

What is GIS (and why should I care)?

lecture 3

overview

what is GIS? how can it be used? timeline of mapping and data visualization

1. **GIS: timeline**
2. **example: geology**
3. **example: map vs use**
4. **example: Borges**

"GIS is a technological field that incorporates **geographical features** with **tabular data** in order to map, analyze, and assess real-world problems."

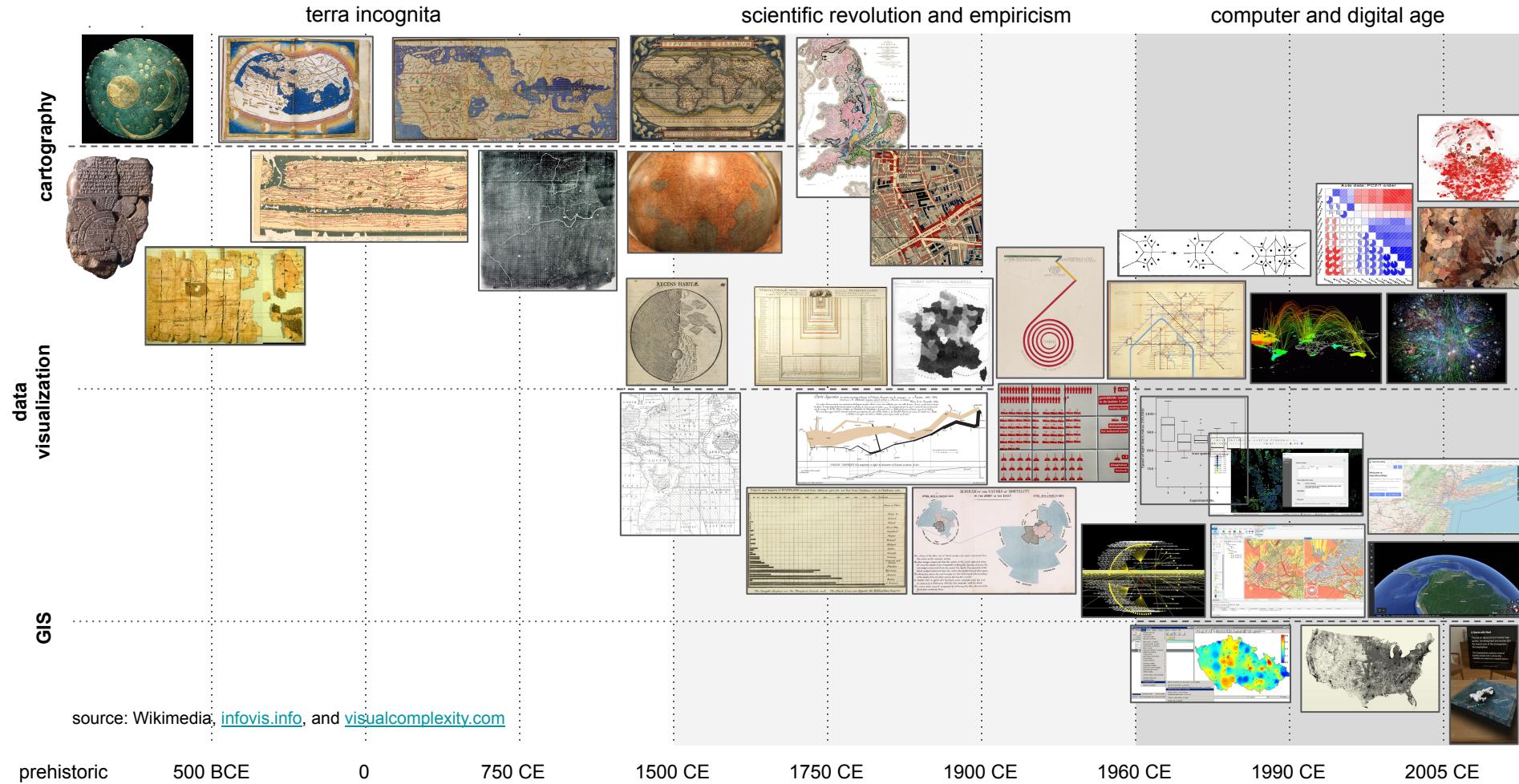
- [GIS lounge](#)

GIS (geographic information system) is a combination of data science and cartography.

