



For Information Displays

Anthony Starks
@ajstarks



Go is great in the back end

A wide-angle photograph of a sky filled with various types of clouds. In the foreground, there are several large, puffy cumulus clouds. Above them, a massive, dark, and turbulent cumulonimbus cloud dominates the upper right portion of the frame. The sky is a deep, saturated blue, providing a stark contrast to the white and grey tones of the clouds.

But sometimes it's about the picture

Information Displays

Packages and Tools

Lots of pictures

Why Go?



Edward Tufte

Display data for precise, effective, quick analysis,
Small multiples, optimizing the data-ink ratio,
Visual and beautiful evidence.



Nigel Holmes

Designing for the context: The data visualizer
asks: “What’s the data?”, the infographics designer:
“What’s the Story?”

An interesting arrangement
of text and graphics designed
to convey a message

I hate pushing pixels

programs are so much
better at it



Photo by deborahschillbach



Fatih Arslan

@fatih

Following



If you don't learn your tool in and out, the tool will block you during the progress. Don't let the tool disrupt you. If there is too much disruption, it's time to switch to a new tool. If there is no such tool, it's time to write your own.

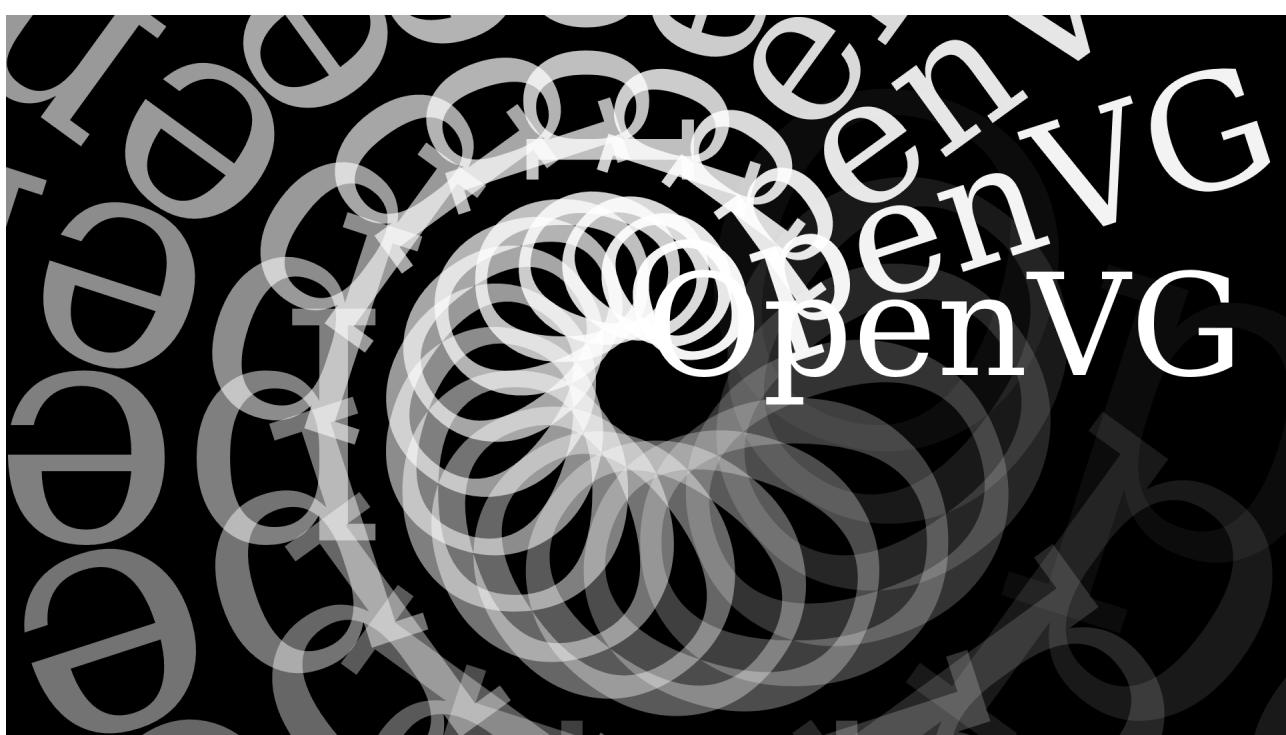
4:43 AM - 12 Apr 2018

SVGo



`go get github.com/ajstarks/svg/...`

OpenVG



`go get github.com/ajstarks/openvg`

Deck



`go get github.com/ajstarks/deck/`
`go get github.com/ajstarks/deck/generate`
`go get github.com/ajstarks/deck/cmd/pdfdeck/`
`go get github.com/ajstarks/deck/cmd/dchart/`





Scale



Roundrect



rgb(164,198,57)

Line

Circle

Arc

Line

Rect

Element

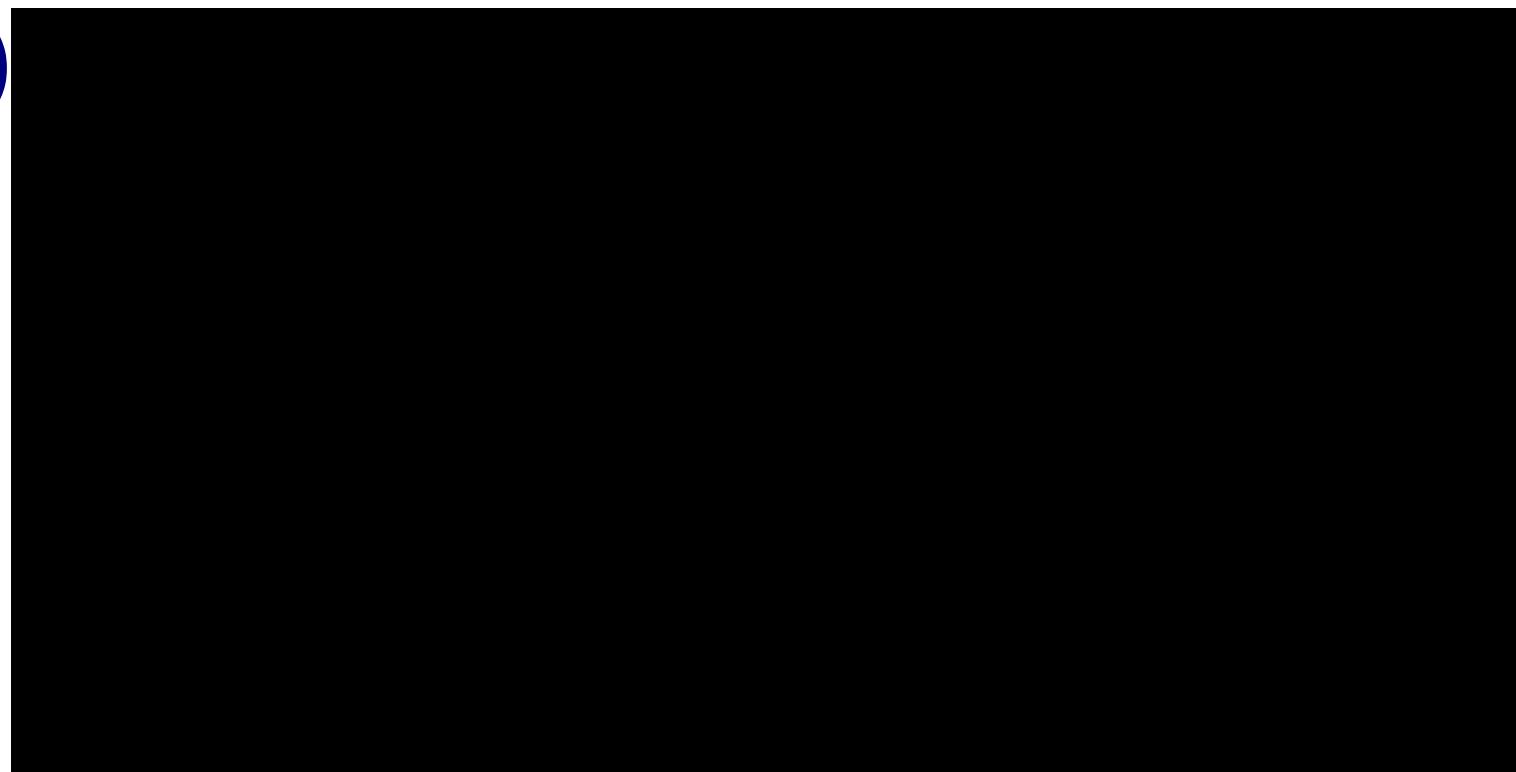
Rect

Arguments

(100,200,250,125)

```
<rect x="100" y="200" width="250" height="125"/>
```

(100, 200)

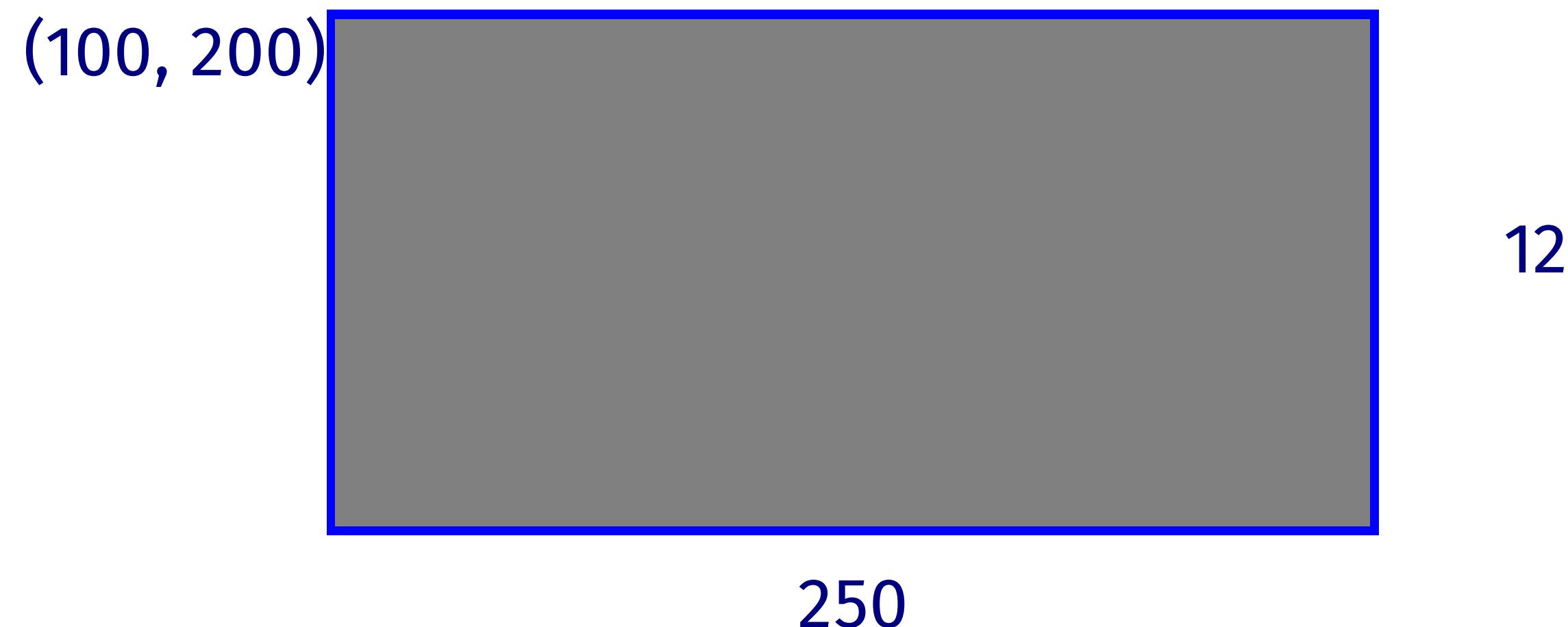


125

250

Element	Arguments	CSS Style
Rect	(100,200,250,125, "fill:gray;stroke:blue")	

```
<rect x="100" y="200" width="250" height="125"  
style="fill:gray;stroke:blue"/>
```



Element

Rect

Arguments

(100,200,250,125,

`id="box"`, `fill="gray"`, `stroke="blue"`)

Attributes

```
<rect x="100" y="200" width="250" height="125"  
      id="box" fill="gray" stroke="blue"/>
```

(100, 200)



125

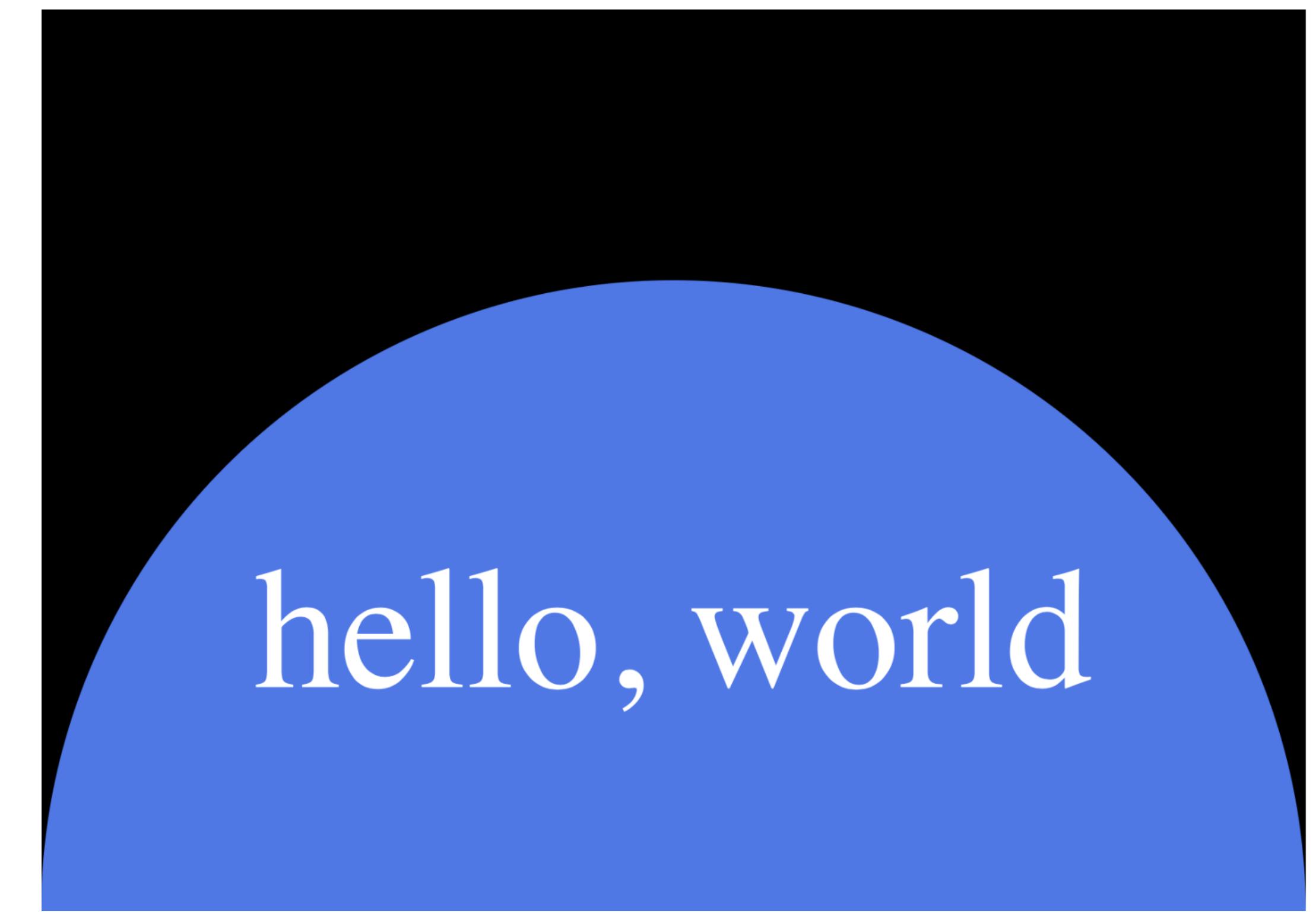
250

```
package main

import (
    "github.com/ajstarks/svg"
    "os"
)

func main() {
    canvas := svg.New(os.Stdout)
    width := 700
    height := 500
    style := "font-size:72pt;fill:white;text-anchor:middle"

    canvas.Start(width, height)
    canvas.Rect(0, 0, width, height)
    canvas.Circle(width/2, height, width/2, "fill:rgb(77, 117, 232)")
    canvas.Text(width/2, height*3/4, "hello, world", style)
    canvas.End()
}
```



localhost:1999/hwsvg.go

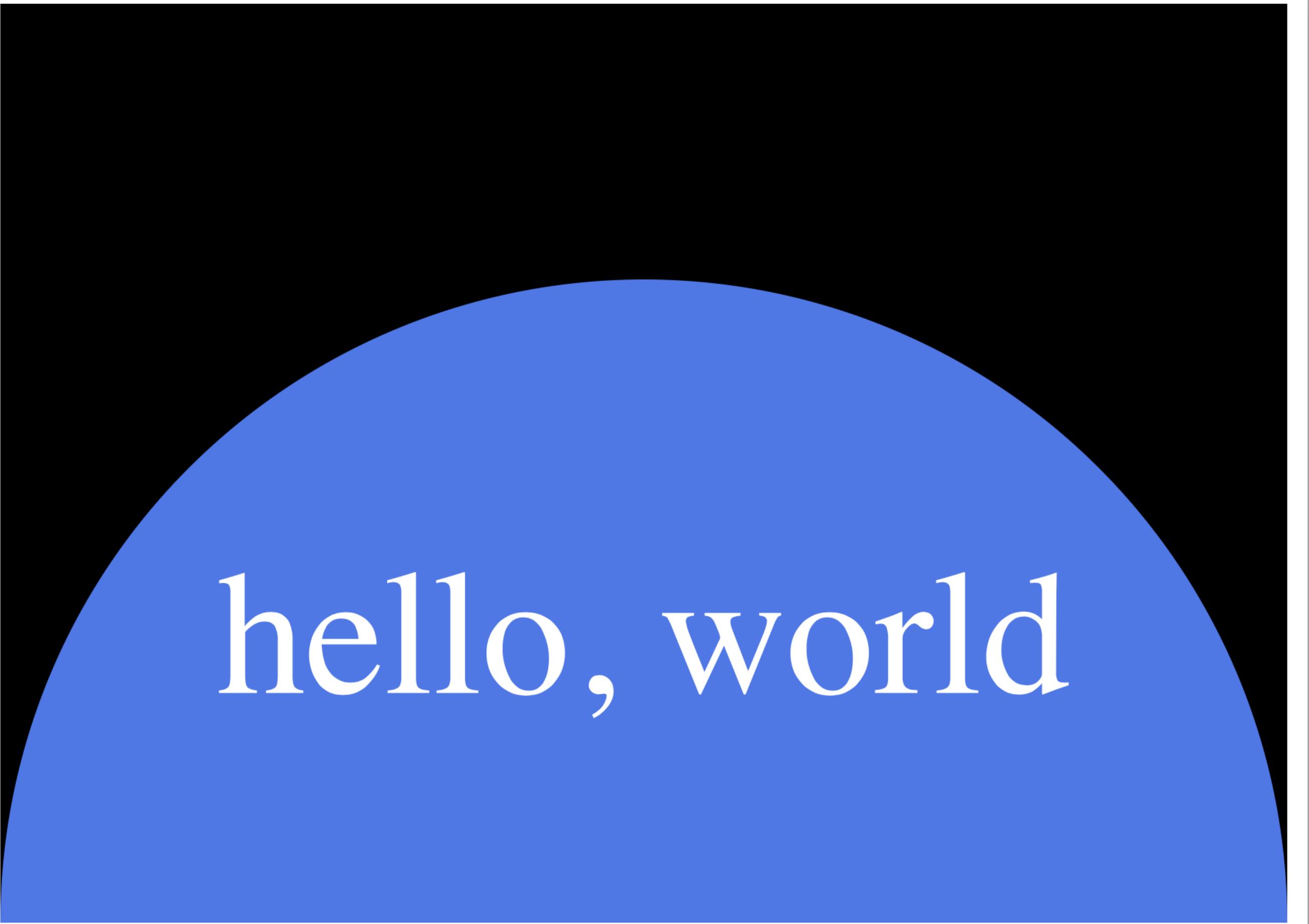
```
package main

import (
    "github.com/ajstarks/svg"
    "os"
)

func main() {
    canvas := svg.New(os.Stdout)
    width := 700
    height := 500
    style := "font-size:72pt;fill:white;text-anchor:middle"

    canvas.Start(width, height)
    canvas.Rect(0, 0, width, height)
    canvas.Circle(width/2, height, width/2, "fill:rgb(77, 117, 232)")
    canvas.Text(width/2, height*3/4, "hello, world", style)
    canvas.End()
}
```

(Shift-Enter to compile and run.) Compile and run after each keystroke



The image shows a developer's environment for creating simple SVGs using Go. On the left, a code editor displays a single Go file named hwsvg.go. The code defines a package main, imports the svgo library and os, and contains a main function. This function creates a new SVG canvas from os.Stdout, sets its width to 700 and height to 500 pixels, and uses the svgo library to draw a blue circle at the center (width/2, height) with a radius of width/2, and to print the text "hello, world" in white font at a position of height*3/4, centered horizontally. The code editor includes a note about using Shift-Enter to compile and run, and a checkbox for "Compile and run after each keystroke". On the right, the browser window shows the resulting SVG visualization. It features a solid black rectangular background. A large, semi-transparent blue circle is centered on the page. Inside the circle, the text "hello, world" is printed in a large, white, sans-serif font.

svgplay

```
localhost:1999/hwsvg.go
```

```
package main

import (
    "github.com/ajstarks/svggo"
    "os"
)

func main() {
    canvas := svg.New(os.Stdout)
    width := 700
    height := 500
    style := "font-size:72pt;fill:white;text-anchor:middle"

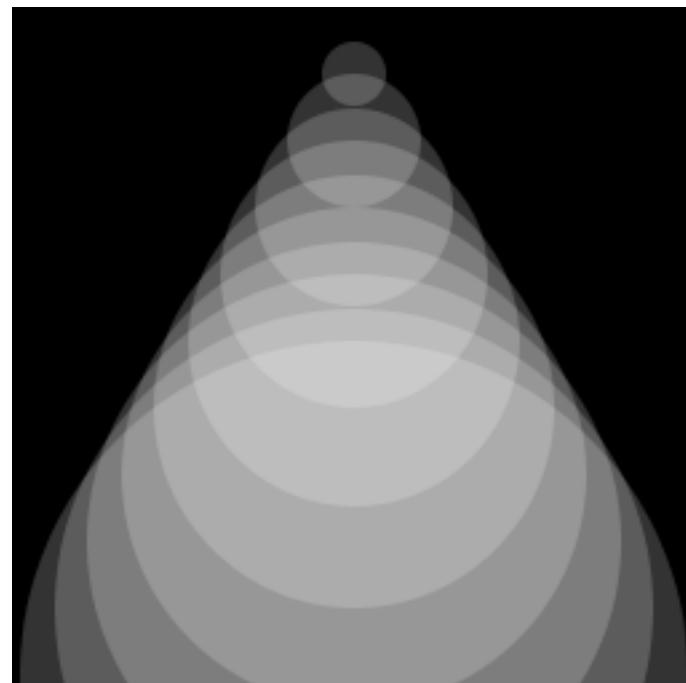
    canvas.Start(width, height)
    canvas.Rect(0, 0, width, height)
    canvas.Circle(width/2, height, width/2, "fill:rgb(255,0,0)")
    canvas.Text(width/2, height*3/4, "hello, Mars", style)
    canvas.End()
}
```

(Shift-Enter to compile and run.) Compile and run after each keystroke

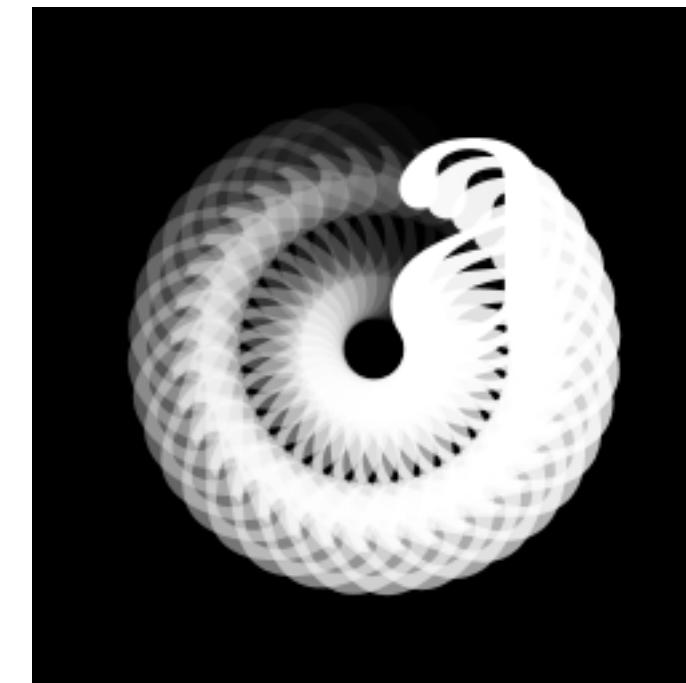
The screenshot shows a web-based development environment. On the left, a code editor displays a Go program named 'hwsvg.go'. The code creates a new SVG canvas from standard output, sets dimensions of 700x500 pixels, and draws a red circle at the center. It then prints the text 'hello, Mars' in large white font at the top of the circle. On the right, the browser's main area displays the resulting SVG output: a solid black rectangle containing a large red circle with the white text 'hello, Mars' centered within it.



