Final Project

Clio3

October 29, 2014

Methodology

It should be noted that this is a project for a class entitled “Programming for Historians.” Historians, at least good ones, let the sources lead them to their conclusions. After reading through the sources, we can make a thesis on how things have changed over time in our particuar fields of interest. So, what happens when we engage these historical sources with programming methodology? Potentially, the programming historian will be able to see things they had not seen previously or connect things in a new way.

After writing my master’s level thesis and engaging in new research, I ended up with a set of data that could protentially be utilized in traditional, historical scholarship. However, given my interests in digital history, it made sense to try my hand as a programming historian to see where the sources could potentially lead.

Introduction

The video game industry in the United States, despite being quite a young technological field, has had an active and tumultuous career, especially when US developers were the predominant force worldwide for video games. However, despite the successful nature that the industry had, it was not without its issues. In the United States, the video game industry has long been known as a “boys’ club” with limited access for non-whites and women. From the early 1960s to the mid-1980s, majority of the known video game developers were, in fact, white middle-class men.

During this time, the great majority of these developers had been involved in some sort of computer science university programs. These programs, especially for the 1960s and 1970s, were not especially diverse, and women were actively discouraged from using “masculine” high-end technologies such as computers.

Since many of these game developers found inspiration, or even directly lifting the code, within each other’s work, this created a network of game developers and the video games that they developed. Given this, it would be interesting to create a network analysis of a selection of video games and their known developers in order to see what kind of connections and inspirations took place from the late 1950s into the mid-1980s.

Beyond just the network analysis, which will provide useful data, it may also be useful to try a few other techniques of plotting the data to see what kind of conclusions can be gained from this methodology.

On Data

For this project, it was important to consider utilizing the types of data for my network analysis. Using a list of video games, developers, and dates that I created during the research process, I was able to create a document for use in this project. One of the issues that arose was the lack of credit for developers in the early video game industry. With the lack of credit, there are a lot of video games without listed creators. This led to the methodology question of whether to include games without credited authors, as this would limit the networks of people, while making the networks of games quite a bit larger.

First, I need to load any necessary packages and data regarding the developers and games that they created so we can potentially see any connections that may be possible to make.

```
library(igraph)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
##
## The following object is masked from 'package:stats':
##
##     filter
##
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(tidyr)
library(stringr)
#library(mullenmisc)
# library(sna)
gamedevs = read.csv("~//Desktop/networkgamedevs.csv", header = TRUE)
basedon<-gamedevs %>%
  select(Game, Based.on)
developer<-gamedevs %>%
  select(Developer, Game)
```

You can also see here that once the data is loaded, it is then separated into two categories. The first is “basedon”, which contains the Game and Based on categories in the CSV file. The second is which developing team worked on which games. This way, this information can be parsed out for plotting and analysis.

Let’s see what happens when we first try to plot the networks with the basedon information.

```
options(height=1000, width = 800)
first_graph<-graph.data.frame(basedon,directed=FALSE)
E(first_graph)
```

```
## Edge sequence:
##
## [1]                                -- Spacewar(1962)
## [2]                                -- Spacewar(1962)
## [3]                                -- Spacewar(1962)
## [4]  Computer Space(1971)          -- Spacewar(1962)
## [5]  Asteroids(1979)               -- Spacewar(1962)
## [6]  Asteroids(1979)               -- Spacewar(1962)
## [7]  Galaxy Game(1971)             -- Spacewar(1962)
```

```
## [8]  Galaxy Game(1971)               -- Spacewar(1962)
## [9]  Orbit War(1974)                 -- Spacewar(1962)
## [10] Space Wars(1979)                -- Spacewar(1962)
## [11] Star Castle(1980)               -- Space Wars(1979)
## [12] Tail Gunner(1979)               -- Space Wars(1979)
## [13] Yar's Revenge(1982)             -- Star Castle(1980)
## [14] Tennis for Two(1958)            -- Magnavox Odyssey Tennis(1972)
## [15] Magnvox Odyssey Tennis(1972)    -- Pong(1972)
## [16] Magnvox Odyssey Tennis(1972)    -- Pong(1972)
## [17] Breakout(1972)                  -- Pong(1972)
## [18] Breakout(1972)                  -- Pong(1972)
## [19] Superbreakout(1978)             -- Breakout(1972)
## [20] Superbreakout(1978)             -- Breakout(1972)
## [21] Space Duel(1982)                -- Asteroids(1979)
## [22] Space Duel(1982)                -- Asteroids(1979)
## [23] Space Duel(1982)                -- Asteroids(1979)
## [24] Space Duel(1982)                -- Asteroids(1979)
## [25] Battlezone(1980)                -- Asteroids(1979)
## [26] Defender(1981)                  -- Asteroids(1979)
## [27] Chopper Command(1982)           -- Defender(1981)
## [28] Gravitar(1982)                  -- Asteroids(1979)
## [29] Thrust(1986)                    -- Gravitar(1982)
## [30] Oids(1987)                      -- Asteroids(1979)
## [31] Tank(1974)                      -- Spacewar(1962)
## [32] Tank(1974)                      -- Spacewar(1962)
## [33] Combat(1977)                    -- Tank(1974)
## [34] Combat(1977)                    -- Tank(1974)
## [35] Combat(1977)                    -- Tank(1974)
## [36] Combat(1977)                    -- Tank(1974)
## [37]                                 -- Gotcha(1973)
## [38]                                 -- Tennis for Two(1958)
## [39]                                 -- Gun Fight(1975)
## [40]                                 -- Atari Basketball(1978)
## [41]                                 -- Atari Basketball(1978)
## [42] Atari Football((1978)           -- Atari Basketball(1978)
## [43] Space Invaders(1979)            -- Spacewar(1962)
## [44] Colossal Cave Adventure(1976)   -- Adventure(1979)
## [45]                                 -- Colossal Cave Adventure(1976)
## [46] Galaxian(1979)                  -- Space Invaders(1979)
## [47] Galaxian(1979)                  -- Space Invaders(1979)
## [48] Galaxian(1979)                  -- Space Invaders(1979)
## [49] Galaga(1981)                    -- Galaxian(1979)
## [50] Mystery House(1980)             -- Wizard and the Princess(1980)
## [51] Mystery House(1980)             -- Wizard and the Princess(1980)
## [52] Mystery House(1980)             -- Colossal Cave Adventure(1976)
```

```
## [53] Mystery House(1980)            -- Colossal Cave Adventure(1976)
## [54]                                -- Pac-Man(1980)
## [55]                                -- Missile Command(1980)
## [56] Avalanche(1978)                -- Kaboom!(1981)
## [57] Avalanche(1978)                -- Breakout(1972)
## [58] Asteroids Deluxe(1981)         -- Asteroids(1979)
## [59]                                -- Centipede(1981)
## [60]                                -- Centipede(1981)
## [61]                                -- Donkey Kong(1981)
## [62] Tempest(1981)                  -- Space Invaders(1979)
## [63]                                -- Softporn Adventure(1981)
## [64]                                -- Ultima(1981)
## [65]                                -- Castle Wolfenstein(1981)
## [66]                                -- E.T. The ExtraTerrestrial(1982)
## [67] Joust(1982)                    -- Defender(1981)
## [68] Joust(1982)                    -- Defender(1981)
## [69] Joust(1982)                    -- Defender(1981)
## [70] Joust(1982)                    -- Defender(1981)
## [71] Joust(1982)                    -- Defender(1981)
## [72] Joust(1982)                    -- Defender(1981)
## [73]                                -- Pole Position(1982)
## [74] Swordquest(1982)               -- Adventure(1979)
## [75] Swordquest(1982)               -- Adventure(1979)
## [76]                                -- Pitfall!(1982)
## [77] Spelunker(1983)                -- Pitfall!(1982)
## [78]                                -- Q'Bert(1982)
## [79]                                -- Q'Bert(1982)
## [80] Dragon's Lair(1983)            -- Adventure(1979)
## [81] Dragon's Lair(1983)            -- Adventure(1979)
## [82] Space Ace(1984)                -- Dragon's Lair(1983)
## [83] Super Mario Brothers(1986)     -- Donkey Kong(1981)
```

```
  set.seed(33)
##png(file = "first_graph.png", width= 800, height=600)
plot(first_graph, layout=layout.fruchterman.reingold, vertex.size=1, vertex.shape="square")
##dev.off()
title("Influence of Early Video Games 1958-1986")
```

