

CS 1102 - Introduction to Computer Studies

Quiz Answers

Further Discussions

- Make a post on Piazza if you have more questions about quizzes.

Quiz in Week 03

Q5 How many bits are required at least to represent 1102 items?

- a) 10 b) **11** c) 12 d) 9

Solution The right answer is **b)**. To represent K items, we will need $\lceil \log_2 K \rceil$ bits where $\lceil \cdot \rceil$ is the ceiling function. $\lceil \log_2 1102 \rceil = 11$.

Q6 If we use two's complement to represent a signed integer with a 4-bit word, what is the representation of the decimal number -6 ?

- a) **1010** b) 1110 c) 1001 d) 1101

Solution The right answer is **a)**. Recall three steps to calculate the representation by two's complement. 1) The binary representation of 6: 0110. 2) Flip all the bits: 1001. 3) Add one to the bits: $1001 + 0001 = 1010$.

Q7 If we use two's complement to represent a signed integer with a 4-bit word, which one of the following operations (in decimal form) will NOT cause overflow?

- a) **-4-4** b) $4+4$ c) $-3-7$ d) $5+6$

Solution The right answer is **a)**. The range of integers that can be represented by 4 bits based on two's complement is from -8 to $+7$. Therefore, $-4 - 4 = -8$ does not cause overflow.

Quiz in Week 04

Q2 How many 2-input AND gates are needed to implement an 8-input AND gate?

- a) 9 b) 4 c) **7** d) 8

Solution The right answer is **c)**. In general, an N -input AND gate can be obtained by concatenating $(N - 1)$ 2-input AND gates. It is the same for OR gates. Two possible implementations are provided in Figure 1.

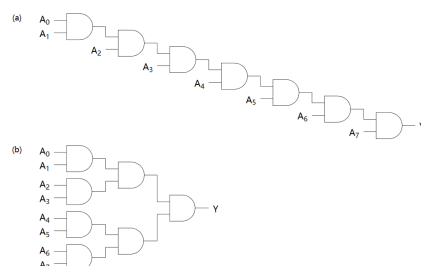


Figure 1: Quiz in Week 04 - Q2: Left-skewed (up) and tree-structured (bottom) conjunction of 8 inputs with 7 binary AND operators. Other implements are possible.

Q3 We use overline to represent the NOT operator. Which of the following expressions is equivalent to $\overline{\overline{A}B}$

- a) $A + B$ b) AB c) $\overline{AB}$ d) $\overline{A + B}$

Solution The right answer is **a)**. We can write the truth table of $\overline{\overline{A}B}$ and all four choices as below. It is clear that $\overline{\overline{A}B}$ is equivalent to $A + B$.

A	B	$\overline{\overline{A}B}$	AB	$\overline{AB}$	$A + B$	$\overline{A + B}$
0	0	0	0	1	0	1
0	1	1	0	1	1	0
1	0	1	0	1	1	0
1	1	1	1	0	1	0

Q4 Consider a circuit with three inputs: A, B and C, which of the following circuits has a truth table indicated below? (0, 1 represents False and True, respectively)

A	B	C	Output
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Figure 2: Week04-Q4

- a) $AB + C$ b) $(A + B)C$ c) $A + BC$ d) $A + B + C$

Solution The right answer is **a)**. We see all these 5 rows with true outputs correspond to the following cases:

$\overline{A}\overline{B}C$: A = False AND B = False and C = True.

$\overline{A}BC$: A = False AND B = True and C = True.

$A\overline{B}C$: A = True AND B = False and C = True.

$AB\overline{C}$: A = True AND B = True and C = False.

ABC : A = True AND B = True and C = True.

Combining these cases, the output can be expressed by the above 5 terms joined by the OR operators:

$$\begin{aligned}
 \text{Output} &= \overline{A}\overline{B}C + \overline{A}BC + A\overline{B}C + AB\overline{C} + ABC \\
 &= (\overline{A} + A)\overline{B}C + (\overline{A} + A)BC + AB\overline{C} \\
 &= \overline{B}C + BC + AB\overline{C} \\
 &= (\overline{B} + B)C + AB\overline{C} \\
 &= C + AB\overline{C} \\
 &= (AB + C)(\overline{C} + C) \\
 &= AB + C
 \end{aligned} \tag{1}$$

Q6 Consider the code in Figure 11 and assume that there is a shortcut circuit mechanism to improve efficiency. We assume that the list L contains 10000 samples from a uniform distribution between 0.0 and 1.0, then 1) which code, either Code A or Code B, runs faster? 2) Do Code A and Code B have the same output, i.e., the value of the variable "count"?

