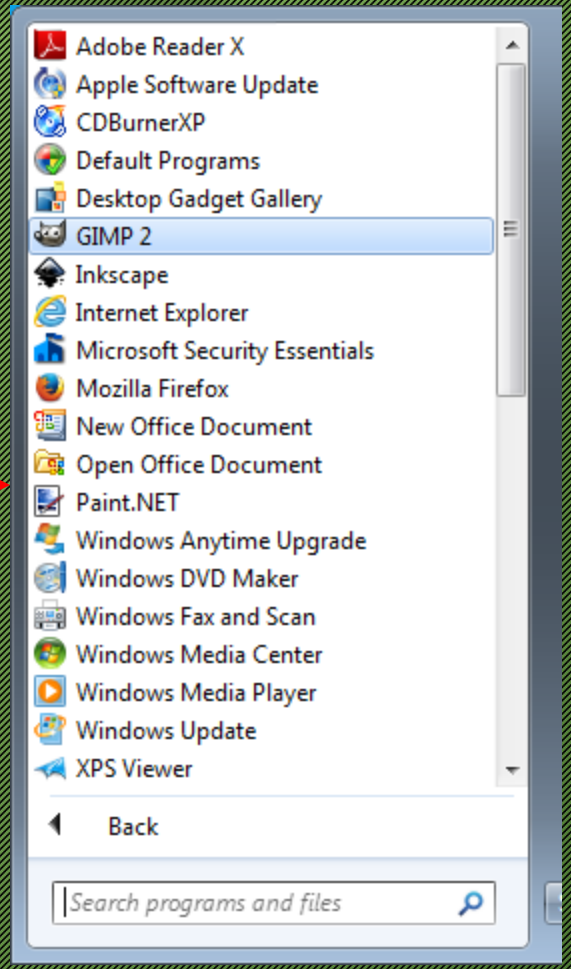
Introduction to GIMP

Overview

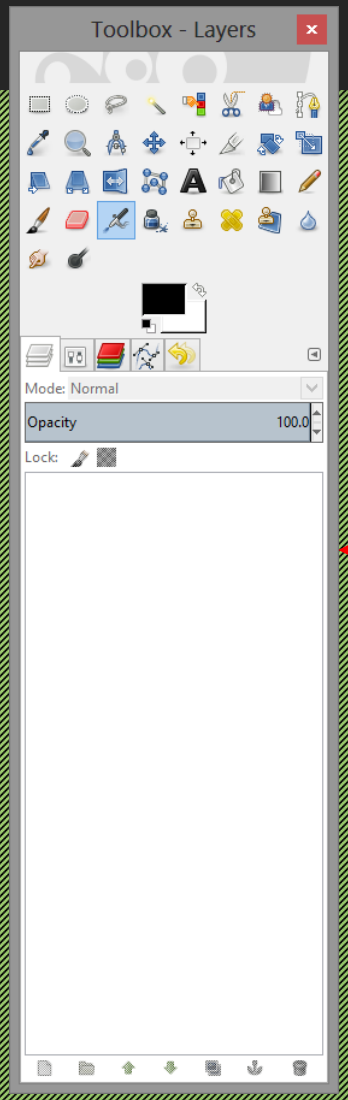
- Opening GIMP
- Default GIMP Layout
- Layers
  - Duplicating Layers
  - Adding Color to Layers
  - Layer Order
  - Opacity
- Selection Tools
- Selection Tools Descriptions

Opening GIMP

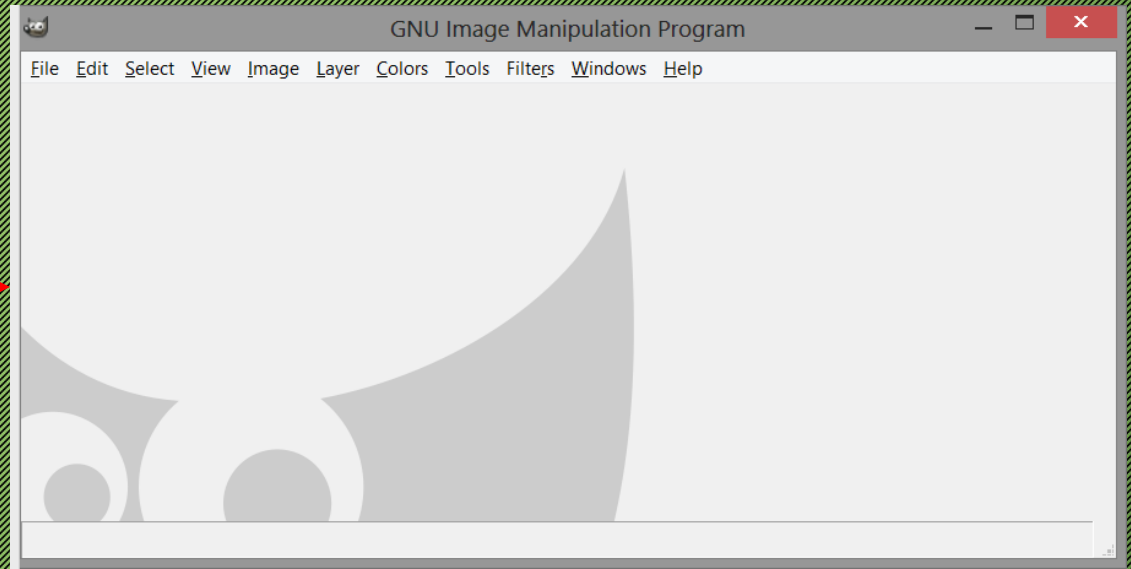
- There should be a GIMP icon on your desktop
- You can also open GIMP through the Start Menu (Start → All Programs → GIMP 2)

