

QUADRATIC PROGRAMMING IN MATLAB

quadprog

$$\min_x \left\{ \frac{1}{2} x' H x + f' x \right\}$$

$$Ax \leq b$$

$$A_{eq} x = b_{eq}$$

$$lb \leq x \leq ub$$

Syntax:

`x = quadprog(H,f,A,b)`

`x = quadprog(H,f,A,b,Aeq,beq)`

`x = quadprog(H,f,A,b,Aeq,beq,lb,ub)`

`x = quadprog(H,f,A,b,Aeq,beq,lb,ub,x0)`

`x = quadprog(H,f,A,b,Aeq,beq,lb,ub,x0,options)`

`[x,fval] = quadprog(...)`

`[x,fval,exitflag] = quadprog(...)`

`[x,fval,exitflag,output] = quadprog(...)`

`[x,fval,exitflag,output,lambda] = quadprog(...)`

Small-scale problem

$$\min_x \left\{ \frac{1}{2} x' H x + d' x \right\},$$

$$Ax \leq b, 0 \leq x$$

$$H = \begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}, d = \begin{bmatrix} -2 \\ -6 \end{bmatrix},$$

$$A = \begin{bmatrix} 1 & 1 \\ -1 & 2 \\ 2 & 1 \end{bmatrix}, b = \begin{bmatrix} 2 \\ 2 \\ 3 \end{bmatrix}$$

```
H = [1 -1; -1 2]
```

```
d = [-2; -6]
```

```
A = [1 1; -1 2; 2 1]
```

```
b = [2; 2; 3]
```

```
lb = zeros(2,1)
```

```
[x,fval,exitflag,output,lambda] = ...  
quadprog(H,d,A,b,[],[],lb)
```

```
x = ( 0.6667, 1.3333)
```

```
fval = -8.2222
```

```
output =
```

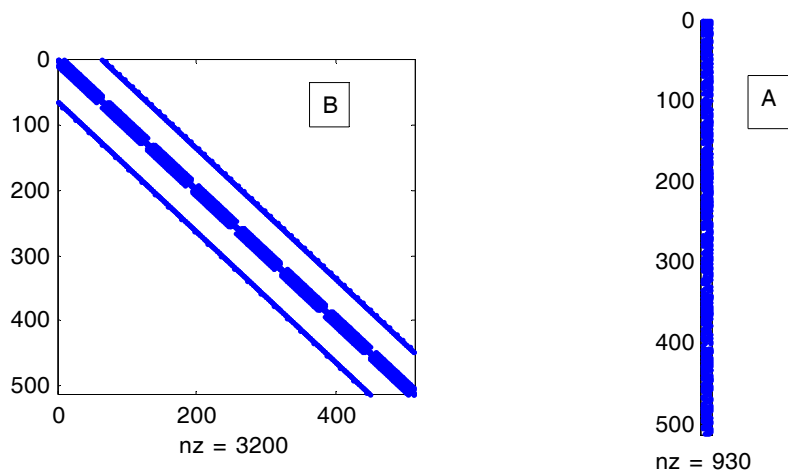
```
    iterations:    3
```

```
    algorithm: 'medium-scale: active-set'
```

LARGE SCALE PROBLEM

Dense, but structured Hessian:

$$H = B + AA'$$



We must avoid forming H !

Special software for forming $H*W$:

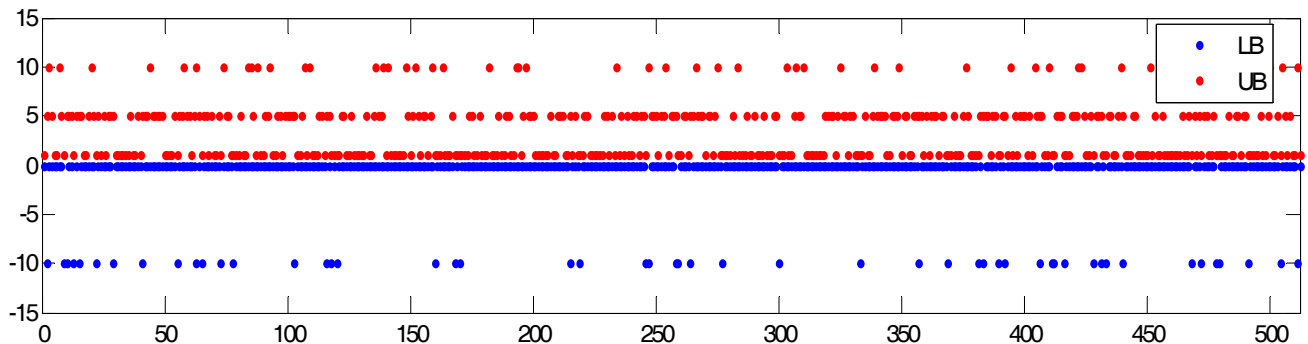
$$W = \text{qpbox4mult}(H, Y)$$

(This is simple: $W = B*Y + A*(A'*Y)$;)

Problem entered by

load qpbox4.mat

A	512x10	11204	double array (sparse)
B	512x512	40452	double array (sparse)
d	512x1	4096	double array
lb	512x1	4096	double array
ub	512x1	4096	double array
xstart	512x1	4096	double array



Optimization terminated: relative function value changing by less than $\sqrt{\text{OPTIONS.TolFun}}$, no negative curvature detected in current trust region model and the rate of progress (change in $f(x)$) is slow.

fval = -1.0538e+003

exitflag = 3

output =

iterations: 18

algorithm: 'large-scale: reflective trust-region'

firstorderopt: 0.0043

cgiterations: 30

x =

