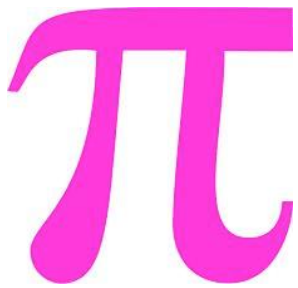
Finding

Lecturer: John Guttag

Finding



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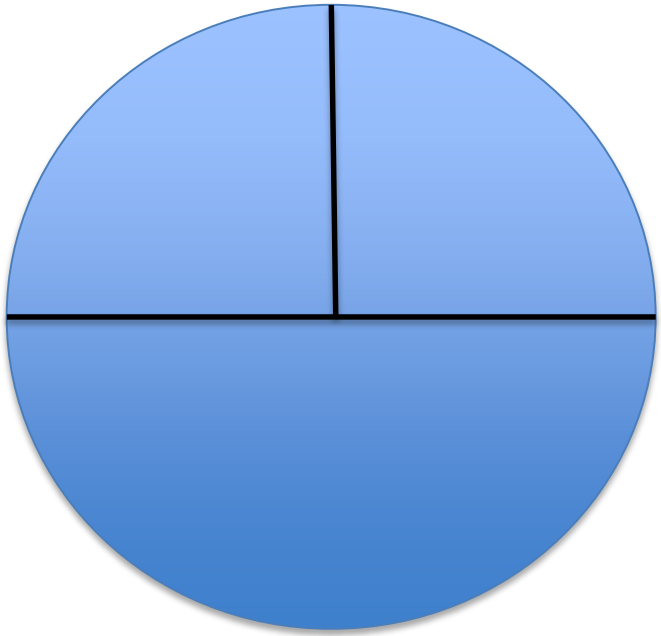


$$\frac{circumference}{diameter} = \mathrm{P} \qquad area = \mathrm{P} * radius^2$$

Rhind Papyrus

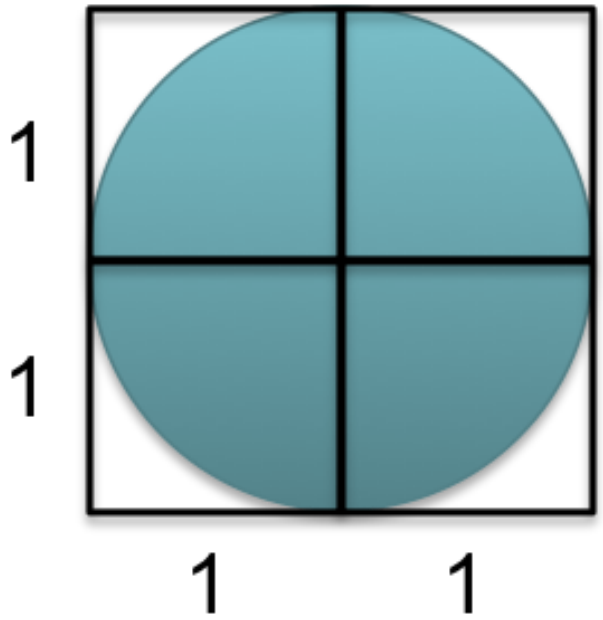
The Bible

"And he made a molten sea, ten cubits from the one brim to the other: it was round all about, and his height was five cubits: and a line of thirty cubits did compass it round about."

—1 Kings 7.23

Archimedes


Archimedes Syracusanus mathematicus ingenio maximus
ΑΡΧΙΜΗΔ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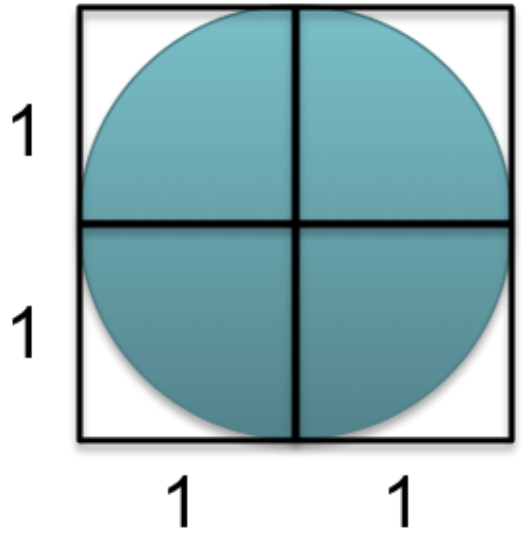
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```
def throwNeedles(numNeedles):
    inCircle = 0
    for Needles in xrange(1, numNeedles + 1, 1):
        x = random.random()
        y = random.random()
        if (x*x + y*y)**0.5 <= 1.0:
            inCircle += 1
    return 4*(inCircle/float(numNeedles))
```

```
def getEst(numNeedles, numTrials):
    estimates = []
    for t in range(numTrials):
        piGuess = throwNeedles(numNeedles)
        estimates.append(piGuess)
    sDev = stdDev(estimates)
    curEst = sum(estimates)/len(estimates)
    print 'Est. = ' + str(curEst) +\
          ', Std. dev. = ' + str(round(sDev, 6))\
          + ', Needles = ' + str(numNeedles)
    return (curEst, sDev)
```

```
def estPi(precision, numTrials):
    numNeedles = 1000
    sDev = precision
    while sDev >= precision/2.0:
        curEst, sDev = getEst(numNeedles, numTrials)
        numNeedles *= 2
    return curEst
```

```
Est. = 3.14844, Std. dev. = 0.047886, Needles = 1000
Est. = 3.13918, Std. dev. = 0.035495, Needles = 2000
Est. = 3.14108, Std. dev. = 0.02713, Needles = 4000
Est. = 3.141435, Std. dev. = 0.016805, Needles = 8000
Est. = 3.141355, Std. dev. = 0.0137, Needles = 16000
Est. = 3.14131375, Std. dev. = 0.008476, Needles = 32000
Est. = 3.141171875, Std. dev. = 0.007028, Needles = 64000
Est. = 3.1415896875, Std. dev. = 0.004035, Needles = 128000
Est. = 3.14174140625, Std. dev. = 0.003536, Needles = 256000
Est. = 3.14155671875, Std. dev. = 0.002101, Needles = 512000
```

The Right Ballpark