```
> restart;
  with( linalg ):
```

Maple Worksheet to Illustrate the Method of Steepest Descent

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WWS URL: http://www.math.sc.edu/~meade/math524/worksheets/steep.ms

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Enter the function to be minimized, f, and its gradient, df.

```
> f := X -> X[1]^2 + a^2 * X[2]^2;
> df := X -> [ 2*X[1], 2*a^2*X[2] ];
>
```

Enter the initial vector, x.0, number of iterates, N, and value of the parameter, a:

```
> x.0 := [a/sqrt(1+a^2), 1/a/sqrt(1+a^2)];
> N := 5;
> a := 20;
>
```

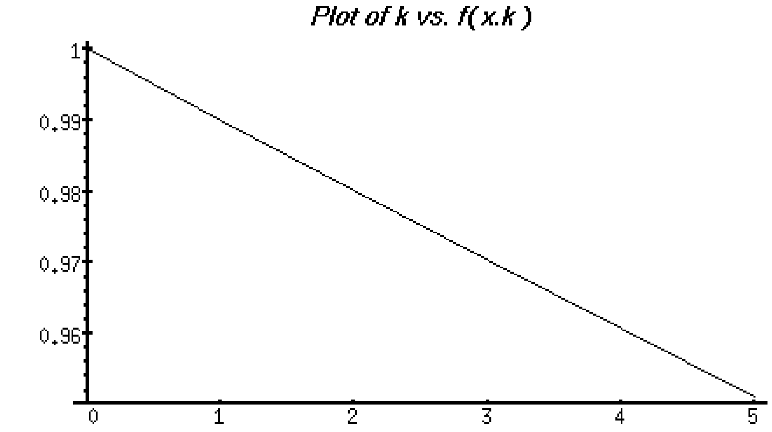
Compute the next N iterates by steepest descent.

```
> for k from 0 to N-1 do
    y.k := f(x.k);
    v.k := df(x.k);
    phi.k := f( evalm( x.k - t*v.k ) );
    phiP.k := -dotprod( df( evalm( x.k - t*v.k ) ), v.k );
    t.k := solve( phiP.k=0, t );
    x.(k+1) := convert( evalm( x.k - t.k*df(x.k) ), list );
  od:
```

and display the results.

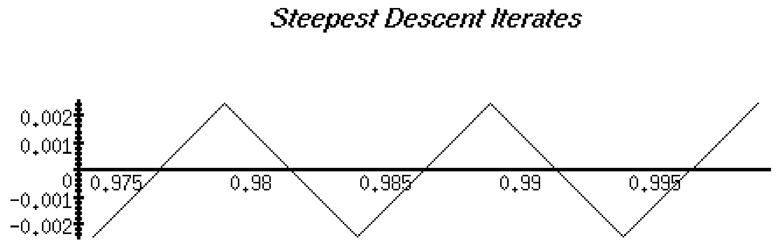
What do we expect to see in the list/plot of function values?

```
> vals := seq( evalf( [k, f(x.k) ]), k=0..N );
  plot( [ vals ], title=‘Plot of k vs. f( x.k )‘ );
```



What do we expect to see in the list/plot of descent directions?

```
> pts := seq( evalf( x.k ), k=0..N );
  plot( [ pts ], title=‘Steepest Descent Iterates‘ );
```



Modifications and Explorations:

1. Change the initial guess. Can you find an initial guess for which the convergence is improved?
2. Change the value of a (both smaller and larger than 20). How does this effect the convergence?

END OF WORKSHEET

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