J Reference Card for version 6.02

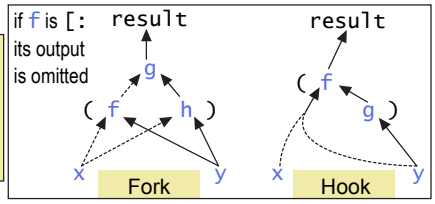
Arithmetic Dyads

2 + 8	Plus	10
2 - 8	Minus	_6
2 * 8	Times	16
2 % 8	Divide	0.25
2 | 8	Residue	0
2 ^ 8	Exponent	256
2 ^. 8	Log	3
3 %: 8	Root	2
2 >. 6	Greater	6
2 <. 6	Lesser	2
36 +. 24	GCD	12
36 *. 24	LCM	72
10 10 #. 8 3	Base	83
10 10 #: 83	Antibase	8 3
2 ! 8	CombOutOf	28
2 ? 8	Deal	4 2

Arithmetic Monads

<. 4.5	Floor	4
>. 4.5	Ceiling	5
* _4 0 3	Sign	_1 0 1
! 4	Factorial	24
? 20	Random in i.y	7
? 0	Random in (0,1)	0.452

x y	args to verbs
m n	nouns
u v	verbs
f g h	verbs
italics	optional



Comparisons (result 1 if TRUE)

=	Equal	>	Greater	>:	GreaterOrEqual
~:	NotEqual	<	Less	<:	LessOrEqual

-: Match (rank _ _): equal in shape, boxing, and values; but if empty, type does not matter.

're' E.'reread' WindowedMatch (ranks may be >1) 1 0 1 0 0 0

Comparisons are tolerant; follow by !.0 for exact comparison

Assignments

(n) =. v	AssignInd: value of n gives name(s) to assign
'n1 n2' =. v1;v2	AssignMult: one level of boxing is removed
'`add sub' =. +`-	AssignAR

A is abcd efgh ijkl mnop

Shorthands

<: 5	y-1	Decrement	4
>: 5	y+1	Increment	6
% 5	1%y	Reciprocal	0.2
-. 0.3	1-y	Complement	0.7
+: 9	y*2	Double	18
-: 9	y%2	Halve	4.5
*: 9	y^2	Square	81
%: 9	2%y	SquareRoot	3
^ 1	e^y	Exp	2.718
^. 7.389	e^.y	NaturalLog	2
#. 1 0 1	2#.y	FromBase2	5
#: 5	2#:y	ToBase2*	1 0 1
m&#.^:_1	m#:y	ToBasem*	

*produce as many result items as needed to hold significance

Searches

'people' i. 'pow'	IndexOf[1]	0 2 6
'people' i: 'pow'	IndexOfLast[1]	3 2 6
'pow' e. 'people'	ElementOf[1]	1 1 0
I. 0 1 1 0 1	IndicesOfOnes	1 2 4
0 2 4 I. 2 3 _1 9	FindInsertionPoint[12]	1 2 0 3
(i. >./) 1 2 8 5	IndexOfLargest[34]	2
3 (= i. 1:) 1 3 3 0	FindFirstTrue[456]	1
3 ([: I. =) 1 3 3 0	IndicesWhereTrue[67]	1 2
m&i. e.&n m&i:	FastSearch (when used repeatedly)	

[1]rank searched for is rank of items of other operand [2]min index before which item can be inserted in order [3]or <. [4]or i: [5]or 0: [6]any comp. or e. [7]or +/ +./ *./

Operations on Ordered Sets

'rare'-. 'er'	RemoveItems	a
~. 'rare'	UniqueItems	rae
~: 'rare'	UniqueSieve	1 1 0 1
i.~'rare'	SelfClassify	0 1 0 3

Selections

1 0 2 # 'abc'	Copy	acc
1j1 0 2 # 'abc'	CopyFill	a cc
1j1 0 2 #!.'*' 'abc'	CopyCustom	a*cc
1 0 1&#^:_1 'ab'	Expand	a b
1 0 1&#^:_1!.'*' 'ab'	ExpandCustom	a*b

Monads i. & i:

i. 3 / 0 1 2	_1 1 { A	ItemsFrom	mnop efgh
i. _3 / 2 1 0	1 3 {"1 A	FromEachRow	bd fh jl np
i. 2 3 / 0 1 2 / 3 4 5	2 1 { A	From (All axes scalar)	j
i: 2 / _2 _1 0 1 2	1 3 { A	From (Omitted trailing axis)	efgh mnop
	1 2 { A	From (Axis 1 Complementary)	efh
	1 3 1 0 2 { A	From (General axes)	feg nmo
	(<a:;2 0) { A	From (Omitted early axis)	ca ge ki om
	1 1 / 3 2 (<"1@[{]) A	FromUnboxed (Fast form)	fo

