Address-of and dereference operators

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5/21/25

& address-of operator

***** dereference operator

Address-of operator and dereferencing operator

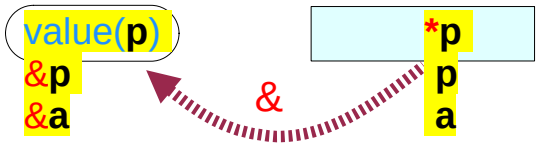
*address-of operator **&** : the address of a variable*

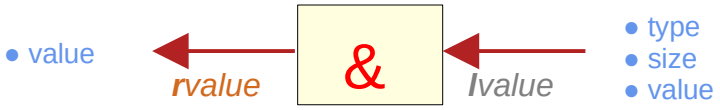
*a **variable** has a memory location whose value can be changed by an assignment*

*a **variable** must be an **l**value*

__&variable__ returns the address of a variable

*__&variable__ returns an **r**value*





Address-of operator and dereferencing operator

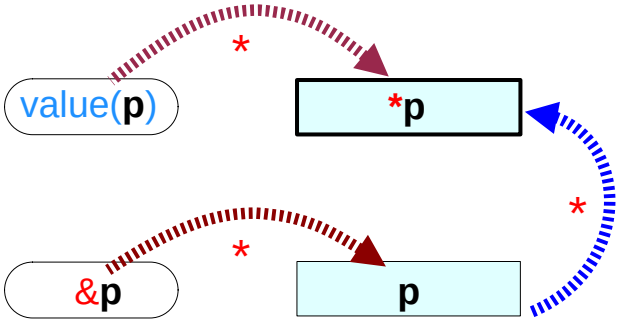
dereferencing operator ***** *: the content at an address*

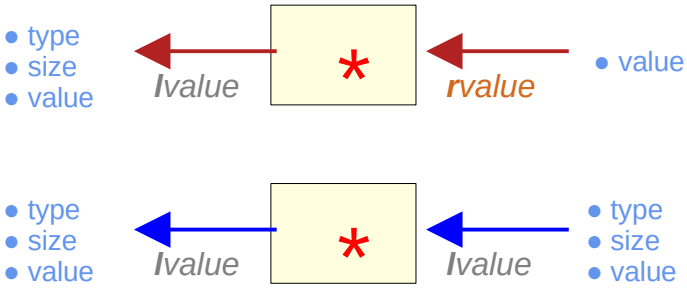
an ***address*** *can be an address value or a pointer variable that holds an address value*

an ***address*** *must be an* ***r****value, or evaluated to be an* ***r****value*

***** ***address*** *returns the content value at the address*

***** ***address*** *returns an* ***l****value*





***p** ≡ ***value(p)**

lvalue and rvalue in assignments

an assignment statement

Left Hand Side *Right Hand Side*

LHS = ***RHS***

- *in the **LHS**, only lvalue can exist*
- *rvalue can exist only in the **RHS***

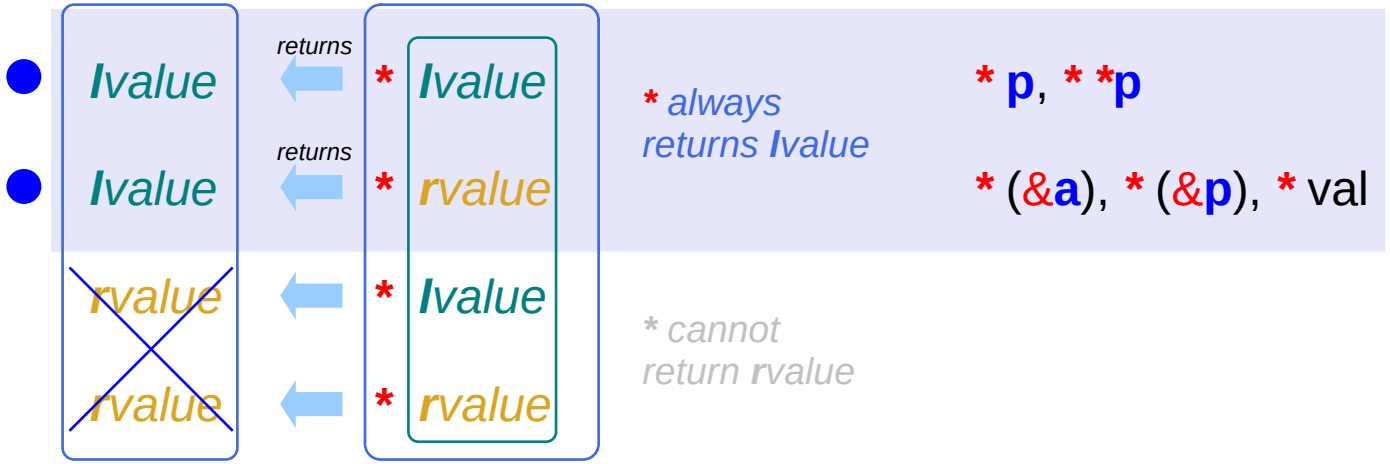
```
int   a,  b = 10 ;
int  *p, *q = &a ;
```

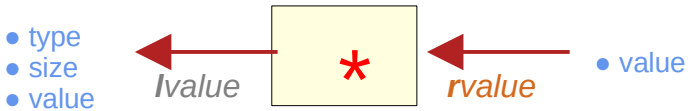
```
 a, b, p, q : lvalues   ... variables  ... RW
 *p, *q     : lvalues   ... variables  ... RW
&a, &b      : rvalues   ... constants  ... RO
```

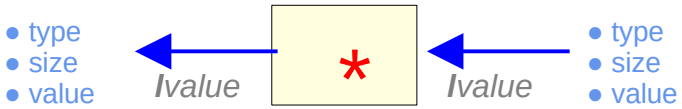
```
lvalue = lvalue
lvalue = rvalue
rvalue = lvalue
rvalue = rvalue
```

```
p  = q  ;
p  = &a ;
&a = p  ;
&a = &b ;
```

lvalue and rvalue with * and & operators





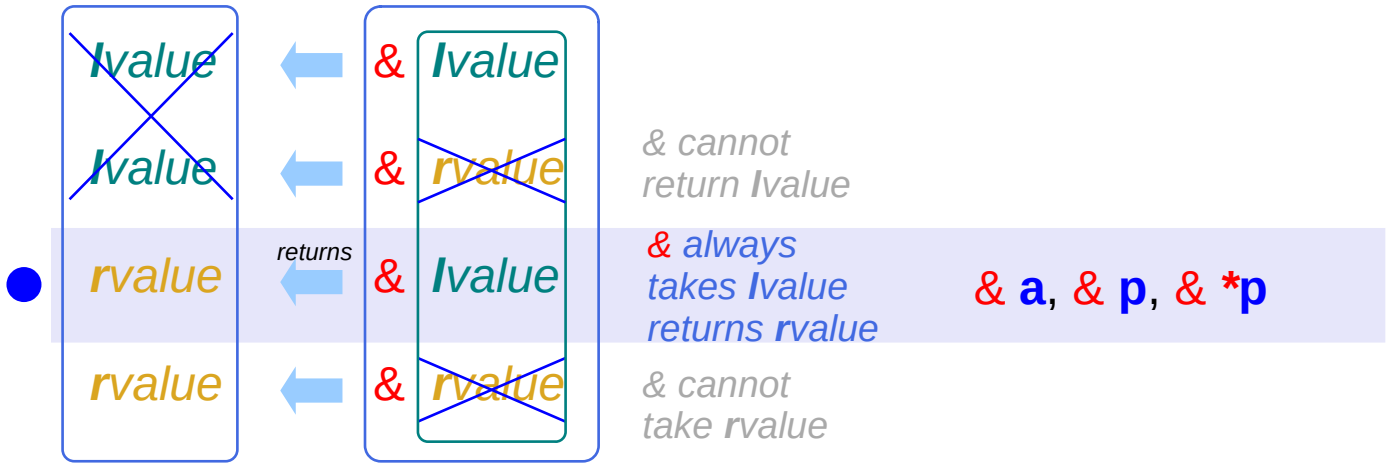


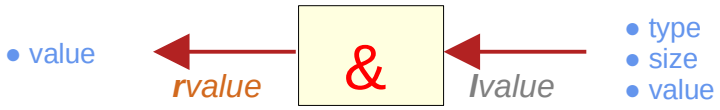
*p ≡ *value(p)

* can be applied to either an **lvalue** variable or a **rvalue** address

* **operand** becomes an **lvalue** variable thus it can be applied successively.

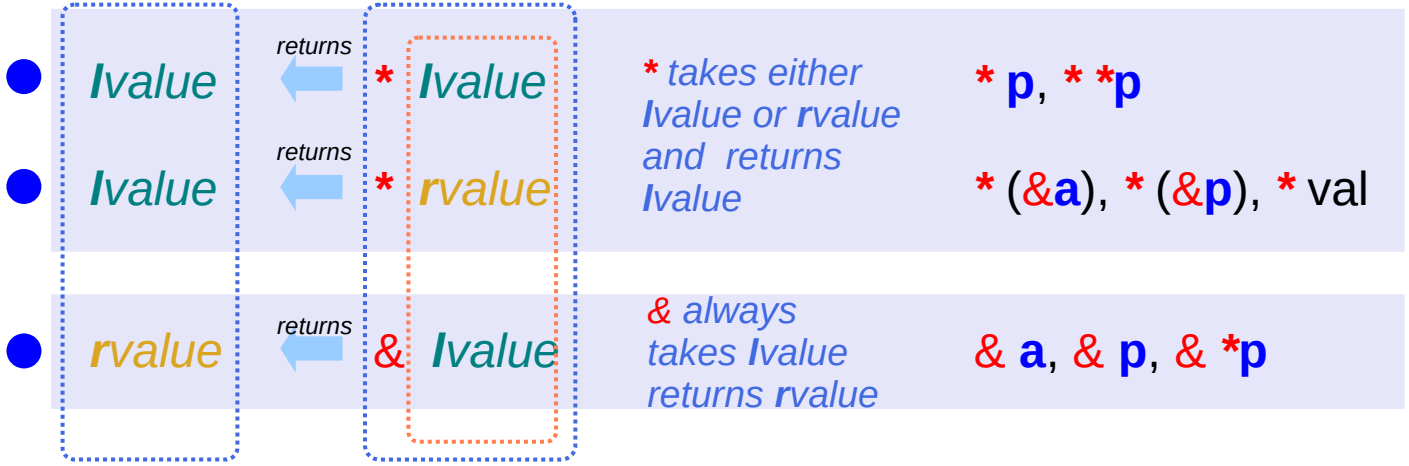
lvalue and rvalue with * and & operators

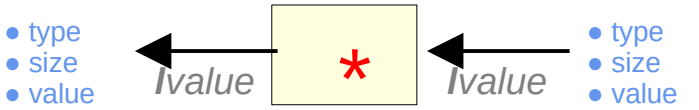


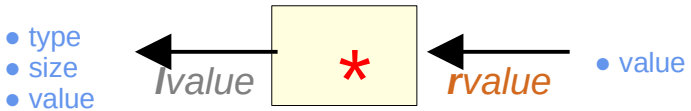


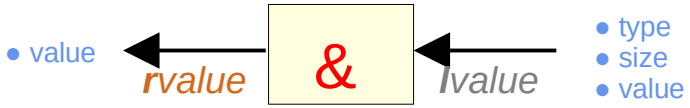
& can be applied
to only an **lvalue** variable and
returns only an **rvalue** address

lvalue and rvalue with * and & operators





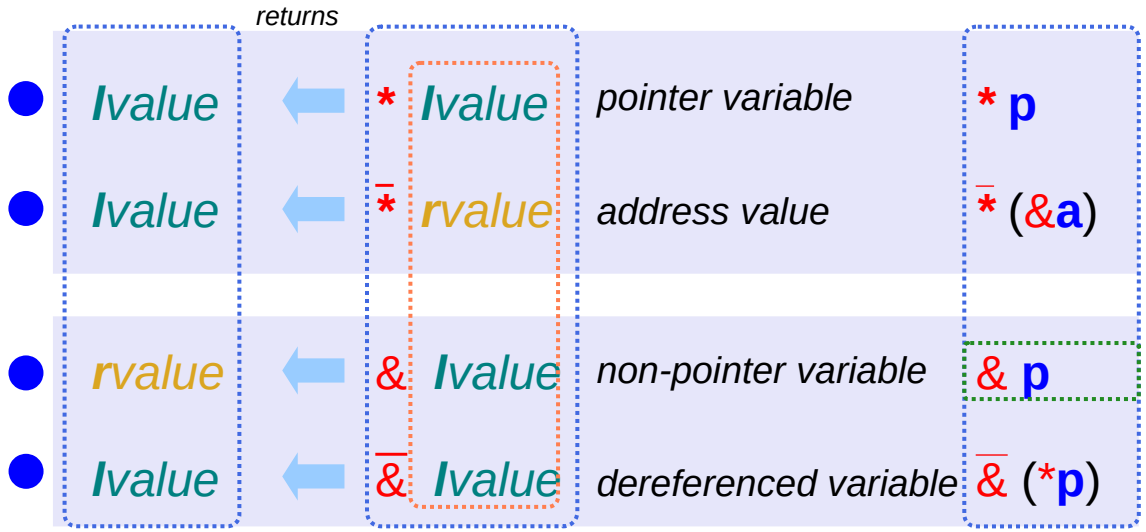




* (an **lvalue** variable)
* (an **rvalue** address)
* **operand** : an **lvalue** variable
* can be applied successively.

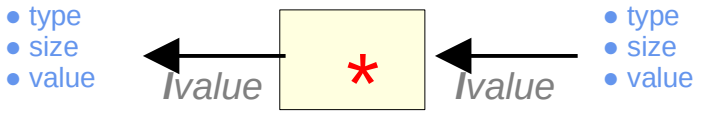
& (an **lvalue** variable)
& **operand** : an **rvalue** address,
& cannot be applied successively.

lvalue and rvalue with * and & operators

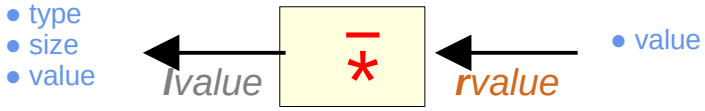


* can be applied successively.
&‾ can be applied successively.

