

□ Funções Exponencial e Radical Múltiplas

Arkanon <arkanon@lsd.org.br>
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0 πaté que é legalzinho, mas o e é que é phoda pacaraleo. Quando menos se espere.

```
time (cat fn.mac | maxima -q)
```

□ 1 $f_n(x) - n \in \mathbb{N}, x \in (0,1] \subset \mathbb{R}$

```
(%i1) f(n,x) := block
(
  [
    f : 1,
    i : 1
  ],
  while (i<=n) do
  (
    f : xi^f,
    i : i+1
  ),
  if x=0 then if remainder(n,2)=0 then 1 else 0 else ev(f,xi=x)
  /*if x=0 then limit(f,xi,x,plus) else ev(f,xi=x) */ /* demora demais para
)${
```



```
df(n,x) := diff(f(n,x),x)$
```

□ 2 $r_n(x) - n \in \mathbb{N}, x > 0 \in \mathbb{R}$

```

(%i3) r(n,x) := block
(
  [
    r : -1,
    i : 1
  ],
  while (i<=n-2) do
  (
    r : -xi^r,
    i : i+1
  ),
  r : xi^xi^r,
  if x=0 then 0 elseif n=0 then 0 elseif n=1 then x else ev(r,xi=x)
  /*if x=0 then limit(r,xi,x,plus) elseif n=0 then 0 elseif n=1 then x else
   *)$)

dr(n,x) := diff(r(n,x),x)$

```

□ 3 Mínimos e Máximos

e ^{+e}	15.15426224147926	◆	r	$r \circ x$
e ⁺¹	2.71828182845904	●	$r_2 x$	$r \circ y$
e ^{-e^-1}	1.44466786100976	■	$r_2 y$	
e ^{+e^-1}	0.69220062755535	■	$f_2 y$	
e ⁻¹	0.36787944117144	●	$f_2 x$	$f \circ y$
e ^{-e}	0.06598803584531	◆	f	$f \circ x$

□ 4 Testes

```

--> n:4$
f(n,x);
df(n,x);
2^2^2^2;
2^(2^(2^(2)));
(((2)^2)^2)^2;

```

```
--> f( 0,0);
f( 1,0);
f( 2,0);
f( 3,0);
f( 0,2);
f( 1,2);
f( 2,2);
f( 3,2);
f( 4,2);
f(100,0);
f(101,0);

f( 38,.5);
f( 39,.5);
f( 40,.5);
f(671,.5);

/* 118 limite recursão 32 bit big float 2x */
/* 144 limite recursão 32 bit big float 1x */
/* 183 limite recursão 32 bit big float 0x */

/* 1979 limite recursão 64 bit big float 2x */
/* 2436 limite recursão 64 bit big float 1x */
/* 3166 limite recursão 64 bit big float 0x */

end$
```

```
--> n:4$
x^x^-x^-x^-1;
r(n,x);
dr(n,x);
```

```
--> r( 0,0);
r( 1,0);
r( 2,0);
r( 3,0);
r( 0,2);
r( 1,2);
r( 2,2);
r( 3,2);
r( 4,2);
r(100,0);
r(101,0);

r( 38,2.0);
r( 39,2.0);
r( 40,2.0);
```

--> r(336,2.0);

□ 5 $\lim_{n \rightarrow \infty} \min f_{2n}(x)$

n	t	x	y	
		1/e	$e^{\sqrt{e}}$	
2	00:00:00.000	0.36787944117144	0.69220062755535	
336	00:00:10.020	0.07120376008026	0.37432842646748	32bit
1000	00:00:48.703	0.06795091135496	0.37027993153836	
2000	00:03:21.536	0.06703716158006	0.36915146353127	
3000	00:11:37.409	0.06671391337319	0.36875506132229	
4000	00:20:04.063	0.06654652728576	0.36855074558021	
5000	00:34:59.069	0.06644356539002	0.36842549864804	
∞	----->	0.06598803584531	0.36787944117144	
		1/e^e	1/e	

```
--> n : 336$  
showtime:true$  
xm : find_root(df(n,x),x,.065,1.072);  
ym : f(n,xm);  
showtime:false$
```