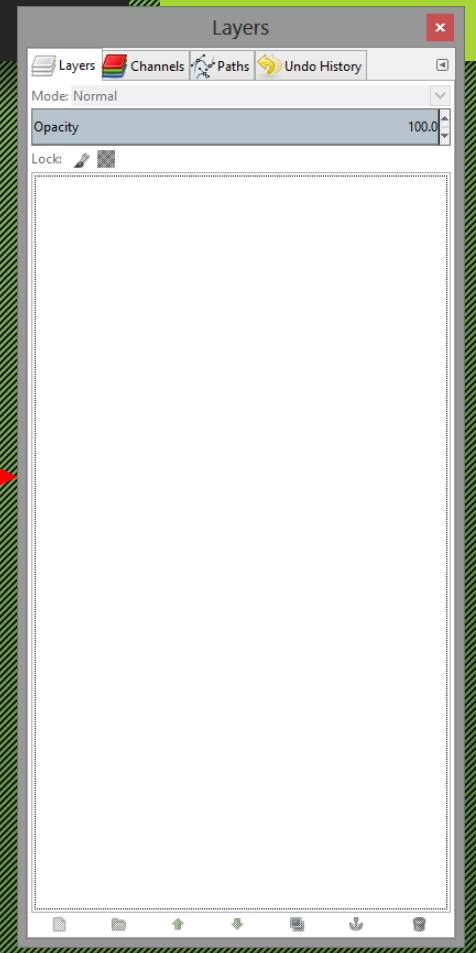


Default GIMP Layout



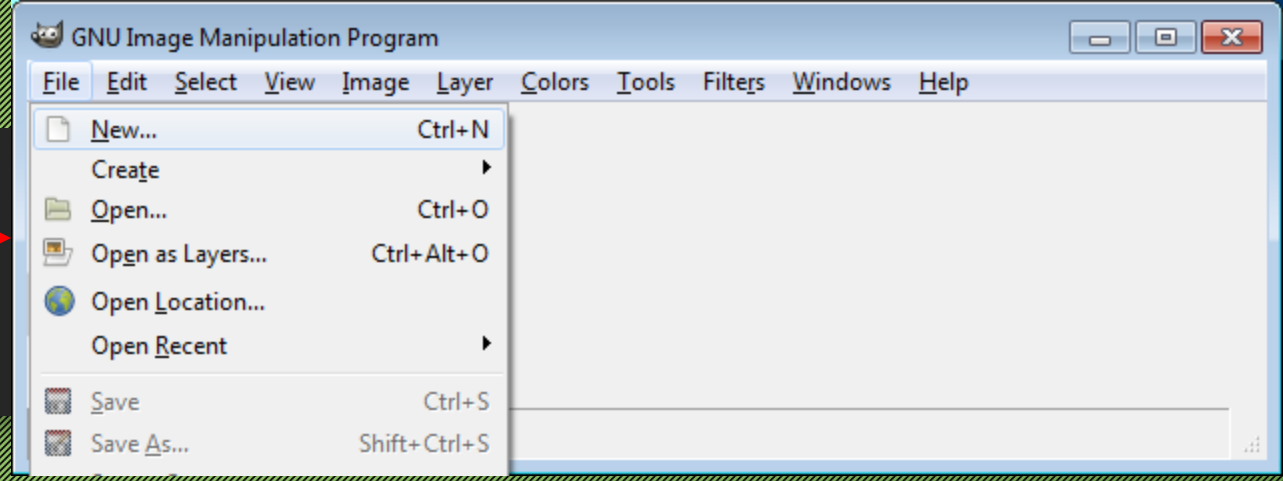
- When GIMP opens, the default setting is three different dialogues (windows)
  - Toolbox
  - Active Image
  - Layers

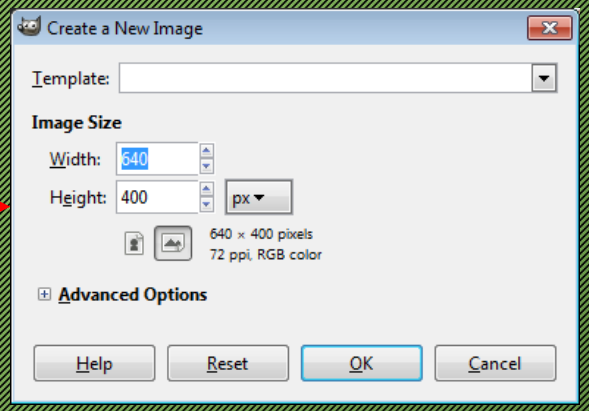


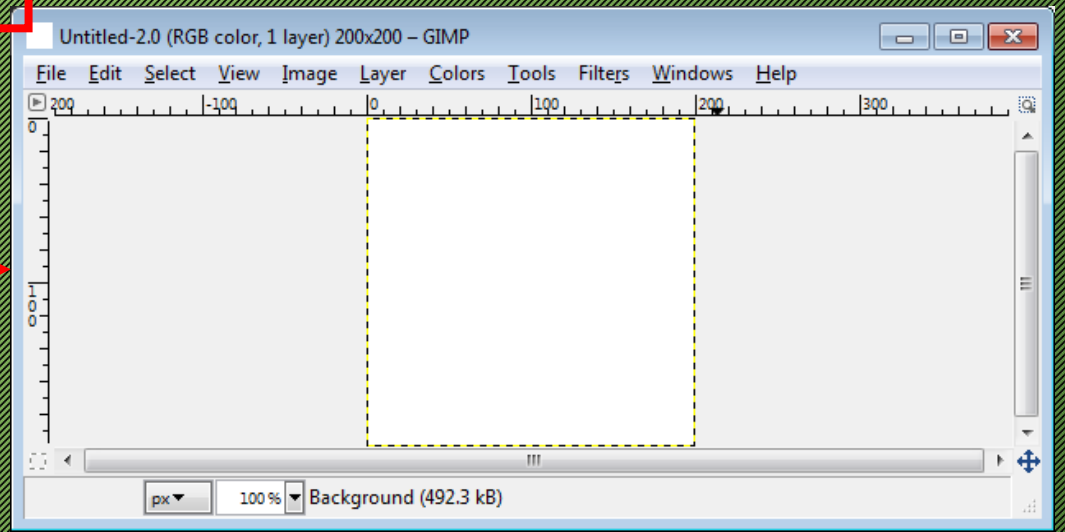


Layers

- Creating Layers
  - In the Active Image Dialogue go to File → New.
  - This will open a dialogue box with options on the size of an image you would like to create. For this tutorial, enter the width as 200 and the height as 200 and click the Okay button.
  - An untitled dialogue window should open with the image sized at 200x200.

