

Getting your bearings in GIS?

In the September 2022 issue of *PE&RS*, this column asked “Which Way is Up?”, discussed three definitions of “North”, and provided tips on how to symbolize each on your map. This month’s tip focuses on a similar issue, how to calculate the bearing (i.e., compass direction) of a line.

As with “North”, there are several ways to define a “bearing.” In navigation and GIS-mapping, a bearing is the horizontal angle, measured in degrees, between the direction of an object and another object, or between that object and that of “true” (i.e. celestial) north. The “absolute bearing” refers to the angle, measured in degrees, between magnetic north (i.e. the magnetic bearing) and an object, while the “relative bearing” refers to the angle, again, measured in degrees, between a craft’s forward direction and the location of another object. Bearings are frequently referred to as “azimuths” which can be measured in degrees clockwise from “north” as geodetic (from celestial north), magnetic (measured from magnetic north) astronomic (from the south) or assumed azimuths. So, when reporting bearings (or azimuths) it is always a good idea to specify which is being reported. For additional information, <https://theconstructor.org/surveying/azimuths-bearings-surveying-difference-determination/38494/>, is a good general reference.

While calculating a bearing in an Esri GIS system seems like it should be a simple matter, the bearing is not one of the properties that is recorded in the standard line-attribute table. Furthermore, the bearing is also not one of the seven geometric features of a line that can be calculated by the “Calculate Geometry” function in the linetable field functions. Then, to make matters even more complex, when displaying or calculating a bearing in ArcGIS Desktop, the bearing is reported counterclockwise from East but calculated by the Add Geometry Attributes script as clockwise from North! So, here are some tips for getting your bearings.

IN ARCGIS DESKTOP

METHOD 1—Interactive when editing/creating a line feature without point snapping – When in an editing session and creating a line feature, start the line, and move the cursor to the end-point. Before clicking the end-point, right-click on the mouse or use the key combination Ctrl-A to reveal the “Direction ...” of the line as in Figure 1. The Direction... window will display the bearing as in Figure 2. **IMPORTANT NOTE:** This “direction” is measured counterclockwise from the EAST (East=0, North=90, West =180, South=270) so to derive the compass bearing, you may want to adjust the value to North. In this case (Figure 2), the reported bearing of 27.2269°, is converted to the compass direction 62.7731° from North.

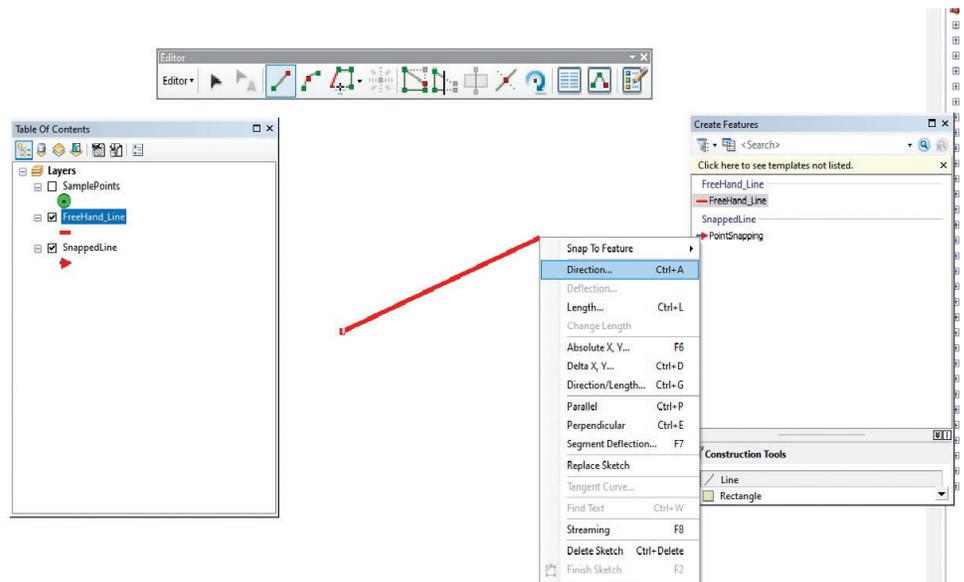


Figure 1. Using the key combination Ctrl-A (or right-mouse clicking) on the end-node of a freehand drawn line feature to start the Properties menu, then selecting the Direction... property.