- a) Code A, Different b) Code B, Same c) Code B, Different d) **Code A, Same**

Solution The right answer is **d)**. Both codes have the same output value because the execution condition for count = count + 1 in both codes is $x \in [0.0, 0.1)$ OR $x \in (0.5, 1.0]$. The conditions are the same.

```

1  list L is 10000 samples from uniform distribution
2
3  # Code A
4  count = 0;
5  for each sample in L:
6      if x > 0.5 OR x < 0.1 then
7          count += 1
8
9  # Code B
10 count = 0;
11 for each sample in L:
12     if x < 0.1 OR x > 0.5 then
13         count += 1

```

Figure 3: Week04-Q6

Code A is faster to execute. For the cases when $x \in [0.1, 0.5]$, in Code A the loop is jumped out directly after checking whether $x > 0.5$ without having to check whether $x < 0.1$. In Code B, these cases are checked twice and take much more time.

Quiz in Week 05

Q1 Assume that there is a shortcut circuit mechanism to improve efficiency; $\&\&$ and $\|\|$ represent AND operator and OR operator, respectively. Variable $x = 2$, $y = 3$, then which of the following expressions will trigger the shortcut mechanism?

- a) $x < 3 \|\| y > 4$ b) $y > 4 \|\| x < 3$ c) $x < 3 \&\& y < 4$ d) $y < 4 \&\& x > 3$

Solution The right answer is **a)**. In the case of AND, the expression is evaluated until we get one false result because the result will then always be false, independent of the further conditions. If there is an expression with $\&\&$ (logical AND), and the first operand itself is false, then a short circuit occurs, the further expression is not evaluated, and false is returned. In the case of OR, the expression is evaluated until we get one true result because the result will always be true, independent of the further conditions. If there is an expression with $\|\|$ (logical OR), and the first operand itself is true, a short circuit occurs, evaluation stops, and true is returned. Therefore, only ' $x < 3 \|\| y > 4$ ' trigger the shortcut mechanism.

Q5 Under the CSS rendering rule "`h1, #h2, .h3 color: red`", which of the following HTML elements is not (necessarily) rendered red?

- a) `<h2 id="h3">content </h2>` b) `<h1 id="h3">content </h1>`
c) `<h2 class="h3">content </h2>` d) `<h3 id="h2">content </h3>`

Solution The right answer is **a)**. The element selector selects HTML elements based on the element name. The id selector uses the id attribute of an HTML element to select a specific element. To select an element with a specific id, write a hash (#) character, followed by the id of the element. The class selector selects HTML elements with a specific class attribute. To select elements with a specific class, write a period (.) character, followed by the class name. Therefore '`<h2 id="h3">content </h2>`' will not be rendered red.

Q6 If the following two Scratch boolean variables are True and False, respectively, then which of the following statements is correct?



Figure 4: Week05-Q6

- a) **x is a number but not an integer** b) x is not a number
c) x is not a number d) x is either not a number or an integer

Solution The right answer is **a)**. The first expression will report true if the input is either an integer or a number. The second expression will report true if the input is an integer. This is because the Floor block reports the closest integer to the given number, and if it is already an integer, it simply reports its input. The second expression is false. Therefore, x is a number.

Q7 If variables a and b are all boolean variables, i.e., they are either 0 or 1. Then which gate does the following Scratch block represent?



Figure 5: Week05-Q7

- a) **XOR** b) OR c) AND d) NAND

Solution The right answer is **a)**. The expression returns 0 only when x equals y, otherwise 1. Therefore it represents the XOR gate.

Quiz in Week 06

Q4 What is the length of array a (the value of a.length) when the following Javascript code is executed?

...

```
var a = [1, 2, 4];
a[2] = 5;
a[7] = 8;
a[4] = 3;
```

...

- a) **8** b) 6 c) 7 d) 5

Solution The right answer is **a)**. The index in an array starts from zero. When operating 'a[7] = 8', a new number 8 would be added into the array 'a' in the 8th position, i.e., '7'. Other options' index is smaller than 7, therefore the length of the array is 8.

