# Arithmseignment Project Examinent Operations//powcoder.com





### Midterm syllabus

Everything before Floating Point representation

Assignment Project Exam Help

- Will announce a/powcoder.com more formal syllabus

  Soon Add WeChat powcoder
- 2 sample midterm exams already available on google drive





Operate on raw bits with 1 = true and 0 = false

AND OR NAND NOR XOR X	UR	NAND	NOR	XUR	XNOR
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In1	Assio	nmer	nt Pro	iệct F	xãm	Heln	~(^)
0	0	0	0	1	1	0	1
0	1 h	itt <b>ps:</b> /	/pow	coder	.com	1	0
1	0	0 0	VeC'h	1	0	1	0
1	1	Aud V	v echi	at pov	vegae	0	1





- "bit-wise" logical operations are done in parallel for corresponding bits
  - ◆ Example & (AND):
    - \* X Assignment Project Exam Help
    - \*Y = 1010 https://powcoder.com \*X AND Y = 7





- "bit-wise" logical operations are done in parallel for corresponding bits
  - Example & (AND):
    - \* X Assignment Project Exam Help
    - \*Y = 1010 https://powcoder.com \*X AND Y = X & Y = 0010





- "bit-wise" logical operations are done in parallel for corresponding bits
  - Example (&) Reduction:
    - \* X Assignment Project Exam Help
    - \* & X = ? https://powcoder.com





- "bit-wise" logical operations are done in parallel for corresponding bits
  - ◆ Example (&) Reduction:
    - \* X Assignment Project Exam Help
    - \* & X = 0&0&1&1 = 0 https://powcoder.com





# **Shifts and Rotates: Logical Right**

#### Logical right

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Intro Assignment Project Exam Help

https://powcoder.com





- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- · Intro Assignment Project Exam Help
- O0110101
   https://powcoder.com
   Shift right by 1
   Add WeChat powcoder





- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Intro Assignment Project Exam Help
- 00110101tps://powcoder.com
- ◆ 00110101 → Add WeChat powcoder





- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Intro Assignment Project Fixam Help
- 001101011 https://powcoder.com
- ◆ 00110101 →
  Add WeChat powcoder





- Move bits to the right, same order
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- Intro Assignment Project Exam Help
- 00110101tps://powcoder.com
- 0011010 Add WeChat powcoder





#### Logical right

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- . Intro Assignment Project Exam Help
- 00110101tps://powcoder.com
- 00011010 Add WeChat powcoder





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#### Logical right

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Intro Assignment Project Fix am Help
- ◆ 00110101 shift right by 1. -> 00011010





### **Shifts and Rotates: Logical Left**

#### Logical left

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Introducing Introd

https://powcoder.com





#### Logical left

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Intro Assignment Project Exam Help

00110https://powcoder.com

Shift left by 2 Add WeChat powcoder





#### Logical left

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Intro Assignment Project Exam Help

00110https://powcoder.com

← 00110101 WeChat powcoder





#### Logical left

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Intro Assignment Project Exam Help

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← 00110101 WeChat powcoder





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- Move bits to the left, same order
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- Intro Assignment Project Exam Help

00110https://powcoder.com







#### Logical left

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Introducient Project Exam Help

```
00110https://powcoder.com
110101000
WeChat powcoder
```





#### Logical left

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Intro Assignment Project Exam Help

00110htps://pitwleattlerycom> 11010100

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Note: Logical Shift left by 1 = Multiply by 2

Note: Logical Shift left by 2 = Multiply by 4

Note: Logical Shift left by 3 = Multiply by 8





### **Shifts and Rotates: Arithmetic Right**

#### Arithmetic right shift

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Reproduce the original MSB into the pew MSB (preserve the sign!!!)

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#### Arithmetic right shift

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Reproduce the original MSE into the pew MSE 00110101 1100 1100 https://powcoder.com Shift right by 2 Add WeChat powcoder





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#### Arithmetic right shift

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Reproduce the project Exam the pew MSB 00110101 1100 1100 1100 1100

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#### Arithmetic right shift

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Reproduce the neighborist Exam the spew MSB 00110101 1100 1100 1100 1100

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#### Arithmetic right shift

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Reproduce the pripinal MSB into the pew MSB 00110101 1100 1100 1101 1100 1101 1100 1101 1100 1101 1100 1101 1100 1101 1100 1

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#### Arithmetic right shift

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Reproduce the original MSB into the new MSB 00110101 1100 1100 1101 1111

