Grammar of Graphics

Geometric objects

- Points
- Bars
- Lines
- Histograms
- Boxplots
- Etc

Geoms

- `geom_point()`
- `geom_bar()`
- `geom_line()`
- `geom_histogram()`
- `geom_boxplot()`

Aesthetic Attributes

Different `aes` available depending on geometry. For points:

- x
- y
- alpha
- colour
- fill
- group
- shape
- size
- stroke

Example: Gapminder

```
library(tidyverse) # Load ggplot2, dplyr, etc
library(gapminder) # Load gapminder data
gapminder
```

```
## # A tibble: 1,704 x 6
##    country     continent  year lifeExp      pop gdpPercap
##    <fct>       <fct>     <int>   <dbl>    <int>     <dbl>
##  1 Afghanistan Asia       1952    28.8  8425333      779.
##  2 Afghanistan Asia       1957    30.3  9240934      821.
##  3 Afghanistan Asia       1962    32.0 10267083      853.
##  4 Afghanistan Asia       1967    34.0 11537966      836.
##  5 Afghanistan Asia       1972    36.1 13079460      740.
##  6 Afghanistan Asia       1977    38.4 14880372      786.
##  7 Afghanistan Asia       1982    39.9 12881816      978.
##  8 Afghanistan Asia       1987    40.8 13867957      852.
##  9 Afghanistan Asia       1992    41.7 16317921      649.
## 10 Afghanistan Asia       1997    41.8 22227415      635.
## # … with 1,694 more rows
```

A simple plot

```
ggplot(gapminder)
```

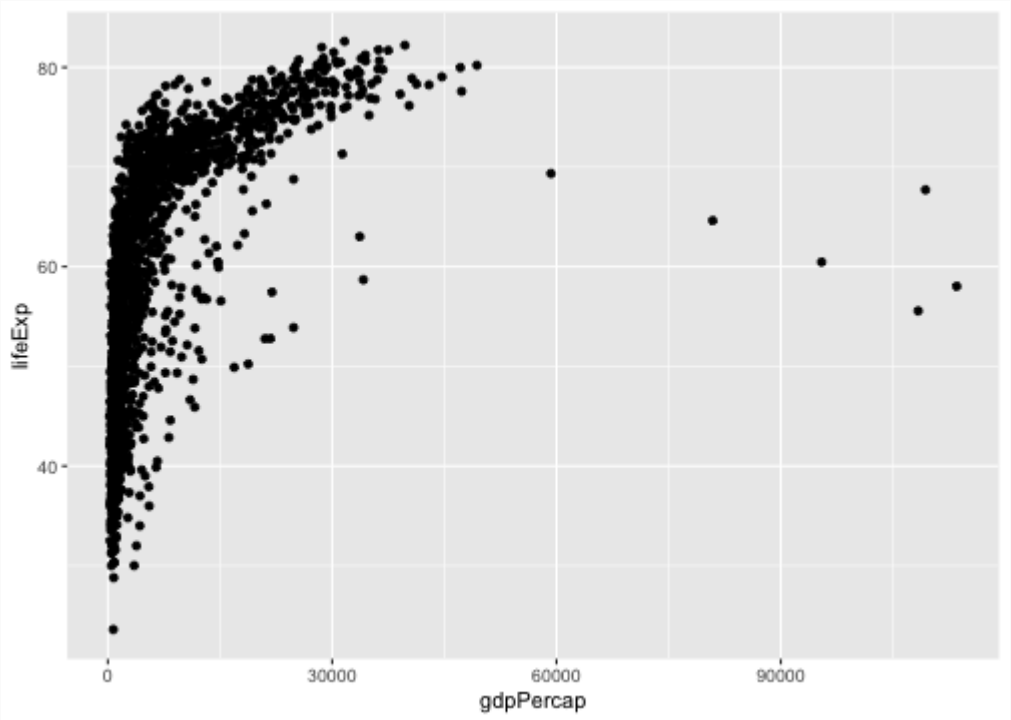
Adding a `geom` layer

```
ggplot(gapminder) +
  geom_point()
```