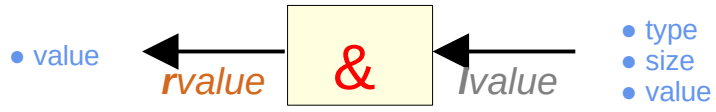
**p
&‾**p = *p
&‾&‾**p = &‾*p = p



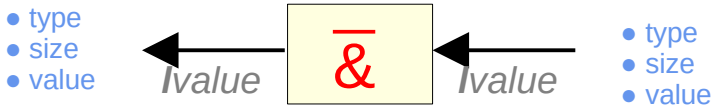
* (an **lvalue** variable)
* **operand**: an **lvalue** variable



*‾ (an **rvalue** address)
*‾ **operand**: an **lvalue** variable



& (an **lvalue** variable)
& **operand**: an **rvalue** address



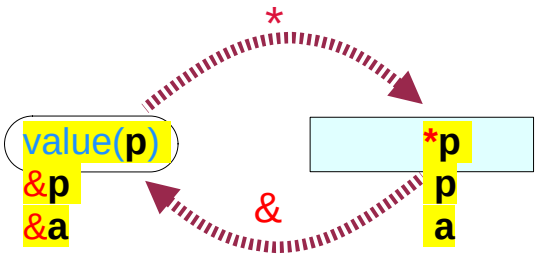
&‾ (an dereferenced **lvalue** variable)
&‾ **operand**: an **lvalue** variable

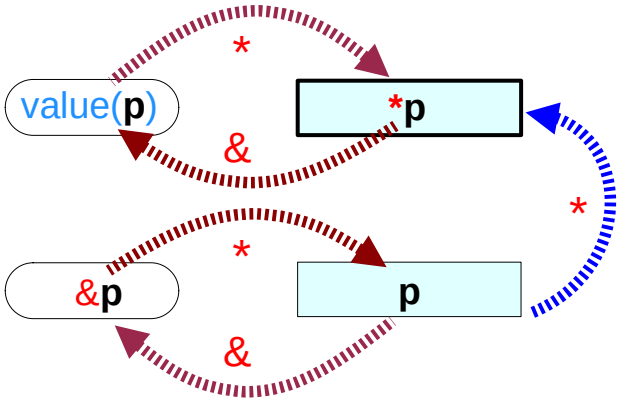
Variable types

a	non-pointer variables	*lvalue*
p	pointer variables	*lvalue*
***p**	dereferenced variables	*lvalue*
val	address values	*rvalue*

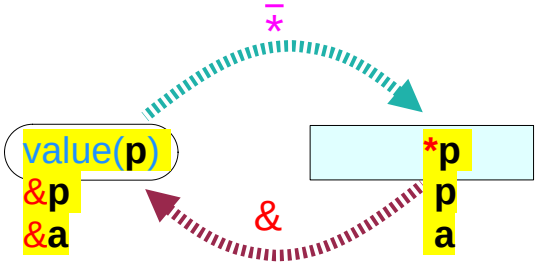
Comparisons (1)

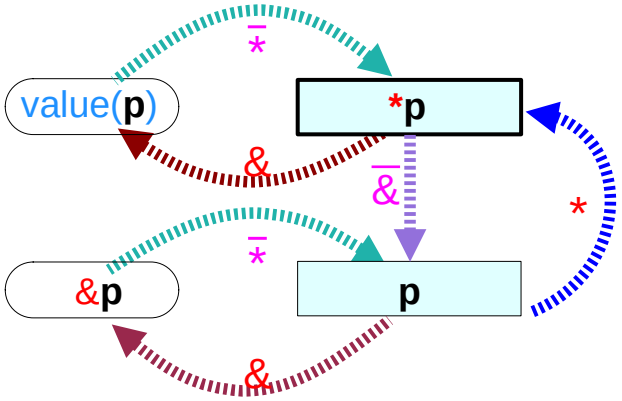
C operators : *, &





augmented operators : $\overline{*}$, $\overline{\&}$





Comparisons (2)

C operators : *, &

	×	a	lvalue
lvalue ←	*	p	lvalue
lvalue ←	*	* p	lvalue
lvalue ←	*	val	rvalue

rvalue ←	&	a	lvalue
rvalue ←	&	p	lvalue
rvalue ←	&	* p	lvalue
	×	val	rvalue

augmented operators : $\overline{*}$, $\overline{\&}$

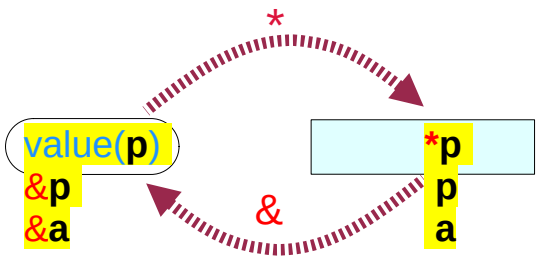
	×	a	lvalue
lvalue ←	*	p	lvalue
lvalue ←	*	* p	lvalue
lvalue ←	$\overline{*}$	val	rvalue

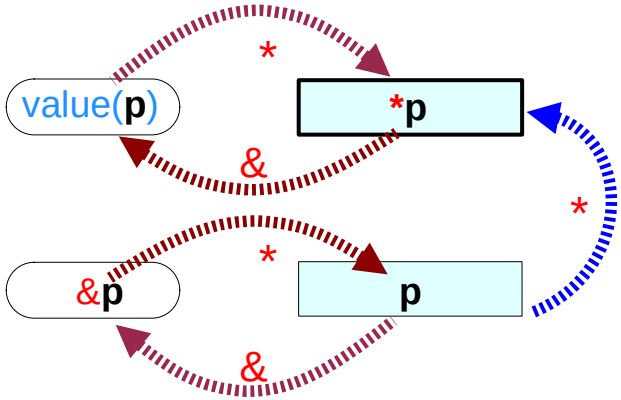
rvalue ←	&	a	lvalue
rvalue ←	&	p	lvalue
rvalue ←	&	* p	lvalue
lvalue ←	$\overline{\&}$	* p	lvalue
	×	val	rvalue

C operators : *, &

	×	a	lvalue
lvalue ←	*	p	lvalue
lvalue ←	*	* p	lvalue
lvalue ←	*	val	rvalue

rvalue ←	&	a	lvalue
rvalue ←	&	p	lvalue
rvalue ←	&	* p	lvalue
	×	val	rvalue

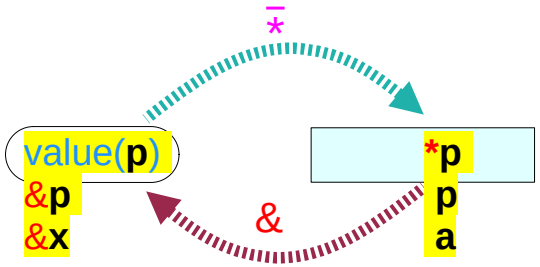


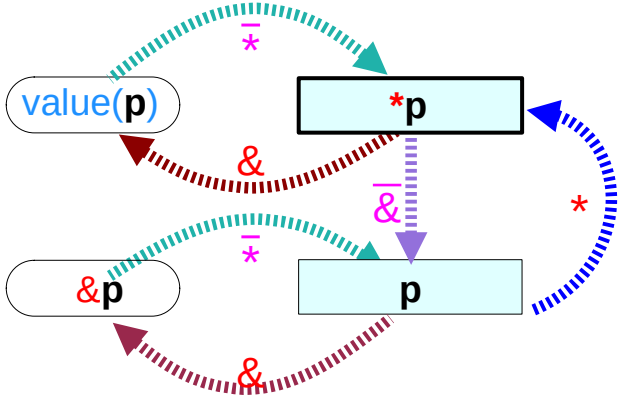


Augmented operators : $\bar{*}$, $\bar{\&}$

	×	a	lvalue
lvalue ←	*	p	lvalue
lvalue ←	*	* p	lvalue
lvalue ←	$\bar{*}$	val	rvalue

rvalue ←	&	a	lvalue
rvalue ←	&	p	lvalue
rvalue ←	&	* p	lvalue
lvalue ←	$\bar{\&}$	* p	lvalue
	×	val	rvalue





Recursive application of the address-of operator

~~&(&(&(c[i])[j])[k])~~

& C operator

takes only **lvalue** variable
returns **rvalue** address value
thus, the above expression is not possible

successive application of **&** is not possible,
Unless intermediate variables and proper
type casting

but, ***p** becomes a **lvalue** variable
* operator can be applied successively.

$\overline{\&}(\overline{\&}(\overline{\&}(c[i])[j])[k])$

$\overline{\&}$ mathematical operator

takes a dereferenced **lvalue** variable
returns **lvalue** variable

successive application of **$\overline{\&}$** is not possible

but, ***p** becomes a **lvalue** variable
* operator can be applied successively.

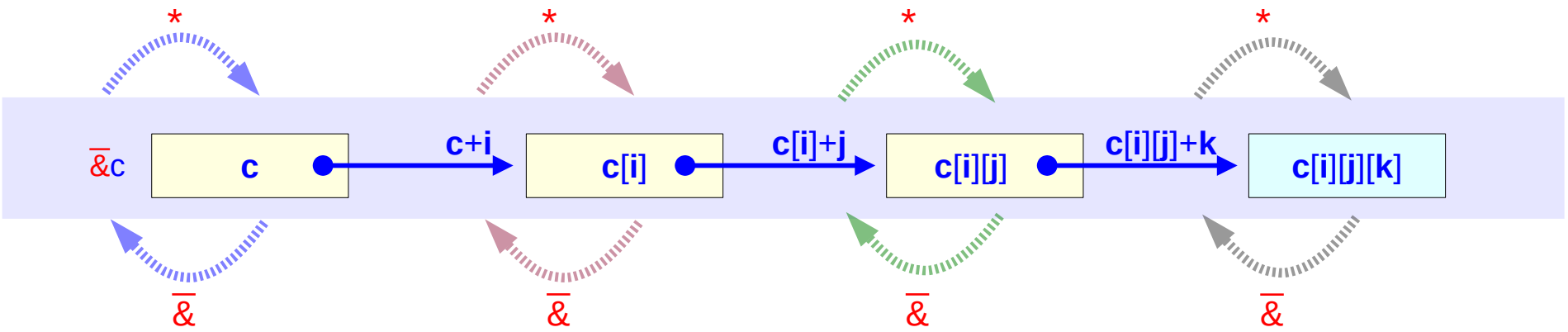
Recursive application of the address-of operator

((*(c+i)+j)+k)

((*(c+i)+j)+k) =
((c[i]+j)+k) =
*(c[i][j]+k) =
c[i][j][k]

&(&(&(c[i])[j])[k])

&(&(&(c[i])[j])[k]) =
(&(&(c[i])[j])+k) =
((&(c[i])+j)+k) =
(((c+i)+j)+k)



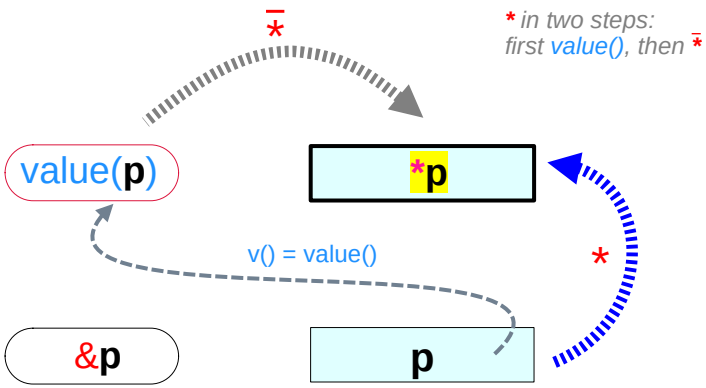
Recursive application of the address-of operator

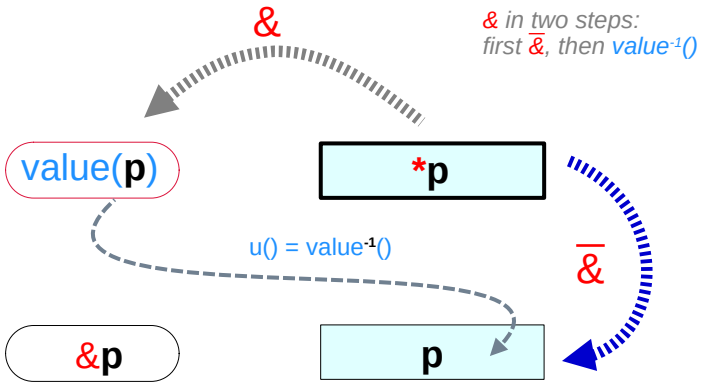
((*(c+i)+j)+k)

$\overline{*}v(\overline{*}v(\overline{*}v(c+i)+j)+k)$

$\overline{\&}(\overline{\&}(\overline{\&}(c[i])[j])[k])$

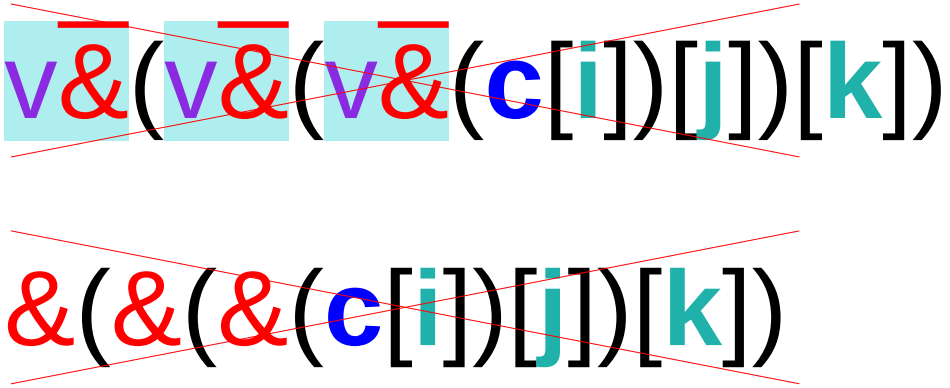
$u\&(u\&(u\&(c[i])[j])[k])$





Recursive application of the address-of operator

successive application of & is not possible,
Unless intermediate variables and proper
type casting



&(c[i][j][k]) = &(*(c[i][j]+k)) = &(*v(c[i][j]+k)) = v(c[i][j]+k)
= c[i][j] + k * sizeof(c[0][0][0])

&(c[i][j]) = &(*(c[i]+j)) = &(*v(c[i]+j)) = v(c[i]+j)
= c[i] + j * sizeof(c[0][0])

&(c[i]) = &(*(c+i)) = &(*v(c+i)) = v(c+i)
= c + i * sizeof(c[0])

Recursive application of the address-of operator

((*(c+i)+j)+k)

((c[i]+j)+k)

*(c[i][j]+k)

c[i][j][k]

$\overline{*}$v($\overline{*}$v($\overline{*}$v(c+i)+j)+k)

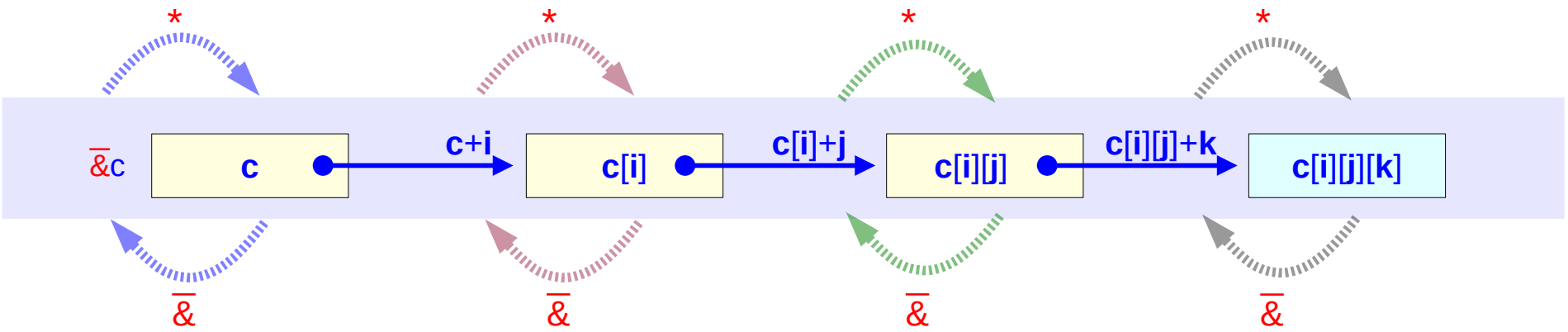
$\overline{\&}$(c[i][j][k]) = c[i][j] + k
$\overline{\&}$(c[i][j]) = c[i] + j
$\overline{\&}$(c[i]) = c + i

c[i][j][k] = *(c[i][j] +k)
c[i][j] = *(c[i] +j)
c[i] = *(c+i)

$\overline{\&}$(c[i][j][k]) = c[i][j] + k * sizeof(c[0][0][0])