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#### Arithmetic right shift

- Move bits to the right, same order
- Throw away the bit that pops off the LSB
- Reproduce the original MSB into the new MSB and Helpew MSB

00110101 arithtps://psyspedegreepy 2 -> 00001101
1100 arithmetadelweetght powcodel111





#### **Shifts and Rotates: Arithmetic Left**

#### Arithmetic left shift

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- ◆ Introckseignmetat Project Exam Help

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#### Arithmetic left shift

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Introckseignment Project Exam Help

```
00110101
https://powcoder.com
Shift left by 2
Add WeChat powcoder
```





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#### Arithmetic left shift

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Introduseignment Project Exam Help

```
00110101
https://powcoder.com
```





#### Arithmetic left shift

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Introckseignment Project Exam Help

```
00110101
https://powcoder.com
00110101
```





#### Arithmetic left shift

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Introdussignment Project Exam Help

```
00110101
https://powcoder.com
```





#### Arithmetic left shift

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- Introcksignment Project Exam Help

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00110101
https://powcoder.com
11010100
```





#### Arithmetic left shift

- Move bits to the left, same order
- Throw away the bit that pops off the MSB
- · Introdussignment Project Exam Help

00110101 arithmetic shift left by 2 -> https://powcoder.com





#### **Shifts and Rotates: Rotate Left**

#### Rotate left

- Move bits to the left, same order
- Put the bit(s) that pop off the MSB into the LSB
- No bits are thrown away or lost Assignment Project Exam Help

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### Rotate left

- Move bits to the left, same order
- Put the bit(s) that pop off the MSB into the LSB
- ♦ No bits are thrown away or lost 00110Assignment Project Exam Help

https://powcoder.com Rotate left 1 Add WeChat powcoder





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### Rotate left

- Move bits to the left, same order
- Put the bit(s) that pop off the MSB into the LSB
- ◆ No bits are thrown away or lost
  00110 Assignment Project Exam Help
  00110101 1100

https://powcoder.com

Add WeChat powcoder





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### Rotate left

- Move bits to the left, same order
- Put the bit(s) that pop off the MSB into the LSB
- ◆ No bits are thrown away or lost 00110 Assignment Project Exam Help 00110101 1100

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#### Rotate left

- Move bits to the left, same order
- Put the bit(s) that pop off the MSB into the LSB
- No bits are thrown away or lost 00110 Assignment Project Exam Help 01101010 https://powcoder.com

Add We Clast a server de

Add WeChat powcoder





- Rotate left (Rotate left 1)
  - Move bits to the left, same order
  - Put the bit(s) that pop off the MSB into the LSB
  - ◆ No bits are thrown away or lost 00110 Assignment Project Exam Help

1100 rotate left by: //powcoder.com

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## **Shifts and Rotates: Rotate Right**

### Rotate right

- Move bits to the right, same order
- Put the bit that pops off the LSB into the MSB
- No bits are thrown away or lost Assignment Project Exam Help

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- Rotate right (rotate right 2)
  - Move bits to the right, same order
  - Put the bit that pops off the LSB into the MSB
  - No bits are thrown away or lost on the lost of the los

https://powcoder.com

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- Rotate right (rotate right 2)
  - Move bits to the right, same order
  - Put the bit that pops off the LSB into the MSB
  - No bits are thrown away or lost 001101010signment Project Exam Help 00110101 https://powcoder.com

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- Rotate right (rotate right 2)
  - Move bits to the right, same order
  - Put the bit that pops off the LSB into the MSB
  - No bits are thrown away or lost 00110 Spignment Project Exam Help

00110101 https://powcoder.com

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- Rotate right (rotate right 2)
  - Move bits to the right, same order
  - Put the bit that pops off the LSB into the MSB
  - No bits are thrown away or lost 00110 Assignment Project Exam Help 01001101 https://powcoder.com

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- Rotate right (rotate right 2)
  - Move bits to the right, same order
  - Put the bit that pops off the LSB into the MSB
  - No bits are thrown away or lost 0011010 relate light by 2 -> 0111 rotate right by 2 -> 0111 numbers: //powcoder.com

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# **Binary Addition**

x 0011 +y 0001 Or in tabular form...

Assignment Project Exam Help							
Carry In	A	В	Sum	Carry Out			
0	https:	//nowco	oder.com	0			
0	0		1	0			
0	Δ¹dd '	Wechai	powcode	0			
0	1	1	Powcode	1			
1	0	0	1	0			
1	0	1	0	1			
1	1	0	0	1			
1	1	1	1	1			





# **Binary Addition**

x 0011 +y 0001 sum 01.00

Or in tabular form...

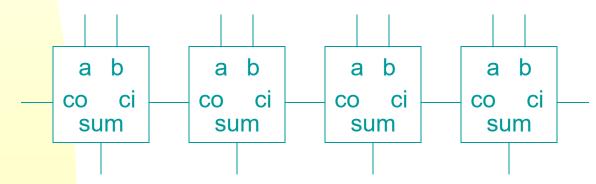
Assignment Project Exam Help							
Carry In	A	B	Sum	Carry Out			
0	hftns	//ndwc	oder.com	0			
0			1	0			
0	Δ <sup>1</sup> dd 1	Wechai	powcode	0			
0			Powcode	1			
1	0	0	1	0			
1	0	1	0	1			
1	1	0	0	1			
1	1	1	1	1			





# **Binary Addition**

- And as a full adder...
- 4-bit Ripple-Carry "adder":
  - Carry values propagate from bit to bit
  - Like Assignment Broject Exam Help
  - ◆ Time propertional tocome permet bits
  - "Lookahead-carry" can propagate carry proportional to be (n) with more space.



a

sum

CO





50

# **Addition: unsigned**

- Just like the simple addition given earlier.
- Examples: (we are ignoring overflow for now)

Assignment Project Exam Help

