Class 5: Data Visual with ggplot

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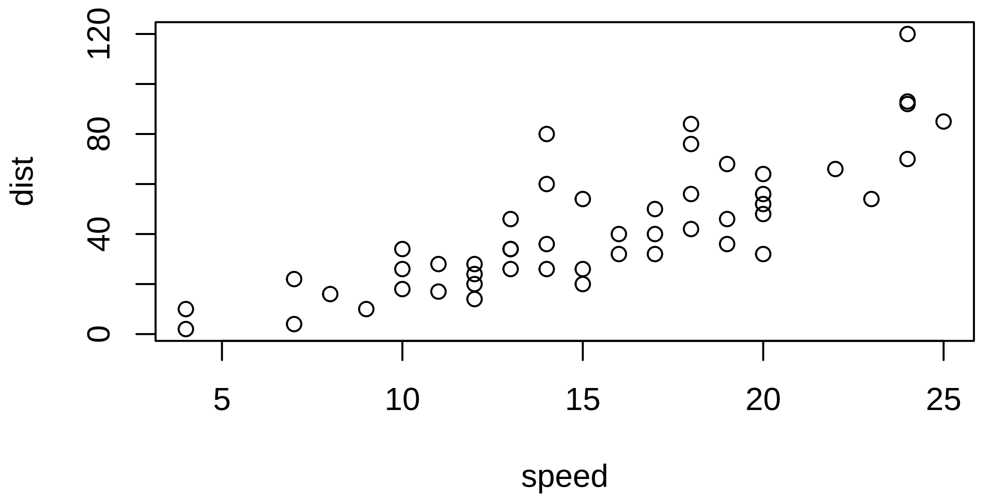
Ways to make figures in R: One of them that **comes with R** is the `plot()` function.

```r
plot(cars)
```



A popular package for plots and figures is called **ggplot2**.

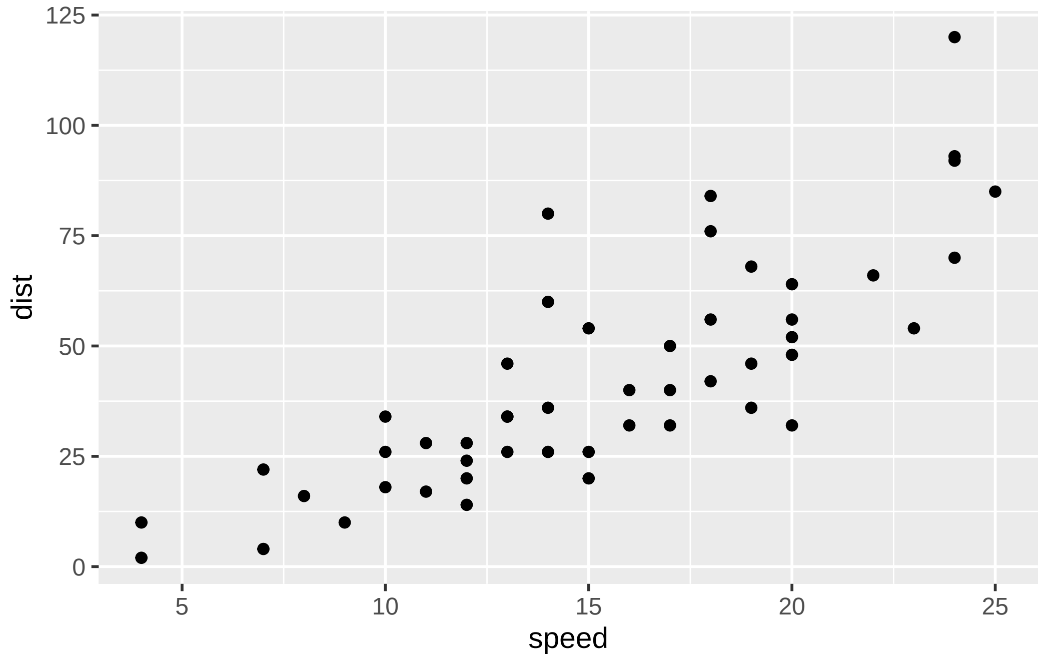
Before I can use an add on package, I must install with the `install.packages()` function. The package name should be in quotes in this command.