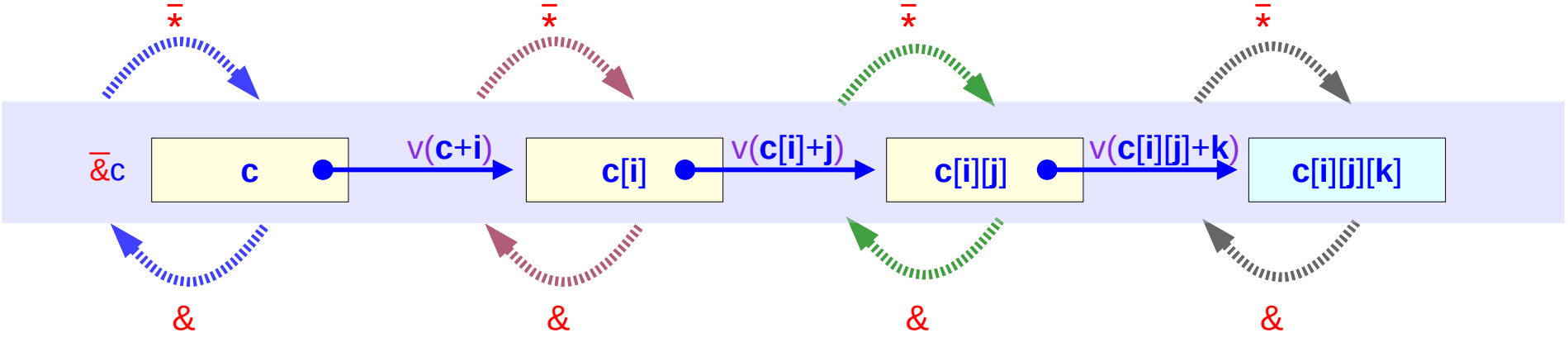
Two step deferencing in type II (1) – without skipping

```
&(c[i][j][k])     = &(*(c[i][j]+k))     = c[i][j]    + k
&(c[i][j])        = &(*(c[i]+j))        = c[i]       + j
&(c[i])           = &(*(c+i))           = c          + i

*&(c[i][j][k])    = *&(*(c[i][j]+k))    = *(c[i][j]  +k)
*&(c[i][j])       = *&(*(c[i]+j))       = *(c[i]     +j)
*&(c[i])          = *&(*(c+i))          = *(c        +i)
```

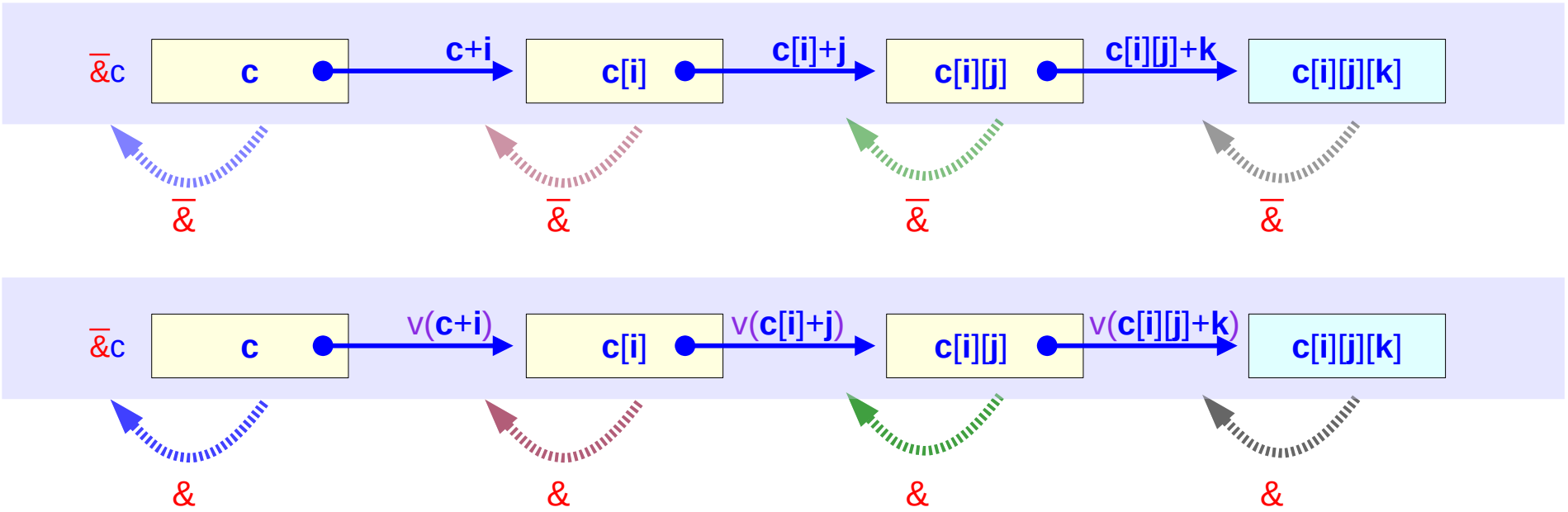


Two step deferencing in type II (1) – without skipping

```
&(c[i][j][k])    = &(*(c[i][j]+k))    = value(c[i][j]  +k)  = c[i][j]  + k * sizeof(c[0][0][0])
&(c[i][j])       = &(*(c[i]+j))       = value(c[i]     +j)  = c[i]     + j * sizeof(c[0][0])
&(c[i])          = &(*(c+i))          = value(c        +i)  = c        + i * sizeof(c[0])

*&(c[i][j][k])   = *&(*(c[i][j]+k))   = *value(c[i][j] +k)  = *(c[i][j] + k * sizeof(c[0][0][0]))
*&(c[i][j])      = *&(*(c[i]+j))      = *value(c[i]    +j)  = *(c[i]    + j * sizeof(c[0][0]))
*&(c[i])         = *&(*(c+i))         = *value(c       +i)  = *(c       + i * sizeof(c[0]))
```

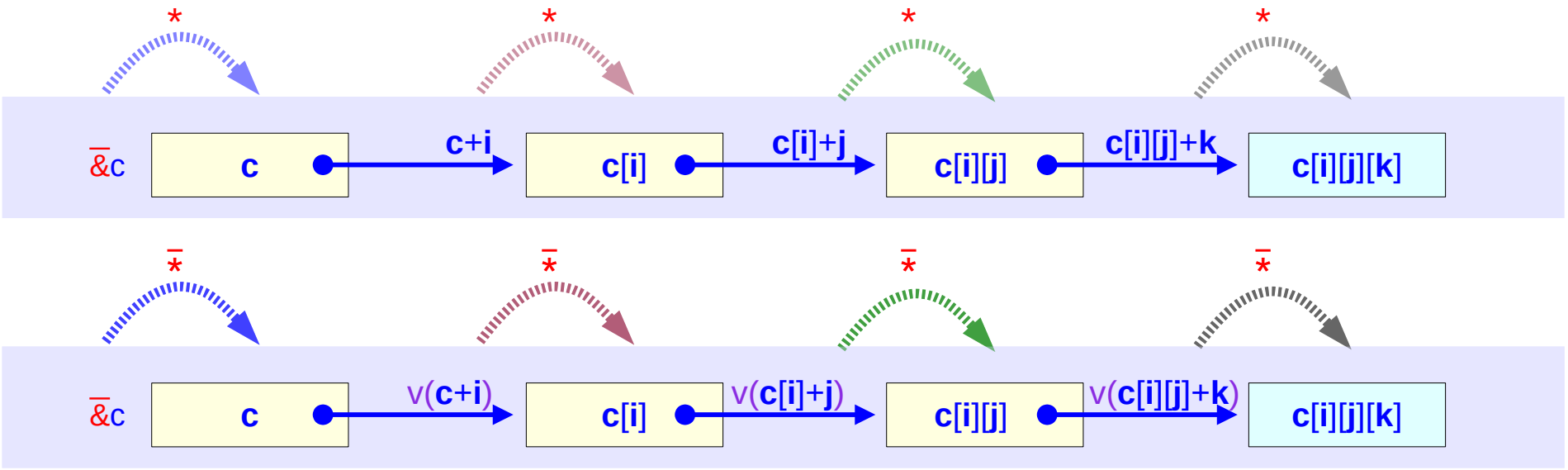


```
&(c[i][j][k])    = &(*(c[i][j]+k))    = c[i][j]    + k
&(c[i][j])       = &(*(c[i]+j))       = c[i]       + j
&(c[i])          = &(*(c+i))          = c          + i

&(c[i][j][k])    = &(*(c[i][j]+k))    = c[i][j]    + k * sizeof(c[0][0][0])
&(c[i][j])       = &(*(c[i]+j))       = c[i]       + j  * sizeof(c[0][0])
&(c[i])          = &(*(c+i))          = c          + i  * sizeof(c[0])
```



*&(c[i][j][k]) = *&(*(c[i][j]+k)) = *(c[i][j] +k)
*&(c[i][j]) = *&(*(c[i]+j)) = *(c[i] +j)
*&(c[i]) = *&(*(c+i)) = *(c +i)

*&(c[i][j][k]) = *&(*(c[i][j]+k)) = *(c[i][j] + k * sizeof(c[0][0][0]))
*&(c[i][j]) = *&(*(c[i]+j)) = *(c[i] + j * sizeof(c[0][0]))
*&(c[i]) = *&(*(c+i)) = *(c + i * sizeof(c[0]))



Two step deferencing in type II (1) – without skipping

```
&(c[i][j][k])      = &(*(c[i][j]+k))      = c[i][j]     + k
&(c[i][j])         = &(*(c[i]+j))         = c[i]        + j
&(c[i])            = &(*(c+i))            = c           + i

*&(c[i][j][k])     = *&(*(c[i][j]+k))     = *(c[i][j]   +k)
*&(c[i][j])        = *&(*(c[i]+j))        = *(c[i]      +j)
*&(c[i])           = *&(*(c+i))           = *(c         +i)


&(c[i][j][k])      = &(*(c[i][j]+k))      = c[i][j]     + k * sizeof(c[0][0][0])
&(c[i][j])         = &(*(c[i]+j))         = c[i]        + j  * sizeof(c[0][0])
&(c[i])            = &(*(c+i))            = c           + i  * sizeof(c[0])

c[i][j][k]         = *&(*(c[i][j]+k))     = *(c[i][j]   + k * sizeof(c[0][0][0])
c[i][j]            = *&(*(c[i]+j))        = *(c[i]      + j  * sizeof(c[0][0]))
c[i]               = *&(*(c+i))           = *(c         + i  * sizeof(c[0]))
```

Two step deferencing in type II (1) – without skipping

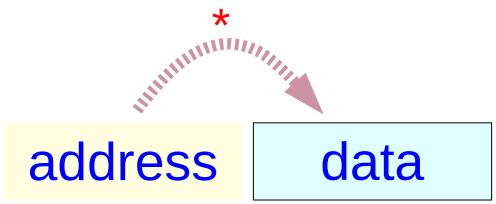
```
&(c[i][j][k])     = c[i][j]    + k
&(c[i][j])        = c[i]       + j
&(c[i])           = c          + i

c[i][j][k]        = *(c[i][j]  +k)
c[i][j]           = *(c[i]     +j)
c[i]              = *(c        +i)


&(c[i][j][k])     = c[i][j]    + k * sizeof(c[0][0][0])
&(c[i][j])        = c[i]       + j  * sizeof(c[0][0])
&(c[i])           = c          + i  * sizeof(c[0])

c[i][j][k]        = *(c[i][j]  + k * sizeof(c[0][0][0])
c[i][j]           = *(c[i]     + j  * sizeof(c[0][0]))
c[i]              = *(c        + i  * sizeof(c[0]))
```

Two step deferencing in type II (1) – without skipping

&(c[i][j][k])	= c[i][j]	+ k	&(c[i][j][k])	= value(c[i][j]	+ k)
&(c[i][j])	= c[i]	+ j	&(c[i][j])	= value(c[i]	+ j)
&(c[i])	= c	+ i	&(c[i])	= value(c	+ i)
c[i][j][k]	= *(c[i][j]	+k)	c[i][j][k]	= * value(c[i][j]	+ k)
c[i][j]	= *(c[i]	+j)	c[i][j]	= * value(c[i]	+ j)
c[i]	= *(c	+i)	c[i]	= * value(c	+ i)

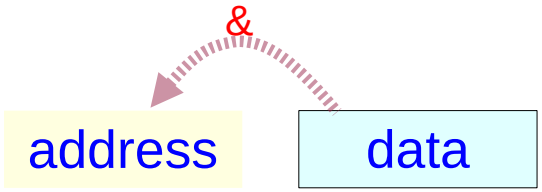
Address-of & and dereference * C operators (1)

Primitive Data Type



rvalue &a → *lvalue* a
constant *variable*

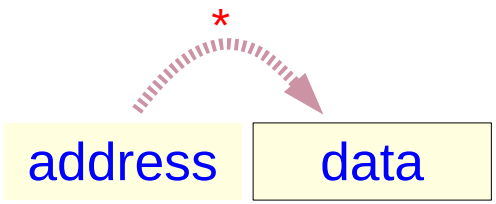
lvalue p → *lvalue* *p
pointer *variable*



rvalue &a ← *lvalue* a
constant *variable*

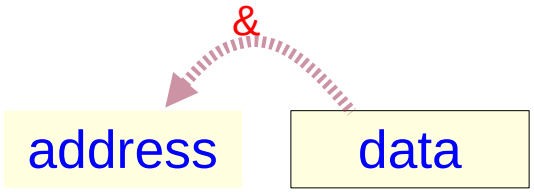
~~*lvalue*~~ p ← *lvalue* *p
pointer *variable*

Pointer Data Type



rvalue &q → *lvalue* q
constant *double pointer*

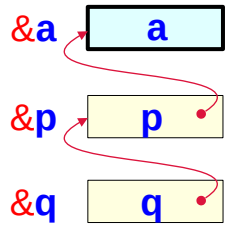
lvalue q → *lvalue* *q
double pointer *pointer*

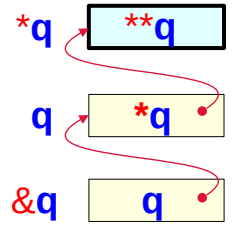


rvalue &q ← *lvalue* q
constant *double pointer*

~~*lvalue*~~ q ← *lvalue* *q
double pointer *pointer*

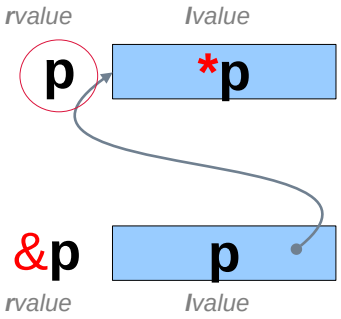
```
int    a ;
int *  p ;
int ** q ;
```





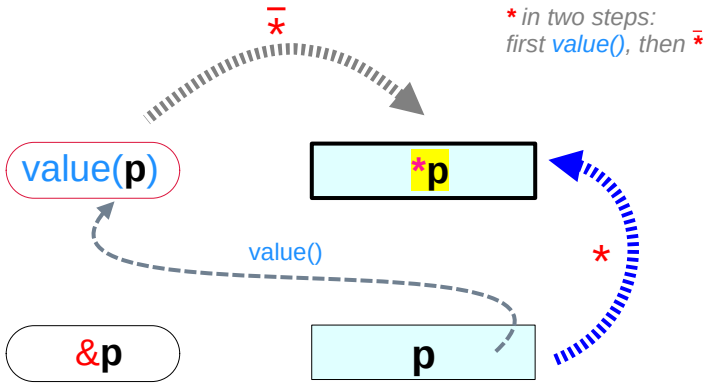
& and * operators in pointer de-referecing

Two step De-reference * operation

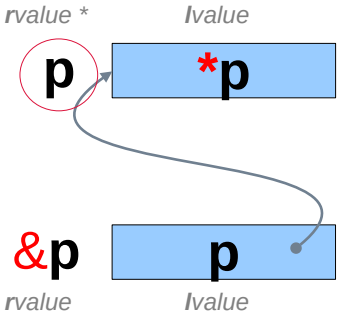


***p** must be evaluated to an address*
*value(**p**) before de-referencing ***p***

think a new operator :
$\overline{*}$ is a mathematical operator
$\overline{*}$ takes rvalue and returns lvalue

