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Strelba1[f_, g_, a_, b_, a1_, a2_, b1_, b2_, y1_, y2_, e_, h_, z0_, Lx_] :=
Strelba2[f_, g_, a_, b_, a1_, a2_, b1_, b2_, y1_, y2_, e_, z0_, Lx_]
Program Strelba1 a Strelba2 počítá řešení y1, y2 soustavy dvou diferenciálních rovnic
y1'=f(x,y1,y2)
y2'=g(x,y1,y2)
na intervalu (a, b) s okrajovými podmínkami
a1 y1(a)+b1 y2(a)=y1 a a2 y1(b)+b2 y2(b)=y2
metodou střelby.
e - požadovaná přesnost pro Newtonovu metodu
h - krok při výpočtu derivace pomocí diference
z0 - počáteční nástřel
Lx - seznam hodnot x, pro které se budou počítat hodnoty řešení y1 a y2
výstupem je graf řešení y1 a y2 seznam řešení y1 a y2 v daných hodnotách Lx
Derivace funkcí y1 a y2 podle parametru jsou v programu Strelba1 počítané diferencně.
Program Strelba2 počítá derivace funkcí y1 a y2 podle parametru pomocí variačních rovnic.

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Program Strelba1: Derivace diferenční formulí

```

Strelba1[f_, g_, a_, b_, a1_, a2_, b1_, b2_, y1_, y2_, e_, h_, z0_, Lx_] :=
Module[{z, zn, s, i, res, res1, res2, y1, y2, x, n, gr1, gr2, v1, v2},
n = Length[Lx];
z = z0;
s = 99 999 999 999;
i = 0;
Print["i", " ", "z", " ", "s"];
Print[i, " ", z];
While[s > e && i < 10,
If[Abs[b1] < 0.00000001,
{res1 = NDSolve[{y1'[x] == f[x, y1[x], y2[x]], y2'[x] == g[x, y1[x], y2[x]],
y1[a] == (y1 - b1 z) / a1, y2[a] == z}, {y1, y2}, {x, a, b}];
res2 = NDSolve[{y1'[x] == f[x, y1[x], y2[x]], y2'[x] == g[x, y1[x], y2[x]],
y1[a] == (y1 - b1 (z + h)) / a1, y2[a] == z + h}, {y1, y2}, {x, a, b}];
{res1 = NDSolve[{y1'[x] == f[x, y1[x], y2[x]], y2'[x] == g[x, y1[x], y2[x]],
y1[a] == z, y2[a] == (y1 - a1 z) / b1}, {y1, y2}, {x, a, b}];
res2 = NDSolve[{y1'[x] == f[x, y1[x], y2[x]], y2'[x] == g[x, y1[x], y2[x]],
y1[a] == z + h, y2[a] == (y1 - a1 (z + h)) / b1}, {y1, y2}, {x, a, b}]}];
zn = z - (a2 (y1[b] /. res1) [[1]] + b2 (y2[b] /. res1) [[1]] - y2) /
((a2 (y1[b] /. res2) [[1]] + b2 (y2[b] /. res2) [[1]]) -
(a2 (y1[b] /. res1) [[1]] + b2 (y2[b] /. res1) [[1]])) / h);
s = Abs[zn - z];
z = zn;
i++;
];
If[Abs[b1] < 0.00000001,
{res = NDSolve[{y1'[x] == f[x, y1[x], y2[x]], y2'[x] == g[x, y1[x], y2[x]],
y1[a] == (y1 - b1 z) / a1, y2[a] == z}, {y1, y2}, {x, a, b}];
{res = NDSolve[{y1'[x] == f[x, y1[x], y2[x]], y2'[x] == g[x, y1[x], y2[x]],
y1[a] == z, y2[a] == (y1 - a1 z) / b1}, {y1, y2}, {x, a, b}]}];
g1 = Plot[Evaluate[y1[x] /. res], {x, a, b}, PlotRange -> All];
g2 = Plot[Evaluate[y2[x] /. res], {x, a, b}, PlotRange -> All];
v1 = Table[{Lx[[i]], (y1[Lx[[i]] /. res) [[1]]}, {i, 1, n}];
v2 = Table[{Lx[[i]], (y2[Lx[[i]] /. res) [[1]]}, {i, 1, n}];
{g1, g2, v1, v2}
]

```

Příklad I: Řešení diferenciální rovnice $y''=y^2$ s okrajovou podmínkou $y(0)=1$ a $y(1)=1$

```

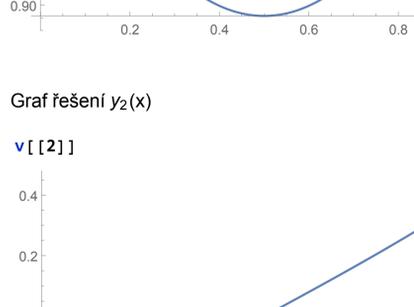
f[x_, y1_, y2_] = y2;
g[x_, y1_, y2_] = y1 * y1;
a = 0;
b = 1;
a1 = 1;
a2 = 1;
b1 = 0;
b2 = 0;
y1 = 1;
y2 = 1;
e = 0.000001;
h = 0.001;
z0 = 0.0;
m = 10;
Lx = Table[N[a + i (b - a) / m], {i, 0, m}];
v = Strelba1[f, g, a, b, a1, a2, b1, b2, y1, y2, e, h, z0, Lx];

```

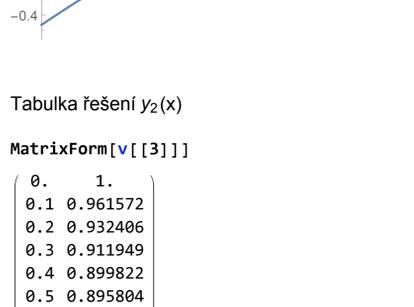
Tabulka řešení $y_2(x)$

i	z	s
0	0.	
1	-0.417515	0.417515
2	-0.432914	0.0153994
3	-0.432936	0.0000213526
4	-0.432936	1.84102×10^{-9}

Graf řešení $y_1(x)$



Graf řešení $y_2(x)$



Tabulka řešení $y_2(x)$

MatrixForm[v[[3]]]

0.	1.
0.1	0.961572
0.2	0.932406
0.3	0.911949
0.4	0.899822
0.5	0.895804
0.6	0.899822
0.7	0.911949
0.8	0.932406
0.9	0.961572
1.	1.

Tabulka řešení $y_2(x)$

MatrixForm[v[[4]]]

0.	-0.432936
0.1	-0.336886
0.2	-0.247341
0.3	-0.162427
0.4	-0.0804866
0.5	-3.02793×10^{-8}
0.6	0.0804865
0.7	0.162427
0.8	0.247341
0.9	0.336886
1.	0.432936

Program Strelba2: Derivace pomocí variačních rovnic

```

Strelba2[f_, g_, a_, b_, a1_, a2_, b1_, b2_, y1_, y2_, e_, z0_, Lx_] :=
Module[{z, zn, s, i, res, res1, res2, y1, y2, p1, p2, x, n, gr1, gr2, v1,
v2, f1, f2, g1, g2, rov1, rov2, rov3, rov4},
f1[x_, y1_, y2_] = D[f[x, y1, y2], y1];
f2[x_, y1_, y2_] = D[f[x, y1, y2], y2];
g1[x_, y1_, y2_] = D[g[x, y1, y2], y1];
g2[x_, y1_, y2_] = D[g[x, y1, y2], y2];
rov1 = y1'[x] == f[x, y1[x], y2[x]];
rov2 = y2'[x] == g[x, y1[x], y2[x]];
rov3 = p1'[x] == f1[x, y1[x], y2[x]] * p1[x] + f2[x, y1[x], y2[x]] * p2[x];
rov4 = p2'[x] == g1[x, y1[x], y2[x]] * p1[x] + g2[x, y1[x], y2[x]] * p2[x];
n = Length[Lx];
z = z0;
s = 99 999 999 999;
i = 0;
Print["i", " ", "z", " ", "s"];
Print[i, " ", z];
While[s > e && i < 10,
If[Abs[b1] < 0.00000001,
{res1 = NDSolve[{rov1, rov2, rov3, rov4, y1[a] == (y1 - b1 z) / a1,
y2[a] == z, p1[a] == (-b1) / a1, p2[a] == 1.0}, {y1, y2, p1, p2}, {x, a, b}]}],
{res1 = NDSolve[{rov1, rov2, rov3, rov4, y1[a] == z, y2[a] == (y1 - a1 z) / b1,
p1[a] == 1.0, p2[a] == (-a1) / b1}, {y1, y2, p1, p2}, {x, a, b}]}];
];
zn = z - (a2 (y1[b] /. res1) [[1]] + b2 (y2[b] /. res1) [[1]] - y2) /
(a2 (p1[b] /. res1) [[1]] + b2 (p2[b] /. res1) [[1]]);
s = Abs[zn - z];
z = zn;
i++;
Print[i, " ", z, " ", s];
];
If[Abs[b1] < 0.00000001,
{res = NDSolve[{y1'[x] == f[x, y1[x], y2[x]], y2'[x] == g[x, y1[x], y2[x]],
y1[a] == (y1 - b1 z) / a1, y2[a] == z}, {y1, y2}, {x, a, b}];
{res = NDSolve[{y1'[x] == f[x, y1[x], y2[x]], y2'[x] == g[x, y1[x], y2[x]],
y1[a] == z, y2[a] == (y1 - a1 z) / b1}, {y1, y2}, {x, a, b}]}];
g1 = Plot[Evaluate[y1[x] /. res], {x, a, b}, PlotRange -> All];
gr2 = Plot[Evaluate[y2[x] /. res], {x, a, b}, PlotRange -> All];
v1 = Table[{Lx[[i]], (y1[Lx[[i]] /. res) [[1]]}, {i, 1, n}];
v2 = Table[{Lx[[i]], (y2[Lx[[i]] /. res) [[1]]}, {i, 1, n}];
{gr1, gr2, v1, v2}
]

```

Příklad I: Řešení diferenciální rovnice $y''=y^2$ s okrajovou podmínkou $y(0)=1$ a $y(1)=1$

```

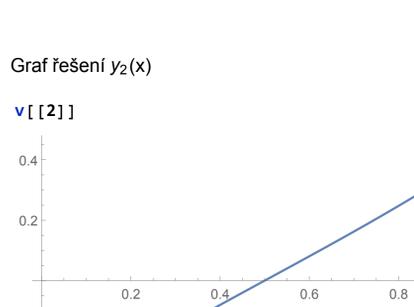
f[x_, y1_, y2_] = y2;
g[x_, y1_, y2_] = y1 * y1;
a = 0;
b = 1;
a1 = 1;
a2 = 1;
b1 = 0;
b2 = 0;
y1 = 1;
y2 = 1;
e = 0.000001;
z0 = 0.0;
m = 10;
Lx = Table[N[a + i (b - a) / m], {i, 0, m}];
v = Strelba2[f, g, a, b, a1, a2, b1, b2, y1, y2, e, z0, Lx];

```

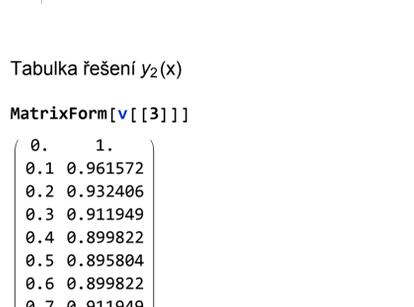
Tabulka řešení $y_2(x)$

i	z	s
0	0.	
1	-0.41755	0.41755
2	-0.432916	0.0153658
3	-0.432936	0.0000199639
4	-0.432936	3.36487×10^{-11}

Graf řešení $y_1(x)$



Graf řešení $y_2(x)$



Tabulka řešení $y_2(x)$

MatrixForm[v[[3]]]

0.	1.
0.1	0.961572
0.2	0.932406
0.3	0.911949
0.4	0.899822
0.5	0.895804
0.6	0.899822
0.7	0.911949
0.8	0.932406
0.9	0.961572
1.	1.

Tabulka řešení $y_2(x)$

MatrixForm[v[[4]]]

0.	-0.432936
0.1	-0.336886
0.2	-0.247341
0.3	-0.162427
0.4	-0.0804866
0.5	-2.90411×10^{-8}
0.6	0.0804865
0.7	0.162427
0.8	0.247341
0.9	0.336886
1.	0.432936