clock



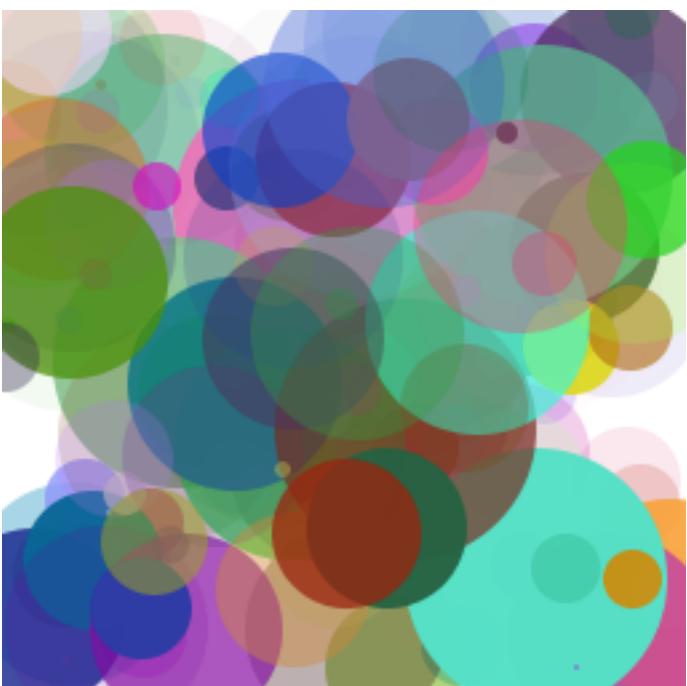
funnel



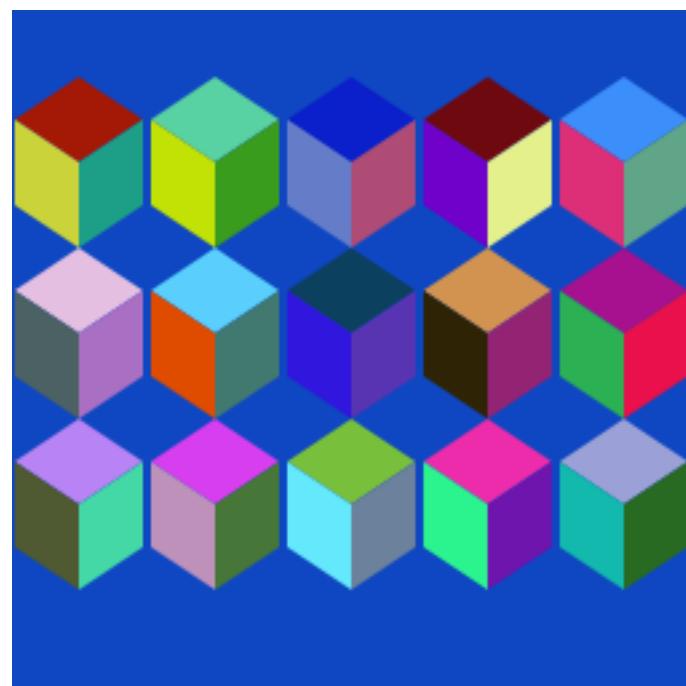
rotext



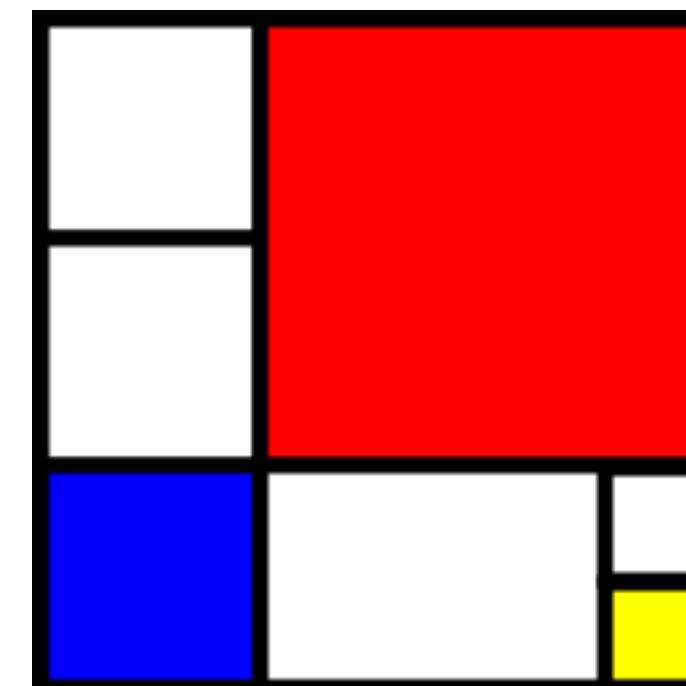
flower



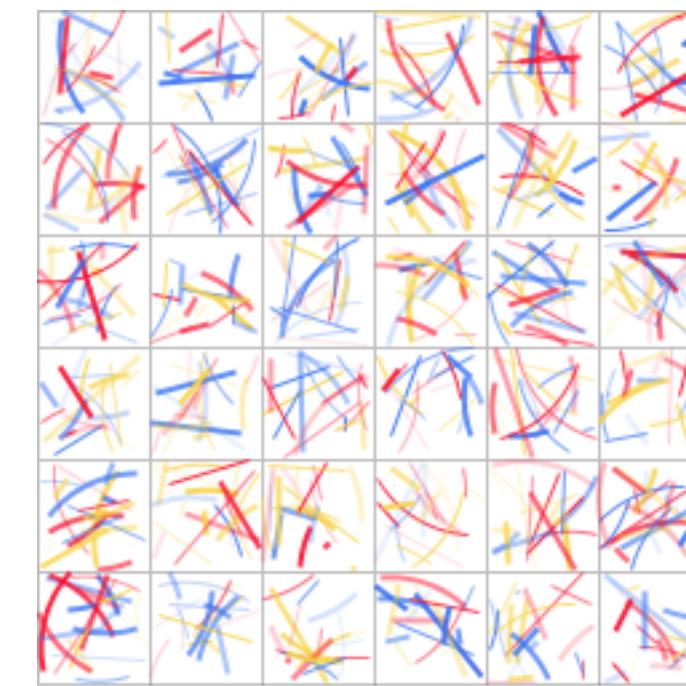
rshape



cube



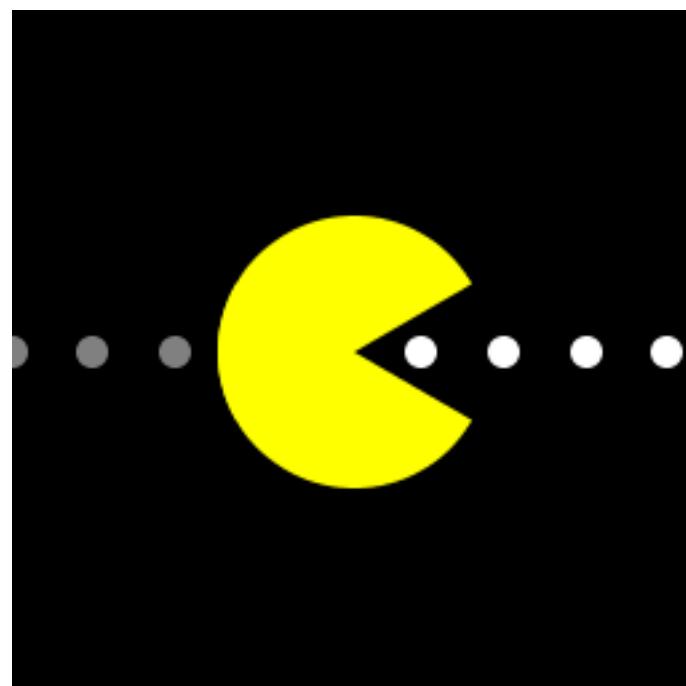
mondrian



lewitt



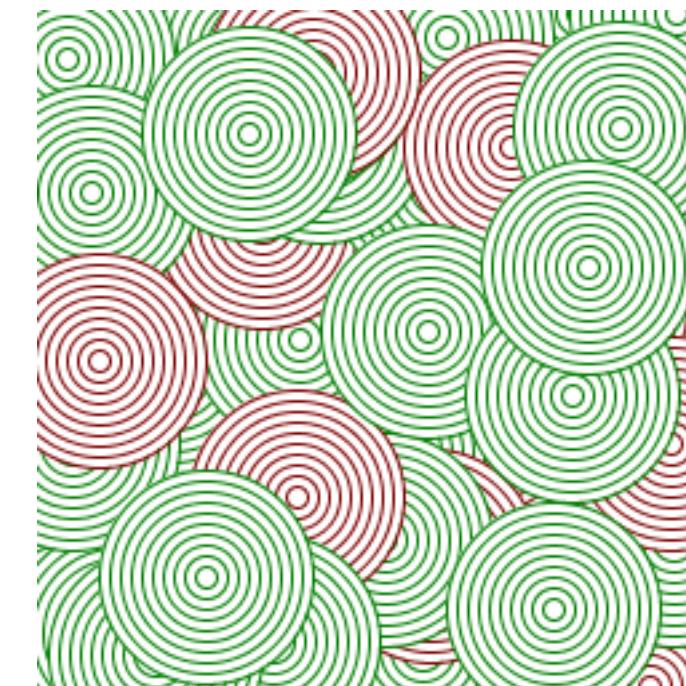
face



pacman



tux

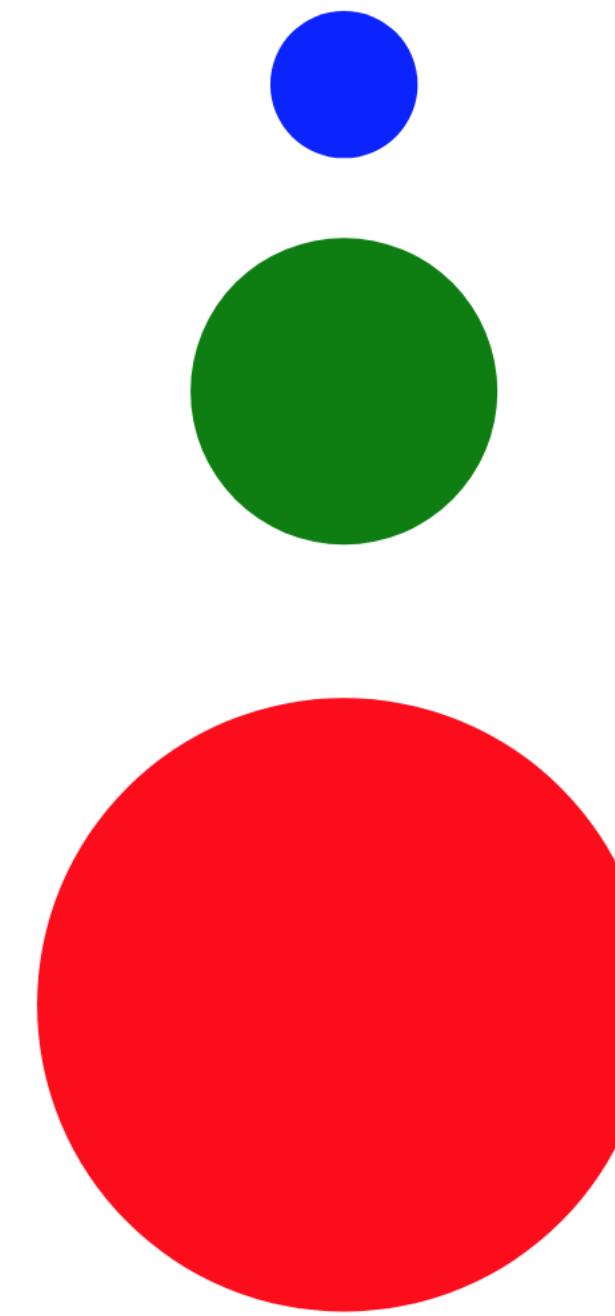


concentric

Data

```
<thing top="100" left="100" sep="100">  
  <item width="50" height="50" name="Little" color="blue">This is small</item>  
  <item width="75" height="100" name="Med"      color="green">This is medium</item>  
  <item width="100" height="200" name="Big"      color="red">This is large</item>  
</thing>
```

Picture



Little:This is small/blue

Med:This is medium/green

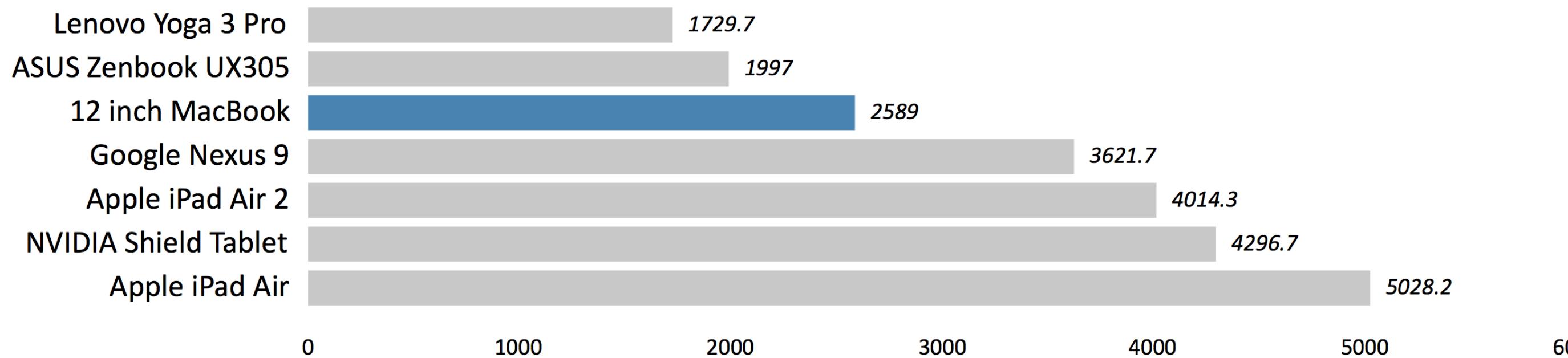
Big:This is large/red

```

<barchart title="2015 MacBook Benchmarks">
    <note>Source: AnandTech, April 14, 2015</note>
    <bdata scale="0,6000,1000"
        title="Mozilla Kraken 1.1 (native browser, milliseconds)">
        <bitem value="1729.7" name="Lenovo Yoga 3 Pro"/>
        <bitem value="1997.0" name="ASUS Zenbook UX305"/>
        <bitem color="steelblue" value="2589.0" name="12 inch MacBook"/>
        <bitem value="3621.7" name="Google Nexus 9"/>
        <bitem value="4014.3" name="Apple iPad Air 2"/>
        <bitem value="4296.7" name="NVIDIA Shield Tablet"/>
        <bitem value="5028.2" name="Apple iPad Air"/>
    </bdata>
</barchart>

```

Mozilla Kraken 1.1 (native browser, milliseconds)



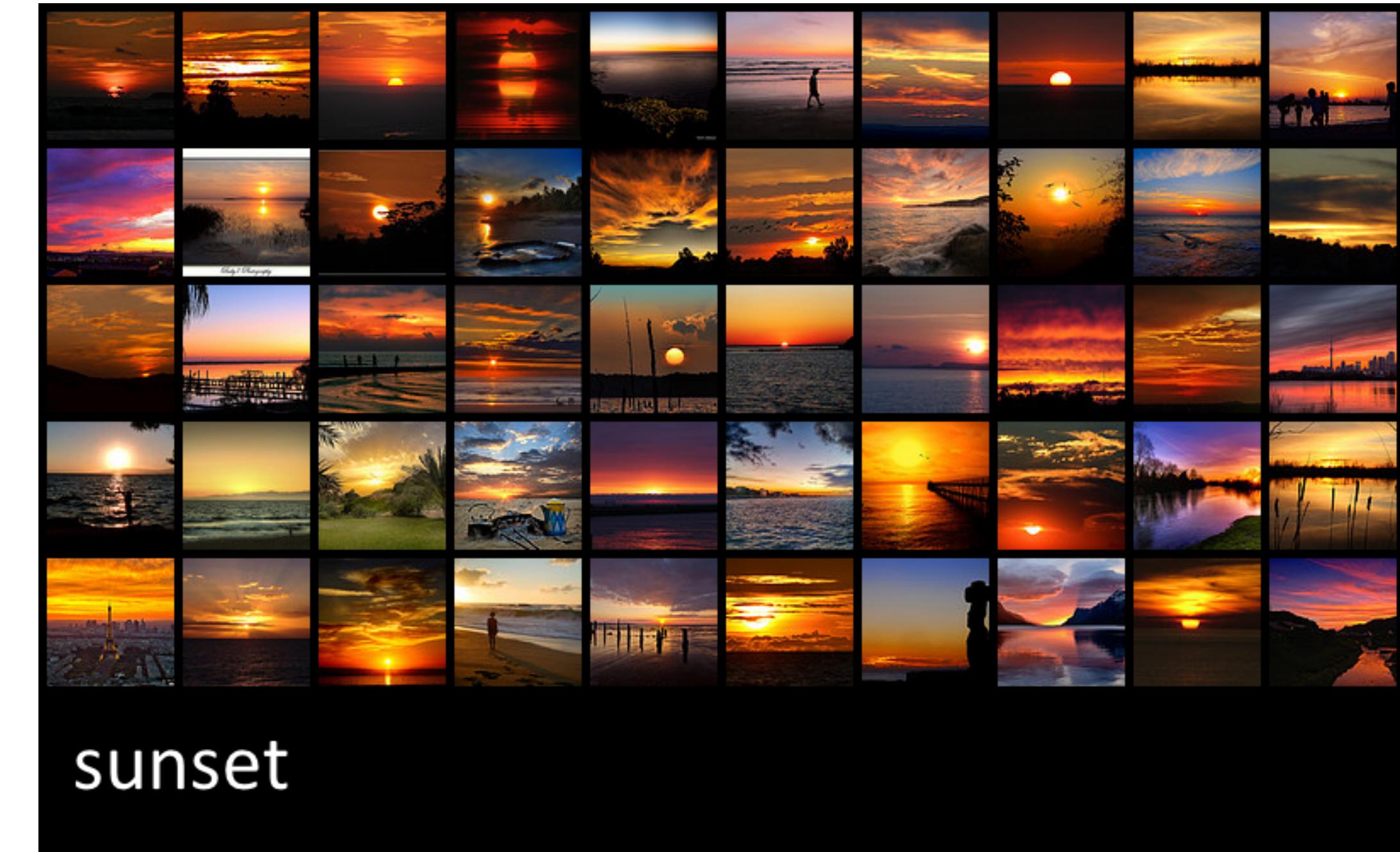
2015 MacBook Benchmarks

Source: AnandTech, April 14, 2015

f50 sunset

```
https://api.flickr.com/services/rest/  
?method=flickr.photos.search  
&api_key=...  
&text=sunset  
&per_page=50  
&sort=interestingness-desc
```

```
<?xml version="1.0" encoding="utf-8" ?>  
<rsp stat="ok">  
  <photos page="1" pages="105615" perpage="50" total="5280747">  
    <photo id="4671838925" ... secret="b070f3363e" server="4068" farm="5" ... />  
    <photo id="3590142202" ... secret="c46752e4d8" server="2441" farm="3" ... />  
    ...  
  </photos>  
</rsp>
```

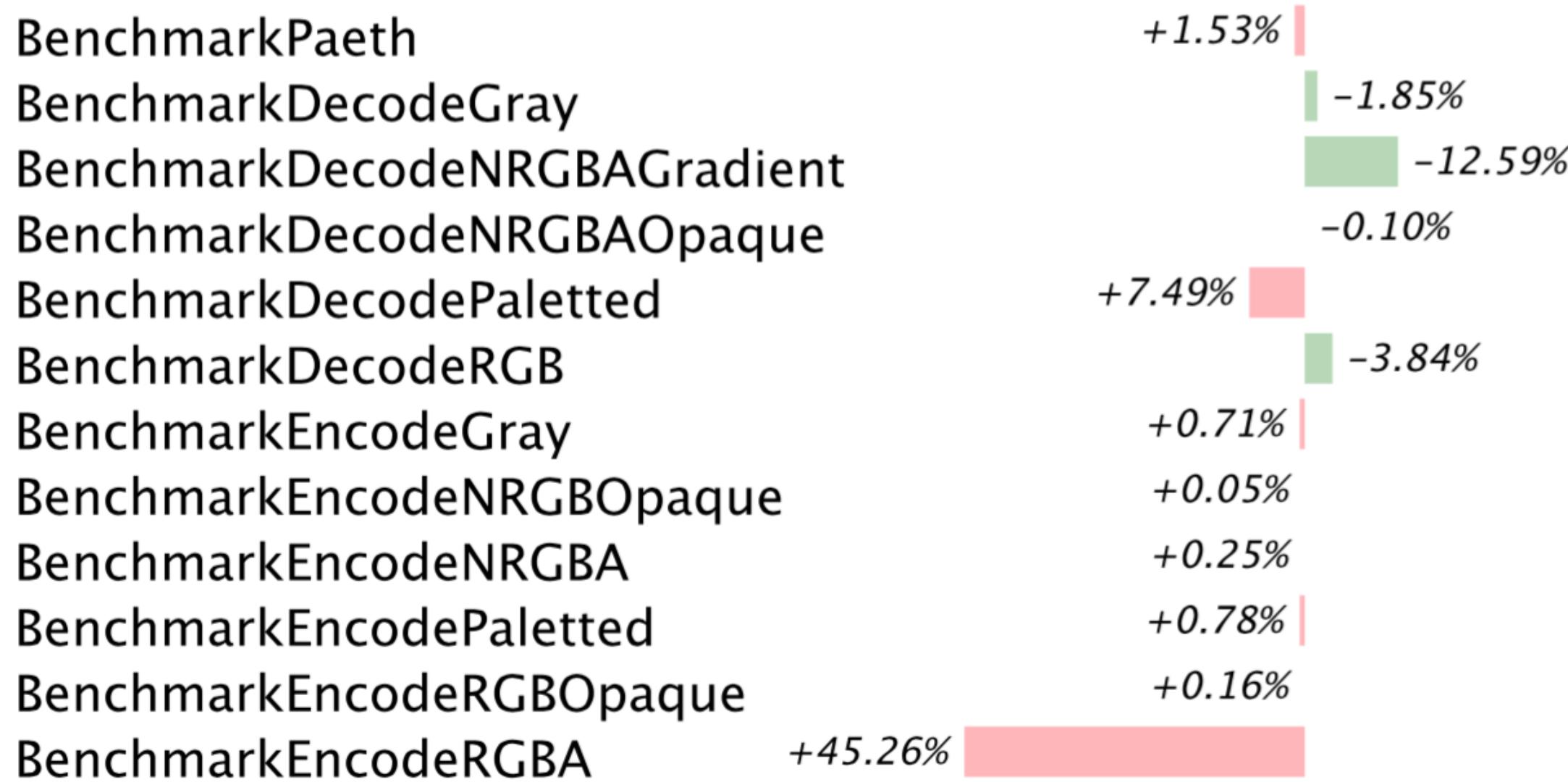


SVGo Clients



benchpng.txt

image/png package: Go 1.3 vs Go 1.4





```
structlayout -json bytes.Reader | structlayout-svg -t "bytes.Reader" > reader.svg
```

Go Programming Language Release History

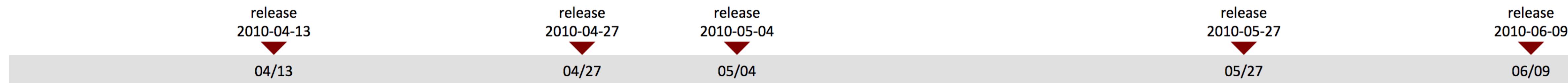
4Q 2009



1Q 2010



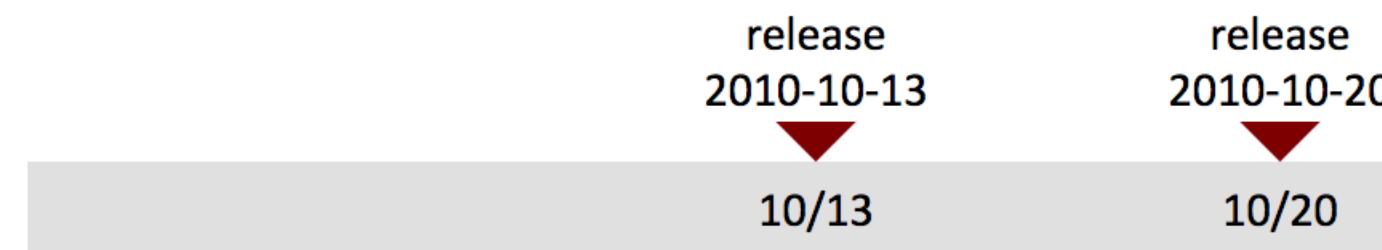
2Q 2010



3Q 2010



4Q 2010





Sample Bullet Graph

The bullet graph features a single, primary measure (for example, current year-to-date revenue) compares that measure to one or more other measures to enrich its meaning, for example, compared to a target), and displays it in the context of qualitative ranges of performance, such as poor, satisfactory, and good.



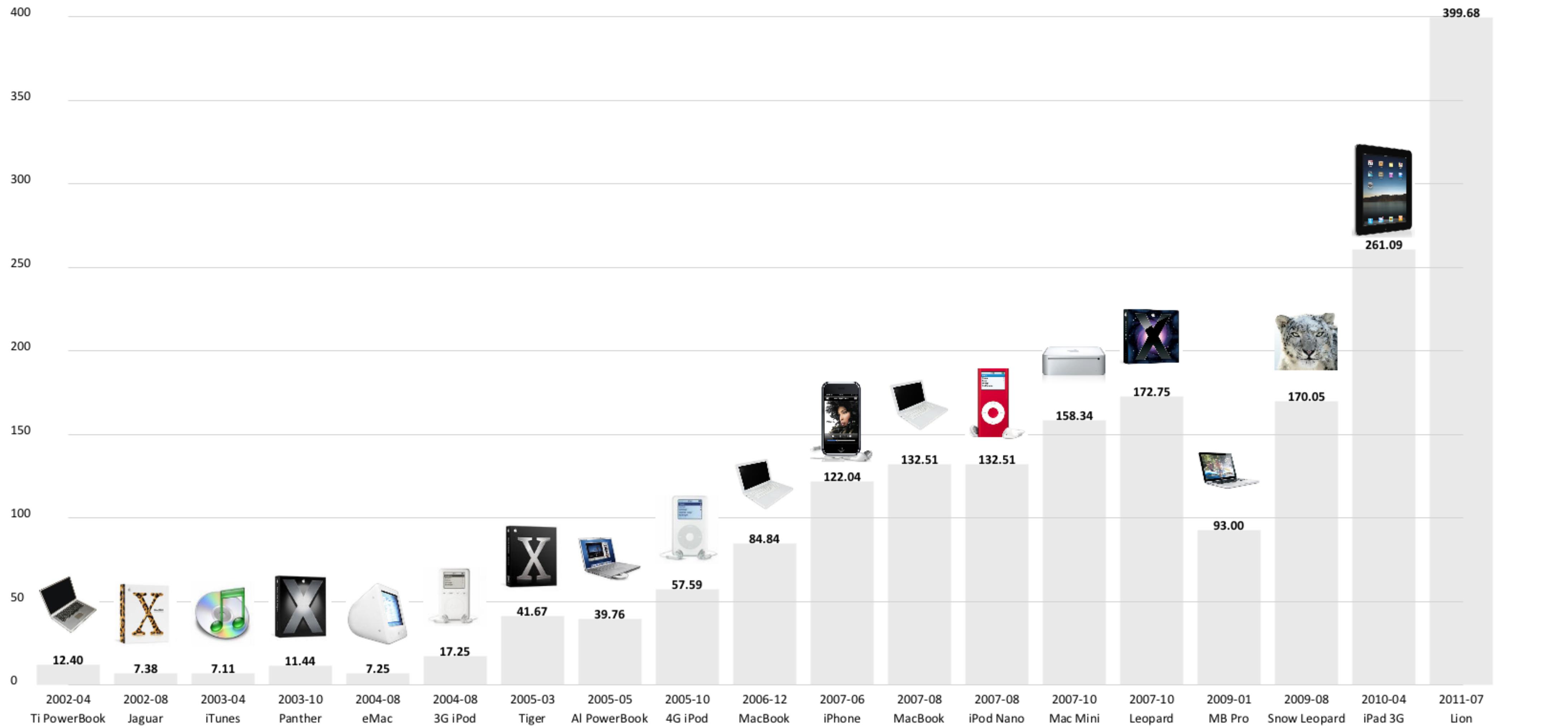
PLANNING TO PLAN



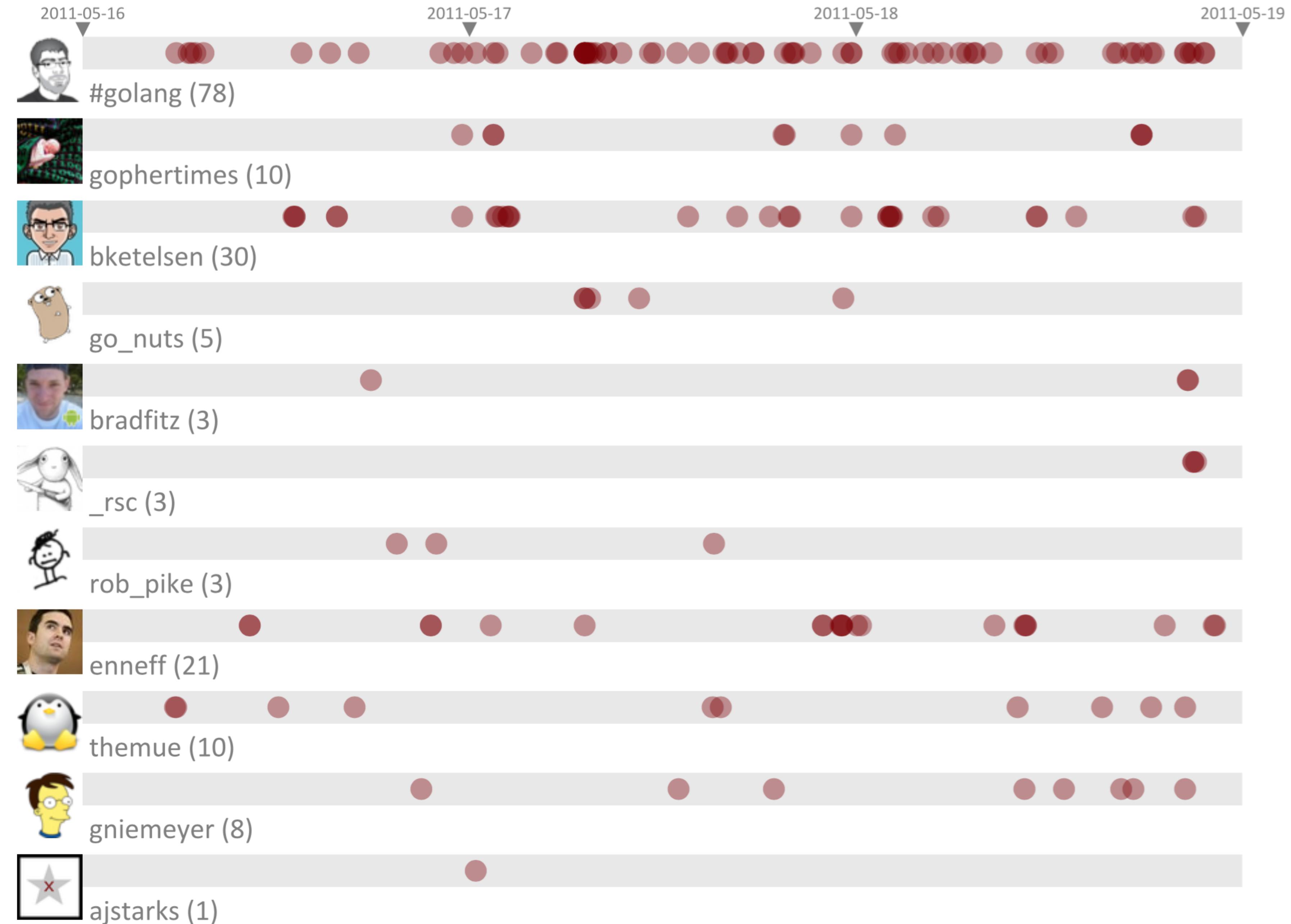




Apple Purchases and Stock Price



Twitter Update Frequency



You are here



JONES

- LAYER TENNIS SEASON 4 WEEK 6 MATCH COMMENTARY BY MIKE MONTEIRO -

MONTIEL



DKNG

- LAYER TENNIS SEASON 4 WEEK 7 MATCH COMMENTARY BY JOHN GRUBER -

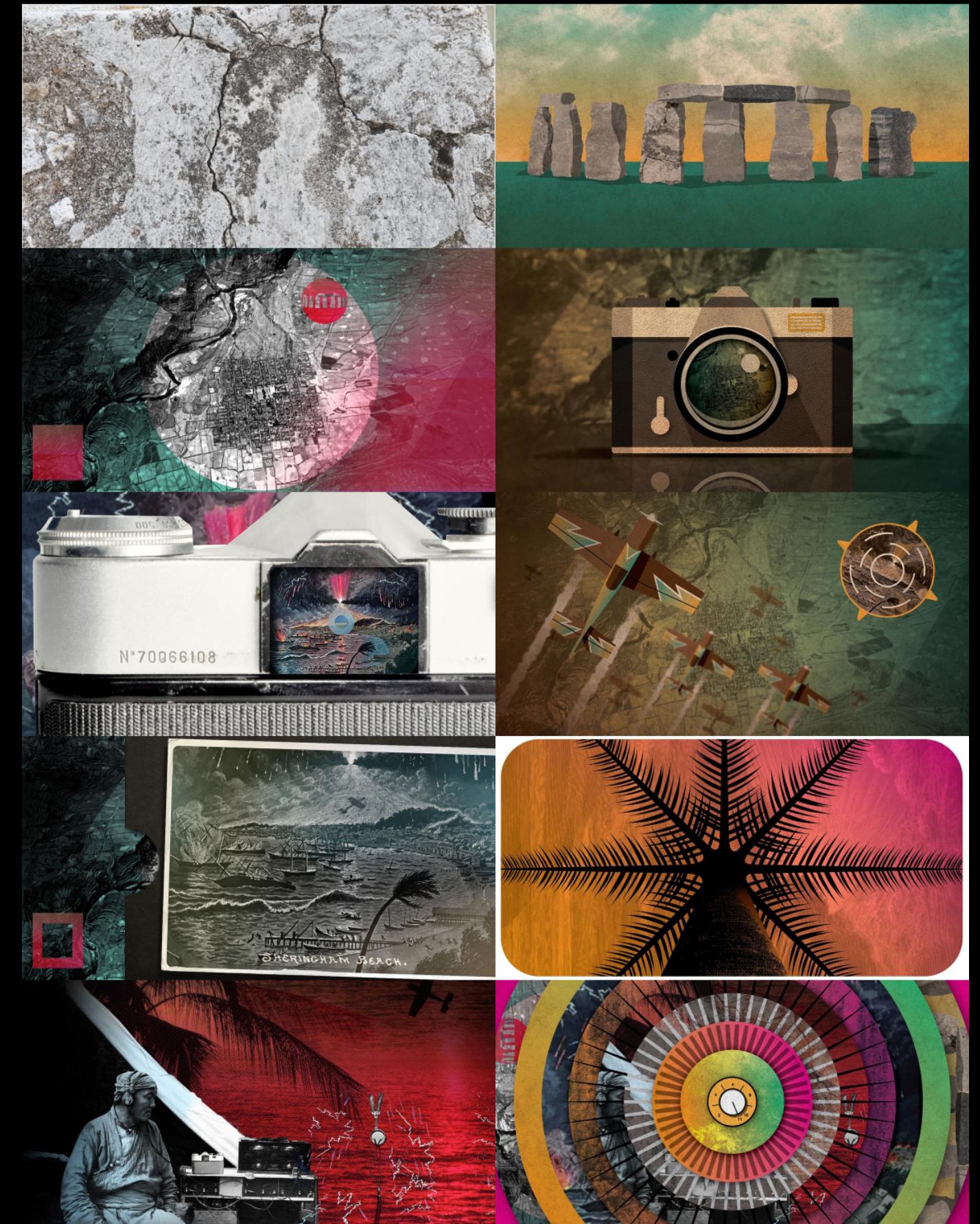
DDL



ANDERSON

- LAYER TENNIS SEASON 4 PLAYOFF QUARTERFINAL COMMENTARY BY BRYAN BEDELL -

DKNG

















```
canvas.Def()
canvas.Gid("unit")
canvas.Polyline(xl, yl, "fill:none")
canvas.Polygon(xp, yp)
canvas.Gend()
```

