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> # Prof. Dr. Serkan Dağ
> # ME 310 Numerical Methods
> # File 7.1
> # Golden-section search for maximum of a function

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> restart :
> Digits := 16 :

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> # Define the equation

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> f := 2·sin(x) -  $\frac{x^2}{10}$ ;

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$$f := 2 \sin(x) - \frac{1}{10} x^2$$

(1)

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> # Specify xl and xu

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> xl := 0.0 :
> xu := 4.0 :

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> # Define maximum number of iterations

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> kmax := 50 :

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> # Number of significant figures and error criterion

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> n := 4 :
> epss :=  $0.5 \cdot 10^{2-n}$ ;

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$$epss := 0.00500000000000000000$$

(2)

```

> # Calculate the golden-ratio

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> R := evalf(  $\frac{(\text{sqrt}(5) - 1)}{2}$  );

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$$R := 0.6180339887498950$$

(3)

```

> # Initialize internal points and function values

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> l0 := xu - xl :
> d := R·l0 :
> x1 := xl + d :
> x2 := xu - d :
> fx1 := evalf(subs(x=x1,f)) :
> fx2 := evalf(subs(x=x2,f)) :

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> # Initiate the search

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> for i from 1 by 1 to kmax
>   while true do

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>     if fx1 > fx2 then

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>       xopt := x1 :

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>       epsa := abs(  $\frac{(xu - xl)}{xopt}$  ) · (1 - R) · 100 :

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>       if epsa < epss then

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>         printf("n %5.1f %9.6f %9.6f %9.6f %9.6f %9.6f %9.6f", i, xl, xu, x1, x2, fx1, fx2) :

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>         break:

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>       end if:

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>     printf("\n %5.1f %9.6f %9.6f %9.6f %9.6f %9.6f %9.6f", i, xl, xu, x1, x2, fx1, fx2) :

```

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>     xl := x2 :

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l0 := xu - xl :
d := R·l0 :
x2 := x1 :
x1 := xl + d :
fx2 := fx1 :
fx1 := evalf(subs(x=x1,f) ) :

```

elif $fx2 > fx1$ **then**

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xopt := x2 :
epsa := abs( (xu - xl) / xopt ) · (1 - R) · 100 :

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if $epsa < epss$ **then**

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printf("\n %5.1f %9.6f %9.6f %9.6f %9.6f %9.6f", i, xl, xu, x1, x2, fx1, fx2) :
break:
end if:

```

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printf("\n %5.1f %9.6f %9.6f %9.6f %9.6f %9.6f", i, xl, xu, x1, x2, fx1, fx2) :

```

```

xu := x1 :
l0 := xu - xl :
d := R·l0 :
x1 := x2 :
x2 := xu - d :
fx1 := fx2 :
fx2 := evalf(subs(x=x2,f) ) :

```

end if:

end do:

1.0	0.000000	4.000000	2.472136	1.527864	0.629974	1.764720
2.0	0.000000	2.472136	1.527864	0.944272	1.764720	1.530976
3.0	0.944272	2.472136	1.888544	1.527864	1.543223	1.764720
4.0	0.944272	1.888544	1.527864	1.304952	1.764720	1.759452
5.0	1.304952	1.888544	1.665631	1.527864	1.713580	1.764720
6.0	1.304952	1.665631	1.527864	1.442719	1.764720	1.775475
7.0	1.304952	1.527864	1.442719	1.390097	1.775475	1.774200
8.0	1.390097	1.527864	1.475242	1.442719	1.773242	1.775475
9.0	1.390097	1.475242	1.442719	1.422619	1.775475	1.775699
10.0	1.390097	1.442719	1.422619	1.410197	1.775699	1.775398
11.0	1.410197	1.442719	1.430297	1.422619	1.775717	1.775699
12.0	1.422619	1.442719	1.435042	1.430297	1.775665	1.775717
13.0	1.422619	1.435042	1.430297	1.427364	1.775717	1.775726
14.0	1.422619	1.430297	1.427364	1.425552	1.775726	1.775721
15.0	1.425552	1.430297	1.428484	1.427364	1.775725	1.775726
16.0	1.425552	1.428484	1.427364	1.426672	1.775726	1.775725
17.0	1.426672	1.428484	1.427792	1.427364	1.775726	1.775726

18.0	1.426672	1.427792	1.427364	1.427100	1.775726	1.775725
19.0	1.427100	1.427792	1.427527	1.427364	1.775726	1.775726
20.0	1.427364	1.427792	1.427628	1.427527	1.775726	1.775726
21.0	1.427364	1.427628	1.427527	1.427465	1.775726	1.775726
22.0	1.427465	1.427628	1.427566	1.427527	1.775726	1.775726