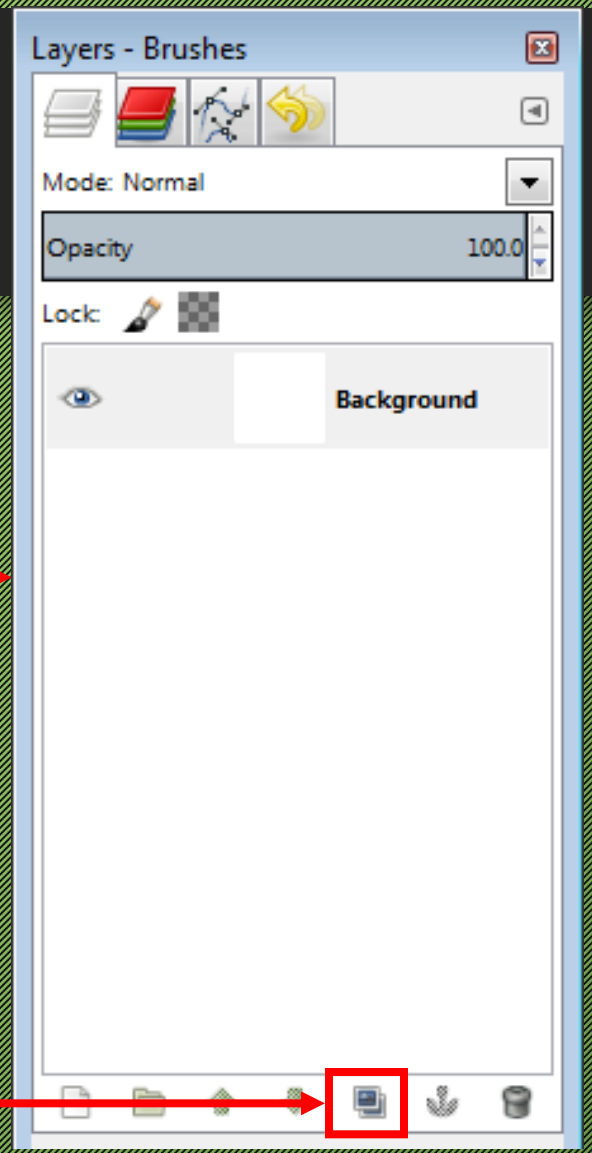


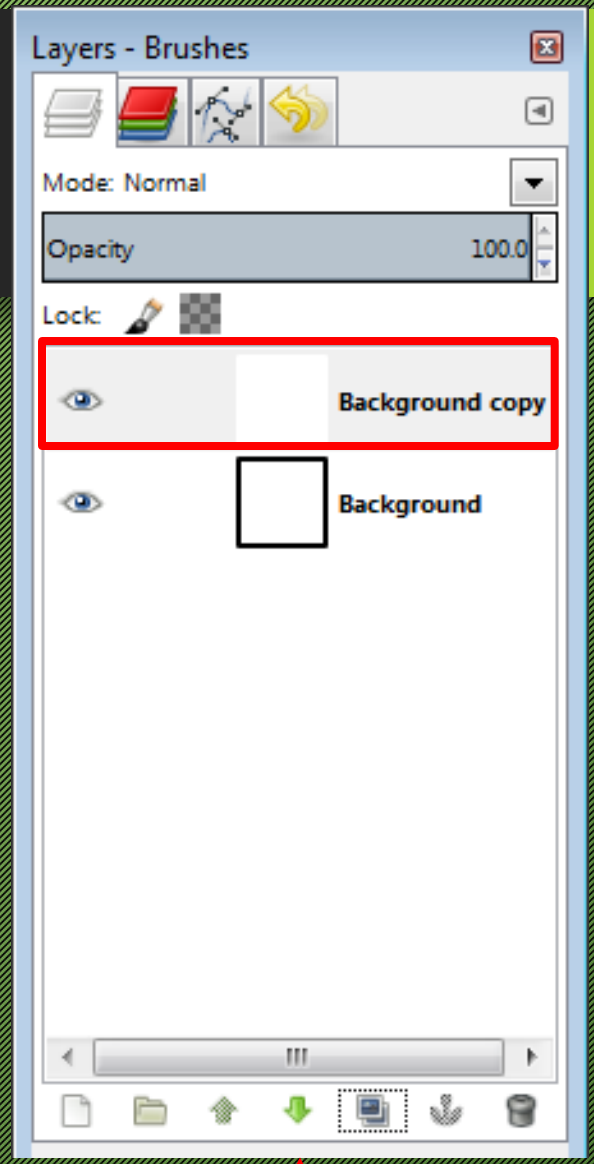




Duplicating Layers

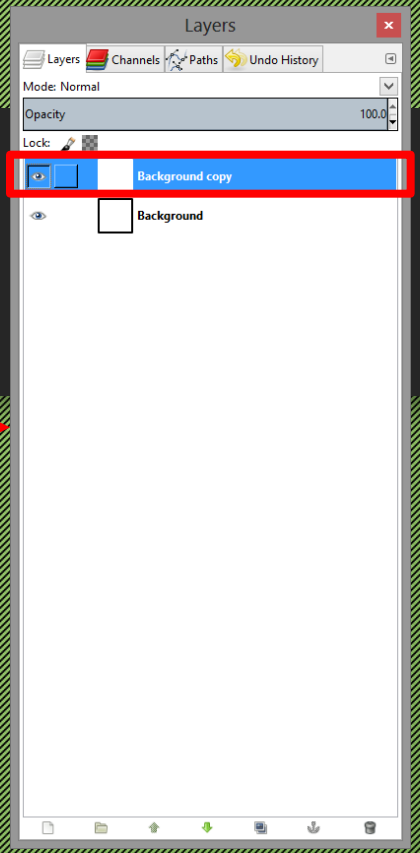
- If you look at the Layers Dialogue, you should see that this new image is called “Background”.
- In the Layers Dialogue, click on the Duplicate Layer button.
- In the Layers Dialogue you should see a new layer named “Background Copy.”

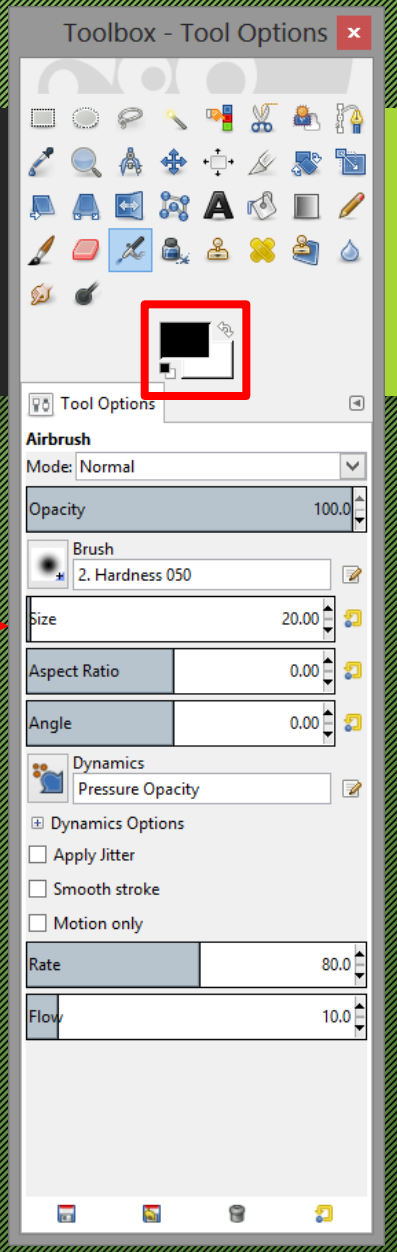


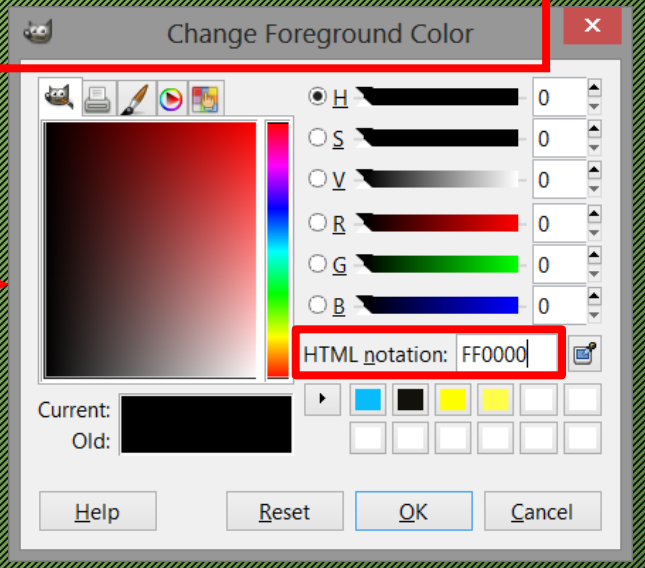


Adding Colors to Layers

- Highlight the Background copy layer selected (highlighted) in the Layers Dialogue.
- Go to the GIMP Toolbox and double click on the Foreground Color button, which will open the Change Foreground Color tool.
- In the HTML notation box type in FF0000 (this is the hexidecimal code for red) and then click OK.

