Functions

Brandon Moretz

21th May 2020

1 Graphs

```
using Plots
using CalculusWithJulia

Plots.PlotlyBackend()
```

```
Plots.PlotlyBackend()
```

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

```
f(x) = 1 - x^2/2
plot(f, -3, 3)

plot(sin, 0, 2pi)
```

$$f(x) = (1 + x^2)^{-1}$$

```
f(x) = 1 / (1 + x^2)
plot(f, -3, 3)
```

$$f(x) = e^{-x^2/2}$$

```
f(x) = exp(-x^2/2)
plot(f, -2, 2)

plot(x -> cos(x), 0, pi/2)

f(x) = tan(x)
plot(f, -10, 10)

f(x) = sin(x)
xs = range(0, 2pi, length = 10)
ys = f.(xs)

plot(xs, ys)
```

```
f(x) = 1/x
xs = range(-1, 1, length = 251)
ys = f.(xs)
ys[xs .== 0.0] .= NaN

plot(xs, ys)

g(x) = abs(x) < .05 ? NaN : f(x)
plot(g, -1, 1)

xs = range(-pi, pi, length = 100)
ys = sin.(xs)

plot(xs, ys)

plot(-xs, ys)

plot(ys, xs)

xs = range(-pi/2, pi/2, length = 100)
ys = [sin(x) for x in xs]

plot(ys, xs)

f(x) = 1 - x^2/2
plot([cos, f], -pi/2, pi/2)

f(x) = x^5 - x + 1
plot([f, zero], -1.5, 1.4)

plot(f, -1.5, 1.4)
plot!(zero)

f(x) = x*(x-1)
plot(f, -1, 2)
scatter!([0, 1], [0,0])

plot(f, title="plot of x*(x-1)",
    xlab = "x axis", ylab = "y axis")

plot(f, linewidth = 5)

plot(f, legend=false)

plot(f, linestyle=:dash)
plot(f, linestyle=:dot)
plot(f, linestyle=:dashdot)

scatter(f, marker = :square, legend=false)
```

1.1 Parametric Graphs

```
f(x) = cos(x); g(x) = sin(x)
xs = range(0, 2pi, length = 100)
plot(f.(xs), g.(xs))

plot(f, g, 0, 2pi)
```

```
g(x) = x^2
f(x) = x^3
plot([g, f], 0, 25)

xs = range(0, 5, length = 100)
plot(g, f, 0, 25)
plot(f, g, 0, 25)

g(x) = x - sin(x)
f(x) = x^3
plot(g, f, -pi/2, pi/2)

g(x) = x - sin(x)
f(x) = x^3

plot(g)
plot!(f)

plot(g, f, -pi/2, pi/2)

R, r, rho = 1, 1/4, 1/4

g(t) = (R-r) * cos(t) + rho * cos((R-r)/r * t)
f(t) = (R-r) * sin(t) - rho * sin((R-r)/r * t)

plot(g, f, 0, max((R-r)/r, r/(R-r))*2pi)

f(x) = x^3 - x
plot([f, zero], -2, 2)

f(x) = x^3 - x

plot([f, zero])
```

Given,

$$f(x) = 3x^4 + 8x^3 - 18x^2$$

Find the point at which f(x) is the smallest.

```
f(x) = 3x^4 + 8x^3 - 18x^2

xs = range(-4, -2, length = 100)
ys = f.(xs)

plot(f)

xs[argmin(ys)]
```

```
-2.98989898989899
```

$$f(x)3x^4 + 8x^3 - 18x^2$$

When is it increasing?

```
f(x) = 3x^4 + 8x^3 - 18x^2

plot(f)
```

$$f(x) = \frac{(x^3 - 2x)}{2x^2 - 10}$$

is a rational function with issues When

$$2x^2 = 10$$

or $x = \pm\sqrt{5}$

```
f(x) = (x^3 - 2x)/(2x^2 - 10)
plot([f, zero], -5, 5)
```

```
f(x) = x <= 10 ? 35.0 : 35.0 + 4.0 * (x-10)
```

```
plot(f, 0, 20)
hline!([55])
```

```
f(x) = cos(x); g(x) = x
```

```
plot([f, g])
vline!([.75])
```

```
f(x) = log(x)-2
plot([f, zero],0, 10)
vline!([7.5])
```

```
xs = range(0, 1, length=250)
f(x) = sin(500*pi*x)
plot(xs, f.(xs))
```

```
plot(f, 0, 1)
```

```
function trimplot(f, a, b, c=20; kwargs...)
   fn = x -> abs(f(x)) < c ? f(x) : NaN
   plot(fn, a, b; kwargs...)
end
```

```
f(x) = 1/x
plot(f, -1, 1)
trimplot(f, -1, 1)
```

```
R, r, rho = 1, 3/4, 1/4
```

```
f(t) = (R-r) * cos(t) + rho * cos((R-r)/r *t)
g(t) = (R-r) * sin(t) + rho * sin((R-r)/r *t)
```

```
plot(f, g, 0, max((R-r)/r, r/(R-r))*2pi, aspect_ratio=:equal)
```

```
function spirograph(R, r, rho)
  f(t) = (R-r) * cos(t) + rho * cos((R-r)/r * t)
  g(t) = (R-r) * sin(t) - rho * sin((R-r)/r * t)

  plot(f, g, 0, max((R-r)/r, r/(R-r))*2pi, aspect_ratio=:equal)
end
```

```
spirograph(1, 3/4, 1/4)
```

```
spirograph(1, 1/2, 1/4)
```

```
spirograph(1, 1/4, 1)
```

```
spirograph(1, 1/8, 1/4)
```