Graphical iterator

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Graphical iterator program

I've written a simple graphical iterator program to help make graphical iterations on the fly. Here it is:

I can't guarantee it'll work for all functions you throw at it, but then again, I can't think of any reason why it wouldn't. Let me know if you come across any or issues!

Setup

```
# set your initial condition and desired number of iterations:
x_0 <- 3.43
N <- 100

# set the iteration plot x axis range (lower and upper bounds):
x_min <- 0; x_max <- 8
y_min <- -2; y_max <- 8

use_custom_range_x <- FALSE
use_custom_range_y <- FALSE

# declare your function here:
func <- function(x){
  return(-2 * sin(x) + x) # function goes here
}
```

The nitty-gritty

```
get_function_data <- function(range = c(-1, 1), steps = 100){

  steps_multiplier <- (range[2]-range[1])/10
  if(steps_multiplier < 1){steps_multiplier <- 1}
  # adds steps to get data for depending on the number of 10s
```

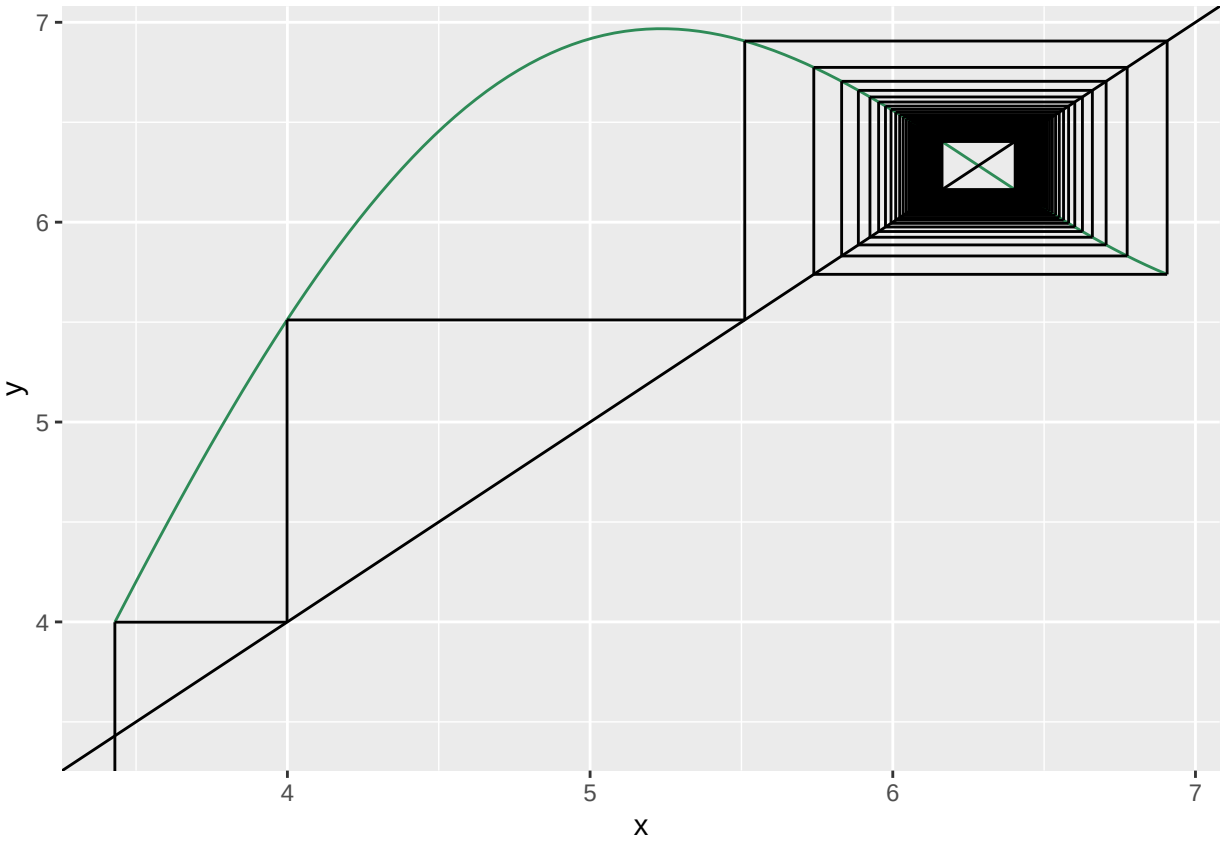
```
  # in the specified plot x range

  x <- seq(from = range[1], to = range[2], length.out = steps * steps_multiplier)

  y <- array(dim = steps * steps_multiplier)
  for(i in 1:length(x)){
    y[i] <- func(x[i])
    }

  return(data.frame(x = x, y = y))
}

graphical_iterator <- function(x_0, N = 100){

  start <- x_0
  vert <- FALSE

  xstarts <- c(start)
  ystarts <- c(y_min)
  xends <- c(start)
  yends <- c(func(start))

  # iteratively get the coordinates of the next segment points
  for(i in 1:(2 * N))
    # range = 2 * N because every step will be described by two segments
  {
    # if the last segment was vertical, the next must be horizontal
    if(vert){
      xstarts <- c(xstarts, start)
      ystarts <- c(ystarts, start)
      xends <- c(xends, start)
      yends <- c(yends, func(start))
      vert <- FALSE
    }
    else{
      xstarts <- c(xstarts, start)
      ystarts <- c(ystarts, func(start))
      xends <- c(xends, func(start))
      yends <- c(yends, func(start))
      vert <- TRUE
      start <- func(start) # update start value
    }
  }
  return(data.frame(xstarts, ystarts, xends, yends))
}

cobweb_traject <- graphical_iterator(x_0 = x_0, N = N)
```

```r
if(use_custom_range_x == FALSE){
  x_min <- min(cobweb_traject$xstarts); x_max <- max(cobweb_traject$xends)
}
if(use_custom_range_y == FALSE){
  y_min <- min(cobweb_traject$xstarts); y_max <- max(cobweb_traject$xends)
}

plot_data <- get_function_data(range = c(x_min,x_max))


get_function_iteration_trajectory <- function(x_0, N = 100){

  x_t <- x_0
  trajectory <- c(x_t)

  for(t in 0:(N-1)){
    x_t <- func(x_t)
    trajectory <- c(trajectory, x_t) # add x_t_1's value to the trajectory vector
  }
  return(trajectory)
}

trajectory <- get_function_iteration_trajectory(x_0 = x_0, N = N)
trajectory <- data.frame(x = 0:(length(trajectory)-1), y = trajectory)
```

