San José State University
Department of Computer Engineering

CMPE 142
Operating Systems
Section 1

Spring 2021
Instructor: Ron Mak

Assignment #2

Assigned: Friday, February 5
Due: Friday, February 12 at 11:30 AM
Team assignment, 100 points max

Pipes
This assignment will give your team practice using pipes, in the bash shell with the pipe operator on the command line, and in a program calling POSIX functions to create, read, and write a pipe. You will also need to use I/O redirection on the command line. You may write your programs in either C or C++.

Part 1: Piping on the bash command line
Write two programs, **`ReadCSV`** and **`MakeTable`**.

`ReadCSV` should read the following text file **`presidents.csv`** via its standard input. The file is in comma-separated values format:

```
1961,1963,John,Fitzgerald,Kennedy
1963,1969,Lyndon,Baines,Johnson
1969,1974,Richard,Milhouse,Nixon
1974,1977,Gerald,R.,Ford
1977,1981,Jimmy,,Carter
1981,1989,Ronald,Wilson,Reagan
1989,1993,George,H.W.,Bush
1993,2001,Bill,Jefferson,Clinton
2001,2009,George,W.,Bush
2009,2017,Barack,Hussein,Obama
2017,2021,Donald,,Trump
```

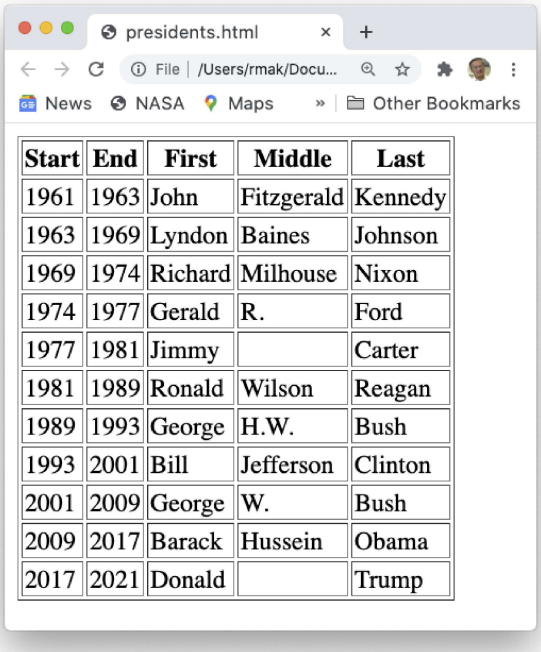
The program should convert the CSV lines to HTML table rows which it should write to its standard output:

```
<tr>
    <td>1961</td><td>1963</td><td>John</td><td>Fitzgerald</td><td>Kennedy</td>
</tr>
<tr>
    <td>1963</td><td>1969</td><td>Lyndon</td><td>Baines</td><td>Johnson</td>
</tr>
<tr>
    <td>1969</td><td>1974</td><td>Richard</td><td>Milhouse</td><td>Nixon</td>
</tr>
<tr>
    <td>1974</td><td>1977</td><td>Gerald</td><td>R.</td><td>Ford</td>
</tr>
<tr>
    <td>1977</td><td>1981</td><td>Jimmy</td><td></td><td>Carter</td>
</tr>
<tr>
    <td>1981</td><td>1989</td><td>Ronald</td><td>Wilson</td><td>Reagan</td>
</tr>
<tr>
    <td>1989</td><td>1993</td><td>George</td><td>H.W.</td><td>Bush</td>
</tr>
<tr>
    <td>1993</td><td>2001</td><td>Bill</td><td>Jefferson</td><td>Clinton</td>
</tr>
<tr>
    <td>2001</td><td>2009</td><td>George</td><td>W.</td><td>Bush</td>
</tr>
<tr>
    <td>2009</td><td>2017</td><td>Barack</td><td>Hussein</td><td>Obama</td>
</tr>
<tr>
    <td>2017</td><td>2021</td><td>Donald</td><td></td><td>Trump</td>
</tr>
```

