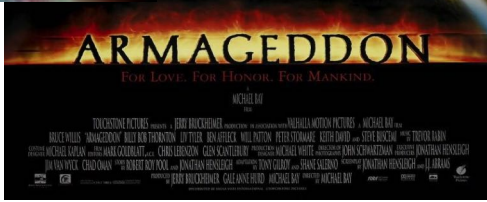
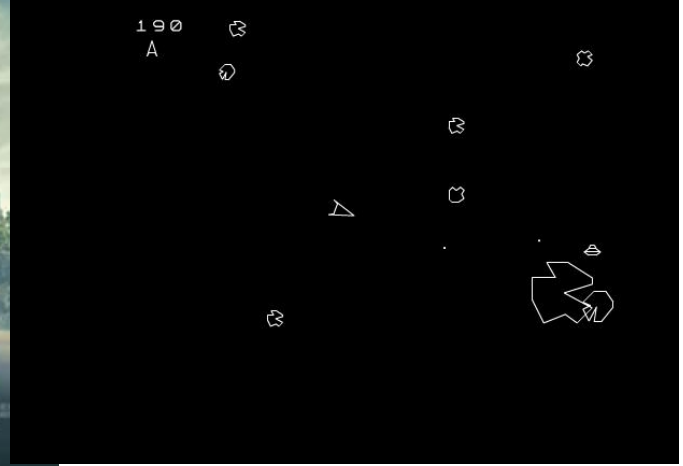
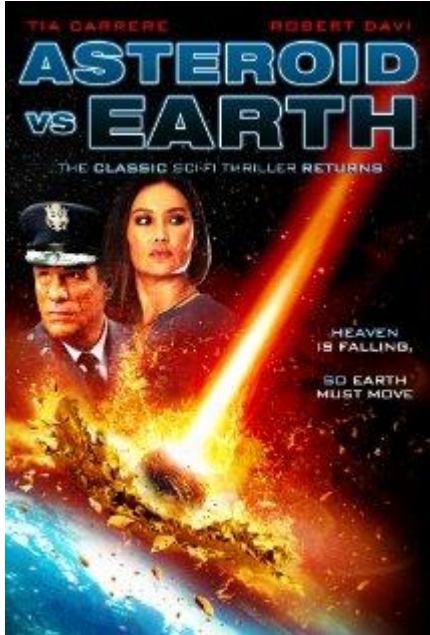




# NASA Asteroid Detection

Joshua Ra'anan

# Death by Asteroids?



Once upon a time, 65 million years ago...



The dinosaurs were wiped out by  
a giant asteroid.

# Chelyabinsk Meteor

- February 15 2013 at 0920 a meteor traveling at > 40,000 mph struck the southern Ural region of Russia
- The impact was equivalent to 500 kilotons of TNT
- The object was undetected before it entered Earth's atmosphere



# How many asteroids can there be?

- As of April 24, 2016, 14221 Near-Earth objects have been discovered. Some 875 of these NEOs are asteroids with a diameter of approximately 1 kilometer or larger. Also, 1690 of these NEOs have been classified as Potentially Hazardous Asteroids (PHAs).
- The belt is estimated to contain between 1.1 and 1.9 million asteroids larger than 1 kilometer (0.6 mile) in diameter, and millions of smaller ones.



# How likely is an asteroid impact

<http://neo.jpl.nasa.gov/risks/>

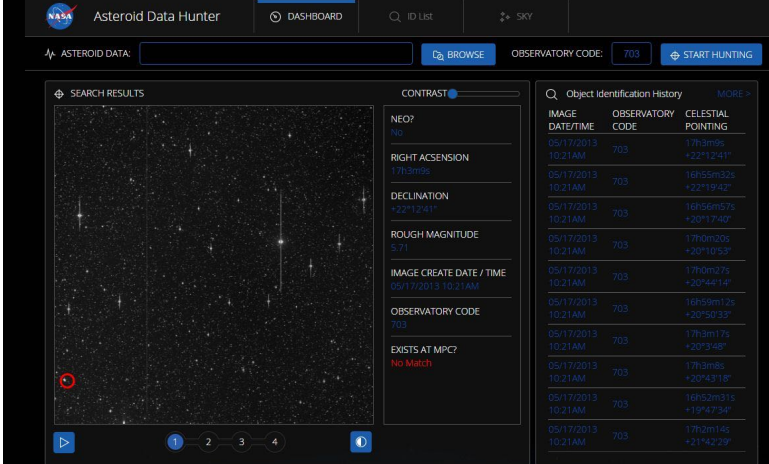


NEVER TELL ME THE ODDS

# About the Application

The application is capable of running on a common laptop/desktop. Algorithms like these will be used on future spacecraft to identify asteroids to maximize the capability of missions in the future.

