

# LinearSolver

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This file is part of CasADi.

CasADi -- A symbolic framework for dynamic optimization.  
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## 1 Linear solvers

We demonstrate solving a dense system  $Ax=b$  by using different linear solvers.

```
[1]: from casadi import *  
    from numpy import *  
    import time
```

```
[2]: n=100
```

We generate  $A \in \mathbf{R}^{n \times n}$ ,  $x \in \mathbf{R}^n$  with  $n = 100$

```
[3]: A=DM([[cos(i*j))-sin(i) for i in range(n)] for j in range(n)])  
    x=DM([tan(i) for i in range(n)])
```

We generate the b vector:

```
[4]: b= mtimes(A,x)
```

Commented out pending completion #1615

## 2 We demonstrate the LinearSolver API with CSparse:

```
s = LinearSolver("s", "csparse", A.sparsity())
```

## 3 Give it the matrix A

```
s.setInput(A,"A") # Do the LU factorization s.prepare()
```

## 4 Give it the matrix b

```
s.setInput(b,"B")
```

## 5 And we are off to find x...

```
s.solve()
```

```
x_ = s.getOutput("X")
```

## 6 By looking at the residuals between the x we knew in advance and the computed x, we see that the CSparse solver works

```
print "Sum of residuals = %.2e" % norm_1(x-x_)
```

## 7 Comparison of different linear solvers

## 8 =====

```
for solver in ("lapacklu","lapackqr","csparse"): s = LinearSolver("s", solver, A.sparsity()) # We create a solver
```

```
s.setInput(A,"A") # Give it the matrix A
```

```
t0 = time.time() for i in range(100): s.prepare() # Do the LU factorization pt = (time.time()-t0)/100
```

```
s.setInput(b,"B") # Give it the matrix b
```

```
t0 = time.time() for i in range(100): s.solve() st = (time.time()-t0)/100
```

```
x_ = s.getOutput("X")
```

```
print "" print solver print "=" * 10 print "Sum of residuals = %.2e" % norm_1(x-x_) print "Preparation time = %0.2f ms" % (pt*1000) print "Solve time = %0.2f ms" % (st*1000) assert(norm_1(x-x_)<1e-9)
```

## 9 Note that these