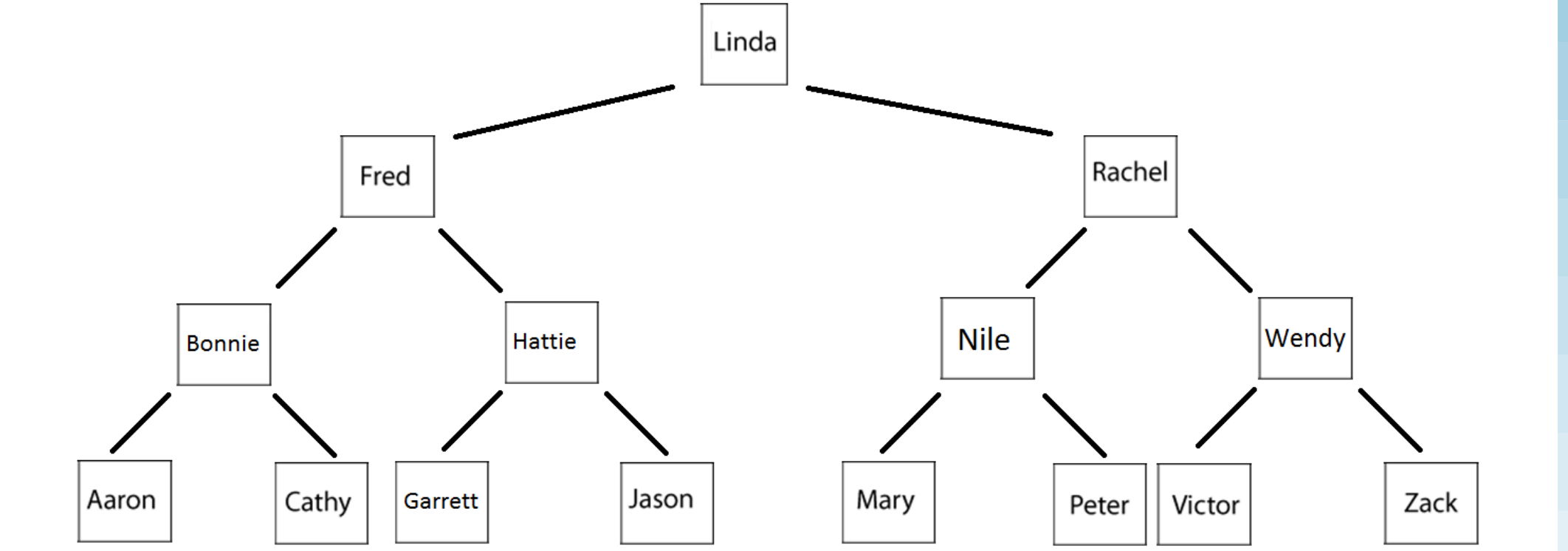


PHILOSOPHY

Qiyam and Alison work together to make mathematics more familiar to the students. The motivation is not to make students mathematicians or even computer scientists, but rather to impress upon them the beauty of logic, abstraction, and the science of data computation. Above all else, the goal is for them to respect the idea that no mathematical idea is inaccessible to them.

SEARCHING IN LOGARITHMIC TIME

From looking up webpages on Google to finding lost documents on a computer, searching is an important concept in computer science. It is therefore crucial for these searches to be fast. But what does it mean to be fast? Mathematics can give us a precise definition. Binary search is a search that takes *logarithmic* time. What this means is that if one is searching for a name out of n names, it would only take two $\log n$ checks to find the name.



WHAT IS MATH?

“If I could prove by logic that you would die in five minutes, I should be sorry you were going to die, but my sorrow would be very much mitigated by pleasure in the proof.”
 –G. H. Hardy

The excitement of mathematics is often lost in the mazes of tedious work and calculations. Students were presented with a broad view of mathematics by reading articles and watching videos about mathematics.

