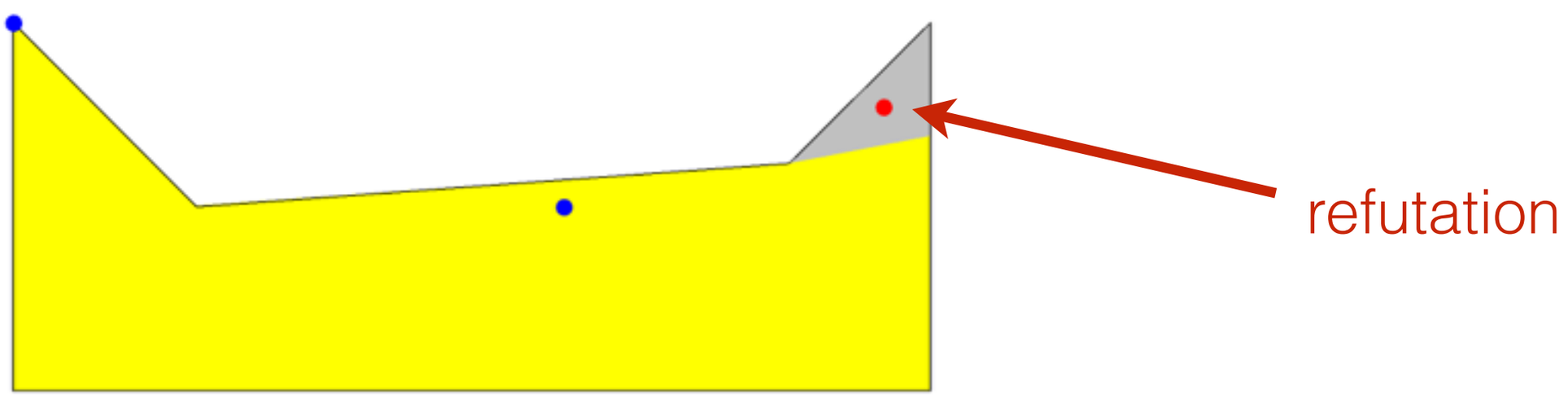
File with problems

`check.pol`

```
1:  (0, 0), (2, 0), (2, 1), (1, 1), (1, 3), (0, 3); (0, 3), (1, 2)
2:  (0, 0), (5, 0), (5, 2), (4.2312351, 1.234), (1, 1), (0, 2); (0, 2), (3, 1)
```

polygon vertices

guards



Encoding your solutions (Part 2)

Solution file:

team name →
team's password →
per-polygon refutations →

```
tiger
lt671vecrskq
1:   (1.56, 0.53)
2:   (4.74, 1.53)
```

- Submit your solutions here (under Part 2):

`http://artgallery.cs.ucl.ac.uk`

Solutions are accepted until **14:00 GMT 26/02/2016**

Part 3: Visualisation

- Implement a visualiser for galleries, guards and visibility:
  - drawing galleries;
  - drawing visibility areas from specific guards;
  - drawing refutations for incomplete guard sets.
- Grading: ***15 points***
- Assessed by the organisers from **14:00 till 17:00**, **26 Feb16**
  - **book a slot for your team!**

Part 4: Implementation report

- Describe your implementation experience
  - language, algorithms, *etc.*
    - details in the specification (see Moodle)
- Grading: ***15 points***
- Submit electronically by **17:00, 26 Feb 2016** (one per team)

Part 5: The Competition!

- Compete with other teams for the *best* solutions in Part I.
- Teams with *all* accepted solutions ranked amongst each other first.
- Check the score table `http://artgallery.cs.ucl.ac.uk` at for details
- Grading: up to ***20 points***.