To use the package I need to load it with the `library()` function.

```r
#install.packages("ggplot2")

library("ggplot2")
```

```r
ggplot(cars) +
  aes(x=speed, y=dist) +
  geom_point()
```

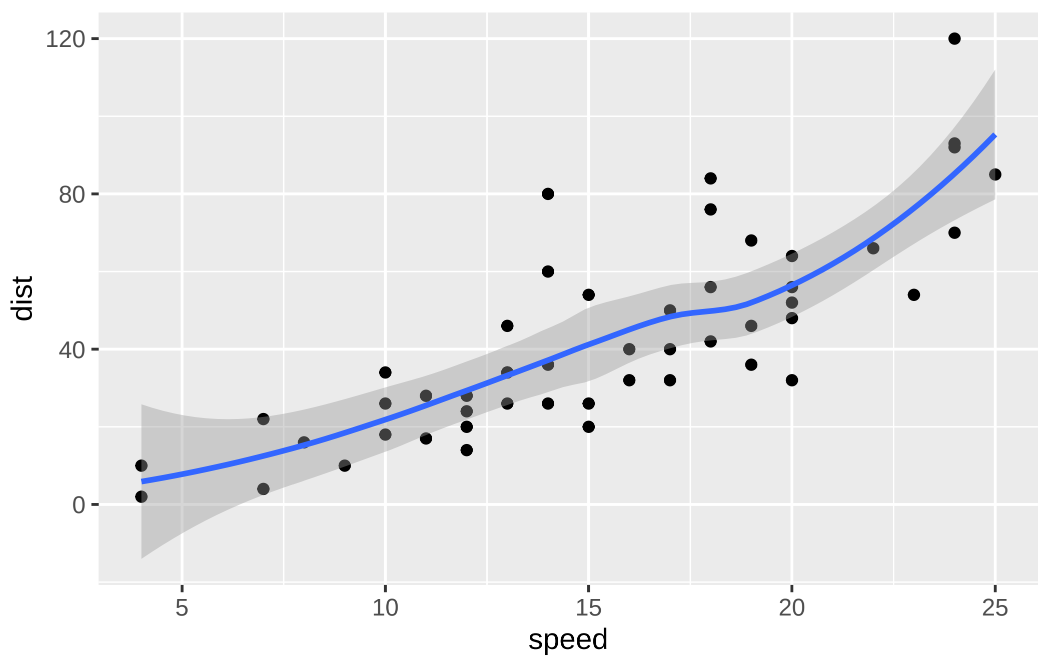


For "simple" graphs like this one, base R code is shorter than ggplot code.

Let's fit a model and show it on the plot.

```r
ggplot(cars) +
  aes(x=speed, y=dist) +
  geom_point() +
  geom_smooth()
```

```
`geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



Every ggplot has at least 3 layers.

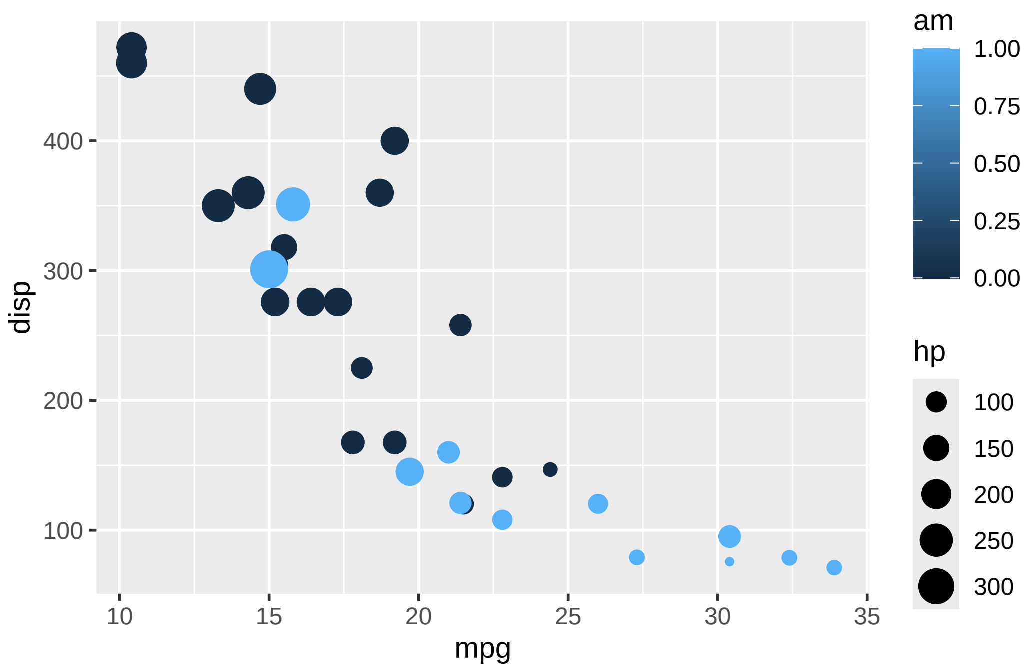
- **data**: data.frame with the numbers you want to plot
- **aesthetics**: mapping of the columns in your data frame to your plot
    - e.g. size of points, position, line type, line width, color, shape of points -**geoms**: there are many of these, but the basics are `geom_point()`, `geom_line()` and `geom_col()`

```
head(mtcars)
```

```
                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

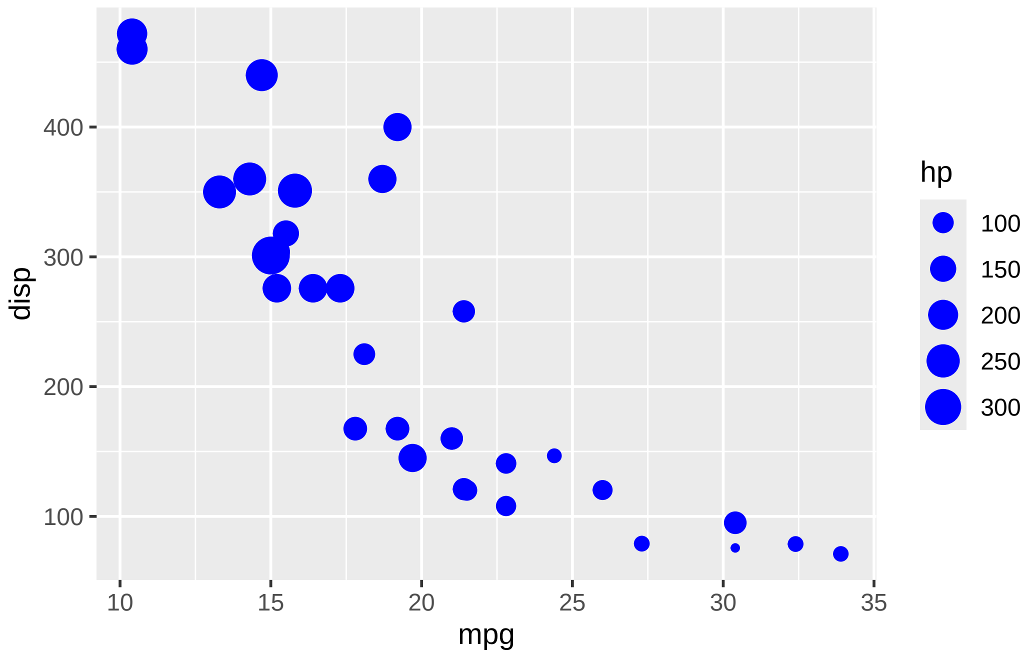
Make a ggplot of the `mtcars` data using `mgp` vs `disp` and set the size of the points to the `hp` and set the color to `am`.

```
ggplot(mtcars) +
  aes(x=mpg, y=disp, size=hp, col= am) +
  geom_point()
```



Now, color all the points blue.

```
ggplot(mtcars) +
  aes(x=mpg, y=disp, size=hp) +
  geom_point(colour="blue")
```



Make a gene expression plot that colors gene expression changes.

```r
url <- "https://bioboot.github.io/bimm143_S20/class-material/up_down_expression.txt"
genes <- read.delim(url)
head(genes)
```

```
        Gene Condition1 Condition2      State
1      A4GNT -3.6808610 -3.4401355 unchanging
2       AAAS  4.5479580  4.3864126 unchanging
3      AASDH  3.7190695  3.4787276 unchanging
4       AATF  5.0784720  5.0151916 unchanging
5       AATK  0.4711421  0.5598642 unchanging
6 AB015752.4 -3.6808610 -3.5921390 unchanging
```

```r
nrow(genes)
```

```
[1] 5196
```

```r
colnames(genes)
```

```
[1] "Gene"       "Condition1" "Condition2" "State"
```

```r
ncol(genes)
```

```
[1] 4
```

```r
table(genes$State)
```

```

      down unchanging         up 
        72       4997        127 
```