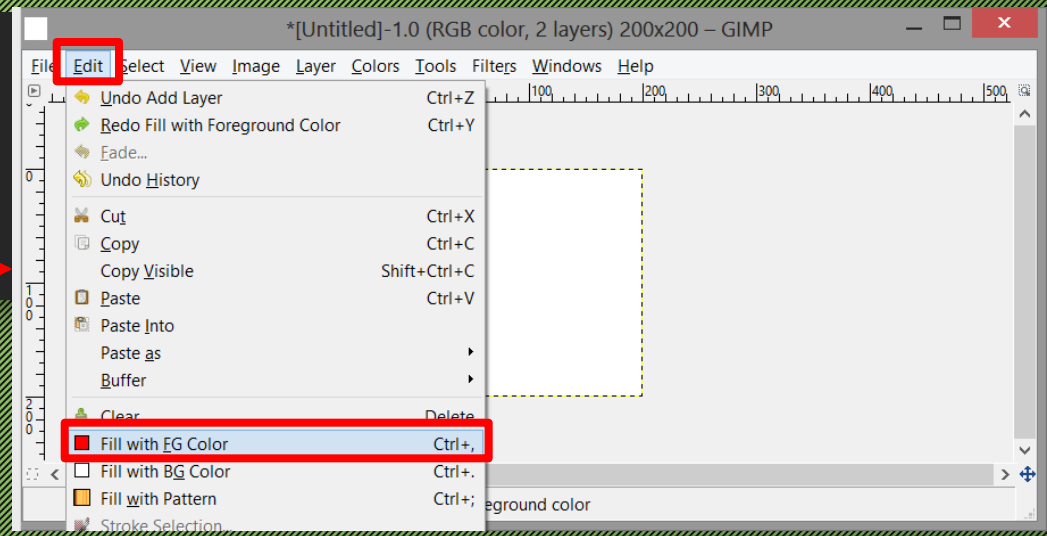


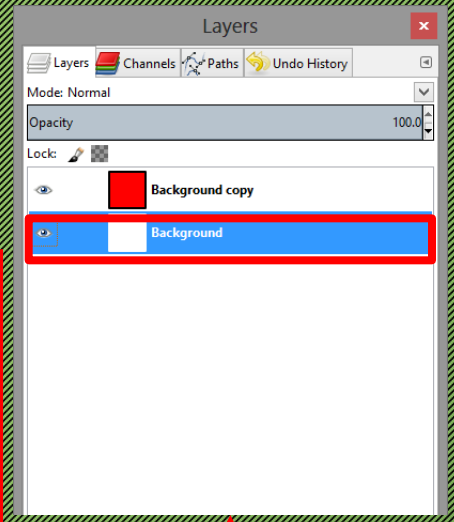


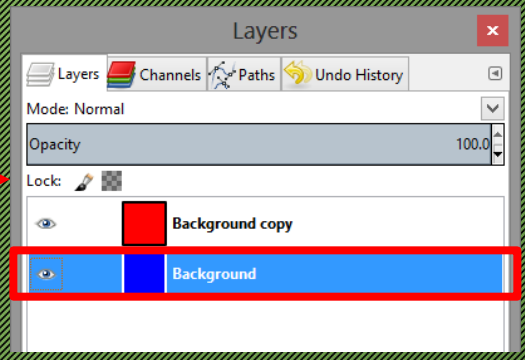


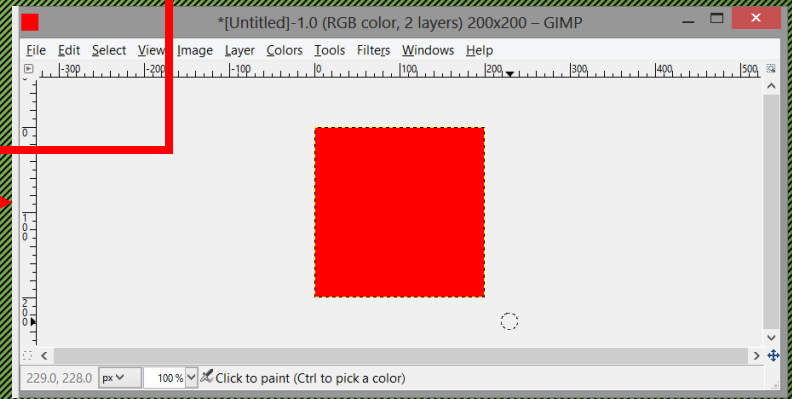
Adding Colors to Layers (cont.)

- In the Active Image Dialogue go to Edit → Fill with FG Color.
- This will fill the Background copy layer with red.
- In the Layers Dialogue click on the Background layer to select it.
- Repeat the same steps on the Background layer, making this layer blue (hexidecimal code 0000FF).