□ 6 $\lim_{n \rightarrow \infty} \max r_{2n}(x)$

n	t	x	y	
		e	$1/e^{\sqrt{e}}$	
2	00:00:00.000	2.71828182845904	1.44466786100976	
334	00:00:10.540	14.03871516171082	2.67120340068981	32bit
1000	00:01:20.293	14.71650607857512	2.70065946011546	
2000	00:05:16.733	14.91709935847640	2.70891517111726	
3000	00:19:14.894	14.98937701954345	2.71182718527080	
4000	00:36:31.561	15.02708016161075	2.71333055757540	
5000	00:74:10.136	15.05036633916233	2.71425295933518	
∞	----->	15.15426224147926	2.71828182845904	
		e^e	e	

```
--> n : 334$  
showtime:true$  
xm : find_root(dr(n,x),x,14.0,15.2);  
ym : r(n,xm);  
showtime:false$
```

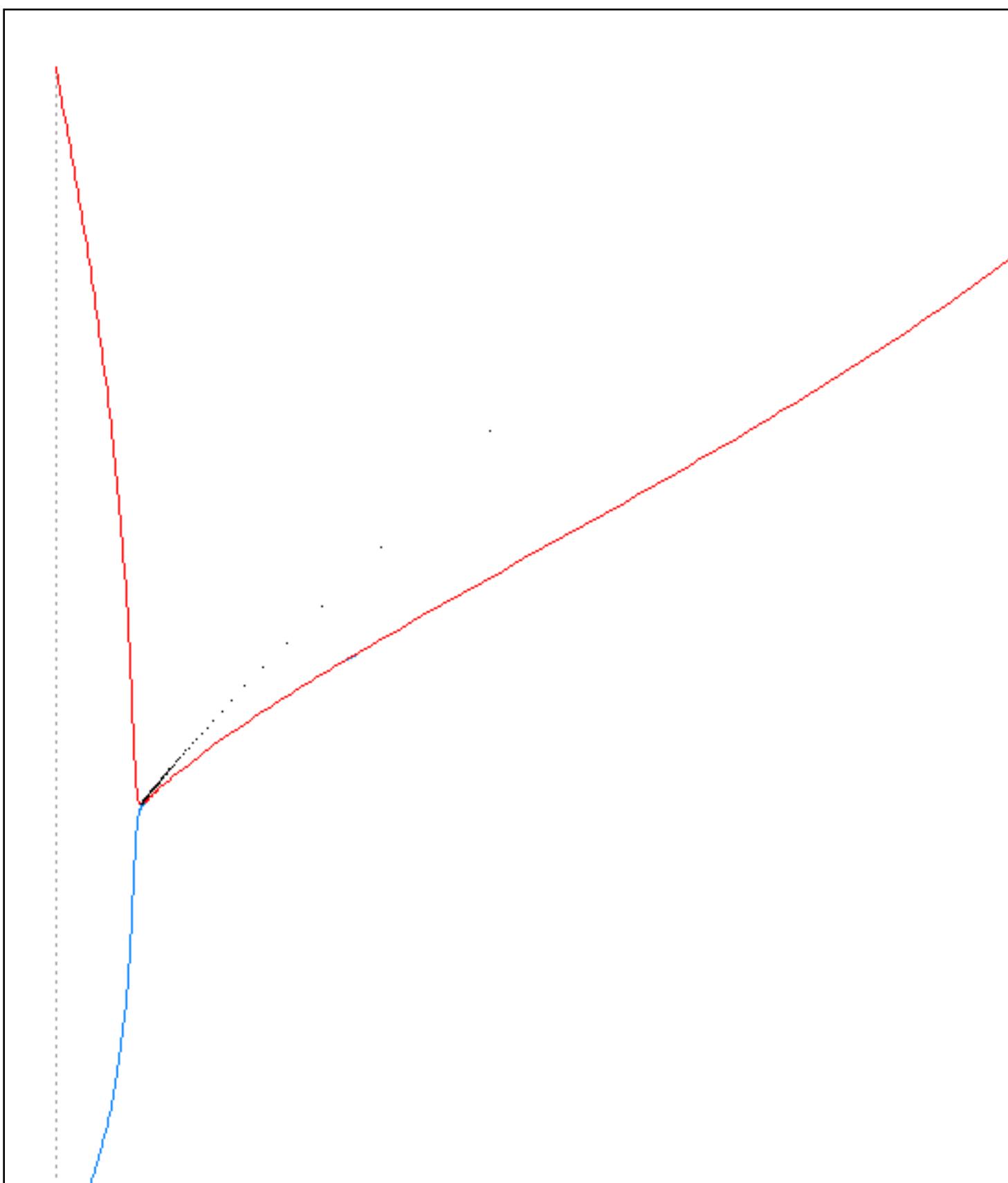
□ 7 Gráficos

```
(%i5) minset(lastn,funcao,intx) := block
(
  [
    i   : 2,
    xm : 0,
    ym : 0,
    set : [],
    fi,
    di
  ],
  while (i<=lastn) do
  (
    fi  : apply(funcao,[i,x]),
    di  : diff(fi,x),
    xm  : find_root(di,x,intx[1],intx[2]),
    ym  : ev(fi,x=xm),
    set : append(set,[[xm,ym]]),
    i   : i+2
  ),
  set
)$
```

```
(%i15) fnplot(record,lastn) := block
(
  [
    funcao : record[1],
    xisz   : record[2],
    intx   : record[3],
    winx   : record[4],
    winy   : record[5]
  ],
  minims      : minset(lastn,funcao,intx),
  wxplot_size : [700,700],
  print(minims[1]),
  print(last(minims)),
  print(length(minims)),
  errormsg:false,
  with_slider
  (
    i,
    makelist(i,i,0,lastn/2),
    [
      if x>0 then apply(funcao,[2*i+1,x]) else xisz[1],
      if x>0 then apply(funcao,[2*i ,x]) else xisz[2],
      [ discrete, minims ]
    ],
    winx,
    winy,
    [ style, lines, lines, dots ],