METHOD 2—Interactive when editing/creating a line feature with feature snapping. When in an editing session and constructing line features by snapping to points, the direction of any segment can be revealed as in Method 1. After snapping to the node, use the Ctrl-A sequence to show the direction. Again, the direction is measured counterclockwise from East. So, in this example (Figure 3), the reported bearing of 158.9755° is converted to 291.0245° from North.

METHOD 3— Using the Add Geometry Attributes script from ArcToolbox to add the bearing to a line feature class. Finally, with ArcGIS 10.8, there is an “Add Geometry Attributes” script in the Data Management Tools | Features Toolset that will add additional geometric attributes, including the bearing, to line feature classes (and/or shapefiles). In the example below, I added three lines to the SnappedLine feature class. Opening the Add Geometry Attributes tool (Figure 4) and check the desired attributes, indicate the linear units and Coordinate Reference System; running the tool will result in those attributes being added to the feature class table (Figure 5). Of course, the direction of the line is From_Node toward To-Node BUT the BEARING is reported from CELESTIAL NORTH!

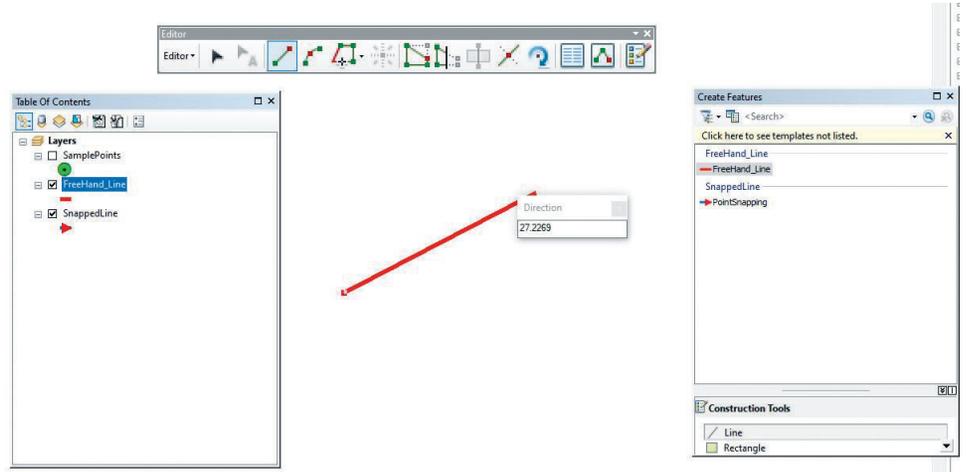


Figure 2. The Direction Window showing the bearing of the line feature. Note: this angle is computed counterclockwise from East.

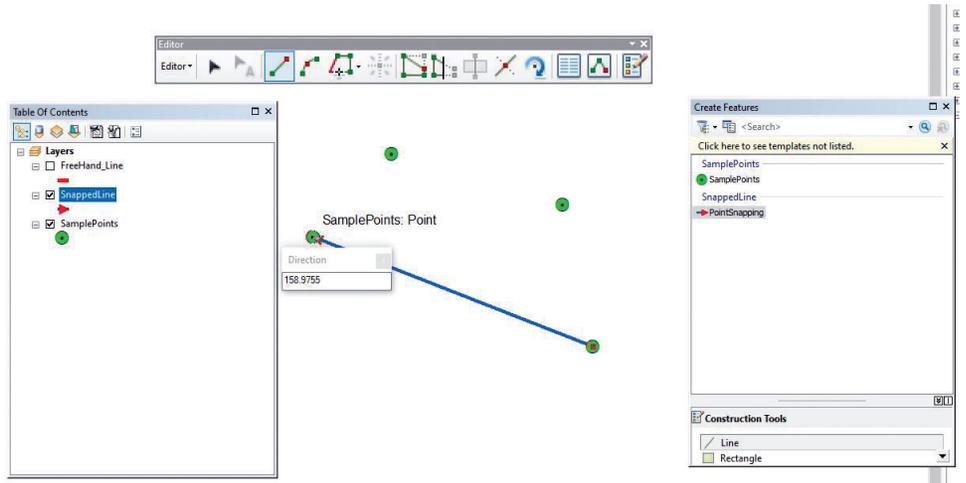


Figure 3. Using the key combination Ctrl-A after snapping a line feature to an end-point to show the Direction window. Again, note that the Direction is reported from East.