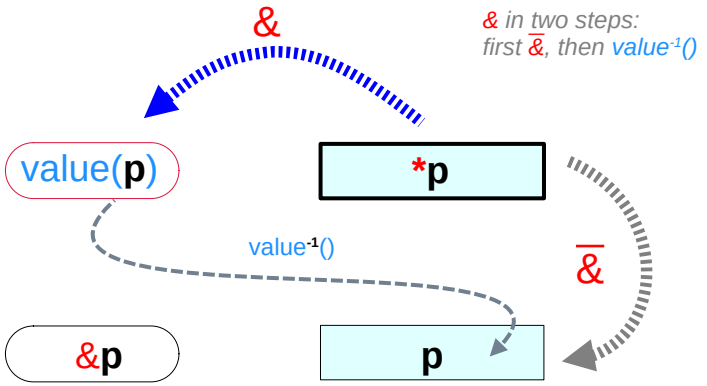


Two step Address-of & operation

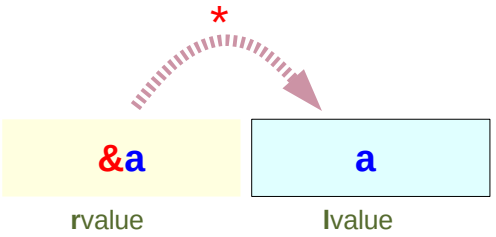


assume that it is possible
*to recover the variable **p** from value(**p**)*

think a new operator :
$\overline{\&}$ is a mathematical operator
$\overline{\&}$ takes lvalue and returns lvalue

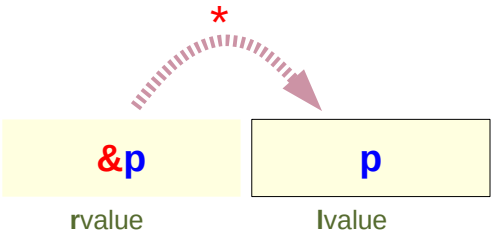


Type, Size, and Value attributes of an **lvalue**



lvalue ⟵ ***rvalue***

a ****&a***



lvalue ⟵ ***rvalue***

p ****&p***

lvalue is associated with a memory location

lvalue has the following attributes
- Type
- Size
- Value

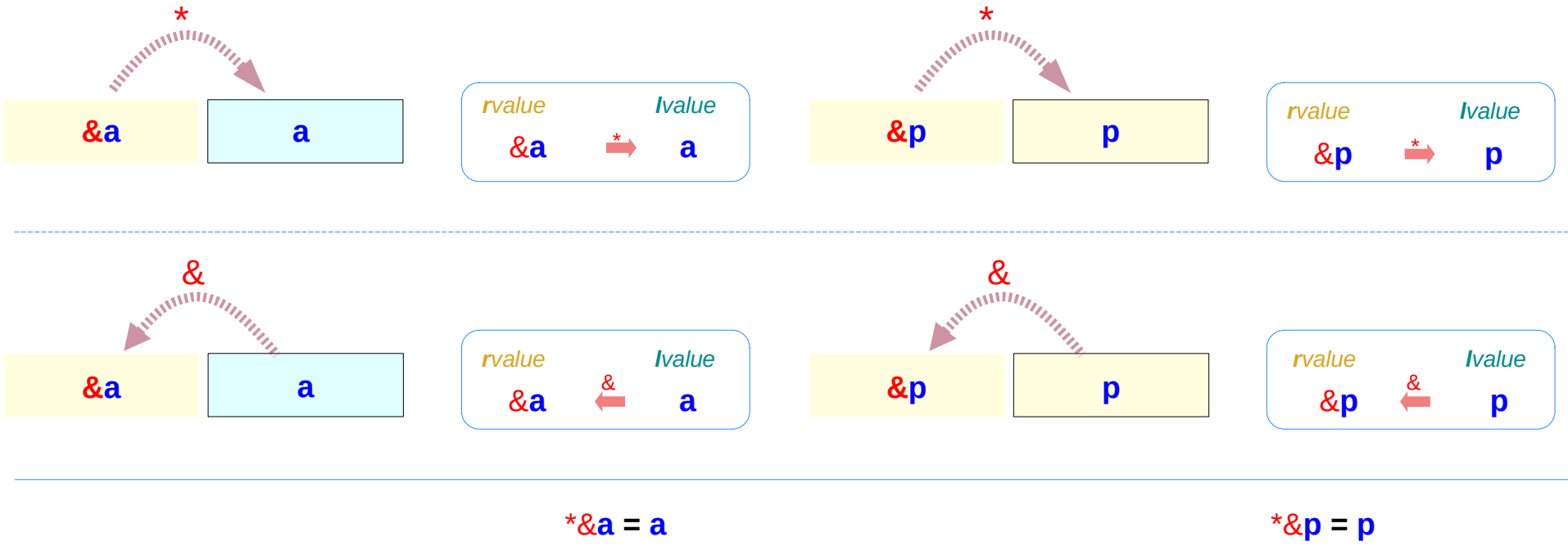
rvalue has the only attribute
- Value

assume the function value()

value(**lvalue**) returns
the Value attribute of **lvalue**

value(**rvalue**) returns
the Value attribute of **rvalue**

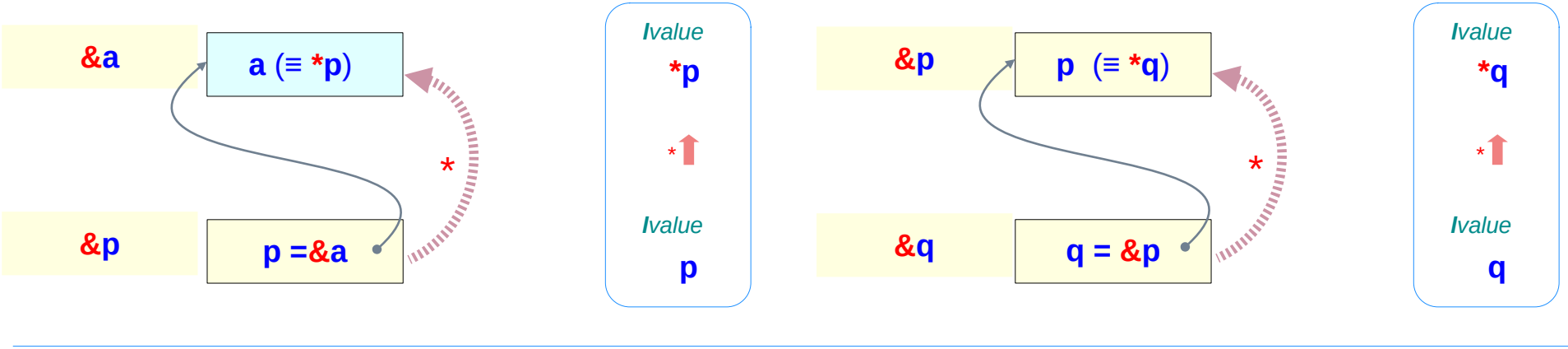
Address-of & and dereference * C operators (1)

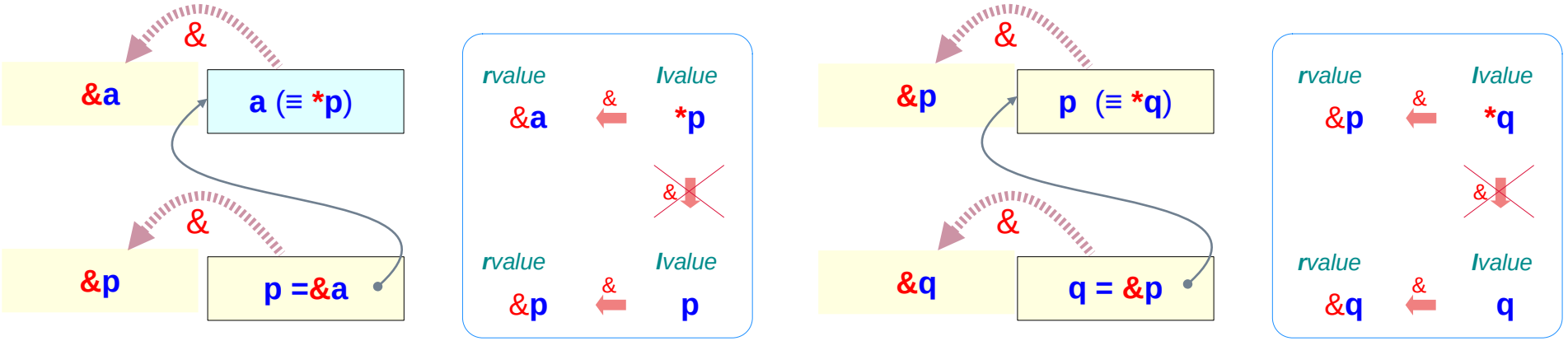


*&a = a

*&p = p

Address-of & and dereference * C operators (2)





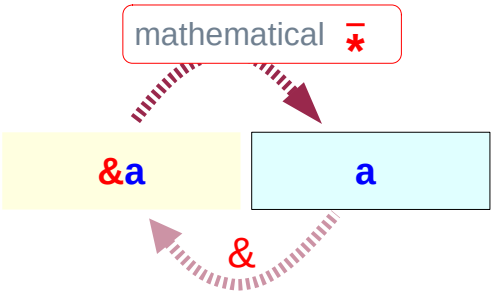
*&p = p

~~&*p = p~~ value(p)

*&q = q

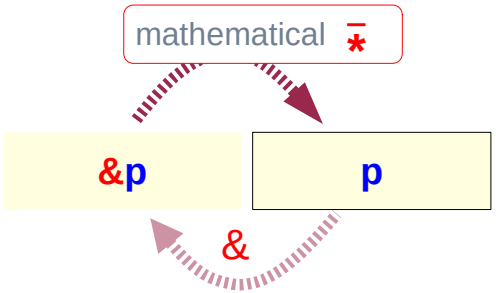
~~&*q = q~~ value(q)

Introducing mathematical operators : $\overline{\&}$ and $\overline{*}$



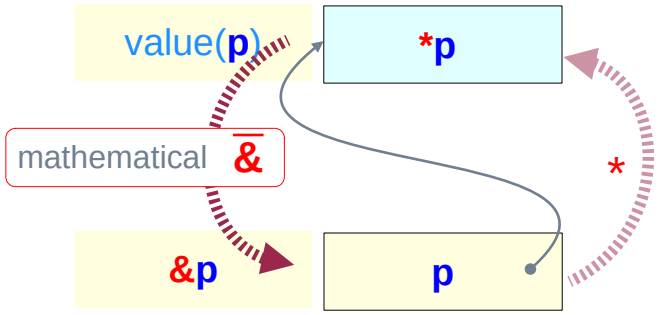
$\overline{*}$ &a = a

&a



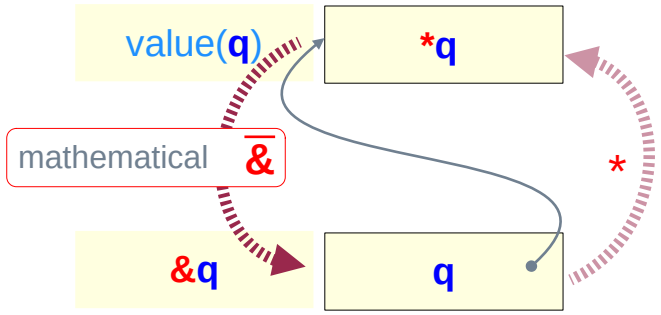
$\overline{*}$ &p = p

&p



*p

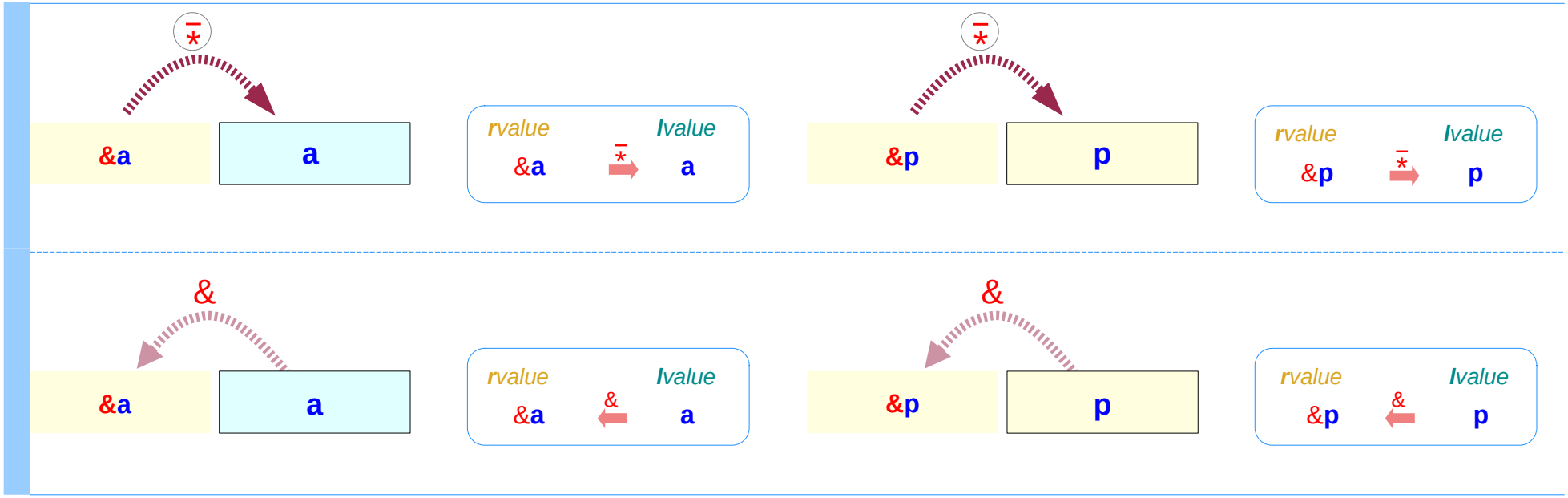
$\overline{\&}$ *p = p



*q

$\overline{\&}$ *q = q

Inverse operators *̄ and &



*̄&a = a

&*̄&a = &a

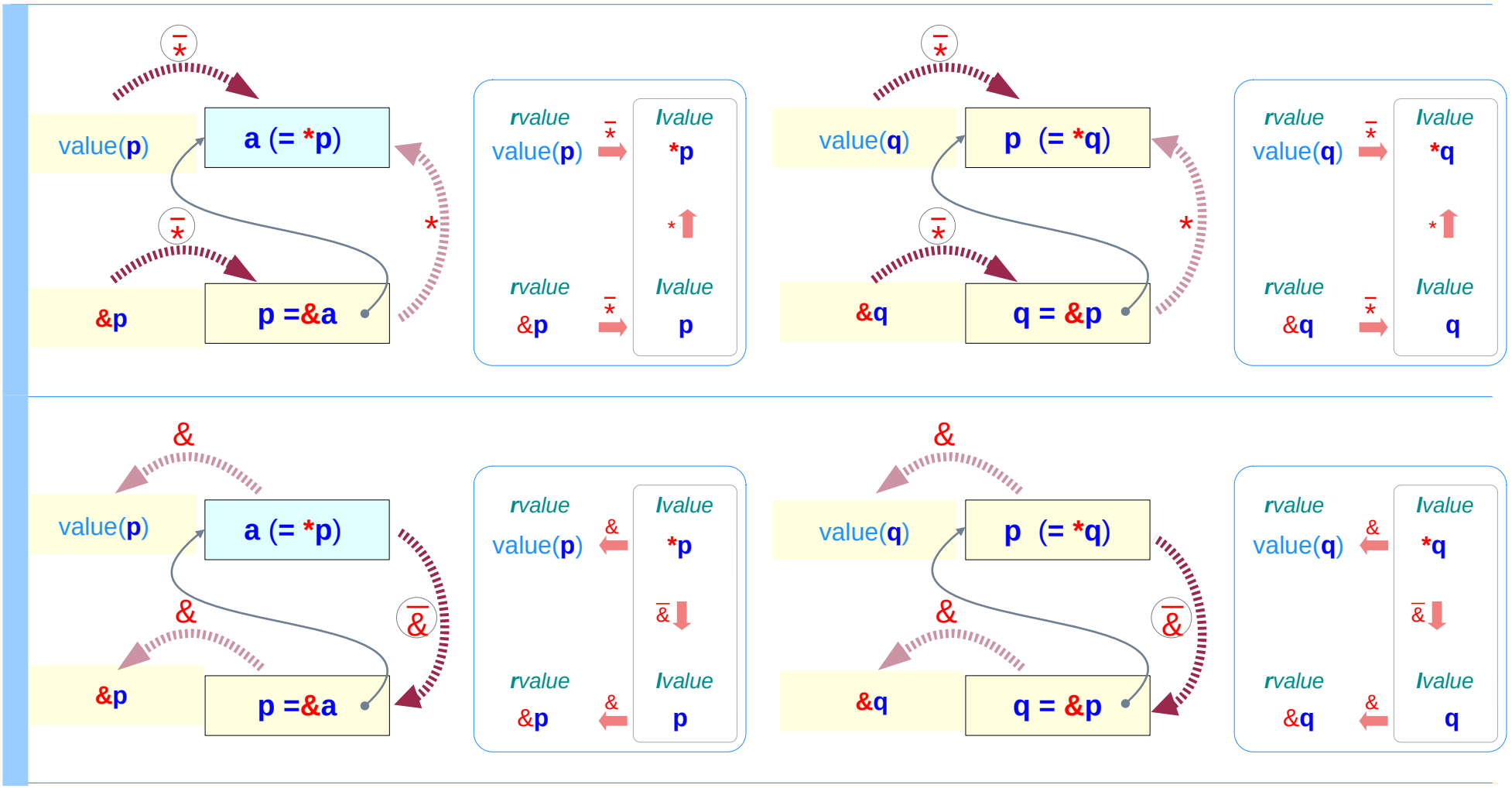
*̄ and & are inverse operators to each other

