Introduction to Computer Programming
Section 8
Lecture 15
Turtle Graphics
What is $\pi$?

Area $= \pi r^2$

If the radius is 1, then

Area $= \pi$
What is $\pi$?

To find the value of $\pi$, we need to find the area of a circle with radius 1.

Problem: How do you find the area of a circle without knowing the value of $\pi$?

Answer: Throw lots of darts at a dartboard.
The area of the circle is a percent of the area of the square
Area of square == 4
Monte Carlo Simulation

Hit --- paint blue
Miss --- paint red
Monte Carlo Simulation

\[
\text{Area} = 4 \left( \frac{\text{Blue Darts}}{\text{Total Darts}} \right)
\]
Roadmap

• Turtle graphics basics
• How to draw lines, polygons
• How to use color
• How to draw circles
• How to draw a dart board
• How to throw darts
• How to detect hits and misses
Turtle Graphics References

• IDLE documentation (turtle module)

How to Think Like a Computer Scientist: Learning with Python 3 (available free on-line)
Version date: November 2011
by Peter Wentworth, Jeffrey Elkner, Allen B. Downey, and Chris Meyers
openbookproject.net/thinkcs/python/english3e/
Turtle Graphics

• A turtle is a graphics programming tool the you can control

• Moves on a canvas:
  – Forward
  – Backward
  – Left
  – Right
Turtle Attributes

• Position
  – coordinates of the turtle on the canvas

• Heading
  – The direction the turtle is facing (in degrees)

• Color
  – The color of the turtle

• Tail position
  – The tail can be up or down
<table>
<thead>
<tr>
<th>Name</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>forward</td>
<td>Distance</td>
<td>Moves the turtle forward</td>
</tr>
<tr>
<td>backward</td>
<td>Distance</td>
<td>Moves the turtle backward</td>
</tr>
<tr>
<td>right</td>
<td>Angle</td>
<td>Turns the turtle clockwise</td>
</tr>
<tr>
<td>left</td>
<td>Angle</td>
<td>Turns the turtle counter-clockwise</td>
</tr>
<tr>
<td>up</td>
<td>None</td>
<td>Picks up the turtle’s tail</td>
</tr>
<tr>
<td>down</td>
<td>None</td>
<td>Puts down the turtle’s tail</td>
</tr>
<tr>
<td>pencolor</td>
<td>Color name</td>
<td>Changes the color of the tail</td>
</tr>
<tr>
<td>fillcolor</td>
<td>Color name</td>
<td>Changes the fill color</td>
</tr>
<tr>
<td>color</td>
<td>Color name</td>
<td>Changes the tail and fill color</td>
</tr>
<tr>
<td>position</td>
<td>None</td>
<td>Returns the current position</td>
</tr>
<tr>
<td>goto</td>
<td>x, y</td>
<td>Moves the turtle to position x, y</td>
</tr>
<tr>
<td>begin_fill</td>
<td>None</td>
<td>Remembers starting point</td>
</tr>
<tr>
<td>end_fill</td>
<td>None</td>
<td>Fills the closed polygon</td>
</tr>
<tr>
<td>reset</td>
<td>None</td>
<td>Clears the canvas</td>
</tr>
</tbody>
</table>
turtle.pencolor("red")
turtle.fillcolor("blue")

Colors available:

www.tcl.tk/man/tcl8.4/TkCmd/colors.htm

turtle.pencolor(.3, .5, 1.0) # red, green, blue