(in RStudio)

Adding a `geom` layer, again

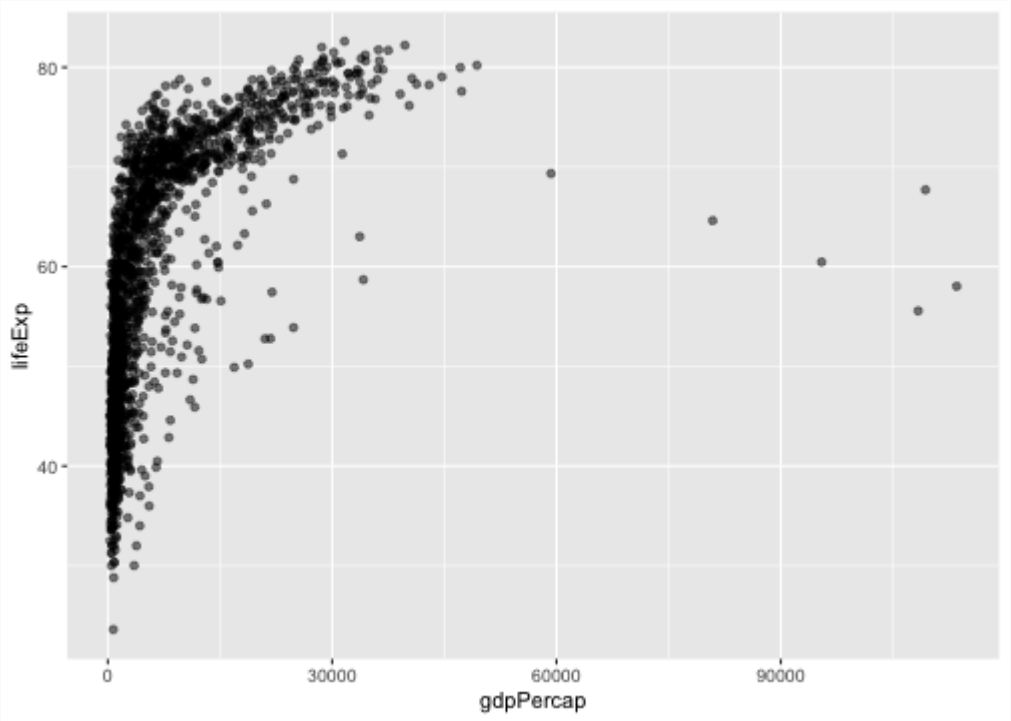
```
ggplot(gapminder) +
  geom_point(aes(x = gdpPercap, y = lifeExp))
```



