Chapter 1 Introduction to J and Graphics

In this chapter we gain a basic understanding of both object based and pixel based graphics. Object based graphics describe a scene in terms of polygons, circles and other geometric objects. Raster images are represented by an array of pixels (picture elements) and the image is described by giving the color of each pixel. We will also develop enough understanding of J to facilitate these preliminary graphics explorations.

1.1 Some Arithmetic with J

Many common J functions consist of a plain ASCII character.

```
   3+8
11
```
plus

```
   3-8
_5
```
minus

```
   3*8
24
```
times

```
   3%8
0.375
```
divide

```
   3^8
6561
```
power

```
  t=: 101
```
give the value `101` the name "`t`"

```
  t^2
10201
```
square it

All of those illustrations of arithmetic had two arguments for each function and hence were ***dyadic*** uses of the function. Those functions also have a different meaning when used with a single right argument; that usage is the ***monadic*** use of the function.

```
  %5
0.2
```
reciprocal

```
  -3
_3
```
negate

```
   _2-4
_6
```

Notice that the underline is used as a negative sign. This is part of the number, not a function. Another monadic function is the exponential function.

```
   ^1
2.71828
```
exponential base *e*

```
  1+^1
3.71828
```
one plus *e*

```
  ^1+1
7.38906
```
e^2

```
   ^2
7.38906
```

```
   1+3*4
13
   3*4+1
15
   (3*4)+1
13
```

J has no hierarchy of functions used to determine the order of evaluation. The order of evaluation is a simple right to left or left to right rule. If you are imagining bottom up evaluation, then the arithmetic is done right to left. Thus, to evaluate `3*4+1` we first compute `4+1` getting `5` and then multiply by `3` to get `15`. On the other hand, if one uses top down evaluation, you may read that expression, `3*4+1`, left to right and think of it as `3` times the sum of `4` and `1`. Of course, the order may be modified with parentheses. Since J has a large number of built in functions, the simplicity of the evaluation rule allows for very concise, but clear, expression of powerful ideas. While the convention may seem unusual for dyadic functions, it is consistent with the common mathematical convention for monadic functions. That is, in common math, if we said or wrote the sine of the log of *t*, then the log would be applied to the *t* before the sine was applied to the result.

J expression	Common Math Expression
`2^10-1`	2^{10-1}
`(2^10)-1`	$2^{10}-1$
`_1+2^10`	$-1+2^{10}$
`-1+2^10`	$-(1+2^{10})$

Figure 1.1.1. J Functions have no Precedence Order

Figure 1.1.1 shows a few J expressions and their common mathematics meaning. The expressions are executed below.

```
   2^10-1
512

   (2^10)-1
1023

   _1+2^10
1023

   -1+2^10
_1025
```

Many J functions are denoted by an ASCII symbol followed by a period or colon.

```
   +:6
12
```
double

```
   *:4
16
```
square

```
   %:2
1.41421
```
square root

```
   ^.2
0.693147
```
natural logarithm

```
   2^.8
3
```
logarithm base 2

Common Math Functions and Arithmetic	J Expression
$x+y$	`x+y`
$x-y$	`x-y`
$\frac{x}{y}$	`x%y`
x^y	`x^y`
$\frac{1}{y}$	`%y`
-y	`-y`
e^y	`^y`
$2y$	`+:y`
$\frac{y}{2}$	`-:y`
y^2	`*:y`
$\sqrt{y}$	`%:y`
$\sqrt[x]{y}$	`x%:y`
$\ln(y)$	`^.y`
$\log_x(y)$	`x^.y`

Figure 1.1.2. Some Mathematical Functions