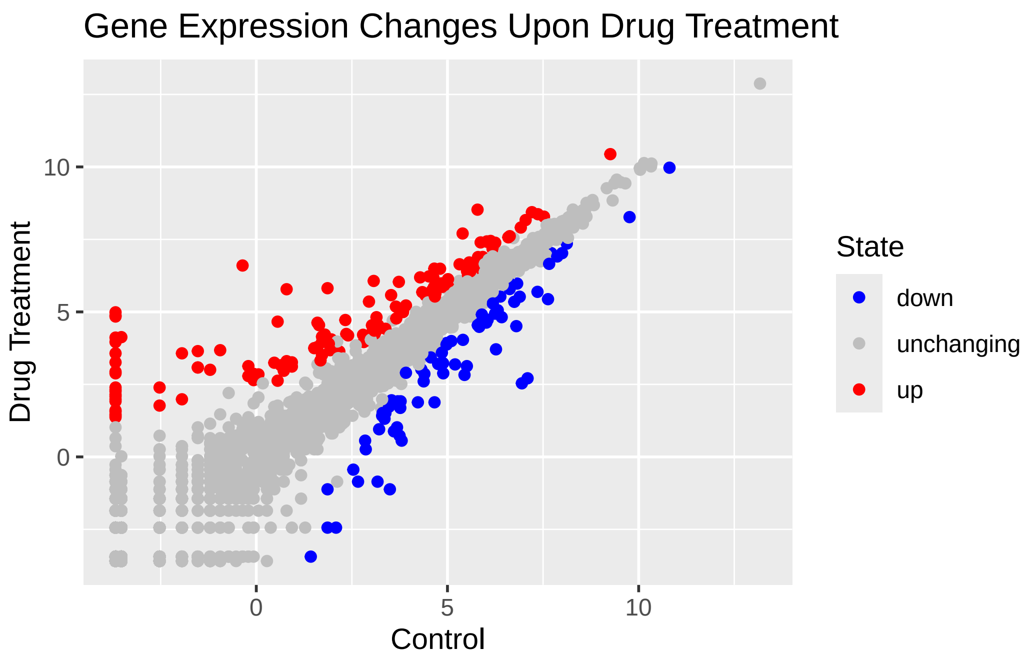
```r
table(genes$State)/nrow(genes) *100
```

```

      down unchanging         up 
  1.385681  96.170131   2.444188 
```

The functions `nrow()`, `ncol()`, and `table()` are helpful for summarizing large data frames.

```r
ggplot(genes) +
  aes(x=Condition1, y=Condition2, col=State) +
  geom_point() +
  scale_color_manual(values=c("blue", "grey", "red")) +
  labs(title="Gene Expression Changes Upon Drug Treatment", x="Control", y="Drug Treatment")
```



```r
url <- "https://raw.githubusercontent.com/jennybc/gapminder/master/inst/extdata/gapminder.ts
gapminder <- read.delim(url)
head(gapminder)
```

```
      country continent year lifeExp      pop gdpPercap
1 Afghanistan      Asia 1952  28.801  8425333  779.4453
2 Afghanistan      Asia 1957  30.332  9240934  820.8530
3 Afghanistan      Asia 1962  31.997 10267083  853.1007
4 Afghanistan      Asia 1967  34.020 11537966  836.1971
5 Afghanistan      Asia 1972  36.088 13079460  739.9811
6 Afghanistan      Asia 1977  38.438 14880372  786.1134
```

```r
library(dplyr)
```

```

Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag
```