Q6 What will be the value of the variable a when the following Javascript code is executed?

...

```
var a = 0;
for(var i = 3; i < 6; i++)
  a++;
```

...

- a) 4 b) 0 c) **3** d) 2

Solution The right answer is **c)**. Firstly, you should know the meanings of 'a++' and 'i++'. 'a++' is equivalent to 'a' = 'a+1'. For example, if 'a' = 0' at present, after operating 'a++', you would get a new 'a' and 'a=1'. Then in this 'for' loop, the 'i' starts from 0. When conducting the 1st loop, the variable 'a' becomes 1 from 0; and the 'i' becomes 4 from 3. The 1st loop ends. In the second loop, 'i=4' is smaller than 6, so the 2nd loop would conduct, and we get 'a=2' and 'i=5' at the last of this time. Because 'i=5' is smaller than 6, the third loop still conducts, and we get 'a=3' and 'i=6'. However, 'i=6' is not smaller than 6, so the next loop wouldn't conduct, and the whole code would end. Therefore, the 'a' is 3.

Quiz in Week 07

Q1 Which of the following is a valid variable name in Javascript?

- a) 1var b) var c) **_var** d) 1_var

Solution: The right answer is **c)**. A variable name cannot begin with digits. "var" is a reserved word in Javascript, so it is not valid, either.

Q3 What are the values of the variable a when code1 and code2 are executed? The first number is for code1 and the second number is for code2.

```
...  
  
var i, a;  
  
// Code 1  
  
a = 0;  


for(i = 0; i < 3; i++)  
  a++;

  
a++;  
  
// Code 2  
  
a = 0;  


for(i = 0; i < 3; i++){  
  a++;  
  a++;  
}

  
...
```

Figure 6: Week07-Q3

- a) 3,3 b) 3,6 c) **4,6** d) 6,6

Solution: The correct answer is **c)**. For Code 1, codes in the red box form a for loop, so `a++` is executed 3 times. After that, another `a++`, i.e., `a++` outside the red box, is executed. Thus, the result of Code 1 is 4. For Code 2, codes in the blue box form a for loop since we use a pair of curly brackets to wrap the codes. In this case, `a++` is totally executed 6 times, the result is 6.

Q4 The Javascript function f is defined below, then what is the returned value of f(4)?

```
...  
  
function f(number){  
  if(number <= 0){  
    return 0;  
  }else{  
    return f(number - 1) + number;  
  }  
}  
...  
...
```

- a) 0 b) 4 c) **10** d) 6

Solution: The right answer is **c**). This function is a recursive function. The result is $0+1+2+3+4 = 10$.

Q6 In the following Javascript code, which variables are global variables?

""

var x;

function f1(){

 x = 2;

}

function f2(){

 var y = 1;

}

function f3(){

 z = 3;

}

""

a) x, y, z

b) x

c) **x, z**

d) z

Solution: The right answer is **c**). x is declared outside the function, so it is a global variable. y is declared inside the function, it is not accessible (visible) from outside the function. If you assign a value to a variable that has not been declared, it will automatically become a global variable, so z is also a global variable.

Quiz in Week 08

Q1 Given the Javascript function f defined below, what is the returned value of f(5)?

""

function f(number)

 if (number != 1){

 return 1;

 } else {

 return f(number - 1) * number;

 }

}

""

a) 24

b) 15

c) 1

d) **120**

Solution: The right answer is **d**). Calculate $f(5)$ recursively as follows, you will obtain $f(5) = 120$.

$f(5) = f(4) * 5$

$f(4) = f(3) * 4$

$f(3) = f(2) * 3$

$f(2) = f(1) * 2$

$f(1) = 1$

Q4 The original content of the HTML element with ID "output" is empty. Consider the two segments of codes below, which of the following statements is correct?

""

// Code A

for(var i = 0; i <= 100000; i++)

```

    document.getElementById('output').innerHTML += "OK";
// Code B
var output = "";
for(var i = 0; i <= 100000; i++)
    output += "OK";
document.getElementById('output').innerHTML = output;

```

- a) Code A and B generate the same output, A is faster
- b) **Code A and B generate the same output, B is faster**
- c) Code A and B generate the same output and have comparable speed
- d) Code A and B generate different outputs.

