



# Workshop B2: efficient computation of Gröbner bases

*(part2)*

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CALFOR – LIP6

SALSA = **S**olvers for **A**lgebraic **S**ystems and **A**pplications

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# Polynomial System Solving

Ideas:

- Efficient algorithms for computing Gröbner bases (F4, F5, ...)
- Gröbner bases: intermediate objects (RUR, isolate real roots)

Please submit your problems !



# Polynomial System Solving

Ideas:

- Solving parametric systems: use the previous steps
- Applications (Crypto/Signal Theory): huge algebraic systems ( $> 100$  variables).
- Software: do it yourself (several sessions with Maple) !

Please submit your problems !



# Problem 1

Question : find all the real roots and

```
vars [u, v, w, a, b, c]
```

```
list
```

```
[u^2+v^2+w^2-1,  
536870912*w^2*b^2+536870912*w^2*c^2+2]
```



# Problem 2

Origin of the problem: Cuspidal Robots  
(Wenger/Rouillier) [Robotic] Level: Middle  
Cuspidal Robots : Resolution using Discriminant  
varieties

Equations : 3 equations in 3 variables  $X, z, \rho$   
depending on 3 parameters  $d_4, d_3, r_2$ .

Inequalities :  $\rho \geq 0$   $d_4 > 0$ ,  $d_3 > 0$ ,  $r_2 > 0$

Hypothesis : none

Informations from roboticians : dimension 0 for  
almost all the parameter's values

Question : number of real solutions of the  
following system wrt the parameter's values

(cuspidal robots are characterized by parameter's