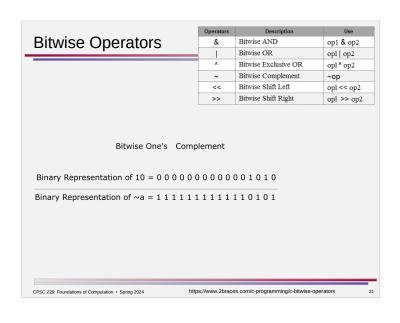


	Operators	Description	Use
Bitwise Operators	&	Bitwise AND	op1 & op2
Bittiee eperatore	_	Bitwise OR	opl op2
	۸	Bitwise Exclusive OR	opl * op2
	~	Bitwise Complement	~op
	<<	Bitwise Shift Left	opl << op2
	>>	Bitwise Shift Right	opl >> op2
Binary Representation of $10 = 0 \ 0 \ 0 \ 0$ Binary Representation of $2 = 0 \ 0 \ 0 \ 0$ Binary Representation of $2 = 0 \ 0 \ 0 \ 0$	000000	000010	
Bitwise OR		, 0 0 0 1 0	
Binary Representation of 10 = 0 0 0 0 0	000000	001010	
Binary Representation of $10 = 0 \ 0 \ 0 \ 0$ Binary Representation of $2 = 0 \ 0 \ 0 \ 0$			
, ,	000000	000010	

Bit Strings as Sets 1 1 0 1 1 0 0 0 • a bit string can also be interpreted as a set - associate each position with an element of the set - treat 1 as "in" and 0 as "not in" • integer types in Java - byte - 8 bits - short - 16 bits - int - 32 bits - long - 64 bits



	Operators	Description	Use
Shift Operators	&	Bitwise AND	op1 & op2
		Bitwise OR	opl op2
	۸	Bitwise Exclusive OR	opl ^ op2
	~	Bitwise Complement	~op
	<<	Bitwise Shift Left	opl << op2
	>>	Bitwise Shift Right	opl >> op2
Binary Representation of a	b = 0 0	00000000	00100
Binary Representation of a<<			
, ,	8 = 0 0	00000000	00100

Hexadecimal

Hex	Decimal	Binary	
0	0	0000	
1	1	0001	$101010110111_{2} = 0 \times AB$
2	2	0010	2
3	3	0011	
4	4	0100	
5	5	0101	
6	6	0110	
7	7	0111	
8	8	1000	
9	9	1001	
A	10	1010	
В	11	1011	
C	12	1100	
D	13	1101	
E	14	1110	
F	15	1111	

Set Operations

- bitwise | corresponds to set union
- bitwise & corresponds to set intersection
- to test whether x is in A (A & X) != 0
- adding an element $A \cup \{x\}$ A | x
- removing an element A \ { x } A & ~x
- generating { x } where x is the element in position pos 1 << pos

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- 1. Suppose that the numbers x and y represent the sets A and B. Show that the set $A \setminus B$ is represented by $x \& (\tilde{y})$.
- 2. Write each of the following binary numbers in hexadecimal:

a) 10110110₂

b) 10₂

c) 111100001111₂

d) 101001₂

3. Write each of the following hexadecimal numbers in binary:

a) 0x123

b) 0xFADE

c) 0x137F

d) 0xFF11

- 4. Give the value of each of the following expressions as a hexadecimal number: b) ~0x3FF0A2FF
 - a) 0x73 | 0x56A

c) (0x44 | 0x95) & 0xE7

d) 0x5C35A7 & 0xFF00

e) 0x5C35A7 & ~0xFF00

f) ~(0x1234 & 0x4321)

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```
Applications

String source = e.getSource().getClass().getName();
int mod = e.getModifiers();

event handling in Java Swing

if ((mod & ActionEvent.ALT_MASK) > 0) {

}
if ((mod & ActionEvent.SHIFT_MASK) > 0) {

}
if ((mod & ActionEvent.META_MASK) > 0) {

}
if ((mod & ActionEvent.CTRL_MASK) > 0) {

}

if ((mod & ActionEvent.CTRL_MASK) > 0) {
```

```
Applications
· Linux file permissions
   $ 1s -1
   drwxr-xr-x. 4 root root 68 Jun 13 20:25 tuned
   -rw-r--r-. 1 root root 4017 Feb 24 2022 vimrc
    • File type: -
                                              • rw-
                                                        user

    Permission settings: rw-r--r--

                                              • r--
                                                        group
    • Extended attributes: dot (.)
                                              • r--
                                                        other
    • User owner: root
    • Group owner: root
                                                                              octal
                                                                          • r (read): 4
   $ chmod ug+rwx example.txt
                                             chmod 644 example.txt
                                                                          • w (write): 2
   $ chmod o+r example2.txt
                                                                          • x (execute): 1
     chmod o-rwx example.txt
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                                      https://www.redhat.com/sysadmin/linux-file-permissions-explained
```

```
function printinformation (): void {
    const info: any = {
        firstName: 'Hendrik',
        lastName: 'Hendrik',
        occupation: 'Hond Student'
    }
    console.log('${info.firstName} ${info.lastName}, ${info.occupation} (${info.affiliation})')

const FIRST_NAME = 1
    const LAST_NAME = 1
    const CAST_NAME = 2
    const Occupation: 'A const AFFILIATION' = 8

function printinformation (which: number): void {
    const info: any = {
        if:stName: 'Nendrik',
        lastName: 'Nendrik',
        lastName: 'Irri,
        occupation: 'PhD Student',
        affiliation: 'LinkOping University'
    }
    if (which & FIRST_NAME) {
        console.log(info.firstName)
    }
    if (which & LAST_NAME) {
        console.log(info.lastName)
    }
    if (which & COUPATION) {
        console.log(info.castName)
    }
    if (which & AFFILIATION) {
        console.log(info.affiliation)
    }
}

https://www.hendrik-erz.de/post/bitwise-flags-are-beautiful-and-heres-why 27
```