    [ color, blue, red, black ],
    [ legend, false ],
    [ box, false ],
    [ gnuplot_preamble, "set size ratio 1" ]
  ),
  errormsg:false
)$

(%i16) /* f xisz intx(sol) winx winy */
fn:[f, [ 0, 1 ], [ 0.01, 1.0 ], [ x, 0, 1 ], [ y, 0, 1 ] ]$  
rn:[r, [ 0, 0 ], [ 2.70, 15.2 ], [ x, 0, 15 ], [ y, 0, 5 ] ]$
```

```
(%i21) showtime:true$ fnplot(fn,300);
showtime:false$
Evaluation took 0.0000 seconds (0.0000 elapsed)
[ 0.36787944117144 , 0.69220062755535 ]
[ 0.071757873994947 , 0.37501880258257 ]
150
(%t22)
```




```
--> i : 0$  
while (i<=n/2) do  
(  
    if (i< 10) then z1 : 0 else z1 : "",  
    if (i<100) then z2 : 0 else z2 : "",  
    plot2d  
(  
    [ f(2*i,x), f(2*i+1,x), [ discrete, minimos ] ],  
    [ x, 0, 1 ],  
    [ legend, concat("f",2*i,"(x)", concat("f",2*i+1,"(x)", "Min Set  
cores,  
    [ style, lines, lines, dots ],  
    [ box, false ],  
    [ plot_format, gnuplot ],  
    [ gnuplot_preamble, "set size 1,1" ],  
    [ gnuplot_term, "pngcairo enhanced size 900,900" ],  
    [ gnuplot_out_file, concat("/export/home/arkanon/fn/frame-",z2,z1,:  
    ),  
    i : i+1  
);  
  
--> n : 8$  
i : 1$  
while (i<=n/2) do  
(  
    plot2d  
(  
    [ f(2*i,x), f(2*i+1,x), [ discrete, minimos ] ],  
    [ x, 0, 1 ],  
    [ legend, false ],  
    cores,  
    [ style, lines, lines, dots ],  
    [ box, false ],  
    [ plot_format, gnuplot ],  
    [ gnuplot_preamble, "set size ratio 1" ],  
    [ gnuplot_term, "pngcairo enhanced size 300,300" ],  
    [ gnuplot_out_file, concat("/export/home/arkanon/public_html/svl.ls:  
    ),  
    i : i+1  
);
```

□ 8 EOF