



MACQUARIE
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Department of Computing

ITEC625 Fundamentals of Computer Science
Workshop - Variables and Operators

Learning outcomes

This weeks workshop is about understanding variables and operators.

1. Twos complement

Convert the following negative decimal numbers to binary assuming storage is in 1 byte and the first bit is used for sign:

- a. -50
- b. -8
- c. -99

2. Storage

Can the following values be stored correctly in the data type assigned to them? If so, state the complete bit-pattern that the following variables are stored as, in the memory.

```
short b = 28;  
int c = 53;  
byte a = 130;  
long d = 65536;  
short e = -203;
```

3. Number systems

Convert each of the following decimal numbers into binary, quinary (base-5) and nonary (base-9)

- a. 8
- b. 29
- c. 52

4. Converting to power of source base

In the lectures, we demonstrated a way to convert an integer n from base- p to base- q when $q = p^k$ (k being an integer more than 1).

EXAMPLE 1:

$n = 11101010$, $p = 2$, $q = 8$

$q = 2^3$, therefore, $k = 3$

Split n in groups of 3 (starting from right side)

11 101 010

Pad the first group if incomplete with 0s.

011 101 010

Convert each group to decimal individually.

3 5 2

Put it together. That's the number in base 8.

Hence, 11101010 in base-2 = 352 in base-8.

EXAMPLE 2:

$n = 10201221$

$p = 3$

$q = 9$

$q = 3^2$, therefore, $k = 2$

Split n in groups of 2 (starting from right side)

10 20 12 21

Pad the first group if incomplete with 0s - not applicable

Convert each group to decimal individually.

3 6 5 7

Put it together. That's the number in base 9.

Hence, 10201221 in base-3 = 3657 in base-9.

Convert the following numbers (source and destination bases provided):

- a. 11100010 in base-2 to base-4
- b. 11100010 in base-2 to base-8
- c. 11100010 in base-2 to base-16
- d. 120100121 in base-3 to base-9
- e. 310223201 in base-4 to base-16

5. Converting from power of destination base

Now we'll do the opposite - convert an integer n from base- q to base- p when $q = p^k$ (k being an integer more than 1).

EXAMPLE 1:

$n = e8f2$

$q = 16$

$p = 2$

$q = 2^4$, therefore, $k = 4$

Convert each symbol to decimal and then to base p .

e	8	f	2
14	8	15	2
1110	1000	1111	10

Pad with leading zeroes to make groups of size k (4)

1110 1000 1111 0010

Put it together

1110100011110010

That's your number in base-p (2)

Hence, e8f2 in base-16 = 1110100011110010 in base-2.

Convert the following numbers (source and destination bases provided):

- a. 5073 in base-9 to base-3
- b. abc123 in base-16 to base-2

6. Expressions

An expression is an operation evaluating to a specific value.

What are the values of the following arithmetic expressions?

- a. $17/5$
- b. $1.0 + 16/5$
- c. $(1.0 + 16)/5$
- d. $3 * ((2 + 5) / (4 - 1) + 17 \% 5)$

7. Boolean expressions

What are the values of the following boolean expressions?

- a. `true && false`
- b. `true && (false || true)`
- c. `true || false`
- d. `false || !(true || false)`
- e. `(5 >= 0 && (5 <= 2 || 5 <= 10))`

8. Bitwise operations

An expression is an operation evaluating to a specific value.

What are the values of the following bitwise operations?

- a. $21 \& 19$
- b. $21 | 19$
- c. $21 \wedge 19$
- d. $12 \ll 2$
- e. $12 \gg 2$

9. Java program

Consider the following scenario:

John takes 5 hours to paint 3 square meters while Jenny takes 15 hours to paint 7 square meters.

If they work together, how much time will they need to paint a wall whose area is 56 square meters? Also determine how much area John paints and how much area Jenny paints.

First devise a solution on paper and verify your solution by ensuring that:

(area painted by john in determined time) +
(area painted by jenny in the same determined time) = total area (56)

Then, write a java program in Eclipse that solves the following problem.

IMPORTANT: Think about the types you'll use to store these values?