```
https://powcoder.com
100001 (33) 00001010 (10)
+011101 A2D WeChat Wedder (14)
```





# **Addition: unsigned**

- Just like the simple addition given earlier.
- Examples: (we are ignoring overflow for now)

### Assignment Project Exam Help

```
100001 (33) 00001010 (10)
+011101 (Add WeChalphwebter (14)
111110 (62) 00011000 (24)
```





## Addition: 2's complement

- Just like unsigned addition
- Assume 6-bit and observe:
  - Ignore carry-outs (overflow)
  - Sign Assignment Project Exam Help
  - ◆ What doquethis/powerfactoring different signs?

### Add WeChat powcoder

```
000011 (3) 101000 (-24) 111111 (-1)
+111100 (-4) +010000 (16) +001000 (8)
```





## Addition: 2's complement

- Just like unsigned addition
- Assume 6-bit and observe:
  - Ignore carry-outs (overflow)
  - Sign Assignment Project Exam Help
  - ◆ What doesthis/poor for adding different signs?

```
Add WeChat powcoder, 1
```

```
000011 (3) 101000 (-24) 111111 (-1)
+111100 (-4) +010000 (16) +001000 (8)
111111 (-1) 111000 (-8) 000111 (7)
```





### More examples: Convert to 2SC and do the addition

$$-20 + 15$$

5 + 12 Assignment Project Exam Help

-12 + -25 https://powcoder.com

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Do at HOME!!!





Don't. Just use addition:

$$\star x - y -> x + (-y) -> x + y' + 1$$

Example: Assignment Project Exam Help

```
https://powcoder.com
10110 (-10)
- 00011 Add WeChat powcoder
```





Don't. Just use addition:

$$\star x - y -> x + (-y) -> x + y' + 1$$

Example: Assignment Project Exam Help

```
https://powcoder.com

10110 (-10) 10110 (-10)

- 00011 Add WeChat poweoder00 (-3)

+ 1
```





Don't. Just use addition:

$$\star x - y -> x + (-y) -> x + y' + 1$$

Example: Assignment Project Exam Help

```
https://powcoder.com

10110 (-10) 10110 (-10)

- 00011 Add WeChat poweoder00 (-3)

+ 1

1 10011
```





- Addition and subtraction are simple in 2's complement, just need an adder and inverters.
- Can als Assiignbitento Ptojetotrie xararide pold an LSB carry in, so for -10 3 we get: https://powcoder.com



(throw away carry out)





### **Overflow in Addition**

Unsigned: When there is a carry out of the MSB

1000 (8)
Assignment Project Exam Help
1 0001 (1)
https://powcoder.com

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## **Overflow in Addition**

- 2's complement: When the signs of the addends are the same, but the sign of the result is different
- Adding Assignments Project Exam Highs never overflows. https://powcoder.com

```
Add WeChat powcoder 0011 (3) + 0110 (6) 1001 (-7)
```



