`|` **`bars` make cores**

`|_` `spec alas (map term tome)`
produces a door (a core with sample)

`|%` `(unit term) (map term tome)`
produces a core (battery and payload)

`|@` `(unit term) (map term tome)`
produces a wet core (battery and payload)

`|:` `[hoon hoon]`
produces a gate with a custom sample

`|.` hoon
produces a trap (a core with one arm)

`|-` `hoon`
produces a trap (a core with one arm) and evaluates it

`|^` `hoon (map term tome)`
produces a core whose battery includes a `$` arm and computes the latter

`|~` `[spec value]`
produces an iron gate

`|*` `[spec value]`
produces a wet gate (a one-armed core with sample)

`|=` `[spec value]`
produces a dry gate (a one-armed core with sample)

`|?` `hoon`
produces a lead trap

`|$` `(lest term) spec`
produces a mold

`$` **`bucs` form molds**

`$@` `[spec spec]`
structure that normalizes a union tagged by head atom

`$_` `hoon`
structure that normalizes to an example `_foo`

`$:` `(list spec)`
forms a cell type (tuple) `[a=foo b=bar c=baz]`

`$%` `(list spec)`
structure that recognizes a union tagged by head atom (*e.g.*, a list of named parameters)

`$<` `[spec spec]`
structure from filter (excluding)

`$>` `[spec spec]`
structure from filter (requiring)

`$|` `[spec hoon]`
structure with verification

`$&` `[spec hoon]`
repaired structure

`$^` `hoon`
structure that normalizes a union tagged by head depth (cell)

`$~` `[hoon spec]`
defines a custom type default value

`$-` `[spec spec]`
structure that normalizes to an example gate

`$=` `[skin spec]`
structure that wraps a face around another structure `foo=bar`

`$?` `(list spec)`
forms a type from a union of other types `?($foo $bar $baz)`

`$.`	`[spec (map term spec)]` structure as read–write core		
`$;`	hoon manual structure		

% cens put the fun in function

`%_`	`[wing (list (pair wing hoon))]` resolves a wing with changes, preserving type	
`%.`	`[hoon hoon]` calls a gate, inverted	
`%^`	`[hoon hoon hoon hoon]` calls a gate with triple sample	
`%+`	`[hoon hoon hoon]` calls a gate with a cell sample	
`%-`	`[hoon hoon]` calls a gate	`(fun arg)`
`%:`	`[hoon (list hoon)]` calls a gate with many arguments	
`%~`	`[wing hoon hoon]` evaluates an arm in a door	`~(arm core arg)`
`%*`	`[wing hoon (list (pair winghoon))]` evaluates an expression, then resolves a wing with changes	
`%=`	`[wing (list (pair wing hoon))]` resolves a wing with changes	`foo(x 1, y 2, z 3)`

: cols make cells

`:_`	`[hoon hoon]` constructs a cell, inverted	
`:^`	`[hoon hoon hoon hoon]` constructs a cell, 4-tuple	`[a b c d]`
`:+`	`[hoon hoon hoon]` constructs a cell, 3-tuple	`[a b c]`
`:-`	`[hoon hoon]` constructs a cell, 2-tuple	`[a b]`, `a^b (a^b^c)`
`:~`	`(list hoon)` constructs a null-terminated list	`~[a b c]`
`:*`	`(list hoon)` constructs an n-tuple	`[a b c d e …]`
`::`	marks a comment (digraph, not rune)	

. dots nock

`.+`	`atom` increments an atom using Nock 4	`+(42)`
`.*`	`[hoon hoon]` evaluates using Nock 2	
`.=`	`[hoon hoon]` tests for equality using Nock 5	`=(a b)`
`.?`	hoon tests for cell or atom using Nock 3	
`.^`	`[spec hoon]` loads from namespace using Nock 12	

-/= terminators terminate

`--`	terminates core expression (digraph, not rune)
`==`	terminates running series of Hoon expressions (digraph, not rune)

^ kets cast

^| hoon
converts a gold core to an iron core (invariant)

