In [47]:
```
using Interact
using Gadfly
```

In [11]:
```
set_default_plot_size(25cm,10cm)
```

Chapter 4 - Optimization

1. Grid Search

Exercise 8

Assume that tax revenue for a government is given by $R(t) = -t^2 + t$, where t is a tax rate. Use the grid search method and find the percentage tax rate that maximizes tax revenue up to 10^{-2} precision.

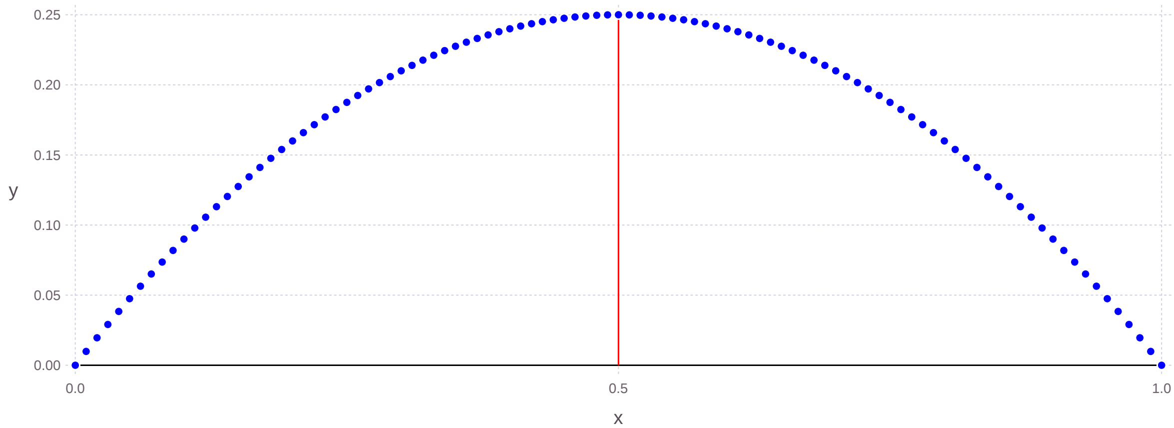
In [44]:
```
function ex8_GridSearch()

    R(t) = -t^2+t

    t = 0:10.0^(-2):1
    y = R.(t)

    results = ["t" "R(t)"; y R.(y)]
    solution = ["t*" "R(t*)"; t[find(y .== maximum(y))][1] maximum(y)]

    p = plot(
        layer(x=t, y=y, Geom.point, Theme(default_color=colorant"blue"), orde
        layer(x=[solution[2,1] solution[2,1]], y=[0 solution[2,2]], Geom.line
        layer(x=[0 1], y=[0 0], Geom.line, Theme(default_color=colorant"black
        Coord.Cartesian(xmin=0,xmax=1)
    )

    return results, solution, p
end;
```

In [45]:
```
ex8_GridSearch()[2]
```

Out[45]:
```
2×2 Array{Any,2}:
  "t*"    "R(t*)"
 0.5     0.25
```

In [46]:
```
ex8_GridSearch()[3]
```

Out[46]:



2. Golden Search

Exercise 9.

Let f be a real valued function such that $f(x) = xcos(x^2)$. Find the maximum of the function using the golden search rule in the interval $[0, 3]$, up to 10^{-10} precision.

In [6]:

```
function ex9_GoldenSearch(x0)

    a = 0; b = 3; tol = 10.0^(-10)
    f(x) = x*cos(x^2)



    path = [x0 0; x0 f(x0)]
    results = ["iter" "x" "cos(x)"]
    iter = 0

    for i in 1:100
        x0 = f(x0); iter += 1
        results = [results; iter x0 cos(x0)]
        path = [path; x0 x0; x0 f(x0)]
    end

    x = (-pi/2):0.01:(pi/2)
    p = plot(
        layer(x=[x[1] x[length(x)]], y=[0 0], Geom.line, Theme(default_color=
        layer(x=x, y=f.(x), Geom.line, Theme(default_color=colorant"blue"), c
        layer(x=x, y=x, Geom.line, Theme(default_color=colorant"green"), orde
        layer(x=path[:,1], y=path[:,2], Geom.line(preserve_order=true), Theme
        Coord.Cartesian(xmin=x[1],xmax=x[length(x)],ymin=0,ymax=1)
    )

    return results, [results[1:4,:]; results[(size(results)[1]-2):size(result
end;
```

In [7]:

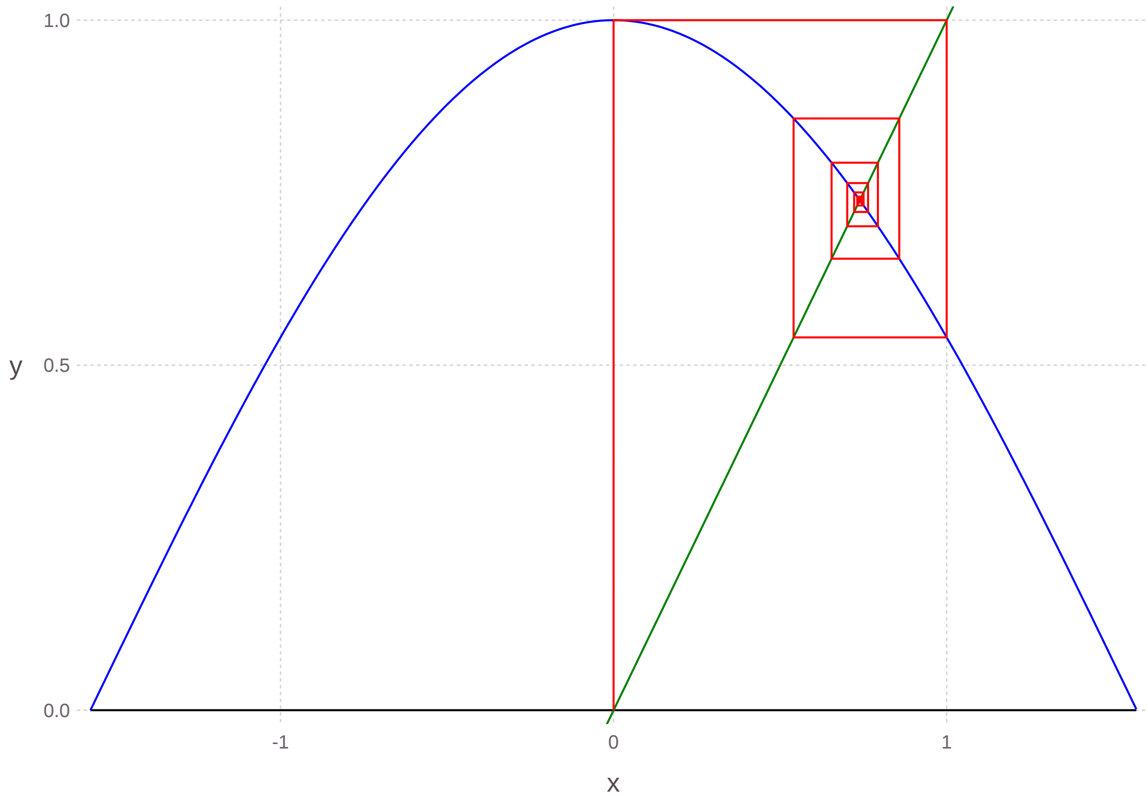
```
ex6_FixedPoint(1)[2]
```

Out[7]:

```
7×3 Array{Any,2}:
    "iter"   "x"       "cos(x)"
   1.0      0.540302  0.857553
   2.0      0.857553  0.65429
   3.0      0.65429   0.79348
  98.0      0.739085  0.739085
  99.0      0.739085  0.739085
 100.0      0.739085  0.739085
```

In [8]:
```
set_default_plot_size(18cm,13cm)

@manipulate for x_0 in (-1.5):0.1:(1.5)
    ex6_FixedPoint(x_0)[3]
end
```

Out[8]:



3. Newton-Rhapson

Exercise 7.

Let $f(x) = 1 - 0.5x^{-0.5} - 0.3x^{-0.2}$. Find x: $f(x) = 0$.

In [9]:

```julia
function ex7_NewtonRhapson(x0)

    f(x) = 1-0.5x^(-0.5)-0.3x^(-0.2)

    h = 10.0^(-15)
    df(x) = (f(x0+h)-f(x0-h))/(2h)

    iter = 1
    path = [x0 0; x0 f(x0)]
    results = ["iter" "x" "f(x)"; iter x0 f(x0)]

    while iter <=1000 && abs(f(x0))>h
        path = [path; (x0 - f(x0)/df(x0)) f(x0)]
        x0 = x0 - f(x0)/df(x0); iter += 1
        path = [path; x0 f(x0)]
        results = [results; iter x0 f(x0)]
    end

    x = 0.2:0.01:1.4
    p = plot(
        layer(x=[x[1] x[length(x)]], y=[0 0], Geom.line, Theme(default_color=
        layer(x=x, y=f.(x), Geom.line, Theme(default_color=colorant"blue"), c
        layer(x=path[:,1], y=path[:,2], Geom.line(preserve_order=true), Theme
        Coord.Cartesian(xmin=x[1],xmax=x[length(x)])
    )

    return results, [results[1:4,:]; results[(size(results)[1]-2):size(result
end;
```

In [10]:

```julia
ex7_NewtonRhapson(1)[2]
```

Out[10]:

```
7×3 Array{Any,2}:
   "iter"   "x"        "f(x)"
  1.0      1.0         0.2
  2.0      0.279424  -0.333025
  3.0      0.44607   -0.101199
  9.0      0.567094  -7.9875e-13
 10.0      0.567094   1.14908e-14
 11.0      0.567094   3.88578e-16
```

In [11]:

```
@manipulate for x0 in 0.2:0.1:1.3
    ex7_NewtonRhapson(x0)[3]
end
```

Out[11]: