1. General Scenario of the Conic Classifier.c

The algorithm in question assists in identifying which conic represents a given equation. It is very useful for educational purposes as it shows the step-by-step calculation leading to the reduced equation of the conic. It will be verified whether it can identify all 9 existing conics, which are: ellipse, hyperbola, parabola, point, intersecting lines, coincident lines, parallel lines, circle, and empty set.

The algorithm initially receives 6 coefficients, which are the coefficients of each term: "a", "b", "c", "d", "e", and "f". If any of these coefficients have roots, they should be written with the number and its root separated by a space. For example, if the value is $10\sqrt{2}$, input should be '10 2', and if it's without a root, input should be '10 1'. After entering all coefficients, the user is asked if the equation is correct, and they should respond with "1" if it is correct and "2" if it is incorrect.

2. Testing Strategies

Functional and mutation tests will be conducted. Various test cases will be developed based on one of the functional test criteria called "partitioning into classes." Test cases will be created to encompass each type of conic in a comprehensive manner, as there are infinite possible test cases for this algorithm. After developing the test cases, mutation testing will be used to determine if these cases are reliable.

3. Test Case Design

0 1 0 1 1 1 4 1 18 1 101 1 1	If any coefficient has a root, enter the number without the root and the root separated by a space (' '). For example, if the value is $10\sqrt{2}$, enter '10 2'. If it's without a root, enter the number and '1' separated by a space (' '). For example, if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e':

	Enter the value of 'f': The equation is: $(0.00)x^2 + (0.00)xy + (1.00)y^2 + (4.00)x + (18.00)y + (101.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (0.00 0.00 2.00) (0.00 1.00 9.00) (2.00 9.00 101.00) The value of '(a-c)-(b^2/4)' is 0 The equation is now: $(1.00)v^2 + (4.00)u + (18.00)v + (101.00) = 0$ The reduced equation is: $w^2 = (-4.00)t$ This equation represents a parabola The coordinates of the focus are (-1.00, 0) The directrix line is x=1.00 The eccentricity of this parabola and all parabolas is 1
25 1 0 1 16 1 -100 1 -64 1 -236 1 1	If any coefficient has a root, enter the number without the root and the root separated by a space (' '). For example, if the value is $10\sqrt{2}$, enter '10 2'. If it's without a root, enter the number and '1' separated by a space (' '). For example, if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e':

	Enter the value of 'f': The equation is: $(25.00)x^2 + (0.00)xy + (16.00)y^2 + (-100.00)x + (-64.00)y + (-236.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (25.00 0.00 -50.00) (0.00 16.00 -32.00) (-50.00 -32.00 -236.00) Our system is: $(25.00)h + (0.00)k + (-50.00) = 0$ $(0.00)h + (16.00)k + (-32.00) = 0$ h is 2.00 and k is 2.00 The center of the conic is: (2.00, 2.00) The equation is now in this form: $(25.00)u^2 + (16.00)v^2 + (-400.00) = 0$ The reduced equation is: $(0.06)s^2 + (0.04)t^2 = 1$ This equation represents an ellipse The major axis measures (10.00) The minor axis measures (8.00) The focal distance measures (6.00) The coordinates of the foci are (0, 3.00) and (0, -3.00) The eccentricity of the ellipse is (0.60) The centrality of the ellipse is (0.80)
5 1 0 1 -4 1	If any coefficient has a root, enter the number without the root and the root separated by a space (' '). For example, if the value is $10\sqrt{2}$, enter '10 2'.

30 1	If it's without a root, enter the number and '1' separated by a space (' ').
8 1	For example, if the value is 10, enter '10 1'.
21 1	Enter the value of 'a':
1	Enter the value of 'b':
	Enter the value of 'c':
	Enter the value of 'd':
	Enter the value of 'e':
	Enter the value of 'f':
	The equation is:
	$(5.00)x^2 + (0.00)xy + (-4.00)y^2 + (30.00)x + (8.00)y + (21.00) = 0$
	Is the equation correct? If yes, press 1. If no, press 2.
	The symmetric matrix is:
	(5.00 0.00 15.00)
	(0.00 -4.00 4.00)
	(15.00 4.00 21.00)
	Our system is:
	$(5.00)h + (0.00)k + (15.00) = 0$
	$(0.00)h + (-4.00)k + (4.00) = 0$
	h is -3.00 and k is 1.00
	The center of the conic is: (-3.00, 1.00)
	The equation is now in this form:
	$(5.00)u^2 + (-4.00)v^2 + (15.00) = 0$
	The reduced equation is:
	$(0.71)s^2 - (1.33)t^2 = 1$
	This equation represents a hyperbola
	The distance between the center and the foci is (2.05)
	The distance between the vertices is (1.22)

