Robustness issues

[D]

Predicates

Exact computation paradigm

A triangulation is

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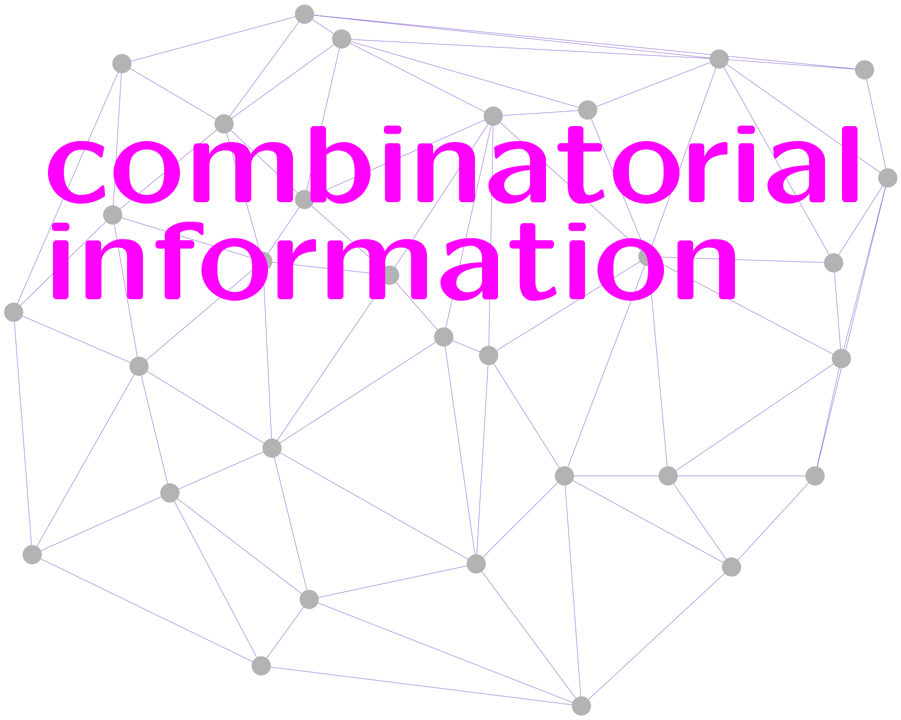
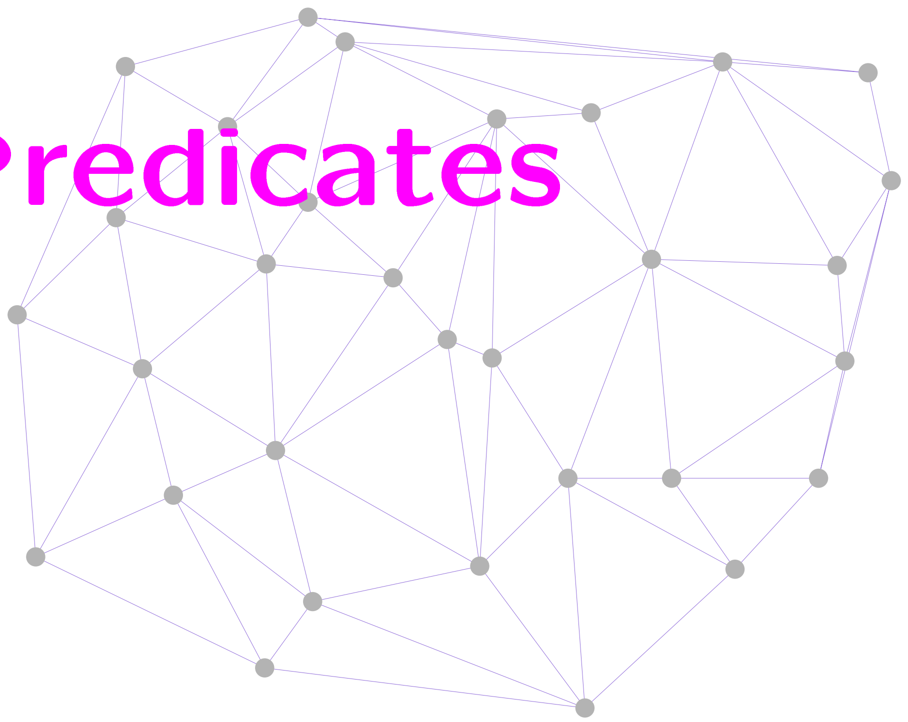


