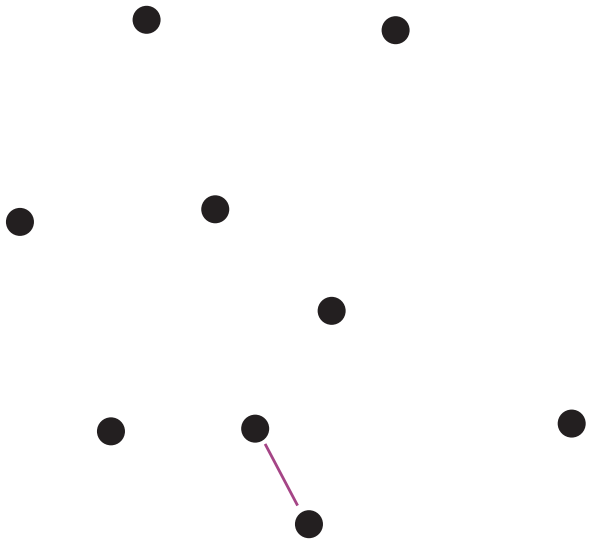
Closest Pair of Points

Quiz
Describe a **brute-force approach** for finding the closest pair of points.



Closest Pair of Points
Brute Force Algorithm

Quiz
Compare this brute force solution to selection sort?

Quiz
What exactly is the output? (Give examples.)

Algorithm *BruteForceClosestPair*
Input Set of $n \geq 2$ points $P_1 = (x_1, y_1), \ldots, P_n = (x_n, y_n)$
Output Indices of 2 points with smallest distance in set

```
1: dmin ← ∞
2: for i ← 1 to n − 1 do
3:     for j ← i + 1 to n do
4:         d ← sqrt((x_i − x_j)^2 + (y_i − y_j)^2)
5:         if d < dmin then
6:             dmin ← d; index1 ← i; index2 ← j
7: return index1, index2
```

	1	2	3	4
1	×	×	×	×
2	×	×	×	×
3	×	×	×	×
4	×	×	×	×

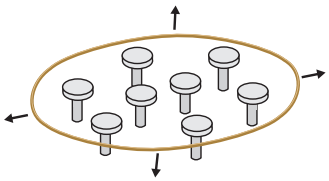
Note loop indices generated similar to selection sort.

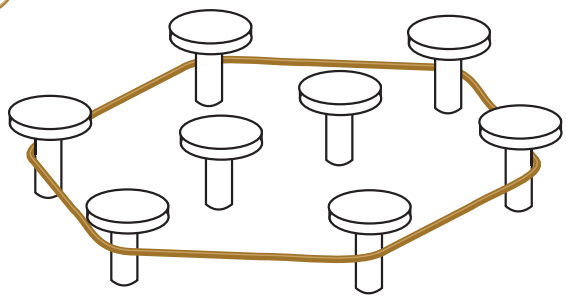
Quiz
How can the run-time be improved? Hint: study the pseudocode.

Performance?

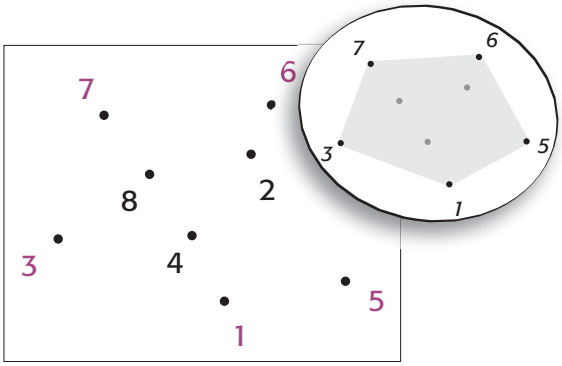
Convex Hull Problem

➪ Computational geometry





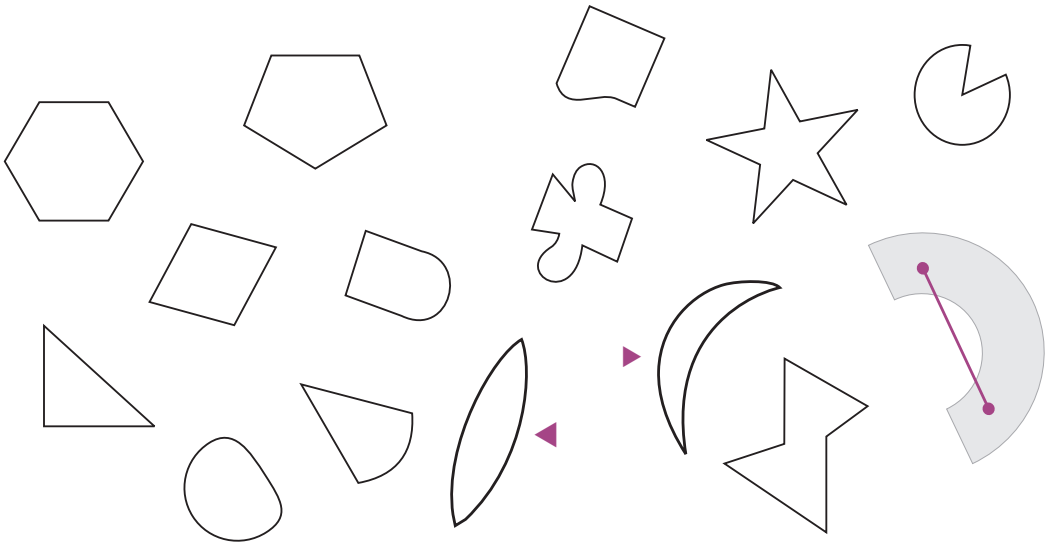
Quiz
What can generally be observed about the enclosing shape in each example?