Well, this is really interesting. This plot shows us the connections of which game influenced which other games. As you can see, there is a large portion in the center that is influenced by Space War, and that node branches out throughout the plot with many games of the period finding some influence.

Let's take the second data frame I created earlier, the "developer" frame, and see what type of connections can be found between the developers and the games they created. This way, we can see what development teams existed.

```
second_graph<-graph.data.frame(developer,directed=FALSE)
E(second_graph)
```

```
## Edge sequence:
##
## [1]  Spacewar(1962)                -- Steven "Slug" Russell
## [2]  Spacewar(1962)                -- Martin "Shag" Graetz
## [3]  Spacewar(1962)                -- Wayne Wiitanen
## [4]  Computer Space(1971)          -- Nolan Bushnell
## [5]  Asteroids(1979)               -- Lyle Rains
## [6]  Asteroids(1979)               -- Ed Logg
## [7]  Galaxy Game(1971)             -- Bill Pitts
## [8]  Galaxy Game(1971)             -- Hugh Tuck
```

```
## [9]  Orbit War(1974)                  -- Silias Warner
## [10] Space Wars(1979)                 -- Larry Rosenthal
## [11] Star Castle(1980)                -- Tim Skelly
## [12] Tail Gunner(1979)                -- Tim Skelley
## [13] Yar's Revenge(1982)              -- Howard Scott Warshaw
## [14] Magnavox Odyssey Tennis(1972)    -- Ralph Baer
## [15] Pong(1972)                       -- Nolan Bushnell
## [16] Pong(1972)                       -- Allan Alcorn
## [17] Breakout(1972)                   -- Steve Jobs
## [18] Breakout(1972)                   -- Steve Wozniak
## [19] Superbreakout(1978)              -- Lyle Rains
## [20] Superbreakout(1978)              -- Ed Logg
## [21] Space Duel(1982)                 -- Rick Maurer
## [22] Space Duel(1982)                 -- Owen Rubin
## [23] Space Duel(1982)                 -- Steve Calfee
## [24] Space Duel(1982)                 -- Dave Sheppard
## [25] Battlezone(1980)                 -- Ed Rotberg
## [26] Defender(1981)                   -- Eugene Jarvis
## [27] Chopper Command(1982)            -- Bob Whitehead
## [28] Gravitar(1982)                   -- Mike Halley
## [29] Thrust(1986)                     -- Jeremy Smith
## [30] Oids(1987)                       -- Dan Hewitt
## [31] Tank(1974)                       -- Steve Bristow
## [32] Tank(1974)                       -- Lyle Rains
## [33] Combat(1977)                     -- Steve Mayer
## [34] Combat(1977)                     -- Joe Decuir
## [35] Combat(1977)                     -- Larry Wagner
## [36] Combat(1977)                     -- Larry Kaplan
## [37] Gotcha(1973)                     -- Allan Alcorn
## [38] Tennis for Two(1958)             -- William Higenbotham
## [39] Gun Fight(1975)                  -- Tomohiro Nishikado
## [40] Atari Basketball(1978)           -- Chris Downend
## [41] Atari Basketball(1978)           -- Alan Miller
## [42] Atari Football((1978)            -- Steve Bristow
## [43] Space Invaders(1979)             -- Tomohiro Nishikado
## [44] Adventure(1979)                  -- Warren Robinett
## [45] Colossal Cave Adventure(1976)    -- William Crowther
## [46] Galaxian(1979)                   -- Kazunori Sawano
## [47] Galaxian(1979)                   -- Koichi Tashiro
## [48] Galaxian(1979)                   -- Shigekazu Ishimura
## [49] Galaga(1981)                     -- Nobuyuki Ohnogi
## [50] Wizard and the Princess(1980)    -- Roberta Williams
## [51] Wizard and the Princess(1980)    -- Ken Williams
## [52] Mystery House(1980)              -- Roberta Williams
## [53] Mystery House(1980)              -- Ken Williams
```

```
## [54] Pac-Man(1980)                    -- Toru Iwatani
## [55] Missile Command(1980)            -- Dave Theurer
## [56] Kaboom!(1981)                    -- Larry Kaplan
## [57] Avalanche(1978)                  -- Dennis Koble
## [58] Asteroids Deluxe(1981)           -- Dave Sheppard
## [59] Centipede(1981)                  -- Ed Logg
## [60] Centipede(1981)                  -- Dona Bailey
## [61] Donkey Kong(1981)                -- Shigeru Miyamoto
## [62] Tempest(1981)                    -- Dave Theurer
## [63] Softporn Adventure(1981)         -- Chuck Benton
## [64] Ultima(1981)                     -- Richard Garriott
## [65] Castle Wolfenstein(1981)         -- Silias Warner
## [66] E.T. The ExtraTerrestrial(1982) -- Howard Scott Warshaw
## [67] Joust(1982)                      -- John Newcomer
## [68] Joust(1982)                      -- Bill Pfutzenreuter
## [69] Joust(1982)                      -- Jan Hendricks
## [70] Joust(1982)                      -- Python Anghelo
## [71] Joust(1982)                      -- Tim Murphy
## [72] Joust(1982)                      -- John Kotlarik
## [73] Pole Position(1982)              -- Toru Iwatani
## [74] Swordquest(1982)                 -- Dan Hitchens
## [75] Swordquest(1982)                 -- Tod Frye
## [76] Pitfall!(1982)                   -- David Crane
## [77] Spelunker(1983)                  -- Tim Martin
## [78] Q'Bert(1982)                     -- Warren Davis
## [79] Q'Bert(1982)                     -- Jeff Lee
## [80] Dragon's Lair(1983)              -- Rick Dyer
## [81] Dragon's Lair(1983)              -- Don Bluth
## [82] Space Ace(1984)                  -- Don Bluth
## [83] Super Mario Brothers(1986)       -- Shigeru Miyamoto
```

```
#png(file = "second_graph.png", width= 600, height=600)
plot(second_graph, layout=layout.fruchterman.reingold, vertex.size=1)
```


```
#dev.off()
```

