Name:

Home TA:

Lab #4

Citizen Science: Planet 9

Introduction

This lab is the first of several "Citizen Science" labs we will do together this semester as part of the zooniverse.org project family. The concept of Citizen Science is that some Astronomical databases are so large and the data so complex that computer algorithms cannot accurately or reliably sort through all of the data to find the kinds of interesting things that astronomers are looking for.

For example, consider NASA's Wide-field Infrared Survey Explorer (WISE) mission: this is a space based telescope that surveyed the entire sky for the first time ever in the infrared part of the spectrum. As a result, we now have a catalog of infrared images of around 700 million astronomical objects. These objects could be asteroids, galaxies, planets, stars, nebulae, or any number of strange objects.

That's where scientific analysis comes in. We must examine the images closely along with other data (in this case, images of the same objects taken at different wavelengths by other surveys) in order to classify the objects we have found. What we are looking for specifically in this case are possible planets located at the edge of our solar system, out beyond the orbit of Neptune.

These kinds of objects are extremely difficult for automated programs to spot. Sure, a very smart computer program might be able to find some planets if you give it some basic guidelines of what to look for, but inevitably, some objects in the sky are outside of the boundaries of whatever definition you provide to your computer algorithm. The human eye, it turns out, is far better at basic pattern recognition that any computer algorithm, and so astronomers have turned to crowdsourcing to find potential planets buried in their immense ocean of data that computers have missed.

In this lab, you will be looking at pictures of many parts of the sky taken by the WISE telescope in two different parts of the spectrum. Both of the images are in the infrared part of the spectrum, at wavelengths of 3.4 and 4.6 microns (about 10 times larger than wavelengths of visible light). By comparing images of the same part of the sky taken at different wavelengths at different times, you may be able to spot something faint moving in the background that will turn out to be a historic discovery of a new planet!

The Zooniverse site does not expect you to be perfect. There are going to be some candidates you see that you are not sure how to classify, and so in some borderline cases, you will find yourself essentially guessing whether or not an object is a real candidate (or "mover"), and you may guess wrong. That's okay. Zooniverse is going to be showing the same objects to dozens of other people as well, hoping to use crowdsourcing to achieve some kind of consensus on which objects are the most likely candidates. Any object that a certain percentage of people say is a good candidate will then be followed up. So you don't have to be perfect, but your best effort is most appreciated.

Before you classify anything, you will be asked to create a login to the Zooniverse site. Please write down your username and password somewhere safe, because you will likely be using the same account for other Citizen Science labs later this semester. If you discover a good candidate, and follow-up confirms and discovers something interesting, then <u>you will get credit for assisting in the discovery</u> of this new, previously unknown object when the scientific papers are published.

<u>Step 1</u>

First, go to backyardworlds.org, which is a part of the Zooniverse family of web sites. Create a login and password that will work for all of the Zooniverse websites. Before you start classifying, you will read through some introductory material so that you better understand what you are looking at, and you will answer the associated questions below.

At the top of the page on backyardworlds.org is a menu bar. Click on the “About” page. Read through this initial information and watch the four-minute introductory video (I recommend viewing the video at high resolution and full screen), then answer the following:

From the video, describe what is WISE0855 and how was it discovered?

When comparing images taken five years apart, some objects appear as “dipoles” and some as “movers”. Explain the difference between these two objects.

Step 2

Now click on “Classify” and read the tutorial that pops up so that you can learn what all of the controls are when examining an image.

Next, examine the field guide in the tab to the right side of the screen. Answer the following questions as you click on each possible object from the field guide.

From the field guide, briefly describe three types of artifacts that you should not mark during your explorations.

Finally, locate the FAQ using the link in the classify page or on one of the menu bars. From the FAQ, answer the following:

Explain what are the numbers shown on the left side and bottom side of the flip book images?

From the FAQ, about how many classifications should you be doing before you find a high proper motion object?

What does SIMBAD stand for, and how is it useful for this project?

Further down in the FAQ, under the big heading “General Astronomy Questions”, answer the following:

Explain what will determine the color of planet 9 (either red or blue) if it were to appear in our data.

What’s the difference between M, L, T and Y dwarf stars?

What are the four closest neighbors to the Sun?

Step 3

Ok, now we are ready to classify, so click on classify and re-read the tutorial so you know what you are looking for. You can do this part with a partner if you like. We need you to complete 60 classifications. Once you have completed 60 classifications, alert your TA, who will initial in the space below to indicate that you have successfully completed the last part of the lab. When you click on the menu button, you will be able to see how many classifications you have completed. If you are having trouble finding this information, your TA can help you.

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There will be no concluding essays for Citizen Science labs, in order to make sure you have plenty of time to actually participate in the scientific project.