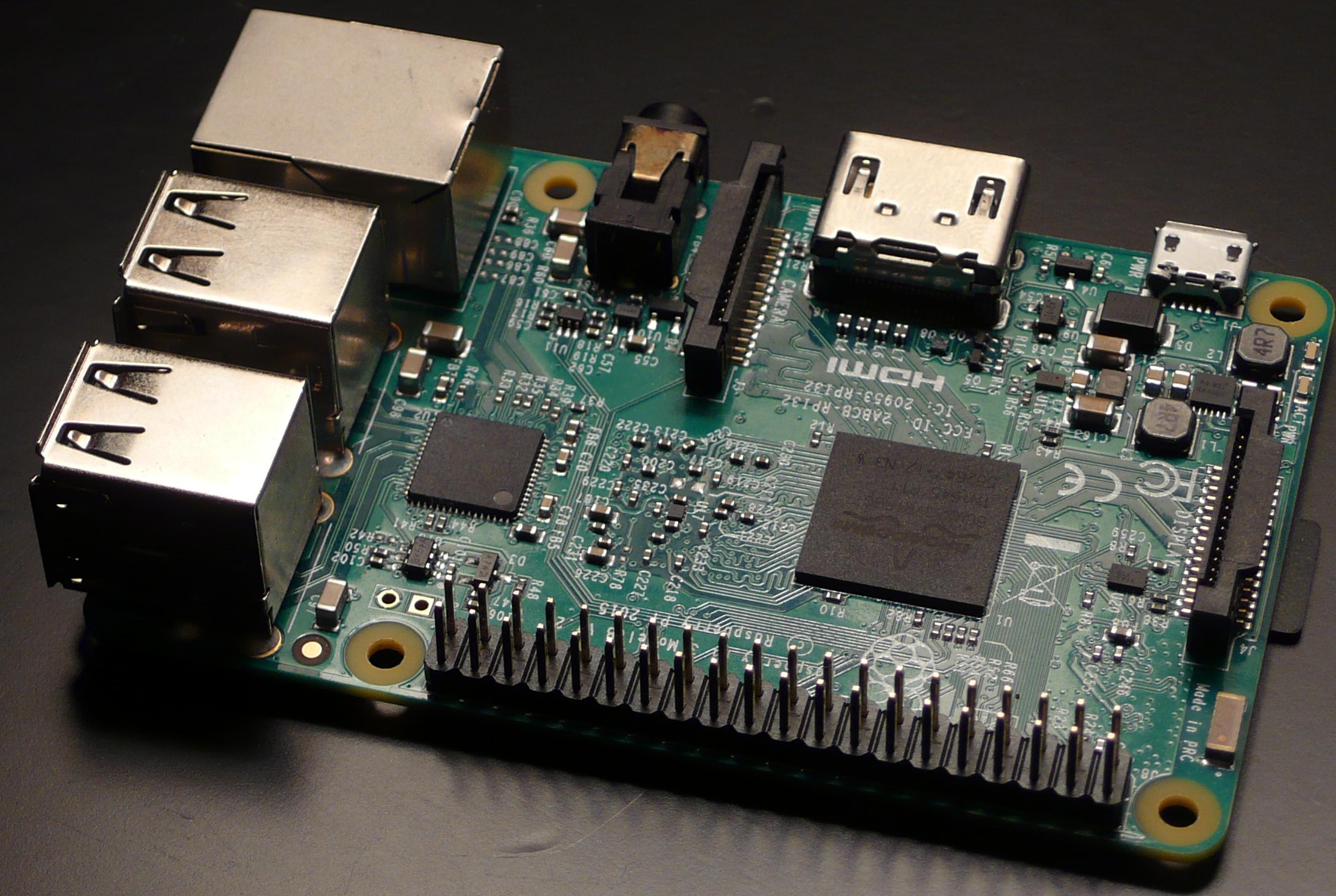


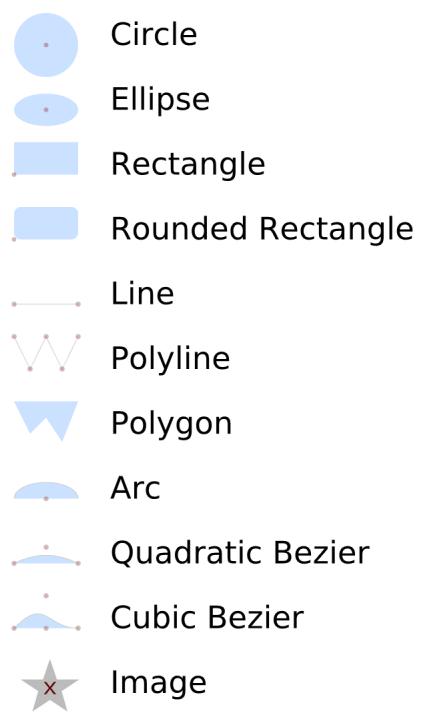
```
canvas.Gid("runit")
canvas.TranslateRotate(150, 180, 180)
canvas.Use(0, 0, "#unit")
canvas.Gend()
canvas.Gend()
canvas.DefEnd()
```



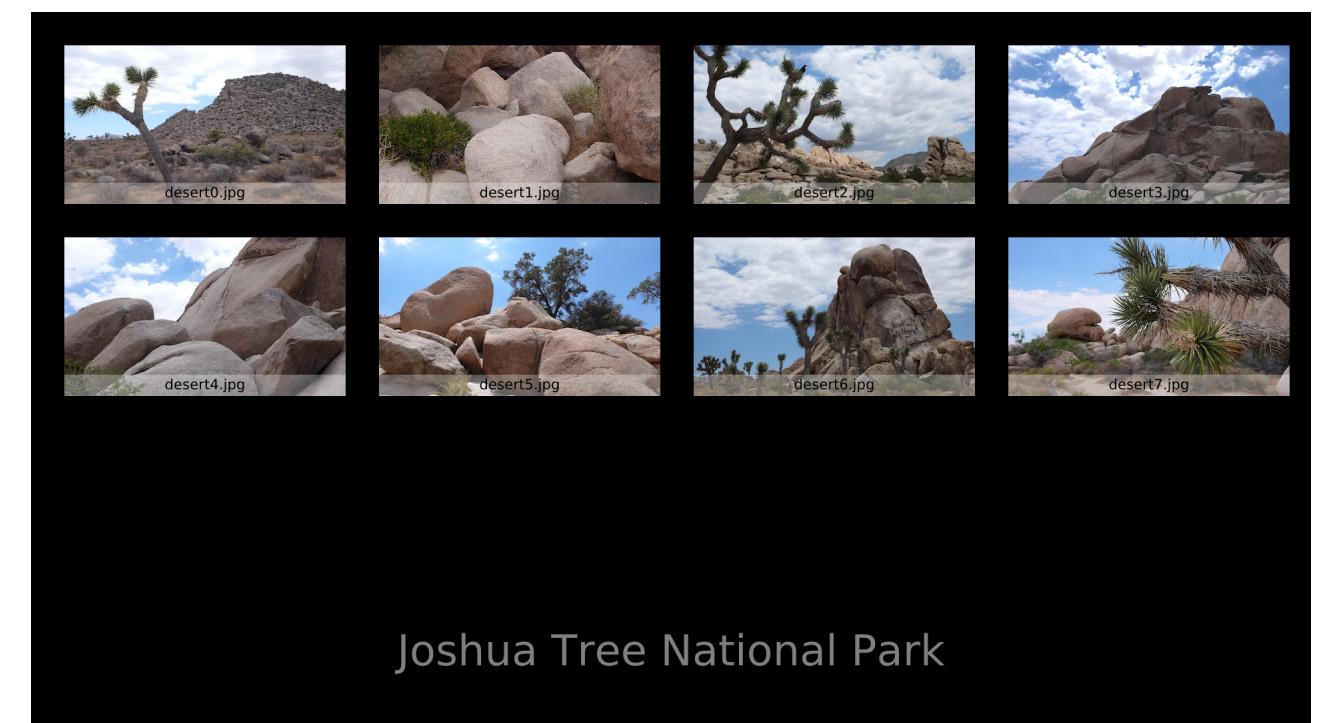
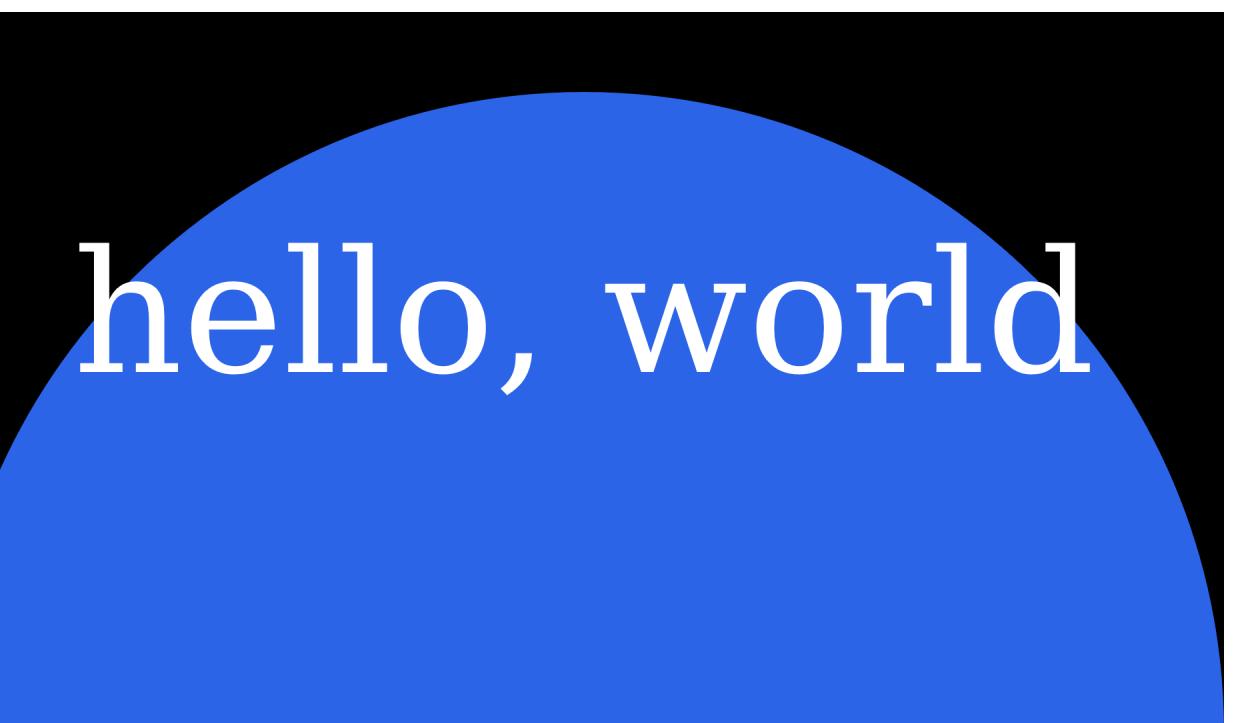
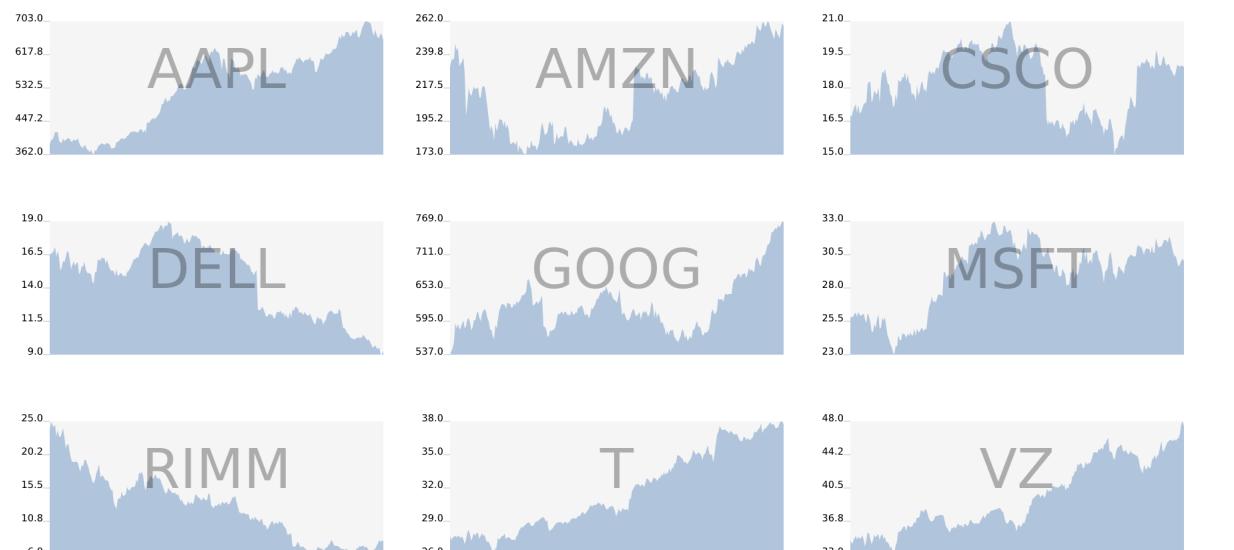
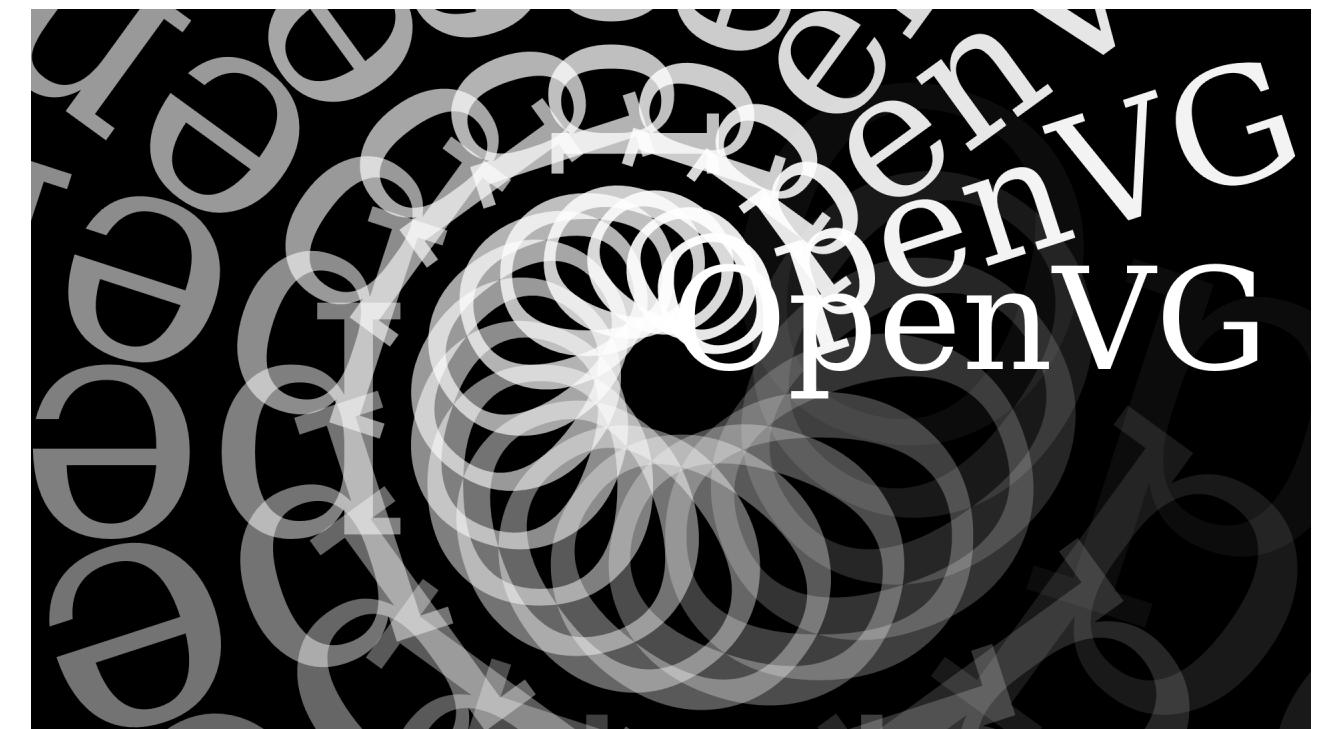
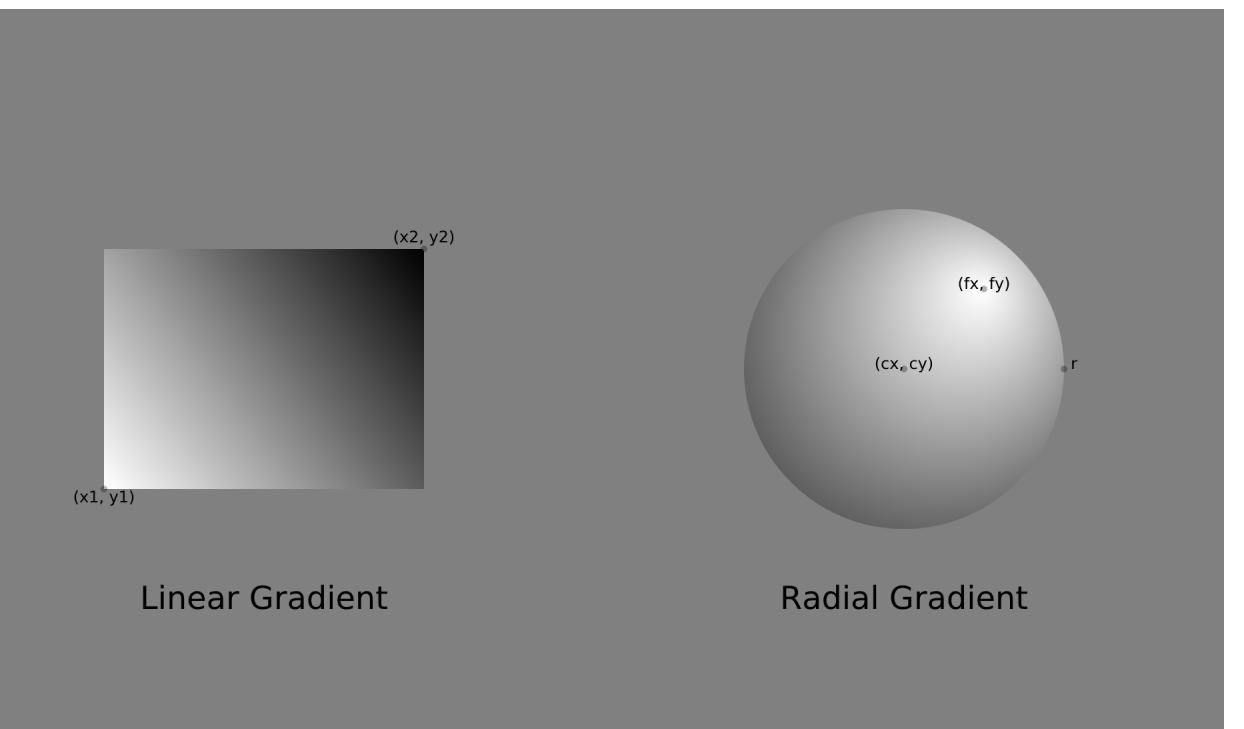
```
for y := 0; < height; y += 130 {
    for x := 100; x < width; x+=100 {
        canvas.Use(x, y, "#unit")
        canvas.Use(x, y, "#runit")
    }
}
```

OpenVG





OpenVG on the Raspberry Pi

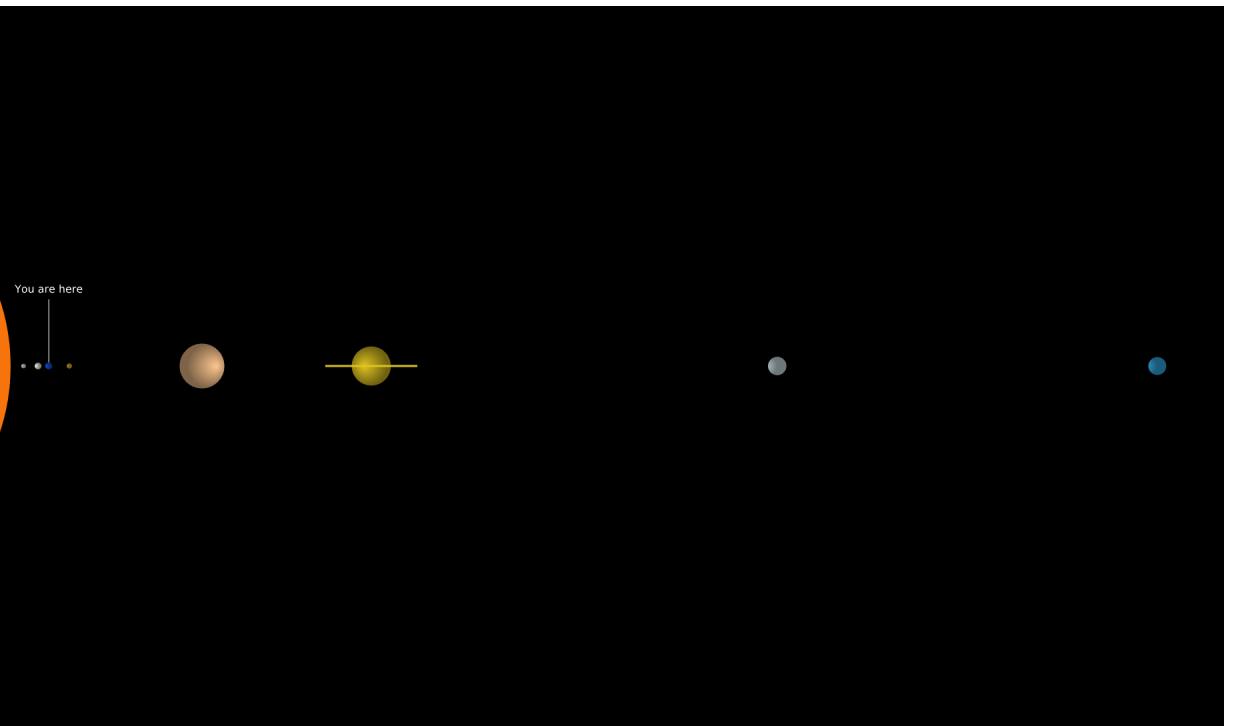


Why I use Go



Anthony Starks

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```
package main
import "fmt"

func main() {
    fmt.Println("hello, world")
}
```

This is the traditional hello, world program.
It's six lines long, and imports the `fmt` package,
leading some to be surprised at the size of the resulting binary.