Solution: The right answer is **b)**. Input / Output / Plot are very time-consuming. Assigning values to `document.getElementById('output').innerHTML` will introduce output to the webpage, so it is very time-consuming.

Q8 What will be the value of the variables a, b, c after executing the following code? (please pay attention to the code blocks)

```

var a = 0, b = 0, c = 0;

```

```

if(true){
    a = 1;
} else
    b = 2;
    c = 3;

```

- a) 1, 2, 3
- b) **1, 0, 3**
- c) 0, 2, 3
- d) 1, 0, 0

Solution: The right answer is **b)**. The condition true will always be true; therefore, the code inside the if block will always be executed. The last line is outside of the if-else. Therefore also been executed.

Q10 What will be the length of the list a (i.e. a.length) after running the following loop?

```

var a = [1, 2];
for(var i = 2; i < 10; i++)
    a[i] = a[i - 1] * a[i - 2];

```

- a) 9
- b) **10**
- c) 8
- d) 2

Solution: The right answer is **b)**. `a = [1, 2, 2, 4, 8, 32, 256, 8192, 2097152, 8589934592]`

Quiz in Week 09

Q9 Given two Javascript variables `var a = 8, b = "8";`, then what is the value of `b+a+a`

- a) **"888"**
- b) "816"
- c) 24
- d) "24"

Solution:

The right answer is **a)**. From the lecture, you have learned that string plus int type would change the type of the int variable to string; therefore, this is a joint of three string sequence.

Quiz in Week 10

Q8 What will be the output of $f(1)$, $f(2)$, $f(3)$ and $f(4)$, respectively, given the function f defined below?

““

```
function f(num){
  var ret = "";
  if (num%2 == 0)
    ret = ret+"2";
  if (num%4 == 0)
    ret = ret+"4";
  return ret;
}
```

““

- a) "", "2", "", "24" b) "", "2", "", "4" c) "", "2", "", "2" d) "", "", "", "4"

Solution:

The right answer is **a**).

for $f(1)$: $1\%2 = 1$, $1\%4 = 1$, $ret = ""$

for $f(2)$: $2\%2 = 0$, $2\%4 = 2$, $ret = "2"$

for $f(3)$: $3\%2 = 1$, $3\%4 = 3$, $ret = ""$

for $f(4)$: $4\%2 = 0$, $4\%4 = 0$, $ret = "2" + "4" = "24"$

Q9 What will be the value of the variable a after executing the following code?

““

```
var a = ""
for (var i = 0; i <=4; i++) {
  if (i%2 == 0)
    a = a+"A";
  else
    a = a+"B";
  a = a+"C";
}
```

““

- a) "ACBCACBCAC" b) "ABCABCA" c) "ACBCACBC" d) "ABCABC"

Solution:

The right answer is **a**).

$i = 0$, $i\%2 = 0$, $a = "AC"$

$i = 1$, $i\%2 = 1$, $a = "ACBC"$

$i = 2$, $i\%2 = 0$, $a = "ACBCAC"$

$i = 3$, $i\%2 = 1$, $a = "ACBCACBC"$

$i = 4$, $i\%2 = 0$, $a = "ACBCACBCAC"$

Quiz in Week 11

Q6 Which of the following is true about the code A: `Math.ceil(Math.random() * 2)` and B: `Math.floor(Math.random() * 2 + 1)`?

- a) They are equivalent.
- b) **They are different. A has more possible outputs.**
- c) They are different, but have the same number of possible outputs.
- d) They are different. B has more possible outputs.

Solution: The right answer is **b**). From the lecture, you have learned that the function `Math.random()` generates a random floating-point numbers in the range of **0 (inclusive) to 1 (exclusive)**. Consequently, `Math.random() * 2` $\in [0, 2)$ and `Math.ceil(Math.random() * 2)` will generate three integers which are 0, 1 and 2. However, `Math.random() * 2 + 1` $\in [1, 3)$ and code B can only generate two integers 1 and 2.