Transparency

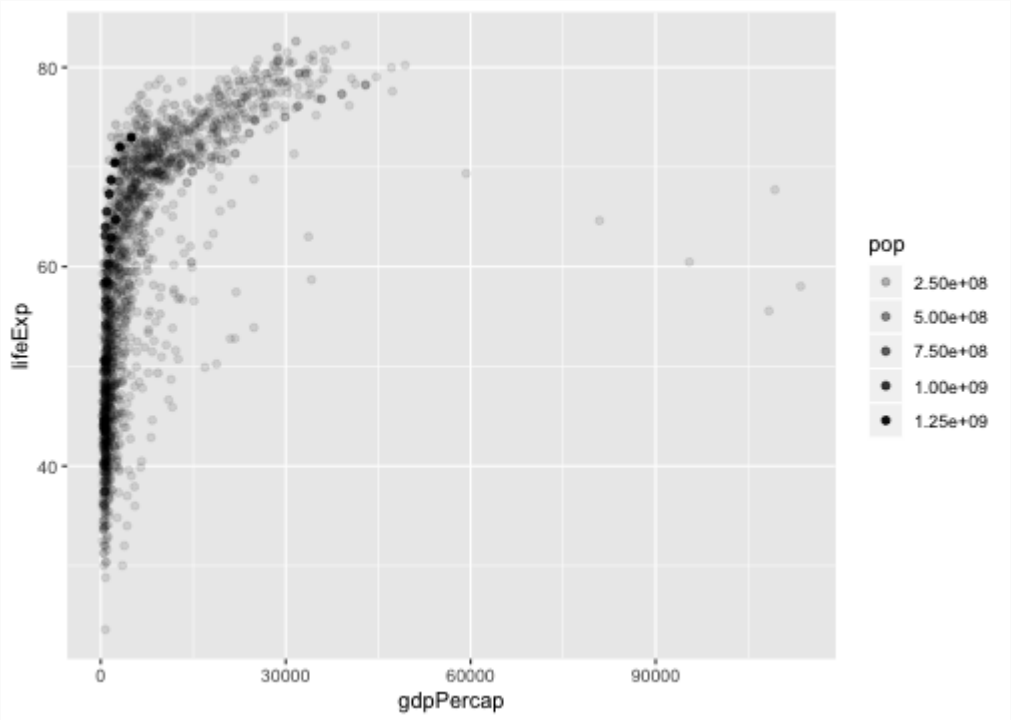
The points seem to be overplotting. This can be fixed by making them transparent with `alpha`, a number between 0 and 1.

```
ggplot(gapminder) +
  geom_point(aes(x = gdpPercap, y = lifeExp), alpha = .5)
```



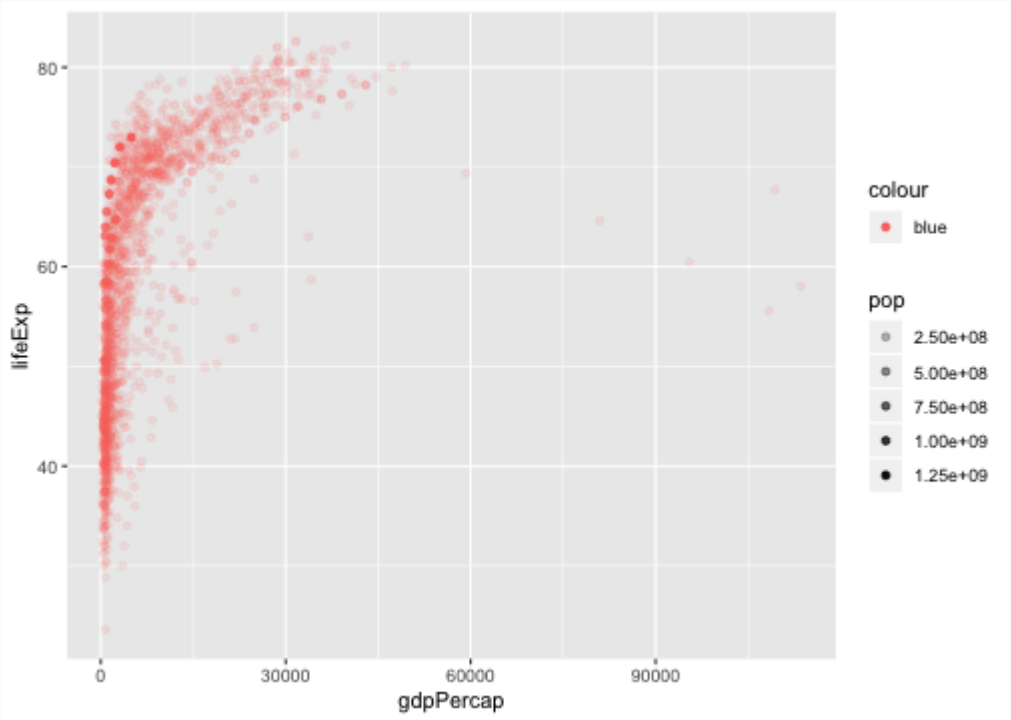
What if...

```
ggplot(gapminder) +
  geom_point(aes(x = gdpPercap, y = lifeExp, alpha = pop))
```