"**A map is not the actual territory.... An ideal map would contain the map of the map, the map of the map of the map, etc., endlessly.... We may call this characteristic self-reflexiveness.**"

- *Science and Sanity*, Alfred Korzybski (1933)

Timeline of Geographical and Statistical Milestones										
terra incognita			scientific revolution and empiricism					computer and digital age		
cartography	star maps: various cultures, earliest known maps, 20,000-16,000 BCE	Geography: Ptolemy used three different projections based on lat / lon. c. 150	Tabula Rogeriana: Al-Idrisi's accurate map combined Ptolemaic and Arab knowledge: 1154	Theatrum Orbis Terrarum: first modern atlas, 1570	Strata of England and Wales: standard-setting geological map, William Smith 1815					
	earliest known world map: Babylon. c. 600 BCE	Cursus publicus: Roman public road network map; Roman Empire, 300-400	Map of the Tracks of Yu Gong: detailed map of Chinese waterways, 1137	Mercator: straight-line projection of world for navigation, 1512-94	Poverty map: London street-level Charles Booth, 1889			Voronoi tessellation: developed for GIS, J. Chen, 1999	corrogram: correlation matrices, Michael Friendly, 2002	
data visualization	Turin papyrus map: geographical and mineral data, Egypt. 1150 BCE	Pei Xiu: used grids and scale for accurate map distance, 224-271		astronomical diagrams: moon, sun, stars, Galileo Galilei, 1610	August Crome: product maps and choropleth maps, area charts, 1753-1833	moral statistics: bar charts and Andre Guerry, 1833	W.E.B. Du Bois: data vis for Civil Rights, Exposition Universelle 1868-1963	interactive linked graphics: graphs, charts, and maps 1987-89	gapminder: interactive global demo/economic stats, 2005	
	Eratothenes and Posidonius: accurate circumference of Earth: 250-050 BCE		Ramon Llull: technical and epistemological diagrams, 1232-1315	Edmond Halley: early weather and contour maps, 1656-1742	Charles Minard: political/economic data in maps and charts, 1781-1870	Otto and Marie Neurath: ISOTYPE infographic method, 1882-1986	John Tukey: new graph and plot types, 1915-2000	Edward Tufte: writer, new era of graphics analysis, 1942-		
GIS				William Playfair: invented bar and pie chart, line graph, 1759-1823	Florence Nightingale: charts of mortality and disease, 1820-1910	Birth of GIS: in USA and Canada, 1960-62	TIGER: first US census GIS release, 1986	ArcGIS: revamp of ESRI (1970) software 1999	Google Maps / Earth / StreetView 2005-7	
						MOSS: early public domain, open-source GIS; US DOI, 1979	PARC: 1st web-based interactive map, Steve Putz 1993	QGIS: free, open source GIS software, 2002		
source: Wikipedia "History of Cartography", datavis "Milestones" project, and GIS lounge timeline.										
prehistoric	500 BCE	0	750 CE	1500 CE	1750 CE	1900 CE	1960 CE	1990 CE	2005 CE	



“The earliest known maps are of the stars, not the earth.”
(wikipedia, “History of Cartography”)



Nebra Sky Disc: oldest known map of the cosmos. c. 1600 BCE

1000 years later...