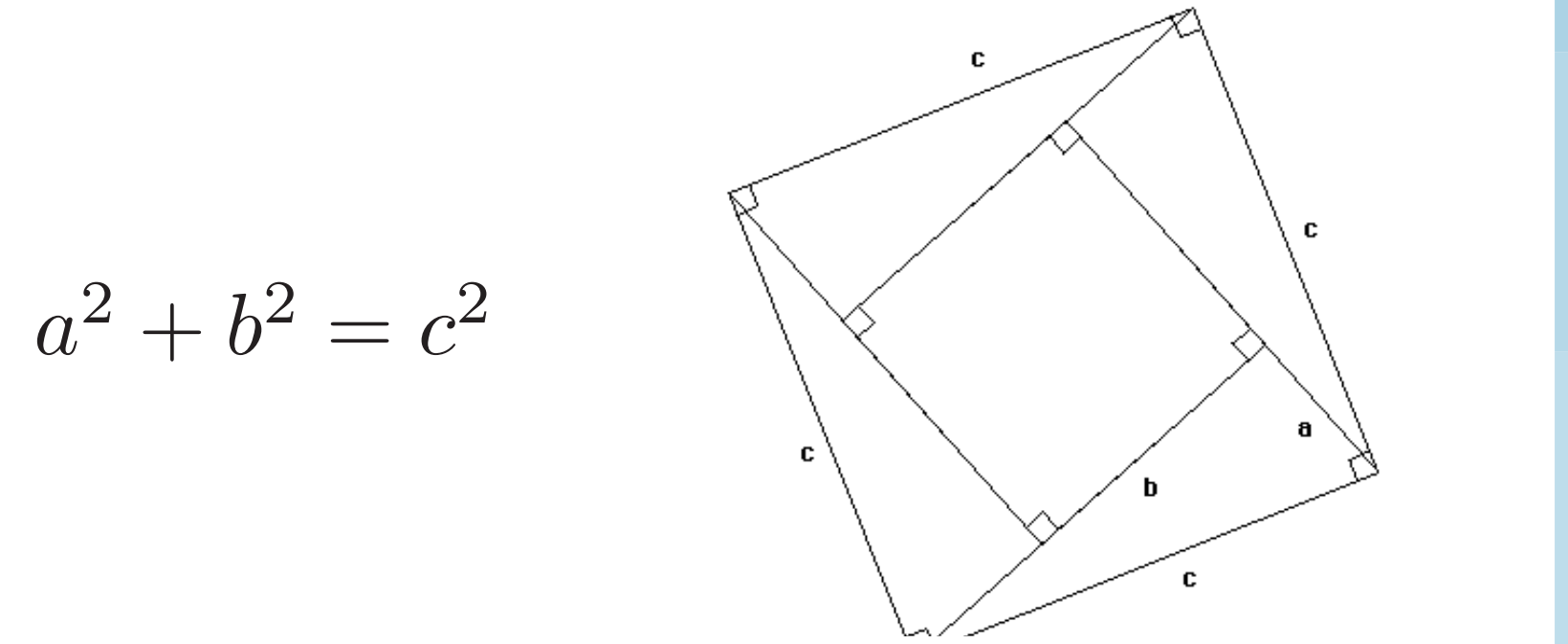
From understanding why mathematics describes the universe so well to the defense of studying the “impractical” number theory to fun mathematical doodles, students gain an appreciation of the diversity within mathematics.



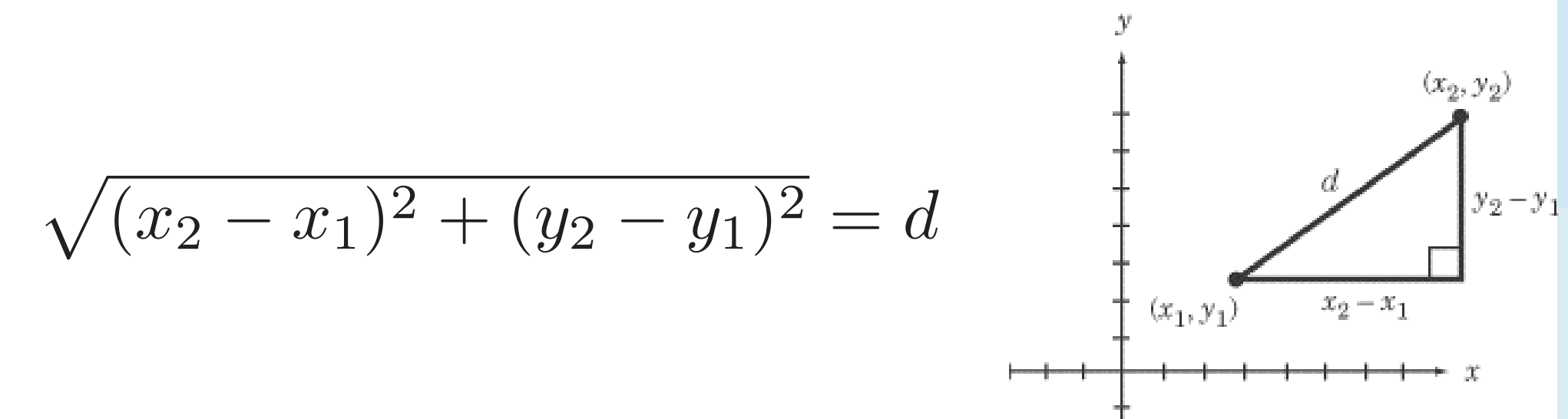
Photos from worldsciencefestival.com/, en.wikipedia.org, and nytimes.com.