Plots

Graphical iteration plot:

```r
plot_data %>%
  ggplot(aes(x, y)) +
  geom_line(colour = "seagreen") +
  geom_abline() +
  geom_segment(data = cobweb_traject, aes(x = xstarts, y = ystarts, xend = xends,
                                          yend = yends)) +
  coord_cartesian(xlim = c(x_min, x_max), ylim = c(y_min, y_max))
```



TODO IN THE FUTURE:

- Colour segments based on distance to fixed points.
- Colour segments based on distance to other segments.

Iteration trajectory time series plot

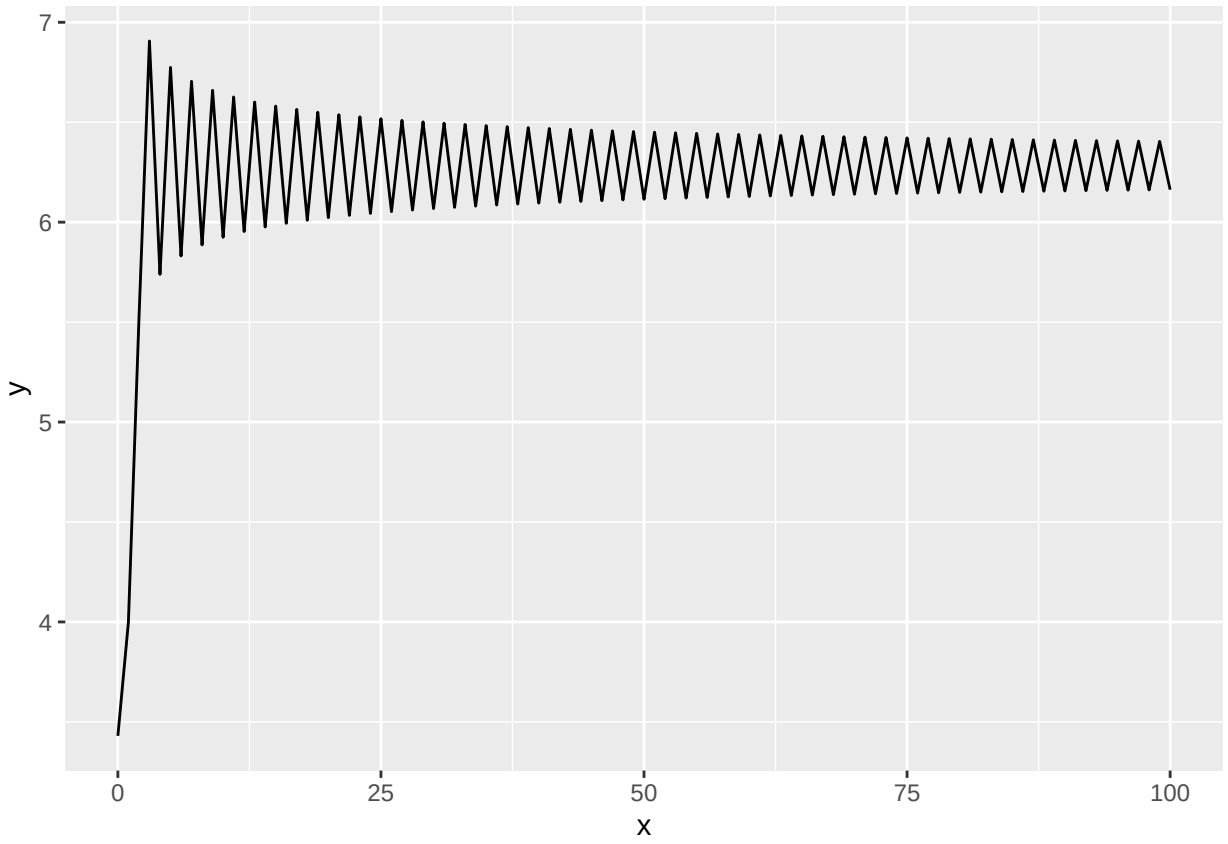
```
trajectory
```

```
##        x        y
## 1      0 3.430000
## 2      1 3.998851
## 3      2 5.510954
## 4      3 6.906425
## 5      4 5.739087
## 6      5 6.774380
## 7      6 5.831020
## 8      7 6.704848
## 9      8 5.886292
## 10     9 6.659402
## 11    10 5.924593
## 12    11 6.626506
## 13    12 5.953274
```

```
## 14   13 6.601192
## 15   14 5.975844
## 16   15 6.580895
## 17   16 5.994232
## 18   17 6.564130
## 19   18 6.009603
## 20   19 6.549967
## 21   20 6.022710
## 22   21 6.537790
## 23   22 6.034065
## 24   23 6.527168
## 25   24 6.044029
## 26   25 6.517795
## 27   26 6.052868
## 28   27 6.509441
## 29   28 6.060781
## 30   29 6.501932
## 31   30 6.067919
## 32   31 6.495134
## 33   32 6.074403
## 34   33 6.488940
## 35   34 6.080328
## 36   35 6.483266
## 37   36 6.085769
## 38   37 