Operations on Booleans

16b1a Base16 constant 26

Dyads:					
+.	OR	*.	AND	~:	XOR
+:	NOR	*:	NAND	=	XNOR

Monad: -. NOT

> < >: <: are also meaningful.

m b.	(0≤m<16) Boolean function with truth table 2 2#:4 4#:m (1 b. is AND)
m b.	(16≤m<32) bitwise Boolean; applies (m-16) b. to each bit of integers

x 32 b. y	x 33 b. y	x 34 b. y
rotate y left x bits	unsigned	signed
	shift y left (x>0) or right (x<0) x bits	

Join and Reshape

, ab / cd	Enfile	abcd
'ab' , 'cd'	Append	abcd
0 1 / 2 3 , 8 9	Append (unequal ranks)	0 1 / 2 3 / 8 9
0 1 / 2 3 , ,8	Append (short)	0 1 / 2 3 / 8 0
0 1 / 2 3 , 8	Append (atom)	0 1 / 2 3 / 8 8
,. 'ab'	EnfileItems	a / b
'ab' ,. 'cd'	AppendItems	ac / bd
$,: 'ab'	Itemize (adds leading axis)	1 2
'ab' ,: 'cd'	Laminate	ab / cd
3 $ 0 1 / 2 3	ReshapeItems	0 1 / 2 3 / 0 1
3 ($,) 0 1 / 2 3	Reshape	0 1 2
3 ; (4 ; 5)	Link	3 | 4 | 5
3 ,&< (4 ; 5)	JoinBoxed	3 | 4 | 5
; 0 1 / 2 3 | ,4 | 6	Raze (expand items of opened boxes to size of largest, then append)	0 1 / 2 3 / 4 0 / 6 6
;: '2 wds'	JWords	2 | wds
;:^:_1 w1 | w2	RazeWords	w1 w2

Whole-Array Operations

|. 'abcde'	Reverse	edcba
2 |. 'abcde'	RotateLeft	cdeab
_2 |. 'abcde'	RotateRight	deabc
2 |.!.'*' 'abcde'	ShiftLeft	cde**
|.!.'*' 'abcde'	ShiftRightOne	*abcd
1 _1 |. abcd / efgh / ijkl / mnop	Rotate (multiaxis)	hefg / lijk / pmno / dabc
|: abcd / efgh / ijkl / mnop	Transpose (reverse axes)	aeim / bfjn / cgko / dhlp
x |: y	ReorderAxes (moves axes x to end of axes)	
'c0 c1 c2' =. |: y	AssignIndividualColumns	
/: 3 1 4 1	GradeUp*	1 3 0 2
/:~ 3 1 4 1	SortUp*	1 1 3 4
'abcd' /: 3 1 4 1	SortUpUsing*	bdac
/:@/: 3 1 4 1	Ordinals*	2 0 3 1
'*' (<1 2)} abcd / efgh / ijkl / mnop	Amend	abcd / ef*h / ijkl / mnop
'*+' [`(#@[)`] } ab / ef / ij / mn	Amend (gerund form)	ab / ef / *+ / mn
y =. x m} y	AmendInPlace (fast form)	

*use \: for descending order

Take and Drop

2 {. i. 6	Take	0 1
_2 {. i. 6	TakeLast	4 5
2 }. i. 6	Drop	2 3 4 5
_2 }. i. 6	DropLast	0 1 2 3
4 {. 2 3	Overtake	2 3 0 0
4 {.!.9 (2 3)	OvertakeCustom	2 3 9 9
2 _2 {. i. 4 4	TakeMultiAxis	2 3 / 6 7
{. 0 1 2	Head	0
{: 0 1 2	Tail	2
}. 0 1 2	Behead	1 2
}: 0 1 2	Curtail	0 1

Box Operations

B is 0 1 2 3 4 5 | 6 7 | 8

L. B	Level	2
$ L:0 B	AtLevel	,2 | ,2 | ,2 | ,2
{. L:1 B	AtLevel	0 1 | 6 | 8
# S:0 B	Spread	2 2 2 2 1
|. &.> B	Each (fast)	4 5 | 2 3 | 0 1 | 7 6 | 8
1 {:: B	Fetch	6 7
0 1 {:: B	Fetch	2 3
0 | 2 0 {:: B	FetchList	4 5 | 0 1