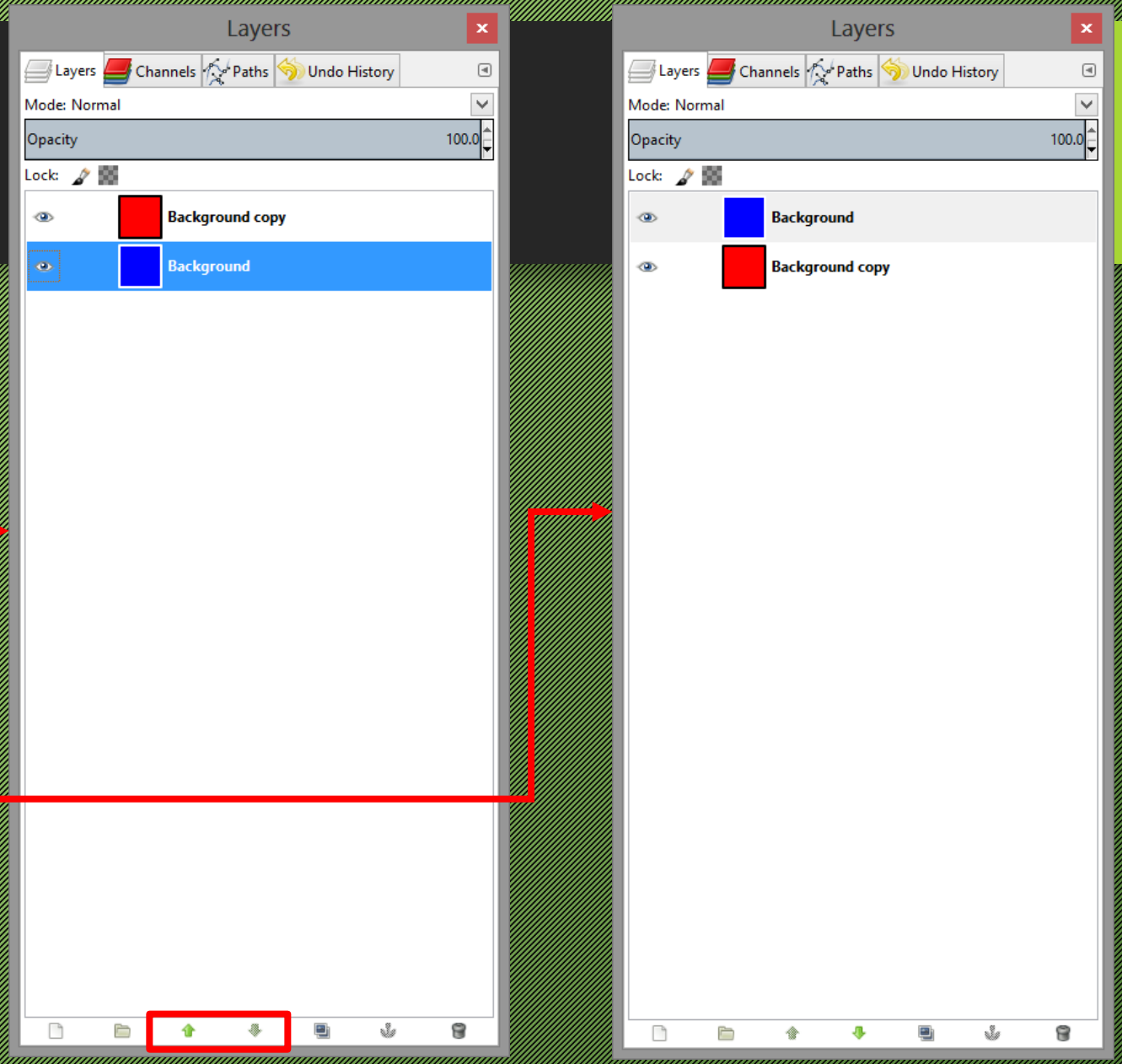






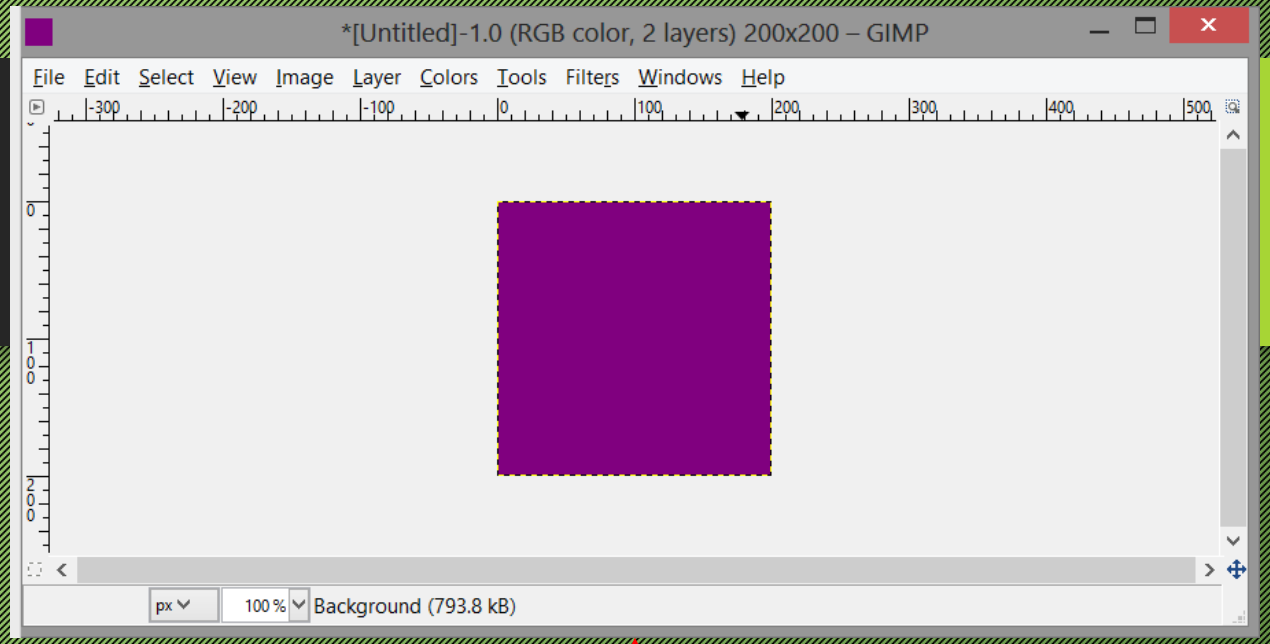
Layer Order

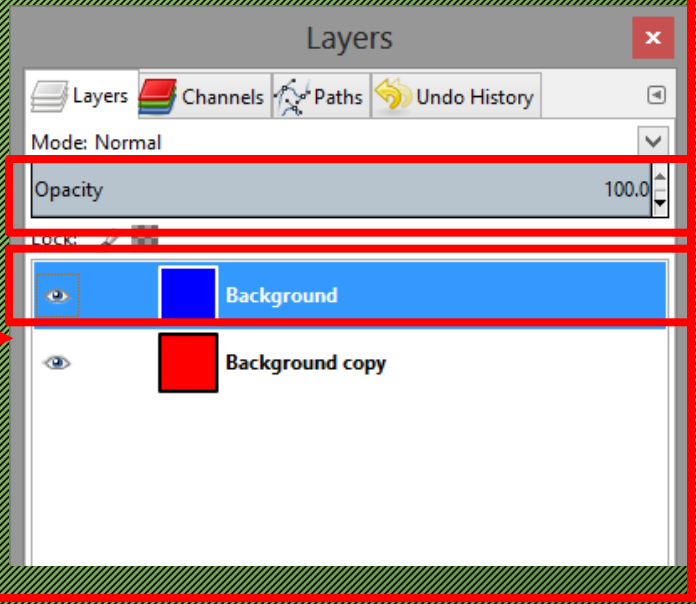
- When you look at the Layers Dialogue you can see the red and blue layers. The red layer is at the top of the stack, so that is the one that shows up in the image.
- With the blue layer selected in the Layers Dialogue, click the UP arrow and. You will now see that the blue layer is at the top of the stack and the image is now blue
- Of course, this works vice-versa, and you can move the blue layer down by selecting it in the Layers Dialogue and then clicking the DOWN arrow.

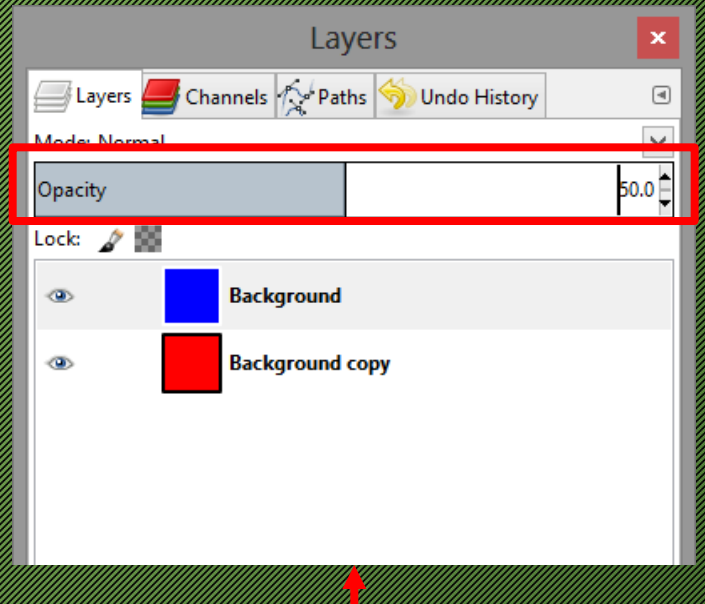


Opacity

- What do you get when you mix red and blue? Purple, of course!
- Select the top layer from the Layers Dialogue (doesn't matter which layer is on top).
- Adjust the opacity in the Layers Dialogue until it is at 50%.
- The image in your Active Dialogue should now be purple.

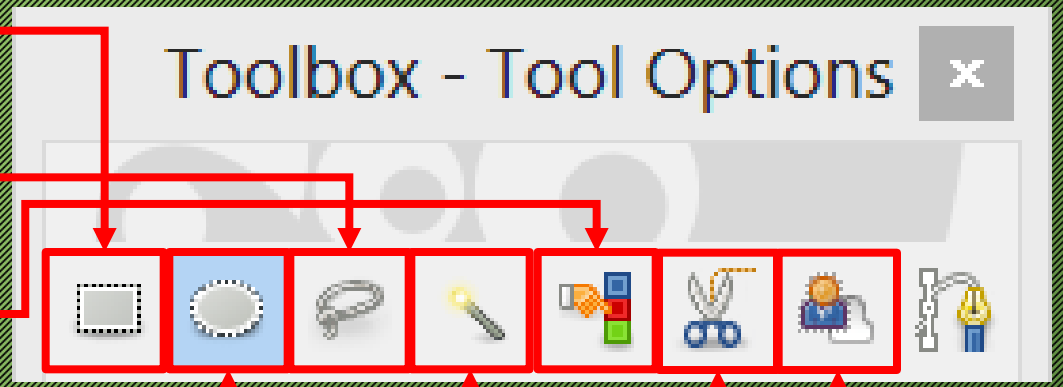






Selection Tools

- There are several selection tools available in GIMP:
  - Rectangle Select Tool
  - Ellipse Select Tool
  - Free Select Tool
  - Fuzzy Select Tool
  - Select by Color Tool
  - Scissors Select Tool
  - Foreground Select Tool



Selection Tools Descriptions

- The Rectangle Selection tool is designed to select rectangular regions of the active layer: it is the most basic of the selection tools, but very commonly used.
- The Ellipse Selection tool is designed to select circular and elliptical regions from an image, with high-quality anti-aliasing if you want it.
- The Free Selection tool, or Lasso, lets you create a selection by drawing it free-hand with the pointer, while holding down the left mouse button (or, for a stylus, pressing it against the tablet). When you release the mouse button, the selection is closed by connecting the current pointer location to the start location with a straight line. You can go outside the edge of the image display and come back in if you want to. The Lasso is often a good tool to use for "roughing in" a selection; it is not so good for precise definition.
- The Fuzzy Select (Magic Wand) tool is designed to select areas of the current layer or image based on color similarity. When using this tool, it is very important to pick the right starting point. If you select the wrong spot, you might get something very different from what you want, or even the opposite. The Wand is a good tool for selecting objects with sharp edges. It is fun to use, so beginners often start out using it a lot. You will probably find, however, that the more you use it, the more frustrated you become with the difficulty of selecting exactly what you want, no more, no less.