```
package main

import (
    "bufio"
    "github.com/ajstarks/openvg"
    "os"
)

func main() {
    width, height := openvg.Init()

    w2 := openvg.VGfloat(width / 2)
    h2 := openvg.VGfloat(height / 2)
    w := openvg.VGfloat(width)

    openvg.Start(width, height)                      // Start the picture
    openvg.BackgroundColor("black")                  // Black background
    openvg.FillRGB(44, 100, 232, 1)                // Big blue marble
    openvg.Circle(w2, 0, w)                         // The "world"
    openvg.FillColor("white")                       // White text
    openvg.TextMid(w2, h2, "hello, world", "serif", width/10) // Greetings
    openvg.End()                                    // End the picture
    bufio.NewReader(os.Stdin).ReadBytes('\n') // Pause until [RETURN]
    openvg.Finish()                                // Graphics cleanup
}
```



OpenVG Functions

Circle (x, y, r VGfloat)

Ellipse (x, y, w, h VGfloat)

Rect (x, y, w, h VGfloat)

Roundrect (x, y, w, h, rw, rh VGfloat)

Line (x1, y1, x2, y2 VGfloat)

Polyline (x, y []VGfloat)

Polygon (x, y []VGfloat)

Arc (x, y, w, h, sa, aext VGfloat)

Qbezier (sx, sy, cx, cy, ex, ey VGfloat)

Cbezier (sx, sy, cx, cy, px, py, ex, ey VGfloat)

Image (x, y VGfloat, w, h int, s string)

Text (x, y VGfloat, s, font string, size int)

TextMid (x, y VGfloat, s, font string, size int)

TextEnd (x, y VGfloat, s, font string, size int)

Partly Cloudy

40°



(feels like 33°)

Tuesday April 17

7:20 pm

Missouri's Governor Was Already in Trouble. A New Felony Claim Adds to That.
U.S. Seeks to Send American ISIS Suspect to Another Country's Custody
Sessions Tries to Put New Pressure on Drug Companies in Opioid Crisis
A Southwest Airlines Engine Explodes, Killing a Passenger
Marco Rubio, Darling of G.O.P. Establishment, Hires a Thorn in Its Side

Mostly Cloudy

47°

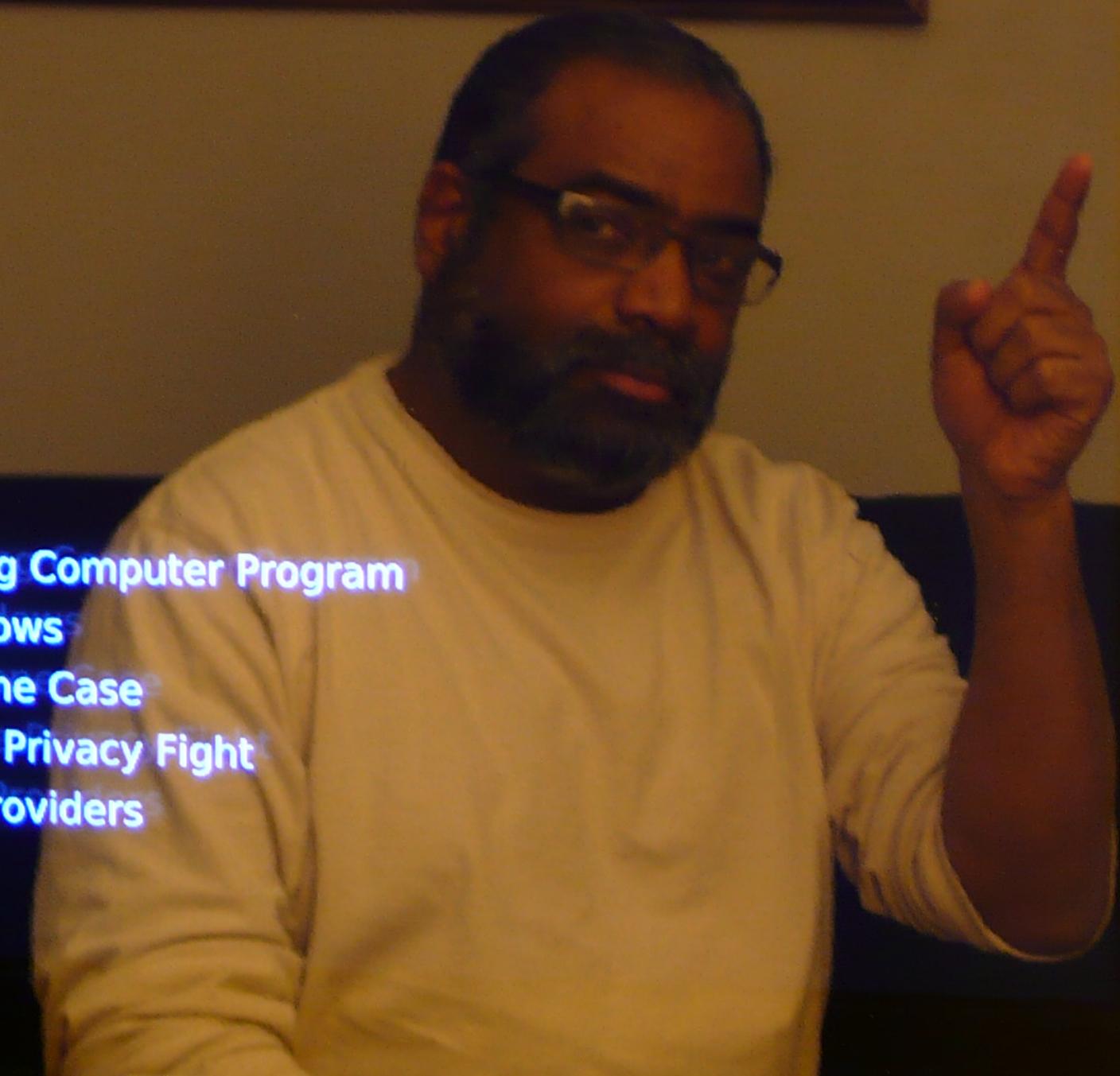


(feels like 45°)

Sunday March 13

3:03 am

Farhad and Mike Discuss the Apple Case and a Go-Playing Computer Program
Getting the Weather Report From Windows
The Government Answers Apple in the iPhone Case
Apple and U.S. Bitterly Turn Up Volume in iPhone Privacy Fight
F.C.C. Proposes Privacy Rules for Internet Providers



MECHANICAL DRAWING

GEOMETRICAL DRAWING

Mostly Cloudy

36° 

(feels like 29°)

29% Chance of precipitation

Tuesday February 23

9:41 pm

Justice Alito Addresses Prospect of an 8-Member Court

Michigan: State Senate Approves Aid to Help Flint Residents Pay Water Bills

Told to 'Take the Gloves Off,' John Kasich Says the Race Is Out of His Hands

Utah: Polygamist Sect Leaders Are Arrested on Fraud Charges

North Carolina: State Lawmakers Target Restroom Anti-Bias Law in Charlotte



HDMI Pi

Clear

66°



Friday April 14

5:55 pm

White House to Keep Its Visitor Logs Secret

Georgia Officers are Fired After Kicking Man at Traffic Stop

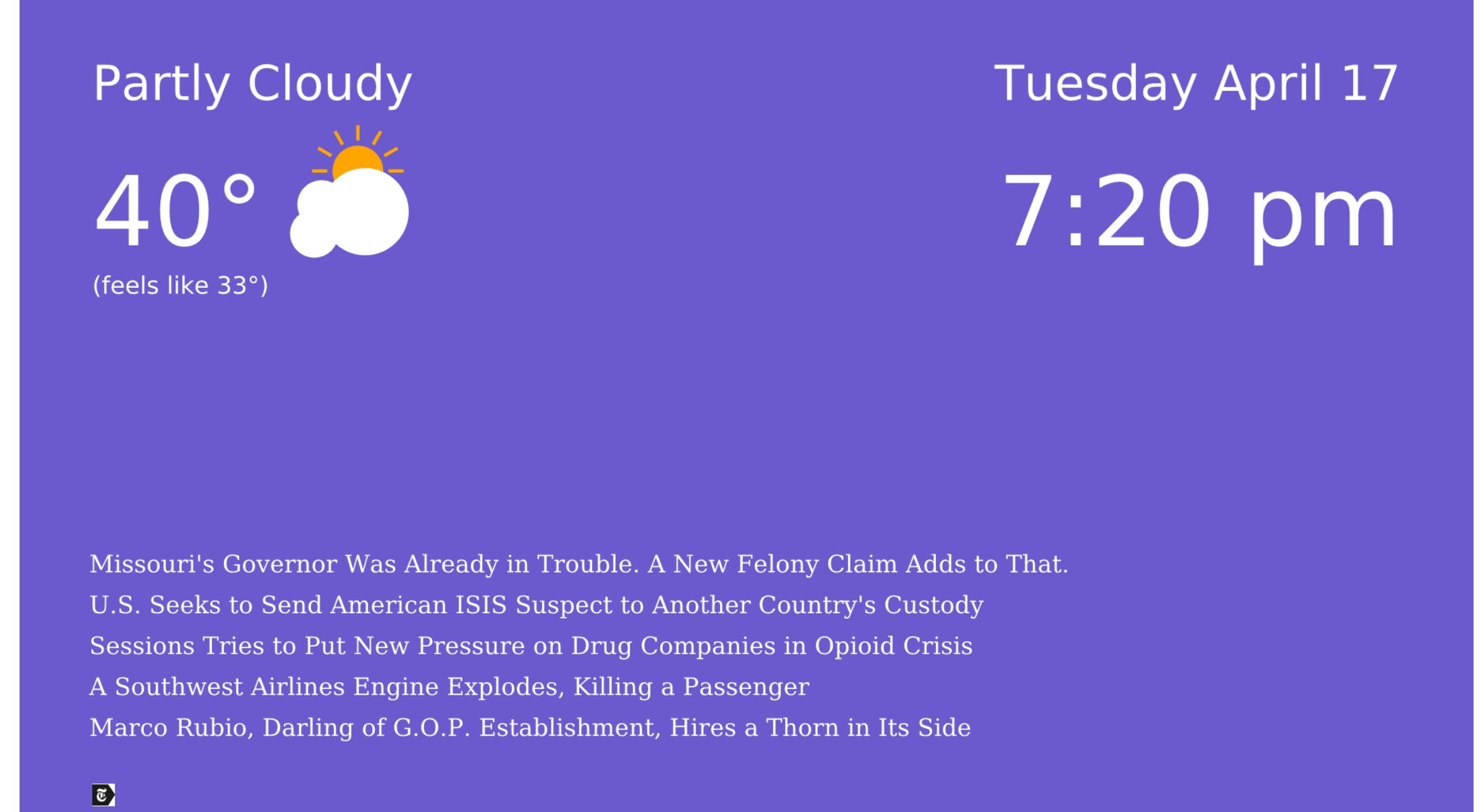
Does a Uniform Keep Officers in Line? The Baltimore Chief Thinks So

Wisconsin Man Who Mailed Manifesto to Trump Is Captured After 10-Day Manhunt

California Today: GoPros, Audiobooks and Other Perks of the Library



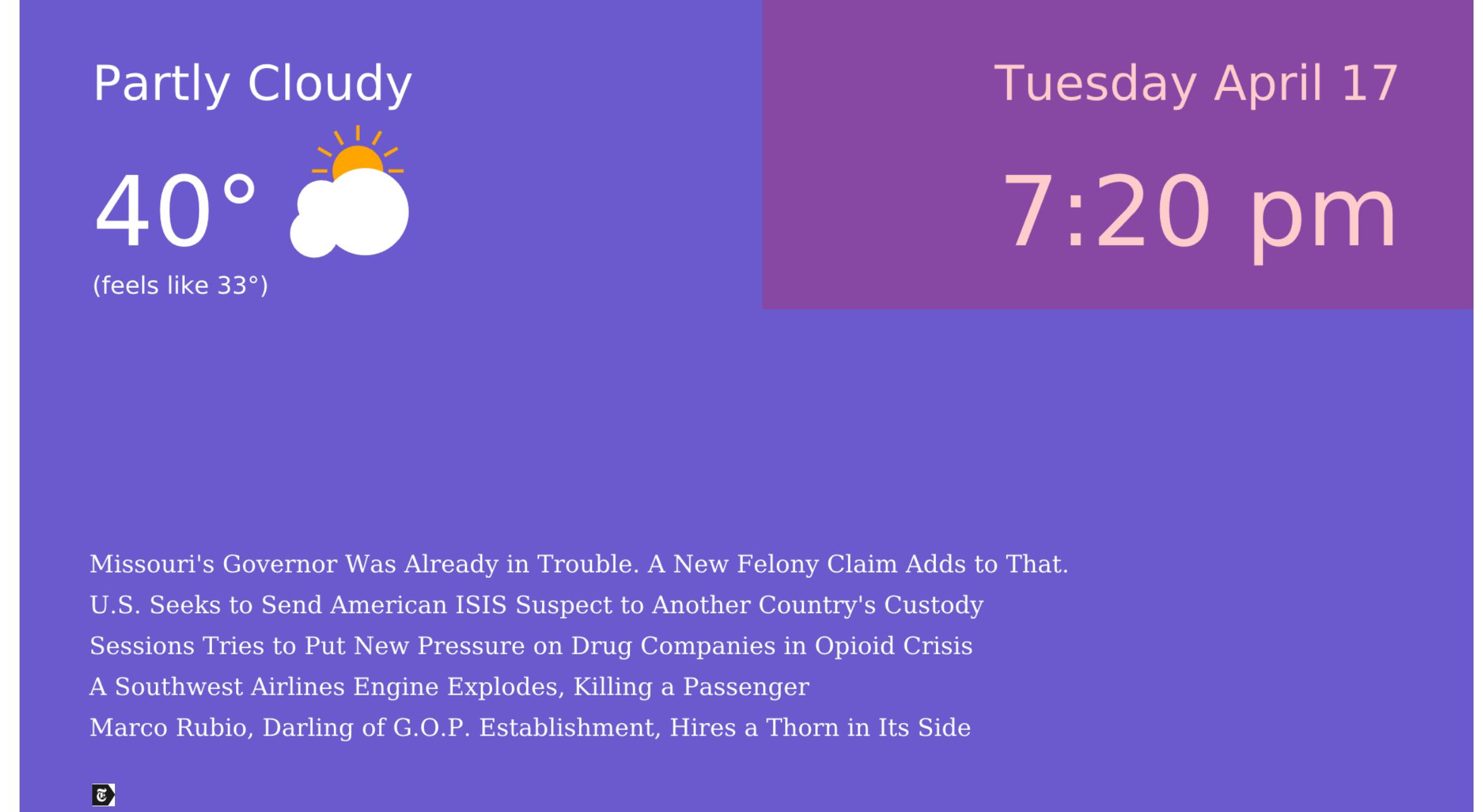
```
func main() {  
  
    //...  
  
    dateticker := time.NewTicker(1 * time.Minute)  
    weatherticker := time.NewTicker(5 * time.Minute)  
    headticker := time.NewTicker(10 * time.Minute)  
    sigint := make(chan os.Signal, 1)  
    signal.Notify(sigint, os.Interrupt)  
  
    for {  
        select {  
            case <-weatherticker.C:  
                canvas.weather(*location)  
            case <-dateticker.C:  
                canvas.clock(*smartcolor)  
            case <-headticker.C:  
                canvas.headlines(*section, *thumb)  
            case <-sigint:  
                openvg.Finish()  
                os.Exit(0)  
        }  
    }  
}
```



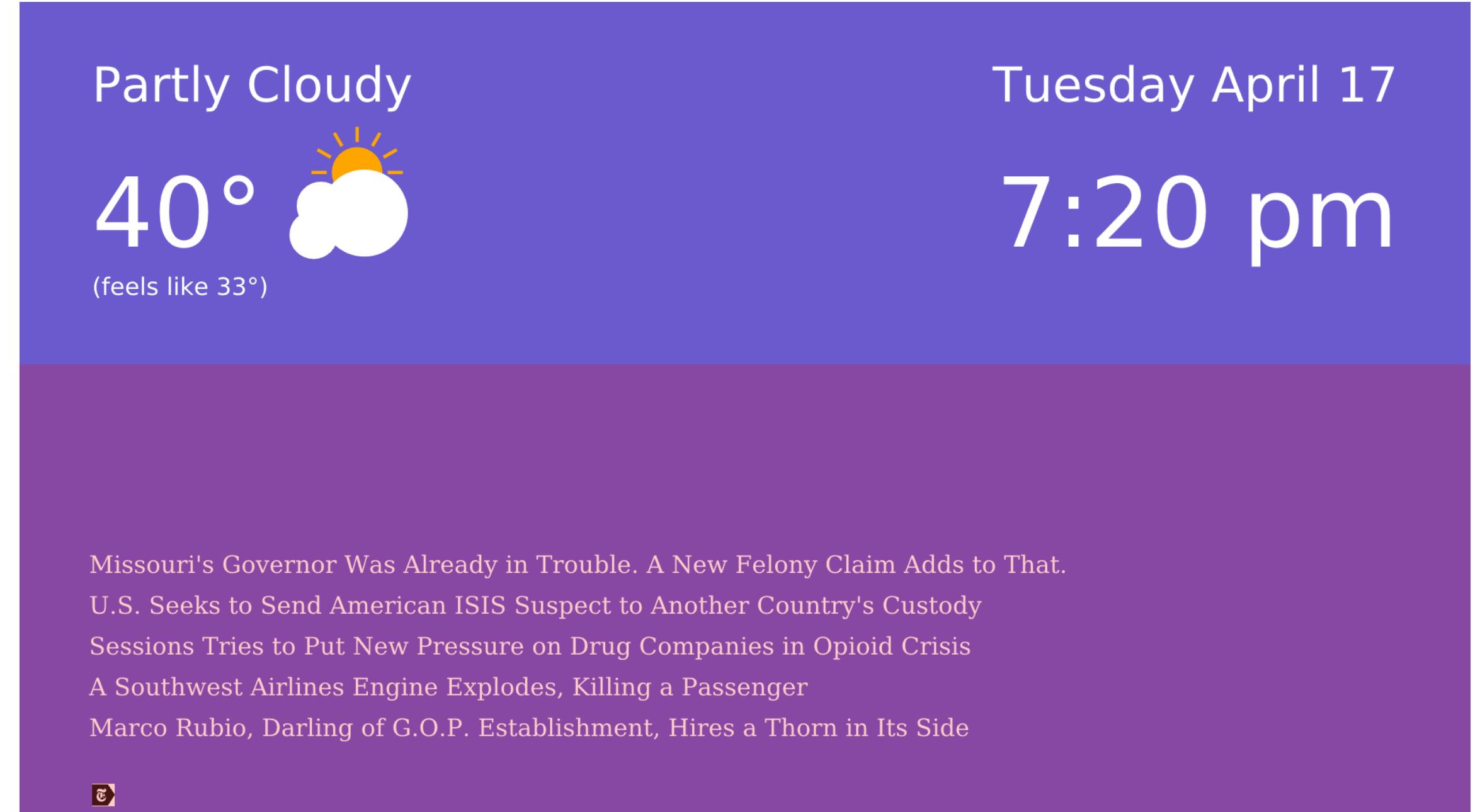
```
func main() {  
    //...  
  
    dateticker := time.NewTicker(1 * time.Minute)  
    weatherticker := time.NewTicker(5 * time.Minute)  
    headticker := time.NewTicker(10 * time.Minute)  
    sigint := make(chan os.Signal, 1)  
    signal.Notify(sigint, os.Interrupt)  
  
    for {  
        select {  
            case <-weatherticker.C:  
                canvas.weather(*location)  
            case <-dateticker.C:  
                canvas.clock(*smartcolor)  
            case <-headticker.C:  
                canvas.headlines(*section, *thumb)  
            case <-sigint:  
                openvg.Finish()  
                os.Exit(0)  
        }  
    }  
}
```



```
func main() {  
  
    //...  
  
    dateticker := time.NewTicker(1 * time.Minute)  
    weatherticker := time.NewTicker(5 * time.Minute)  
    headticker := time.NewTicker(10 * time.Minute)  
    sigint := make(chan os.Signal, 1)  
    signal.Notify(sigint, os.Interrupt)  
  
    for {  
        select {  
            case <-weatherticker.C:  
                canvas.weather(*location)  
            case <-dateticker.C:  
                canvas.clock(*smartcolor)  
            case <-headticker.C:  
                canvas.headlines(*section, *thumb)  
            case <-sigint:  
                openvg.Finish()  
                os.Exit(0)  
        }  
    }  
}
```



```
func main() {  
  
    //...  
  
    dateticker := time.NewTicker(1 * time.Minute)  
    weatherticker := time.NewTicker(5 * time.Minute)  
    headticker := time.NewTicker(10 * time.Minute)  
    sigint := make(chan os.Signal, 1)  
    signal.Notify(sigint, os.Interrupt)  
  
    for {  
        select {  
            case <-weatherticker.C:  
                canvas.weather(*location)  
            case <-dateticker.C:  
                canvas.clock(*smartcolor)  
            case <-headticker.C:  
                canvas.headlines(*section, *thumb)  
            case <-sigint:  
                openvg.Finish()  
                os.Exit(0)  
        }  
    }  
}
```



Deck



a Go package for presentations

Start the deck <deck>

Set the canvas size <canvas width="1200" height="900"/>

Begin a slide <slide bg="white" fg="black">

Draw some text <text xp="50" yp="90" sp="5" font="" color="" opacity="" align="c">Deck elements</text>

Place an image <image name="follow.jpg" caption="Dreams" xp="70" yp="60" width="640" height="480" scale="" />

Make a bullet list <list xp="10" yp="70" sp="3" color="" opacity="" type="bullet">

- text, list, image
- line, rect, ellipse
- arc, curve, polygon

End the list </list>

Draw a line <line xp1="20" yp1="10" xp2="30" yp2="10" sp="" color="" opacity="" />

Draw a rectangle <rect xp="35" yp="10" wp="4" hp="3" color="rgb(127,0,0)" opacity="" />

Draw an ellipse <ellipse xp="45" yp="10" wp="4" hp="3" color="rgb(0,127,0)" opacity="" />

Draw an arc <arc xp="55" yp="10" wp="4" hp="3" a1="0" a2="180" color="rgb(0,0,127)" opacity="" />

Draw a quadratic bezier <curve xp1="60" yp1="10" xp2="75" yp2="20" xp3="70" yp3="10" color="" opacity="" />

Draw a polygon <polygon xc="75 75 80" yc="8 12 10" color="rgb(0,0,127)" opacity="" />

End the slide </slide>

End of the deck </deck>

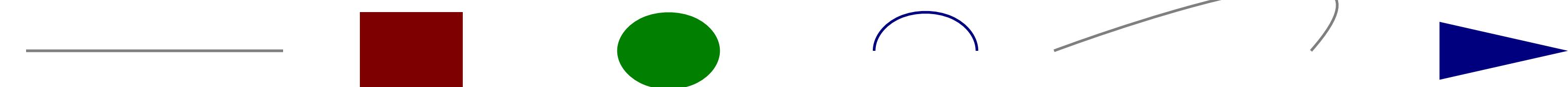
Anatomy of a Deck

Deck elements

- text, list, image
- line, rect, ellipse
- arc, curve, polygon



Dreams



Percent Grid

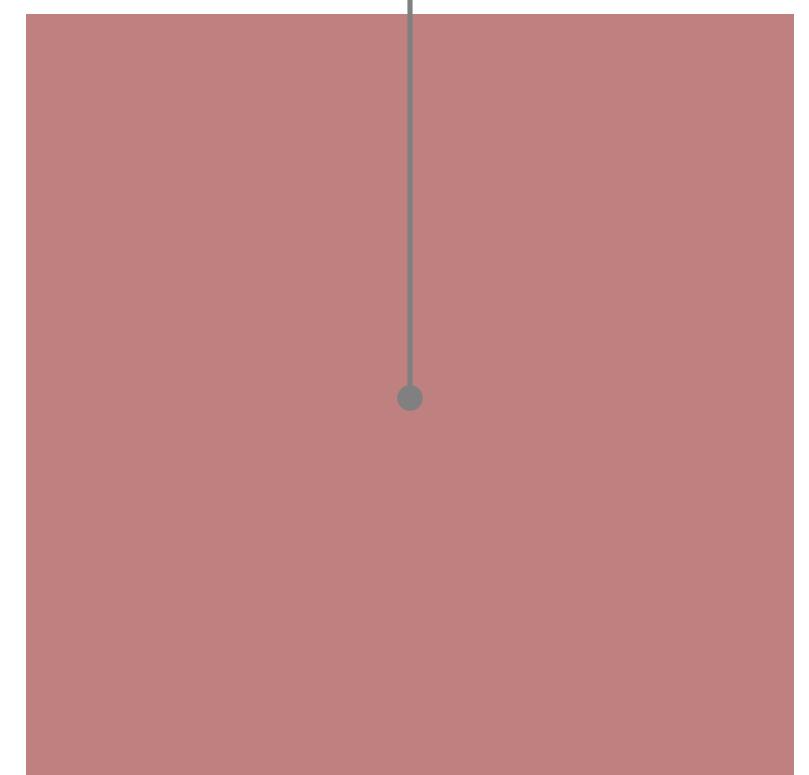
10%, 50%

Hello

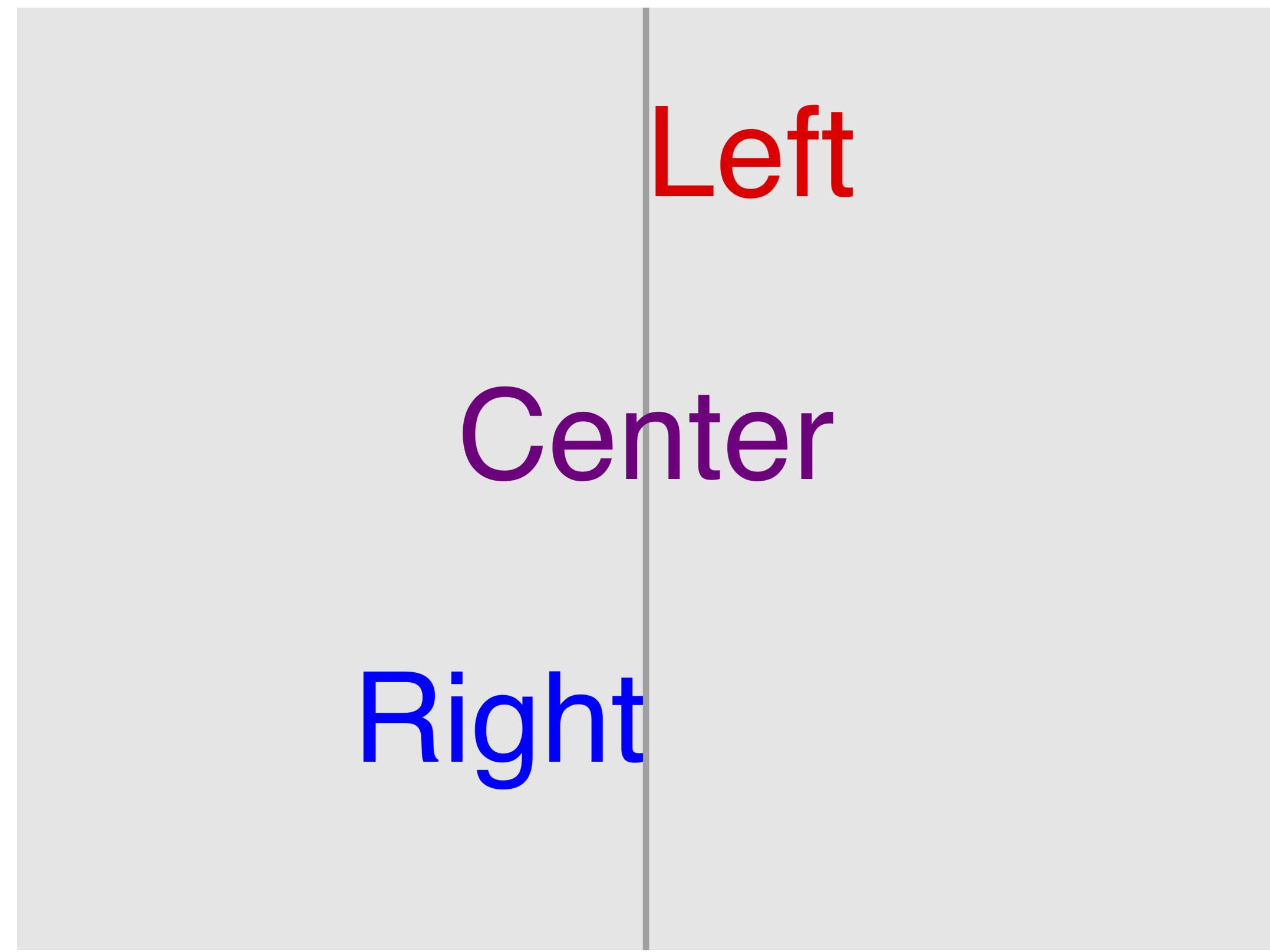
50%, 50%



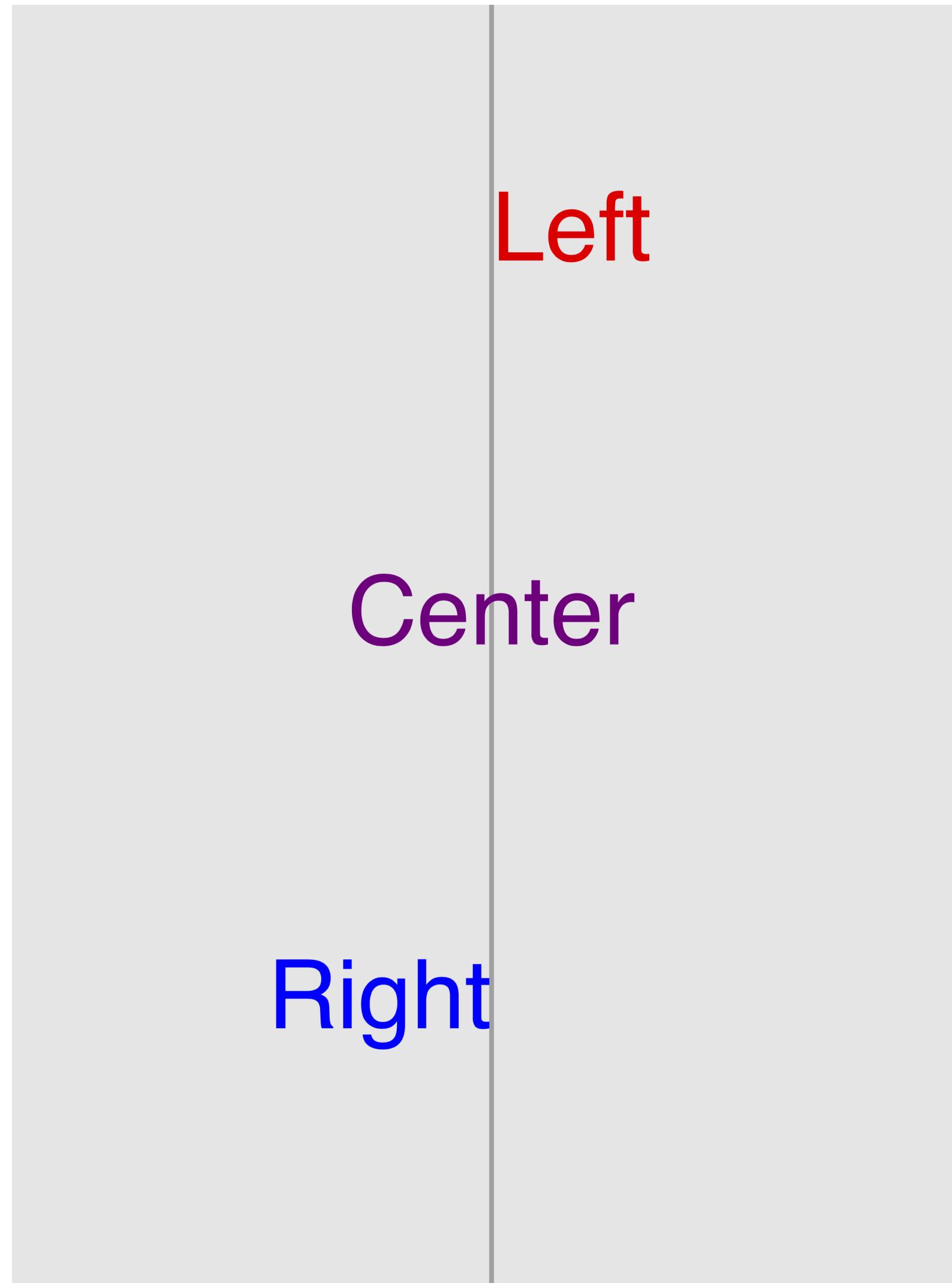
90%, 50%



Percentage-based layout



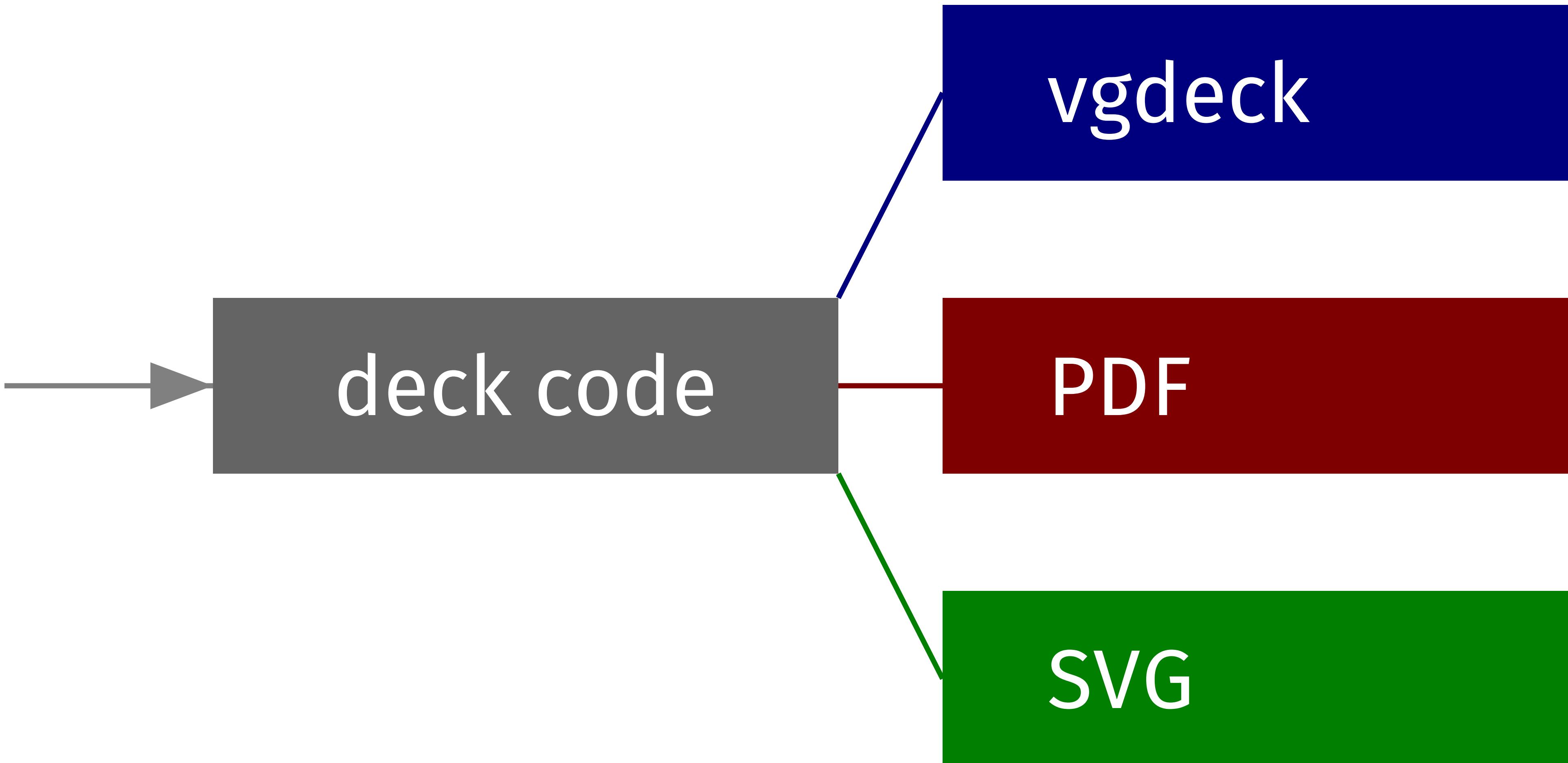
Landscape



Portrait

Scaling the canvas

Process



deck/generate text and list functions

Text (x, y float64, s, font string, size float64, color string, op ...float64)

TextBlock (x, y float64, s, font string, size, margin float64, color string, op ...float64)

TextMid (x, y float64, s, font string, size float64, color string, op ...float64)

TextEnd (x, y float64, s, font string, size float64, color string, op ...float64)

Code (x, y float64, s string, size, margin float64, color string, op ...float64)

List (x, y, size float64, items []string, ltype, font, color string)

deck/generate graphic functions

Image (x, y float64, w, h int, name string)

Arc (x, y, w, h, size, a1, a2 float64, color string, op ...float64)

Circle (x, y, w float64, color string, op ...float64)

Ellipse (x, y, w, h float64, color string, op ...float64)

Square (x, y, w float64, color string, op ...float64)

Rect (x, y, w, h float64, color string, op ...float64)

Curve (x1, y1, x2, y2, x3, y3, size float64, color string, op ...float64)

Line (x1, y1, x2, y2, size float64, color string, op ...float64)

Polygon (x, y []float64, color string, op ...float64)

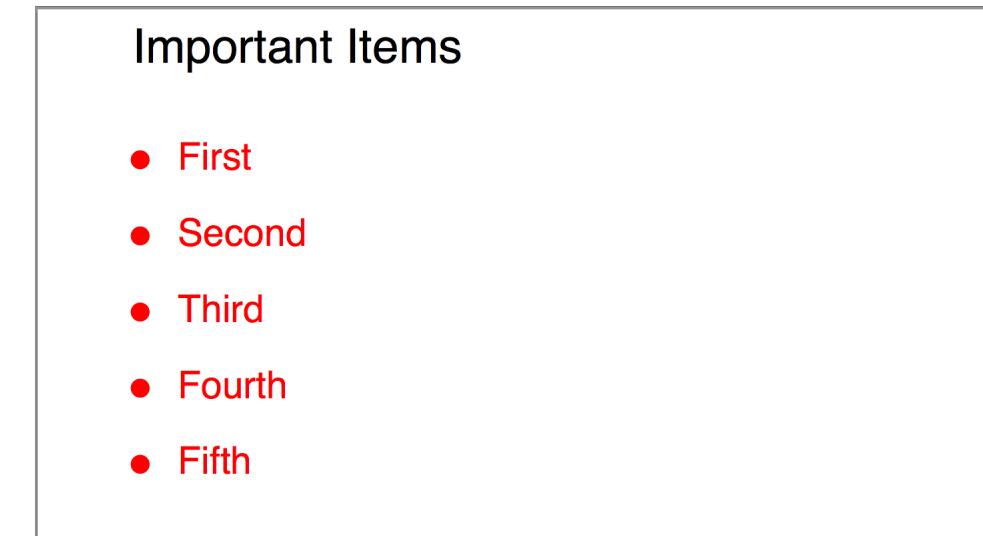
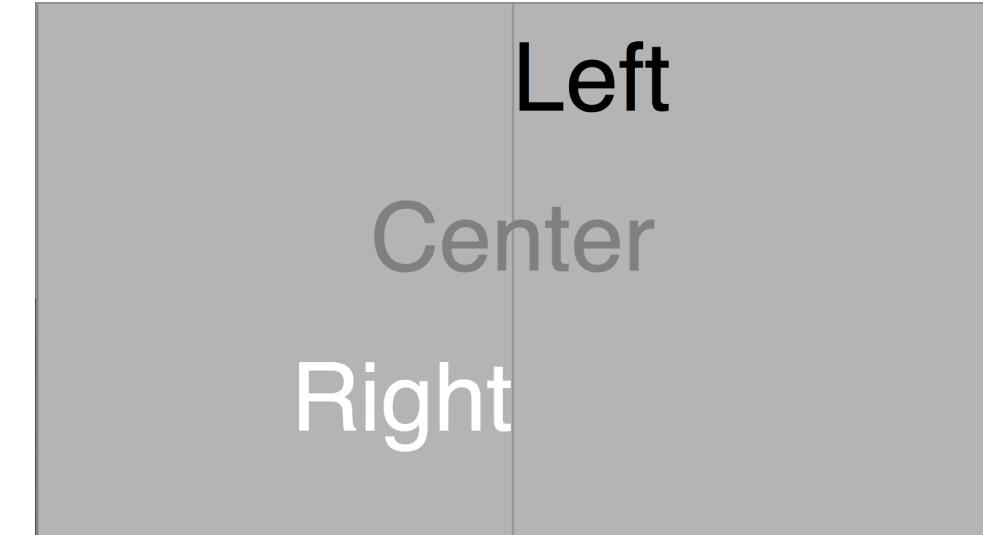
```
func main() {
    deck := generate.NewSlides(os.Stdout, 1600, 900) // 16x9 deck to stdout
    deck.StartDeck() // start the deck

