

# MANY CHEERFUL FACTS

presents

## $\int e^{-x^2} dx$ and Friends

a talk by Matt Satriano

12:10 - 1:00pm on Wednesday, September 27th, in room 1015.

Have you ever told your Calculus students that  $\int e^{-x^2} dx$  has no closed form? In this talk we begin by defining what it means for a function to be “integrated in elementary terms”. Then using a theorem of Liouville that greatly restricts the possible elementary antiderivatives of a function, we will show that a function of the form  $f e^g$  has an elementary antiderivative if and only if a certain first-order linear differential equation has a rational polynomial solution. In particular, we will be able to deduce that  $e^{-x^2}$  cannot be integrated in elementary terms.

*I am the very model of a modern Major General,  
I've information vegetable, animal, and mineral,  
I know the kings of England, and I quote the fights historical  
From Marathon to Waterloo, in order categorical;  
I'm very well acquainted, too, with matters mathematical,  
I understand equations, both the simple and quadratical,  
About binomial theorem I'm teeming with a lot o' news,  
With many cheerful facts about the square of the hypotenuse!*

- Gilbert & Sullivan  $P \circ P$

The website for Many Cheerful Facts is  
<http://www.math.berkeley.edu/~siveson/cheerful/>