https://learnopencv.com

Convex Set of Points

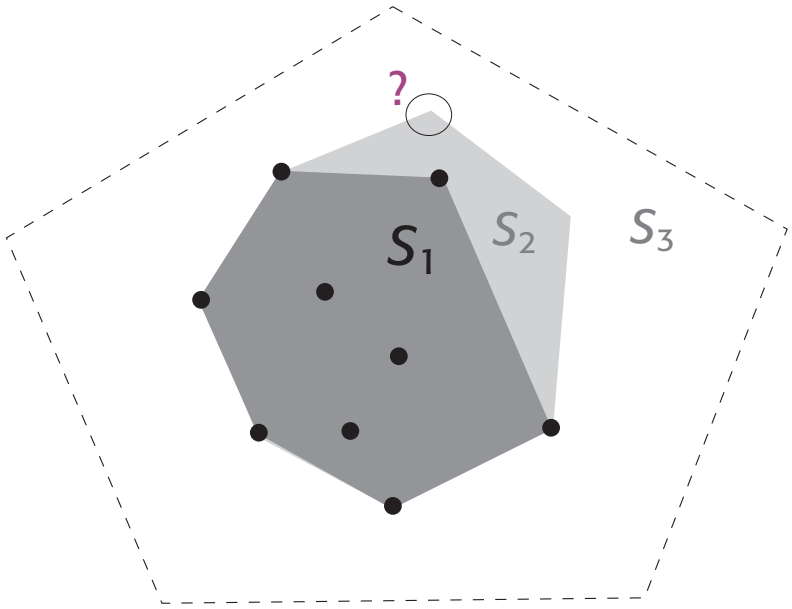
➪ Convex set



Quiz
Are points P_1 ... P_8 from previous slide a convex set?

Convex Set of Points
The Convex Hull

- Convex polygon
- Convex hull



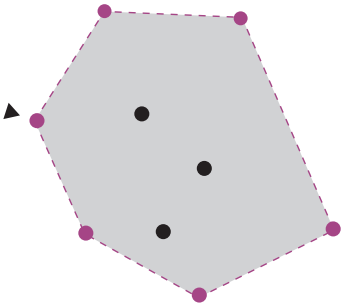
Quiz
Which of the convex sets S_1,S_2,S_3 is the **convex hull** for the shown set of points?

The Convex Hull Theorem

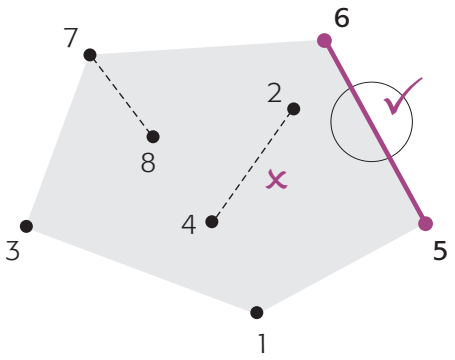
➪ Polygon vertices

The convex hull of any set S of $n > 2$ points (not all on the same line) is a *convex polygon* with the vertices at some of the points of S.

Note S_2 (previous slide) is convex but some of its vertices are not in S.



Brute Force Convex Hull Algorithm Idea



- ➪ **Extreme point**
- ➪ **Line segment**

Exercise
Write the input and output parts of a pseudocode.

- ➪ **Observation: line segments**
- ➪ **Brute force approach**
- ➪ **Steps outline, efficiency**
- ➪ **Line segment test (later)**

May be performed without a formula in a pen-paper application.

Brute Force Convex Hull Programming Challenge

📖 **Exercise** 3.3-11
Hint: use pseudocode from *closestPair* as starting point.

➪ **Write proper pseudocode**

➪ **Code your solution**

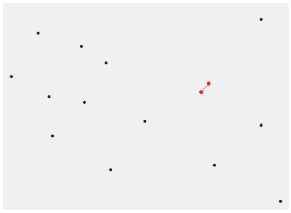
You can visually see if your solution is correct.

➪ **Use JSDraw to draw c. hull**

There is a code demo in the assignment support page to help with the code.

➪ **Test instance (homepage)**

hashimi.ws/cs223/assignment.php



Brute Force Convex Hull
Line Segment Test

Exercise
Write a pseudocode for the brute force algorithm described in the lecture. Hint: use the closest pair pseudocode as starting point.