    deck.StartSlide("rgb(180,180,180)")
    // ...
    deck.EndSlide()

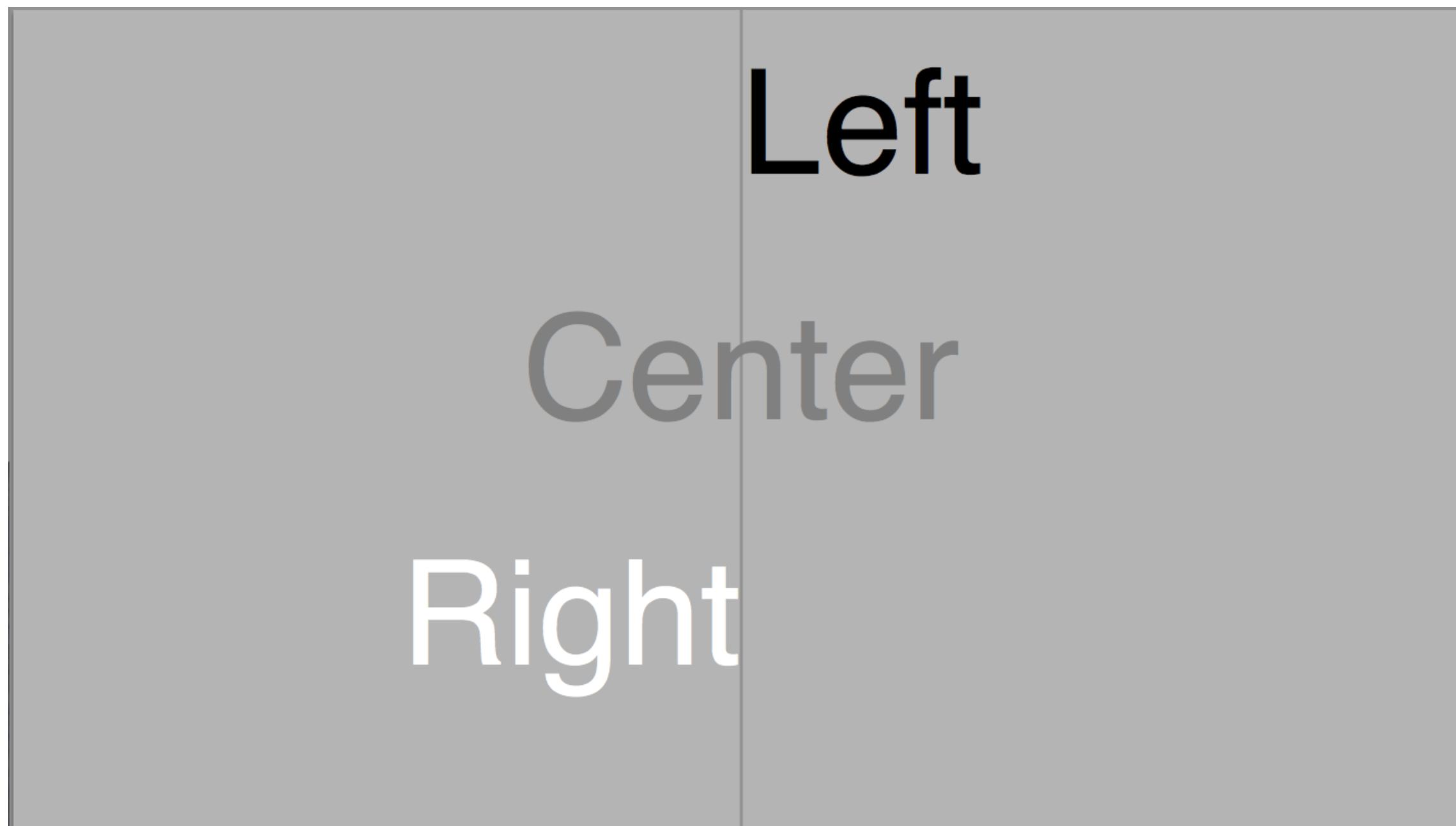
    deck.StartSlide()
    // ...
    deck.EndSlide()

    deck.StartSlide("black", "white")
    // ...
    deck.EndSlide()

    deck.EndDeck() // end the deck
}
```



```
// Text alignment
deck.StartSlide("rgb(180,180,180)")
deck.Text(50, 80, "Left", "sans", 10, "black")
deck.TextMid(50, 50, "Center", "sans", 10, "gray")
deck.TextEnd(50, 20, "Right", "sans", 10, "white")
deck.Line(50, 100, 50, 0, 0.2, "black", 20)
deck.EndSlide()
```



```
// List
items := []string{"First", "Second", "Third", "Fourth", "Fifth"}
deck.StartSlide()
deck.Text(10, 90, "Important Items", "sans", 5, "")
deck.List(10, 70, 4, items, "bullet", "sans", "red")
deck.EndSlide()
```

Important Items

- First
- Second
- Third
- Fourth
- Fifth

```
// Picture with text annotation
quote := "Yours is some tepid, off-brand, generic 'cola'. " +
        "What I'm making is \"Classic Coke\""
person := "Heisenberg"
deck.StartSlide("black", "white")
deck.Image(50, 50, 1440, 900, "classic-coke.png")
deck.TextBlock(10, 80, quote, "sans", 2.5, 30, "")
deck.Text(65, 15, person, "sans", 1.2, "")
deck.EndSlide()
```



A View of User Experience: Designing for People

Anthony Starks / ajstarks@gmail.com / @ajstarks

Design



What works good is better than what looks good, because what works good lasts.

Ray Eames

Designing for People

title A View of User Experience: Designing for People Anthony Starks / ajstarks@gmail.com / @ajstarks

section Design gray white

caption eames.png Ray Eames What works good is better than what looks good, because what works good lasts.

capgen slides.txt | pdfdeck ... > slides.pdf

```

#!/bin/sh
. $HOME/Library/deckfuncs.sh

deck begin
  canvas 1200 900
  slide begin white black
    ctext "Deck elements" 50 90 5
    image follow.jpg "Dreams" 70 60 640 480

    blist 10 70 3
      li text, list, image
      li line, rect, ellipse
      li arc, curve, polygon
    elist

    line 20 10 30 10
    rect 35 10 4 3      "rgb(127,0,0)"
    ellipse 45 10 4 3   "rgb(0,127,0)"
    arc 55 10 4 3 0 180 "rgb(0,0,127)"
    curve 60 10 75 20 70 10
    polygon "75 75 80" "8 12 10" "rgb(0,0,127)"

  slide end
deck end

```

Deck elements

- text, list, image
- line, rect, ellipse
- arc, curve, polygon



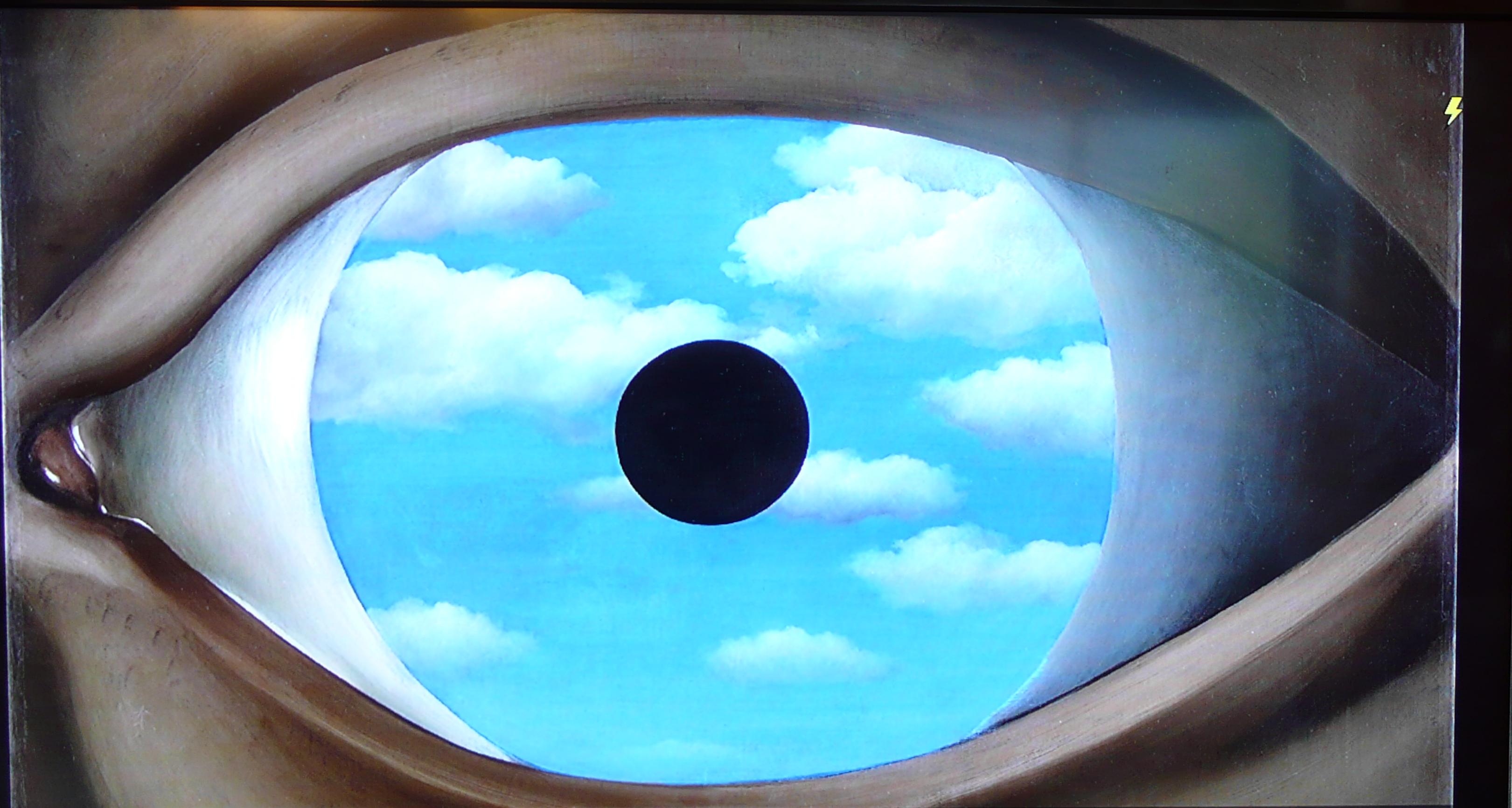
Dreams



Deck Web API

`sex -dir [start dir] -listen [address:port] -maxupload [bytes]`

GET	/	List the API
GET	/deck/	List the content on the server
GET	/deck/?filter=[type]	List content filtered by deck, image, video
POST	/deck/content.xml?cmd=1s	Play a deck with the specified duration
POST	/deck/content.xml?cmd=stop	Stop playing a deck
POST	/deck/content.xml?slide=[num]	Play deck starting at a slide number
DELETE	/deck/content.xml	Remove content
POST	/upload/ Deck:content.xml	Upload content
POST	/table/ Deck:content.txt	Generate a table from a tab-separated list
POST	/table/?textsize=[size]	Specify the text size of the table
POST	/media/ Media:content.mov	Play the specified video



LG

Design Examples

Top

Left

Right

Bottom

10%

30%

70%

10%

Header (top 10%)

Summary
(30%)

Detail
(70%)

Footer (bottom 10%)

My Story

Section

One

Two

Three

Four

Five

Six

Document Links

Add web and mailto links with the link attribute of the text element.

Once rendered as a PDF, clicking on the link opens the default browser or email client.

The image contains two screenshots. The top screenshot shows a PDF viewer window titled "deck-fira-4x3.pdf (page 53 of 57)". It displays a quote in white text on a dark blue background: "Python and Ruby programmers come to Go because they don't have to surrender much expressiveness, but gain performance and get to play with concurrency." Below the quote, it says "Less is exponentially more" and "Rob Pike". The bottom screenshot shows a web browser window titled "command center: Less is e...". The URL in the address bar is "commandcenter.blogspot.com/2012/06/less-is-exp...". The page content is identical to the quote in the PDF, along with some additional text: "What you're given is a set of powerful but easy to understand, easy to use building blocks from which you can assemble—compose—a solution to your problem. It might not end up quite as fast or as sophisticated or as ideologically motivated as the solution you'd write in some of those other languages, but it'll almost certainly be easier to write, easier to read, easier to understand, easier to maintain, and maybe safer." Below this, there is another quote: "To put it another way, oversimplifying of course: Python and Ruby programmers come to Go because they don't have to surrender much expressiveness, but gain performance and get to play with concurrency." At the bottom, there is a final note: "C++ programmers *don't* come to Go because they have fought hard to gain exquisite control of their programming domain, and don't want to surrender any of it. To them, software isn't just about getting the job done, it's about doing it a certain way." The issue is then summarized as "The issue, then, is that Go's success would contradict their world view."

Python and Ruby programmers come to Go because they don't have to surrender much expressiveness, but gain performance and get to play with concurrency.

Less is exponentially more

Rob Pike

What you're given is a set of powerful but easy to understand, easy to use building blocks from which you can assemble—compose—a solution to your problem. It might not end up quite as fast or as sophisticated or as ideologically motivated as the solution you'd write in some of those other languages, but it'll almost certainly be easier to write, easier to read, easier to understand, easier to maintain, and maybe safer.

To put it another way, oversimplifying of course:

Python and Ruby programmers come to Go because they don't have to surrender much expressiveness, but gain performance and get to play with concurrency.

C++ programmers *don't* come to Go because they have fought hard to gain exquisite control of their programming domain, and don't want to surrender any of it. To them, software isn't just about getting the job done, it's about doing it a certain way.

The issue, then, is that Go's success would contradict their world view.

BOS



SFO

Virgin America 351

Gate B38

8:35am

On Time

JFK



IND

US Airways 1207

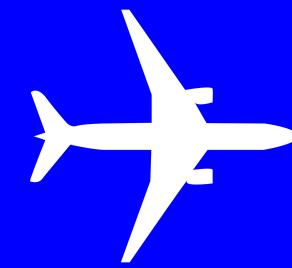
Gate C31C

5:35pm

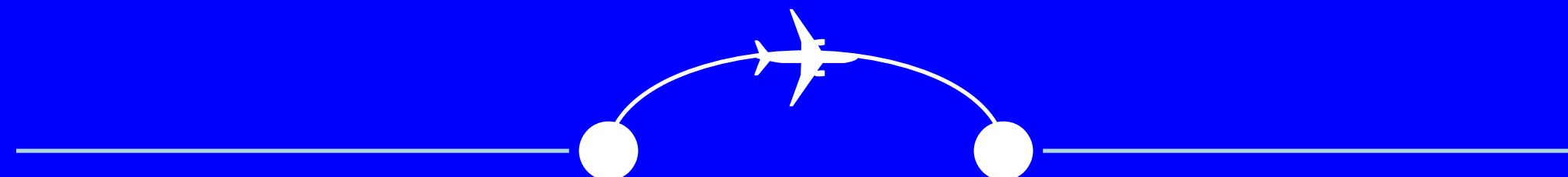
Delayed

Flight Information

Los Angeles (LAX)



New York/Newark (EWR)



1,958 mi

3,151 km

Distance to Destination

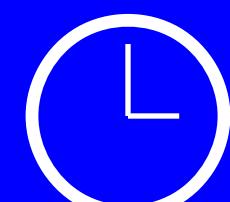
596 mi

798 km

Time to Destination

Estimated time of arrival

Local time of arrival



1:20

12:14 am

12:14 am

Ground speed



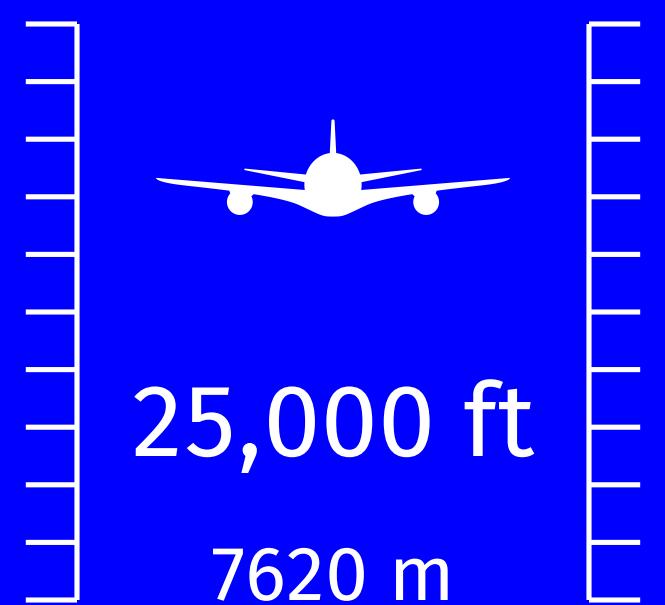
Headwind



Outside Temperature



Current Altitude



AAPL	179.98	3.04	(1.72%)
AMZN	1578.89	27.03	(1.74%)
FB	185.23	2.89	(1.58%)
GOOGL	1160.84	31.46	(2.79%)
MSFT	96.54	2.11	(2.23%)

AAPL	181.72	1.74	(0.97%)
AMZN	1598.39	19.50	(1.24%)
FB	184.76	-0.47	(-0.25%)
GOOGL	1165.93	5.09	(0.44%)
MSFT	96.77	0.23	(0.24%)

AAPL	175.30	-2.72 (-1.53%)
AMZN	1544.93	-26.75 (-1.70%)
FB	172.56	-12.53 (-6.77%)
GOOGL	1100.07	-34.35 (-3.03%)
MSFT	92.89	-1.71 (-1.81%)