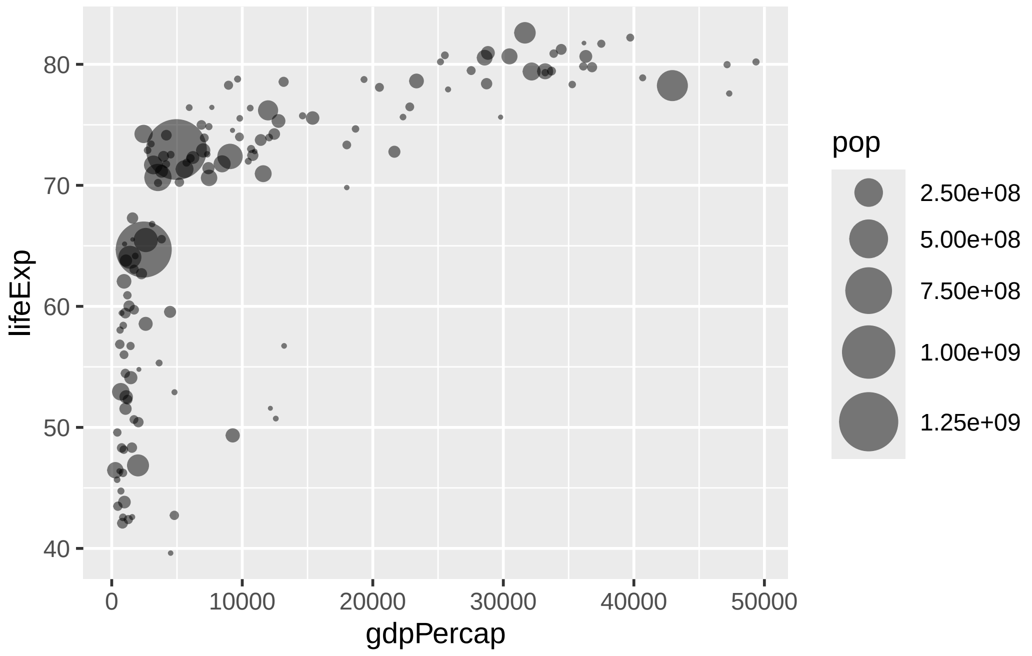
```
The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
gapminder_2007 <- gapminder %>% filter(year==2007)
gapminder_1957 <- gapminder %>% filter(year==1957)
```

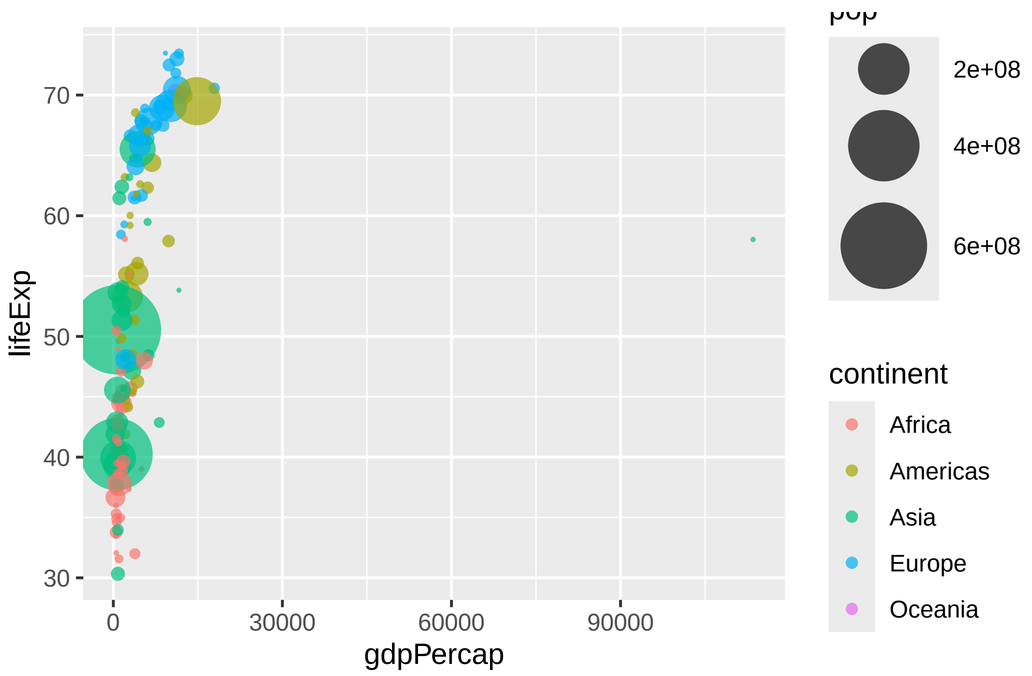
Make a plot of the 2007 data.

```
ggplot(gapminder_2007) +
  aes(x=gdpPercap, y=lifeExp, size= pop) +
  geom_point(alpha=0.5) +
  scale_size_area(max_size=10)
```