6.478042
## 39   38 6.090790
## 40   39 6.473211
## 41   40 6.095443
## 42   41 6.468726
## 43   42 6.099770
## 44   43 6.464547
## 45   44 6.103809
## 46   45 6.460641
## 47   46 6.107589
## 48   47 6.456979
## 49   48 6.111139
## 50   49 6.453537
## 51   50 6.114479
## 52   51 6.450293
## 53   52 6.117631
## 54   53 6.447230
## 55   54 6.120611
## 56   55 6.444330
## 57   56 6.123434
## 58   57 6.441579
## 59   58 6.126114
## 60   59 6.438966
## 61   60 6.128663
```

```
## 62   61 6.436479
## 63   62 6.131091
## 64   63 6.434108
## 65   64 6.133407
## 66   65 6.431845
## 67   66 6.135619
## 68   67 6.429681
## 69   68 6.137736
## 70   69 6.427610
## 71   70 6.139764
## 72   71 6.425624
## 73   72 6.141709
## 74   73 6.423719
## 75   74 6.143576
## 76   75 6.421889
## 77   76 6.145371
## 78   77 6.420128
## 79   78 6.147098
## 80   79 6.418434
## 81   80 6.148761
## 82   81 6.416801
## 83   82 6.150364
## 84   83 6.415226
## 85   84 6.151911
## 86   85 6.413706
## 87   86 6.153405
## 88   87 6.412237
## 89   88 6.154849
## 90   89 6.410818
## 91   90 6.156246
## 92   91 6.409444
## 93   92 6.157597
## 94   93 6.408114
## 95   94 6.158906
## 96   95 6.406825
## 97   96 6.160175
## 98   97 6.405575
## 99   98 6.161406
## 100  99 6.404363
## 101 100 6.162600
```

```
trajectory %>%
  ggplot(aes(x, y)) +
  geom_line()
```


7
6
5
4
y
0
25
50
75
100
x