Distance Calculator

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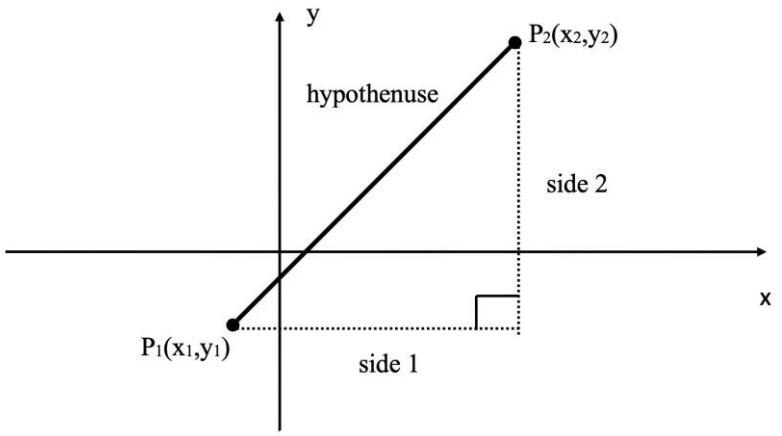
ENGR-AD 1000, Fall 2022

STEP 1: Problem Identification and Statement

The problem statement will be to *compute the distance between two points on a plane.*

STEP 2: Gathering of Information and Input and Output Description

In order to compute the distance between the two points, we can use the Pythagorean Theorem todetermine the hypotenuse of the associated right-angle triangle, as illustrated below:



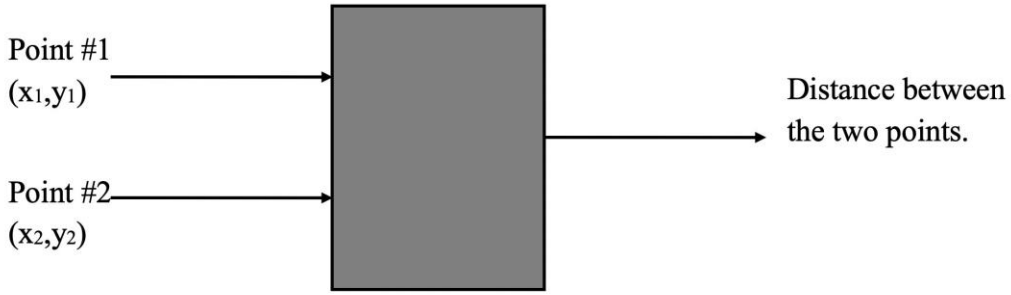
$$\text{Hypothenuse} = \sqrt{(side\,1)^2 + (side\,2)^2} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

The input/output information can be presented as follows:

The <u>inputs</u> are: point 1 (x_1,y_1), point 2 (x_2, y_2).

The <u>outputs</u> are: the distance between the two points.

Alternatively, the inputs and outputs could be represented using a black-box diagram:



STEP 3: Test Cases and Algorithm Design

A) Test Cases

The Pythagorean Theorem is used to compute the distance between 2 points as shown in the figure below. The hypotenuse of the right-angle triangle defines the distance between the two points. The lengths of the other sides of the right-angle triangle are easily computed using the coordinates of each point. The figure also includes the computation of the two points P1 = (-1,-3), P2 = (4,6) which is approximately 10.3. These input/output values serve as one test case.

The following table provides a set of test cases that can be used to test the algorithm and software. It is wise to verify the program for input coordinates that are a mixture of both positive and negative values, including all possible combinations (note that the set is not complete).

Test Case	***P_1***	***P_2***	***Hypotenuse***
1	*(-1,-3)*	*(4,6)*	*10.3*
2	*(0,0)*	*(3,4)*	*5.0*
3	*(1,1)*	*(1,1)*	*0*
4	*(-1,-1)*	*(1,1)*	*2.8*

B) Algorithm (pseudocode)

The algorithm can be expressed as:

Get values of x1 and y1

Assign values to x1 and y1

Get values of x2 and y2

Assign values to x2 and y2

Assign x2-x1 to length1

Assign y2-y1 to length2

Assign $\sqrt{length1^2 + length2^2}$ *to distance*

Print distance

STEP 4: Implementation.

```
/* Name: Damiane Kapanadze, Student Number: dk4770   */

/* Date: 08/09/2023 */

/* Program: distance.cpp   */

/* Description: This program computes the distance between two points.   */


#include <iostream>
#include <cmath>

using namespace std;

int main()
{
	/* Declare and initialize the variables */
	double x1, y1, x2, y2, length1, length2, distance;

	// Get the values of the points form the user
	cout << "Enter the x and y coordinates for the first point" << endl;
	cin >> x1 >> y1;
	cout << "Enter the x and y coordinates for the second point" << endl;
	cin >> x2 >> y2;

	/* Compute the sides of a right triangle */
	length1 = x2 - x1;
	length2 = y2 - y1;

	/* Compute the distance between the two points. */
	distance = sqrt(length1*length1 + length2*length2);

	/* Print the distance */
	cout << "The distance between the two points is " << distance << endl;
	system("pause");
	return (0);
}
 /*--------------------------------End--------------------------------*/
```

STEP 5: Tests and Verification (and Debugging)

Test Case 1: For P1 = (-1,-3) and P2 = (4,6), the output is:

```
Enter the x and y coordinates for the first point
-1 -3
Enter the x and y coordinates for the second point
4 6
The distance between the two points is 10.2956
Press any key to continue . . .
```

which is in agreement with the test case expected output.

Test Case 2: For P1 = (0,0) and P2 = (3,4), the output is:

```
Enter the x and y coordinates for the first point
0 0
Enter the x and y coordinates for the second point
3 4
The distance between the two points is 5
Press any key to continue . . .
```

which is in agreement with the test case expected output.

Test Case 3: For P1 = (1,1) and P2 = (1,1), the output is:

```
Enter the x and y coordinates for the first point
1 1
Enter the x and y coordinates for the second point
1 1
The distance between the two points is 0
Press any key to continue . . .
```

which is in agreement with the test case expected output.

Test Case 4: For P1 = (-1,-1) and P2 = (1,1), the output is:

```
Enter the x and y coordinates for the first point
-1 -1
Enter the x and y coordinates for the second point
1
1
The distance between the two points is 2.82843
Press any key to continue . . .
```

which is in agreement with the test case expected output.

We conclude that the program is functioning correctly since all test cases are verified.

The User's Guide

- *To execute the program, compile and run the code found in the file named distance.cpp*
- *The user will be prompted to enter the 2 points' coordinates;*
- *The output displayed on the screen is the distance between the two points.*