Selection Tools Descriptions (cont.)

- The Select by Color tool is designed to select areas of an image based on color similarity. It works a lot like the Fuzzy Select tool (“Magic Wand”). The main difference between them is that the Magic Wand selects *contiguous* regions, with all parts connected to the starting point by paths containing no large gaps; while the Select by Color tool selects all pixels that are sufficiently similar in color to the pixel you click on, regardless of where they are located.
- The Intelligent Scissors tool is an interesting piece of equipment: it has some features in common with the Lasso, some features in common with the Path tool, and some features all its own. It is useful when you are trying to select a region defined by strong color-changes at the edges. To use the Scissors, you click to create a set of "control nodes", also referred to as anchors or control points, at the edges of the region you are trying to select. The tool produces a continuous curve passing through these control nodes, following any high-contrast edges it can find. If you are lucky, the path that the tool finds will correspond to the contour you are trying to select.
- This tool lets you extract the foreground from the active layer or from a selection. It is based on the SIOX method (Simple Interactive Object Extraction).

GIS

- Geographical Information Science
  - Not just computerised maps

- Data Capture ('EO' – though often = just physical/RS)
  - Survey: GPS, EDM, Laserscanner
  - RS: Aerial/Satellite, but also other sensors, Sensor Networks
  - Primary Data, Secondary Data (verification techniques/theory/PAI)

- Analysis, 2D Map – Cartography, also whole field of (Geo)Visualisation, (incl. 3D)

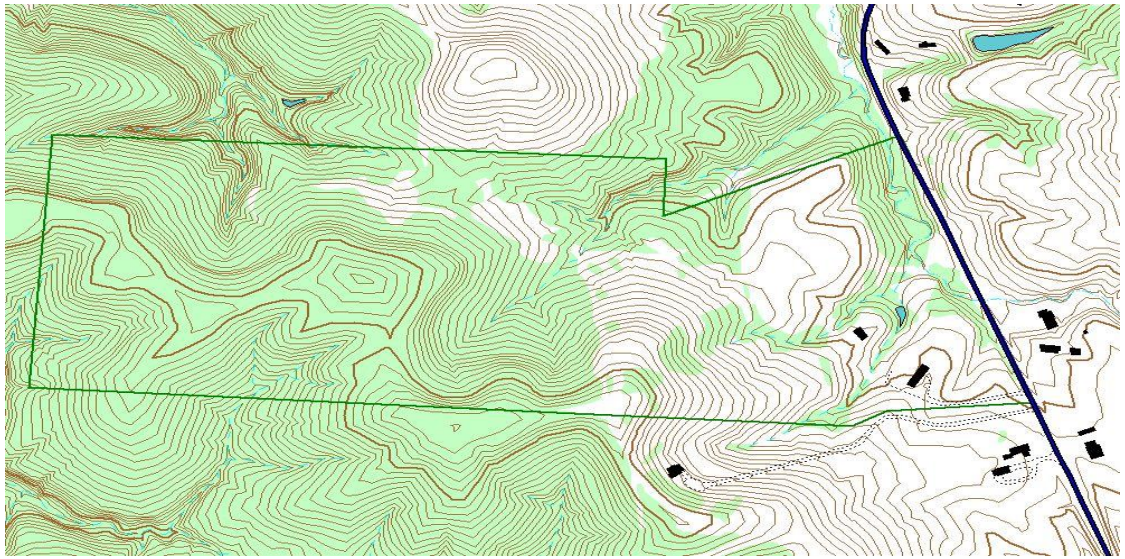
- Visualisation can also permit further analysis
  - Exploratory (Spatial) Data Analysis – EDA/ESDA

What is GIS?

GIS Stands for Geographic Information System

It's not one thing:

- Software
- People
- Map
- Company
- Spreadsheet
- Computer



What is GIS?

It's a combination of all of those things

The term describes any information system that integrates, stores, edits, analyzes, shares, and displays geographic information for informing decision making. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations. - Wikipedia

What is GIS?

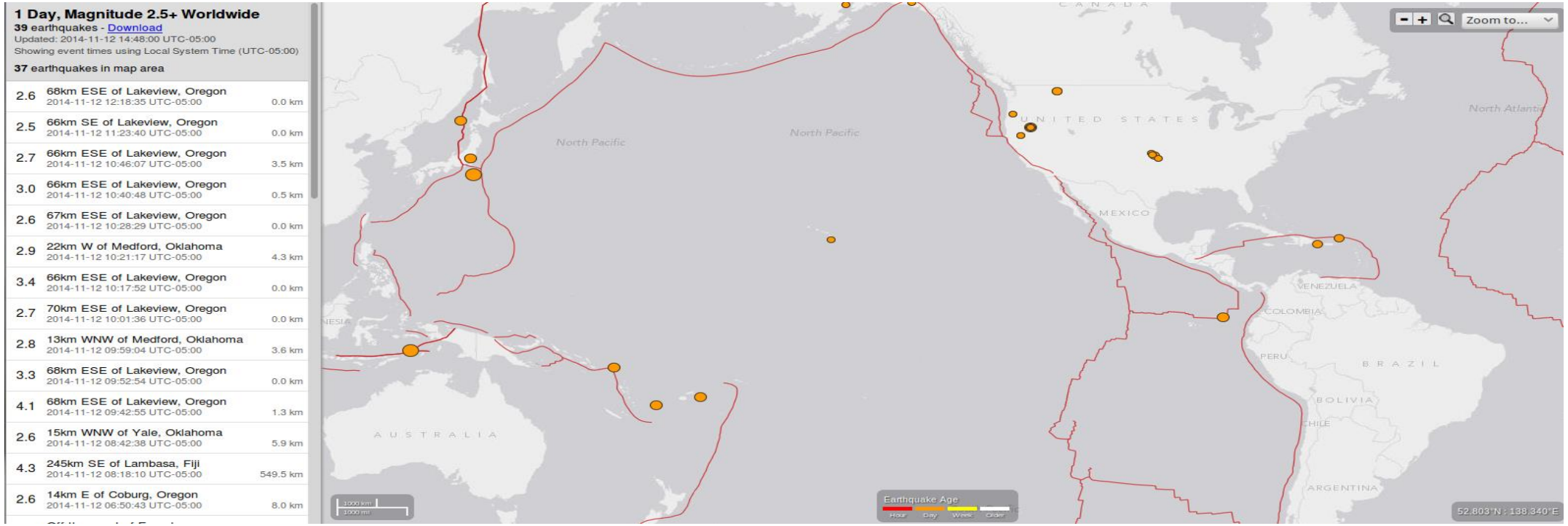
Who uses it?

- Police
- Utility Companies
- Military
- Counties
- Cities
- Private Companies
- Shipping/Transportation

- Forestry
- Department of Transportation
- Health Departments
- Humanitarian Relief

What is GIS?

