Assignment 4 - Due Monday February 9

(1) **The Pythagorean Theorem**
   (a) If a right triangle has legs of length 1 and 2, what is the length of the hypothenuse?
   Solution: Let c be the length of the hypothenuse. By the Pythagorean Theorem, $c^2 = 1^2 + 2^2 = 1 + 4 = 5$, so $c = \sqrt{5} \approx 2.236067977$.
   (b) If a right triangle has a leg of length 1 and a hypothenuse of length 3, what is the length of the other leg?
   Solution: let x be the length of the other leg. Then $x^2+1 = 9$. so $x^2 = 8$, so $x = \sqrt{8} \approx 2.828427125$.
   (c) Suppose you know the base of a rectangle has a length of 4 cm and a diagonal has a length of 5 cm. Find the area of the rectangle.
   Solution: The rectangle with the diagonal gives us two right triangles. Each of these triangles has a leg of length 4 cm and a hypothenuse of length 5 cm. The Pythagorean Theorem gives us that the length of the other leg is 3 cm. So the rectangle has sides of length 3 cm and 4 cm. This gives us an area of $12\,\text{cm}^2$.

(2) **The Scarecrow** In the 1939 movie *The Wizard of Oz*, when the brainless scarecrow is given the confidence to think by the Wizard (by merely handing him a diploma, by the way), the first words the scarecrow utters are, "The sum of the square roots of any two sides of an isosceles triangle is equal to the square root of the remaining side." An isosceles right triangle is a right triangle having both legs the same length. Suppose that an isosceles right triangle has legs each of length 3. What is the length of the hypotenuse? Is the scarecrow's assertion valid? This question illustrates the true value of a diploma without studying.
   Solution: Let c be the length of the hypothenuse of an isosceles right triangle with legs of length 3. The Pythagorean Theorem says that $c^2 = 9 + 9 = 18$ and therefore $c = \sqrt{18} = 3\sqrt{2}$. However, the scarecrow asserts that $\sqrt{c} = \sqrt{9}+\sqrt{9} = 3+3 = 6$, so $c = 36$. 36 is obviously not equal to $3\sqrt{2}$.

(3) **The Practical Side of Pythagoras** Suppose you are building a patio and you want to make sure that its sides meet at right angles. Give a practical and easy method, using your knowledge

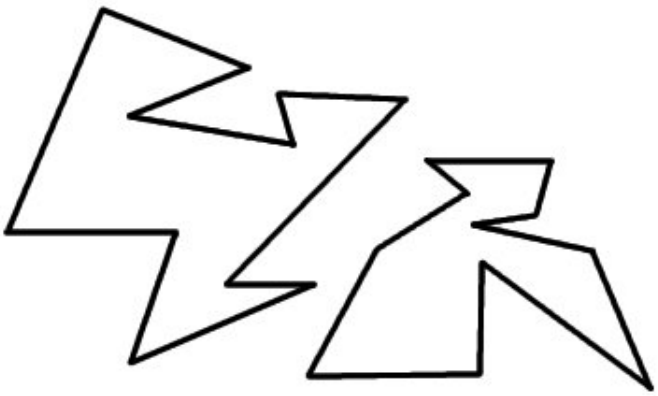
of the Pythagorean Theorem, to check that the angle between two adjacent sides is 90°.

Solution: The idea here is that it is much easier to measure lengths than it is to measure angles. The best thing to do is to start at the corner that you want to make straight and measure 3 units (in a unit that is convenient to you - not too big, it needs to fit; and not too small, it needs to be accurate) along one leg of your angle, and 4 units along the other. Then measure the distance between the two endpoints. This needs to be 5 units. If it is less, make your angle a little bigger; if it is more, make your angle a bit smaller.

(4) **Pythagoras, Plato and Euclid** Write a short essay on the contributions that Pythagoras, Plato, and Euclid made to the development of mathematics and its effects on society. (This should be between a half and a whole page long.)

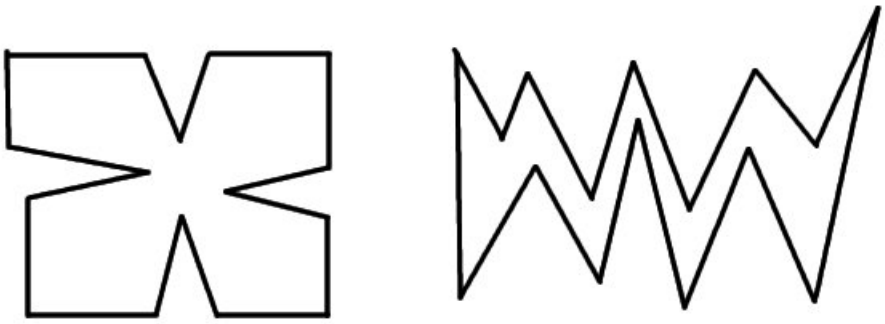
(5) **Create your own gallery** Use the program on the CD-ROM in the back of the book to create at least three interesting galleries and place cameras at as few vertices as possible. Sketch or print out your floors plans with the camera positions.

(6) **Putting cameras in place** For each of the following two floor plans place a minimal number of cameras so that every point of the museum is within view. Also indicate for each camera which part of the museum is visible from that camera.

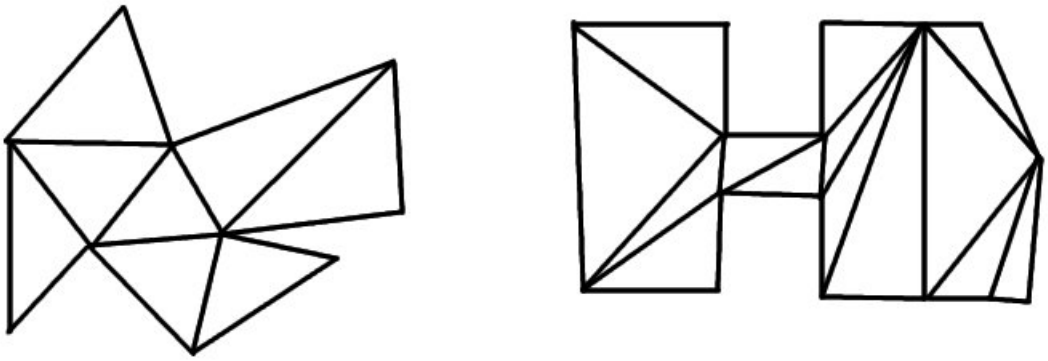


(7) **Triangulating** Triangulate the following floor plans by adding straight segments that do not cross each other, yet span the

insides and extend from one corner to another.



(8) **Tricolour Me** For each of the following triangulations colour the corners red, blue or green in such a way that every triangle has all three colours.



If these were the floor plans of three museums, where would you place the cameras?