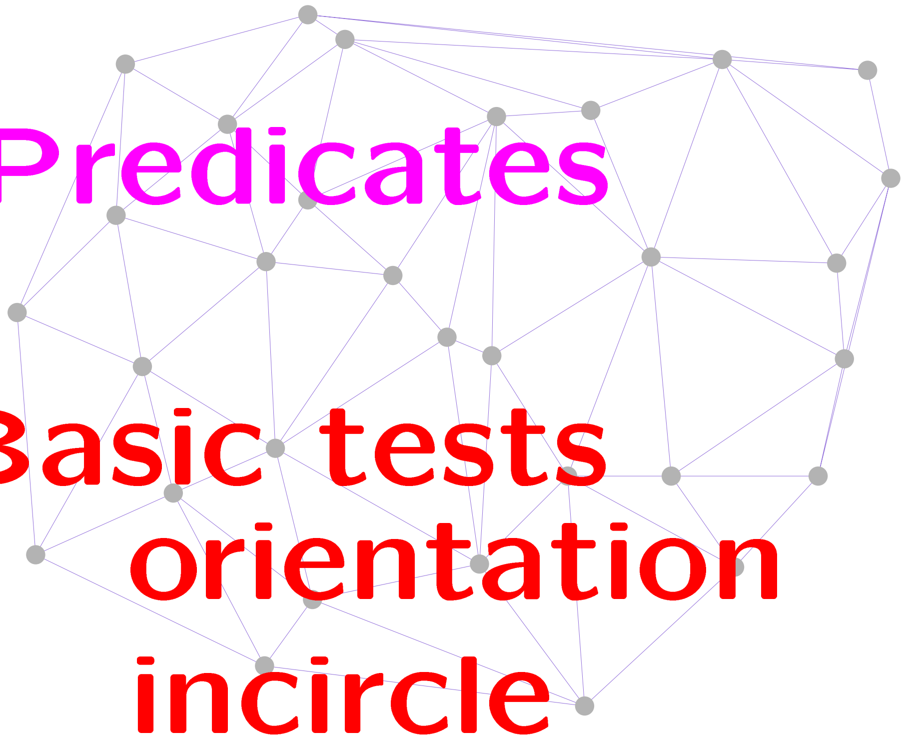
a combinatorial information

Algorithms uses



Predicates

Algorithms uses



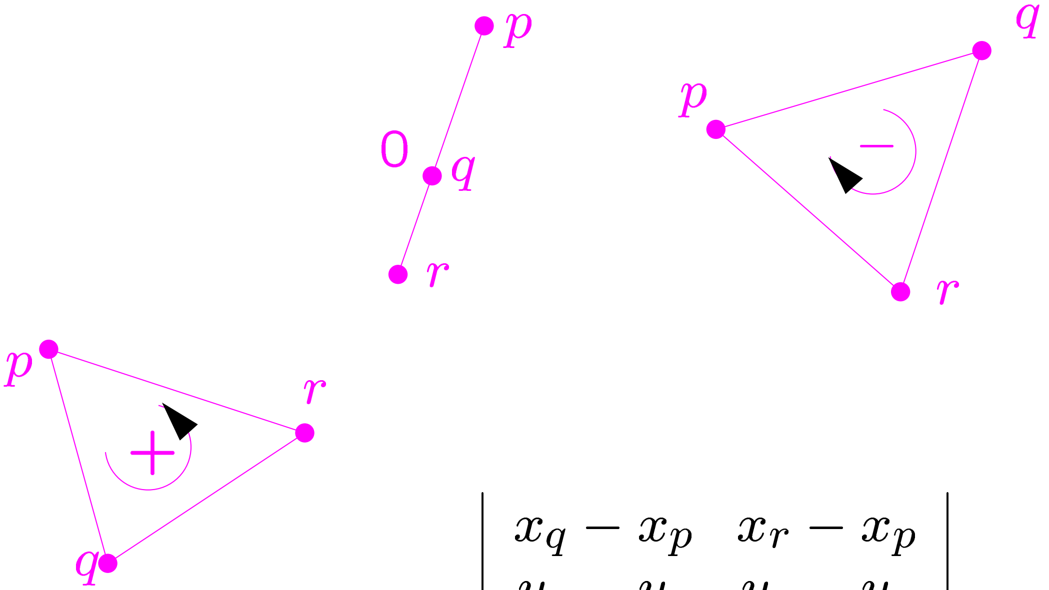
Predicates

Basic tests

orientation

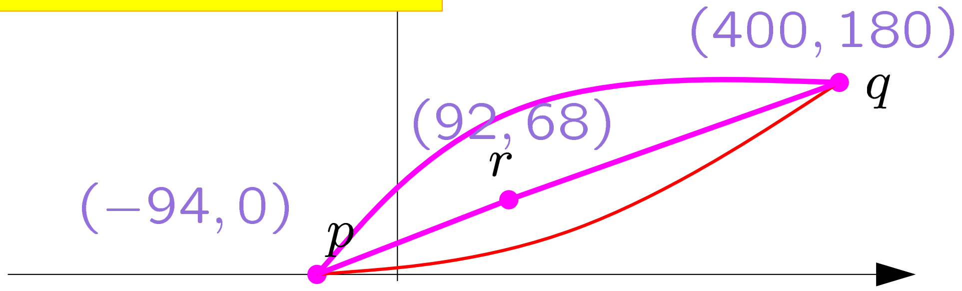
incircle

Orientation test



$$\begin{vmatrix} x_q - x_p & x_r - x_p \\ y_q - y_p & y_r - y_p \end{vmatrix}$$

