

Computer Resources For Astronomy

An overview document for Thornbury U3A Astronomy Group

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1 Introduction

This document is intended to provide an overview of computer resources for astronomy.

2 Hardware

It is assumed that group members may have access to one or more of the following devices:

- Windows PC, laptop, or tablet.
- Apple PC, laptop or tablet (iPad).
- Linux PC, laptop, or tablet.
- Android smartphone
- Apple iPhone
- Windows phone
- GoTo Telescope

3 Purposes

Why are we interested in these computer resources ? I think our requirements can be categorized as follows:

- Mapping the night sky, to see what constellations, planets etc are visible tonight, or to identify something.
- Generating star maps to assist observing, or to help locate a specific object.
- Studying particular astronomical topics of interest.
- Exploring the latest discoveries at the worlds main observatories and telescopes.

- Seeing results from current or previous space missions.
- Telescope control and imaging
- Creating and modifying images
- Distributed programmes using BOINC
- Using interactive web-based programmes e.g. Galaxy Zoo
- Obtaining real astronomical data and analyzing it using available or self-created tools.
- Software libraries and toolkits

Clearly, some of these topics will be a minority interest only...

4 Resources

4.1 Apps

There are so many apps available, it is always worth searching the net or 'app store'. Here are a few examples. Some of these are free, others are not.

4.1.1 Windows PC

| | |
|-------------------------|---|
| <i>Stellarium</i> | A 'planetarium' program: it shows you what the sky looks like from a given location at a specified data and time. Free. |
| <i>Cartes du Ciel</i> | Creates printable maps of selected parts of the sky e.g. finder charts. Free. Also called SkyMap. |
| <i>Universe Sandbox</i> | Simulations of gravitation, orbits, solar systems etc Not free (£19.49 in Steam) |
| <i>Aladin</i> | Virtual Observatory (VO). Photo images; many catalogues. |
| <i>Celestia</i> | 3D Viewer. Not updated since 2011, but new version may be on the way. |
| <i>Digital Universe</i> | |
| <i>Google Sky</i> | |
| <i>Redshift</i> | |
| <i>Starry Night</i> | |

4.1.2 Apple

Sky Safari
Star Walk
NASA App
Solar System
Celestia

4.1.3 Android

Star Walk 2
Star Chart
Sky Map
Solar Walk
Stellarium Mobile
ISS Tracker
Heavens Above

Some apps (e.g. Sky Map) benefit from a gyroscope sensor, if your device has one. AM: My current Android phone (Motorola MOTOG3) does not have this sensor, so Sky Map can't show me what I am pointing it at.

4.2 Websites

It would be silly to try to provide anything beyond a short 'favourites' list here. Modern search engines should allow you to find useful information on almost any astronomical topic of interest.

Here are a few examples:

General

www.heavens-above.com

www.skyandtelescope.com

Astronomical Images

<https://apod.nasa.gov/apod/archivepix.html>

<http://hubblesite.org/images/gallery>

<https://www.eso.org/public/>

Astronomy News

<http://www.astronomy.com/>

https://www.sciencedaily.com/news/space_time/astronomy/

<https://www.universetoday.com/>

Observatories

www.nrao.edu

www.eso.org

<http://www.jodrellbank.manchester.ac.uk/>

Spacecraft

www.space.com

<https://www.nasa.gov/>

<https://www.esa.int/ESA>

Eclipses

<https://eclipse.gsfc.nasa.gov/eclipse.html>

Equipment

<https://stargazerslounge.com>

4.3 Distributed Programmes

These are sometimes described as 'Public Volunteer Computing Projects'.

'SETI@home' is the best-known and largest 'distributed computing' project; its objective is to search for signs of 'Extraterrestrial Intelligence' in radio signals received at the Arecibo Radio Telescope. Many users have installed the client on their PC or other computer. The client downloads data from a central server, processes it, and uploads the results back to the server. Users are 'credited' in some sense according to the processing time they have contributed.

BOINC is a software library that was originally developed for the 'SETI@home' project. It has been enhanced to prevent 'cheating' by users who tried to obtain more 'credit' than they have actually earned.

