calculate Pi

built-in

Notice: always check is there any built-in function first

```
% doc('num2str')
disp(num2str(pi, 15))
```

```
3.14159265358979
```

Liu Hui's method

Wiki: https://en.wikipedia.org/wiki/Liu_Hui%27s_%CF%80_algorithm

L_n: side length of n-polygons $2 - L_{2n}^2 = \sqrt{2 + 2 - L_n^2}$

h_n: height for each triangle in n-polygons $h_n = \sqrt{1 - L_n^2/4}$

S_n: area of n-polygons $S_n = \frac{1}{2} \mathrm{n} L_n h_n \approx \pi$

denote $x_n = 2 - L_n^2$

$x_6 = 1$

$x_{2n} = \sqrt{2 + x_n}$

$\pi \approx S_n = \frac{1}{4} n \sqrt{4 - x^2}$

```
x = 1;
for n = 6*2.^(1:10)
    x = sqrt(2+x);
    my_pi = n/4*sqrt(4-x^2);
    fprintf('n, my_pi = %10d,  %.15f\n', n, my_pi) %doc('fprintf')
end
```

```
n, my_pi =         12,  3.000000000000001
n, my_pi =         24,  3.105828541230247
n, my_pi =         48,  3.132628613281242
n, my_pi =         96,  3.139350203046893
n, my_pi =        192,  3.141031950890367
n, my_pi =        384,  3.141452472285344
n, my_pi =        768,  3.141557607912925
n, my_pi =       1536,  3.141583892159359
n, my_pi =       3072,  3.141590463278451
n, my_pi =       6144,  3.141592105876295
```

Buffon's Needle Problem (Monte Carlo Simulation)

Wiki: https://en.wikipedia.org/wiki/Buffon%27s_needle

TODO: add explaination

```
num1 = 1e5;
x1 = rand(1,num1);
theta = rand(1,num1)*2*pi;
tmp1 = x1+sin(theta);
my_pi = 2*num1/sum(tmp1<0 | tmp1>1);
disp(num2str(my_pi,15))
```

```
3.13150766436501
```

Series expansion

```
disp(num2str(my_pi,15))
```

Wiki: https://en.wikipedia.org/wiki/Leibniz_formula_for_%CF%80

TODO: add explaination

```
num1 = 1e4;
my_pi = 4*sum((2*(mod(1:num1,2)==1)-1)./(2*(1:num1)-1));
```

```
3.14149265359003
```