

Laboratory Assignment 3

Objectives

- More work with recursive functions
- Work with the `random` function

Activities

1. The following continued fraction provides an approximation for π :

$$\frac{4}{\pi} = 1 + \cfrac{1^2}{2 + \cfrac{3^2}{2 + \cfrac{5^2}{2 + \cfrac{7^2}{2 + \ddots}}}}$$

Note that the numerator of each continued fraction is the square of the next largest odd number. Also, for the base case, you can use 2 as the denominator in the fraction. For example, if the fraction with $\frac{7^2}{2 + \ddots}$ is the final fraction, you can ignore the diagonal dots (there are no recursive calls past this one). Therefore, the last fraction computed would be $\frac{7^2}{2}$. Write a Scheme function to compute this continued fraction. Your function should take one parameter, the number of continued fractions to compute recursively.

2. Another method of approximating π is achieved through the product of the following nested radicals:

$$\frac{2}{\pi} = \sqrt{\frac{1}{2}} \cdot \sqrt{\frac{1}{2} + \frac{1}{2}\sqrt{\frac{1}{2}}} \cdot \sqrt{\frac{1}{2} + \frac{1}{2}\sqrt{\frac{1}{2} + \frac{1}{2}\sqrt{\frac{1}{2}}}} \dots$$

Write a Scheme function which computes the product of these nested radicals for a given number of terms, k .

3. The game of *Craps* is a dice game in which the player rolls two dice. The player may win the game on the first roll by rolling a 7 or 11. Write a Scheme function that approximates the probability of winning at *Craps* on the first roll by simulating a large number of dice rolls. You will need to use the `random` function to simulate a randomly thrown die. The `random` function takes one integer argument k , and returns a random exact integer in the range 0 to $k-1$.

For example, to simulate the roll of one die:

```
(random 6)
```

will return an integer in the range 0 to 5. You can add one to obtain roll values in the range 1 to 6. To simulate the rolling of two dice, you will have to use `random` to simulate each die separately and compute the sum of their values.

Your function should take a formal parameter n indicating the number of rolls to simulate and return a decimal representing the percent of rolls won. What win percentage is your simulation approaching as n gets large?