It is now used for a variety of similar projects, known as 'volunteer', 'distributed', or 'grid' computing projects. The best known projects of this type are probably '[SETI@home](#)' and GIMP (Great Internet Mersenne Prime search – not to be confused with GIMP Image software). These are some projects with an astronomical flavour:

- | | |
|----------------------------------|---|
| - seti@home | Search for extraterrestrial life |
| - MilkyWay@home | Creating map of 'star streams' in MW from Sloan DSS data. |
| - Einstein@home | Pulsar search; has found 55 psrs; uses data from LIGO and Arecibo |
| - asteroids@home | Czech; studies of asteroids |
| - universe@home | Poland; cosmological studies. |
| - cosmology@home | Studying cosmological models |
| - stardust@home | Stardust mission – particles from Comet Wild |
| - theSkyNet | Australian – galaxy studies. Dormant ? |

To get an introduction to BOINC, and to see a list of these projects, search for BOINC and start with the Wikipedia entry.

- Using interactive web-based programmes e.g. Galaxy Zoo

From the website www.zooniverse.org

What is the Zooniverse?

The Zooniverse is the world's largest and most popular platform for people-powered research. This research is made possible by volunteers — hundreds of thousands of people around the world who come together to assist professional researchers. Our goal is to enable research that would not be possible, or practical, otherwise. Zooniverse research results in new discoveries, datasets useful to the wider research community, and many publications.

Typically you are presented with images of galaxies, and are asked to classify them by their appearance. You may be the first person to see any image of a particular galaxy, because the major images are made by an automated telescope system, and the galaxies themselves are located and extracted from the main image by software.

There are many other projects on Zooniverse, some of which are astronomical e.g. variable stars, galaxy clusters.

4.4 Software

There are various repositories on the web where free software can be found. Also some Linux distributions will include a selection of astro software. These tools and libraries will mostly be of interest to professional astronomers, but you might find something of interest, especially if you are using data from data repositories as shown in the next section.

'ascl.net/code/all' is a large catalogue of source code for many astronomical purposes; mainly of interest to professionals.

4.5 Data Repositories

Many actual scientific projects now make their data archives available, usually after a period of time when the scientists themselves have exclusive access.

These websites provide lists of such sites:

<http://tdc-www.harvard.edu/astro.data.html>

<https://ned.ipac.caltech.edu/Documents/References/Sites>

A brief sample of these data repositories might include these:

| | |
|------------|--------------------------|
| SDSS | Sloan Digital Sky Survey |
| Hubble | Deep sky imaging |
| Hipparchos | Astrometry |
| Gaia | |

For example, some amateurs download raw image data from Hubble and create their own composite images.

4.6 Telescope Control

Many modern telescopes (e.g. Meade or Celestron scopes 6" and upwards) have GoTo capability, and it may be possible to connect the scope to a laptop or PC, and control the telescope (and CCD camera) from there. Recent models may also include a WiFi capability, which means that you can install an App on a mobile phone and use it to control the scope.

GoTo means that the telescope is equipped with a catalogue of galaxies, nebulae etc, perhaps containing tens or thousands of objects, and once the telescope is aligned, you can select an item from the list and the telescope will align with the object, if it is above the horizon. If such a telescope is not housed in an observatory you will need to realign the positioning mechanism each time you set it up. This involves pointing the scope at three or more specific stars.

4.7 Digital Imaging

If your telescope is equipped with a CCD camera, or if you connect a conventional digital camera to your telescope, there are programmes designed to help with processing the image files when they are transferred to your device.

Registax is a programme which takes a 'set' of digital images and produces an optimised or enhanced final image. For example if your telescope/camera is pointing at Jupiter, many of your images may be affected by poor seeing. Registax searches through the images to 'pick out' the best parts so as to optimise the final image (this is my assumption – I have not used it...).

Photoshop

GIMP – This is a free programme available on Windows and Linux which has similar capabilities to PhotoShop.

4.8 Remote Telescopes

This is the concept of telescopes around the world which are made available remotely for public use. Generally you create an account and then you can submit an observation request, and receive images or data in return.

For an introduction try

<https://www.awesomeastronomy.com/component/tags/tag/remote-telescopes>

This article refers to these telescopes:

<http://www.telescope.org/login.php>

<https://www.itelescope.net/>

<https://deepskywest.com>

<https://www.sierra-remote.com>