2 decimal digits



exact $= 112$

$(400 + 94) * 68 - (92 + 94) * 180 =$

$494 * 68 - 186 * 180$

$490 * 68 - 190 * 180$

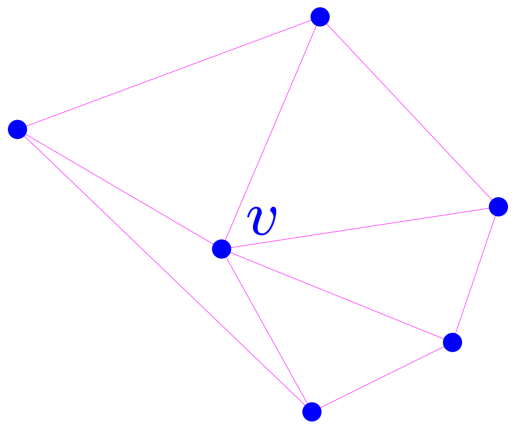
$= 33320 - 34200$

$= 33000 - 34000$

$= -1000$

Floating point

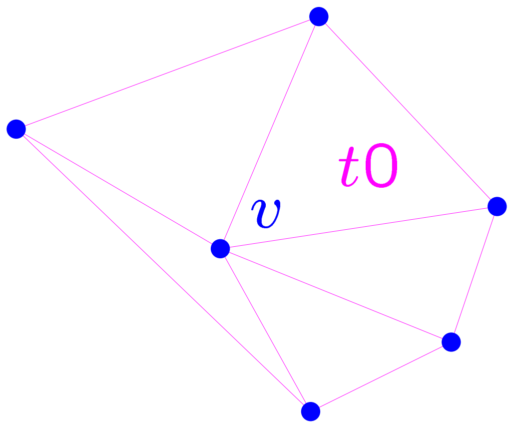
Rounded arithmetc → bugs



Example :

