

24th Annual

Rowan University Programming Contest

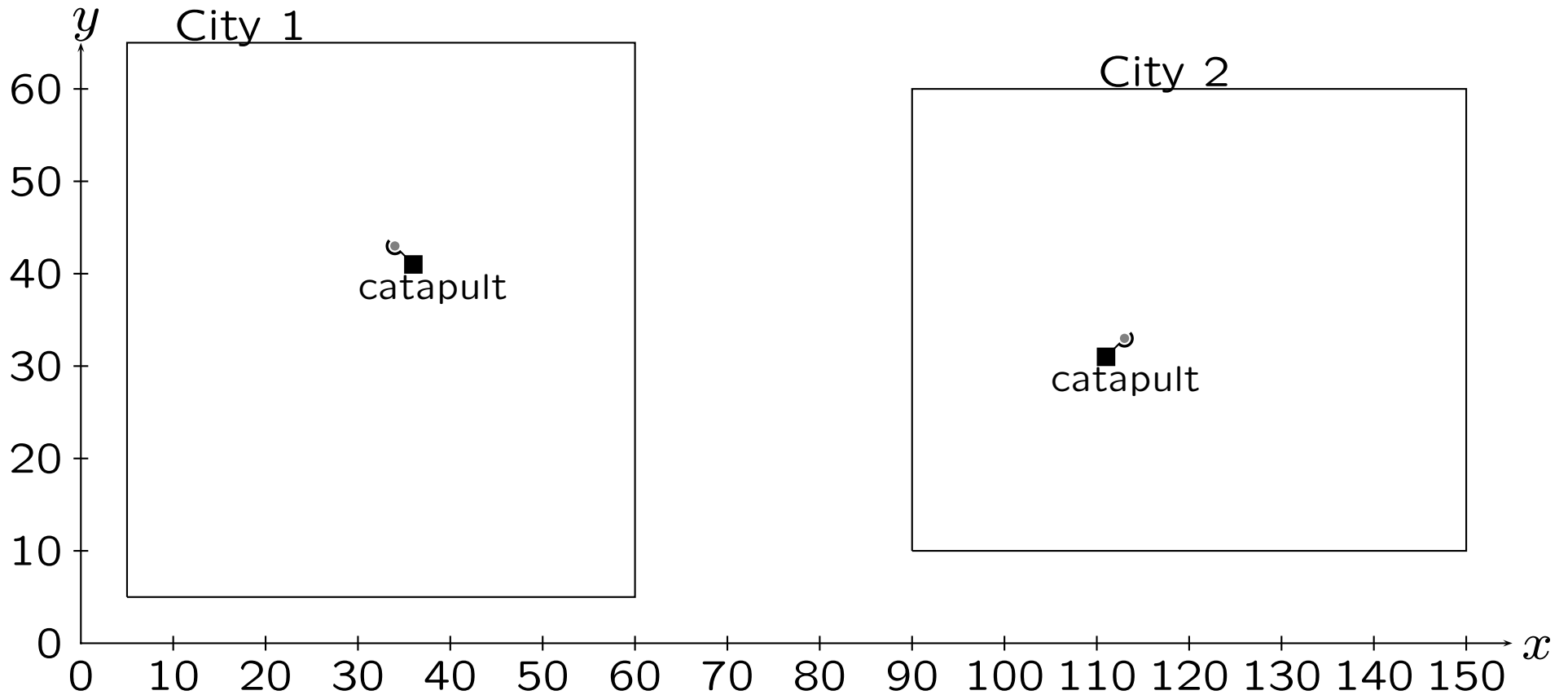
hosted by the

Computer Science Department

Friday, 16 April 2010



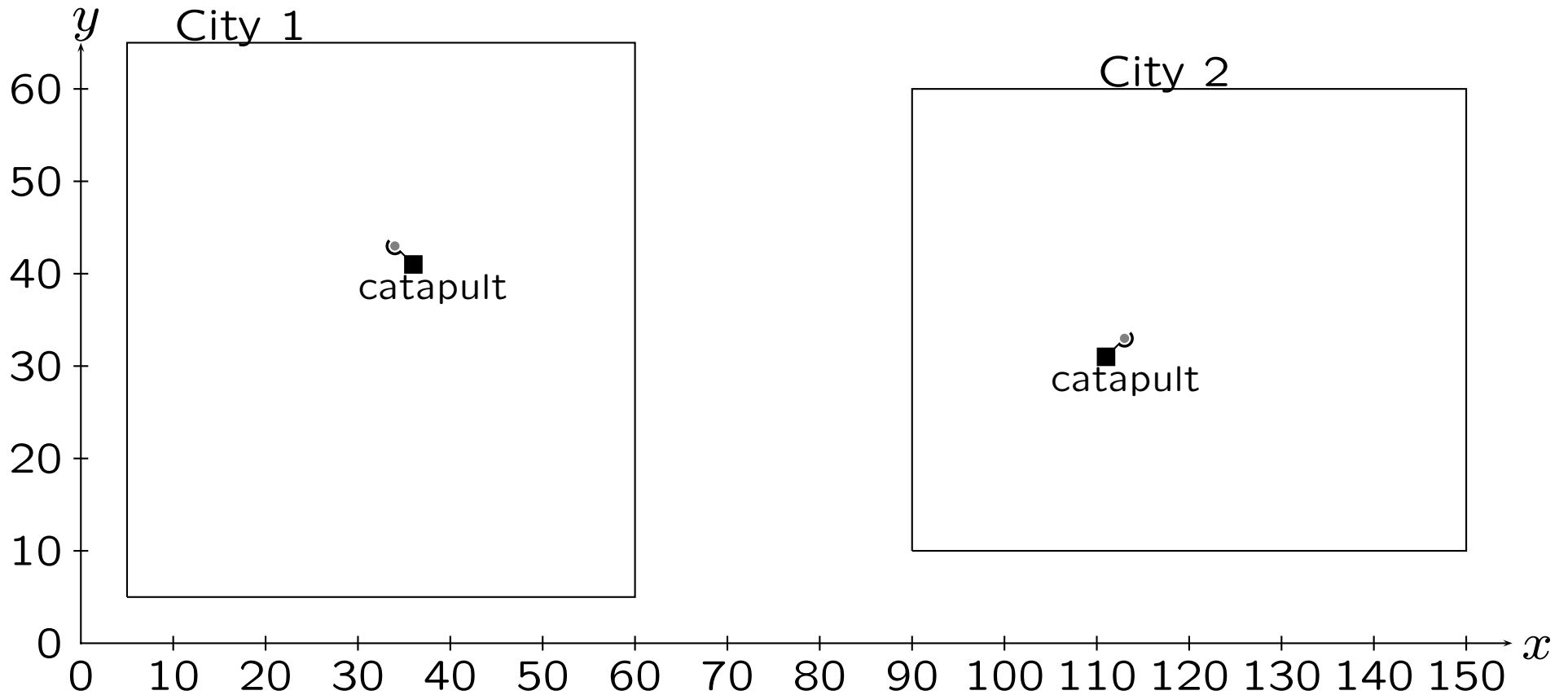
Walled Cities



Two neighboring cities are surrounded by indestructible walls.

Relations have been strained for some time.

Walled Cities



Negotiations break down; spies are sent to scout locations; preparations for battle begin.

Walled Cities

City 1's generals have barrels of gunpowder prepared:

5 3 8 5 8

City 2's generals have barrels of gunpowder prepared:

5 8 3 6 4

Barrels are measured by blast radius, and are listed in the order they'll be used.

Walled Cities

City 1 chooses targets:

(140, 20)

(152, 45)

(115, 15)

(109, 32)

(140, 50)

City 2 chooses targets:

(20, 20)

(53, 12)

(45, 60)