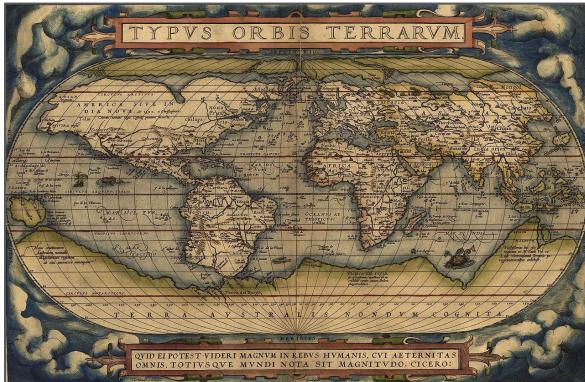
earliest known world map:
Babylon. c. 600 BCE

500 years later...



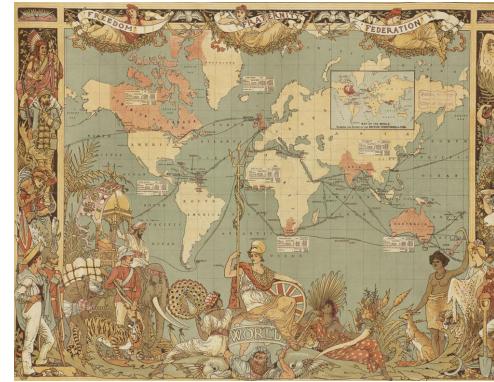
Tabula Rogeriana: Al-Idrisi's accurate map combined Ptolemaic and Arab knowledge. 1154

Theatrum Orbis Terrarum: first modern atlas, 1570



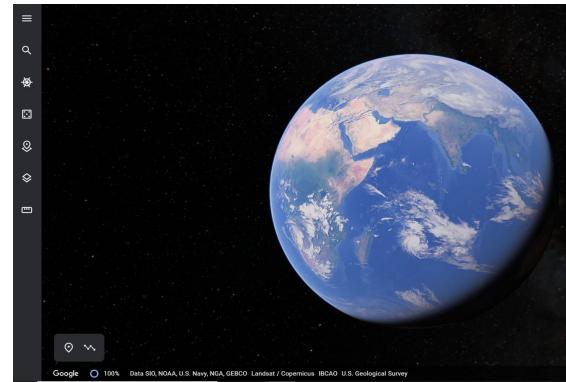
420 years later...

310 years later...



Extent of the British Empire: 1886

150 years later...



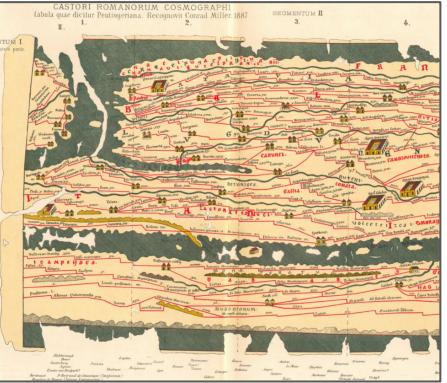
Genealogy of territorial mapping | 7

GIS for Designers
VT | A+D | SU22



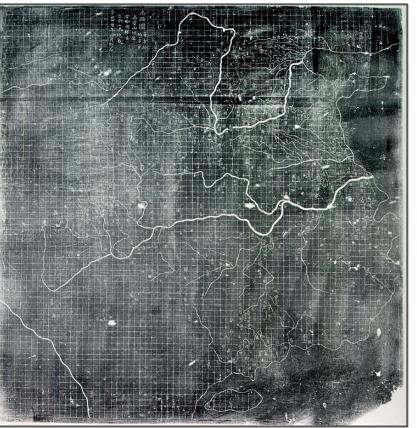
Turin papyrus map: geographical and mineral data, Egypt. 1150 BCE

1500 years later...