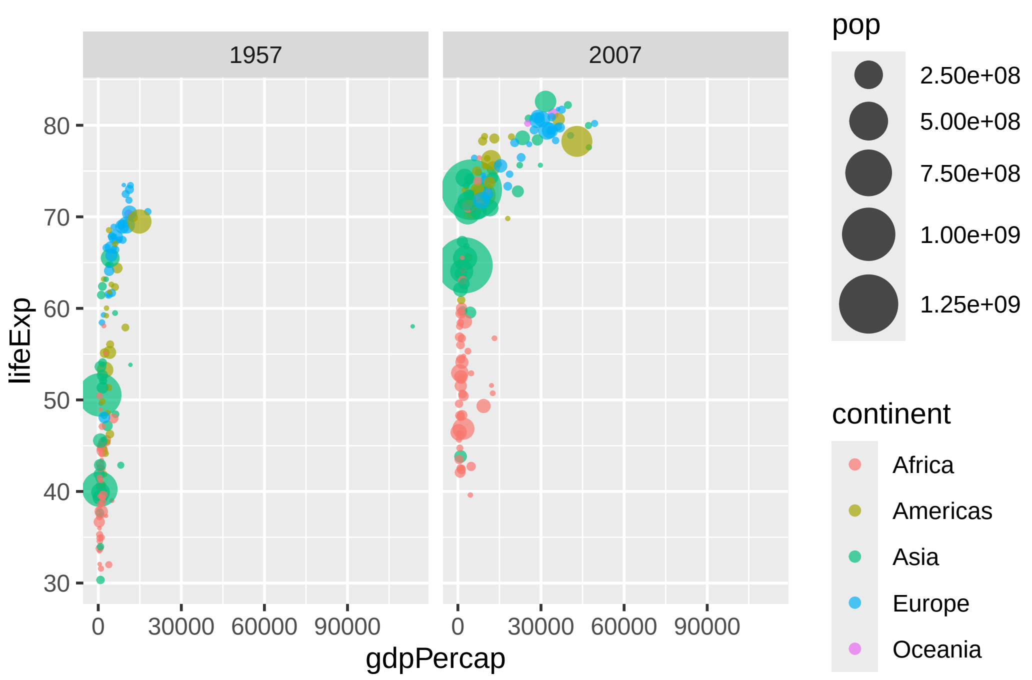
Make a plot of the 1957 data.

```
ggplot(gapminder_1957) +
  aes(x=gdpPercap, y=lifeExp, size= pop, col= continent) +
  geom_point(alpha=0.7) +
  scale_size_area(max_size=15)
```



Make a plot of both 2007 and 1957 data.

```
gapminder_1957_2007 <- gapminder %>% filter(year==1957 | year==2007)
ggplot(gapminder_1957_2007) +
  geom_point(aes(x = gdpPercap, y = lifeExp, color=continent,
                 size = pop), alpha=0.7) +
  scale_size_area(max_size = 10) +
  facet_wrap(~year)
```



You can use `geom_col()` to create bar charts.

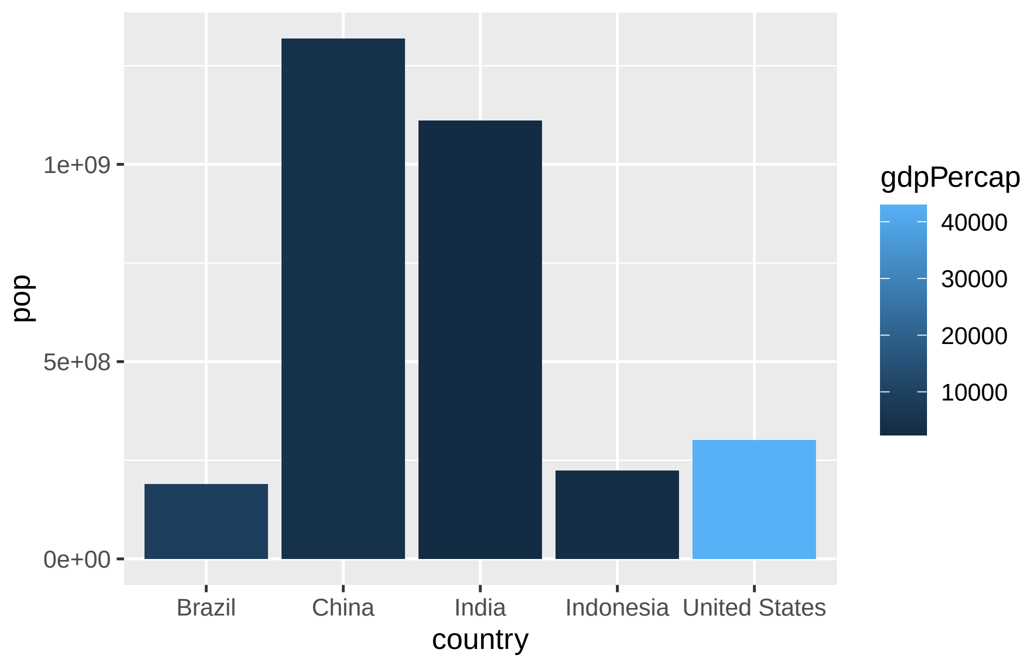
```
gapminder_top5 <- gapminder %>%
  filter(year==2007) %>%
  arrange(desc(pop)) %>%
  top_n(5, pop)

gapminder_top5
```