*̄&p = p

&*̄&p = &p

*̄ and & are inverse operators to each other

Inverse operators $\overline{\&}$ and *



$\overline{*}\&p = p$

$\&\overline{*}p = p$

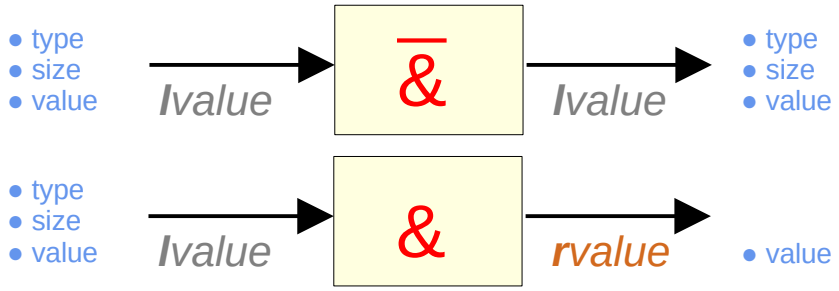
$\overline{*}\&q = q$

$\&\overline{*}q = q$

C operators and mathematical operators

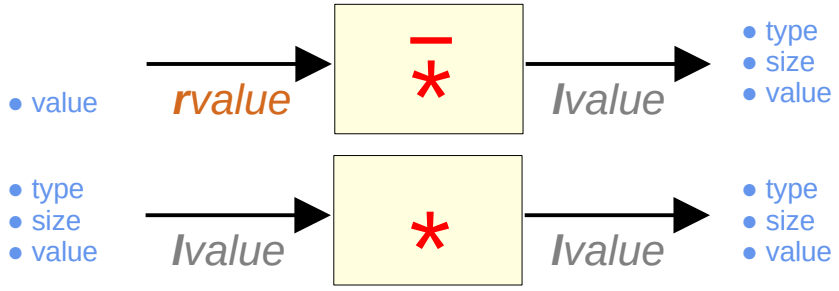
Address-of operation

&x	=	value(&x)
C Expressions		Mixed Expressions

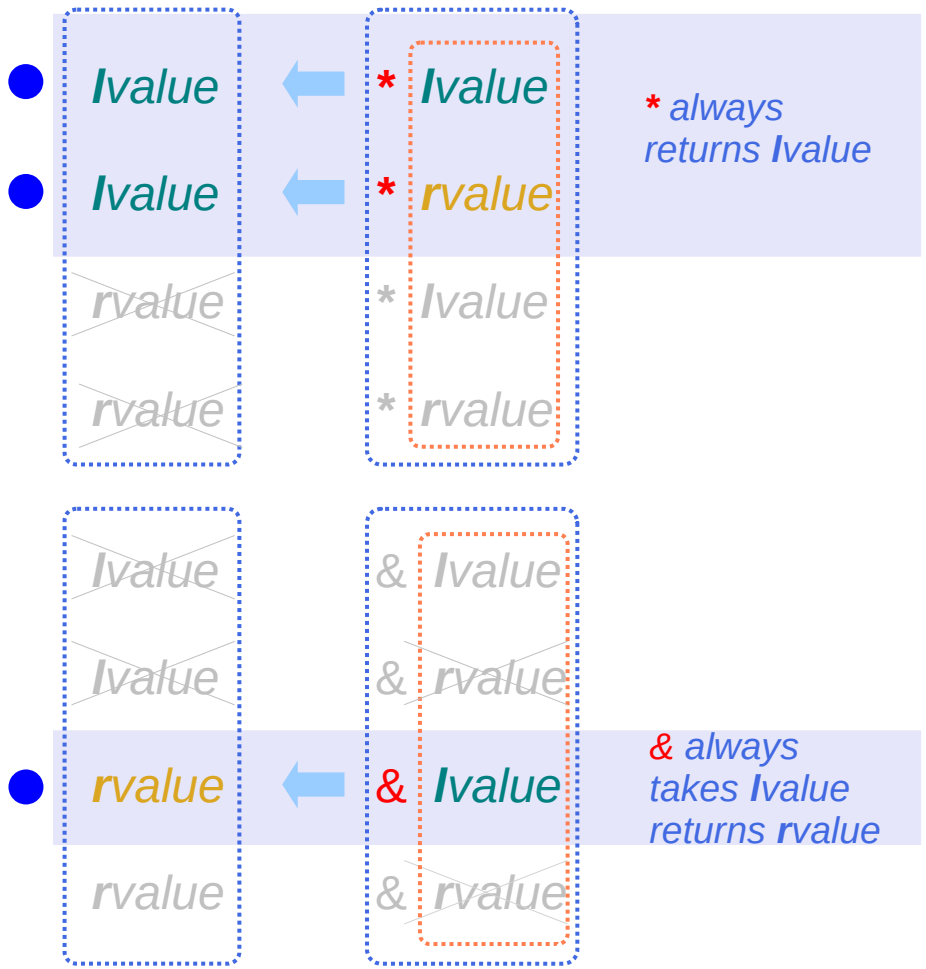


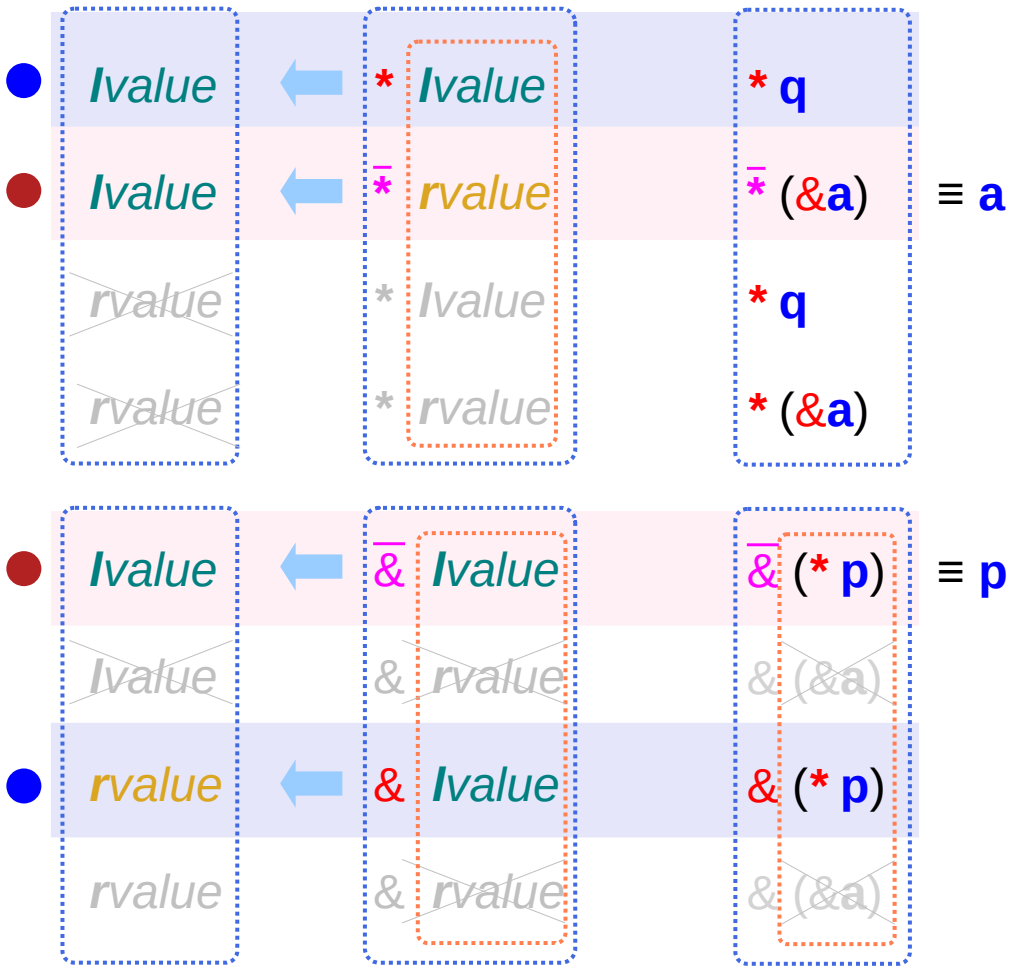
De-reference operation

*p	=	*value(p)
C Expressions		Mixed Expressions



lvalue and rvalue with * and & operators





a, **p**, **q** : lvalues … variables … RW
***p**, ***q**, ****q** : lvalues … variables … RW
&a, **&p**, **&q** : rvalues … constants … RO

Examples of inverse operators

$\bar{*}\&a \Rightarrow a$

$\bar{*}\&p \Rightarrow p$

$\bar{*}\&q \Rightarrow q$

$\bar{*}value(p) \Rightarrow *p \Rightarrow a$

$\bar{*}value(q) \Rightarrow *q \Rightarrow p$

$\bar{*}value(*q) \Rightarrow **q \Rightarrow *p \Rightarrow a$

$\bar{\&}*p \Rightarrow p$

$\bar{\&}*q \Rightarrow q$

$\bar{\&}**q \Rightarrow *q$

Extended Operators

$*\&a \Rightarrow a$

$*\&p \Rightarrow p$

$*\&q \Rightarrow q$

$*p \Rightarrow a$

$*q \Rightarrow p$

$**q \Rightarrow *p \Rightarrow a$

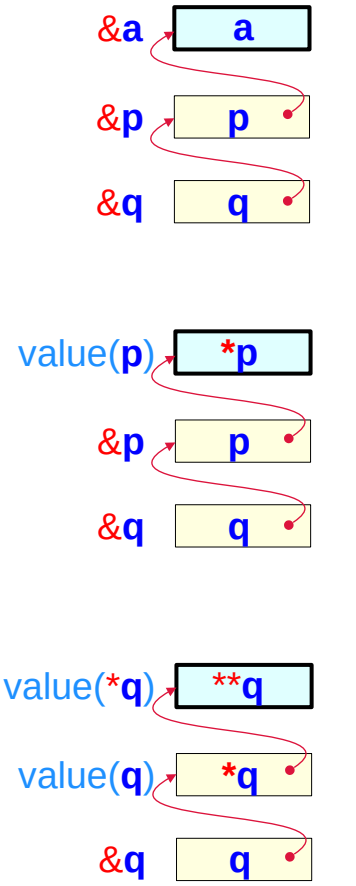
$\&*p \Rightarrow \&a$

$\&*q \Rightarrow \&p$

$\&**q \Rightarrow \&a$

C Operators

```
int    a ;
int *  p = & a ;
int ** q = & p ;
```



Operands of mathematical operators : & and *

* address value

& * value(**P**) ➡ value(**P**)

* & variable

* &**X** ➡ **X**

& * pointer

& ***P** ➡ **P**

dereferenced pointer

& ~~pointer~~

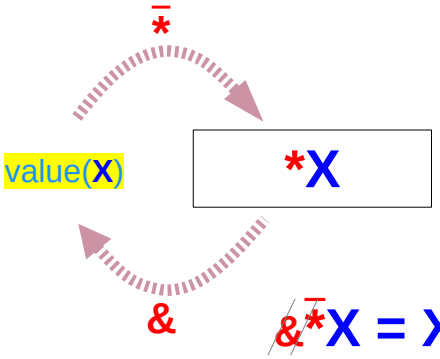
* &**Q** ➡ **Q**

must be a dereferenced pointer

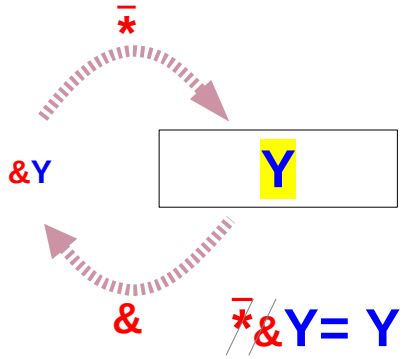
not considering
simultaneous pointing

Q must be a dereferenced pointer
i.e, **Q = *p** ➡ &**Q = p**

& and mathematical $\bar{*}$

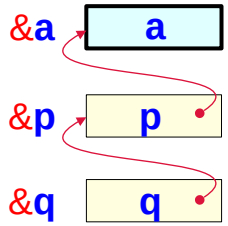


$\& \bar{*} X = X$



$\bar{*} \& Y = Y$

```
int    a ;
int *  p = & a ;
int ** q = & p ;
```



$\& \bar{*} value(a) = value(a)$

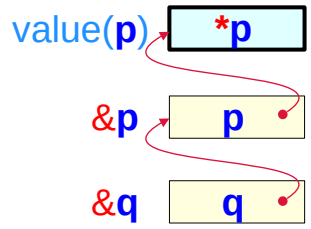
$\& \bar{*} value(p) = value(p)$

$\& \bar{*} value(q) = value(q)$

$\bar{*} \& a = a$

$\bar{*} \& p = p$

$\bar{*} \& q = q$



$\& *a = value(a)$

$\& *p = value(p)$

$\& *q = value(q)$

$\bar{*} \& a = a$

$\bar{*} \& p = p$

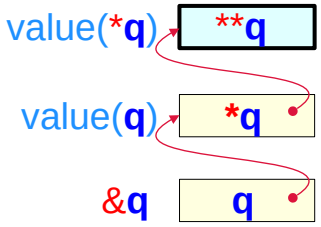
$\bar{*} \& q = q$

$* \& a = a$

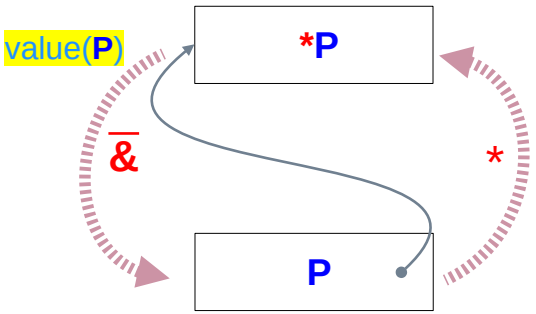
$* \& p = p$

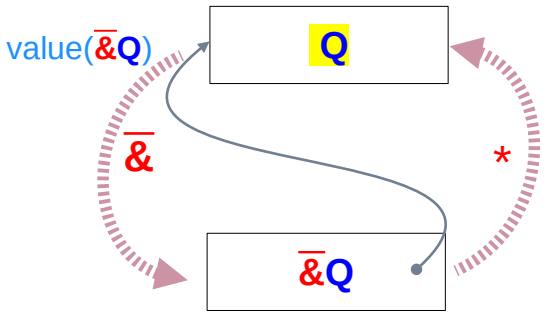
$* \& q = q$

C expressions



* and mathematical &





$\overline{\&}{}^{*}P = P$

if not considering simultaneous pointing

${}^{*}\overline{\&}Q = Q$

$\overline{\&}\ {}^{*}p = p$

$\overline{\&}\ {}^{*}q = q$

$\&\ {}^{*}p = value(p)$

$\&\ {}^{*}q = value(q)$

${}^{*}\ \overline{\&}{}^{*}p = {}^{*}p$

${}^{*}\ \overline{\&}{}^{*}q = {}^{*}q$

$\overline{{}^{*}}\ \&{}^{*}p = {}^{*}p$

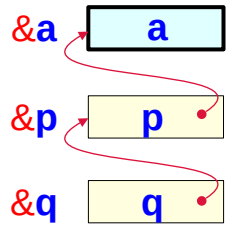
$\overline{{}^{*}}\ \&{}^{*}q = {}^{*}q$