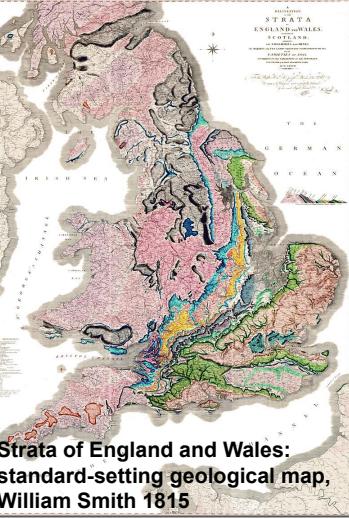
Cursus publicus: Roman public road network map. Roman Empire, 300-400

800 years later...



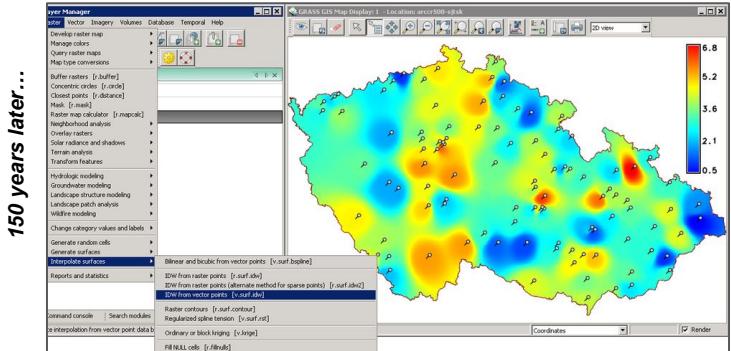
Map of the Tracks of Yu Gong: detailed map of Chinese waterways, 1137

700 years later...

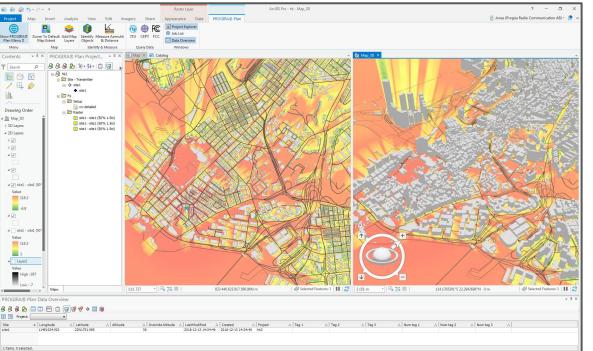


Strata of England and Wales: standard-setting geological map, William Smith 1815

GRASS: descendent of MOSS; early public domain, open-source GIS; USACE, 1982 (image: early 2000s GUI)



17 years later...



ArcGIS: revamp of ESRI software, 1999
(image: mid 2010s GUI)

20 years later...



