Using AFNI Interactively

- Start AFNI from the command line
  - ◇ `afni` reads datasets from current directory
  - ◇ `afni dir1 ...` reads datasets from directories listed
  - ◇ `afni -R` reads datasets from current directory and from all directories below it
- AFNI reads the file named `.afnirc` from your home directory, if it is present
  - ◇ Used to change many of the defaults (cf. file README.environment)
- Minor but useful features of the AFNI controller window:
  - ◇ xyz-coordinate display in upper left corner shows current focus location
    - ↪ By default, the coordinates are in RAI order (from the DICOM standard):
      x = Right (negative) to Left (positive)
      y = Anterior (negative) to Posterior (positive)
      z = Inferior (negative) to Superior (positive)
    - ↪ This display order can be changed to the neuroscience imaging order LPI:
      x = Left (negative) to Right (positive)
      y = Posterior (negative) to Anterior (positive)
      z = Inferior (negative) to Superior (positive)

◇ The `BHelp` button: when pressed, the cursor changes to a hand shape; use it to click on any AFNI button and you will get a small help popup

↪ AFNI also has 'tooltips' or 'hints'

◇ Press the `New` button to open a new AFNI controller

↪ Used to look at more than one dataset at a time

↪ `Define Datamode`→`Lock` can be used to lock controllers together by coordinates

▷ All windows within a controller are always locked together

◇ Press the `Views` button to close/open the control panel at right

◇ Press the `done` button twice to exit AFNI

↪ Don't press a mouse button in the blank area to the right of `done`!

◇ The `Switch` buttons let you control which datasets are being viewed

↪ `Switch Session` controls which directory datasets are drawn from

↪ `Switch Anatomy` controls the background (grayscale) dataset

▷ Current anat dataset determines resolution of images displayed

↪ `Switch Function` controls the overlay (color) dataset

▷ Func datasets will be interpolated (if needed) to anat resolution

↪ Current datasets are named in AFNI controller titlebar

- Touring the Image Viewer
  - ◇ Open with the `Image` buttons
    - ↪ Button colors will invert; press button to raise viewer window
  - ◇ Crosshairs show the current focus location
    - ↪ Also show the cut planes for the other image viewers
    - ↪ When using image montage, other viewers show multiple crosshairs
  - ◇ Slider below image lets you move between slices
    - ↪ Left-click and drag 'thumb' to move past many slices
    - ↪ Left-click ahead or behind thumb to move 1 image at a time
      - ▷ Hold click down to scroll continuously through slices
    - ↪ Middle-click in 'trough' to jump quickly to a given location
  - ◇ Vertical intensity bar to right of image shows mapping from numbers stored in image to colors shown on screen
    - ↪ Bottom of intensity bar corresponds to smallest numbers displayed
    - ↪ Top corresponds to largest numbers displayed
    - ↪ Smallest-to-largest display range is selected from `Disp` control panel
      - ▷ Or from hidden popup menu on intensity bar
    - ↪ All image viewers use the same intensity bar
      - ▷ Unless AFNI is started with the `-uniq` option

◇ Buttons at right of intensity bar control image display (mostly colors)

↪ `Colr` changes grayscale to color spectrum, and back

↪ `Swap` swap top of intensity bar with bottom

↪ `Norm` returns the intensity bar to normal (after you mess it up)

↪ `c` controls contrast

↪ `b` controls brightness

▷ Useful combination: `c` ▲ 2–3 times, `b` ▼ 2–3 times

↪ `r` rotates the intensity bar (useless, but very fun)

↪ `g` changes the gamma factor (nonlinearity) for the intensity bar

↪ `i` changes the size of the image in the window

↪ `9` changes the opacity of the color overlay

▷ This control only present for TrueColor displays

◇ At bottom right, the arrowpad controls the crosshairs

↪ Arrows move 1 pixel in that direction for that window

▷ Sagittal ◀ is same as Axial ▲

↪ Central button closes and opens crosshair gap

↪ Items on AFNI controller (below xyz display) also alter crosshairs

▷ Can change color, gap size, . . .