This one gives us some information, but it's a little hard to read and decipher. I will try a different method of displaying.

Let's bipartite.

```
bipartite.mapping(second_graph)
```

```
## $res
## [1] TRUE
##
## $type
##   [1] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALS
E FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE F
ALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FA
LSE FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TR
UE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRU
E  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
V(second_graph)$type <- bipartite.mapping(second_graph)$type
is.bipartite(second_graph)
```

```
## [1] TRUE
```

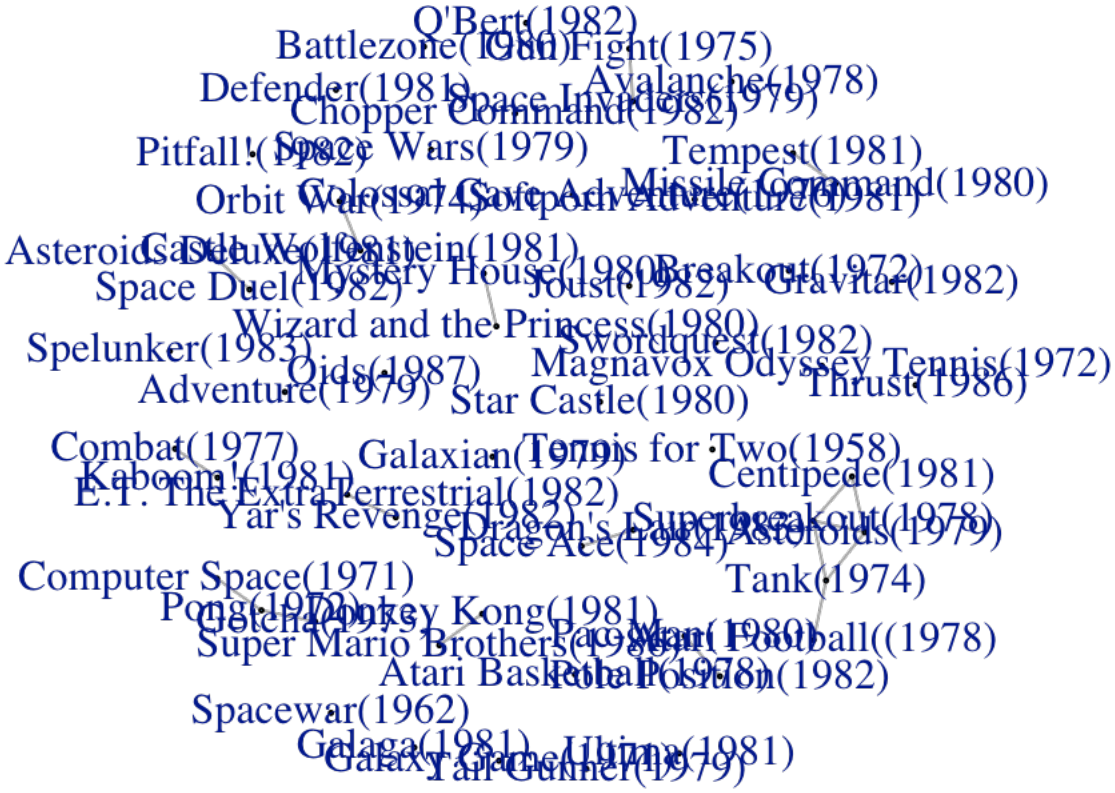
```
#png(file = "secondgraph2.png", width= 600, height=600)
plot(second_graph,layout=layout.fruchterman.reingold, vertex.size=1)
#dev.off()
title("Developers and their Games")
```

Okay, so this one is a little easier to understand. It shows the which developers worked on which games, and it also demonstrates connections regarding these developers, such as teams and who worked together.

```
bipartite <- bipartite.projection(second_graph)
#png(file = "bipartite.png", width= 600, height=600)
plot(bipartite$proj1, layout=layout.fruchterman.reingold, vertex.size=1)
```

This is another view of the teams, which shows the edges as the games that are in common and the nodes are the developers.

```
plot(bipartite$proj2, layout=layout.fruchterman.reingold, vertex.size=1)
```




```
#dev.off()
```

This view shows the games with the same developers– the opposite of what we just showed.

```
##E(bipartite$proj2)
##E(bipartite$proj2)$weight
#png(file = "bipartite3.png", width= 600, height=600)
##plot(bipartite$proj2, ,vertex.size=1, edge.width = E(bipartite$proj2)$weight)
#dev.off()
```