Partitions

`<\ i. 3`	Prefixes	,0 | 0 1 | 0 1 2
`2 <\ i. 4`	Infixes	0 1 | 1 2 | 2 3
`_2 <\ i. 5`	Infixes, no overlap	0 1 | 2 3 | ,4
`<\. i. 3`	Suffixes	0 1 2 | 1 2 | ,2
`3 <\. i. 5`	Outfixes	3 4 | 0 4 | 0 1
`_3 <\. i. 5`	Outfixes, no overlap	3 4 | 0 1 2
`3 4` `2 2` `u;.3`	u applied to SubArrays[1] (all shaded)	abcdefgh ijklmnop qrstuvwx yz01234 5 6789ABCD EFGHIJKL MNOPQRST
`3 4` `2 2` `u;._3`	u applied to FullSubArrays[1] (shaded+border)	
`1 _2` `3 2` `u;.0`	u applied to SubArray[2] (shaded)	abcdef ghijkl mnopqr stuvwx
`<;.1 'people'`	CutOnHead[3]	peo | ple
`<;.2 'people'`	CutOnTail[3]	pe | ople
`0 1 0 1 <;.1 i. 4`	CutStartAtOne[3]	1 2 | ,3
`0 1 0 1 <;.2 i. 4`	CutEndAtOne[3]	0 1 | 2 3
`'people' </. i. 6`	Key	0 3 | 1 5 | ,2 | ,4

The operations (< or u) shown in the examples can be replaced by any verb, or with a gerund m in which case the components of m are applied cyclically, one per partition.

[1] x is *boundary*, `:shape`. Subarrays start at all possible combinations of multiples of the atoms of `boundary`, and have the shape `|shape`. A negative component of `shape` reverses that axis in each subarray.

[2] x is *corner*, `:shape`. The subarray starts at `corner` and has shape `|shape`. A negative component of `corner` causes the subarray to extend backward in that component; a negative component of `shape` reverses that axis in the subarray.

[3] `;._1` omits the first, and `;._2` the last, item in each partition.

Control Structures

```
if. T do. B0 else. B1 end.
if. T do. B0 elseif. T1 do. B1 elseif. T2 do. B2 end.[1]
while. T do. B end.[1] whilst. T do. B end.[1] (skips T first time)
for. T do. B end. (loop #T times)   for_xyz. T do. B end.[2]
break. (jump out of loop)   continue. (go to end of loop)
select. T fcase. T0 do. B0 fcase T1 do. B1 end.[1] (fcase falls through)
try. B0 catch. B1 catcht. B2 end. (execute B1 if error in B0)[3]
returnresult return.
```

[1] omitted T is true [2] sets *xyz* and *xyz*`_index` for each loop
[3] `catch.` catches `throw.` from a called function

Insert

`u/ y`	Insert u between items of y		
`u/ 1 3 5`	Insert	`1 u 3 u 5`	
`+/ 1 3 5`	Sum	9	
`+/\ 1 3 5`	RunningSum	1 4 9	
`+/\. 1 3 5`	RevRunningSum	9 8 5	
`m/ y`	Insert verbs from gerund m		

Gerunds

`u`	TwoVerbGerund	
`u''`	OneVerbGerund	
`+:`*: `:0 i. 3`	Append verb results	0 2 4 0 1 2
`+`'' `:6`	MakeVerb	+
`]`!`-@.* 0 3 _2`	Agenda*	0 6 2

*u@.v (rank v) is *x* `((x v y){u)`:6 y`

Shape and Rank

`$ i. 2 3`	ShapeOf	2 3
`# i. 2 3`	TallyOf	2
`#@$ i. 2 3`	RankOf	2
`+/` 0 1 2 3		2 4
`+/"1` 0 1 2 3		1 5
`+/"0` 0 1 2 3		0 1 2 3
`1 2 +/"0` 0 1 2 3 4 5		1 2 3 5 6 7
`1 2 3 +/"1` 0 1 2 3 4 5		1 3 5 4 6 8
`1 2 3 +/"0` 0 1 2 3 4 5		length error

x u/ y applies u between each cell of x and all of y

Trigonometry and Calculus

`1 o. 1r3p1`	Sin	0.866
`2 o. 1r3p1`	Cos	0.5
`3 o. 1r3p1`	Tan	1.732
`other o. y`	Trig Functions	
`o. 1`	PiTimes	3.1416
`p. 6 5 1`	Roots	1 | _3 _2
`p. 1 | _3 _2`	Coeffs	6 5 1
`6 5 1 p. 2`	EvalPoly	20
`1 | _3 _2 p. 2`	EvalPoly	20
`p.. 6 5 1`	PolyDeriv	5 2
`6 p.. 5 2`	PolyIntegral	6 5 1
`*: d. 1`	Derivative	+:
`*: D. 1`	PartialDeriv	
`*:`+: D. 1`	AssignDeriv	
`1e_8 u D: n y`	SecantSlope of nth derivative	
`^ t. 1 2 3`	TaylorCoeff	1 0.5 0.167
`u`v t. n`	AssignTaylor	
`^ t: 1 2 3`	ExpTaylor	1 1 1
`^ T. 3`	TaylorApprox	1 1 0.5&p.
`m H. n`	HypergeometricSeries	