```

func stockslide(deck *generate.Deck, symbols []string) {
    x := left
    y := top

    rintr := (top-bottom)/float64(len(symbols))
    size := rintr/2.5
    cintr := size*4

    var color string
    for _, s := range symbols {
        stock, err := stockapi(s)
        if err != nil || stock.Symbol == "" {
            continue
        }
        if stock.Change < 0 {
            color = negcolor
        } else {
            color = poscolor
        }
        deck.Text(x, y, stock.Symbol, "sans", size, "")
        x += cintr * 2
        deck.TextEnd(x, y, fmt.Sprintf("%.2f", stock.Price), "sans", size, "")
        x += cintr
        deck.TextEnd(x, y, fmt.Sprintf("%.2f", stock.Change), "sans", size, color)
        x += cintr
        deck.TextEnd(x, y, fmt.Sprintf("(%.2f%%)", stock.PctChange), "sans", size, color)
        x = left
        y -= rintr
    }
    deck.Text(footx, footy, time.Now().Format("2006-01-02 15:04:05"), "sans", 1.5, "yellow")
}

```

AAPL	181.72	1.74 (0.97%)
AMZN	1598.39	19.50 (1.24%)
FB	184.76	-0.47 (-0.25%)
GOOGL	1165.93	5.09 (0.44%)
MSFT	96.77	0.23 (0.24%)

2018-03-12 21:05:06

So, the next time you're
about to make a subclass,
think hard and ask yourself

what would Go do

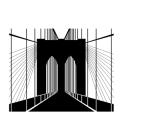
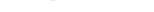
Andrew Mackenzie-Ross



go

build	compile packages and dependencies
clean	remove object files
doc	show documentation for package or symbol
env	print Go environment information
fix	run go tool fix on packages
fmt	run gofmt on package sources
generate	generate Go files by processing source
get	download and install packages and dependencies
install	compile and install packages and dependencies
list	list packages
run	compile and run Go program
test	test packages
tool	run specified go tool
version	print Go version
vet	run go tool vet on packages

Go Proverbs

-  Don't communicate by sharing memory, share memory by communicating.
-  Concurrency is not parallelism.
-  Channels orchestrate; mutexes serialize.
-  The bigger the interface, the weaker the abstraction.
-  Make the zero value useful.
-  interface{} says nothing.
-  Gofmt's style is no one's favorite, yet gofmt is everyone's favorite.
-  A little copying is better than a little dependency.
-  Syscall must always be guarded with build tags.
-  Cgo must always be guarded with build tags.
-  Cgo is not Go.
-  With the unsafe package there are no guarantees.
-  Clear is better than clever.
-  Reflection is never clear.
-  Errors are values.
-  Don't just check errors, handle them gracefully.
-  Design the architecture, name the components, document the details.
-  Documentation is for users.
-  Don't panic.



Don't communicate
by sharing memory,
share memory by
communicating.



The bigger the interface,
the weaker the abstraction.



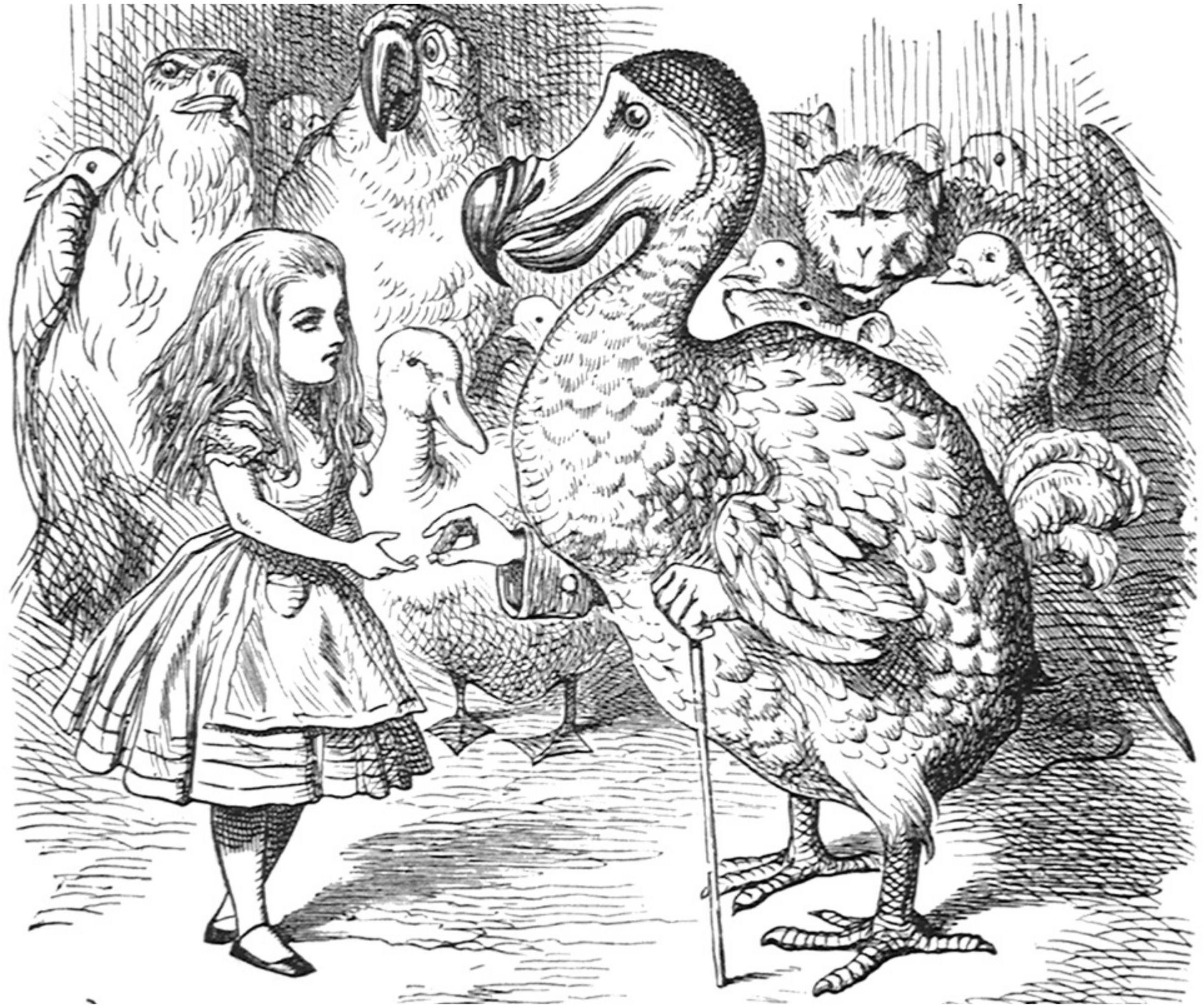
Make the zero
value useful.

Chapter V



Advice from a Caterpillar

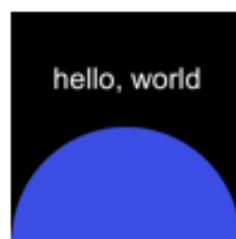
THE Caterpillar and Alice looked at each other for some time in silence: at last the Caterpillar took the hookah out of its mouth, and addressed her in a languid, sleepy voice. “Who are you?” said the Caterpillar. This was not an encouraging opening for a conversation. Alice replied, rather shyly, “I—I hardly know, sir, just at present—at least I know who I was when I got up this morning, but I think I must have been changed several times times since then.”



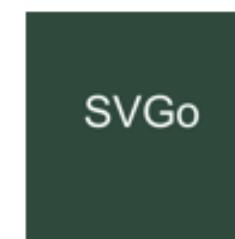
"You promised to tell me your history, you know," said Alice, "and why it is you hate—C and D," she added in a whisper, half afraid that it would be offended again. "Mine is a long and a sad tale!" said the Mouse, turning to Alice, and sighing. "It is a long tail, certainly," said Alice, looking down with wonder at the Mouse's tail; "but why do you call it sad?" And she kept on puzzling about it while the Mouse was speaking, so that her idea of the tale was something like this:—

Fury said to a mouse, That he met in the house,
"Let us both go to law:I will prosecute
YOU—Come, I'll take no denial; We must have a trial:For really this morning I've nothing to do."
Said the mouse to the cur, "Such a trial, dear Sir, With no jury or judge, would be wasting our breath."
"I'll be judge, I'll be jury," Said cunning old Fury:
"I'll try the whole cause, and condemn you to death."

SVGo Examples



hello.go



SVGo



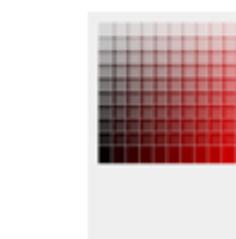
rl.go



concentric.go



concentric2.go



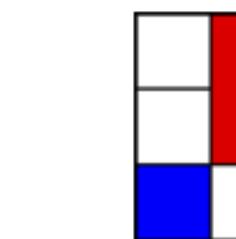
cgrid.go



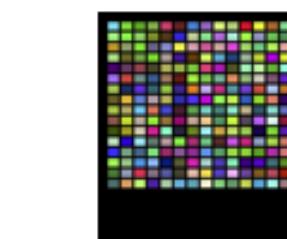
diag.go



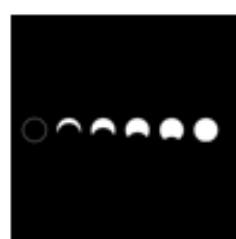
shining.go



mondrian.go



richter.go



eclipse.go



pacman.go



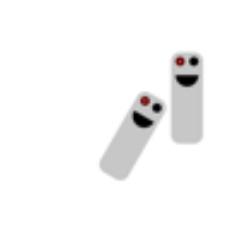
pyramid.go



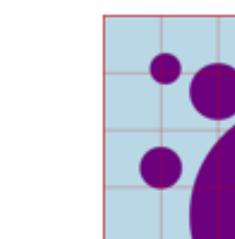
cloud.go



color-clouds.go



creepy.go



d4h.go



sunearth.go



conception.go



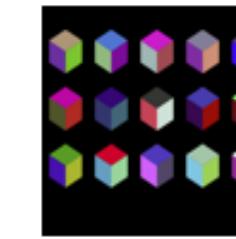
conception2.go



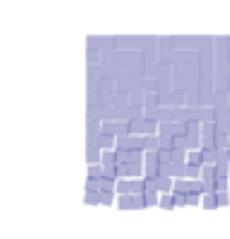
randbox.go



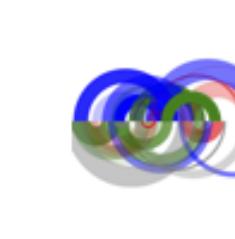
randspot.go



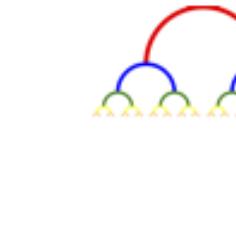
cube.go



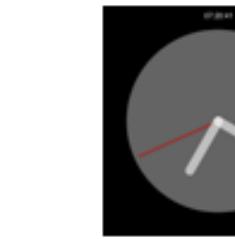
schotter.go



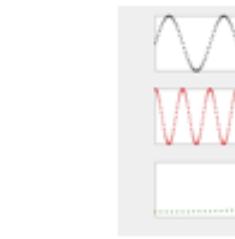
randarc.go



reurse.go



clock.go



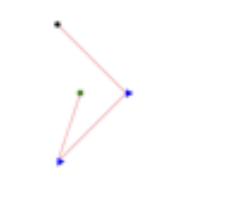
plotfunc.go



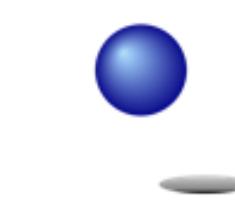
therm.go



pattern.go



marker.go



gradient.go



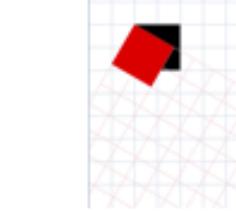
fontrange.go



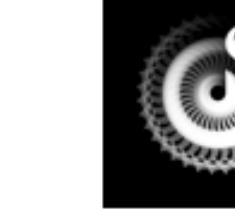
uni.go



lorem.go



rotate.go



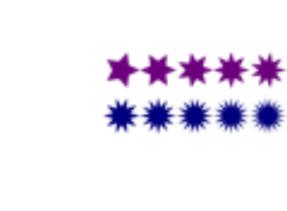
rottext.go



skewabc.go



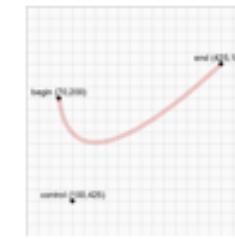
gear.go



star.go



starx.go



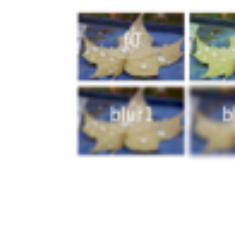
swoosh.go



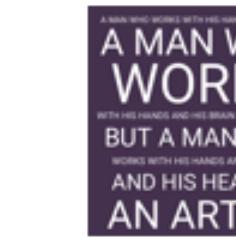
textpath.go



imfade.go



fe.go



artist.go



go.go

codepicdeck

```

package main

import (
    "fmt"
    "github.com/ajstarks/svggo"
    "os"
)

func main() {
    xp := []int{50, 70, 70, 50, 30, 30}
    yp := []int{40, 50, 75, 85, 75, 50}
    xl := []int{0, 0, 50, 100, 100}
    yl := []int{100, 40, 10, 40, 100}
    bgcolor := "rgb(227,78,25)"
    bkcolor := "rgb(153,29,40)"
    stcolor := "rgb(65,52,44)"
    stwidth := 12
    stylefmt := "stroke:%s;stroke-width:%d;fill:%s"
    canvas := svg.New(os.Stdout)
    width, height := 500, 500
    canvas.Start(width, height)
    canvas.Def()
    canvas.Gid("unit")
    canvas.Polyline(xl, yl, "fill:none")
    canvas.Polygon(xp, yp)
    canvas.Gend()
    canvas.Gid("runit")
    canvas.TranslateRotate(150, 180, 180)
    canvas.Use(0, 0, "#unit")
    canvas.Gend()
    canvas.Gend()
    canvas.DefEnd()
    canvas.Rect(0, 0, width, height, "fill:"+bgcolor)
    canvas.Gstyle(fmt.Sprintf(stylefmt, stcolor, stwidth, bkcolor))
    for y := 0; y < height; y += 130 {
        for x := -50; x < width; x += 100 {
            canvas.Use(x, y, "#unit")
            canvas.Use(x, y, "#runit")
        }
    }
    canvas.Gend()
    canvas.End()
}

```



shining.go [8]

```

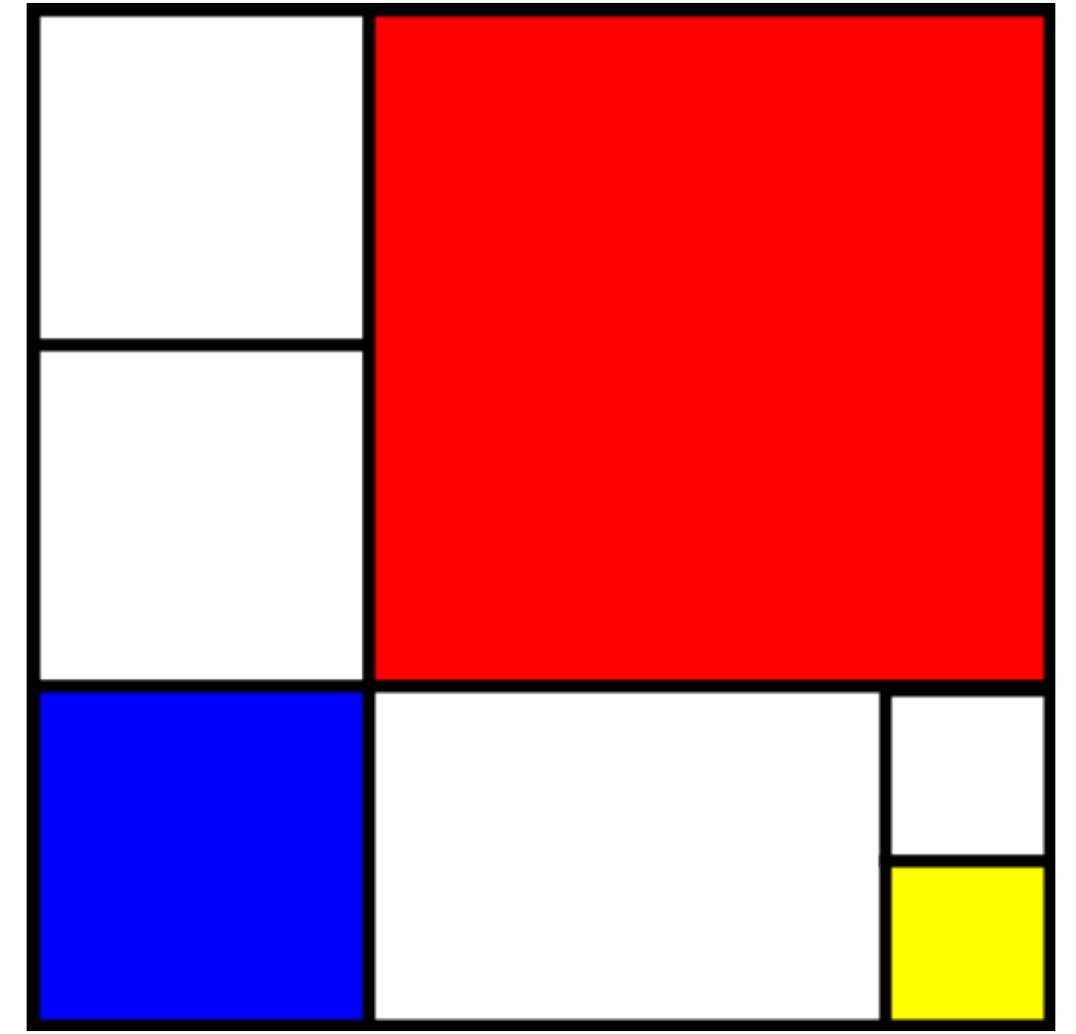
package main

import (
    "os"
    "github.com/ajstarks/svggo"
)

var (
    canvas = svg.New(os.Stdout)
    width  = 500
    height = 500
)

// Piet Mondrian - Composition in Red, Blue, and Yellow
func main() {
    w3 := width / 3
    w6 := w3 / 2
    w23 := w3 * 2
    canvas.Start(width, height)
    canvas.Gstyle("stroke:black;stroke-width:6")
    canvas.Rect(0, 0, w3, w3, "fill:white")
    canvas.Rect(0, w3, w3, w3, "fill:white")
    canvas.Rect(0, w23, w3, w3, "fill:blue")
    canvas.Rect(w3, 0, w23, w23, "fill:red")
    canvas.Rect(w3, w23, w23, w3, "fill:white")
    canvas.Rect(width-w6, height-w3, w3-w6, w6, "fill:white")
    canvas.Rect(width-w6, height-w6, w3-w6, w6, "fill:yellow")
    canvas.Gend()
    canvas.Rect(0, 0, width, height, "fill:none;stroke:black;stroke-width:12")
    canvas.End()
}

```



mondrian.go [9]

```

package main

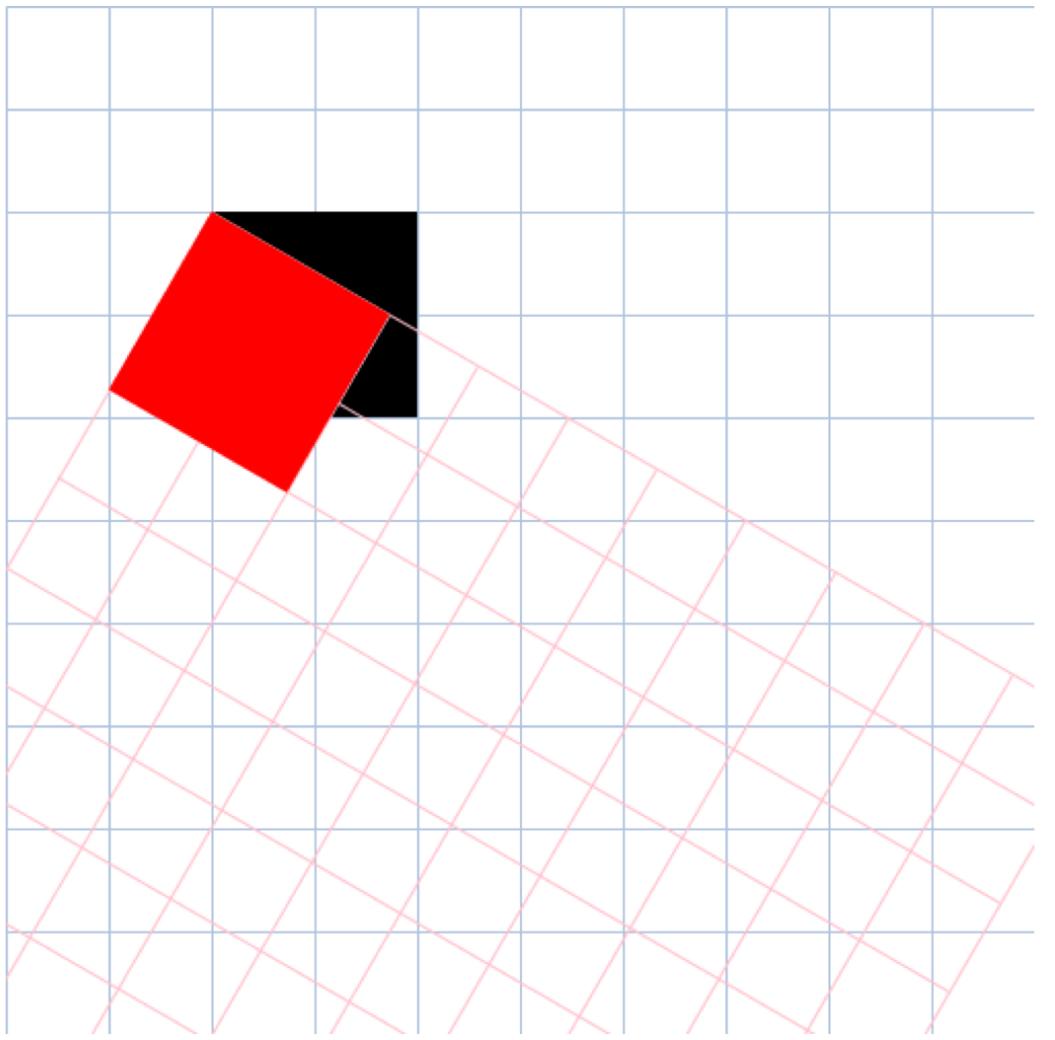
import (
    "os"
    "github.com/ajstarks/svg"
)

var (
    canvas = svg.New(os.Stdout)
    width  = 500
    height = 500
)

func tro() {
    canvas.Rect(100, 100, 100, 100)
    canvas.TranslateRotate(100, 100, 30)
    canvas.Grid(0, 0, width, height, 50, "stroke:lightsteelblue")
    canvas.Rect(0, 0, 100, 100, "fill:red")
    canvas.Gend()
}

func main() {
    canvas.Start(width, height)
    canvas.Grid(0, 0, width, height, 50, "stroke:lightsteelblue")
    tro()
    canvas.End()
}

```



rotate.go [36]

```

package main

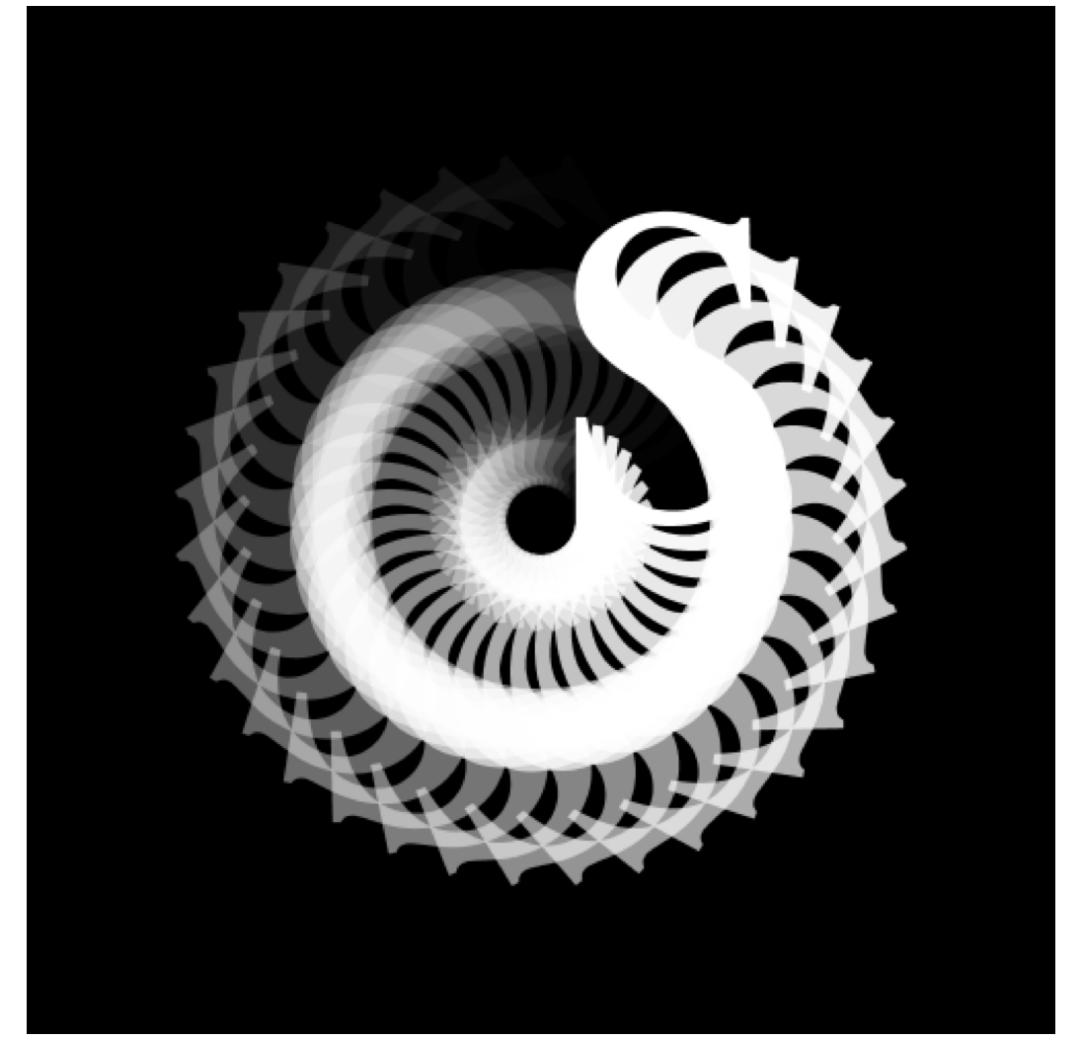
import (
    "os"
    "github.com/ajstarks/svg"
)

var (
    canvas = svg.New(os.Stdout)
    width  = 500
    height = 500
)

