Galaxy Zoo and Beyond: Citizen Science through Analysis of Existing Databases

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“Data avalanche” in all areas of science

Doubling time of science data is one year (Szalay & Gray 2001)

• Some scientific problems can be solved only by humans
• Lots of data, very few astronomers
Problem: Kevin’s Sanity (2007)

- Kevin Schawinski (Oxford astronomy grad student)
- His advisor asked him to classify 50,000 galaxies… by Friday
- He complained to a friend in a pub
- But there are 850,000 more!
Solution: Galaxy Zoo
Galaxy Classification

Galaxy Ref: 587742615100588313

Choose the Galaxy Profile by clicking the buttons below:

- SPIRAL GALAXY
- ELLIPTICAL GALAXY
- STAR
- MERGERS
- CLOCK
- ANTI
- EDGE ON
- UNCLEAR

Citizen Science Alliance

Johns Hopkins University
Galaxy Zoo: week one

- June 19, 2007: spot on BBC morning radio, website
- Traffic melted web server
- 50,000 galaxies = 1 “Kevin-week”
Website Clicks -> Dataset

- About 40 classifications per galaxy
- Are the classifications reliable?
  - Inter-rater reliability, with 40 raters
  - Spot-checking against classifications by professionals (including Kevin)
A Searchable Dataset

900,000 galaxies classified
"Probably spirals"

265,000 galaxies to 80% consensus
“Almost certainly spirals”

<table>
<thead>
<tr>
<th>J222114.45+130620.3</th>
<th>J110927.44+151648.7</th>
<th>J131629.79+250854.4</th>
<th>J104132.47+172358</th>
<th>J081115.84+491301.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>J093639.19+011501.2</td>
<td>J104455.79+310335.4</td>
<td>J142213.94+172350.3</td>
<td>J144414.75+224451.8</td>
<td>J090102.43+231324.5</td>
</tr>
<tr>
<td>J140058.89+160028.5</td>
<td>J124559.75+584704.1</td>
<td>J000908.62+145659.2</td>
<td>J133008.03+485335.7</td>
<td>J155631.55+060253.3</td>
</tr>
</tbody>
</table>

42,000 galaxies to 95% consensus
“We have no idea”

165,000 galaxies to less than 50% consensus
Galaxy Zoo science

- 18 peer-reviewed publications by our team and counting…
- 91 papers with “Galaxy Zoo” in title or abstract

Galaxy Zoo: The large-scale distribution of spiral galaxy spins *


Galaxy Zoo: Morphologies derived from visual inspection of galaxies from the Sloan Digital Sky Survey *
Galaxy Zoo Forum

- Original goal: cope with E-mail volume by letting volunteers answer each others’ questions
- Evolved into place to talk science
- Led to independent group investigations
Deeper engagement: peas

“Give peas a chance” (joke)

Spectral analysis using online tools:

Re: Give peas a chance!

Quote from: zookeeperKevin on December 14, 2007, 01:32:19 PM

I wonder if the "pea selection" yields a sample of interesting objects....

I don't know if 85 [OIII] ELGs is of interest to anyone......14 aren't catalogued.

A telescope in Spain called CADIS has done a lot of Emission Line Galaxy surveys.

http://www.mpa-hd.mpg.de/CADIS/

In this article in mentions oxygen-rich OIII galaxies at around the same distance as...
Deeper engagement: peas

• Volunteers’ work led to published paper
The Volunteers

The Zooniverse Community

424,305 people just like you...

Name: Michael Joseph Halm
Age: 62
Occupation: Amateur astronomer
Joined Zooniverse: December 2007
Michael’s Zooniverse: “I like working in astronomy, exploring the universe with fellow explorers - and without all the number-crunching I had to deal with in theoretical astrophysics, before I dropped out.”

Michael

I'd like to be featured here too!
Age and gender (n=10,708)
Motivations to Volunteer

- Interviews & posts coded into themes (3 raters)
- Twelve categories of motivation
- Follow-up survey

<table>
<thead>
<tr>
<th>Category Name</th>
<th>Description (used in survey instrument)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribute</td>
<td>I am excited to contribute to original scientific research.</td>
</tr>
<tr>
<td>Learning</td>
<td>I find the site and forums helpful in learning about astronomy.</td>
</tr>
<tr>
<td>Discovery</td>
<td>I can look at galaxies that few people have seen before.</td>
</tr>
<tr>
<td>Community</td>
<td>I can meet other people with similar interests.</td>
</tr>
<tr>
<td>Teaching</td>
<td>I find Galaxy Zoo to be a useful resource for teaching other people.</td>
</tr>
<tr>
<td>Beauty</td>
<td>I enjoy looking at the beautiful galaxy images.</td>
</tr>
<tr>
<td>Fun</td>
<td>I had a lot of fun categorizing the galaxies.</td>
</tr>
<tr>
<td>Vastness</td>
<td>I am amazed by the vast scale of the universe.</td>
</tr>
<tr>
<td>Helping</td>
<td>I am happy to help.</td>
</tr>
<tr>
<td>Zoo</td>
<td>I am interested in the Galaxy Zoo project.</td>
</tr>
<tr>
<td>Astronomy</td>
<td>I am interested in astronomy.</td>
</tr>
<tr>
<td>Science</td>
<td>I am interested in science.</td>
</tr>
</tbody>
</table>
Motivation Data (n=10,532)

- Likert Scale (1-7) for each motivation
- “Which of the reasons is MOST important?”
- 40%: “I am excited to contribute to original scientific research.”
OldWeather.com

- Historical temperature data for climate change
“Zooniverse” platform

- Zooniverse.org
- Internet destination for citizen scientists
- Many projects accessible
  - Volunteers move from one to another
- Technological platform to develop projects
The big dream for science

- Citizen science should be a standard tool in scientists’ toolkit
- Analogy: Zooniverse as observatory
  - Scientists can apply for time with volunteers
  - If board approves an idea, we develop interface and promote project to our volunteers
The big dream for volunteers

- Participating in science should be as common as participation in sports today
- **Difference:** citizen science adds to goals of professional science
- **Difference:** everybody wins
Future Research

1) What motivates volunteers to come back, and to engage more deeply?
2) How do features of data (e.g. beauty) and task (e.g. challenge) affect motivation?
3) What can volunteers learn about science content and nature of science?
4) What can we apply from outside our field (social media, game design…)?
Acknowledgements

400,000 Zooniverse volunteers, including…

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• Helen Buckley
• Brian Gray

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