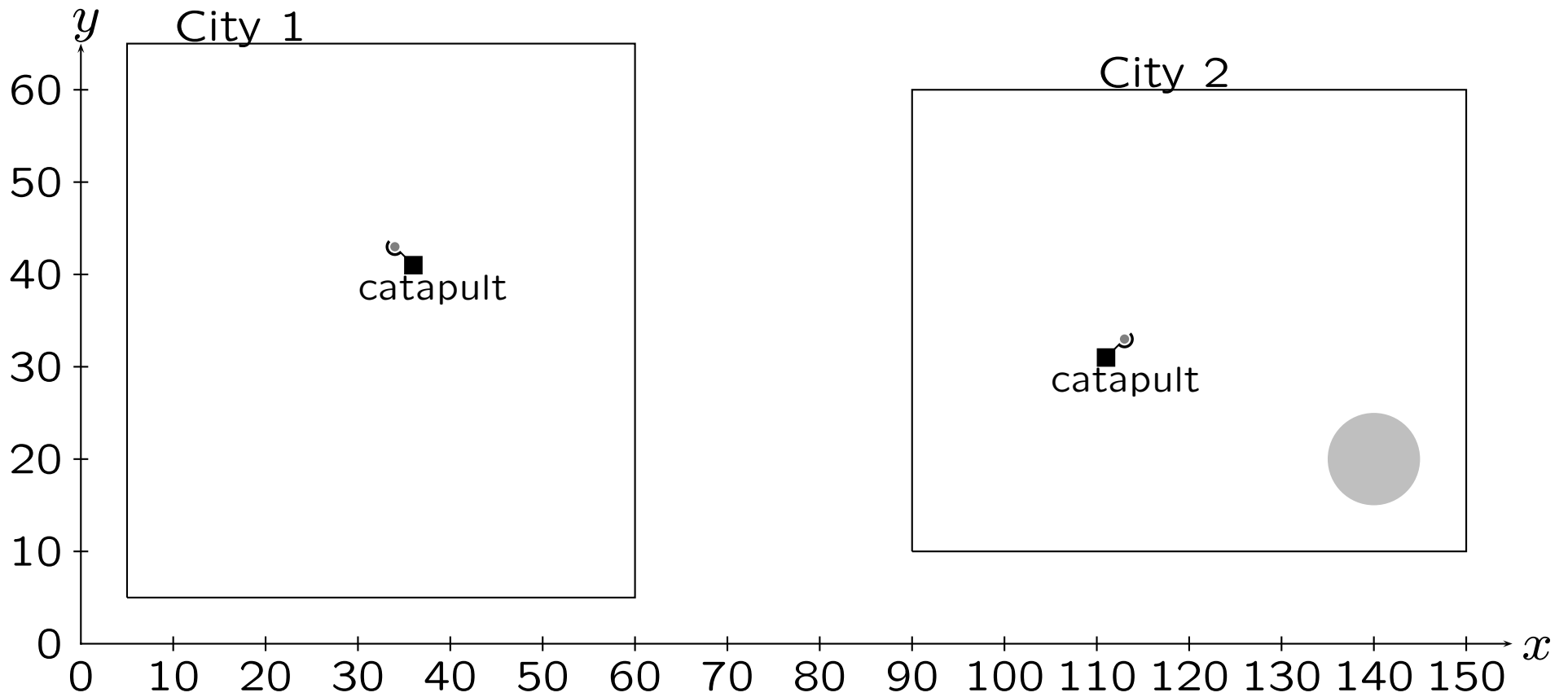
(20, 50)

(30, 40)

Targets are listed as (x, y) pairs, and are listed in the order they'll be attacked.