^. [hoon hoon]
typecasts on value

^- [spec hoon]
typecasts by explicit type label `` `foo`bar ``

^+ [hoon hoon]
typecasts by inferred type (a fence)

^& hoon
converts a core to a zinc core (covariant)

^~ hoon
folds constant at compile time

^= [skin hoon]
binds name to a value `foo=bar`

^? hoon
converts a core to a lead core (bivariant)

^* spec
bunt, produces default mold value `*foo`

^: spec `,foo`
produces a 'factory' gate for a type (switch from regular parsing to spec/type parsing)

~ sigs hint

~| [hoon hoon]
prints in stack trace if failure

~$ [term hoon]
profiler hit counter

~_ [hoon hoon]
prints in stack trace, user-formatted

~% [chum hoon tyre hoon]
registers jet

~/ [chum hoon]
registers jet with registered context

~< [$@(term [term hoon]) hoon]
raw hint, applied to product ("backward")

~> [$@(term [term hoon]) hoon]
raw hint, applied to computation ("forward")

~+ [@ hoon]
caches a computation

~& [@ud hoon hoon]
prints (used for debugging)

~? [@ud hoon hoon hoon]
prints conditionally (used for debugging)

~= [hoon hoon]
detects duplicate

~! [hoon hoon]
prints type if compilation failure

; mics make

;: [hoon (list hoon)]
calls a binary function as an n-ary function `:(fun a b c d)`

;/ hoon
(Sail) yields tape as XML element

;< `[spec hoon hoon hoon]`
glues a pipeline together (monadic bind)

;~ `[hoon (list hoon)]`
glues a pipeline together with a product-sample adapter (monadic bind)

;; `[spec hoon]`
normalizes with a mold, asserting fixpoint

;+
(Sail) makes a single XML node

;*
(Sail) makes a list of XML nodes from Hoon expression

;= `marl:hoot`
(Sail) makes a list of XML nodes

= tises alter

=| `[spec hoon]`
combines default type value with the subject

=. `[wing hoon hoon]`
changes one leg in the subject

=? `[wing hoon hoon hoon]`
changes one leg in the subject conditionally

=^ `[skin wing hoon hoon]`
pins the head of a pair; changes a leg with the tail

=: `[(list (pair wing hoon)) hoon]`
changes multiple legs in the subject

=/ `[skin hoon hoon]`
combines a named noun with the subject

=; `[skin hoon hoon]`
combines a named noun with the subject, inverted

=< `[hoon hoon]`
composes two expressions, inverted `foo:bar`

=> `[hoon hoon]`
composes two expressions

=- `[hoon hoon]`
combines a new noun with the subject

=* `[(pair term (unit spec)) hoon hoon]`
defines an alias

=, `[hoon hoon]`
exposes namespace (defines a bridge)

=+ `[hoon hoon]`
combines a new noun with the subject

=~ `(list hoon)`
composes many expressions

? wuts test

?| `(list hoon)`
logical OR (loobean) `|(foo bar baz)`

?: `[hoon hoon hoon]`
branches on a boolean test

?. `[hoon hoon hoon]`
branches on a boolean test, inverted

?< `[hoon hoon]`
negative assertion

?> `[hoon hoon]`
positive assertion

?- `[wing (list (pair spec hoon))]`
switches against a union, no default

?^ `[wing hoon hoon]`
branches on whether a wing of the subject is a cell

?= `[spec wing]`
tests pattern match

?# `[skin wing]`
tests pattern match

?+ `[wing hoon (list (pair spec hoon))]`
switches against a union, with default

?& `(list hoon)`
logical AND (loobean) `&(foo bar baz)`

?@ `[wing hoon hoon]`
branches on whether a wing of the subject is an atom

?~ `[wing hoon hoon]`
branches on whether a wing of the subject is null

?! `hoon`
logical NOT (loobean) `!foo`

! `zaps` run wild

!:
turns on stack trace

!.
turns off stack trace

!, `[*hoon hoon]`
emits AST of expression (use as `!,  *hoon  expression`)

