**Fundamentals** *init* creates a nested stack that is required for drawing. *draw* executes the stack.

The pen is started in default down position. penup and pendown change the pen status.

Black is the default color of the pen. It can be changed with the *pencolor* command. *Note – colors need to be defined – see Appendix 1.* 

Coordinates are given in the cartesian convention (x,y), with +x left to right, and +y down to up. Default coordinates are (0,0), the upper left of the user screen (IV Quadrant).

The pen is moved using either *moveto* (dict x y -- dict) or *moverel* (dict x y -- dict). Each word takes x y coordinates and moves the pen either to an absolute position (moveto) or relatively from where the current pen position is (moverel). The numbers are pixel lengths.

The orientation of the imagined turtle is changed by turnto (dict r -- dict) or turn (dict r -- dict). Each word takes a radian measure and turns the orientation either to an absolute angle (turnto) or relatively from where the current angle is (turn). The numbers are assumed radian degrees. The default orientation is 0, which points directly East. Note: to provide an angle in degrees, use rad ( d -- r ) to convert from degrees to radians.

#### **Drawing**

To explore drawing in mjoy, start wth the following methods:

```
.s == stack reverse print This allows inspecting the stack without changing it.
cs == start ; Clears the drawing screen.
go == penup 100 -100 moveto pendown 0 turnto Positions the pen ready to draw
```

#### There are two ways to draw in mjoy:

- 1) Specify coordinates (this is a connect-the-dots metaphor)
- 2) Control the rotation and forward movement of an imaginary turtle with pen attached (this is the follow-your-nose metaphor)

## Example 1 – Triangle by specifying coordinates

```
triangle == 25 20 moverel 25 -20 moverel -50 0 moverel init go triangle draw
```

# **Example 2 – Triangle by controlling Turtle**

```
t-leg == 50 \text{ move } 120 \text{ rad turn}

t2 == 3 \text{ [t-leg] times}
```

## Example 3 – Home & Church – an example program

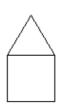
```
go == penup 100 -100 moveto pendown 0 turnto
go2 == penup 200 -100 moveto pendown 0 turnto

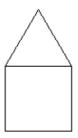
t-leg == 50 move 120 rad turn
triangle == 3 [t-leg] times
square-leg == 50 move 90 rad turn
square == 4 [square-leg] times
home == triangle -90 rad turn square

xtriangle == 3 [70 move 120 rad turn] times
xsquare == 4 [70 move 90 rad turn] times
church == xtriangle -90 rad turn xsquare

init go home go2 church draw
```







go == penup 100 -100 moveto pendown 0 turnto go2 == penup 200 -100 moveto pendown 0 turnto

t-leg == 50 move 120 rad turn triangle == 3 [t-leg] times square-leg == 50 move 90 rad turn square == 4 [square-leg] times home == triangle -90 rad turn square

xtriangle == 3 [70 move 120 rad turn] times xsquare == 4 [70 move 90 rad turn] times church == xtriangle -90 rad turn xsquare

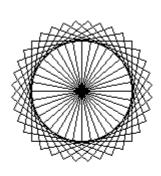
init go home go2 church draw

#### **Example 4 – Mathematical Drawing - Squaring the Circle**

This simple three line program draws a pattern that may be familiar:

square == 4 [50 move 90 rad turn] times
pivot == 10 rad turn
init go 36 [square pivot] times draw

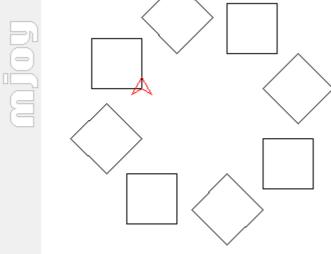




square == 4 [50 move 90 rad turn] times pivot == 10 rad turn init go 36 [square pivot] times draw

## Example 5 - An interactive turtle-logo in mjoy

```
red == 255
go == penup 100 -100 moveto pendown 90 rad turnto
square == 4 [50 move 90 rad turn] times
spin == -45 rad turn penup 50 move pendown
turtle == 1 pensize red pencolor 120 rad turn 12 move 210 rad turn 20
      move -120 rad turn 20 move 210 rad turn 11 move
; == dup dup ' pen dictget [turtle] [] if draw
cs == start ;
( ** Demo Program ** )
     (clearscreen)
go;
square ;
spin ;
square ;
spin ;
6 [square spin] times ;
```



## **Authors:**

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+ some changes from fpstefan.de

## Appendix 1. Color codes

It is recommended to put these definitions into your core.txt file.

```
black == 0
red == 255
white == 16777215
blue == 16711680
green == 32768
yellow == 65535
brown == 128
darkgray == 8421504
maroon == brown
darkgrey == darkgray
aqua == 16776960
fuchsia == 16711935
gray == 8421504
grey == gray
lime == 65280
lightgray == 12632256
navy == 8388608
olive == 32896
purple == 8388736
silver == 12632256
teal == 8421376
gold == 55295
orange == 42495
```

Reference: http://www.rapidtables.com/web/color/RGB Color.htm