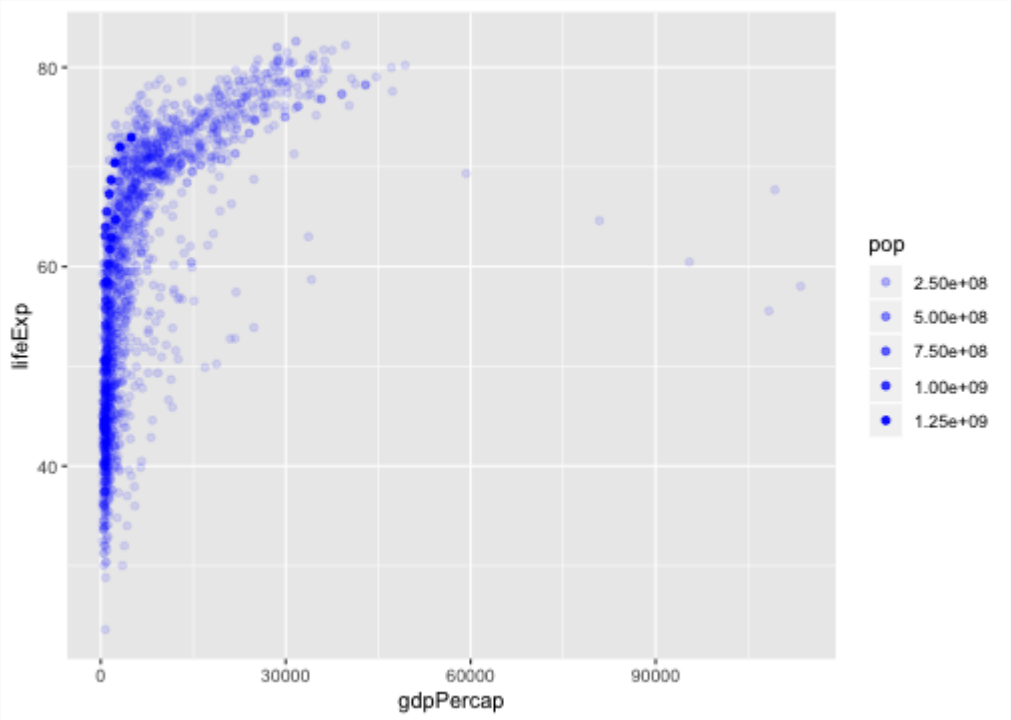
Blue points

```
ggplot(gapminder) +
  geom_point(aes(x = gdpPercap, y = lifeExp,
                 alpha = pop, colour = "blue"))
```



Blue points, again

```
ggplot(gapminder) +
  geom_point(aes(x = gdpPercap, y = lifeExp,
                 alpha = pop), colour = "blue")
```



A subtlety to be aware of

There is a difference between **setting** and **mapping** aesthetics.

- Mapping dynamically links data to aesthetics through `aes()`.
- Setting a parameter to a fixed value is done *outside* of `aes`.