New York Times augmented reality storytelling, 2021

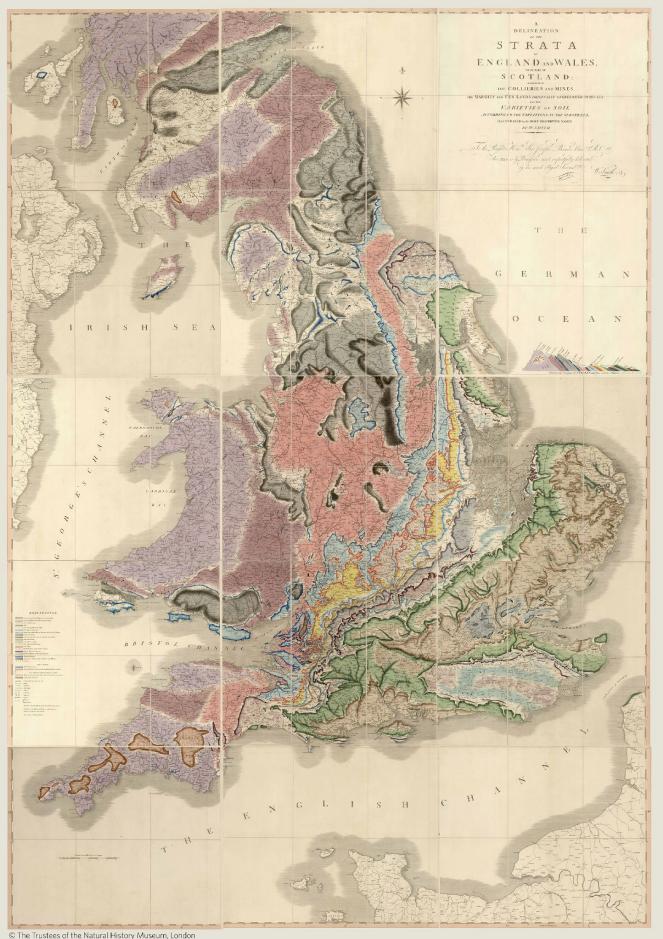
It Starts with Heat

The hot air above Dixie's flames rose quickly, funneling heat and smoke into the lowest level of the atmosphere, the troposphere.

The troposphere contains most of Earth's clouds and is where the weather we experience usually occurs.