	The eccentricity of the hyperbola is (1.53) The distance from the center to the directrix is (2.36) The distance from the directrix to each focus is (1.79)
1 1 -2 1 1 1 0 1 0 1 0 1 1	If any coefficient has a root, enter the number without the root and its root separated by a space (' '). For example, if the value is 10√2, enter '10 2'. If it's without a root, enter the number and '1' separated by a space (' '). For example, if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e': Enter the value of 'f': The equation is: $(1.00)x^2 + (-2.00)xy + (1.00)y^2 + (0.00)x + (0.00)y + (0.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (1.00 -1.00 0.00) (-1.00 1.00 0.00) (0.00 0.00 0.00) As this equation doesn't have linear terms, we can skip the translation process. The value of A is 0.00, and the value of C is 2.00. The value of '(a-c)-(b^2/4)' is 0. $(2.00)t^2 = 0$

	This equation represents two identical lines.
17 2 -84 2 17 2 0 1 0 1 0 1 1	If any coefficient has a root, enter the number without the root and its root separated by a space (' '). For example, if the value is $10\sqrt{2}$, enter '10 2'. If it's without a root, enter the number and '1' separated by a space (' '). For example, if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e': Enter the value of 'f': The equation is: $(24.04)x^2 + (-118.79)xy + (24.04)y^2 + (0.00)x + (0.00)y + (0.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (24.04 -59.40 0.00) (-59.40 24.04 0.00) (0.00 0.00 0.00) As this equation doesn't have linear terms, we can skip the translation process. The value of A is -35.36, and the value of C is 83.44. The reduced equation is: $(-35.36)s^2 + (83.44)t^2 = 0$

	This equation represents two intersecting lines.
15 5 7 1 14 2 -6 2 -7 2 14 1 1	If any coefficient has a root, enter the number without the root and its root separated by a space (' '). For example, if the value is 10√2, enter '10 2'. If it's without a root, enter the number and '1' separated by a space (' '). For example, if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e': Enter the value of 'f': The equation is: $(33.54)x^2 + (7.00)xy + (19.80)y^2 + (-8.49)x + (-9.90)y + (14.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (33.54 3.50 -4.24) (3.50 19.80 -4.95) (-4.24 -4.95 14.00) Our system is: $(33.54)h + (3.50)k + (-4.24) = 0$ $(3.50)h + (19.80)k + (-4.95) = 0$ h is 0.10, and k is 0.23. The center of the conic is: (0.10, 0.23) The equation is now in this form: $(33.54)u^2 + (7.00)uv + (19.80)v^2 + (12.42) = 0$

	The value of A is 34.38, and the value of C is 18.96. The reduced equation is: $(34.38)s^2 + (18.96)t^2 = (-12.42)$ The equation represents an empty set.
457 1 0 1 457 1 0 1 0 1 0 1 1	If any coefficient has a root, enter the number without the root and its root separated by a space (' '). For example, if the value is $10\sqrt{2}$, enter '10 2'. If it's without a root, enter the number and '1' separated by a space (' '). For example, if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e': Enter the value of 'f': The equation is: $(457.00)x^2 + (0.00)xy + (457.00)y^2 + (0.00)x + (0.00)y + (0.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (457.00 0.00 0.00) (0.00 457.00 0.00) (0.00 0.00 0.00) As this equation doesn't have linear terms, we can skip the translation process. The reduced equation is:

	$(457.00)s^2 + (457.00)t^2 = 0$ The equation represents a point.
8 1 0 1 8 1 0 1 0 1 -72 1 1	If any coefficient has a root, enter the number without the root and its root separated by a space (' '). For example, if the value is 10*sqrt(2), enter '10 2'. If it's without a root, enter the number and '1' separated by a space (' '). For example, if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e': Enter the value of 'f': The equation is: $(8.00)x^2 + (0.00)xy + (8.00)y^2 + (0.00)x + (0.00)y + (-72.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (8.00 0.00 0.00) (0.00 8.00 0.00) (0.00 0.00 -72.00) As this equation doesn't have linear terms, we can skip the translation process. The reduced equation is: $(1.00)s^2 + (1.00)t^2 = (9.00)$ The equation represents a circle.
6 1 12 1 6 1	If any coefficient has a root, enter the number without the root and its root separated by a space (' '). Example: if the value is 10*sqrt(2), enter '10 2'.