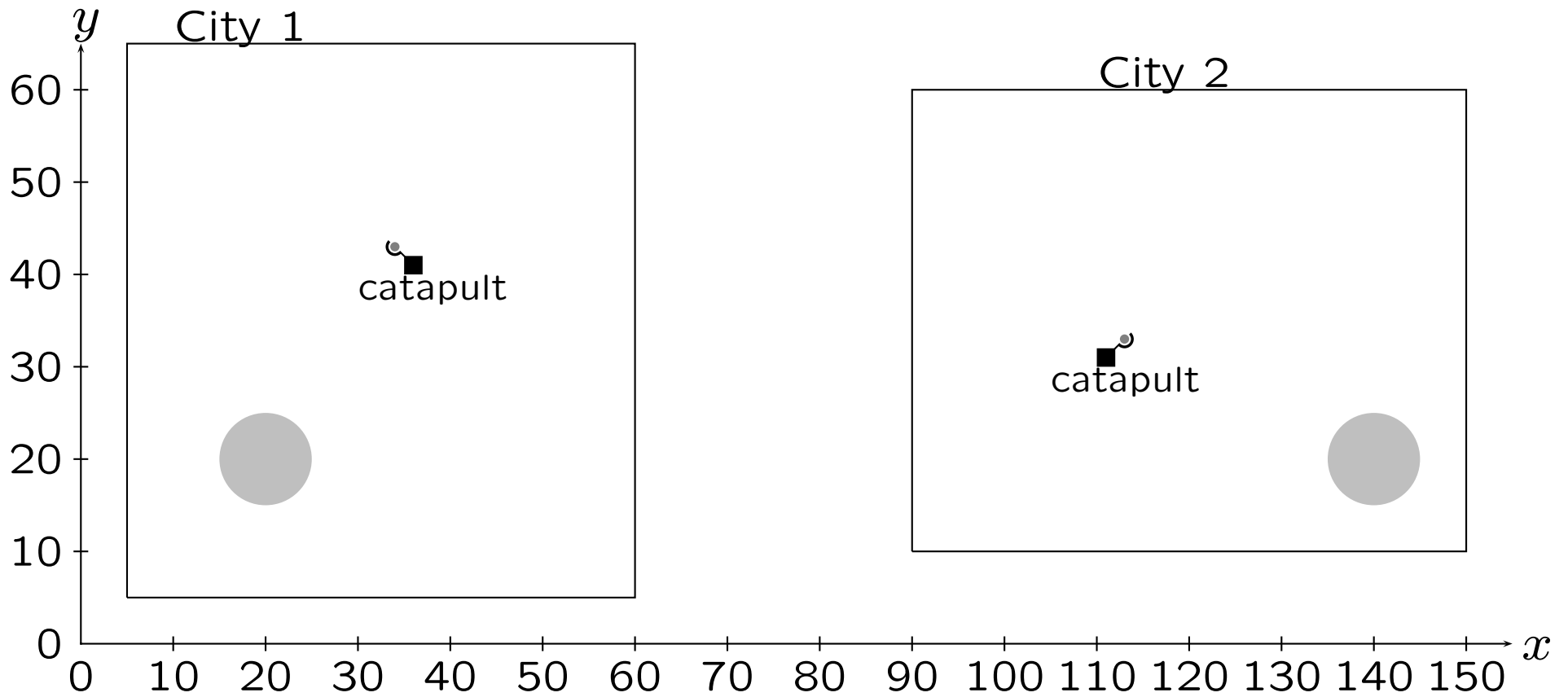
Walled Cities

City 1 fires first – per the plan, barrel size 5, target (140, 20):