Now, I want to take the same information and see if I can create a community plot through the walktrap function. Here, I am loading in the CSV again, but this time, I changed it so that it includes all the information. I have a further idea of what to do here, but I will see what this looks like first.

```
gamedevs = read.csv("~//Desktop/networkgamedevs.csv", header = TRUE)
gamedevgraph<-graph.data.frame(gamedevs, directed=FALSE)
```

```
comm<-walktrap.community(gamedevgraph)
length(comm)
```

```
## [1] 39
```

```
sizes(comm)
```

```
## Community sizes
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 3
0 31 32 33 34 35 36 37 38 39
##  9  5  6  6  4  7  4  4  3  3  3  3  3  3  3  3  3  3  3  4  2  2  2  2  2  2  2  2  2
2  2  2  2  2  2  2  2  2  2
```

```
modularity(comm)
```

```
## [1] 0.958
```

```
membership(comm)
```

```
##          Steven "Slug" Russell          Martin "Shag" Graetz                  Wayne Wi
itanen                  Nolan Bushnell                       Lyle Rains
Ed Logg                     Bill Pitts                        Hugh Tuck                 S
ilias Warner                Larry Rosenthal                   Tim Skelly
Tim Skelley             Howard Scott Warshaw                  Ralph Baer
Allan Alcorn                    Steve Jobs                    Steve Wozniak
Rick Maurer                    Owen Rubin                     Steve Calfee
Dave Sheppard                   Ed Rotberg                    Eugene Jarvis
Bob Whitehead                   Mike Halley
##                               7                             7
7                               2                             1
1                              10                            10
16                              21                            37
38                              13                            28
2                              15                            15
4                               4                             4
4                              22                            24
39                              33
##                   Jeremy Smith                  Dan Hewitt                    Steve
Bristow                 Steve Mayer                   Joe Decuir
Larry Wagner                Larry Kaplan           William Higenbotham              T
omohiro Nishikado               Chris Downend                 Alan Miller
Warren Robinett             William Crowther              Kazunori Sawano
Koichi Tashiro          Shigekazu Ishimura            Nobuyuki Ohnogi
Roberta Williams                Ken Williams                  Toru Iwatani
Dave Theurer                Dennis Koble                  Dona Bailey
```

Shigeru Miyamoto Chuck Benton
35 30
1 3 3
3 3 27
14 9 9
26 25 8
8 8 23
20 20 19
18 31 1
17 32
Richard Garriott John Newcomer Bill Pfutze
nreuter Jan Hendricks Python Anghelo
Tim Murphy John Kotlarik Dan Hitchens
Tod Frye David Crane Tim Martin
Warren Davis Jeff Lee Rick Dyer
Don Bluth Spacewar(1962) Computer Space(1971) A
steroids(1979) Galaxy Game(1971) Orbit War(1974)
Space Wars(1979) Star Castle(1980) Tail Gunner(1979)
Yar's Revenge(1982) Magnavox Odyssey Tennis(1972)
34 6
6 6 6
6 6 11
11 29 36
12 12 5
5 7 2
1 10 16
21 37 38
13 28
Pong(1972) Breakout(1972) Superbreakou
t(1978) Space Duel(1982) Battlezone(1980) De
fender(1981) Chopper Command(1982) Gravitar(1982)
Thrust(1986) Oids(1987) Tank(1974)
Combat(1977) Gotcha(1973) Tennis for Two(1958)
Gun Fight(1975) Atari Basketball(1978) Atari Football((1978)
Space Invaders(1979) Adventure(1979) Colossal Cave Adventure(1976)
Galaxian(1979) Galaga(1981) Wizard and the Princess(1980)
Mystery House(1980) Pac-Man(1980)
2 15
1 4 22
24 39 33
35 30 1
3 2 27
14 9 1
14 26 25
8 23 20

```
20                              19
##           Missile Command(1980)                    Kaboom!(1981)                  Avalanch
e(1978)          Asteroids Deluxe(1981)                  Centipede(1981)                Donke
y Kong(1981)                    Tempest(1981)        Softporn Adventure(1981)
Ultima(1981)        Castle Wolfenstein(1981) E.T. The ExtraTerrestrial(1982)
Joust(1982)              Pole Position(1982)                Swordquest(1982)
Pitfall!(1982)                  Spelunker(1983)                    Q'Bert(1982)
Dragon's Lair(1983)                Space Ace(1984)      Super Mario Brothers(1986)
##                               18                                3
31                               4                                 1
17                               18                               32
34                               16                               13
6                               19                               11
29                               36                               12
5                                5                               17
```

```
memb<-membership(comm)
names(memb[memb==1])
```

```
## [1] "Lyle Rains"            "Ed Logg"               "Steve Bristow"         "Dona Bailey
"           "Asteroids(1979)"       "Superbreakout(1978)"   "Tank(1974)"            "Atari
Football((1978)" "Centipede(1981)"
```

```
#png(file = "coolgraph.png", width= 800, height=600)
plot(gamedevgraph, layout=layout.fruchterman.reingold, vertex.color=memb,vertex.size=1, edg
e.width=E(gamedevgraph)$weight)
#dev.off()
title("Development Teams")
```

Well, this community plot is interesting, but this is a little messy. Let's trying it again with the information we used earlier.