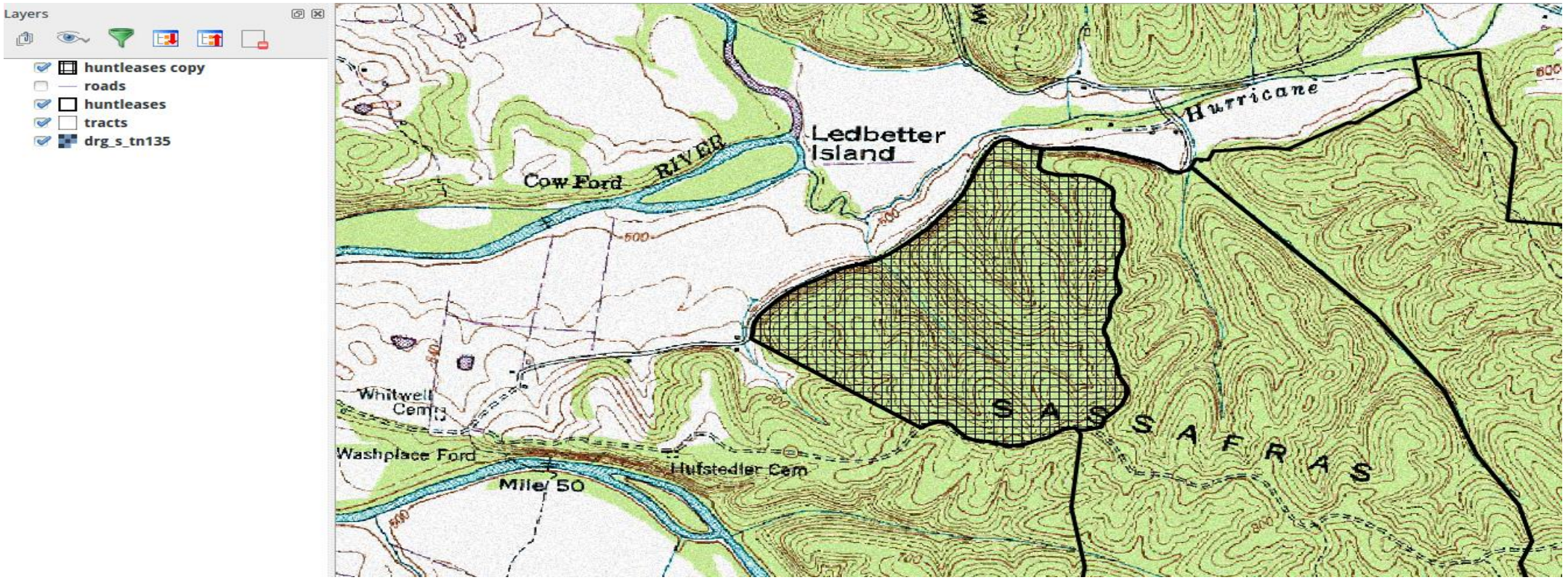
Who uses it?



GIS on the Internet! Where are the Earthquakes?

What is GIS?

Who uses it?



GIS on the Desktop! Where can the hunt club blow holes through deer?

What is GIS?

We are terminology heavy!

LIDAR

Projections

ST_Geometry

Mobile

DEM

Is the G Geospatial or Geographic?

Aerial Imagery

Digital Terrain Models

Routing

Networking

FOSS4G

Nodes

Points

Vertices

What is GIS?

We are Software Heavy!

ESRI - http://www.esri.com
QGIS - http://www.qgis.org
Intergraph - http://www.intergraph.com
Open Source - http://www.osgeo.org
Autodesk - http://usa.autodesk.com
Google - http://www.google.com
Oracle - http://www.oracle.com
Refractions - http://postgis.refractions.net
Fulcrum App – http://www.fulcrumapp.com

GIS – Three or Four Kinds

- Desktop Application / Full Package
- Web Mapping / Feature Server / Server GIS
- Web Browser with GIS Tools / Thick Client
- Apps, Mashups, APIs – Distributed GIS

Spatial Phenomena

- Land Use – Urban, Rural, Building Types
- Flood Risk, Water Transport, Soil Type
- Topography – Elevation, Slope, Aspect
  - How does topog' affect 'occurrence' in landscape
- People – Travel to work, shop, emergency services

Modelling

- Conceptual Models
  - To understand world, predict conditions at locations in time and/or space
- Mathematical Models
  - Numerical models where formalised - some idealised, some less so
- Data Models
  - Structure and flow of information in time and space
- Spatial Data – often (not always) represented in maps
  - (Lots of) Data with spatial component, some attempts to address time too
- Computerised Spatial Data -> Quick *Spatial* Analysis over wide extent
  - GIS – Geographical Information Science (and/or Systems)

GIS History / Software

- Geography Techniques (by hand) pre 1960s: John Snow, Minard's Map (Napoleon)
- Forestry – Canada (+E Africa) - CGIS
  - First GIS – Roger Tomlinson 1960+, operational from 1971+
- USA – Government Organisations: USGS, US Forest Serv, others incl. CIA
- Academia
  - **Edinburgh** – GIMMS 1970+ (Sold from 1973), MSc GIS 1985+
  - Harvard – Computer Graphics and Spatial Analysis Lab 1965
- ESRI 1969 Env. Consultancy – Arc/Info 1982 -> ArcView Desktop 1995 -> ArcGIS 1999
- Physics/Space (Moon landings) later CAD/Utilities – LaserScan/Intergraph 1969
- Demographics/Consultancy – MapInfo 1986
- OpenSource – GRASS, Quantum GIS (QGIS), gvSIG, … link to DBMS
- Web GIS – WMS, WFS, Google Maps, Google Earth, OGC, OpenStreetMap

Data Types

- Vector – Discrete Entities *within* space
  - Points
  - Lines
  - Polygons

- Raster – Contin's Field/Surface *across* space
  - Elevation
  - pH
  - Growth Pot'l as secondary data based on above

Attributes

- Vector – Multiple Attributes (Properties)
  - Attributes are of each feature (point, line, poly)
- Raster – Single Attribute (Value) e.g. pH
  - Each cell has a different value of this attribute
  - BUT! Can also have in turn *Value Attributes* e.g.
    1 = Acid, 7 = Neutral, 14 = Alkaline
  - BUT! Again only one per value!

Spatial Co-incidence – Map Layers

- Combination of spatial and aspatial (often numerical) manipulation of data
- Grids lie on top of each other. Co-incident cells can then be combined numerically to give result.
- GIS all about combining info from different *Layers*
- *Layers form a stack – but usually only in model – multiple measures found in same x,y,z (cell) location*
  - E.g. elevation, pH, salinity – each of these in different grid layer

Overlay – Attribute Transfer

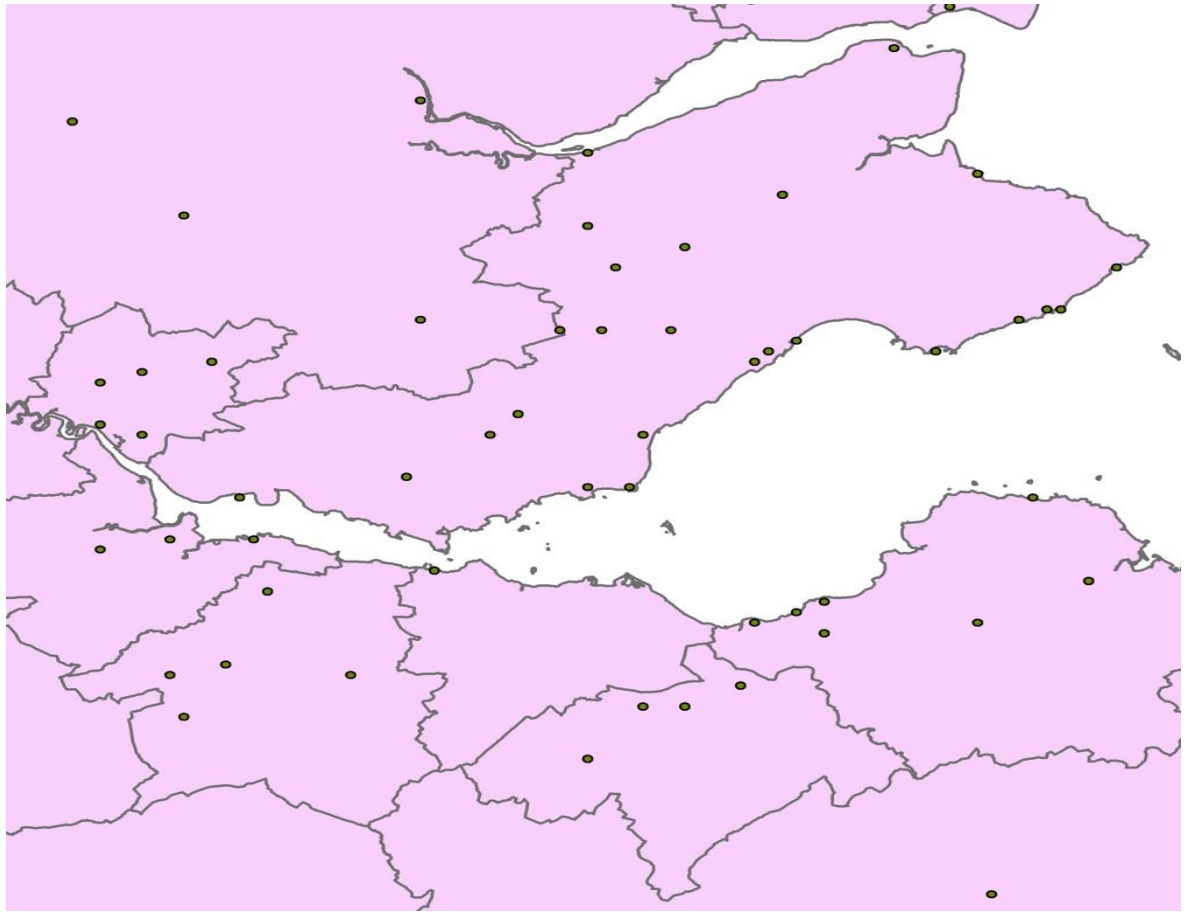
- Can convert between raster + vector but limited and tend to be treated in isolation but can be viewed together easily

