

NOTES FROM

THE KIM

HARRIS COURSE

GIVEN AT SLAC

in June ~~this year~~ 1980



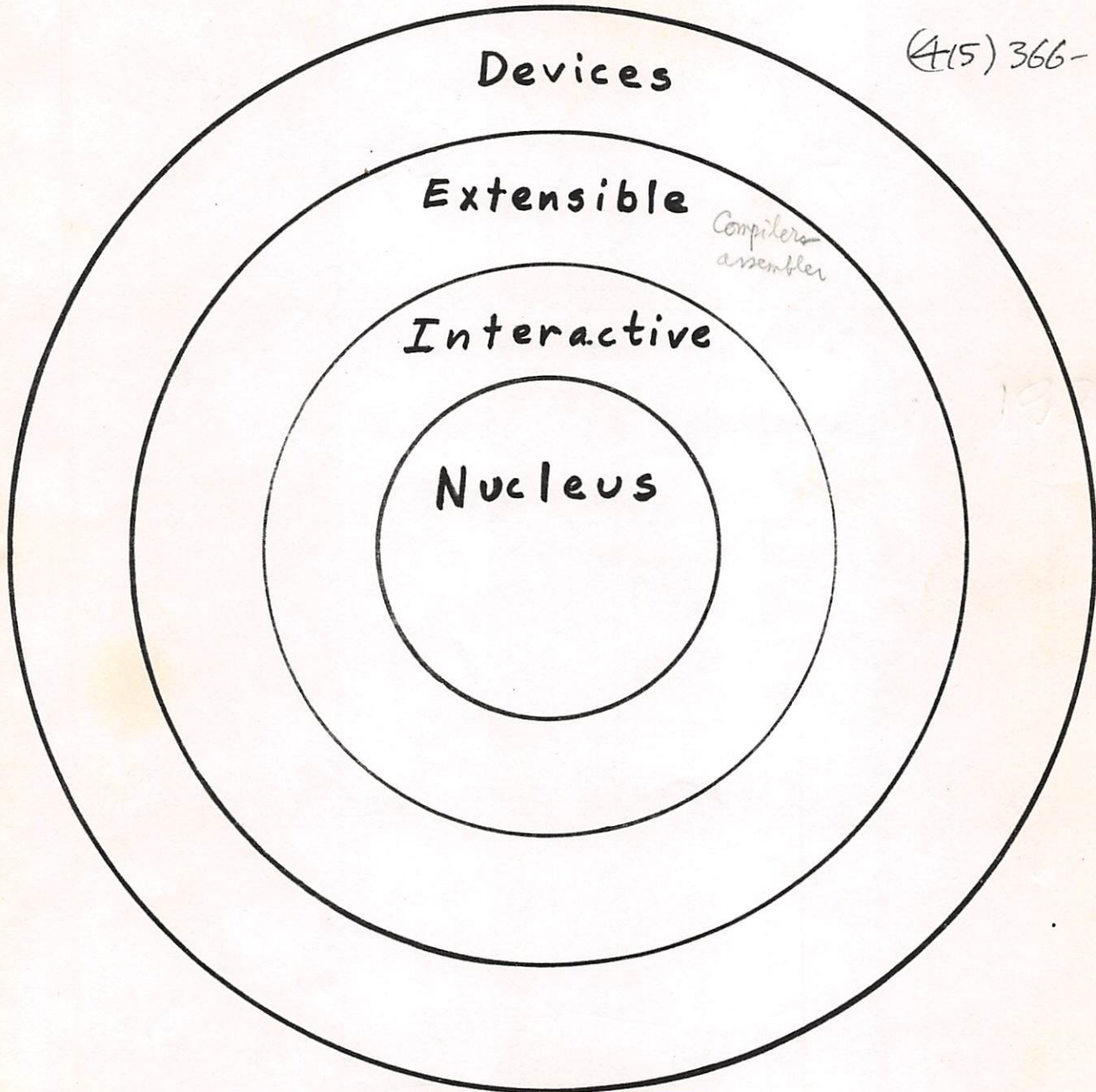
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61  
at

# FORTH'S LAYERS

Application  
Layers

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# FORTH LANGUAGE

**WORD** — a sound or a combination of sounds, or its representation in writing, that symbolizes and communicates a meaning ... a command or an order.

(from the American Heritage Dictionary)

## FORTH SYNTAX:

a sequence of words,  
separated by spaces  
possibly terminated by a Carriage Return

A word may contain any ASCII characters except spaces, Carriage Return, or Back Space (which erases previous character entered, except Carriage Return).