!; `[hoon hoon]`
emits the type for an expression using the type of type

!> `hoon`
wraps a noun in its type

!< `hoon`
lift dynamic value into static context

!@ `[(list wing) hoon hoon]`

!= `hoon`
makes the Nock formula for a Hoon expression

!? `[$@(@ {@ @}) hoon]`
restricts Hoon version

!! `~`
crashes

/ `fases` file (`+ford` arm of `%clay`)

/? `foo`
pin a version number

/- `foo, *bar, baz=qux`
imports a file from the `sur` directory (`*` pinned with no face, `=` with specified face)

/+ `foo, *bar, baz=qux`
imports a file from the `lib` directory (`*` pinned with no face, `=` with specified face)

/= `clay-raw  /sys/vane/clay`
imports results of user-specified path wrapped in face

/% `%mark`
imports mark definition from `mar/`

/$ `%from %to`
imports mark conversion gate from `mar/`

/* `myfile  %hoon  /gen/myfile/hoon`
imports the contents of a file in the desk converted to a mark (build-time static data)

/~ `face  type  /path`
imports contents of a directory under `face=(map @ta type)`

+ `luses` arm cores

+|
labels a chapter (produces no arm)

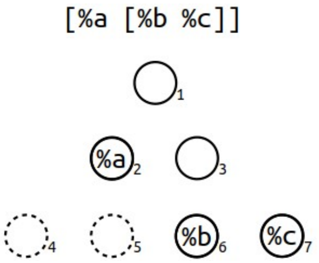
+$ `[term spec]`
produces a structure arm (type definition)

++ `[term hoon]`
produces a (normal) arm

+* `[term term spec]`
produces a type constructor arm

syntax

```
+1:[%a [%b %c]] [%a [%b %c]]
+2:[%a [%b %c]] %a
+3:[%a [%b %c]] [%b %c]
+4:[%a [%b %c]] %ride failed
+6:[%a [%b %c]] %b
+7:[%a [%b %c]] %c
```



```
.:[%a [%b %c]] [%a [%b %c]]
-:[%a [%b %c]] %a
+:[%a [%b %c]] [%b %c]
-<:[%a [%b %c]] %ride failed
+<:[%a [%b %c]] %b
+>:[%a [%b %c]] %c
```

`&n`	*n*th element
`|n`	tail after *n*th element
`<[1 2 3]>`	renders list as a tape
`>[1 2 3]<`	renders list as a tank

lark syntax equivalents

+1		+5	->
+2	-	+6	+<
+3	+	+7	+>
+4	-<	+8	-<-

`.`	current subject
`+`	`+:.`
`-`	`-:.`
`+>`	`+>:.`
`a.b.c`	limb search path

`^face`	face in outer core (`^^face`)
`..arm`	core in which `++arm` is defined
`,  ,.`	strip the face
`-:!>`	type spear, use as `-:!>(.3.14)`

	`~`	0 (nil)
`%.y`	`&`	yes/true/`0`
`%.n`	`|`	no/false/`1`
	`%a`	constant
	`$`	empty `term` (`@tas`)

`eny`	entropy
`now`	current time
`our`	ship

`` `a ``	`[~ a]`
`~[a b c]`	`[a b c ~]`
`[a b c]~`	`[[a b c] ~]`
`a/b`	`[%a b]`

`'urbit'`	cord, atom `@t`
`"urbit"`	tape or list of characters
`=wire`	shadow type name (in defn)
`/path`	path name
`%`	current path