This new method is approximately 15% better than the current method of identifying asteroids in the main belt (Asteroids that orbit between Mars & Jupiter).



NASA Asteroid Data Hunter

DASHBOARD

Q ID List

SKY

ASTEROID DATA: [BROWSE] OBSERVATORY CODE: 703 [START HUNTING]

SEARCH RESULTS

CONTRAST

NEO?  
No

RIGHT ASCENSION  
17h30m5s

DECLINATION  
+22°19'41"

ROUGH MAGNITUDE  
5.21

IMAGE CREATE DATE / TIME  
05/17/2013 10:21 AM

OBSERVATORY CODE  
703

EXISTS AT MPC?  
No Match

Object Identification History

IMAGE DATE/TIME	OBSERVATORY CODE	CELESTIAL POINTING
05/17/2013 10:21 AM	703	17h30m5s +22°19'41"
05/17/2013 10:21 AM	703	16h35m03s +22°19'42"
05/17/2013 10:21 AM	703	16h35m07s +20°17'40"
05/17/2013 10:21 AM	703	17h00m20s +20°10'53"
05/17/2013 10:21 AM	703	17h00m27s +20°44'14"
05/17/2013 10:21 AM	703	16h35m01s +20°50'33"
05/17/2013 10:21 AM	703	17h30m17s +20°3'48"
05/17/2013 10:21 AM	703	17h30m5s +20°43'18"
05/17/2013 10:21 AM	703	16h32m03s +19°47'36"
05/17/2013 10:21 AM	703	17h20m16s +21°42'29"