This is my "based on"" again.

```
gamedevs = read.csv("~//Desktop/networkgamedevs.csv", header = TRUE)
gamedevgraph2<-graph.data.frame(basedon, directed=FALSE)
comm<-walktrap.community(gamedevgraph2)
length(comm)
```

```
## [1] 7
```

```
sizes(comm)
```

```
## Community sizes
##  1  2  3  4  5  6  7
##  7 20 13  6  4  4  3
```

```
modularity(comm)
```

```
## [1] 0.7088
```

```
membership(comm)
```

```
##                  Spacewar(1962)           Computer Space(1971)                  Asteroid
s(1979)              Galaxy Game(1971)                Orbit War(1974)                Spac
e Wars(1979)               Star Castle(1980)              Tail Gunner(1979)             Ya
r's Revenge(1982)  Magnavox Odyssey Tennis(1972)                    Pong(1972)
Breakout(1972)             Superbreakout(1978)              Space Duel(1982)
Battlezone(1980)                 Defender(1981)          Chopper Command(1982)
Gravitar(1982)                   Thrust(1986)                   Oids(1987)
Tank(1974)                   Combat(1977)                 Gotcha(1973)           Tenni
s for Two(1958)                Gun Fight(1975)
##                              3                              3
3                              3                              3
5                              5                              5
5                              2                              4
4                              4                              3
3                              7                              7
3                              3                              3
3                              3                              2
2                              2
##          Atari Basketball(1978)          Atari Football((1978)           Space Invader
s(1979)               Adventure(1979)  Colossal Cave Adventure(1976)               Ga
laxian(1979)                  Galaga(1981)  Wizard and the Princess(1980)            My
stery House(1980)                 Pac-Man(1980)          Missile Command(1980)
Kaboom!(1981)                 Avalanche(1978)         Asteroids Deluxe(1981)
Centipede(1981)               Donkey Kong(1981)                Tempest(1981)       Soft
porn Adventure(1981)                    Ultima(1981)       Castle Wolfenstein(1981) E.T. T
he ExtraTerrestrial(1982)                    Joust(1982)            Pole Position(1982)
Swordquest(1982)                Pitfall!(1982)
##                              2                              2
6                              1                              1
6                              6                              1
1                              2                              2
4                              4                              3
2                              2                              6
2                              2                              2
2                              7                              2
1                              2
##                Spelunker(1983)                  Q'Bert(1982)            Dragon's Lai
r(1983)                 Space Ace(1984)      Super Mario Brothers(1986)
Magnvox Odyssey Tennis(1972)
##                              2                              2
1                              1                              2
2                              4
```

```
memb<-membership(comm)
names(memb[memb==1])
```

```
## [1] "Adventure(1979)"                "Colossal Cave Adventure(1976)" "Wizard and the Prin
cess(1980)" "Mystery House(1980)"           "Swordquest(1982)"              "Dragon's Lair(
1983)"           "Space Ace(1984)"
```

```
#png(file = "coolgraph.png", width= 800, height=600)
plot(gamedevgraph2, layout=layout.fruchterman.reingold, vertex.color=memb,vertex.size=1, ed
ge.width=E(gamedevgraph2)$weight)
#dev.off()
title("Based On Part 2")
```

WOW! I am really impressed with this, and I think it tells us some good information, although in very similar ways to what the first graph says.

I will also try to use the developer data frame from earlier to make a community plot.

```
gamedevs = read.csv("~//Desktop/networkgamedevs.csv", header = TRUE)
gamedevgraph3<-graph.data.frame(developer, directed=FALSE)

comm<-walktrap.community(gamedevgraph3)
length(comm)
```

```
## [1] 39
```

```
sizes(comm)
```

```
## Community sizes
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 3
0 31 32 33 34 35 36 37 38 39
##  9  5  6  6  4  7  4  4  3  3  3  3  3  3  3  3  3  3  3  4  2  2  2  2  2  2  2  2  2
2  2  2  2  2  2  2  2  2  2
```

```
modularity(comm)
```

```
## [1] 0.958
```

```
membership(comm)
```

```
##           Steven "Slug" Russell           Martin "Shag" Graetz                 Wayne Wi
itanen                   Nolan Bushnell                     Lyle Rains
Ed Logg                      Bill Pitts                      Hugh Tuck                   S
ilias Warner                 Larry Rosenthal                     Tim Skelly
Tim Skelley            Howard Scott Warshaw                    Ralph Baer
Allan Alcorn                    Steve Jobs                   Steve Wozniak
Rick Maurer                    Owen Rubin                    Steve Calfee
Dave Sheppard                   Ed Rotberg                    Eugene Jarvis
Bob Whitehead                   Mike Halley
##                             7                             7
7                              2                             1
1                             10                            10
16                             21                            37
38                             13                            28
2                             15                            15
4                              4                             4
4                             22                            24
39                             33
##                    Jeremy Smith                      Dan Hewitt                    Steve
```

Bristow Steve Mayer Joe Decuir
Larry Wagner Larry Kaplan William Higenbotham T
omohiro Nishikado Chris Downend Alan Miller
Warren Robinett William Crowther Kazunori Sawano
Koichi Tashiro Shigekazu Ishimura Nobuyuki Ohnogi
Roberta Williams Ken Williams Toru Iwatani
Dave Theurer Dennis Koble Dona Bailey
Shigeru Miyamoto Chuck Benton
35 30
1 3 3
3 3 27
14 9 9
26 25 8
8 8 23
20 20 19
18 31 1
17 32
Richard Garriott John Newcomer Bill Pfutze
nreuter Jan Hendricks Python Anghelo
Tim Murphy John Kotlarik Dan Hitchens
Tod Frye David Crane Tim Martin
Warren Davis Jeff Lee Rick Dyer
Don Bluth Spacewar(1962) Computer Space(1971) A
steroids(1979) Galaxy Game(1971) Orbit War(1974)
Space Wars(1979) Star Castle(1980) Tail Gunner(1979)
Yar's Revenge(1982) Magnavox Odyssey Tennis(1972)
34 6
6 6 6
6 6 11
11 29 36
12 12 5
5 7 2
1 10 16
21 37 38
13 28
Pong(1972) Breakout(1972) Superbreakou
t(1978) Space Duel(1982) Battlezone(1980) De
fender(1981) Chopper Command(1982) Gravitar(1982)
Thrust(1986) Oids(1987) Tank(1974)
Combat(1977) Gotcha(1973) Tennis for Two(1958)
Gun Fight(1975) Atari Basketball(1978) Atari Football((1978)
Space Invaders(1979) Adventure(1979) Colossal Cave Adventure(1976)
Galaxian(1979) Galaga(1981) Wizard and the Princess(1980)
Mystery House(1980) Pac-Man(1980)
2 15

```
1                                4                                22
24                               39                               33
35                               30                                1
3                                2                                27
14                                9                                1
14                               26                               25
8                                23                               20
20                               19
##           Missile Command(1980)                  Kaboom!(1981)                  Avalanch
e(1978)          Asteroids Deluxe(1981)                 Centipede(1981)                Donke
y Kong(1981)                  Tempest(1981)       Softporn Adventure(1981)
Ultima(1981)       Castle Wolfenstein(1981) E.T. The ExtraTerrestrial(1982)
Joust(1982)             Pole Position(1982)               Swordquest(1982)
Pitfall!(1982)                 Spelunker(1983)                   Q'Bert(1982)
Dragon's Lair(1983)               Space Ace(1984)     Super Mario Brothers(1986)
##                               18                               3
31                                4                               1
17                               18                               32
34                               16                               13
6                                19                               11
29                               36                               12
5                                5                                17
```

```
memb<-membership(comm)
names(memb[memb==1])
```

```
## [1] "Lyle Rains"            "Ed Logg"               "Steve Bristow"         "Dona Bailey
"           "Asteroids(1979)"       "Superbreakout(1978)"   "Tank(1974)"            "Atari
Football((1978)" "Centipede(1981)"
```

```
#png(file = "coolgraph.png", width= 800, height=600)
plot(gamedevgraph3, layout=layout.fruchterman.reingold, vertex.color=memb,vertex.size=1, ed
ge.width=E(gamedevgraph3)$weight)
#dev.off()
title("Development Teams")
```

This shows which games were created by which development teams.

