**נספח**

התוכנית הבאה מחשבת את השורש הריבועי של מספר נתון בדיוק רצוי (של הריבוע) ןמשווה לפונקצית הספרייה.

/\* sqrt1.c - solve with fixed points \*/

#include <stdio.h>

#include <math.h>

long double my\_abs(long double x)

{

 if (x < 0)

 return -x;

 else

 return x;

} /\* my\_abs \*/

long double my\_sqrt(long double x0, long double eps)

{

 long double xn;

 int flag = 1;

 if ( x0 == 1.0)

 return 1.0;

 if ( x0 == 0.0)

 return 0.0;

 printf("x0 = %Lf\n", x0);

 xn = x0;

 do {

 printf("xn = %22.18Lf\n", xn);

 xn = (xn + x0/xn)/2.0;

 } while( my\_abs(xn\*xn - x0) > eps);

 if (flag == 1)

 return xn;

 else

 return 1.0/xn;

 return xn;

} /\* my\_sqrt \*/

int main()

{

 long double x0 = 10.0;

 int i;

 printf(" sqrt(%Lf) = %22.18Lf\n", x0, my\_sqrt(x0,

 0.000000000000001));

 printf("lib sqrt(%Lf) = %22.18Lf\n", x0, sqrtl(x0));

} /\* main \*/

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C:\> sqrt1.exe

x0 = 10.000000

xn = 10.000000000000000000

xn = 5.500000000000000000

xn = 3.659090909090909091

xn = 3.196005081874647092

xn = 3.162455622803890097

xn = 3.162277665175674835

 sqrt(10.000000) = 3.162277660168379336

lib sqrt(10.000000) = 3.162277660168379332

C:\>

התוכנית הבאה פותרת את המשוואה sin(x) = cos(2x) במעלות על ידי שיטת ה- bisection.

/\* sqrt1.c - solve with fixed points \*/

#include <stdio.h>

#include <math.h>

long double pi = 3.1415926535897932;

long double f(long double x)

{

 return sinl(x\*pi/180.0) - cosl(2.0\*x\*pi/180.0);

} /\* f \*/

long double bisection( long double (\*fun)(long double), long double a,

long double b, long double eps)

{

 long double x, f;

 do {

 x = (a+b)/2.0;

 f = (\*fun)(x);

 printf("a= %Lf, b = %Lf, x = %Lf\n", a, b, x);

 printf("f(a) = %Lf, f(b) = %Lf, f(x) = %Lf\n\n", (\*fun)(a),

(\*fun)(b), (\*fun)(x));

 if (fabsl(f) < eps)

 return x;

 if ( (\*fun)(a)\*f < 0.0)

 b = x;

 else

 a = x;

 } while( fabs(b-a) > eps);

 return x;

} /\* bisection \*/

int main()

{

 long double xstar;

 int i;

 xstar = bisection(f, 0.0, 45.0, 0.0000001);

 printf(" sin(%Lf) = cos(%Lf) \n", xstar, 2\*xstar);