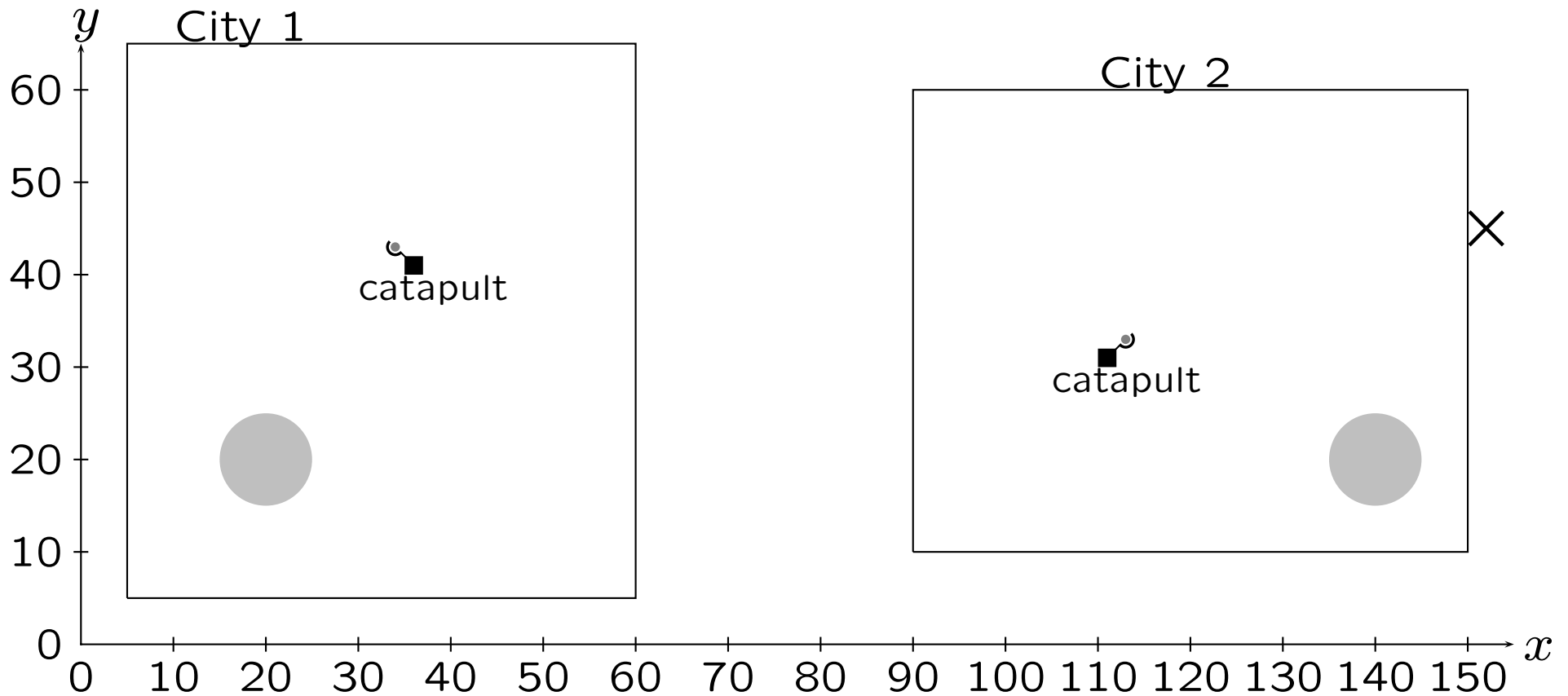
Walled Cities

City 2 fires back – per the plan, barrel size 5, target (20, 20):



Walled Cities

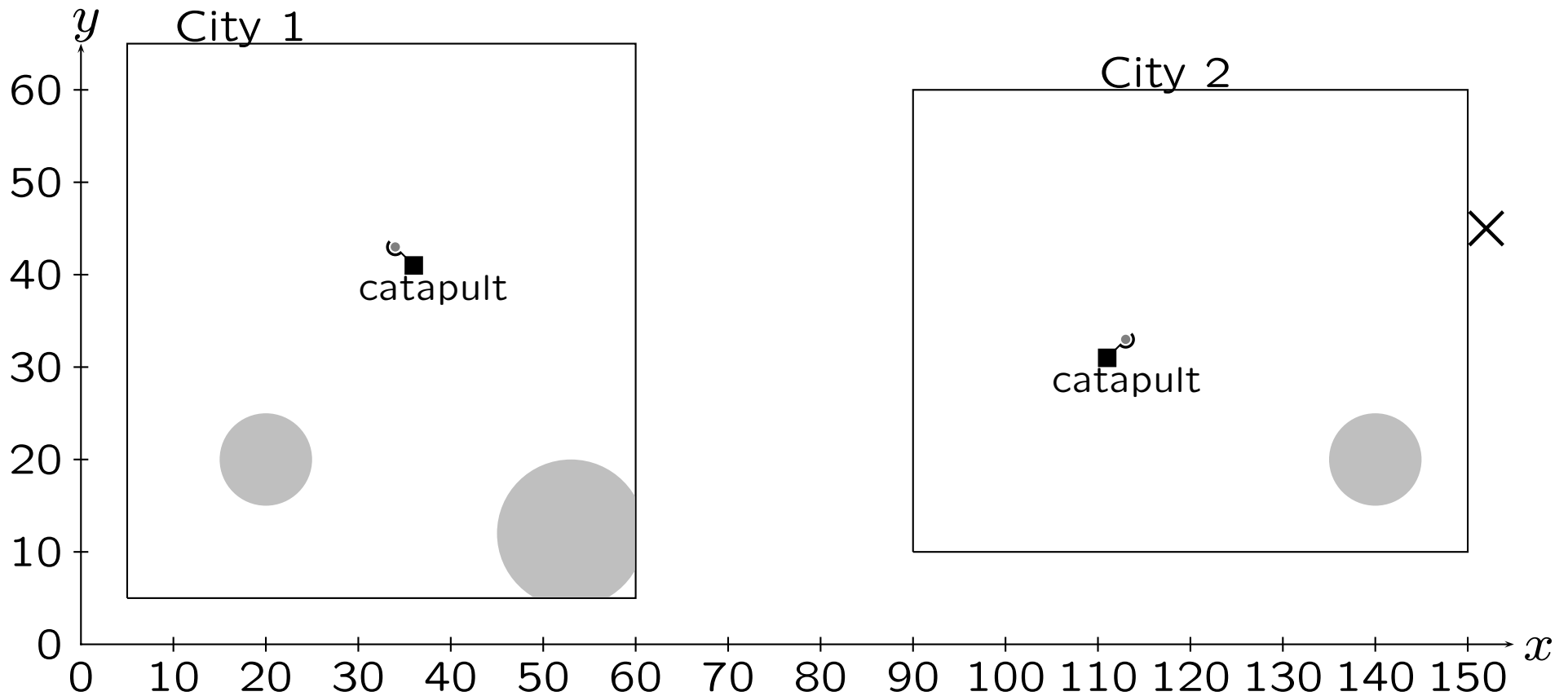
City 1 fires again – per the plan, barrel size 3, target (152, 45):



But this one missed the city entirely.