turn ccw
around v

Rounded arithmetc → bugs

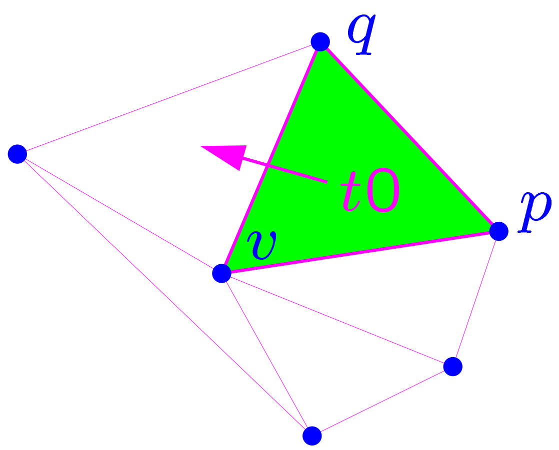


Example :

turn ccw
around v

do
  let vpq ccw triangle
  go to neighbor through qv
while triangle $\neq t0$

Rounded arithmetc → bugs



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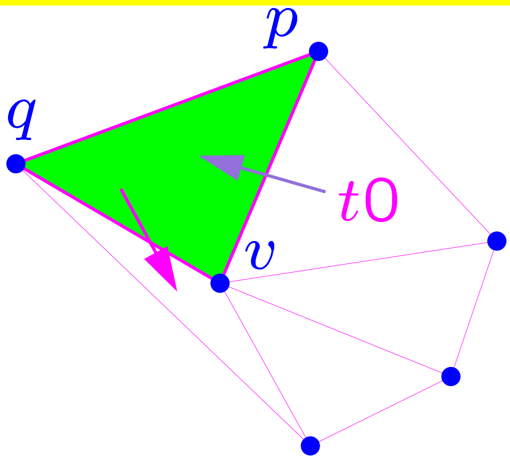

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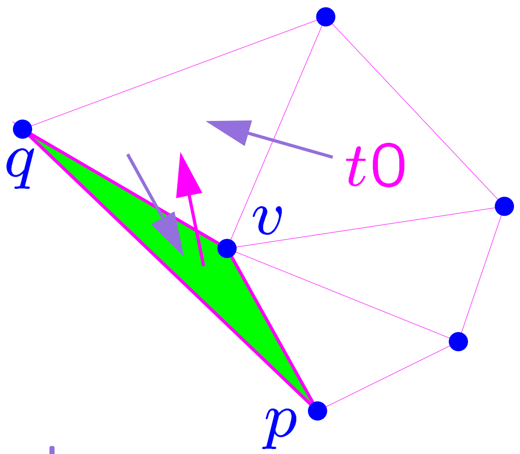

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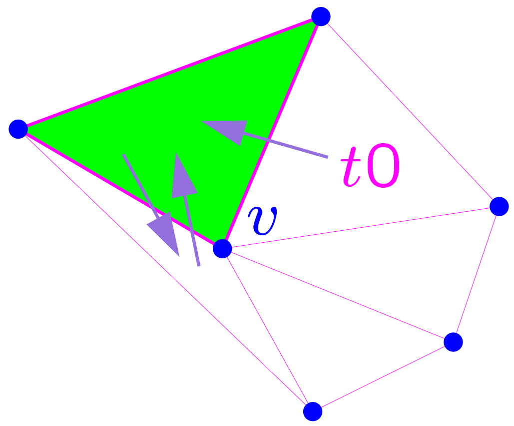


Example :