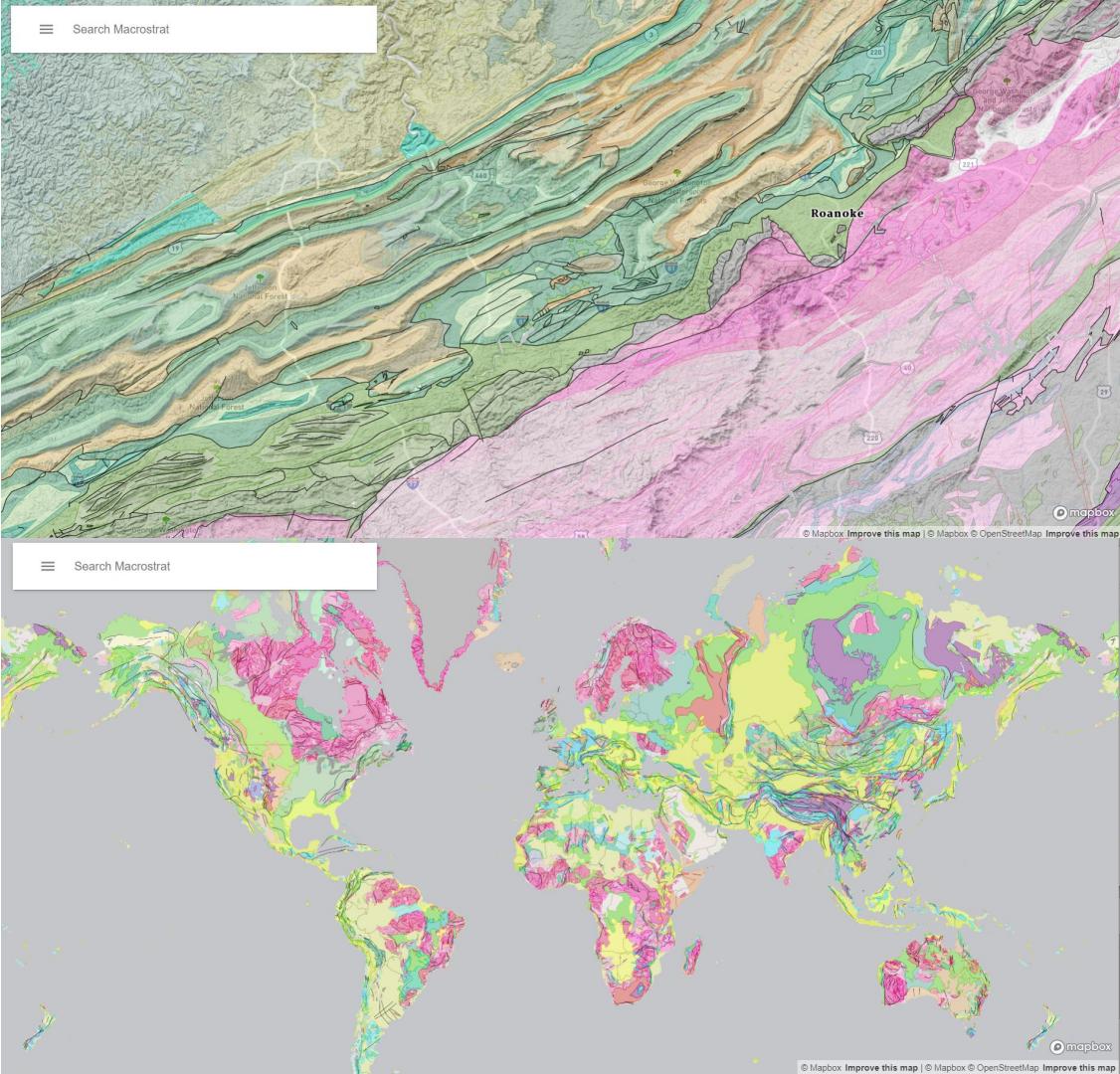
TAP TO CONTINUE

geological maps | 8



above: Strata of England and Wales: standard-setting geological map, William Smith 1815

right: [Macrostrat](#) interactive geological map



Compared with the “Tracks of Yu Gong” map from China, 1137, the “Every river in the US” and “Every road in the US” maps from nearly 900 years later celebrate the density of data over practical use.



Map of the Tracks of Yu Gong: detailed map of Chinese waterways, 1137

Every road in the US:
FATHOM, c. 2013



Every river in the US:
Nelson Minar, 2013



On Exactitude in Science (Jorge Luis Borges)
from Collected Fictions, translated by Andrew Hurley

. . .In that Empire, the Art of Cartography attained such Perfection that the map of a single Province occupied the entirety of a City, and the map of the Empire, the entirety of a Province. In time, those Unconscionable Maps no longer satisfied, and the Cartographers Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it. The following Generations, who were not so fond of the Study of Cartography as their Forebears had been, saw that that vast Map was Useless, and not without some Pitilessness was it, that they delivered it up to the Inclemencies of Sun and Winters. In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars; in all the Land there is no other Relic of the Disciplines of Geography.

—Suarez Miranda, Viajes devarones prudentes, Libro IV, Cap. XLV, Lerida, 1658

In this short story, Borges describes a map which perfectly reproduces the state of an empire in geographic totality. However, this map does not mention including any people.

What does it mean to include people in a map?

What would it mean to perfectly recreate both a nation's geographical AND demographic state?

How far are we from achieving this?

"The inventions of philosophy are no less fantastic than those of art: Josiah Royce, in the first volume of his work *The World and the Individual* (1899), has formulated the following: 'Let us imagine that a portion of the soil of England has been levelled off perfectly and that on it a cartographer traces a map of England. The job is perfect; there is no detail of the soil of England, no matter how minute, that is not registered on the map; everything has there its correspondence. This map, in such a case, should contain a map of the map, which should contain a map of the map of the map, and so on to infinity.'

Why does it disturb us that the map be included in the map and the thousand and one nights in the book of the *Thousand and One Nights*? Why does it disturb us that Don Quixote be a reader of the *Quixote* and Hamlet a spectator of *Hamlet*? I believe I have found the reason: these inversions suggest that if the characters of a fictional work can be readers or spectators, we, its readers or spectators, can be fictions."

— Jorge Luis Borges, *Partial Magic in the Quixote* (1964)



The Great Polish Map of Scotland;
images from Google Maps, May 2022

Additional References

“History of Cartography Project”,
University of Wisconsin-Madison, great
free 6-volume collection:

<https://geography.wisc.edu/histcart/>

Visual Complexity, a database of
historical data visualization:

<http://www.visualcomplexity.com/vc/>

Flowing Data, collection of recent data
visualizations:

<https://flowingdata.com/>

Macrostrat interactive geological map:
[https://macrostrat.org/map/#/z=1.5/x=16/
y=23/bedrock/lines/](https://macrostrat.org/map/#/z=1.5/x=16/y=23/bedrock/lines/)