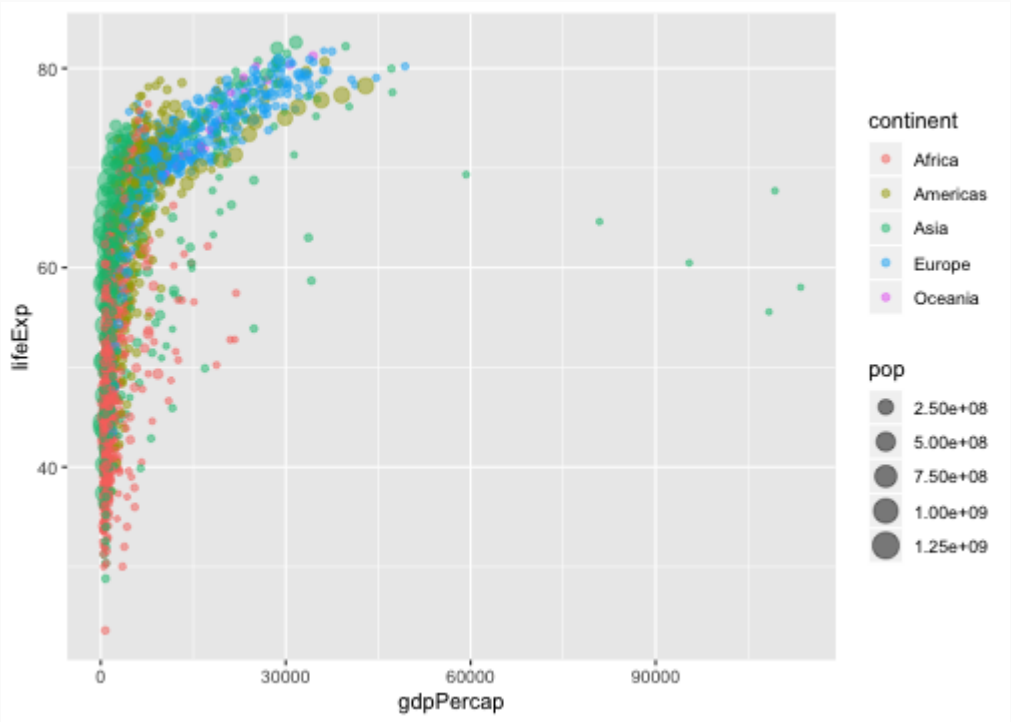
R colors

```
colors()
```

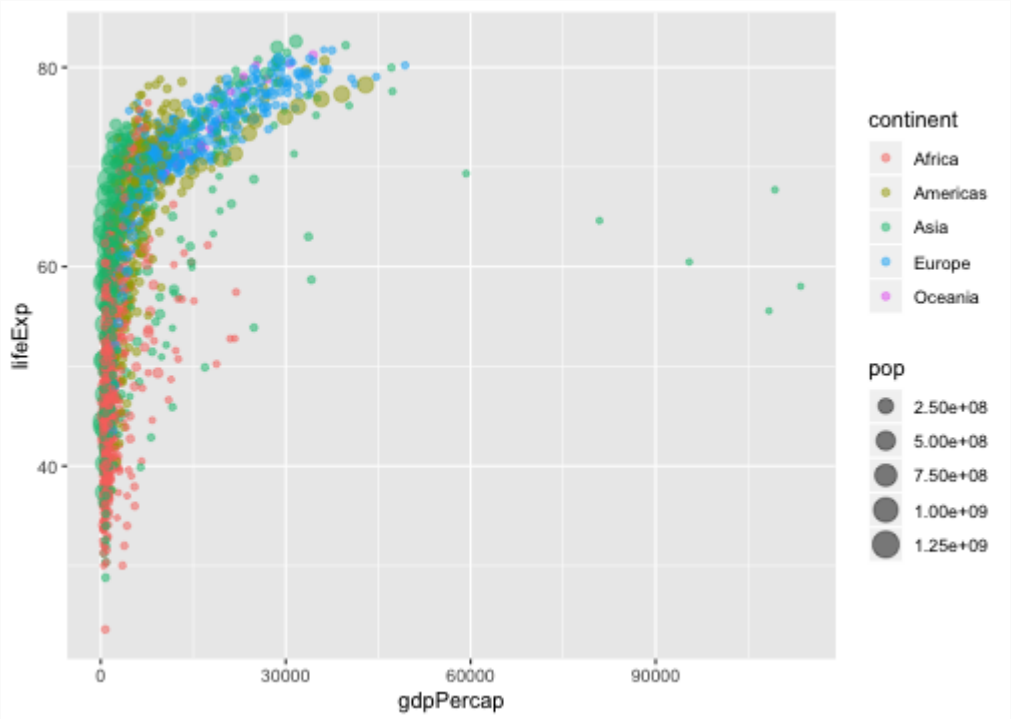
```
##   [1] "white"           "aliceblue"           "antiquewhit
##   [4] "antiquewhite1"   "antiquewhite2"       "antiquewhit
##   [7] "antiquewhite4"   "aquamarine"          "aquamarine1
##  [10] "aquamarine2"     "aquamarine3"         "aquamarine4
##  [13] "azure"           "azure1"              "azure2"
##  [16] "azure3"          "azure4"              "beige"
##  [19] "bisque"          "bisque1"             "bisque2"
##  [22] "bisque3"         "bisque4"             "black"
##  [25] "blanchedalmond"  "blue"                "blue1"
##  [28] "blue2"           "blue3"               "blue4"
##  [31] "blueviolet"      "brown"               "brown1"
##  [34] "brown2"          "brown3"              "brown4"
##  [37] "burlywood"       "burlywood1"          "burlywood2"
##  [40] "burlywood3"      "burlywood4"          "cadetblue"
##  [43] "cadetblue1"      "cadetblue2"          "cadetblue3"
##  [46] "cadetblue4"      "chartreuse"          "chartreuse1
##  [49] "chartreuse2"     "chartreuse3"         "chartreuse4
##  [52] "chocolate"       "chocolate1"          "chocolate2"
##  [55] "chocolate3"      "chocolate4"          "coral"
##  [58] "coral1"          "coral2"              "coral3"
```