MATHEMATICAL LITERACY

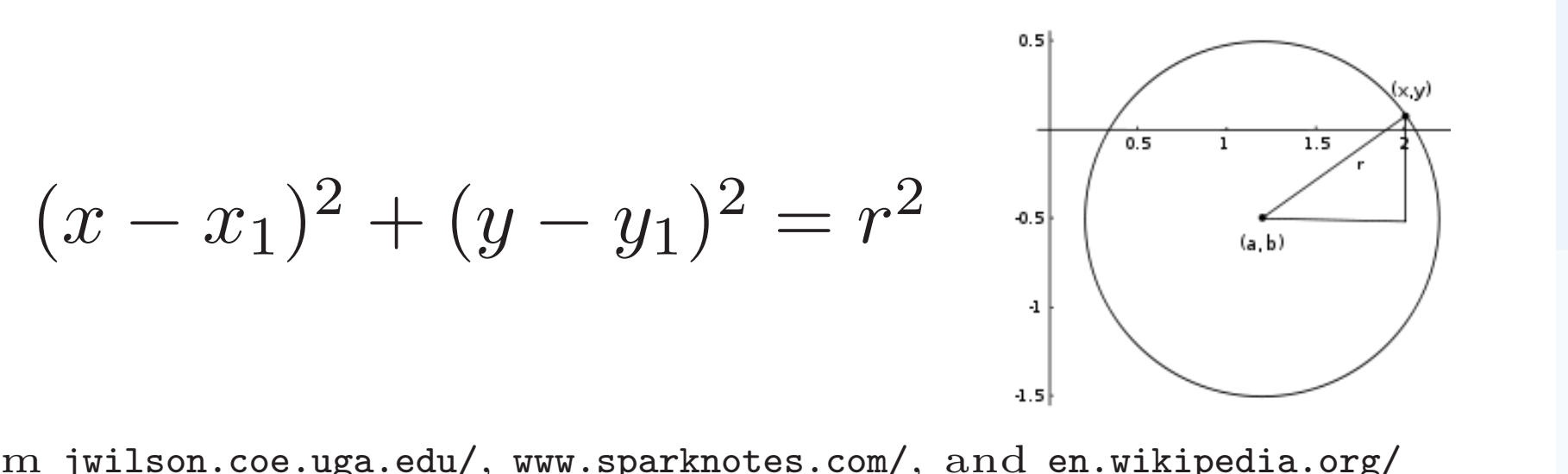
Why is the equation of a circle the way it is? By definition, a circle is the set of all points equidistant from a center (x_1, y_1) . In class, Alison and Qiyam showed how the mathematical definition of a circle can be derived from the Pythagorean Theorem.



Once proven, it can be shown that the distance formula follows.