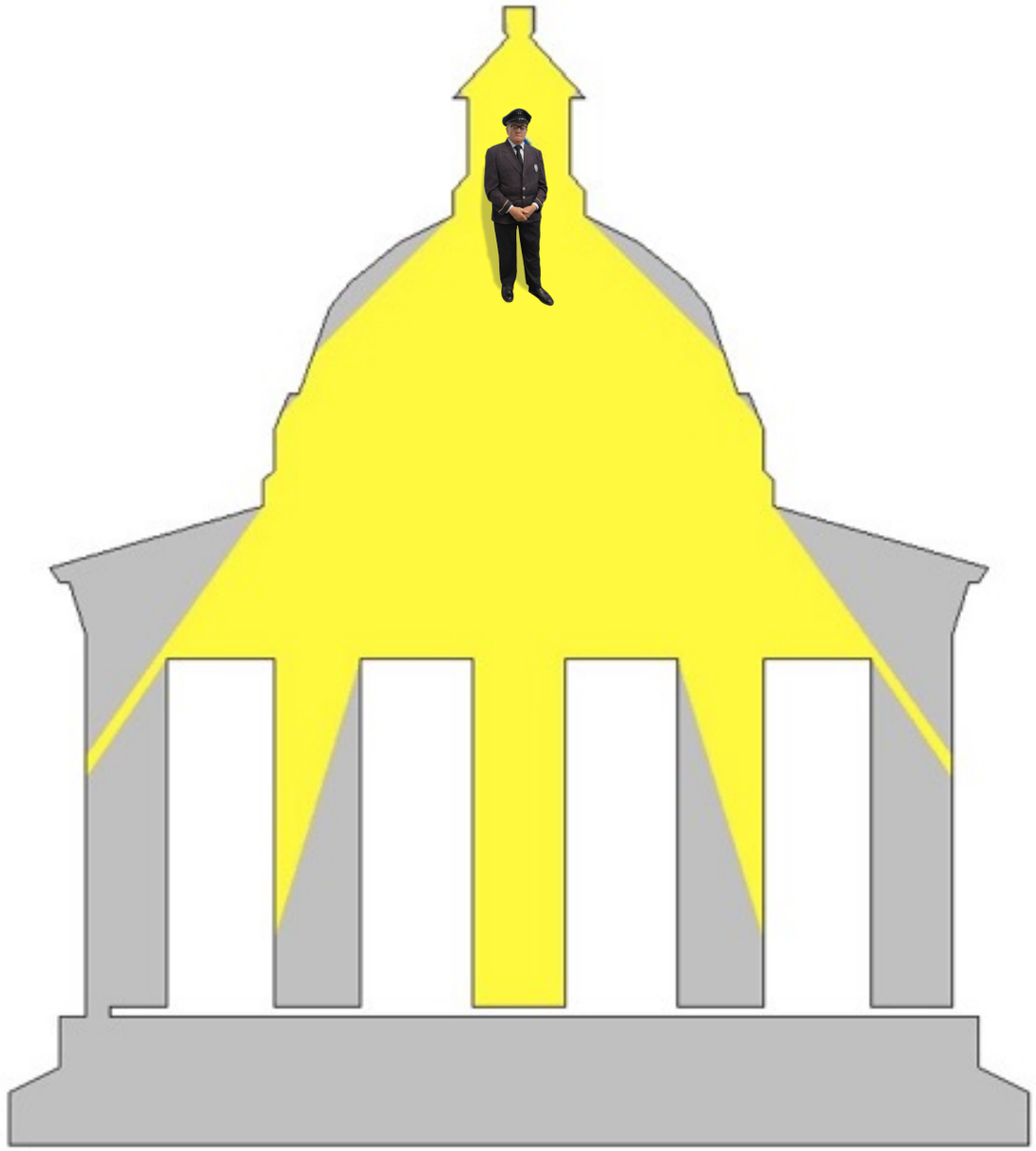
Rank	Score
1	20
2-3	15
4-5	10
6-7	5
>7	0

Overall grading

Task	Max grade
Computing “good enough” guard set	30
Checking a flawed guard set	20
Visualisation of the solutions	15
Implementation report	15
The Competition	20

This week schedule

	Monday, 22 Feb	Tuesday, 23 Feb	Wednesday, 24 Feb	Thursday, 25 Feb	Friday, 26 Feb
10:00-11:00	ULU Malet Suite (Introductory lecture)	Roberts 421	Bedford Way LG04	Roberts 106	Roberts 421
11:00-13:00		Christopher Ingold XLG2 Auditorium	Chadwick B05 LT	Medawar G01 Lankester LT	Cruciform B404 - LT2
13:00-14:00	Lunch	Lunch	Birkbeck Clore Management Centre B01	Lunch	Lunch
14:00-16:00	Cruciform B404 - LT2	Cruciform B304 - LT1		Medawar G01 Lankester LT	Birkbeck Malet Street B36
16:00-18:00	Roberts 106	Cruciform B304 - LT1		Medawar G01 Lankester LT	Roberts G06 Sir Ambrose Fleming LT (Concluding lecture at 17: 00)

Helpdesk (green) = Time and locations where staff and/or TAs will be present so you could ask questions.
Lectures (blue) = Introductory and concluding lectures

Good luck!