Walled Cities

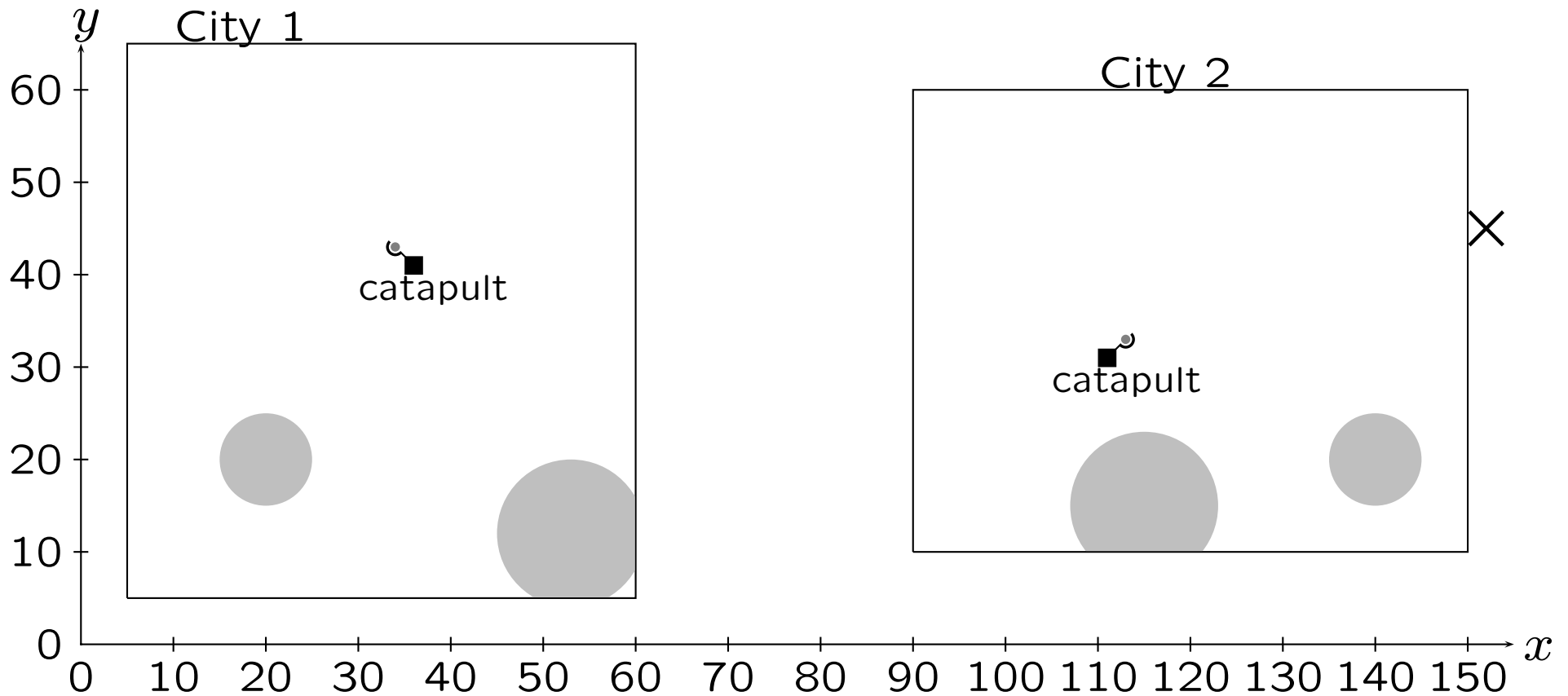
City 2 fires again – per the plan, barrel size 8, target (53, 12):



This one, near the walls, doesn't quite destroy a complete circle.