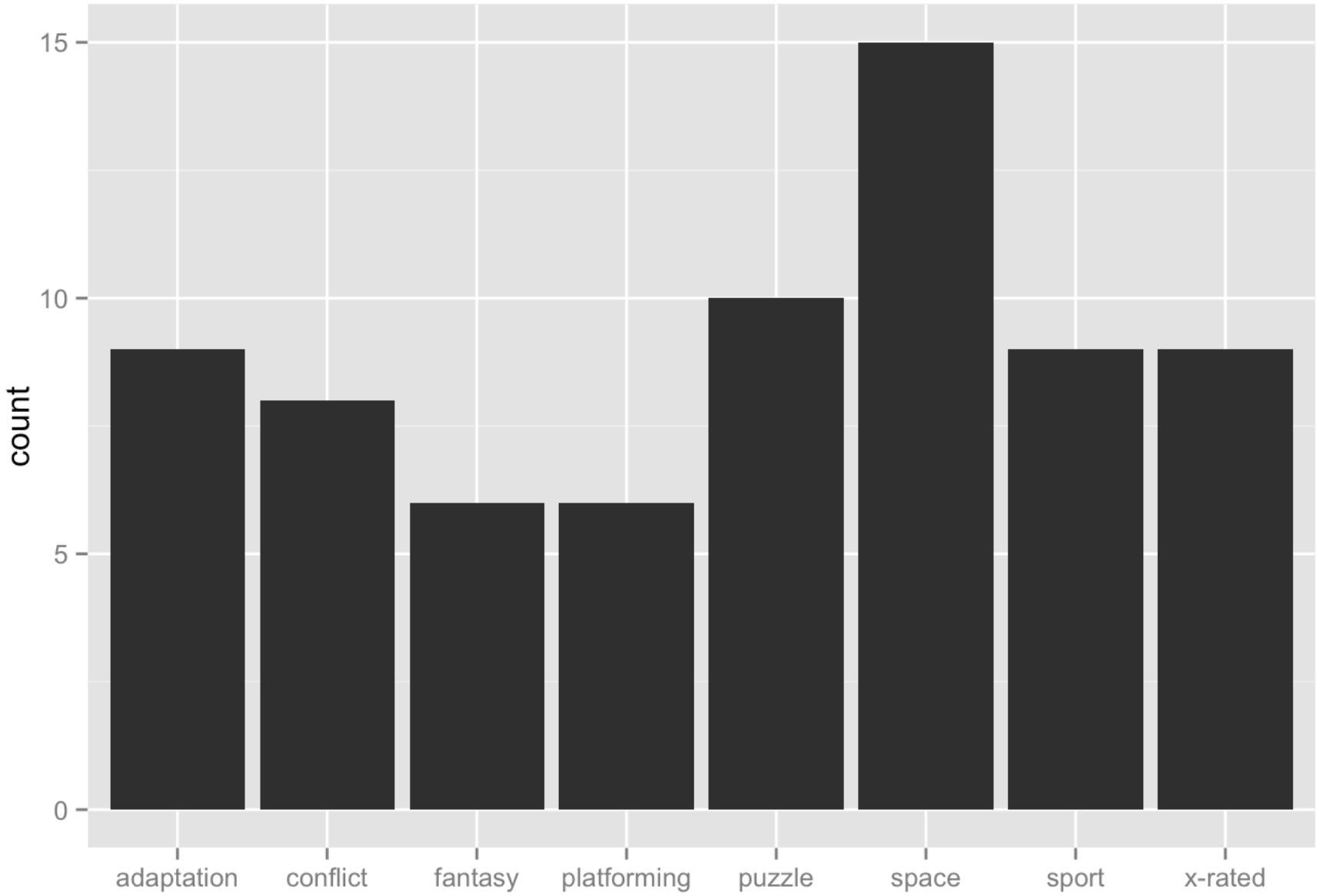
Although these network graphs tell us a lot about the early game industry in the United States, there are other things that can be gathered from the early game industry.

Here, I loaded in another CSV file, but this one contains the title of the game, the year it was published, the format (coin-op, computer, home, etc.), place of origin, and the category (space, puzzle, etc.) of the game.

```
mydata <- read.csv("~/Desktop/games.csv", stringsAsFactors=FALSE, header=TRUE)
library(dplyr)
library(ggplot2)
library(tidyr)
mydata<-read.csv("~/Desktop/games.csv")
```

Using this information, we can plot several different things from the data. For example, this plot demonstrates the numbers for different genres of games.

```
ggplot(data=mydata,
       aes(x=Type)) + geom_bar()
```