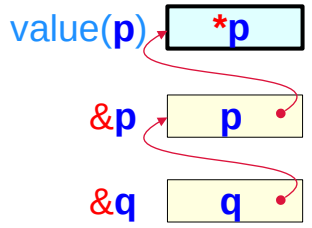
$* \ \&{}^{*}p = {}^{*}p$

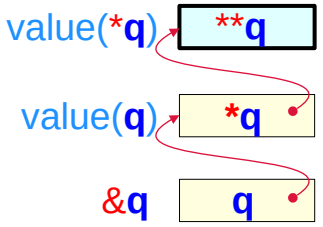
$* \ \&{}^{*}q = {}^{*}q$

C operators

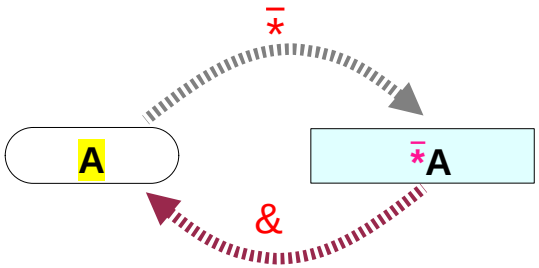
```
int    a ;
int *  p = & a ;
int ** q = & p ;
```





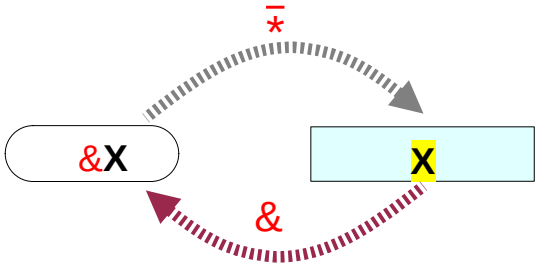


Requirements of address and data



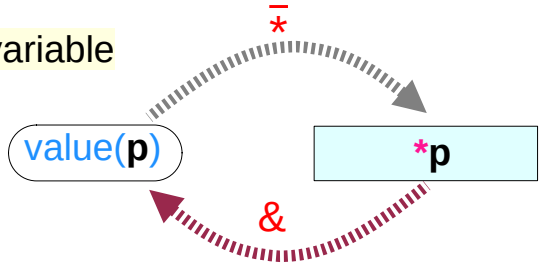
A : an address value - a number

value(**p**), &**p**, &**x**



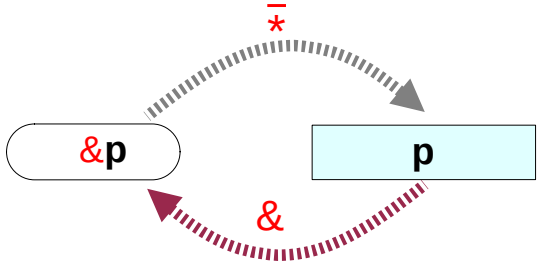
X : a variable ***p**, **p**, **a**

***p :** a dereferenced variable



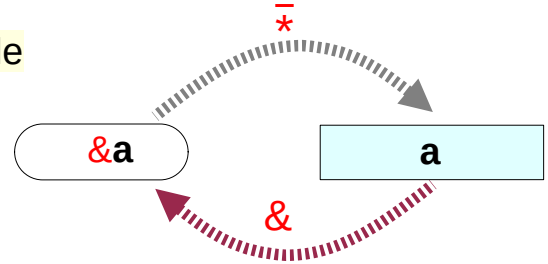
Pointer Dereferencing

p : a pointer variable



Pointer Data

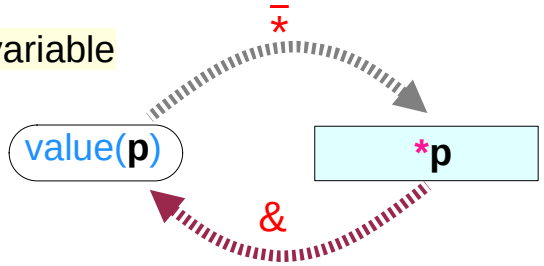
a : a primitive variable



Non-pointer Data

Inverse relations of & and $\bar{*}$ operators

***p :** a dereferenced variable

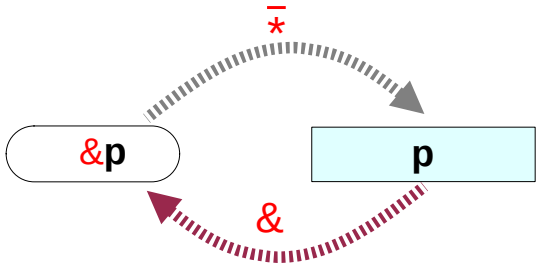


$\bar{*}$ value(**p**) = ***p**

$\&\bar{*}$ value(**p**) = & ***p** = value(**p**)

$\bar{*}\&$ $\bar{*}$value(**p**) = $\bar{*}\&$ ***p** = $\bar{*}$value(**p**) = ***p**

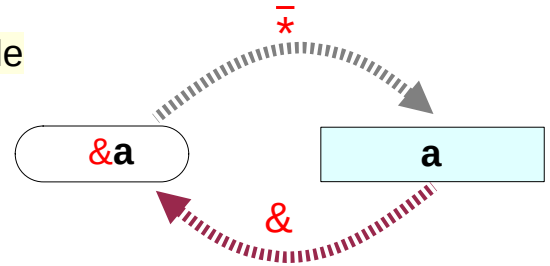
p : a pointer variable



$\bar{*}$ &**p** = **p**

$\&\bar{*}$ &**p** = &**p**

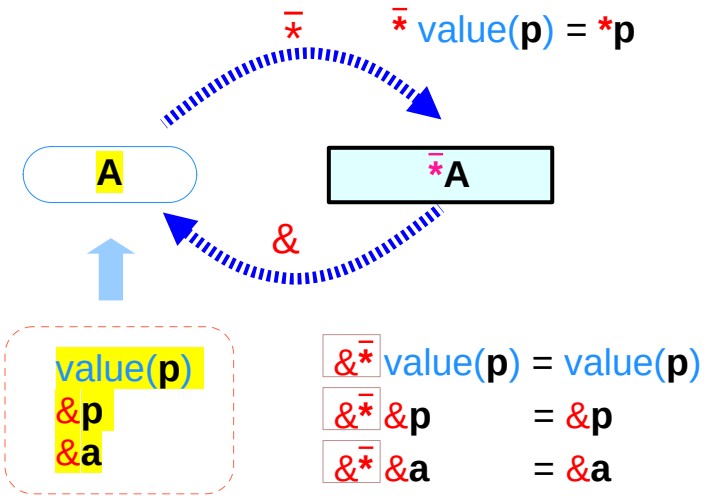
a : a primitive variable

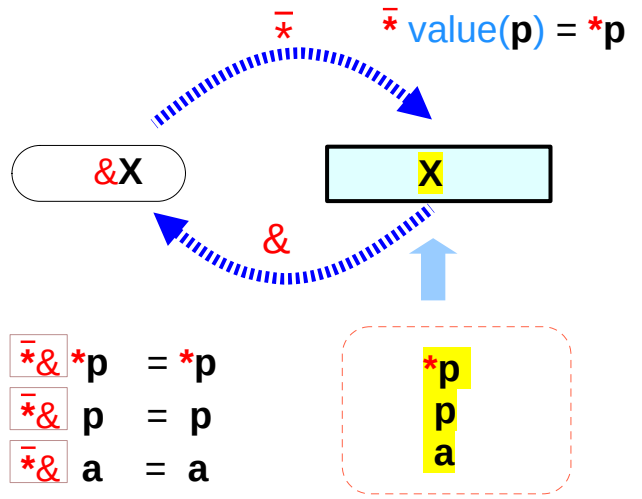


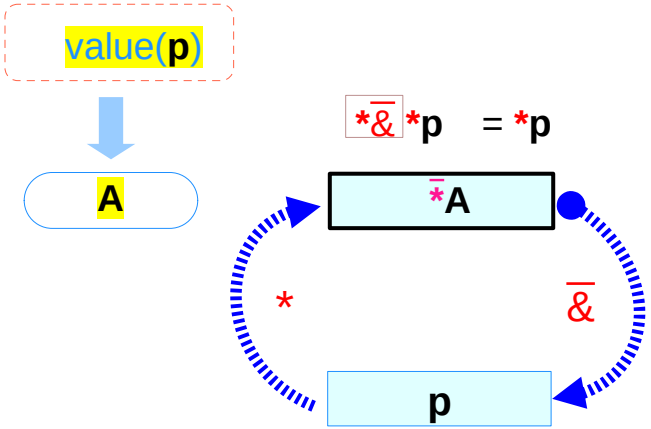
$\bar{*}$ &**a** = **a**

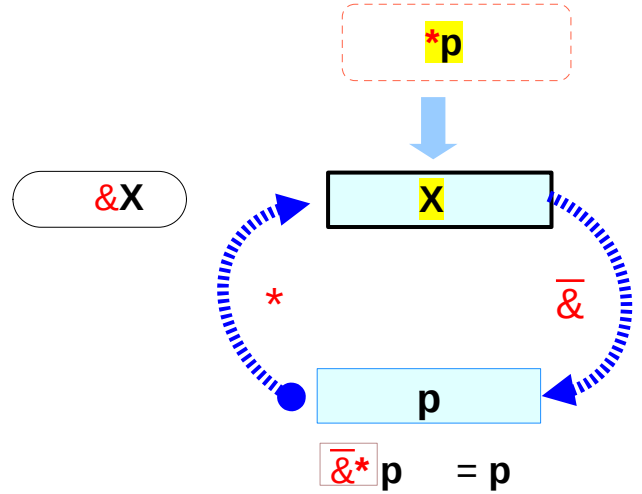
$\&\bar{*}$ &**a** = &**a**

Requirements of pointed address and data



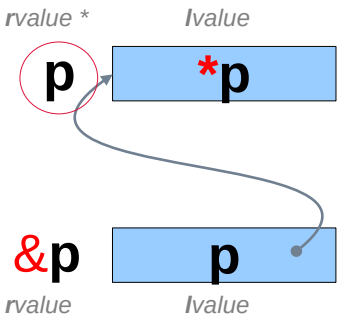




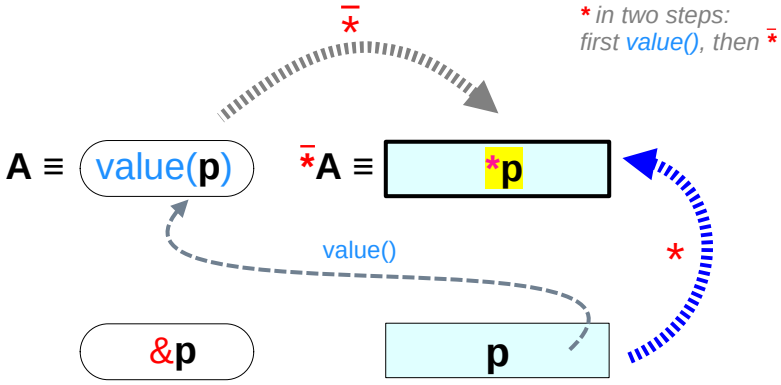


& and * operators in pointer de-referecing (1)

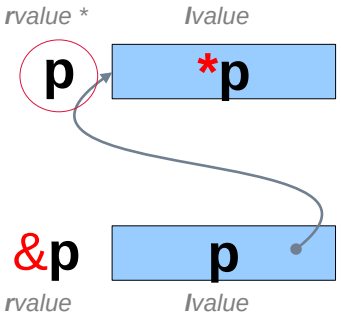
Two step De-reference * operation



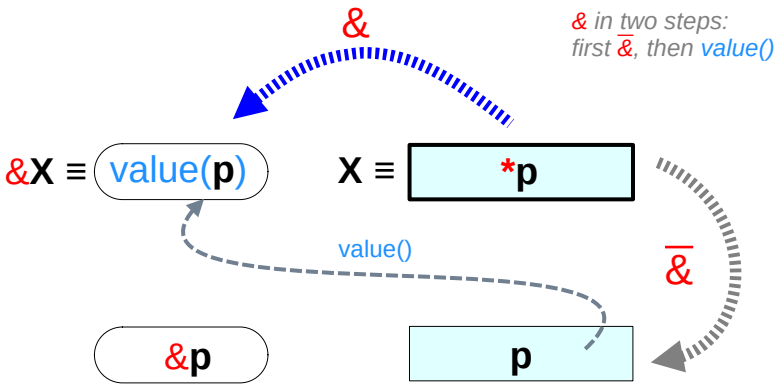
*p	=	$\bar{*}$value(p)
C Expressions		Mixed Expressions
$\bar{*}$A	=	*value^{-1}(A)



Two step Address-of & operation

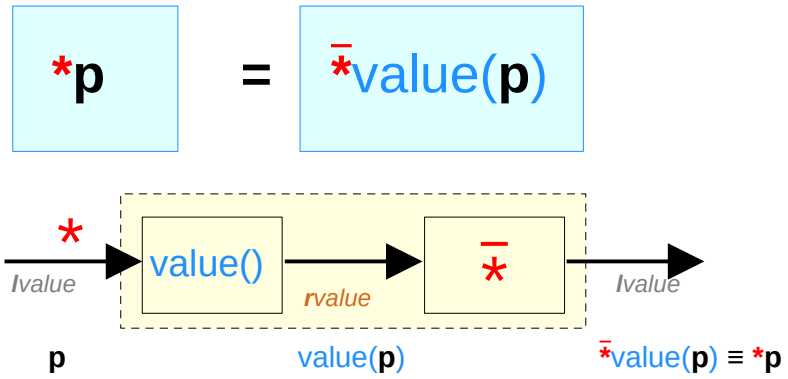


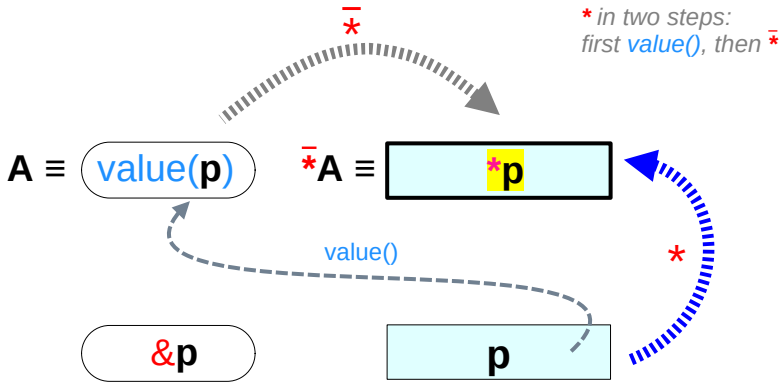
&X	=	value($\bar{\&}$X)
C Expressions		Mixed Expressions
$\bar{\&}$X	=	value^{-1}(&X)