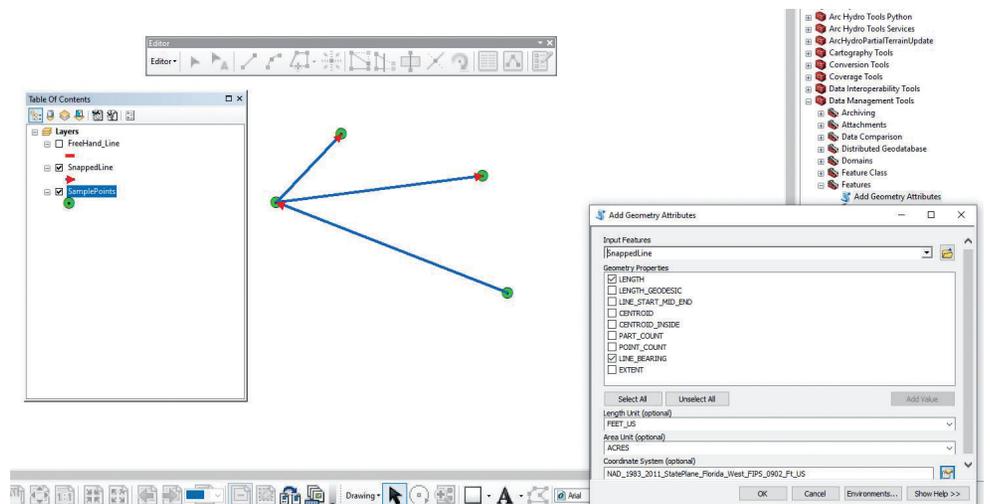


Figure 4. Using the Add Geometry Attribute script found in the Data Management Tools | Features toolset and choosing to add the LENGTH and LINE_BEARING attributes to the SnappedLine feature class.

IN ARCGIS PRO

The same interactive and tabular methods described for ArcGIS Desktop also work in ArcGIS Pro. The only difference is that the interactive methods now give you options (Figure 6, drop down arrow) of displaying the direction as N Az (North=True Azimuth), SAz (South = Astronomic Azimuth), P (Polar Azimuth), or QB (Quadrant Bearing). The Add Geometry Attributes tool is again found in the Data Management Tools | Features Toolset.

While not as straight-forward as a user might hope, determining the direction of a line or a line feature class is not that challenging once you get your bearings.

Send your questions, comments, and tips to GISTT@ASPRS.org.

Al Karlin, Ph.D., CMS-L, GISP is with Dewberry's Geospatial and Technology Services group in Tampa, FL. As a senior geospatial scientist, Al works with all aspects of Lidar, remote sensing, photogrammetry, and GIS-related projects. He also teaches beginning map making at the University of Tampa.