func main() {
    a := 1.0
    ai := 0.03
    ti := 10.0

    canvas.Start(width, height)
    canvas.Rect(0, 0, width, height)
    canvas.Gstyle("font-family:serif;font-size:244pt")
    for t := 0.0; t <= 360.0; t += ti {
        canvas.TranslateRotate(width/2, height/2, t)
        canvas.Text(0, 0, "s", canvas.RGBA(255, 255, 255, a))
        canvas.Gend()
        a -= ai
    }
    canvas.Gend()
    canvas.End()
}

```



rottext.go [37]

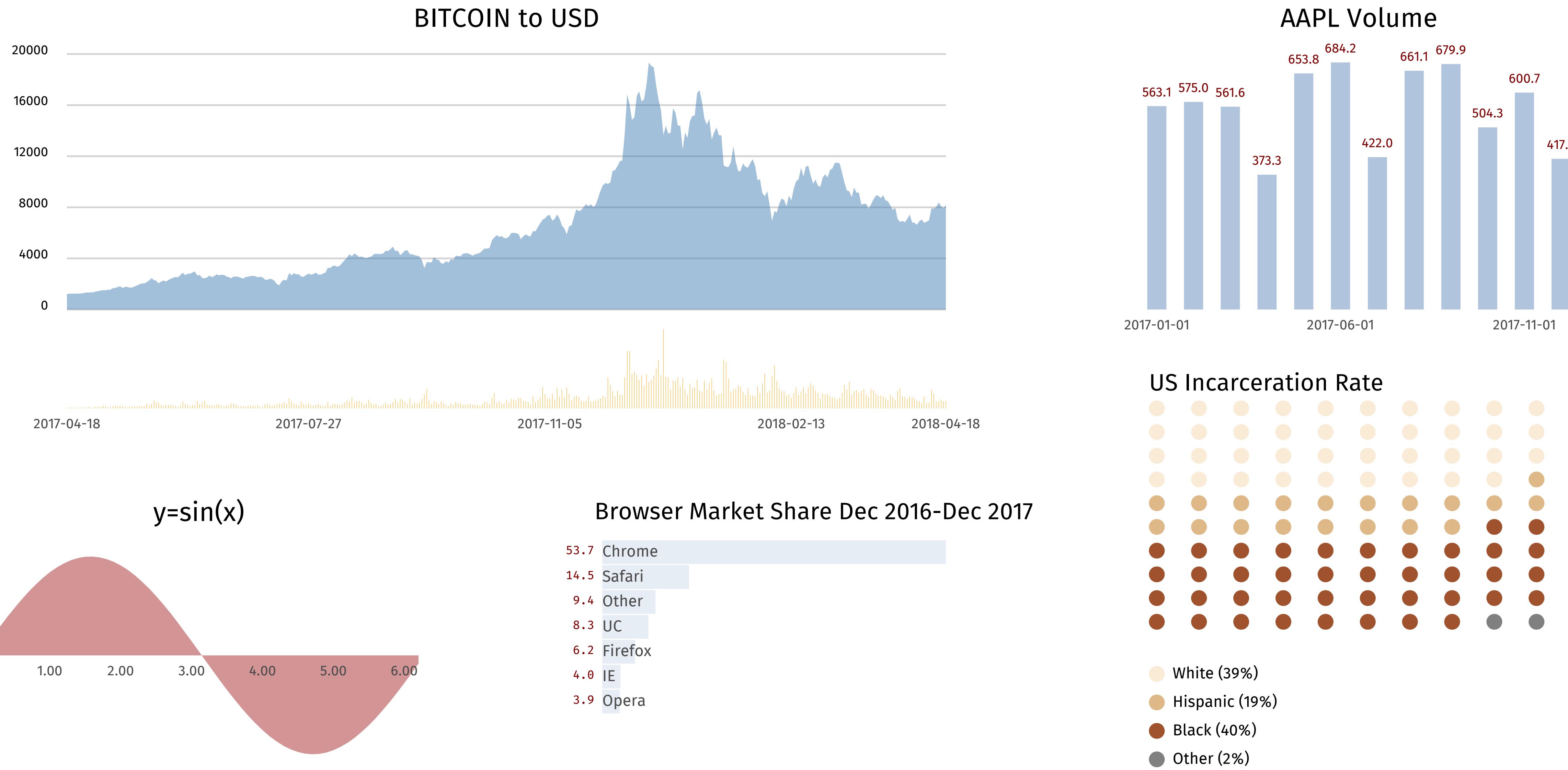
The new masters of our universe
are people who are essentially
only half-educated.

They have had no exposure to the humanities or the social sciences, the academic disciplines that aim to provide some understanding of how society works, of history and of the roles that beliefs, philosophies, laws, norms, religion and customs play in the evolution of human culture

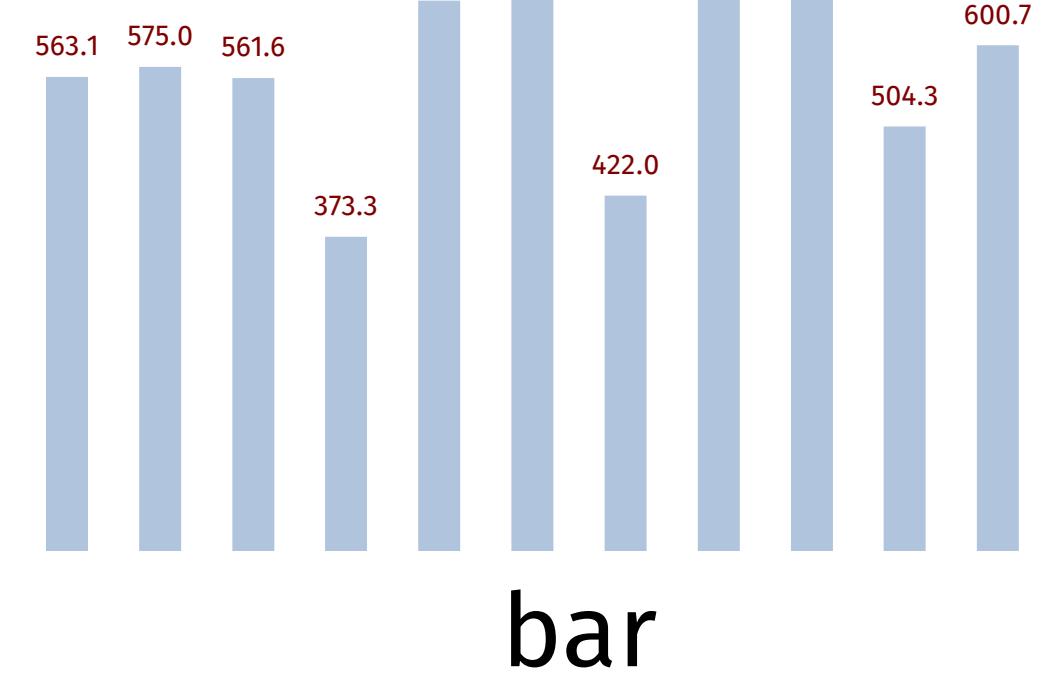
John Naughton, The Guardian, 19 November, 2017



dchart: charts for deck

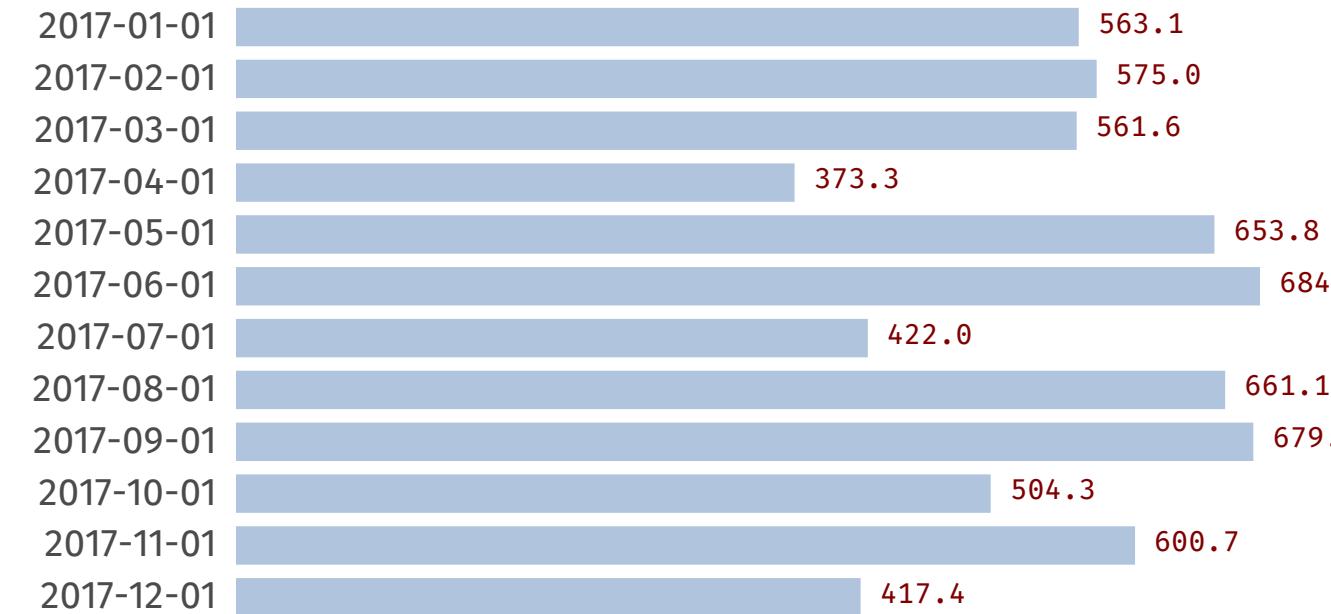


AAPL Volume



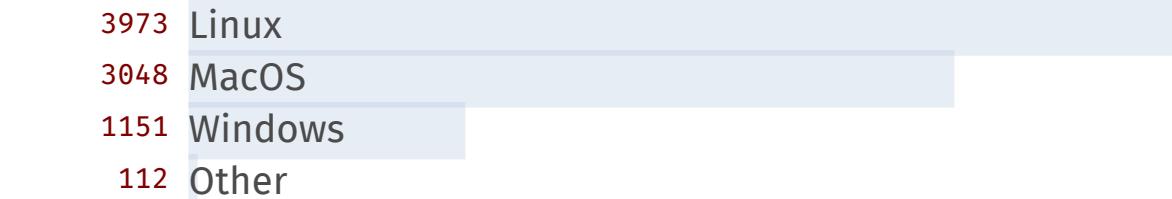
bar

AAPL Volume

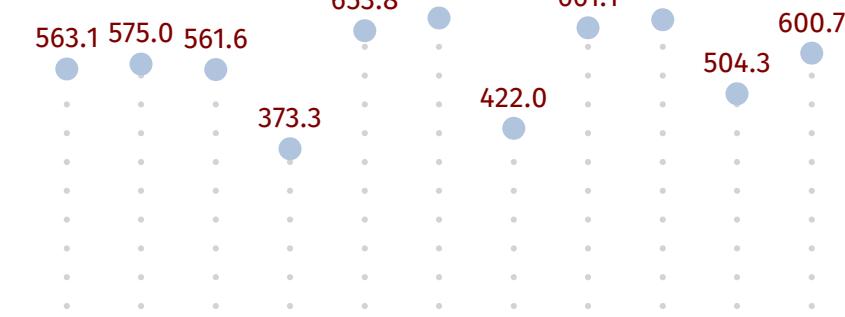


hbar

I Primarily develop Go on (2017)



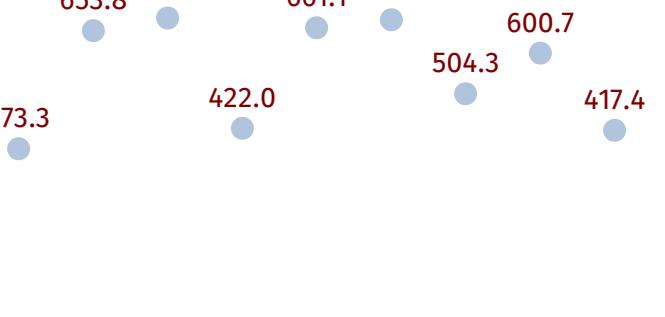
wbar



dot



vol

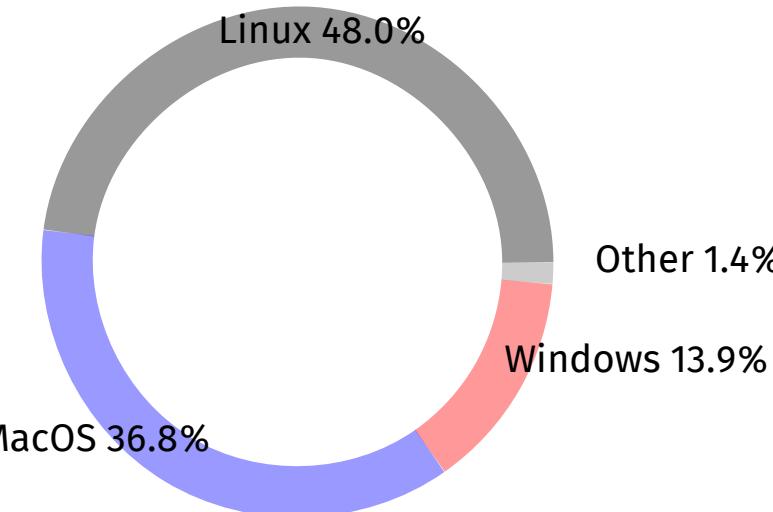


scatter



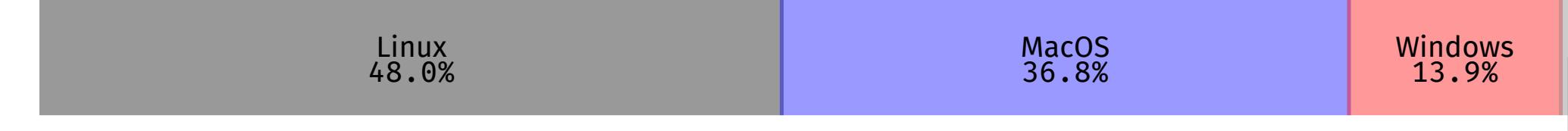
line

I Primarily develop Go on (2017)



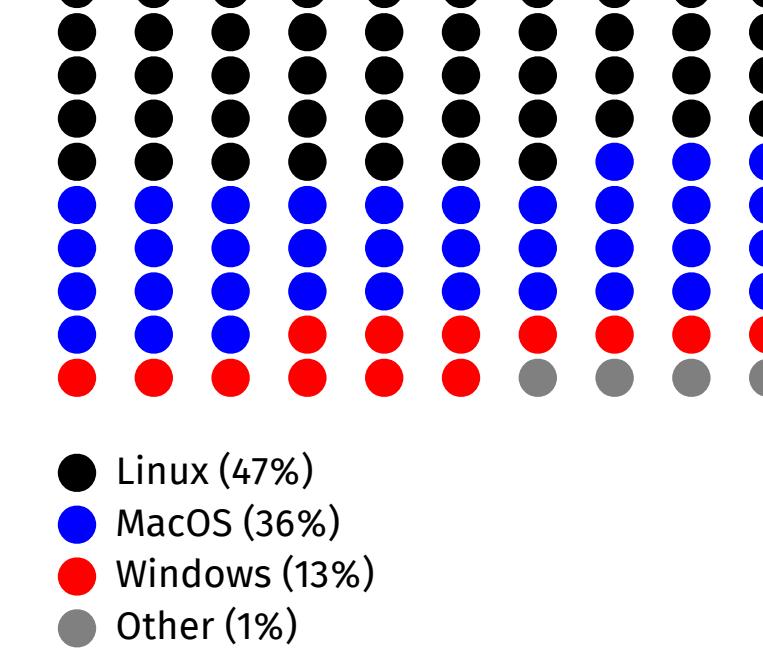
donut

I Primarily develop Go on (2017)



pmap

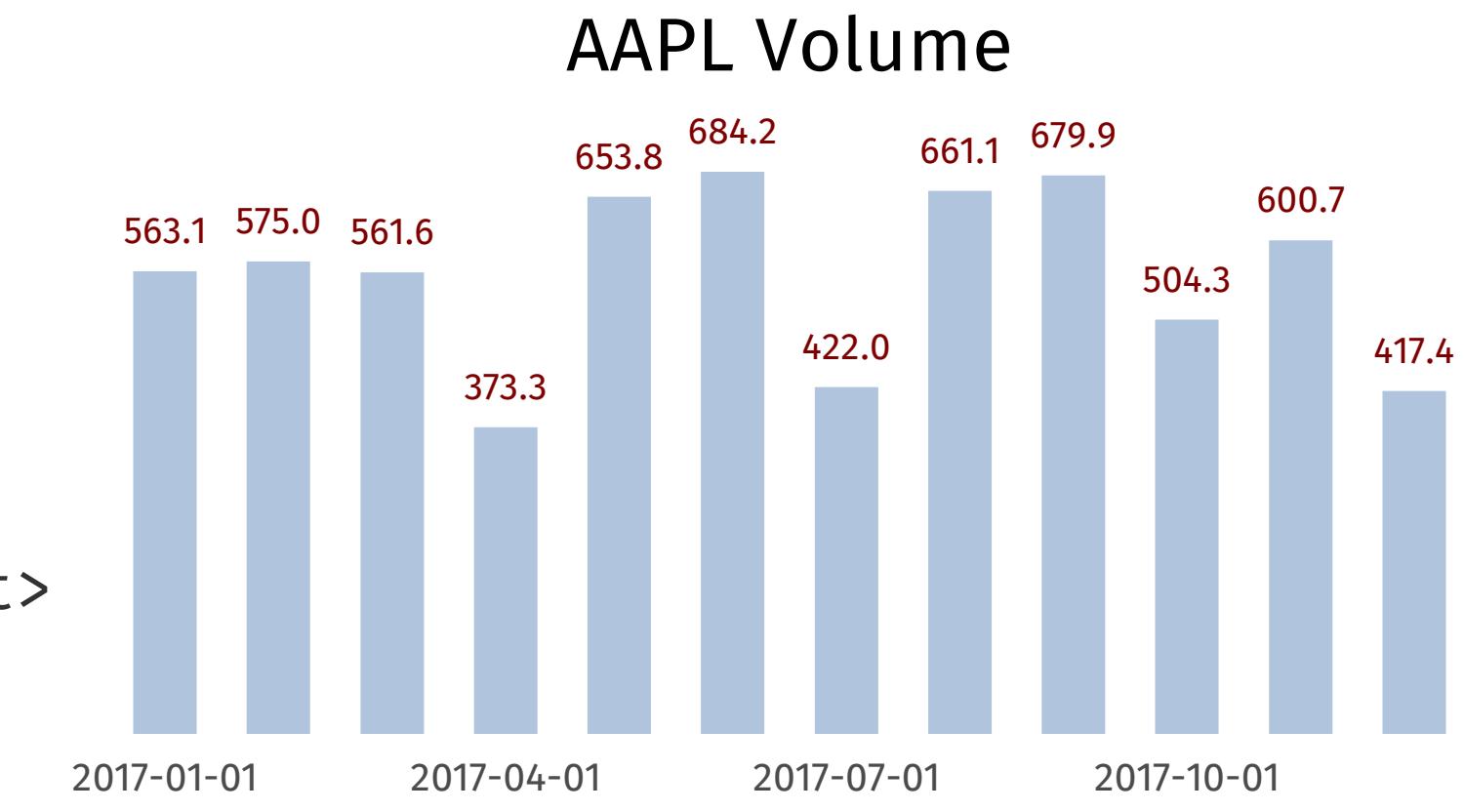
I Primarily develop Go on (2017)



pgrid

```
# AAPL Volume
2017-01-01      563.122
2017-02-01      574.969
2017-03-01      561.628
2017-04-01      373.304
2017-05-01      653.755
2017-06-01      684.178
2017-07-01      421.992
2017-08-01      661.069
2017-09-01      679.879
2017-10-01      504.291
2017-11-01      600.663
2017-12-01      417.354
```

```
<deck>
  <slide>
    <text ...>AAPL Volume</text>
    <line ... color="lightsteelblue"/>
    <text ... color="rgb(127,0,0)">563.1</text>
    <text ... color="rgb(75,75,75)">2017-01-01</text>
  </slide>
</deck>
```



data | dchart | pdf

Chart Types

-bar	bar chart (default true)
-wbar	word bar chart (default false)
-hbar	horizontal bar chart (default false)
-scatter	scatter chart (default false)
-dot	dot plot (default false)
-line	line chart (default false)
-vol	volume plot (default false)
-pgrid	proportional grid (default false)
-pmap	proportional map (default false)
-donut	donut chart (default false)

Chart Elements

-grid	show gridlines on the y axis (default false)
-val	show values (default true)
-valpos	value position (t=top, b=bottom, m=middle) (default "t")
-yaxis	show a y axis (default true)
-yrange	specify the y axis labels (min,max,step)
-fulldeck	generate full deck markup (default true)
-title	show the title (default true)
-chartitle	specify the title (overiding title in the data)
-xlabel	x axis label interval (default 1, 0 to supress all labels)
-xlast	show the last x label
-hline	horizontal line at value with label

Position and Scaling

-top	top of the plot (default 80)
-bottom	bottom of the plot (default 30)
-left	left margin (default 20)
-right	right margin (default 80)
-min	set the minimum value
-max	set the maximum value
-dmin	data minimum (default false, min=0)

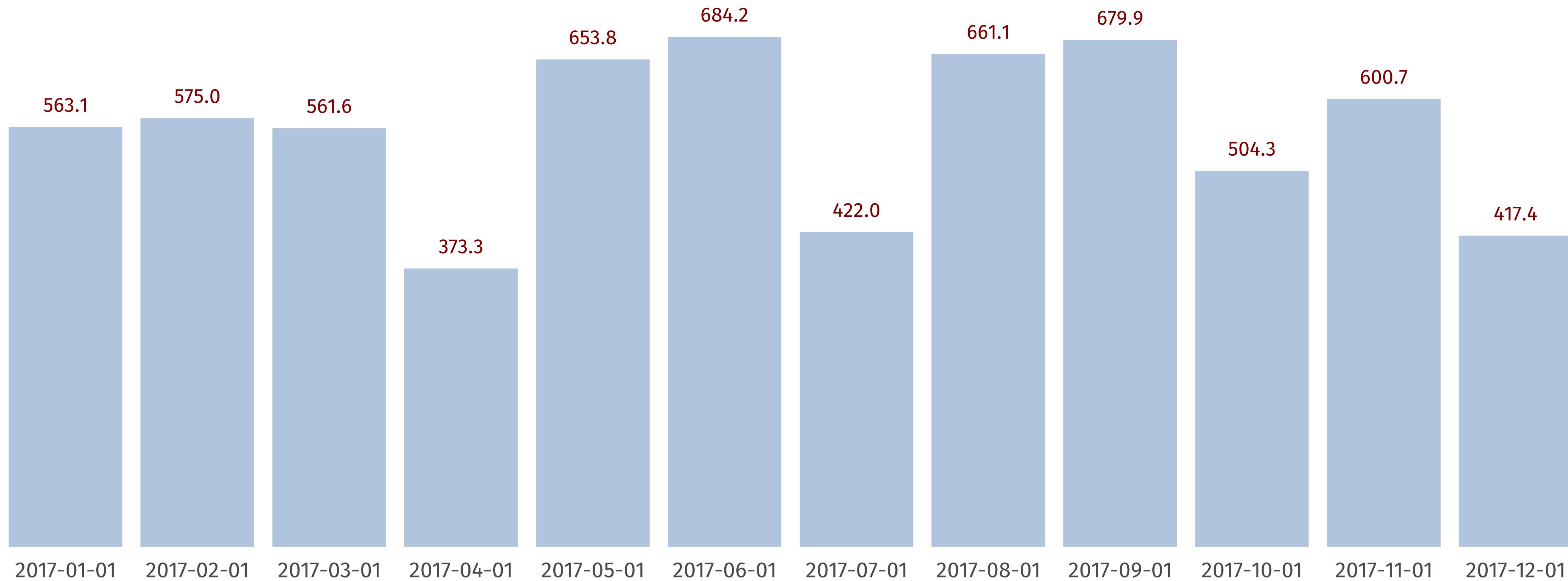
Measures and Attributes

-barwidth	barwidth (default computed from data size)
-ls	linespacing (default 2.4)
-textsize	text size (default 1.5)
-color	data color (default "lightsteelblue")
-vcolor	value color (default "rgb(127,0,0)")
-datafmt	data format for values (default "%.1f")
-psize	diameter of the donut (default 30)
-pwidth	width of the donut or proportional map (default 3)

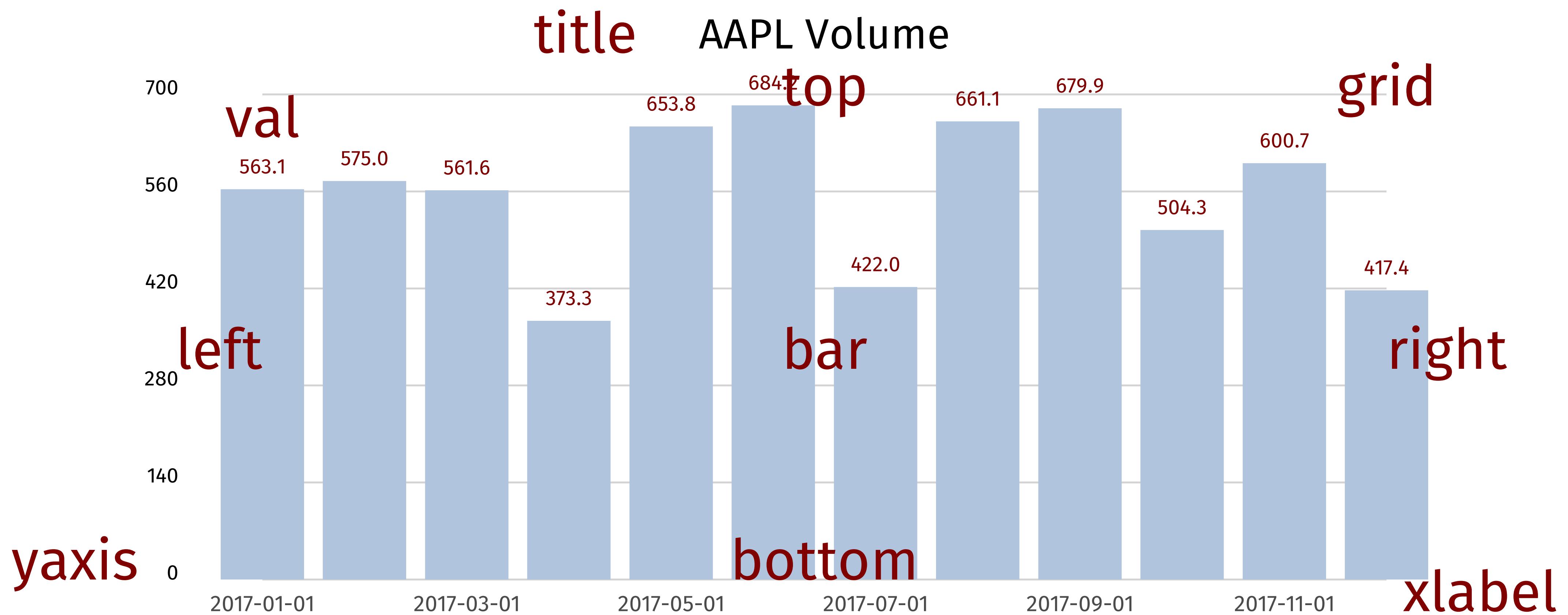
CSV

-csv	read CSV files (default false)
-csvcol	specify the columns to use for label,value

AAPL Volume



dchart AAPL.d



dchart -left=20 -right=80 -top=75 -yaxis -xlabel=2 -grid AAPL.d

```

package main

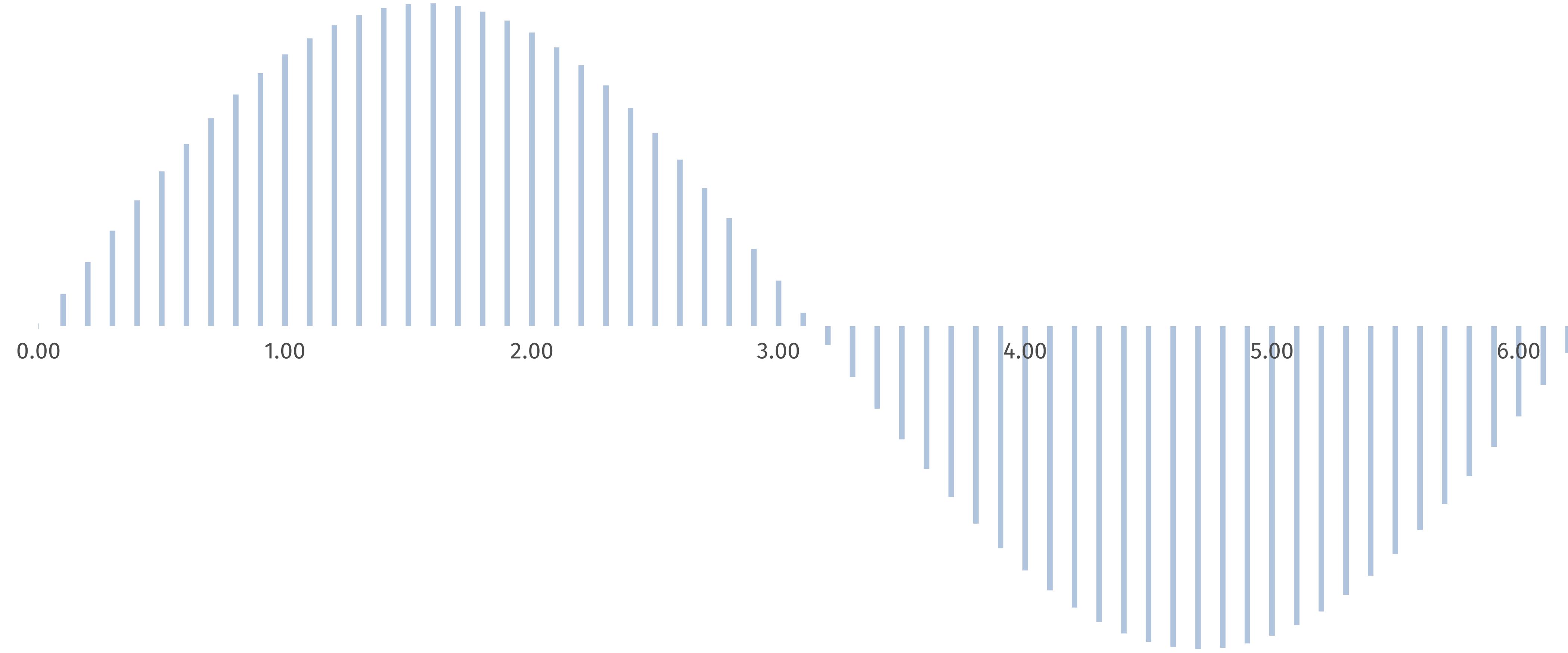
import (
    "fmt"
    "math"
)