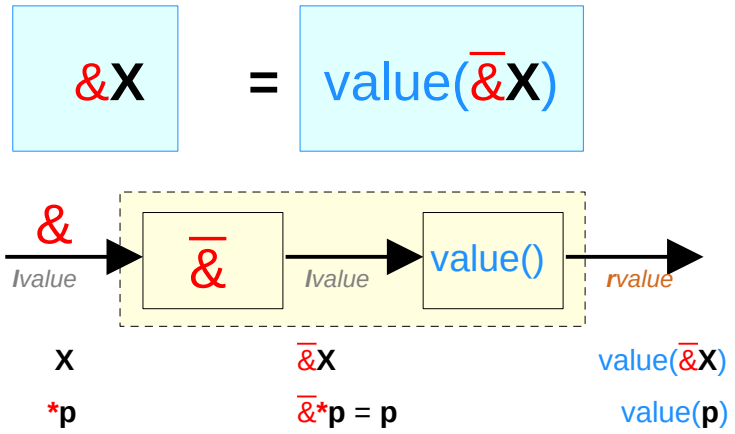
& and * operators in pointer de-referecing (2)

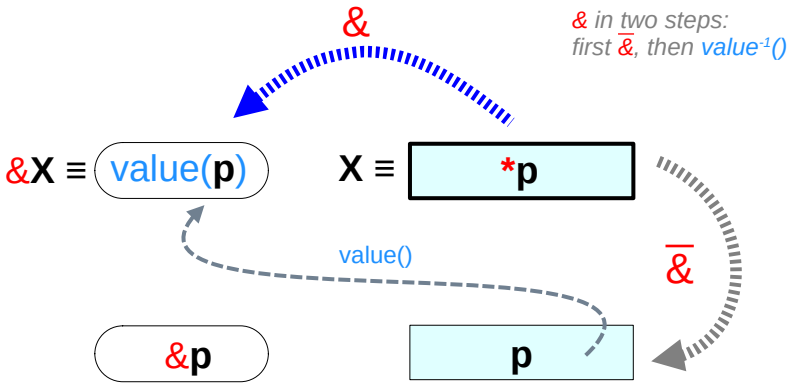
Two step De-reference * operation





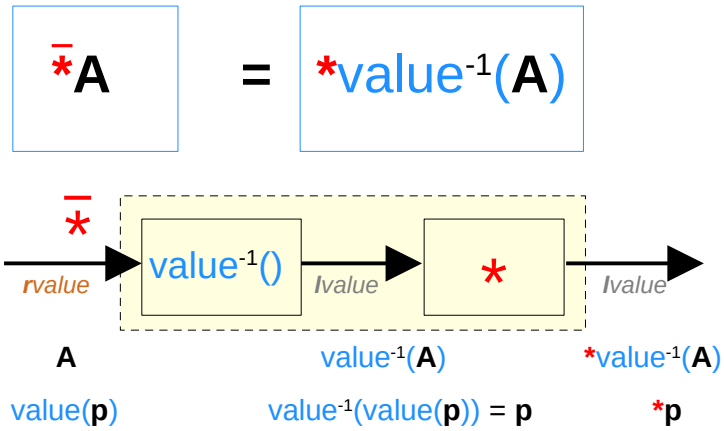
Two step Address-of & operation

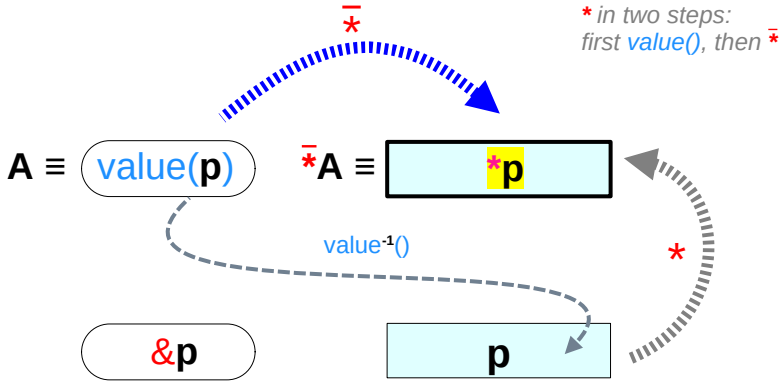




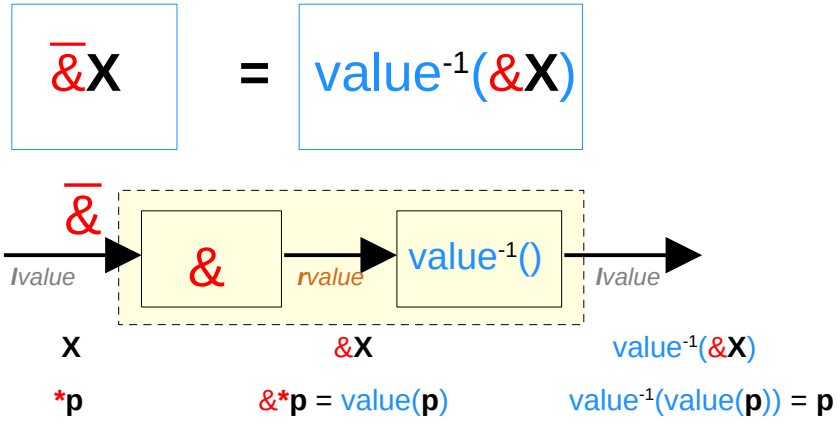
& and * operators in pointer de-referecing (3)

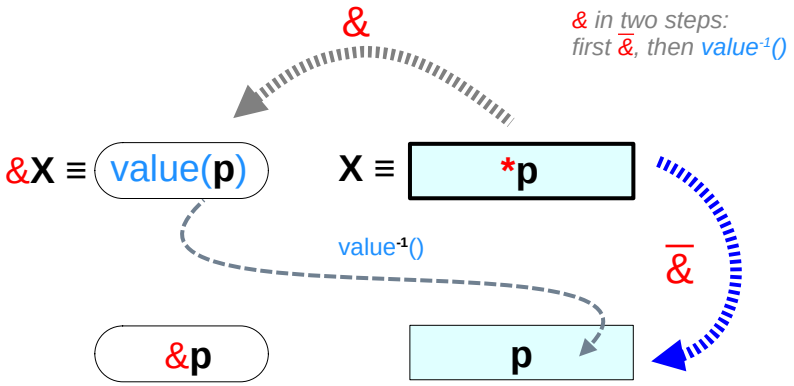
Two step De-reference * operation





Two step Address-of & operation





Two step address-of **&** and $\overline{\&}$ operators

for &**X**, **X** can be ***p**, **p**, **a**

&X	=	value($\overline{\&}$X)

C Expressions

*p a dereferenced variable
p a pointer variable
a a primitive variable

& **X**

& ***p** = & * value(**p**)
= value(**p**)

& **p**

& **a**

for $\overline{\&}$**X** = **p**, **X** must be ***p**

$\overline{\&}$X	=	value^{-1}(&X)

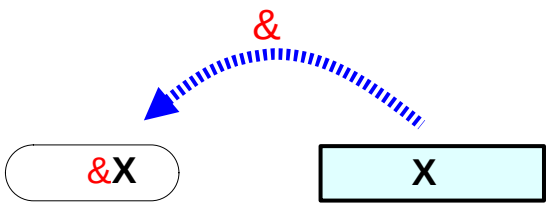
*p a dereferenced variable
~~p a pointer variable~~
~~a a primitive variable~~

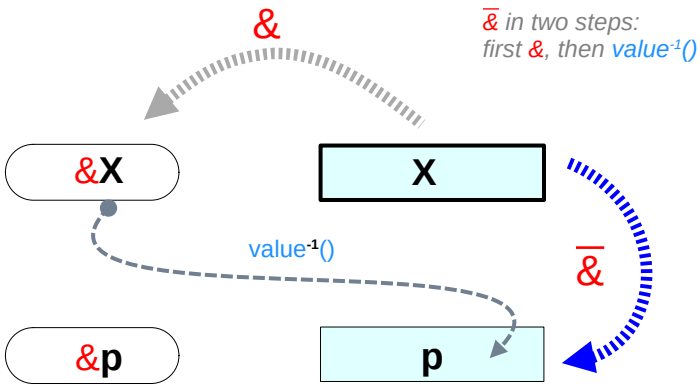
$\overline{\&}$ **X** = **p**

$\overline{\&}$ ***p** ≡ **p**

~~$\overline{\&}$ **p**~~

~~$\overline{\&}$ **a**~~





Two step de-referece *̄ and * operators

for *̄**A**, **A** can be value(**p**), &**p**, &**a**

*value(**p**)* value of a pointer variable
*&**p*** address of a pointer variable
*&**a*** address of a primitive variable

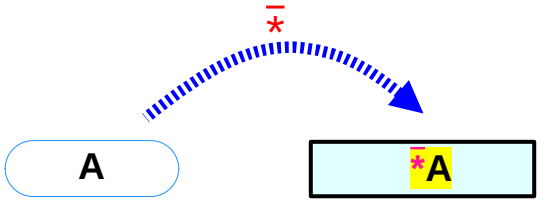
*̄**A**	=	***value**$^{-1}$(**A**)

*̄ **A**

*̄ value(**p**) = ***p**

*̄ &**p** = **p**

*̄ &**a** = **a**



for *̄**A** = ***p**, **A** must be value(**p**)

*value(**p**)* value of a pointer variable
~~*&**p*** address of a pointer variable~~
~~*&**a*** address of a primitive variable~~

***p**	=	*̄***value**(**p**)

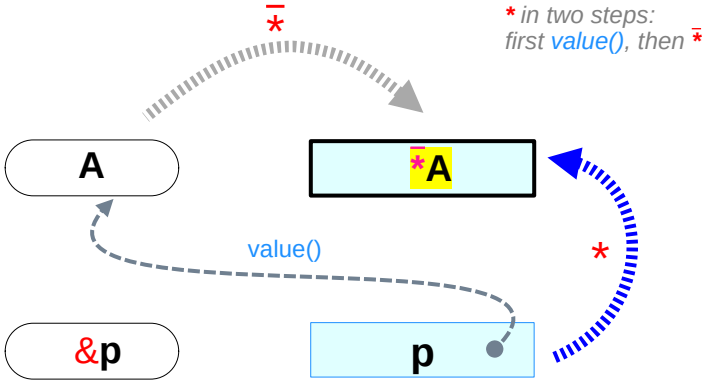
C Expressions

* **p**

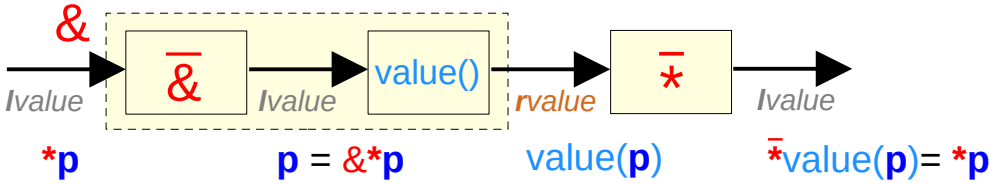
* **p** ≡ *̄**value**(**p**)

