Stat 133
Assignment 10: Google Earth Animation using KML
April 7, 2016

Your task is to create a Google Earth animation showing the locations and times for the earthquake catalog stored in the file `NCEDC3+quakes.csv` on bCourses. Google Earth uses a particular dialect of XML called KML.

This assignment will walk you through the steps to create an animation. When you are done, upload your `.Rmd` file with the code that creates the KML file. Don't turn in the KML file itself. The questions throughout the rest of this assignment are to assist you in creating the .Rmd file; you don't need to upload them either.

A few comments:

- To find out about valid tags in KML, we'll refer to the KML reference at `https://developers.google.com/kml/documentation/kml_tut#for-more-information`.
- If you get stuck, don't try to do everything at once; think about what the XML code is that you want to create first. Draw a tree diagram to visualize it. *Then* write your R code to generate it.
- When creating XML objects in `R`, you need to be careful about the order of the commands, as this can affect the finished document.

1. I have given you a KML file, `earthquakes6.kml`, that contains the locations for the earthquakes in this dataset that are magnitude 6 or greater. Open this file in Google Earth (you will need to download Google Earth first). Each earthquake is shown with a pushpin. Now open the file in a text editor (for example Atom). Make a tree diagram of what this KML file looks like. You don't need to include all the Placemark nodes, but make sure you diagram at least one.

   Your first task will be to make a file like this, but with all the earthquakes of magnitude 4 or greater.

2. To do this, first load the file `NCEDC3+quakes.csv` into `R` and create two vectors, one for longitude and one for latitude. Include only the locations of earthquakes with magnitude 4 or greater.

3. Load the `XML` package. Using `newXMLDoc` and `newXMLNode`, set up the KML document and create the root node. You will need to add the argument `namespaceDefinitions = "http://www.opengis.net/kml/2.2"` when you create the root node to indicate this is a KML file.

4. Referring to your diagram, use `newXMLNode` to create the Document node and its children.

5. Create just one Placemark node, putting in whatever latitude and longitude you want. You may want to refer to your tree diagram and the KML reference link I gave you.

6. Add a line of `R` code to save the XML document. Run your `Rmd` file. Open up the KML file you just created in a text editor. Does everything look as you expect? If not, go back and modify your `R` code and run everything again. If it looks ok, try opening your KML file in Google Earth. You should see one pushpin.

7. Now go back and modify your code to have a `for` loop that goes over each earthquake location you have in your longitude and latitude vectors. Note that the names that you give the nodes in `R` can be reused each time through the loop; the only thing that needs to change is the content of the leaf node.

   Once you've done this, again open up Earthquakes.kml in Google Earth, and also open it up in a text editor. At this point it's difficult to see what's going on, due to the large number of pushpins.

8. Now we'll add a TimeStamp node inside each Placemark node, corresponding to the date and time at which the earthquake occurred. This will allow us to restrict the earthquakes we see to those in a given time range.

   - To see the syntax for a TimeStamp node, look at its entry in the KML Reference here: `https://developers.google.com/kml/documentation/kmlreference#timestamp` What is the format if we want to include both date and time? We need to match this *exactly* when we create the nodes in `R`.
   - Before the loop, create a new character vector containing the formatted dates and times for all the earthquakes, using the format you found in the documentation. Hint: `quakes$DateTime` is stored as a factor, so we first need to convert it to a character vector. Try

     ```
     datetime <- as.character(quakes$DateTime)
     datetimefix <- gsub("/", "-", datetime)
     ```

   - Diagram what a Placemark node looks like when it has a TimeStamp node in addition to a Point node. Refer to the example in the KML reference to see what a TimeStamp node looks like.
   - Use `newXMLNode` within the loop to create a TimeStamp node within each Placemark node. (Note that the leaf nodes in this case have tag `when`.)
   - Run your .Rmd file again, then reload the KML file into Google Earth. If you did the last part correctly, there should now be a slider at the top. Experiment with it. You can change the length of time the pushpins are shown by separating the two parts of the slider. Click on the icon that looks like a clock to view an animation moving through time. You can slow down the speed of the animation if you click on the icon that looks like a wrench.

   TURN IN JUST YOUR .Rmd file.