Presentation notes

- Collatz Conjecture, Syracuse Problem, Hasse's Algorithm, Kakutani's Problem, Ulam's Problem
- function
  - *Collatz function $C(x)$*
  - $3x + 1$ function
- what is the conjecture
  - that natural numbers will eventually reach 1 or the one cycle
  - number theory – study of integers and integer valued functions
  - the mathematical way
  - is there a divergent trajectory?
  - negative numbers give you three different cycles: $-1, -5, -17$
  - are there other cycles?
- what other things we can define about the function
  - forward orbits
  - height $h(m)$
- has been verified up to $17 \times 2^{58} > 4.899 \times 10^{18}$, all go to 1
- history:
  - first published about in Klamkin 1963
  - Collatz said he started thinking about this in the 1930s, informally in a lecture by him in 1950 at the International Math. Congress in Cambridge Mass.
  - really took off with journals starting in 1970
  - continues on to this day
- examples of some sequences
  - a couple easy ones for the board
  - some to put into the presentation
- see how easy this is? But now prove it
  - several incomplete proofs
  - Yamada 1981 – mathematically faulty
  - Cadogan 2006 – incorrect indices in a function
  - Bruckman 2008 – would prove that the starting cycle at 1 does not exist
- what is interesting about it?
  - super simple yet not solved
  - maybe new areas of mathematics will be needed to prove this and thus advance mathematics as a whole
  - prime factorization and how it changes if you add 1
- one person wrote that it might be unverifiable
- references
  - Lagarias, J. C. (2011). The $3x + 1$ Problem: An Annotated Bibliograhpy (1963-1999)
  - Lagarias, J. C. (2012). The $3x + 1$ Problem: An Annotated Bibliograhpy, II (2000-2009)