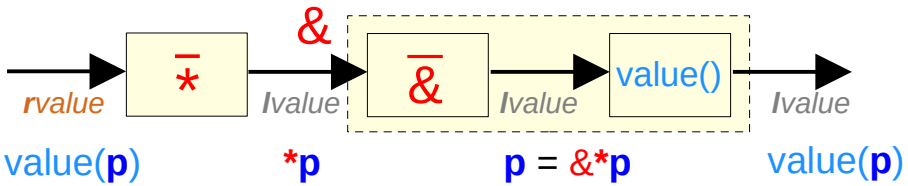
~~* &**p** = **p**~~

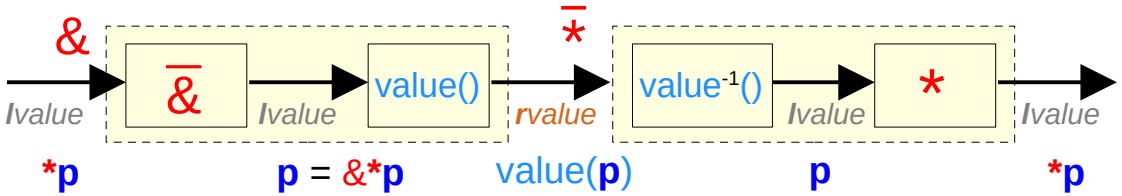
~~* &**a** = **a**~~

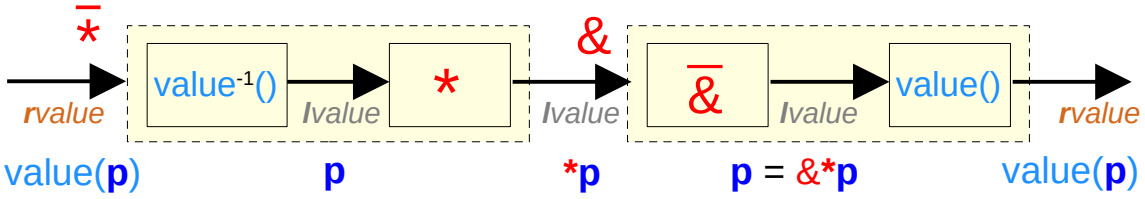


Inverse operators : & and $\bar{*}$ in pointer de-referencing





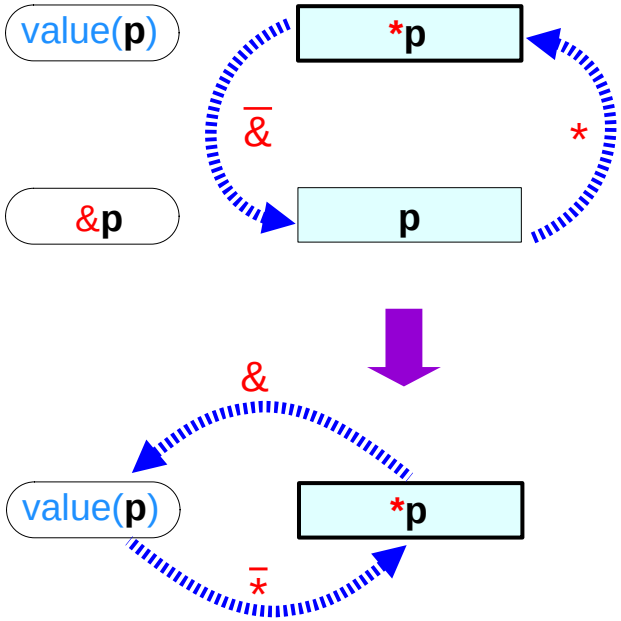




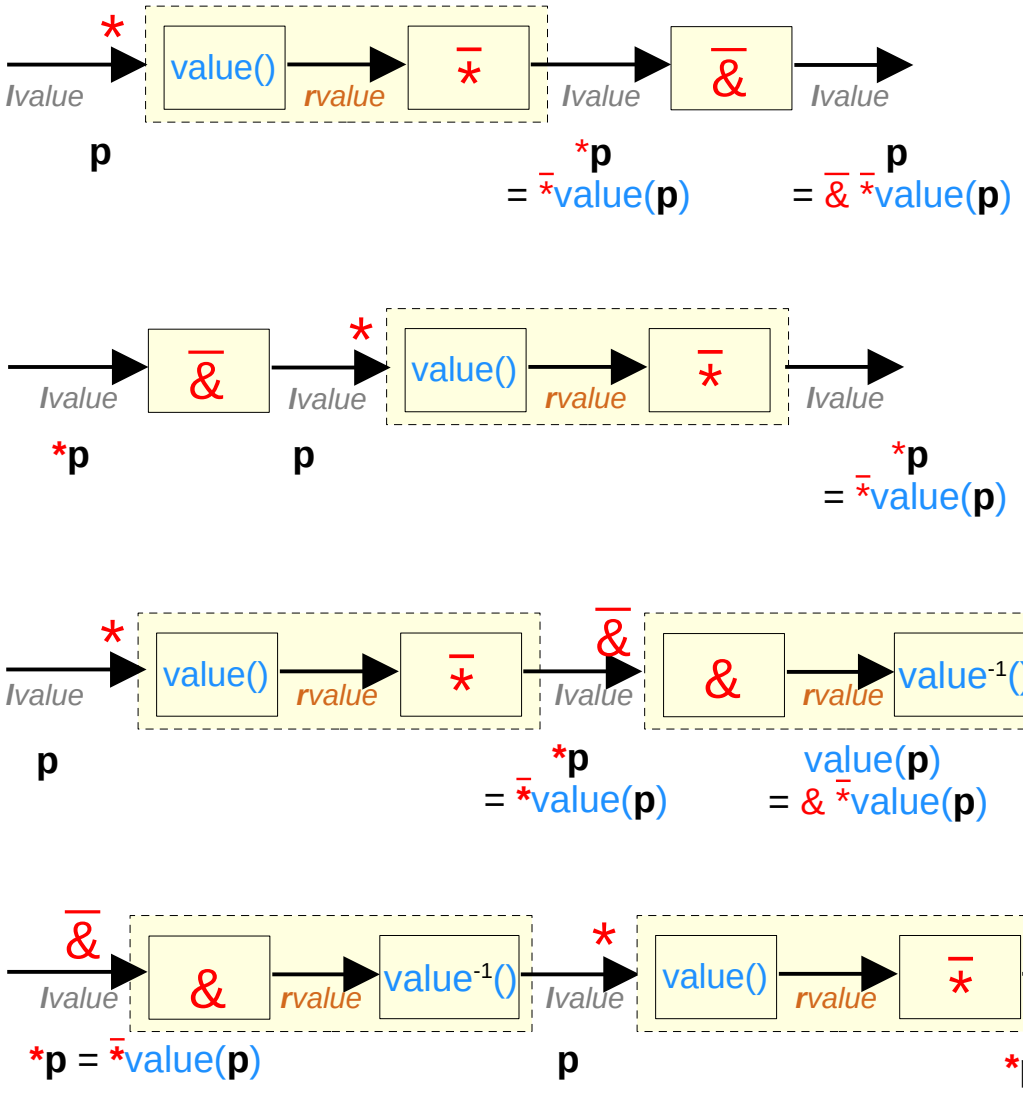
$\bar{*}$ value(**p**) = ***p**

$\bar{*}$ value(**p**) = & ***p** = value(**p**)

$\bar{*}$ $\bar{*}$value(**p**) = $\bar{*}$ $\bar{*}$ ***p** = $\bar{*}$value(**p**) = ***p**



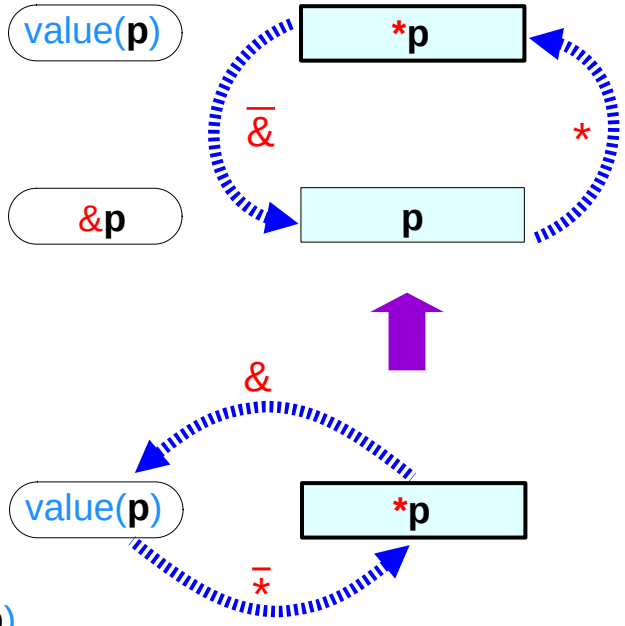
Inverse operators of & and *



$\overline{*}$ value(**p**) = ***p**

$\overline{\&}$ * **p** = **p** **p** = $\overline{\&}$ $\overline{*}$value(**p**)

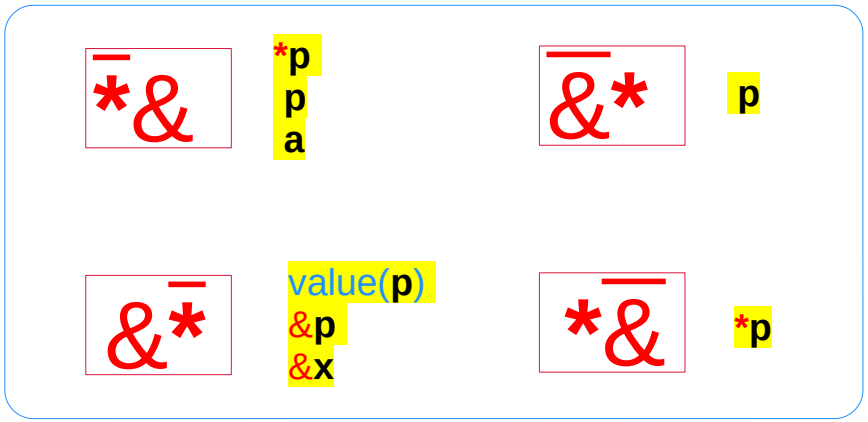
* $\overline{\&}$ ***p** = ***p** value(**p**) = & $\overline{*}$value(**p**)



Inverse operators in pointer referencing (1)

*& *p = *p
*& p = p
*& a = a

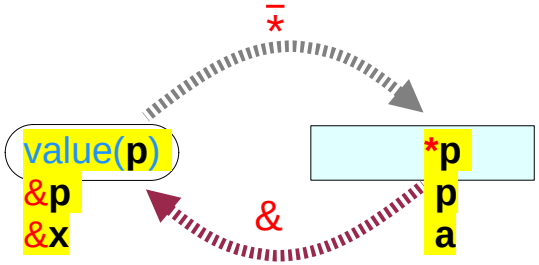
&* value(p) = value(p)
&* &p = &p
&* &a = &a

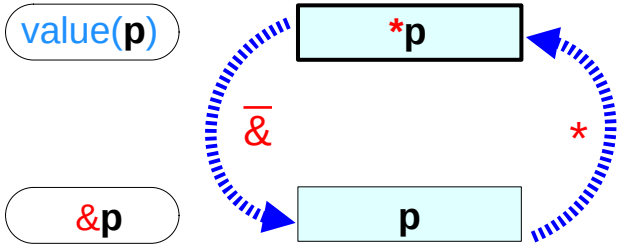


&* p = p

*& *p = *p

Math expressions

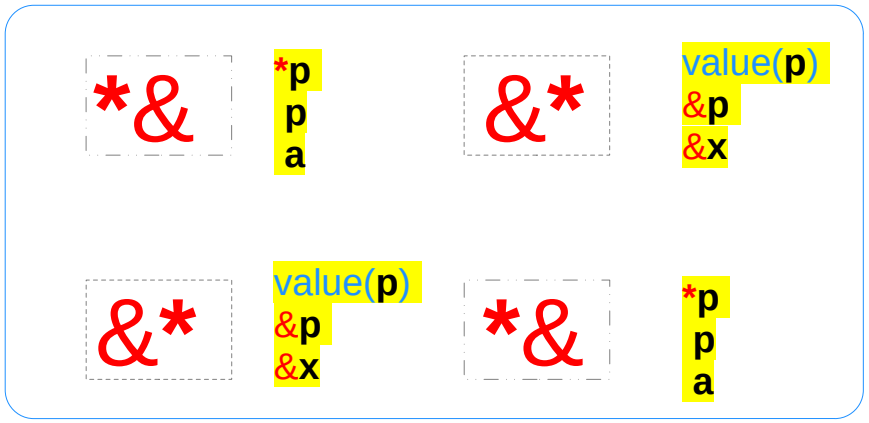




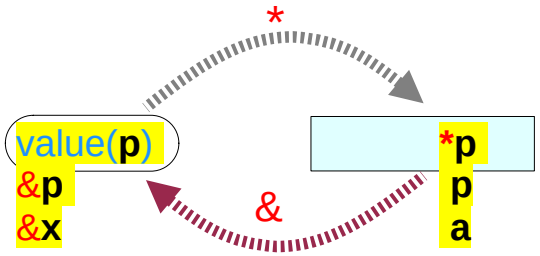
Inverse operators in pointer referencing (2)

*& *p = *p
*& p = p
*& a = a

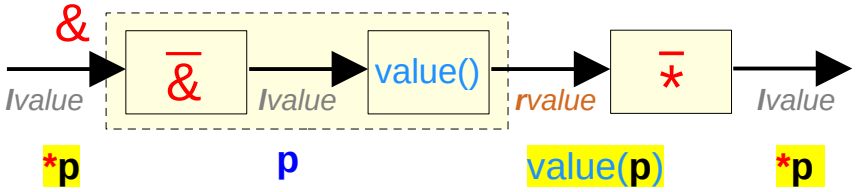
&* value(p) = value(p)
&* &p = &p
&* &a = &a

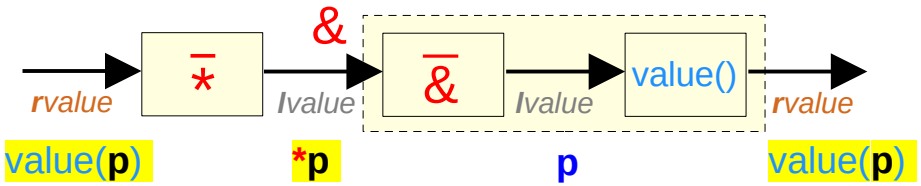


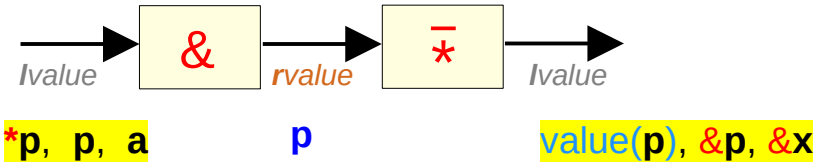
C expressions

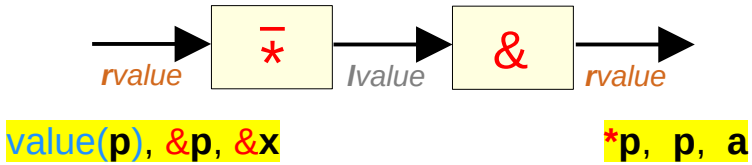


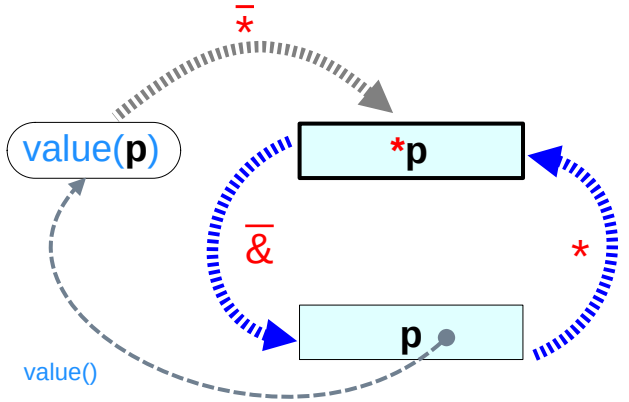
Inverse operators in pointer referencing (3)

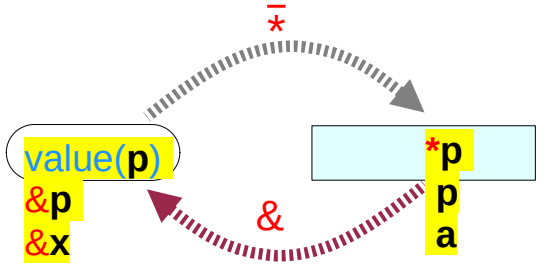




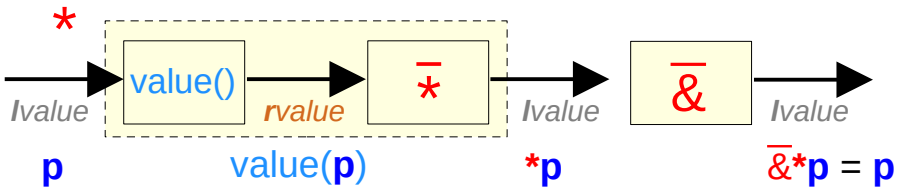


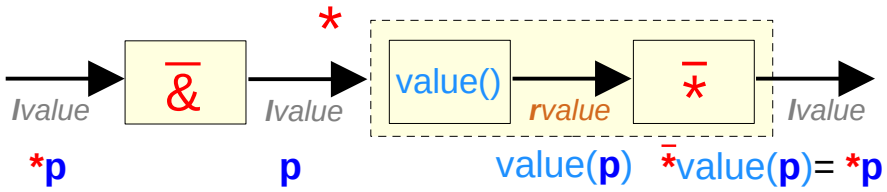


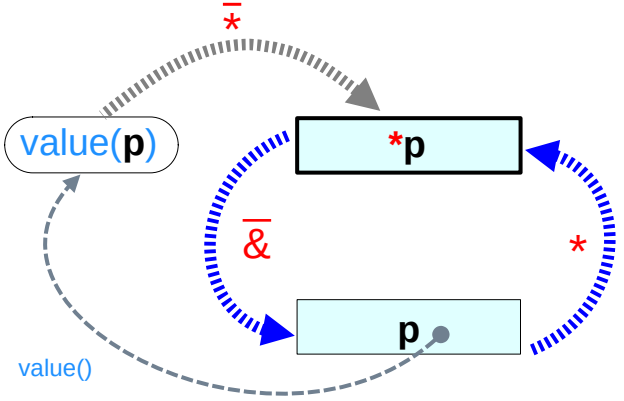


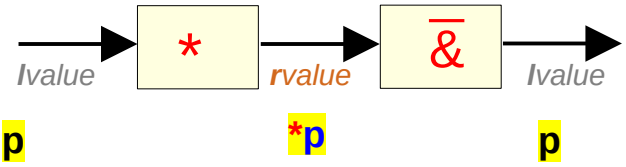


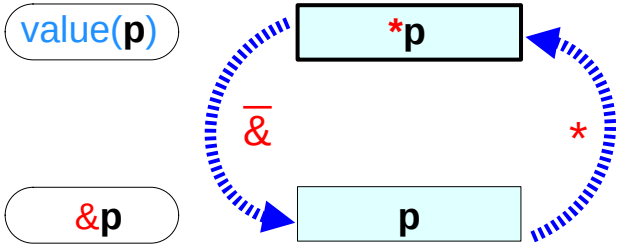
Inverse operators in pointer referencing (3)

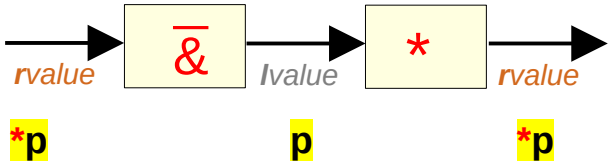












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[1] Essential C, Nick Parlante
[2] Efficient C Programming, Mark A. Weiss
[3] C A Reference Manual, Samuel P. Harbison & Guy L. Steele Jr.
[4] C Language Express, I. K. Chun