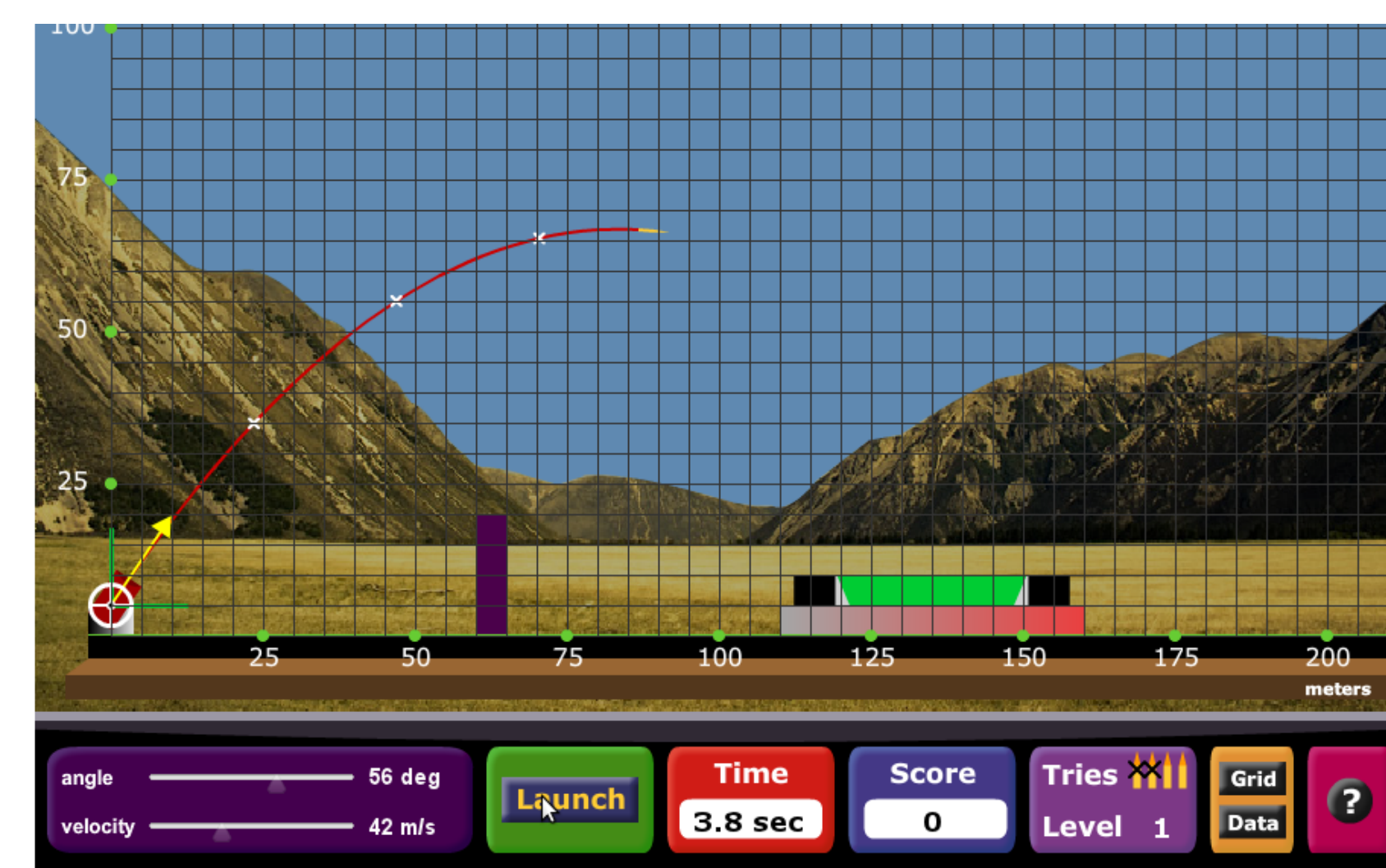


Finally, with a bit of rewriting, the equation of a circle is complete.



Images from jwilson.coe.uga.edu/, www.sparknotes.com/, and en.wikipedia.org/

PROJECTILES AND QUESTIONS



Projectile motion is a phenomenon that is well-suited for the Algebra and Pre-Calculus classes. The online game, ProjectTRIG from the *mathplayground.com*, is a fun way to relate to many mathematical ideas.

When the question is “at what time does the projectile land?” the parametric form is the best model to use.

$$y = -4.9t^2 + V_v t + H_0 \quad (1)$$

$$x = V_h t \quad (2)$$

But when the question is how to adjust the angle and initial velocity of the projectile so that it hits the target, the form that best suits the problem is