Format

`99 ". '2 5.5 xx'`	Numbers	2 5.5 99
`5j2 ": 1.468 2.3`	Format	1.47 2.30
`7j_2 ": 2.3`	Format	2.30e0
`'n[CR]4.' 8!:2 ]3 _5`	Format	3 5CR

Complex Numbers

`2x1`	ExpNum	2*e^1
`1p2`	CircNum	1*π^2
`+ 3j4`	Conjugate	3j_4
`+. 3j4`	RealImag	3 4
`*. 3j4`	LenAngle	5 0.927
`| 3j4`	Magnitude	5
`j. 1j2`	TimesJ	_2j1
`3 j. 4`	Complex	3j4
`r. 1r3p1`	Cis (^j. y)	0.5j0.87
`2 r. 1p1`	TimesCis	_2j0

Constants

TAB	tab	9{a.
LF	line feed	10{a.
FF	form feed	12{a.
CR	carriage return	13{a.
CRLF	CR LF pair	
DEL	delete (delimiter)	127{a.

Matrix Operations

`%. y`	MatrixInverse
`x %. y`	MatrixDivide
`x +/ .* y`	MatrixMultiply
`-/ .* y`	Determinant
`+/ .* y`	Permanent

Mathematics

`A. 2 0 1`	AnagramIndex	4
`4 A. 'abc'`	Anagram	cab
`C. 2 1 0`	PermForm	1 | 2 0
`1 | 2 0 C. 'abc'`	Permute	cba
`C.!.2 =/~ 0 1`	PermParity	_1 1
`p: 3`	YthPrime	7
`x p: y`	PrimeInfo	various
`q: 56`	PrimeFactors	2 2 2 7
`_ q: 56`	PrimeExps	3 0 0 1
`__ q: 56`	PrimeFacExp	2 7 3 1
`x: 1%3`	Exact	1r3
`x:^:_1 (1r3)`	Inexact	0.3333
`2 x: 1r2`	NumDenom	1 2

Adverbs and Conjunctions

`u~ y`	Reflexive	y u y
`x u~ y`	Passive	y u x
`x u^:n y`	Power	execute x&u for n times; if n<0, execute inverse of x&u for −n times; if n=0, result is y
`x u^:v y`	Power	where n is given by x v y
`x u^:v y`	If	y if x v y is false(0), x u y if x v y is true(1)
`u^:_`	Converge	repeat u until result is constant
`x u^:v^:_ y`	DoWhile	repeat u while x v y is 1
`u^:a:`	ConvergeHistory	repeat u until result is constant, return all intermediate values
`{~^:a:&0`	ChaseChain	follow chain of record positions
`u :.v`	Inverse	like u, but inverse is v
`u ::v`	Adverse	u, but execute v if error during u
`x u@v y`	Atop	x u@:v"v y
`x u@:v y`	At	u x v y
`1 2 +/@* 3 4`	Atop	3 8 NB. (+/ 1*3) , (+/ 2*4)
`1 2 +/@:* 3 4`	At	11 NB. +/ 1 2 * 3 4
`x u&:v y`	Appose	(v x) u v y
`x u&v y`	Compose*	x u&:v"mv y
`x u&.:v y`	Dual	v^:_1 (v x) u v y
`x u&.v y`	Dual*	x u&.:v"mv y
`>:&. > 1 2 3`		2 | 3 | 4
`>:&.:> 1 2 3`		2 3 4
`m&v y` or `u&n y`	MonadFromDyad	m v y or y u n
`x m&v y`	same as (m&v) ^:x y (x u&n y similarly)	

*mv is monadic rank of v

Selected Foreigns & Miscellaneous

`". '2 + 3'`	Execute sentence 5
`u b. y`	Info on u: y=_1 inverse; 0 ranks; 1 identity function
`u M.`	Memoize: u, but saving results for possible reuse
`3!:0 y`	Datatype of y
`3!:1 y`	Binary representation of y as coded character string
`3!:3 y`	Binary representation of y as displayable hex array
`x 3!:4 inty`	Numeric/bytestring conversion. x>0: convert list y to char list, 2^x (int) or 2^>:x (float) chars/number. x<0: convert char list y to numeric list, 2^−x (int) or 2^>:−x (float) chars/number. x=0: 2-byte short to unsigned int
`x 3!:5 floaty`	
`4!:0 <'name'`	Class of `name`, _1 if undefined
`5!:5 <'name'`	String which, if interpreted, creates the value of `name`
`6!:0 ''`	Current time Y M D H M S
`x 6!:2 'sentence'`	Average execution time of `sentence` over x samples
`7!:2 'sentence'`	Space to execute `sentence`

$. Sparse matrix $: Recursion s: Symbol u: Unicode a. Alphabet

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