◇ Buttons along bottom provide various services

↪ `Disp` controls the way images are displayed and saved

- ▷ Pops up its own control window: most controls change image immediately
- ▷ Orientation controls at top let you flip image around
- ▷ `No Overlay` lets you turn color overlays off (crosshairs; function)
- ▷ `Min-to-Max` ⇒ intensity bar is data min-to-max
- ▷ `2%-to-98%` ⇒ intensity bar is smallest 2% of data to largest 98%
- ▷ `Free Aspect` lets you distort image shape freely
- ▷ `Save` panel controls how images are saved to disk:
  - All buttons off ⇒ saved image file contains slice raw data
  - `Nsize Save` ⇒ same, but images are 2^N in size
  - `PNM Save` ⇒ images are saved in PPM/PGM format (color/gray)
  - `Save One` ⇒ for saving montage (in PNM format)
  - `Save to .xxx(s)` ⇒ saves image(s) to specified format
- ▷ `Tran 0D` lets you transform voxel values before display
  - `Log10` and `SSqrt` useful for images with extreme values
- ▷ `Tran 2D` provides some image filters
  - `Median9` can be useful for printing images
- ▷ `Rowgraphs` lets you graph the voxel values from image rows
  - If you want columns, flip the image with `CCW 90`
- ▷ `Surfgraph` lets you graph the voxel values in a surface graph

▷ Three extra image processing filters are provided at the bottom
  - `Sharpen` is sometimes useful for deblurring images

▷ `Reset` sets controls back to what they were when you opened `Disp`

▷ `Done` closes this control window

◇ `Save` lets you save images from viewer to disk files

↪ Warning: Images are saved as sent to the viewer, not as displayed

▷ Means that aspect ratio of saved image may be wrong (non-square pixels)

▷ Can fix with `Define Datamode`→`Warp Anat on Demand`

↪ `Save:bkg` means it will save the background image data itself, whatever format it may be in (bytes, shorts, floats, complex numbers, RGB byte triples)

↪ `Save:pnm` means it will save the displayed image in PNM format

▷ PPM for color, PGM for gray-only images

▷ You might have to convert this to some other format

▷ See AFNI FAQ #57 for instructions on image format conversion

↪ `Save:one` means it will save the entire Montage in PNM format

▷ This is the only way to save a Montage layout (within AFNI)

▷ All other options only `Save` the single "focus" image

↪ `Save.xxx` means it will save the image in the "xxx" format

▷ You can also set this using a hidden right-click popup on the `Save` button

▷ Options depend on presence of image conversion programs on your system

↪ After you press `Save`, then it asks for a filename prefix

↪ Except for `Save:one`, it then asks for 'from' and 'to' slice indexes

▷ You can save many images this way

▷ Filenames in form `prefix.0037.pnm`, for slice number 37

▷ `Save:one` immediately saves its one file after prefix is entered

◇ `Mont` lets you display a rectangular layout of images

↪ Pops up its own little control window

▷ Controls at top do nothing until action is selected at bottom

↪ `Across` and `Down` determine number of sub-images shown

↪ `Spacing` determines how far apart the selected slices are

▷ Every n^{th} slice, for $n = 1, 2, \ldots$

▷ Multiple crosshairs in other image viewers will show montage slices

↪ `Border` lets you put some blank pixels between the sub-images

▷ `Color` lets you choose the color of the border pixels

↪ At the bottom, the action controls cause something to happen

▷ `Quit` closes the Montage control window

▷ `1x1` changes `Across` and `Down` back to 1

▷ `Draw` actually causes the montage to be drawn

▷ `Set` $\Rightarrow$ `Draw` then `Quit`

- ◇ `Rec` lets you record images for later `Save`-ing
  - ↪ So you can build a sequence of images from any set of AFNI controls
    - ▷ Change colormaps, functional thresholds, datasets, ...
  - ↪ Then save them to disk for later animation, etc.
    - ▷ Can make GIF animations with Unix programs whirlgif and gifsicle
  - ↪ `Rec` button pops down a menu that sets the record mode
    - ▷ `Off` ⇒ recording is off
    - ▷ `Next One` ⇒ next image displayed is recorded, then goes back to `Off`
    - ▷ `Stay On` ⇒ record each image when displayed
    - ▷ Controls below the line determine where in the recording sequence the saved images will be stored
  - ↪ Recorded images go into a new image viewer, with its own controls
    - ▷ Its slider moves between recorded images
    - ▷ `Kill` will delete an image from the recorded sequence
    - ▷ `Save` will save record images
      - Right-click on `Save` to bring up menu of format options
    - ▷ `Done` to close the recorded image viewer