- Can however easily combine vector layers – mathematical combination of geometry – easy to cut-up and intersect => Vector Overlay

- Vector Overlay all about Attribute Transfer

Overlay – Point in Polygon

- Which district has the most towns?
  - Count the number of town points in each district poly
- In which district does this town lie?
  - Attribute (verb) each town with the name of the district polygon in which it falls
- Points 'lie on top' of solid coloured polys in our stack



Overlay – Polygon Overlay

- Degree of overlap between different districts/zones/catchment areas

- E.g. *Erase* SSSI polygons from potential Golf Course polygons (unless you are a Trump)

- Intersect pollution zones with population zones (> 10,000 pop) to get danger zones!

Co-ord’te Reference Systems (CRS) – Map Projections, Datums

- Spatial Data can be measured/located in:
  - Angular Units – Lat, Long, e.g. 56º23'4'' (dms), 56.38º (dd)
  - Linear Units – Flat Grid-based: Easting, Northing, e.g. metres, ft
- Spherical (Angular) = 'Geographic' CRS (unprojected)
- Flat Planar (Linear) = 'Projected' CRS, e.g. BNG, UTM
- All CRS based on a reference datum – a model of the Earth’s surface/shape. This MUST be correctly defined, for any later projection (curved to flat) to WORK correctly.
- If collecting GPS data in Britain, we want to end up in BNG but MUST define source data as WGS84 datum / geographic sys as THAT is what the GPS uses. Once source data defined we can project to BNG.

Simple GIS – Google Earth

- Last point less of an issue if using Simple GIS – Google Earth – uses WGS84 lat long; loads in KML files – now often saved by GPS software directly. E.g. GPS Utility. Or just write raw KML or use converter prog.

- Simple annotation / measurement tools etc. but also clever features, e.g. timestamp allows animation/viewing change through time

- Beware – Google ***Maps*** uses its own Mercator projection but you can link to KML URL in Google Maps

- Can make 'mashups': Google Maps, JavaScript, WMS, Scanned Maps

NO pricey GIS package required

Industry Standard - ArcGIS

- ArcGIS: ArcMap – 2D, ArcScene 3D, ArcCatalog, others
- Relatively easy to get started, though can at times be overwhelming! Some similarity to Word/Excel in structure
- ArcToolbox now primary interface to functionality (or command line) though various toolbars (drop-down menus) too
- Beware – from v10 Arc tries to save everything to a default geodatabase in user's home path. In UoE, home path is M: and for undergrads this may still be quite small. Thus must keep some space on M: even if other space available

File Formats

- Shapefile – Actually a set of 3-6 files (min 3)
  - Prob one of most widely used file type – though closed, proprietary format
  - Myfile.shp (*geom*), Myfile.shx, Myfile.dbf (*attrs*), .prj, ...
  - Move each file, or .zip all together at OS; just move the .shp in ArcCatalog

- Geodatabase
  - Single file at OS level – neatly holds all vectors & rasters
  - File Geodatabase now 1Tb (and there are ways to get up to 256 Tb!)
  - In time will likely be the only thing to use (other GIS still use shp for now)

- Coverage (vector); Grid (raster)
  - Older formats you may need to know about
  - Hybrid structure of one folder mygrid and a shared info folder – shared between ALL coverages and grids in a containing folder
  - Move ALL of these at OS – or better still use ArcCatalog only!

Data Storage Theory

- Hybrid Arc/Info model based on storing correct *type* of data in best place for that
- Data can be re-joined when required
- Same principle means store only relevant info in a table of particular feature types and join these at query/display time – also use key tables & numbers to reduce data vols
- Relational DBs good for this and can store spatial data – Many offer spatial extensions with spatial analysis functions

Database Storage

- Can connect GIS to RDBMS for:
  - Better querying
  - Robust storage
  - Multi-user access and sophisticated control (only one user edits electoral district at a time!)

- Examples:
  - ArcSDE – Create GeoDatabase in RDBMS
  - SPIT – Connects QGIS to PostgreSQL(PostGIS)

Open (Source) GIS

- PostGIS, MySQL – Open Source DBMS – implement OGC standards
- OGC – Consortium of 482 Companies/Orgs – Define *Open* Standards
- OSGeo Found'n – Support develop't of op'n source Geospatial software
- GRASS – Orig. US Army, now project of OS Geo
- GDAL (Conversion), GEOS (Geometry), rasdaman (rasters)
- Quantum GIS (QGIS) – Another OSGeo Project
  - MapServer export, OpenStreetMap editor, Run GRASS datasets/tools within
- MapTiler (uses GDAL2Tiles) – Create OpenLayers/Google Maps Tilesets

Web GIS

- Tools – MapTiler, OpenLayers, MapServer, GeoServer
- Developers' Platforms – JavaScript, AJAX, SVG, Java
- Google Earth/Maps, Virtual Earth, Streetmap
- OpenStreetMap, (interesting to compare against OS!)
- OS Get-a-map; OS OpenData (Apr 2010); OpenData API
- Simple User Requirements? – ArcGIS Online

A Brief History of ESRI/ArcGIS:

- ESRI Founded in 1969.
- ArcINFO released 1982 (discontinued in 2010).
- Arcview released In 1991 (discontinued in 2002).
- ArcINFO 8 released 1999 (became ArcGIS Desktop).
- Software has blossomed into ArcGIS Server, Mobile, Desktop, ArcGIS Online (Cloud).
- ESRI has a International Conference every year in San Diego.
- Smaller Regional Meetings all over the US (and worldwide).

What is ArcGIS Desktop?

Comes in 3 versions:

- Basic (cheapest)
- Standard
- Advanced (most expensive)

The difference is in it's abilities

- Advanced can do everything
- Basic is essentially a data viewer with limited functionality.

There are a ton of extensions:

- Spatial Analyst
- 3D Analyst
- <fill in the blank> Analyst

ArcGIS Desktop is two programs (Catalog and Desktop)

What is ArcGIS Desktop?

What does it do?

- Views Vector
  - CAD
  - Shapefile
  - Geodatabase
- Views Raster
  - TIF
  - ECW
  - SID
- Performs Analysis
- Makes Maps
- Generates reports