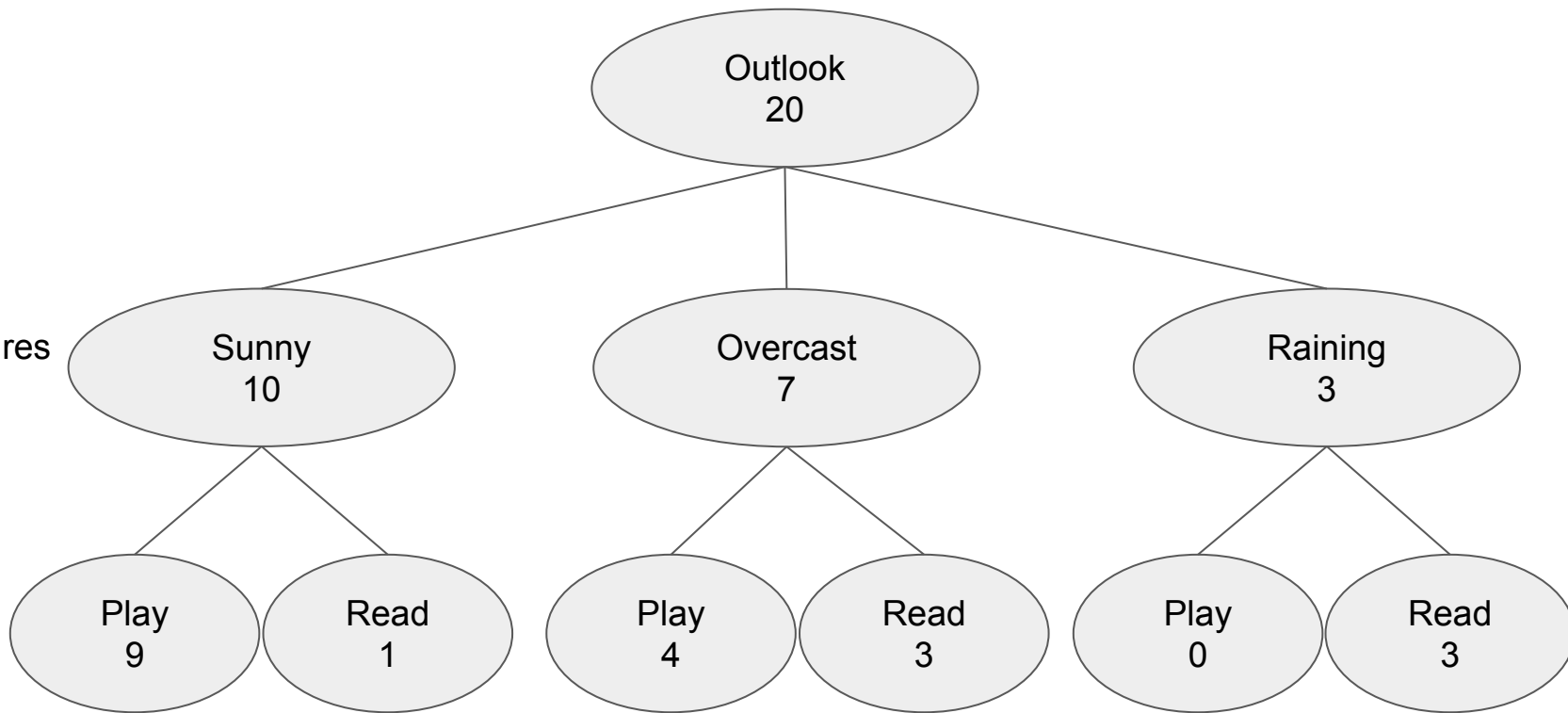
# Sample Algorithm

- 1) Use image diffing to detect changes between each of the 4 images vs their common signal. The changes are “blobs” of pixels in each of the diff images.
- 2) Examine blobs to find similar ones in linear motion between the 4 images and call these Candidate Asteroids (CA's).
- 3) Compute features on CA's.
- 4) Train the following RF classifiers on the CA's features: the probability of being an asteroid, the probability of being a NEO, the probability of being overlapped in the truth data.
- 5) Apply the classifiers and produce the results.



# Decision Tree

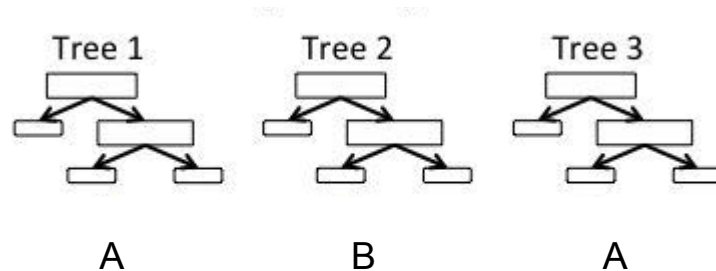
Features



# Random Forest

Bagging - To average noisy and unbiased models to create a model with low variance

Random forests use a modified tree learning algorithm that selects, a random subset of the features creating multiple decision trees.



# Asteroid Mining

- The Philae lander successfully landed on the Churyumov-Gerasimenko comet on November 12 2014
- These include gold, iridium, silver, osmium, palladium, platinum, rhenium, rhodium, ruthenium and tungsten for transport back to Earth; iron, cobalt, manganese, molybdenum, nickel, aluminium, and titanium for construction; water and oxygen to sustain astronauts; as well as hydrogen, ammonia, and oxygen for use as rocket propellant.



# Sources

[https://en.wikipedia.org/wiki/Chelyabinsk\\_meteor](https://en.wikipedia.org/wiki/Chelyabinsk_meteor)

[https://en.wikipedia.org/wiki/Asteroid\\_mining](https://en.wikipedia.org/wiki/Asteroid_mining)

<http://neo.jpl.nasa.gov/faq/>

<https://github.com/PlanetaryResources/NTL-Asteroid-Data-Hunter/tree/master/Algorithms>

<http://solarsystem.nasa.gov/planets/asteroids/indepth>

# Go find some asteroids!

<https://www.topcoder.com/asteroids/>