} /\* main \*/

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C:\> bisection1.exe

a= 0.000000, b = 45.000000, x = 22.500000

f(a) = -1.000000, f(b) = 0.707107, f(x) = -0.324423

a= 22.500000, b = 45.000000, x = 33.750000

f(a) = -0.324423, f(b) = 0.707107, f(x) = 0.172887

a= 22.500000, b = 33.750000, x = 28.125000

f(a) = -0.324423, f(b) = 0.172887, f(x) = -0.084173

a= 28.125000, b = 33.750000, x = 30.937500

f(a) = -0.084173, f(b) = 0.172887, f(x) = 0.042706

a= 28.125000, b = 30.937500, x = 29.531250

f(a) = -0.084173, f(b) = 0.042706, f(x) = -0.021205

a= 29.531250, b = 30.937500, x = 30.234375

f(a) = -0.021205, f(b) = 0.042706, f(x) = 0.010640

a= 29.531250, b = 30.234375, x = 29.882812

f(a) = -0.021205, f(b) = 0.010640, f(x) = -0.005311

a= 29.882812, b = 30.234375, x = 30.058594

f(a) = -0.005311, f(b) = 0.010640, f(x) = 0.002658

a= 29.882812, b = 30.058594, x = 29.970703

f(a) = -0.005311, f(b) = 0.002658, f(x) = -0.001328

a= 29.970703, b = 30.058594, x = 30.014648

f(a) = -0.001328, f(b) = 0.002658, f(x) = 0.000664

a= 29.970703, b = 30.014648, x = 29.992676

f(a) = -0.001328, f(b) = 0.000664, f(x) = -0.000332

a= 29.992676, b = 30.014648, x = 30.003662

f(a) = -0.000332, f(b) = 0.000664, f(x) = 0.000166

a= 29.992676, b = 30.003662, x = 29.998169

f(a) = -0.000332, f(b) = 0.000166, f(x) = -0.000083

a= 29.998169, b = 30.003662, x = 30.000916

f(a) = -0.000083, f(b) = 0.000166, f(x) = 0.000042

a= 29.998169, b = 30.000916, x = 29.999542

f(a) = -0.000083, f(b) = 0.000042, f(x) = -0.000021

a= 29.999542, b = 30.000916, x = 30.000229

f(a) = -0.000021, f(b) = 0.000042, f(x) = 0.000010

a= 29.999542, b = 30.000229, x = 29.999886

f(a) = -0.000021, f(b) = 0.000010, f(x) = -0.000005

a= 29.999886, b = 30.000229, x = 30.000057

f(a) = -0.000005, f(b) = 0.000010, f(x) = 0.000003

a= 29.999886, b = 30.000057, x = 29.999971

f(a) = -0.000005, f(b) = 0.000003, f(x) = -0.000001

a= 29.999971, b = 30.000057, x = 30.000014

f(a) = -0.000001, f(b) = 0.000003, f(x) = 0.000001

a= 29.999971, b = 30.000014, x = 29.999993

f(a) = -0.000001, f(b) = 0.000001, f(x) = -0.000000

a= 29.999993, b = 30.000014, x = 30.000004

f(a) = -0.000000, f(b) = 0.000001, f(x) = 0.000000

a= 29.999993, b = 30.000004, x = 29.999998

f(a) = -0.000000, f(b) = 0.000000, f(x) = -0.000000

 sin(29.999998) = cos(59.999996)

C:\>

התוכנית הבאה פותרת את אותה משוואה של התוכנית האחרונה אבל בשיטת regula falsi. מעניין לשים לב שהאינטרוול אינו מתכווץ אבל השיטה מתכנסת מהר יותר:

/\* regula1.c - solve with fixed points \*/

#include <stdio.h>

#include <math.h>

long double pi = 3.1415926535897932;

long double f(long double x)

{

 return sinl(x\*pi/180.0) - cosl(2.0\*x\*pi/180.0);

} /\* f \*/

long double regula( long double (\*fun)(long double), long double a,

long double b, long double eps)

{

 long double x, f;

 do {

 x = (a\*(\*fun)(b) - b\*(\*fun)(a))/((\*fun)(b) - (\*fun)(a));

 printf("a = %Lf, b = %Lf, x = %Lf\n", a, b, x);

 printf("f(a) = %Lf, f(b) = %Lf, f(x) = %Lf\n\n",

 (\*fun)(a),(\*fun)(b), (\*fun)(x));

 f = (\*fun)(x);

 if (fabsl(f) < eps)

 return x;

 if ( (\*fun)(a)\*f < 0.0)

 b = x;

 else

 a = x;

 } while( fabsl(b-a) > eps);

 return x;

} /\* regula \*/

int main()

{

 long double xstar;

 int i;

 xstar = regula(f, 0.0, 45.0, 0.0000000001);

 printf(" sin(%Lf) = cos(%Lf) \n", xstar, 2\*xstar);

} /\* main \*/

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C:\> regula1.exe

a = 0.000000, b = 45.000000, x = 26.360390

f(a) = -1.000000, f(b) = 0.707107, f(x) = -0.161684

a = 26.360390, b = 45.000000, x = 29.829265

f(a) = -0.161684, f(b) = 0.707107, f(x) = -0.007735

a = 29.829265, b = 45.000000, x = 29.993427

f(a) = -0.007735, f(b) = 0.707107, f(x) = -0.000298

a = 29.993427, b = 45.000000, x = 29.999750

f(a) = -0.000298, f(b) = 0.707107, f(x) = -0.000011

a = 29.999750, b = 45.000000, x = 29.999990

f(a) = -0.000011, f(b) = 0.707107, f(x) = -0.000000

a = 29.999990, b = 45.000000, x = 30.000000

f(a) = -0.000000, f(b) = 0.707107, f(x) = -0.000000

a = 30.000000, b = 45.000000, x = 30.000000

f(a) = -0.000000, f(b) = 0.707107, f(x) = -0.000000

a = 30.000000, b = 45.000000, x = 30.000000

f(a) = -0.000000, f(b) = 0.707107, f(x) = -0.000000

 sin(30.000000) = cos(60.000000)

C:\>