◇ Hidden image popup menu (using Button 3 or right-click)

↪ `Jumpback` lets you jump the focus position back to its last place

▷ For when you click in the wrong place and get lost

↪ `Jump to (xyz)` lets you enter xyz-coordinates (in mm) and then the focus position will jump there

▷ External program 3dclust can generate xyz coordinates of interest

▷ In progress: incorporation of San Antonio Talairach Daemon coordinates

↪ `Jump to (ijk)` lets you jump to a particular voxel index location

↪ `Image display` lets you turn control widgets on and off

▷ Can unclutter screen a little

▷ Useful if you want to make a screenshot

◇ Hidden intensity bar popup menu

↪ `Choose Display Range` lets you pick the range of numbers that are mapped to intensity bar colors

▷ Normally, each image is mapped to colors separately

- Using `Min-to-Max` or 2%-to-98% from `Disp`

▷ If you want each image to be mapped the same, then must give bottom-to-top values via this menu item (separate them with spaces)

▷ If you set third (optional) input 'ztop' to 1, values above 'top' are set to 0

▷ To restore normal auto-mapping, set 'bot' and 'top' both to 0

↪ `Choose Zero Color` lets you choose the color that is displayed for voxel values that are exactly 0

- ▷ Can be useful for filling in regions that were set to 0 by some program
- ▷ For example, values below 'bot' from `Choose Display Range` (and above 'top' if 'ztop' was set to 1)
- ▷ Choose the 'none' color to return to normal display

↪ `Choose Flatten Range` is used to control the `Flatten` filter from the `Disp` control window

- ▷ This is almost useless — don't bother to try it

↪ `Choose Sharpen Factor` is used to control the `Sharpen` filter from the `Disp` control window

- ▷ Larger values mean more sharpening

- Touring the Graph Viewer
  - ◇ Graph viewer takes voxel values from same dataset as image viewer
    - ↪ If dataset has only 1 sub-brick, graph viewer only shows numbers
    - ↪ To look at images from one dataset locked to graphs from another dataset, must use 2 AFNI controllers and `Define Datamode`→`Lock` on AFNI control panel
  - ◇ If graph and image viewer in same slice orientation are both open, crosshairs in image window change to show a box containing dataset voxels being graphed
  - ◇ Central sub-graph (current focus location) is outlined in yellow
    - ↪ Current time index is marked with small red diamond
    - ↪ Left-clicking in a non-central sub-graph moves that location to focus
    - ↪ Left-clicking in central sub-graph moves time index to that point
      - ▷ Can also use `Index` control in AFNI controller
    - ↪ Right-clicking in any sub-graph pops up some statistics of its data
    - ↪ Left-clicking in icon (lower left corner) causes icon and menu buttons to disappear
      - ▷ Useful if you want to do a screenshot to save window
      - ▷ Left-clicking in same place will bring icon and buttons back

◇ Opt menu button lets you control how graphs appear

↪ Many items have [keyboard] shortcuts

▷ Make sure you are typing into the correct window!

↪ Scale changes scale of graphs

▷ Mapping from voxel values to screen pixels

▷ Down [-] shrinks graphs vertically; Up [+] expands them

▷ Auto [a] makes AFNI pick a nice scale factor

▷ Choose lets you pick exact scale factor

- Can choose positive values=pix/datum or negative=datum/pix
- pix/datum = number of screen pixels for each change of 1 in data
- datum/pix = size of change in data for each screen pixel

▷ Current scale factor is shown below graphs

▷ Scale factor does not change when you resize graph, change matrix, etc.