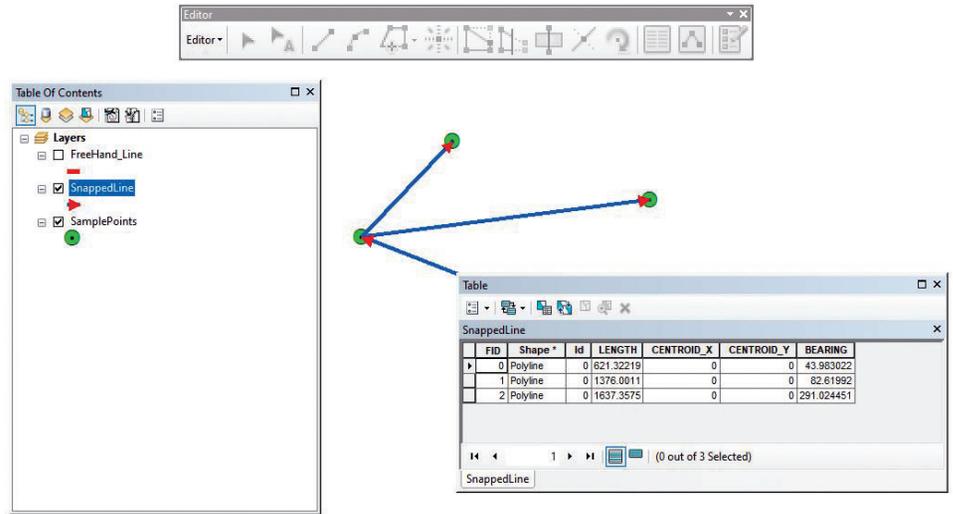


Figure 5. The resulting feature attribute table after running the Add Geometry Attributes script. Note that the script added the CENTROID_X and CENTROID_Y field but did not calculate these values. Use “Calculate Geometry” to populate these fields. Also note that the BEARING values are reported from Celestial North!

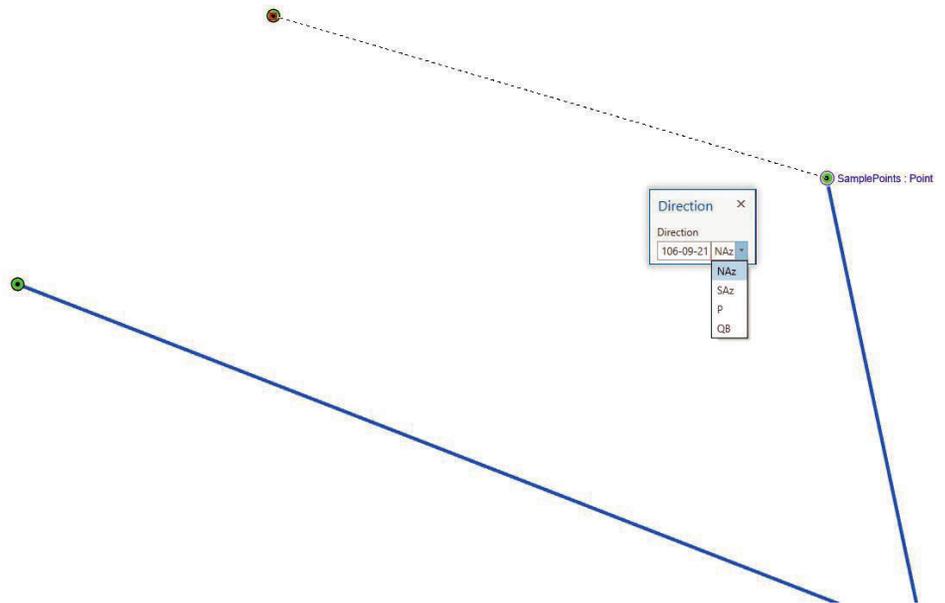
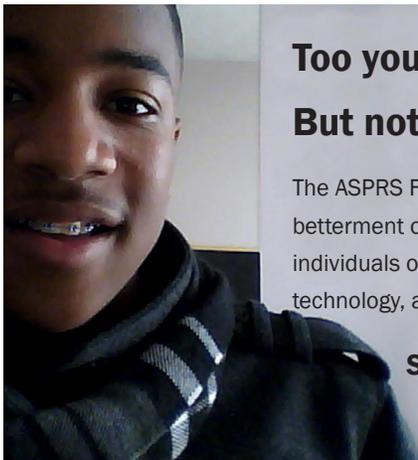


Figure 6. In ArcGIS Pro, the interactive (Ctrl-A) Direction property provides optional reports for the bearing.



Too young to drive the car? Perhaps!

But not too young to be curious about geospatial sciences.

The ASPRS Foundation was established to advance the understanding and use of spatial data for the betterment of humankind. The Foundation provides grants, scholarships, loans and other forms of aid to individuals or organizations pursuing knowledge of imaging and geospatial information science and technology, and their applications across the scientific, governmental, and commercial sectors.

Support the Foundation, because when he is ready so will we.

asprsfoundation.org/donate