## Uniqueness:

Words are distinguished from all others by length (ie, number of characters) and first 31 characters.

normally 32

variable

WIDTH

determine

no. chars/word

Serial in dictionary

# "EXECUTION"

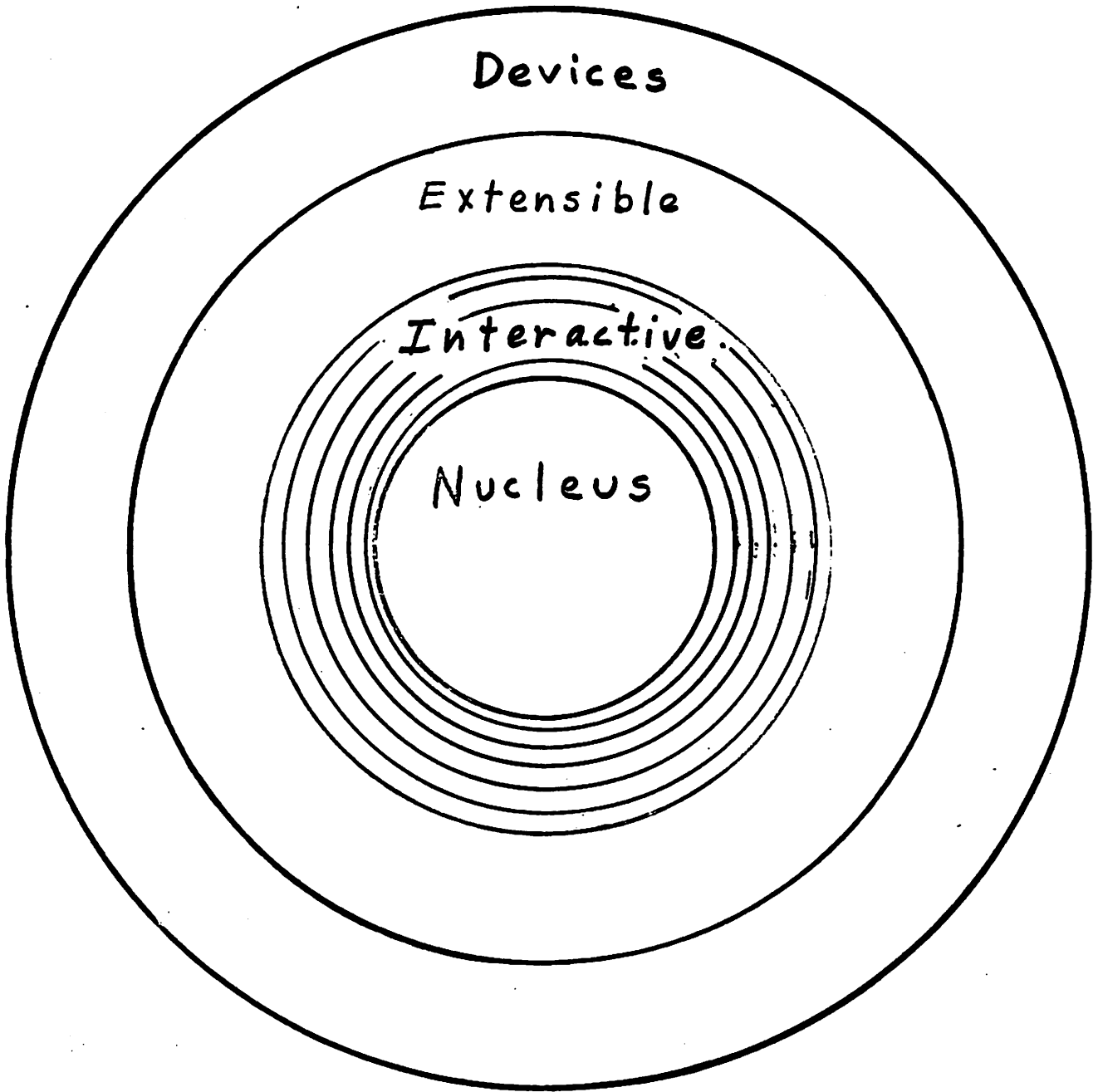
Application  
Layers

Devices

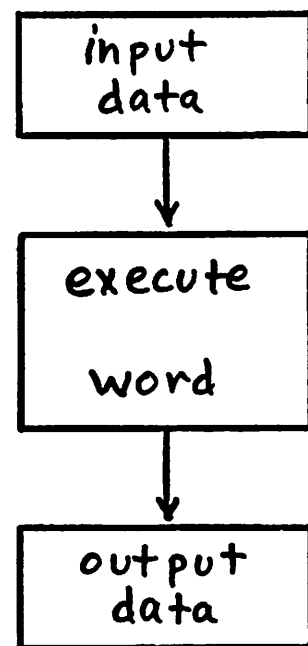
Extensible

Interactive

Nucleus



# EXECUTING a FORTH WORD



examples of words:

<u>FORTH</u>	<u>123</u>	(CR)	<u>OK</u>
word executed	word converted to binary and stored		reply indicates all words successfully processed

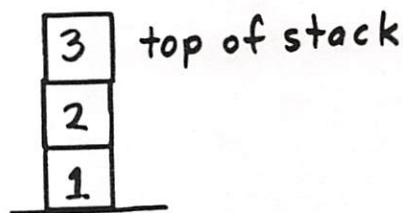
. (CR) 123 OK  
 command to print out and discard most available number

*FORTH has no equivalent to a program "statement"*

Stack usage:

numbers entered are pushed onto a stack.

1 2 3 (CR) OK



- (CR) 3 OK
- (CR) 2 OK
- (CR) 1 OK
- (CR) STACK EMPTY



# SIGNED INTEGERS

16 bit, range:            signed -32768 to 32767  
                                   unsigned 0 to 65535

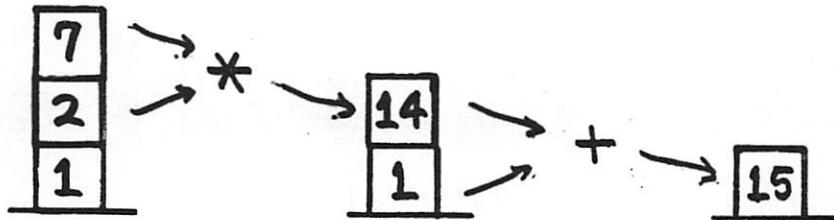
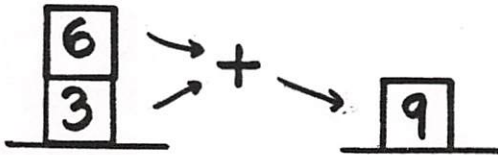
- 100 . (CR) -100 OK
- 1 U. (CR) 65535 OK
- 32767 . (CR) 32767 OK
- 32768 . (CR) -32768 OK
- 32768 U. (CR) 32768 OK
- 65535 . (CR) -1 OK
- 65535 U. (CR) 65535 OK

# Operators & Operands

Operands (data) are on the stack.

Operators take their inputs from the stack and leave their outputs on the stack.

input      process      output







# ARITHMETIC OPERATORS:

16 bit signed integer (range -32,768 to 32,767)

+				
-		n1	n2	--- (n1-n2)
*				
/	numerator	denominator		--- quotient
MOD	numerator	denominator		--- remainder
/MOD	numerator	denominator		--- rem. quot.
MINUS			n	--- -n
ABS			n	---  n
1+	1-	2+	2-	
MAX		n1	n2	--- greater
MIN		n1	n2	--- smaller
* /		n1	n2	--- quotient of
		(32bit intermediate product)		$\frac{n1 * n2}{n3}$
		n1	n2	--- rem. quot.

16 bit unsigned integer (range 0 to 65,535)

- AND
- OR
- XOR

Examples of arithmetic operators:

3 MINUS . (CR) -3 OK

-3 ABS . (CR) 3 OK

17 4 MAX . (CR) 17 OK

0 -1 MIN . (CR) -1 OK

The composite operators  $*/$  and  $*/MOD$  are useful for scaled, fixed point calculations:

5% of 20000

20000 5 100  $*/$  . (CR) 1000 OK

5½% of 20000

20000 55 1000  $*/$  . (CR) 1100 OK



# 32 bit signed integers

Each takes 2 stack cells

d --- nlow nhigh

Entering: digits

punctuation characters:

.

Display: D.

examples

12.3 D. (CR) 123 OK

32 bit signed integer ← extended arithmetic operators  
(chopped off)  
 (range -2,147,483,648 to  
 2,147,483,647)

D+                                    d1 d2            ---            d(d1+d2)

DMINUS                                d            ---            -d

M+ ← not in FIG FORTH

M+                                    d n            ---            d sum

M/                                    d n            ---            ( $\frac{d}{n}$  quot.)

M/MOD                                d n            ---            d( $\frac{d}{n}$  quot.) rem.  
← unsigned

M\*                                    n1 n2            ---            32 bit prod.  
↑    ↑  
16 bits each

M stands for "mixed"

POLYFORTH has also

M\*/                                d n1 n2            ---             $\frac{dn_1}{n_2}$