0 1 -9 1 1	If it's without a root, enter the number and '1' separated by a space (' '). Example: if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e': Enter the value of 'f': The equation is: $(6.00)x^2 + (12.00)xy + (6.00)y^2 + (0.00)x + (0.00)y + (-9.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (6.00 6.00 0.00) (6.00 6.00 0.00) (0.00 0.00 -9.00) As this equation doesn't have linear terms, we can skip the translation process. The value of A is 12.00 and the value of C is -0.00. The value of '(a-c)-(b^2/4)' is 0. $(12.00)s^2 = 9.00$ The equation represents two parallel lines.
1 -1 1 1 0 65165 47 0	If any coefficient has a root, enter the number without the root and its root separated by a space (' '). Example: if the value is 10*sqrt(2), enter '10 2'.

-10 1 2 1 23 1 1	If it's without a root, enter the number and '1' separated by a space (' '). Example: if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e': Enter the value of 'f': The equation is: $(1.00)x^2 + (0.00)xy + (0.00)y^2 + (-10.00)x + (2.00)y + (23.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. The symmetric matrix is: (1.00 0.00 -5.00) (0.00 0.00 1.00) (-5.00 1.00 23.00) The value of '(a-c)-(b²/4)' is 0. The equation now appears as follows: $(1.00)u^2 + (-10.00)u + (2.00)v + (23.00) = 0$ The reduced equation is: $t^2 = (-2.00)w$ This equation represents a parabola. The coordinates of the focus are (0, -0.50). The directrix line is y=0.50. The eccentricity of this and all parabolas is 1.
1 1 0 35	If any coefficient has a root, enter the number without the root and its root separated by a space (' ').

4 1	Example: if the value is 10*sqrt(2), enter '10 2'.
4 1	
8 1	If it's without a root, enter the number and '1' separated by a space (' ').
4 1	Example: if the value is 10, enter '10 1'.
2	
1 1	Enter the value of 'a':
0 351	Enter the value of 'b':
4 1	Enter the value of 'c':
4 1	Enter the value of 'd':
8 1	Enter the value of 'e':
4 1	Enter the value of 'f':
1	
	The equation is:
	$(1.00)x^2 + (0.00)xy + (4.00)y^2 + (4.00)x + (8.00)y + (4.00) = 0$
	Is the equation correct? If yes, press 1. If no, press 2.
	The symmetric matrix is:
	(1.00 0.00 2.00)
	(0.00 4.00 4.00)
	(2.00 4.00 4.00)
	Our system is:
	$(1.00)h + (0.00)k + (2.00) = 0$
	$(0.00)h + (4.00)k + (4.00) = 0$
	h is -2.00 and k is -1.00.
	The center of the conic is: (-2.00, -1.00).
	The equation now appears as follows:
	$(1.00)u^2 + (4.00)v^2 + (-4.00) = 0$
	The reduced equation is:
	$(0.25)s^2 + (1.00)t^2 = 1$
	This equation represents an ellipse.

	The major axis measures (4.00). The minor axis measures (2.00). The focal distance measures (3.46). The coordinates of the foci are (-1.73, 0) and (1.73, 0). The eccentricity of the ellipse is (0.87). The centrality of the ellipse is (0.50).
1 1 1 1 1 1 1 1 1 1 1 1 7 6 1	If any coefficient has a root, enter the number without the root and its root separated by a space (' '). Example: if the value is 10*sqrt(2), enter '10 2'. If it's without a root, enter the number and '1' separated by a space (' '). Example: if the value is 10, enter '10 1'. Enter the value of 'a': Enter the value of 'b': Enter the value of 'c': Enter the value of 'd': Enter the value of 'e': Enter the value of 'f': The equation is: $(1.00)x^2 + (1.00)xy + (1.00)y^2 + (1.00)x + (1.00)y + (1.00) = 0$ Is the equation correct? If yes, press 1. If no, press 2. This option is not valid, please enter again. This option is not valid, please enter again. The symmetric matrix is: (1.00 0.50 0.50) (0.50 1.00 0.50) (0.50 0.50 1.00) Our system is: (1.00)h + (0.50)k + (0.50) = 0

	(0.50)h + (1.00)k + (0.50) = 0 h is -0.33 and k is -0.33. The center of the conic is: (-0.33, -0.33). The equation now appears as follows: (1.00)u^2 + (1.00)uv + (1.00)v^2 + (0.67) = 0 The value of A is 1.50 and the value of C is 0.50. The reduced equation is: (1.50)s^2 + (0.50)t^2 = (-0.67) This equation represents an empty set.

4. Execution

After the tests, some equivalent mutants were found, such as when entering "0 X" (X representing any non-negative number) or "Y 0" (Y representing any number) for a coefficient, the coefficient value for the calculation will always be zero. After selecting the "best" test cases, no errors were identified in the code.

5. Analysis of Results and Next Steps

Up to this point, with the tests conducted, the algorithm appears to fulfill its intended purpose. If more time were available, I would attempt to use tools like Selenium and Proteum to optimize this testing process.