- You usually have to auto-scale [a] afterwards

↪ Matrix changes number of sub-graphs

▷ Down [m] and Up [M] decrease and increase number

▷ Choose lets you pick number exactly

- Alternative: keyboard [N], type number, then [Enter] key
- Range of allowable matrix size is 1..21

↪ Grid lets you change spacing of vertical grid lines

- ▷ Useful for showing regular timing interval (e.g., task timing)
- ▷ Down [g] and Up [G] decrease and increase spacing
- ▷ Choose lets you pick number exactly
- ▷ Current grid spacing is shown below graphs
- ▷ Pin Num lets you pick the horizontal length of the sub-graph
  - Default length is number of sub-bricks in dataset
  - Make it longer ⇒ graphs end before window
  - Make it shorter ⇒ graphs are truncated
  - Useful when switching between datasets of different lengths
  - Set this to 0 to get back to default operation
  - Current number of time points is shown below graphs
- ▷ HorZ [h] will put in a dashed line at the $y = 0$ level in sub-graphs
  - Only useful if data range spans negative and positive values!

↪ Slice lets you change slices

- ▷ Down [z] and Up [Z] move one slice
- ▷ Can also choose slice directly from menu
- ▷ Current voxel indexes are shown below graphs
  - Corresponds to Voxel Coords? display in AFNI controller

↪ `Colors, Etc.` lets you alter the colors/lines used for drawing

- ▷ Lines used for sub-graph frame boxes, grid lines, data graphs, FIM orts/ideals, and double plots can have colors changed and can be made thicker
  - Grid color is also used to limn central sub-graph
- ▷ Can choose to graph curves as lines, points, or both together
- ▷ Can change color of background and text
- ▷ Can change gap between sub-graph boxes

↪ `Baseline` [b] changes how the sub-graphs are plotted

- ▷ All sub-graphs have same scale factor, to convert values into vertical pixels
- ▷ Baseline for each sub-graph is value that is plotted at bottom of sub-graph
- ▷ Default: all sub-graphs have different baselines
  - Baseline = smallest value in each displayed time series
  - This can be confusing; same vertical location doesn't mean same value
  - Shown below graphs as `Base: separate`
- ▷ If `Baseline` is pressed in, all sub-graphs get same baseline
  - Baseline = smallest value in all displayed time series
  - Shown below graphs as `Base: common`
  - Usually need to rescale [a] after changing `Baseline`

▷ Range of central sub-graph is shown at left of graph region
- Central bottom (baseline) value is shown at lower left
- Upper left shows value at top of central sub-graph box
- Number in [brackets] shows data range of one sub-graph box's height
- If baselines are separate, bot/top values only apply to central sub-graph!

↪ `Show text?` [t] allows you to see text display of values instead of graphs

↪ `Save PNM` [S] lets you save a snapshot of window to a PNM image file

↪ `Write Center` [w] lets you write data from central sub-graph to a file

▷ File is in ASCII format ⇒ can be imported into other programs

▷ Filename is of form `xxx_yyy_zzz.suffix.1D` (using voxel indexes)

▷ `suffix` is chosen using `Set 'w' suffix` button

↪ `Tran 0D` and `Tran 1D` let you transform the data before graphing

▷ `Log10` and `SSqrt` useful for images with extreme values

▷ `Median3` and `OSfilt3` are for smoothing time series

▷ Other choices are functions controlled by/from plugins

▷ `Double Plot` lets you plot output of `Tran 1D` and original data together
- Color of transformed data from `Dplot` on the `Colors, Etc.` menu
- `Dataset#2` transformation lets you plot two datasets together

↪ X-axis menu lets you choose how graph x-axis is chosen

- ▷ Default: x is linear in time
- ▷ Can instead choose x from a .1D format file from disk
- ▷ Useful only in very limited circumstances

↪ Done [q] closes the graph viewer window

◇ [Keystrokes] in graphs that have no menu items are

↪ [<] moves time index down by 1
↪ [>] moves time index up by 1
↪ [1] moves time index to beginning (time index $= 0$)
↪ [l] moves time index to end
↪ [L] turns off/on the AFNI logo in the corner

◇ FIM menu controls interactive functional image calculations

↪ Will be documented later — I'm exhausted right now