func main() {
    fmt.Println("# y=sin(x)")
    for x := 0.0; x < math.Pi*2; x += 0.1 {
        fmt.Printf("%.2f\t%.4f\n", x, math.Sin(x))
    }
}

```

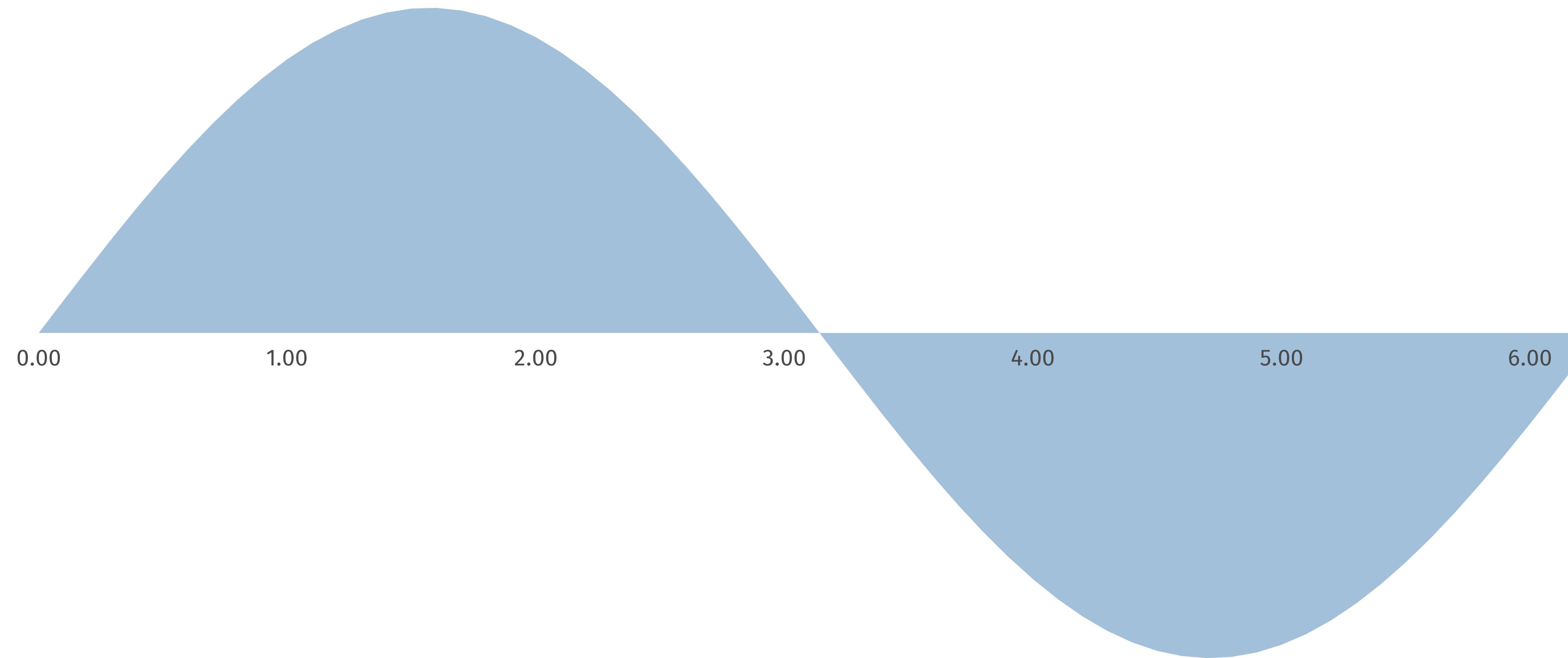
# y=sin(x)	
0.00	0.0000
0.10	0.0998
0.20	0.1987
0.30	0.2955
0.40	0.3894
0.50	0.4794
0.60	0.5646
0.70	0.6442
0.80	0.7174
...	
5.80	-0.4646
5.90	-0.3739
6.00	-0.2794
6.10	-0.1822
6.20	-0.0831

$y=\sin(x)$

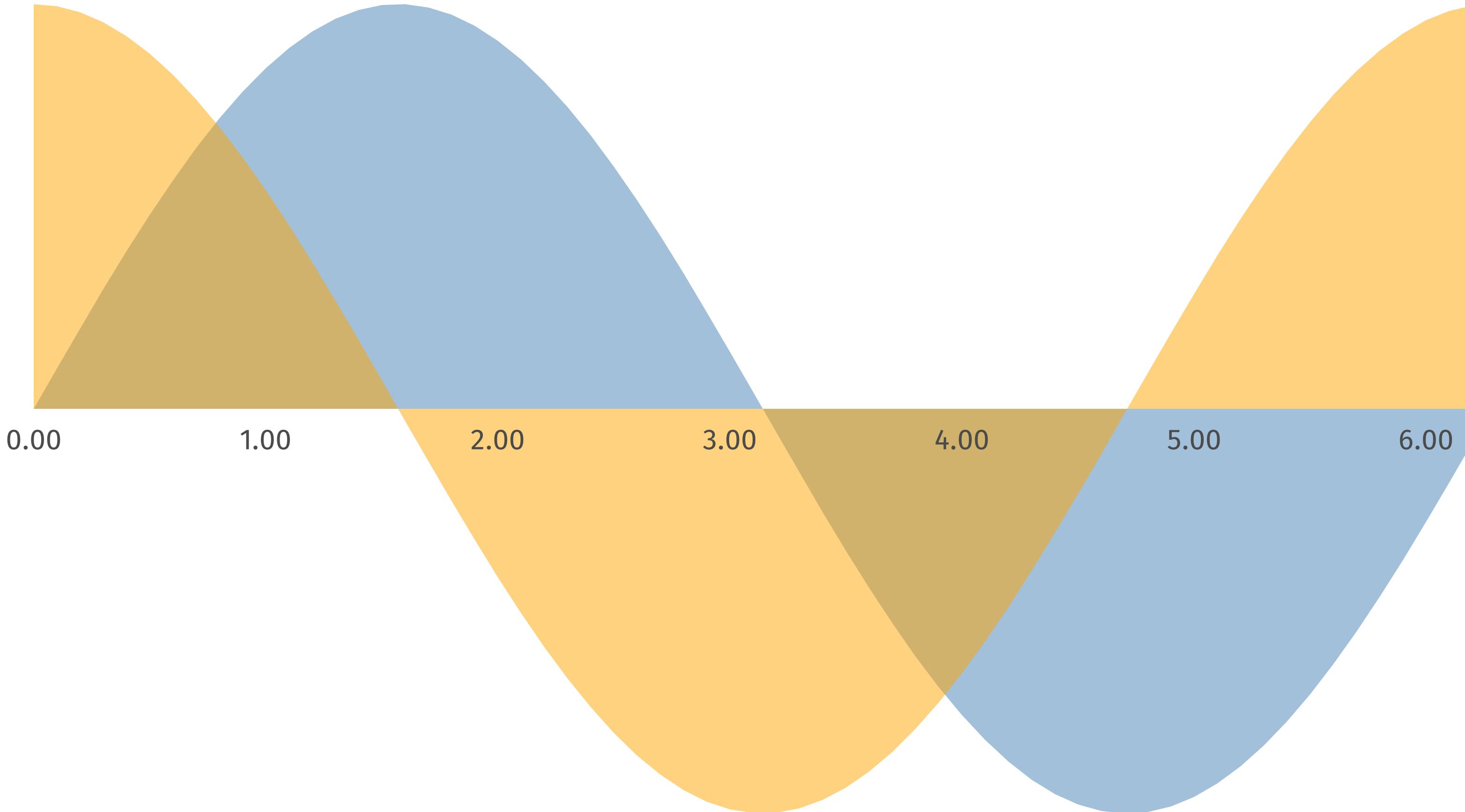


sine | dchart -val=f -bottom=50 -xlabel=10

$y=\sin(x)$



sine | dchart -val=f -bottom=50 -xlabel=10 -bar=f -color=steelblue -vol

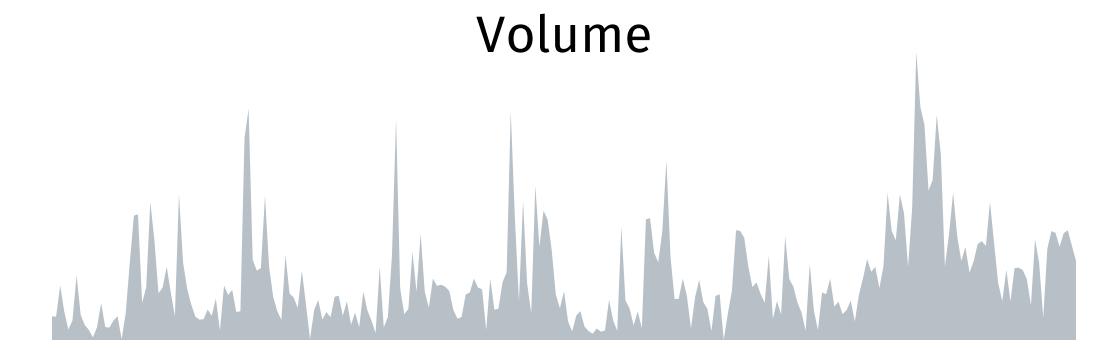


```
#!/bin/sh
mopts="-fulldeck=f -bar=f -vol -top=90 -bottom 60 -left=20 -right=80 -val=f -title=f"
mfunc -f sine | dchart $mopts -color=steelblue -xlabel=10
mfunc -f cosine | dchart $mopts -xlabel=0 -color=orange
```

Stock Performance

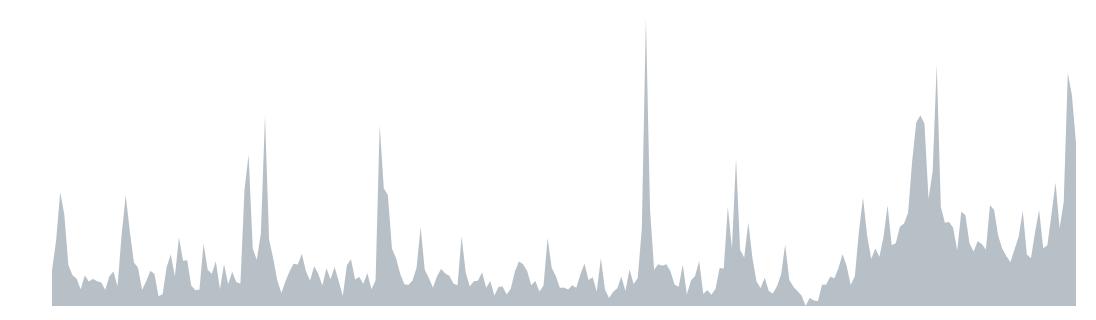
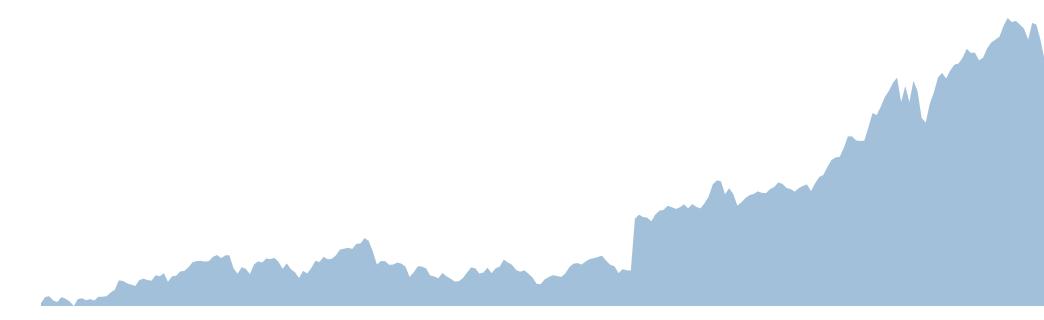
Apple

AAPL



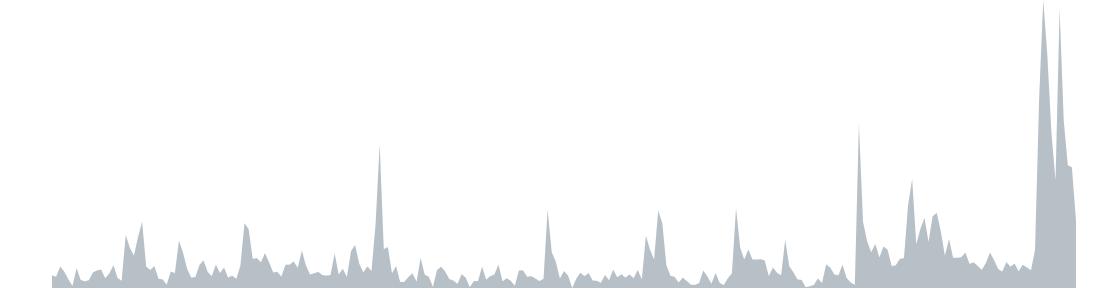
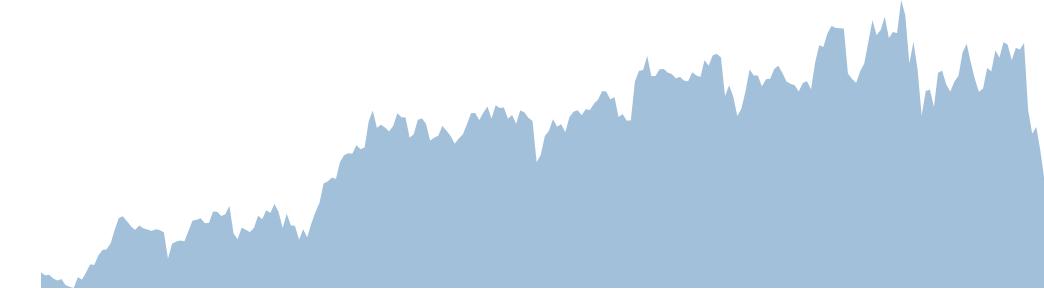
Amazon.com

AMZN



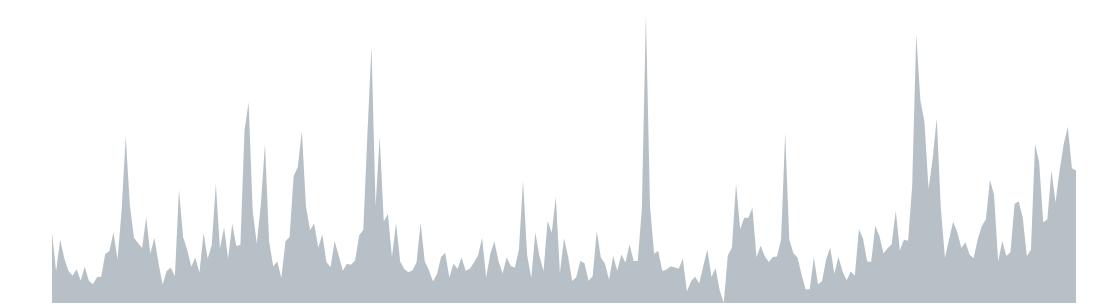
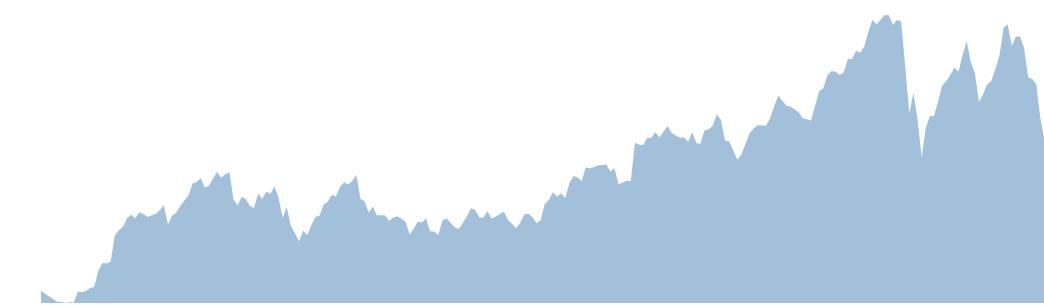
Facebook

FB



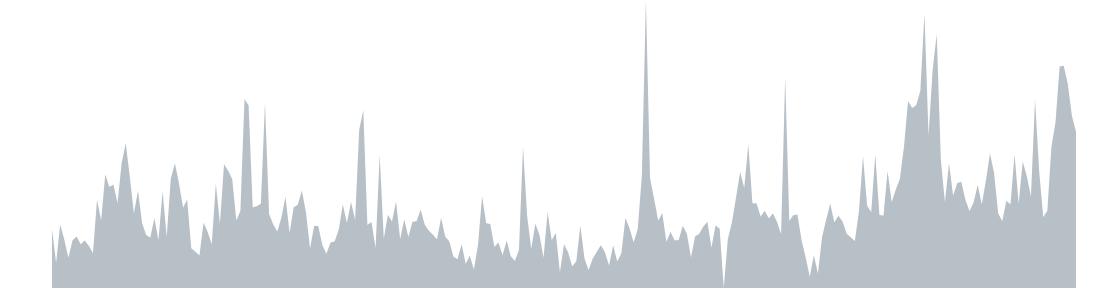
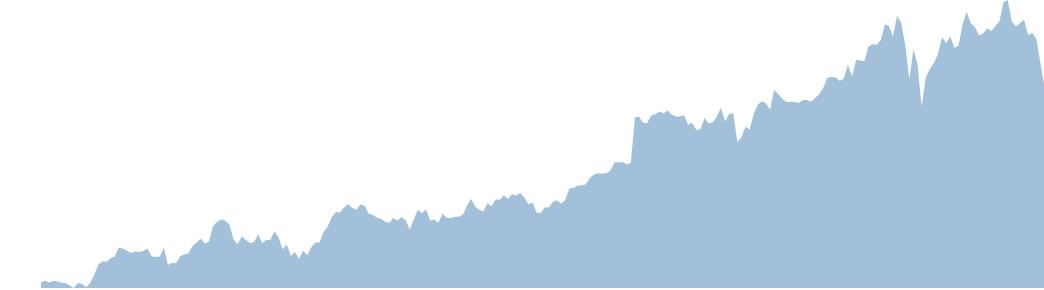
Alphabet

GOOG



Microsoft

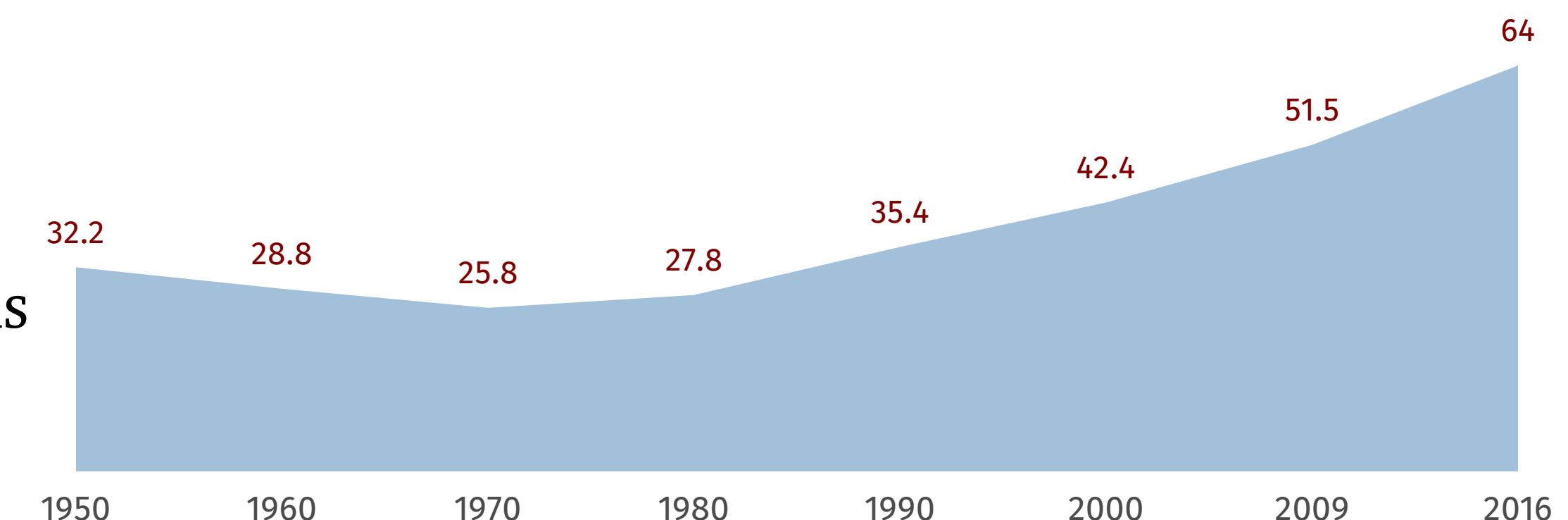
MSFT



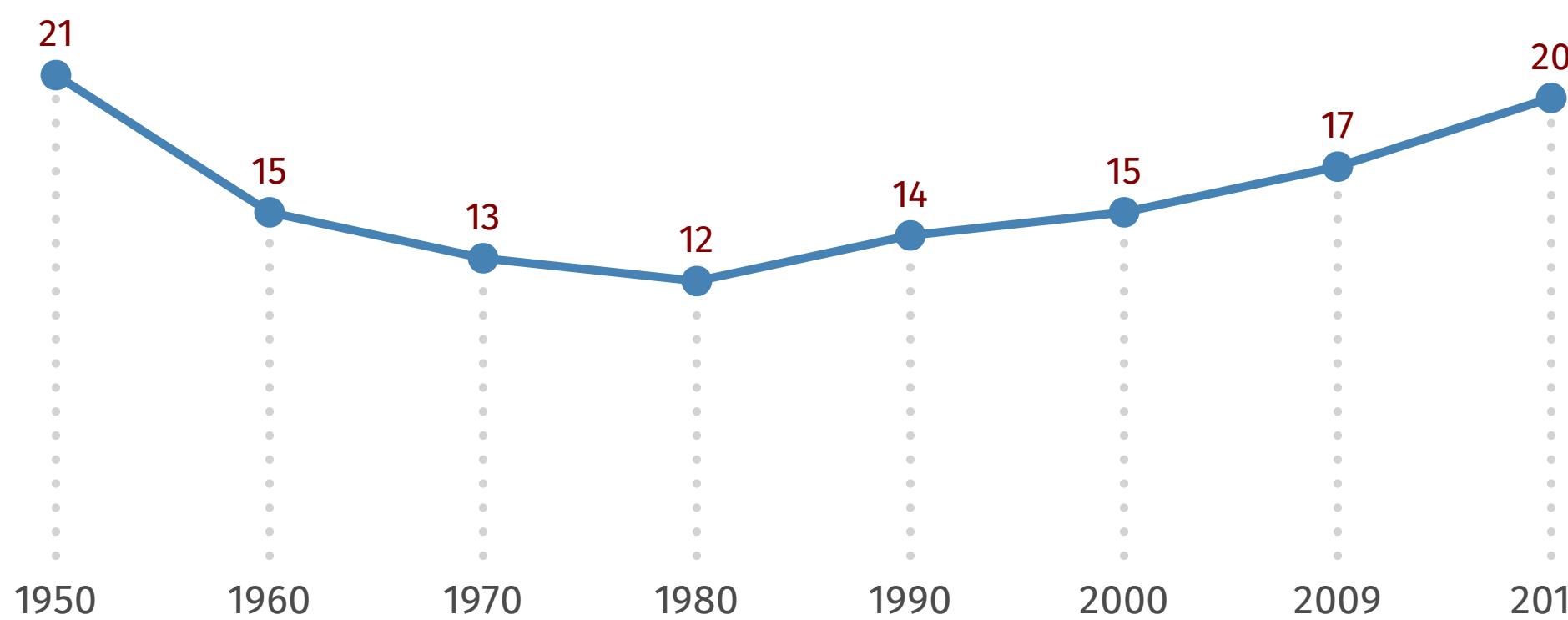
A record 64 million Americans live in multigenerational households

The number and share of Americans living in multi-generational family households have continued to rise, despite improvements in the U.S. economy since the Great Recession. In 2016, a record 64 million people, or 20% of the U.S. population, lived with multiple generations under one roof, according to a new Pew Research Center analysis of census data.

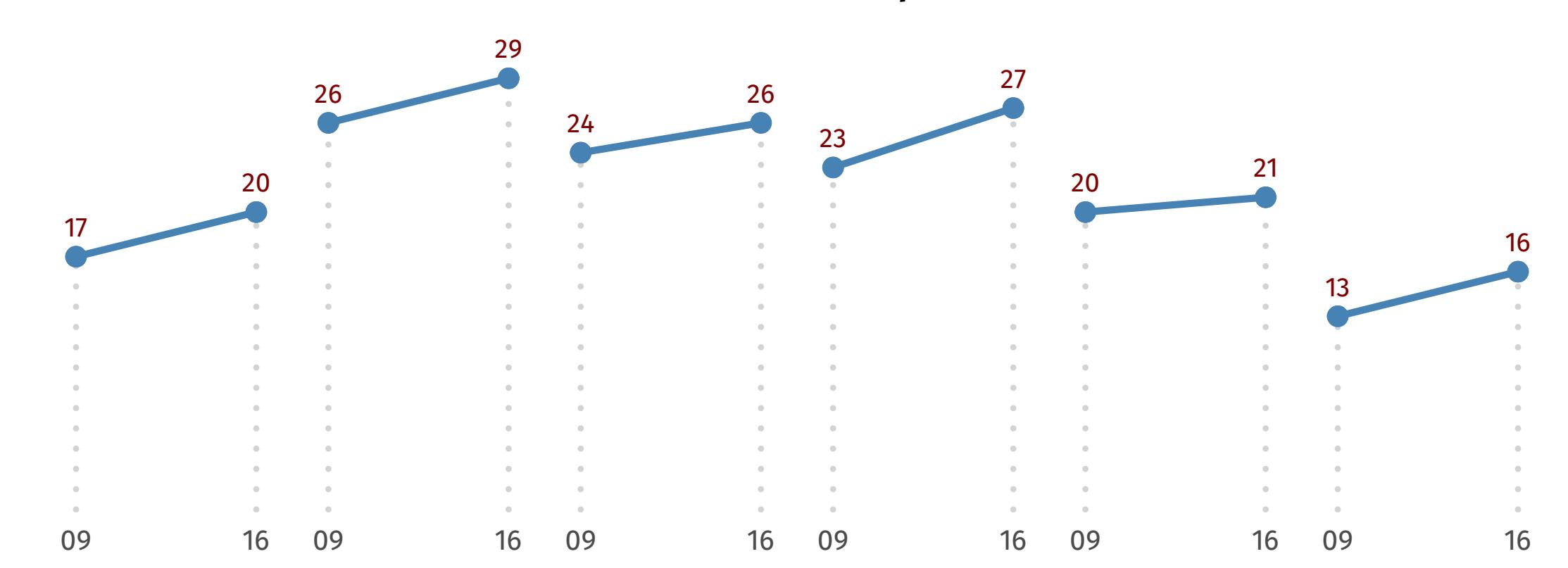
Multigenerational households (millions)



% of Americans in multigenerational households



Total Asian Black Hispanic Other White



What is it about Go?

f m t

func

io.Writer

io.Reader

net/http

encoding/xml

encoding/json

encoding/csv

cgo

The Community

From: Russ Cox
Subject: Re: [go-nuts] Visualizing Random Number Generators...
Date: March 5, 2010 1:14:44 EST
To: ajstarks <ajstarks@gmail.com>

are you going to share the library
or just tease us with pictures? ;-)

Thompson wanted to create a comfortable computing environment constructed according to his own design, using whatever means were available.

Dennis M. Ritchie, “The Development of the C Language”

Go is not the product of a Whiggish development process. We were just trying to get something that worked for us.

Rob Pike, “Origin of Go’s interface design”, golang-nuts

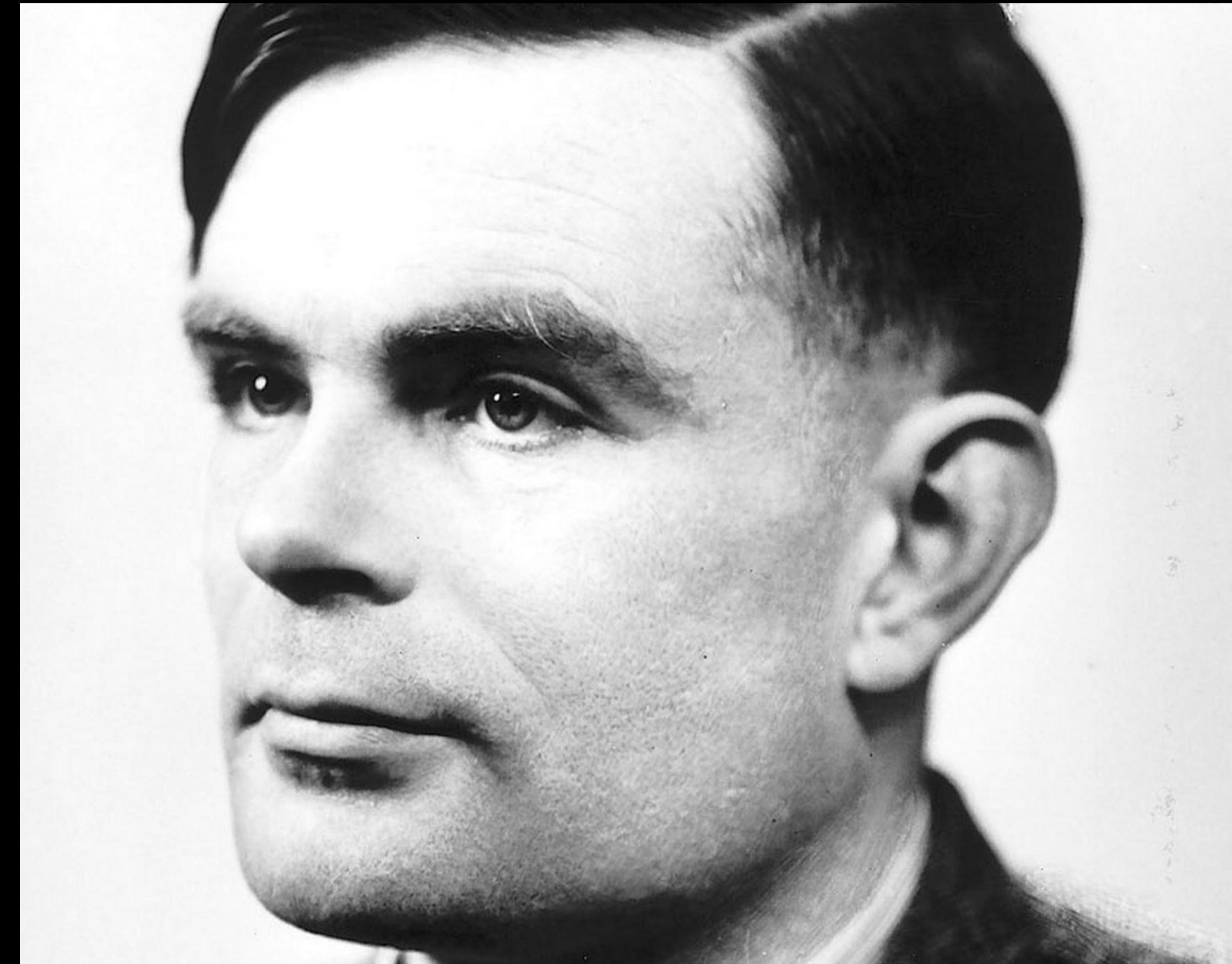
Making Tools

Fun

Reducing the distance from
the idea to the picture



Picasso



Turing

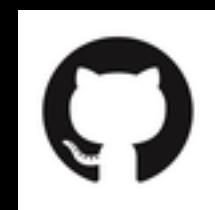
Thank you



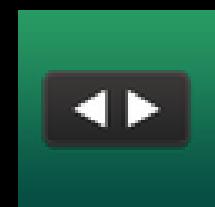
@ajstarks



ajstarks@gmail.com



github.com/ajstarks



speakerdeck.com/ajstarks



flickr.com/photos/ajstarks