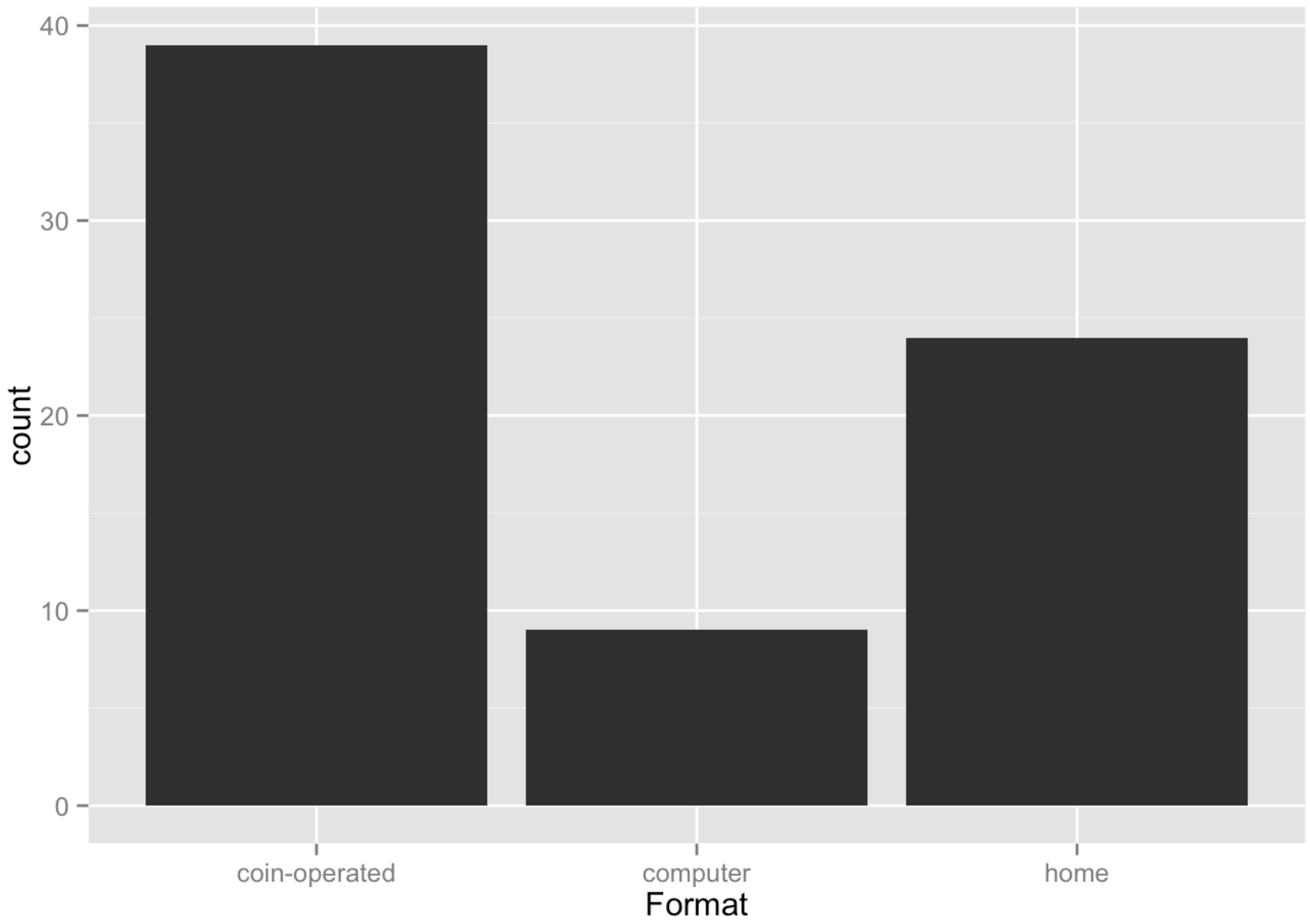
Although not a visualization, we can also do type counts, which is helpful to present next to the visualization that I just created. It shows the numbers of the genres in the data that I have.

```
mydata %>%
  group_by(Type) %>% summarize(Type_Count = n()) %>% arrange(desc(Type_Count))
```

```
## Source: local data frame [8 x 2]
##
##          Type Type_Count
## 1       space         15
## 2      puzzle         10
## 3  adaptation          9
## 4       sport          9
## 5     x-rated          9
## 6    conflict          8
## 7     fantasy          6
## 8 platforming          6
```

It can also demonstrate information such as what format these games were released for in regards to the system.

```
ggplot(data=mydata,
       aes(x=Format)) + geom_bar()
```



Here, as expected, we can see that the vast amount of games that were released in the early industry were coin-operated games.

```
mydata %>%
  select(Year,Origin,Type)
```

```
##    Year Origin        Type
## 1  1958     us       sport
## 2  1962     us       space
## 3  1971     us       space
## 4  1972     us       sport
## 5  1973     us      puzzle
## 6  1974     us       sport
## 7  1974     us    conflict
## 8  1975  us/jp    conflict
## 9  1975     us       sport
## 10 1976     us      puzzle
```

```
## 11 1976     us       sport
## 12 1977     us    conflict
## 13 1978     us       sport
## 14 1978     us       sport
## 15 1979     us       space
## 16 1979     jp       space
## 17 1979     us       space
## 18 1979     us       sport
## 19 1979     us platforming
## 20 1979     jp       space
## 21 1980     us     fantasy
## 22 1980     us      puzzle
## 23 1980     us       space
## 24 1980     jp      puzzle
## 25 1980     us    conflict
## 26 1980     us       space
## 27 1981     us      puzzle
## 28 1981     us      puzzle
## 29 1981     us       space
## 30 1981     us      puzzle
## 31 1981     jp platforming
## 32 1981     jp platforming
## 33 1981     us       space
## 34 1981     us     x-rated
## 35 1981     us     fantasy
## 36 1981     us     fantasy
## 37 1981     us    conflict
## 38 1982     us  adaptation
## 39 1982     jp      puzzle
## 40 1982     jp      puzzle
## 41 1982     us    conflict
## 42 1982     jp platforming
## 43 1982     us       sport
## 44 1982     us    conflict
## 45 1982     us       space
## 46 1982     us     fantasy
## 47 1982     us     x-rated
## 48 1982     us     x-rated
## 49 1982     jp       space
## 50 1982     us       space
## 51 1982     us     x-rated
## 52 1982     us  adaptation
## 53 1982     us     fantasy
## 54 1982     us platforming
## 55 1982     us      puzzle
```

```
## 56 1982     us  adaptation
## 57 1982     jp       space
## 58 1982     jp  adaptation
## 59 1982     us     x-rated
## 60 1982     us     x-rated
## 61 1982     us     x-rated
## 62 1983     us    conflict
## 63 1983     us  adaptation
## 64 1983     us  adaptation
## 65 1983     us     fantasy
## 66 1983     us  adaptation
## 67 1983     us     x-rated
## 68 1983     us  adaptation
## 69 1984     us  adaptation
## 70 1984     us       space
## 71 1986     us     x-rated
## 72 1986     jp platforming
```

Here, we will try and arrange the data so that we can find out how many games were released each year.