Your turn

Write out the `ggplot` code to produce the following plot:



```
ggplot(gapminder) +
  geom_point(aes(x = gdpPercap, y = lifeExp,
                 colour = continent, size = pop),
             alpha = .5)
```

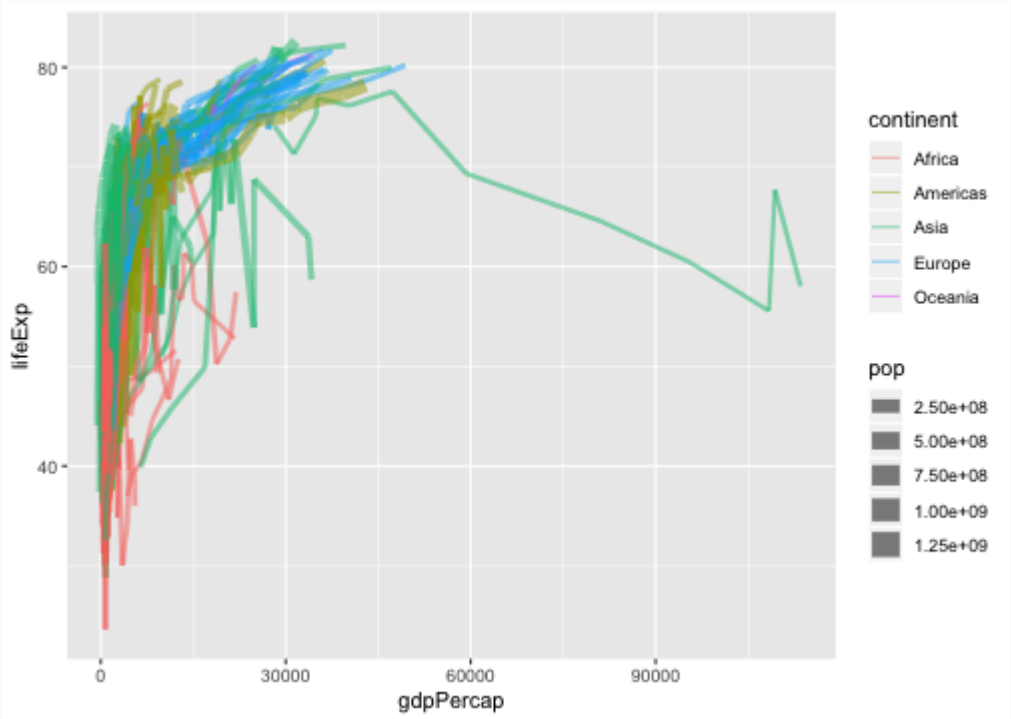


Your turn

Write out the `ggplot` code to produce the following plot:

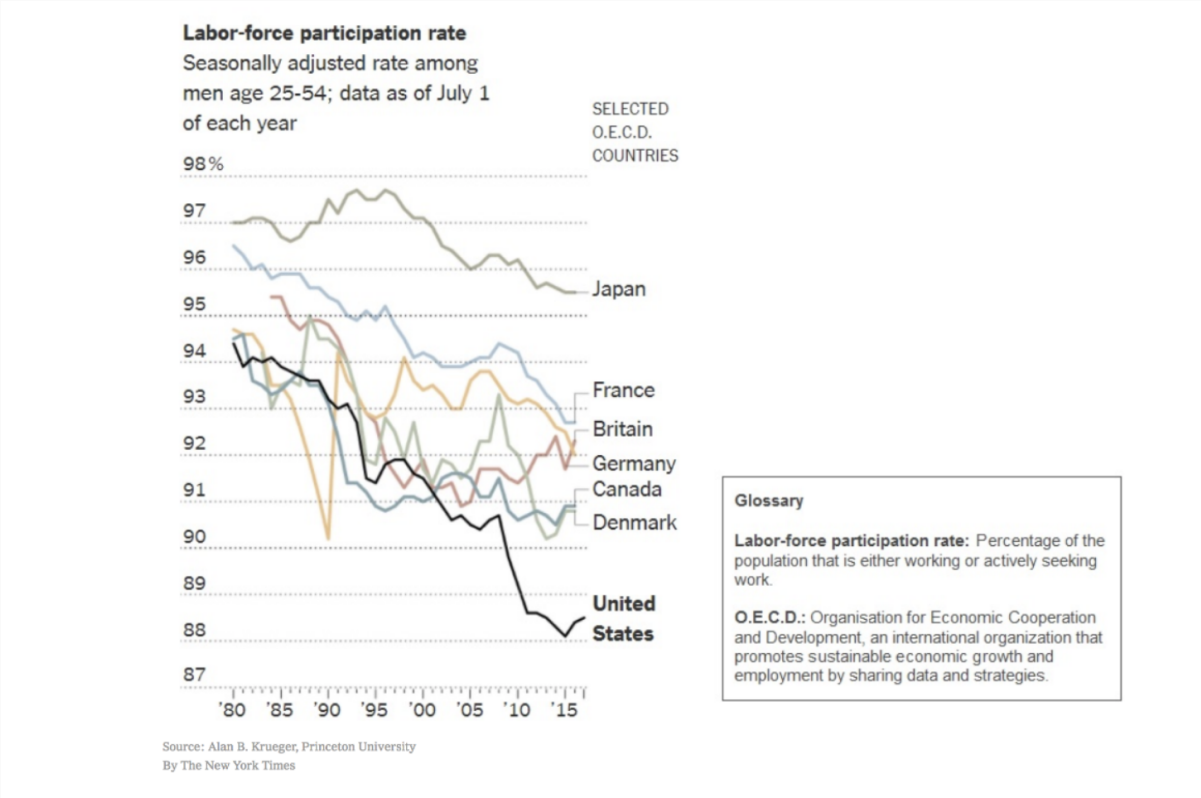
```
ggplot(gapminder) +
  geom_line(aes(x = gdpPercap, y = lifeExp,
                colour = continent, size = pop,
                group = country),
            alpha = .5)
```

```
ggplot(gapminder) +
  geom_line(aes(x = gdpPercap, y = lifeExp,
                colour = continent, size = pop,
                group = country),
            alpha = .5)
```



In the news

Sketch this plot, write the ggplot2 code that produced it, and sketch the data set from which it must have originated.



Extra

- facets