Walled Cities

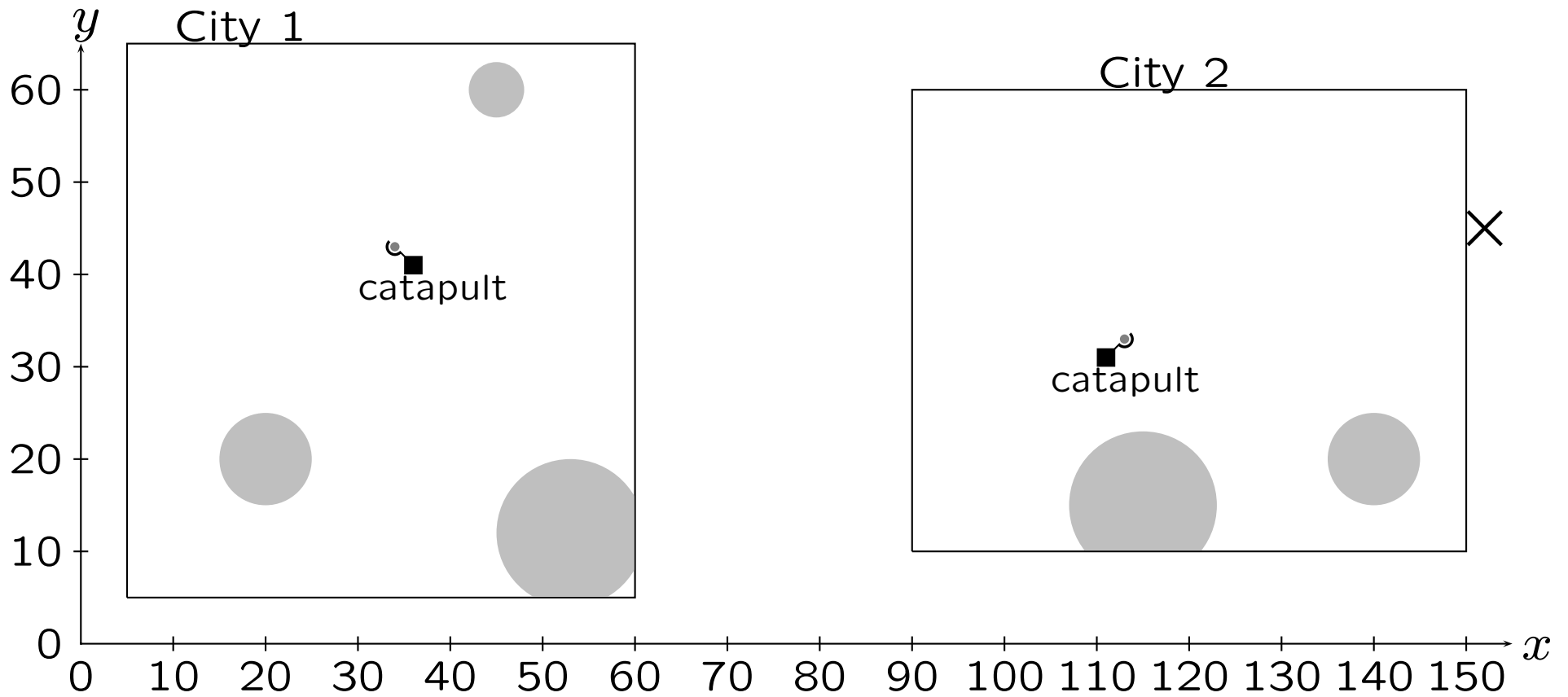
City 1 fires again – barrel size 8, target (115, 15):



This shot also doesn't destroy a complete circle.