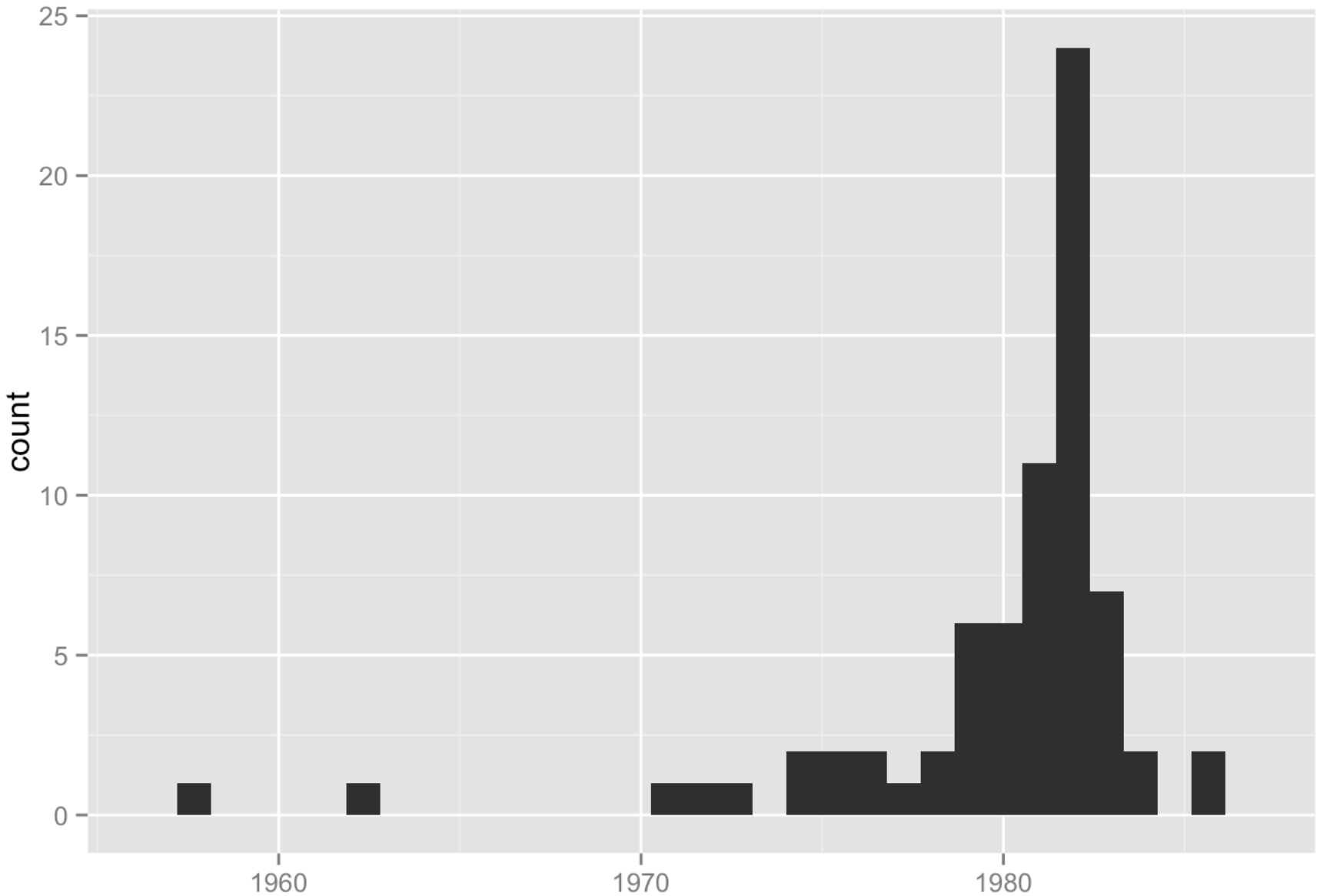
```
mydata %>%
  group_by(Year) %>%
  summarize(Games_Per_Year = n()) %>%
  arrange(Games_Per_Year)
```

```
## Source: local data frame [17 x 2]
##
##    Year Games_Per_Year
## 1  1958              1
## 2  1962              1
## 3  1971              1
## 4  1972              1
## 5  1973              1
## 6  1977              1
## 7  1974              2
## 8  1975              2
## 9  1976              2
## 10 1978              2
## 11 1984              2
## 12 1986              2
## 13 1979              6
## 14 1980              6
## 15 1983              7
## 16 1981             11
## 17 1982             24
```

As expected, the number is quite small at the beginning, but it has vast amounts of growth in the late 1970s and 1980s. Knowing that this was the time period where the industry was beginning to have quality control issues with many games, the growth in the early 1980s is telling. We can also visualize this through a plot.

```
ggplot(data=mydata,
       aes(x=Year)) + geom_bar()
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```



This is an interesting visualization, although partially difficult to gain in depth insight beyond the early testing of video game development and the spike in the early 1980s.

What else can be gleamed from this data?

Well, for instance, we can find out when each genre had its first appearance in the data.

```
mydata %>%
  group_by(Type) %>%
  summarize(First_Instance= min(Year))
```

```
## Source: local data frame [8 x 2]
##
##          Type First_Instance
## 1  adaptation           1982
## 2    conflict           1974
## 3     fantasy           1980
## 4 platforming           1979
## 5      puzzle           1973
## 6       space           1962
## 7       sport           1958
## 8     x-rated           1981
```

```
mydata %>%
  group_by(Origin) %>%
  summarize(First_Instance= min(Year))
```

```
## Source: local data frame [3 x 2]
##
##   Origin First_Instance
## 1     jp           1979
## 2     us           1958
## 3  us/jp           1975
```

This tells us nothing really interesting.

```
mydata %>%
  group_by(Origin) %>%
  summarize(Last_Instance= min(Year))
```

```
## Source: local data frame [3 x 2]
##
##   Origin Last_Instance
## 1     jp          1979
## 2     us          1958
## 3  us/jp          1975
```

But this might!

```
mydata %>%
  group_by(Type) %>%
  summarize(Last_Instance= max(Year))
```

```
## Source: local data frame [8 x 2]
##
##          Type Last_Instance
## 1  adaptation          1984
## 2    conflict          1983
## 3     fantasy          1983
## 4 platforming          1986
## 5      puzzle          1982
## 6       space          1984
## 7       sport          1982
## 8     x-rated          1986
```

Conclusion