Lesson 6 Application: identifying quadrilaterals

# Learning goals

1. Design algorithms and write programs for solving familiar math problems.
2. Reinforce understanding of Grade 10 mathematics by examining it from an algorithmic point of view.

# Agenda

1. Intro to the quadrilateral identification problem
2. Hierarchy of quadrilaterals
3. Criteria for identifying a parallelogram
4. Team Investigation: criteria for identifying the other quadrilaterals
5. Generating test cases with Geometer’s Sketchpad

## Intro to the problem

**Recall Problem #3 from Assignment 2:**

Given 4 ordered pairs, identify the type of quadrilateral that they form.

This is a more complex problem than the other two in the assignment. The way to start is to understand it on paper first. For some problems this might take a day. Or it might take a month.

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| --- | --- |
| **Input**:  4 points (x1, y1), (x2, y2), (x3, y3), (x4, y4) given in segment-order.  (That is, point 1 connects to point 2, and point 2 connects to point 3, but point 1 does not connect to point 3.) | **Output**:  Whether the quadrilateral formed by these 4 points is a square, rectangle, rhombus, trapezoid, parallelogram, kite or just a boring quadrilateral |

## Hierarchy of quadrilaterals

Polygon

Quadrilateral

Trapezoid Kite

Parallelogram

Rectangle Rhombus

Square

## Basic structure of the program

x1 = int(input…))

…

y4 = int(input…))

#Calculations involving the four points, such as lengths and slopes of segments.

#

#

if #SOME CONDITION THAT GUARANTEES WE HAVE A SQUARE

print(“Square”)

elif #SOME CONDITION THAT GUARANTEES THE SHAPE IS A RECTANGLE

print(“Rectangle”)

elif #CONDITION FOR RHOMBUS

print(“Rhombus”)

elif #CONDITION FOR PARALLELOGRAM

print(“Parallelogram”)

elif #CONDITION FOR TRAPEZOID

print(“Trapezoid”)

elif #CONDITION FOR KITE

print(“Kite”)

else:

print(“Boring quadrilateral”)

## Deriving the condition for being a parallelogram

There are several ways we could prove that a shape is a parallelogram

1. Show that both pairs of opposite sides have equal length
2. Show that both pairs of opposite sides are parallel
3. Show that the diagonals bisect each other

Which one of these conditions would be the simplest to verify in a computer program?

Condition 1 seems easy, since we know how to calculate the lengths of line segments.

L12 = length from Point 1 to Point 2 =

L23 = length from Point 2 to Point 3 =

L34 = length from Point 3 to Point 4 =

L41 = length from Point 4 to Point 1 =

How could we code that formula in Python?

L12 = Math.sqrt((x2-x1)\*\*2 + (y2-y1)\*\*2))

We’d put these formulas right after the input statements, but before the if-statement.

Then our if-statement for the parallelogram would look like

elif L12 == L34 and L23 == L41:

print(“Parallelogram”)

How might we calculate a slope if we needed one?

s12 = slope of the line from Point 1 to Point 2 = (y2 – y1)/(x2 – x1) etc.

How might we test whether two lines are parallel? Perpendicular?

Students derive this on their own in groups

## Students form teams of 3. Each team should pick a shape to analyse and determine the condition, the calculations needed, and the elif statement in Python.