Geographic support for Vega-lite

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ABSTRACT
In this paper we describe how we add Geographic support to Vega-Lite, a high-level grammar that enables rapid specification of interactive data visualizations. This project involves adding geo projection to Vega-Lite and providing a tile layer to Vega/vega-embed. Ultimately, this allows for the use of the succinct Vega-Lite syntax to project latitude and longitude coordinates onto an Euclidean plane, as well as the ability to display more detailed geographic information about any given geographic coordinates.

INTRODUCTION
Vega-lite specifications are compiled into Vega specifications, which is a visualization grammar. Currently Vega-Lite does not support cartographic projections on geographic coordinates. Meanwhile, Vega has geo and geopath transforms which can perform these projections but without a tile layer. To make Vega-Lite support projections with a tile layer, we want to add the tile layer at the Vega and Vega-Embed level. Then, we adapt the Vega-Lite to allow users to visualize geographic coordinates.

RELATED WORK
Vega, Vega-Lite, and Vega-Embed are developed by the UW Interactive Data Lab.[1]

METHODS
In this section, we will discuss the choices we made in implementing our changes, and the reasoning behind those choices.

Leaflet Plugin for Vega and Vega-Embed
Instead of implementing our own tile layers at the Vega level, we opted to use Leaflet[2], an "open-source javascript library for mobile-friendly interactive maps." Leaflet's rich variety of interaction features made it an optimal choice for this task.

We opted to perform this implementation as a plugin because we wanted to make use of the Vega runtime API instead of modifying the actual Vega codebase.

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Synchronization between the Vega layer and the Leaflet layer was the biggest hurdle we needed to overcome. We solved this by outputting the center, translate, and scale from the geo and and geo-path transforms as signals which the Leaflet plugin can read and and adapt to accordingly.

Adding Geo Projections to Vega-Lite
The high-level goal for adding geo projections was simple: we modify Vega-Lite to allow users to note that a data element should be projected in a certain way. The actual implementation of this is actually fairly complex.

In order to support this feature, the first step was to determine the Vega-Lite syntax which would produce a Vega specification that projects latitude/longitude data onto a euclidean plane. We explored a number of approaches to this, and decided on the syntax described in FIGURE N (PUT BELOW THIS).

The next step was to identify and modify the parts of the Vega-Lite codebase which needed to be modified in order to implement the changes we needed.

A hurdle we ran into while performing these changes was that we had to perform some refactoring work on the current Vega-lite codebase to adapt the changes for the map projections part.

RESULTS
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Future Work

Every submission should begin with an abstract of about 150 words, followed by a set of keywords. The abstract and keywords should be placed in the left column of the first page under the left half of the title. The abstract should be a concise statement of the problem, approach and conclusions of the work described. It should clearly state the paper's contribution to the field of HCI.

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