`MakeTable` should read those HTML table rows from its standard input and put the rows into an HTML table and write a complete HTML file **`presidents.html`** via its standard output (the program adds the lines in red):

```
<html>
<body>
<table border='1'>
    <tr>
        <th>Start</th><th>End</th><th>First</th><th>Middle</th><th>Last</th>
    </tr>
    <tr>
        <td>1961</td><td>1963</td><td>John</td><td>Fitzgerald</td><td>Kennedy</td>
    </tr>
    <tr>
        <td>1963</td><td>1969</td><td>Lyndon</td><td>Baines</td><td>Johnson</td>
    </tr>
    <tr>
        <td>1969</td><td>1974</td><td>Richard</td><td>Milhouse</td><td>Nixon</td>
    </tr>
    <tr>
        <td>1974</td><td>1977</td><td>Gerald</td><td>R.</td><td>Ford</td>
    </tr>
    <tr>
        <td>1977</td><td>1981</td><td>Jimmy</td><td></td><td>Carter</td>
    </tr>
    <tr>
        <td>1981</td><td>1989</td><td>Ronald</td><td>Wilson</td><td>Reagan</td>
    </tr>
    <tr>
        <td>1989</td><td>1993</td><td>George</td><td>H.W.</td><td>Bush</td>
    </tr>
    <tr>
        <td>1993</td><td>2001</td><td>Bill</td><td>Jefferson</td><td>Clinton</td>
    </tr>
    <tr>
        <td>2001</td><td>2009</td><td>George</td><td>W.</td><td>Bush</td>
    </tr>
    <tr>
        <td>2009</td><td>2017</td><td>Barack</td><td>Hussein</td><td>Obama</td>
    </tr>
    <tr>
        <td>2017</td><td>2021</td><td>Donald</td><td></td><td>Trump</td>
    </tr>
</table>
</body>
</html>
```

Therefore, to convert **`presidents.csv`** to **`presidents.html`** on a single bash command line, you will need to use I/O redirection and piping. You should be able to open **`presidents.html`** in a web browser:



Start	End	First	Middle	Last
1961	1963	John	Fitzgerald	Kennedy
1963	1969	Lyndon	Baines	Johnson
1969	1974	Richard	Milhouse	Nixon
1974	1977	Gerald	R.	Ford
1977	1981	Jimmy		Carter
1981	1989	Ronald	Wilson	Reagan
1989	1993	George	H.W.	Bush
1993	2001	Bill	Jefferson	Clinton
2001	2009	George	W.	Bush
2009	2017	Barack	Hussein	Obama
2017	2021	Donald		Trump

Programs that are used with pipes are often called **filters** because they filter data passing through them.

Tip: Look up the POSIX C functions **`getline()`** and **`getdelim()`** and the C++ function **`getline()`** to read the CSV file.

Part 2: Piping using the POSIX functions

Write a single program **`PipeMakeTable`** that performs the same conversion on the command line. It will read **`presidents.csv`** from its standard input and write **`presidents.html`** via its standard output using I/O redirection.

This program must create a pipe and fork a child process. The parent process reads its standard input (redirected on the command line from **`presidents.csv`**) and writes the HTML table rows to the pipe. The child process then reads the HTML rows from the pipe and writes the HTML page to its standard output (redirected on the command line to **`presidents.html`**).

In other words, the parent process performs the same conversion as program **`ReadCSV`** from Part 1 and the child process performs the same conversion as program **`MakeTable`** from Part 1.

What to submit

Submit the following to Canvas, Assignment #2: Pipes

- Source files (either C or C++) of your programs **`ReadCSV`**, **`MakeTable`**, and **`PipeMakeTable`**.
- A screen shot of the terminal showing the execution of program **`ReadCSV`** by itself on the command line with input redirected from **`presidents.csv`** and its output (the HTML rows) on the terminal.
- A screen shot of the complete command for Part 1 where programs **`ReadCSV`** and **`MakeTable`** and input file **`presidents.cvs`** together create output file **`presidents.html`**. (Just show the command.)
- The **`presidents.html`** files generated in Part 1 and Part 2 (the files from both parts should have the same content).

Rubric

Your submission will be graded according to these criteria:

Criteria	Max points
• Source file(s) of program **`ReadCSV`**	• 15
• Screen shot of the terminal showing the execution of **`ReadCSV`**	• 10
• Source file(s) of program **`MakeTable`**	• 15
• Screen shot of the complete bash command line for Part 1.	• 10
• Source file(s) of program **`PipeMakeTable`**	• 30
• HTML file **`presidents.html`** from Part 1	• 10
• HTML file **`presidents.html`** from Part 2	• 10