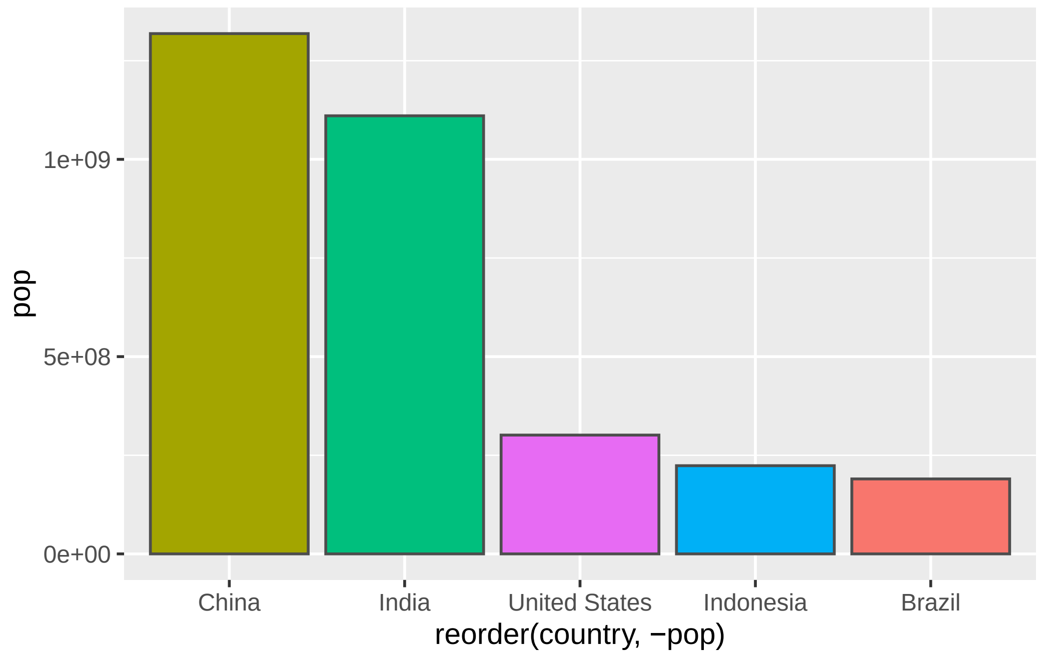
```
        country continent year lifeExp        pop gdpPercap
1         China      Asia 2007  72.961 1318683096  4959.115
2         India      Asia 2007  64.698 1110396331  2452.210
3 United States  Americas 2007  78.242  301139947 42951.653
4     Indonesia      Asia 2007  70.650  223547000  3540.652
5        Brazil  Americas 2007  72.390  190010647  9065.801
```

You can color by numeric values and get a gradient or categorical and get different colors for each category.

```
ggplot(gapminder_top5) +
  aes(x = country, y = pop, fill=gdpPercap) +
  geom_col()
```



```r
ggplot(gapminder_top5) +
  aes(x=reorder(country, -pop), y = pop, fill=country) +
  geom_col(col="grey30") +
  guides(fill="none")
```



```
ggsave("top5countrygraph.pdf")
```

```
Saving 5.5 x 3.5 in image
```

Can save plots from ggplot to the computer using `ggsave("")`.