turn ccw
around v

do
  let vpq ccw triangle
  go to neighbor through qv
while triangle $\neq t0$

Infinite loop

Exact computation paradigm

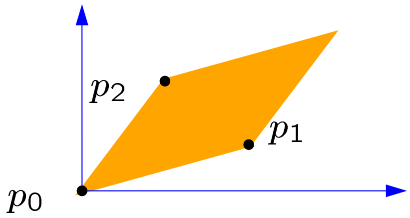
Answer predicates exactly

Predicate $= sign(P(x))$

P polynomial
small degree P

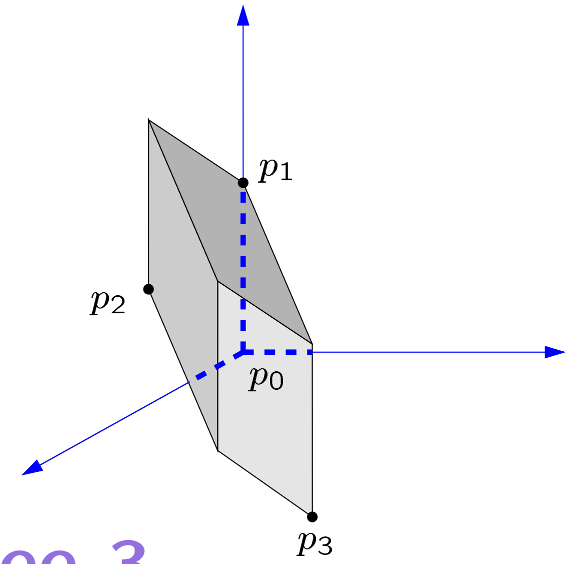
Filters
Perturbation scheme

$P(x)$	Orientation



Area

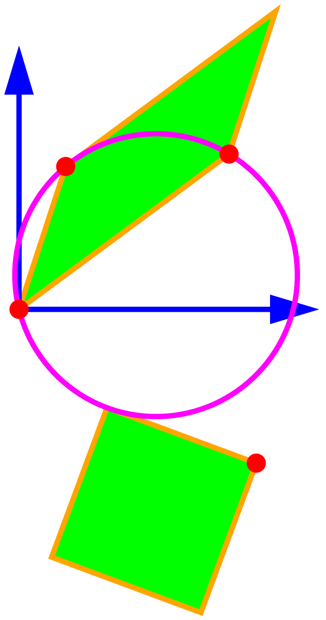
degree 2



Volume

degree 3

$P(x)$	Incircle



degree 4

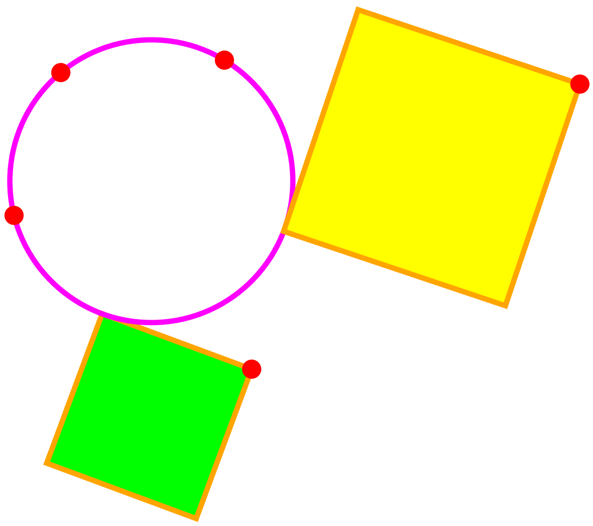
Volume $\times$ power

Insphere

degree 5

$P(x)$	Power comparison

degree 6



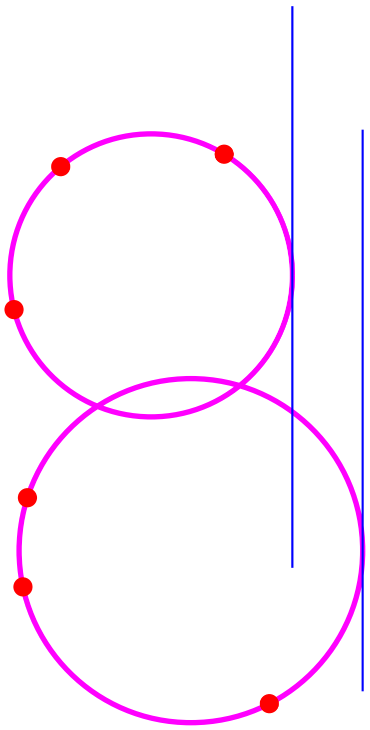
Deletion Algorithm

in 3D

degree 8

$P(x)$	x order

degree 24



Sweep line Algorithm