W4260: Problem Set #2
Due: Monday, September 27

Problem 1

Use (extended) Simpson’s rule to integrate the lookback time formula ($t_L(z)$) from problem set 1. Do this for a range of step sizes. Determine how the “error” decreases with decreasing step size – be quantitative and try to determine a relation between the “error” and the step size.

Repeat the same integral using the simple method from the first problem set. How does the error decrease in this case? There is a limit to how accurate a result you can obtain: why?

Problem 2

Integrate the function:

$$\int_0^\infty \frac{x dx}{e^x + 1}$$

You may use any method you choose (state clearly which method you use), but give an estimate of the error in your result. Also state any transformations applied.

Problem 3

Use a Monte-Carlo integration to evaluate the area enclosed by the unit circle (i.e. circle with radius $r$). Repeat for a variety of random values $N$. How does the error in the area decrease with increasing $N$?

To generate a random number from 0 to 1 in python, use:

```python
import random
x = random.random()
```

Note: When submitting solutions, please include (1) the program listing, (2) any input to the program, and (3) all program output. The output alone is not a valid solution. You may consult other students, but please write and run your program yourself. Also, if you do work with others, please indicate who you worked with. Solutions may be emailed to gb2141@columbia.edu (preferably as one email with attachments clearly marked); please be sure to include the course number and the problem set number in the subject (e.g. W4260 Problem Set 2). Thanks.