elementary molds

`*`	noun
`@`	atom (`atom`)
`^`	cell
`?`	loobean
`~`	null

@p notation

`@`	*Empty aura*	
`@c`	*Unicode codepoint*	`~-~45fed.`
`@d`	*Date*	
`@da`	*Date, absolute*	`~2020.12.25..7.15.0..1ef5`
`@dr`	*Date, relative*	`~d71.h19.m26.s24..9d55`
`@f`	*Loobean (for compiler, not castable)*	`&`
`@i`	*Internet address*	
`@if`	*IPv4 address*	`.195.198.143.90`
`@is`	*IPv6 address*	`.0.0.0.0.0.1c.c3c6.8f5a`
`@n`	*Nil (for compiler, not castable)*	`~`
`@p`	*Phonemic base*	`~laszod-dozser-fosrum-fanbyr`
`@q`	*Phonemic base, unscrambled (used with Urbit HD wallet)*	`.~laszod-dozser-dalteb-hilsyn`
`@r`	*IEEE-754 floating-point number*	
`@rh`	*Floating-point number, half-precision, 16-bit*	`.~~3.14`
`@rs`	*Floating-point number, single-precision, 32-bit*	`.3.141592653589793`
`@rd`	*Floating-point number, double-precision, 64-bit*	`.~3.141592653589793`
`@rq`	*Floating-point number, quadruple-precision, 128-bit*	`.~~~3.141592653589793`
`@s`	*Integer, signed (sign bit low)*	
`@sb`	*Signed binary*	`--0b10.0000`
`@sd`	*Signed decimal*	`--1.000`
`@sv`	*Signed base-32*	`--0v201.4gvml.245kc`
`@sw`	*Signed base-64*	`--0w2.04AfS.G8xqc`
`@sx`	*Signed hexadecimal*	`--0x2004.90fd`
`@t`	*UTF-8 text (cord)*	`'urbit'`
`@ta`	*ASCII text (knot)*	`~.urbit`
`@tas`	*ASCII text symbol (term)*	`%urbit`
`@u`	*Integer, unsigned*	
`@ub`	*Unsigned binary*	`0b10.1011`
`@uc`	*Bitcoin address*	`0c1A1zP1eP5QGefi2DMPTfTL5SLmv7DivfNa`
`@ud`	*Unsigned decimal*	`8.675.309`
`@ui`	*Unsigned decimal*	`0i123456789`
`@uv`	*Unsigned base-32*	`0v88nvd`
`@uw`	*Unsigned base-64*	`0wx5~J`
`@ux`	*Unsigned hexadecimal*	`0x84.5fed`

Capital letters at the end of auras indicate the bitwidth in binary powers of two, starting from `A`.

`@ubD`	signed single-byte (8-bit) decimal
`@tD`	8-bit ASCII text
`@rhE`	half-precision (16-bit) floating-point number
`@uxG`	unsigned 64-bit hexadecimal
`@uvJ`	unsigned 512-bit integer (frequently used for entropy)

Auras are non-coercive, but conversions may have to go via the empty aura: `^-(@ud ^-(@ 'foo'))`.

Nock 4K

A noun is an atom or a cell. An atom is a natural number. A cell is an ordered pair of nouns.

Reduce by the first matching pattern; variables match any noun.

```
nock(a)             *a
[a b c]             [a [b c]]

?[a b]              0
?a                  1
+[a b]              +[a b]
+a                  1 + a
=[a a]              0
=[a b]              1

/[1 a]              a
/[2 a b]            a
/[3 a b]            b
/[(a + a) b]        /[2 /[a b]]
/[(a + a + 1) b]    /[3 /[a b]]
/a                  /a

#[1 a b]            a
#[(a + a) b c]      #[a [b /[(a + a + 1) c]] c]
#[(a + a + 1) b c]  #[a [/[(a + a) c] b] c]
#a                  #a

*[a [b c] d]        [*[a b c] *[a d]]

*[a 0 b]            /[b a]                                   slot operator (noun at tree address)
*[a 1 b]            b                                        constant
*[a 2 b c]          *[*[a b] *[a c]]                         evaluate
*[a 3 b]            ?*[a b]                                  test for atom
*[a 4 b]            +*[a b]                                  increment
*[a 5 b c]          =[*[a b] *[a c]]                         distribution

*[a 6 b c d]        *[a *[[c d] 0 *[[2 3] 0 *[a 4 4 b]]]]    if-then-else
*[a 7 b c]          *[*[a b] c]                              compose
*[a 8 b c]          *[[*[a b] a] c]                          extend
*[a 9 b c]          *[*[a c] 2 [0 1] 0 b]                    invoke
*[a 10 [b c] d]     #[b *[a c] *[a d]]                       edit noun

*[a 11 [b c] d]     *[[*[a c] *[a d]] 0 3]                   hint
*[a 11 b c]         *[a c]

*a                  *a                                       interpret
```