$$y = -4.9 \left(\frac{x}{V_h} \right)^2 + V_v x + H_0 \quad (3)$$

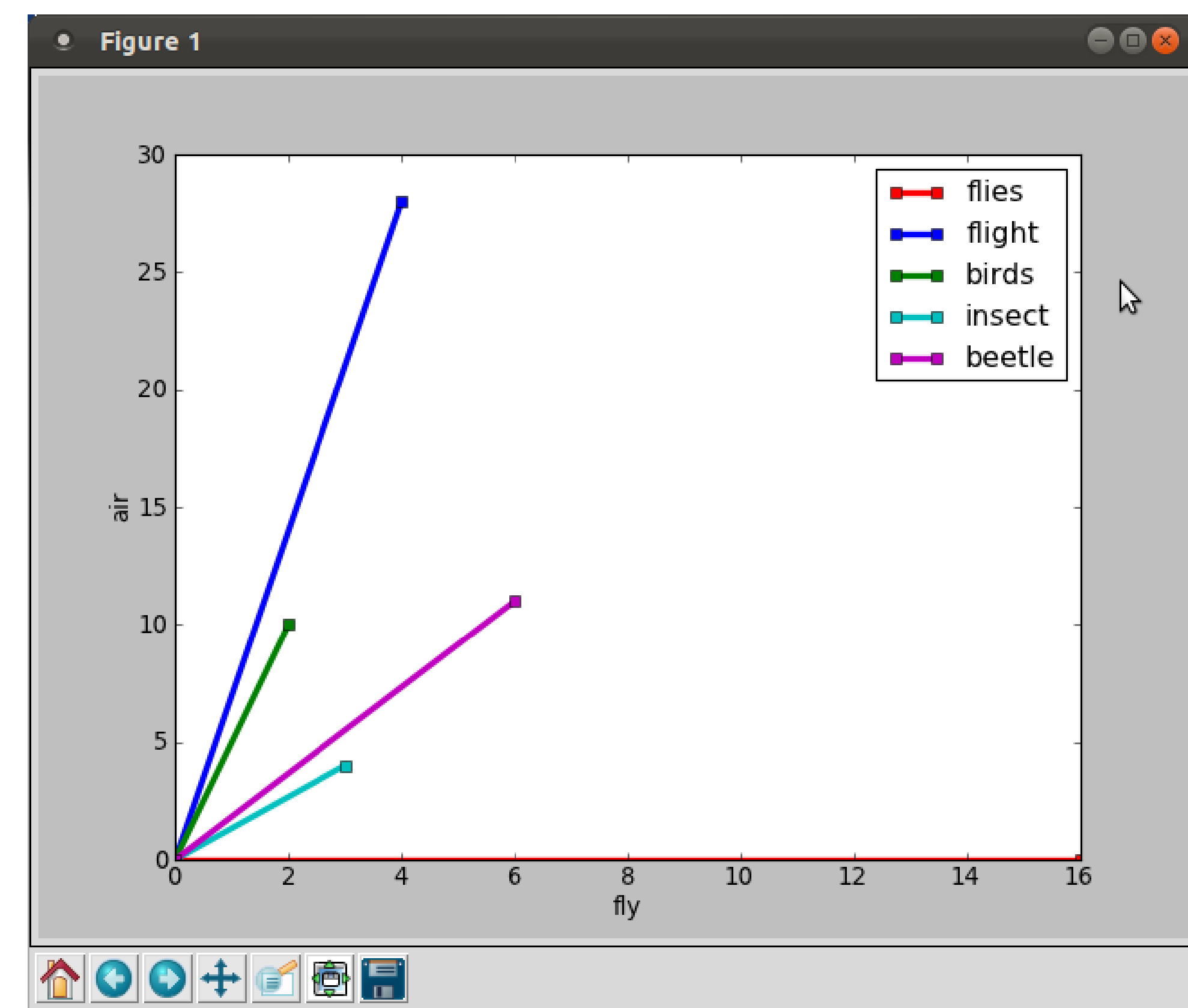
PREDICTING HOUSING PRICES

Predicting housing prices is difficult because not only is it dependent on many factors (neighborhood, size, age), but also because the data isn’t exact. Making the best prediciton is equivalent to finding the line (more generally, hyperplane) that best fits the data points. Though it may seem daunting, it is in fact a simple application of differential calculus.

DOCUMENTS AND VECTORS

How similar are two documents? This is a question that interests scientists who study natural language processing. One common way is transform an entire document into a space of term frequency.

For example, the Wikipedia article on birds may contain the word “fly” twice and the word “air” 15 times. This creates a vector in the space of the frequency of the words “fly” and “air”.



Once plotted, the documents manifest themselves as vectors and computing similarity is a matter of computing the angle between each vector (or the cosine of the angle).

$$similarity = \cos \theta = \frac{a \cdot b}{||a|| ||b||} \quad (4)$$