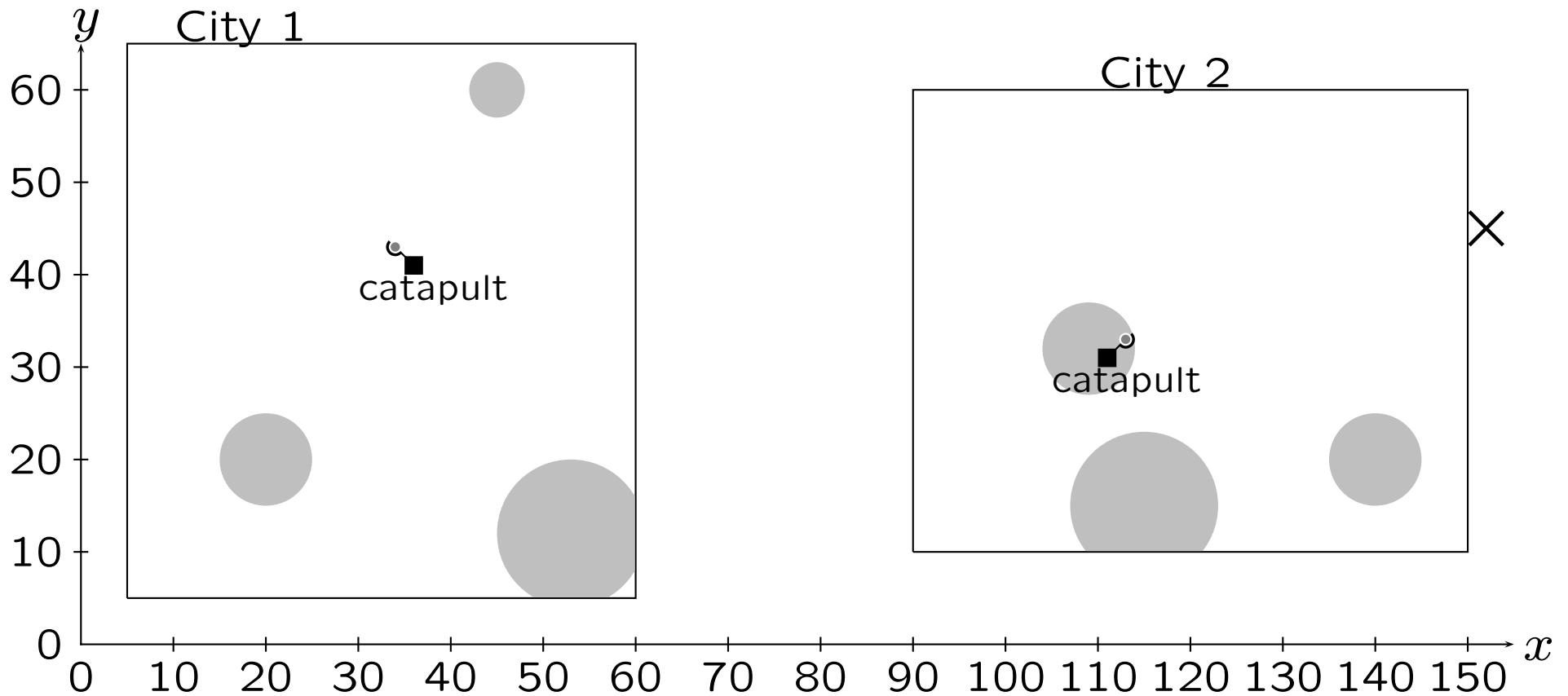
Walled Cities

And again, City 2 returns fire: blast radius 3, target (45, 60):



Walled Cities

And City 1 keeps up the assault, blast radius 5, target (109, 32):



Destroying City 2's catapult, and forcing their surrender.

Walled Cities

After the battle is over, the accountants insist on damage assessment: the area of each city that was damaged has to be computed.

Since some of the barrels might have missed entirely, their damage area is zero.

Since some barrels landed near the wall, their damage area doesn't make a perfect circle.

Figuring out the actual area damaged by the blasts requires doing some math.

Walled Cities

The **distance** between two points (x_1, y_1) and (x_2, y_2) is:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

The **area** of a circle with radius r is:

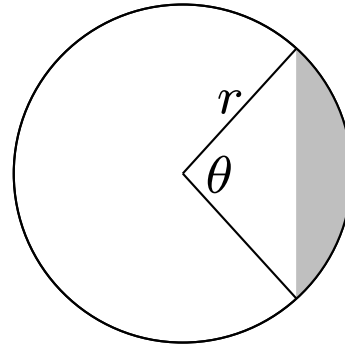
$$A = \pi r^2$$

(For our purposes, $\pi = 3.14159265$.)

Walled Cities

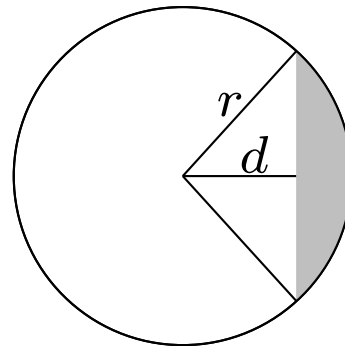
The **area** of a circle segment is

$$A = \frac{1}{2}r^2(\theta - \sin(\theta))$$



The vertex **angle** (labeled θ) of an isosceles triangle is

$$\theta = 2 \arccos\left(\frac{d}{r}\right)$$



θ is measured in radians.

The Challenge

Write a program that reads in information about the two cities and their battle plans, and reports which side's catapult would be destroyed first (if either), and the total area of damage inside each city.