A: `Math.ceil(Math.random() * 2)`

B: `Math.floor(Math.random() * 2 + 1)`

Math.random() $\rightarrow [0, 1)$
*Math.random() * 2 $\rightarrow [0, 2)$*
*Math.ceil(Math.random() * 2) $\rightarrow 0, 1, 2$*
 $\rightarrow$ very low probability
*Math.random() * 2 + 1 $\rightarrow [1, 3)$*
*Math.floor(Math.random() * 2 + 1) $\rightarrow 1, 2$*

Figure 7: Week11-Q6

Q7 Which of the following is true about the code A: `Math.floor(Math.random() * 2 + 1)` and B: `Math.floor(Math.random() * 2) + 1`?

- a) They are different but have the same number of all possible outputs.
- b) **They are equivalent.**
- c) They are different, B has more possible outputs.
- d) They are different, A has more possible outputs.

Solution: The right answer is **b**). As analyzed in Q6 solution, code A `Math.floor(Math.random() * 2 + 1)` can only generate two integers 1 and 2. In code B, `Math.floor(Math.random() * 2)` will generate two integers 0 and 1, such that code B will generate integers 1 and 2.

A: `Math.floor(Math.random() * 2 + 1)`

B: `Math.floor(Math.random() * 2) + 1`

*Math.random() * 2 + 1 $\rightarrow [1, 3)$*
*Math.floor(Math.random() * 2 + 1) $\rightarrow 1, 2$*
*Math.random() * 2 $\rightarrow [0, 2)$*
*Math.floor(Math.random() * 2) $\rightarrow 0, 1$*
*Math.floor(Math.random() * 2) + 1 $\rightarrow 1, 2$*

Figure 8: Week11-Q7

Q8 Which of the following is true about the code A: `Math.floor(Math.random() * 2)` and B: `Math.floor(Math.random()) * 2`?

- a) They are equivalent.
- b) They are different but have the same number of possible outputs.
- c) **They are different, A has more possible outputs.**
- d) They are different, B has more possible outputs.

Solution: The right answer is **c)**. From the lecture, you have learned that the function `Math.random()` generates a random floating-point numbers in the range of **0 (inclusive) to 1 (exclusive)**. In code A, `Math.floor(Math.random() * 2)` will generate two integers 0 and 1. However, in code B, `Math.floor(Math.random())` always equals 0, so code B will have one output 0.

A: `Math.floor(Math.random() * 2)`

B: `Math.floor(Math.random()) * 2`

Math.random() → [0, 1)
*Math.random() * 2 → [0, 2)*
*Math.floor(Math.random() * 2) → 0, 1*
Math.floor(Math.random()) → 0
*Math.floor(Math.random()) * 2 → 0*

Figure 9: Week11-Q8

Q9 Given an Javascript variable `var A = Math.random() + Math.random() * 5;` and another variable `var B = Math.random() * 6;`, which of the following statement is true?

- a) A and B have different probability distributions, in addition, they have the same lower bound but different upper bounds.
- b) A and B have different probability distributions, in addition, they have different upper and lower bounds.
- c) **A and B have different probability distributions, but they have the same upper and lower bound.**
- d) A and B have the same probability distribution.

A: `Math.random() * 6`

B: `Math.random() + Math.random() * 5`

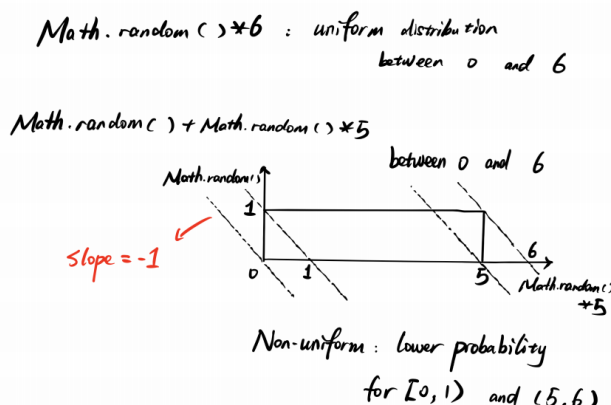


Figure 10: Week11-Q9

Solution: The right answer is **c**). The lower bound and the upper bound of both variable A and B are 0 and 6, respectively. However, `Math.random() * 6` generates a uniform distribution between 0 and 6. By contrast, `Math.random() + Math.random() * 5` does not follow a uniform distribution, as the figure indicates above.

Q10 Given an Javascript variable `var A = Math.random() * 2;` and another variable `var B = Math.random() * 2;`, then we calculate another variable `var C = A + B`. What is the probability of the variable C between 1 and 3?

(Hint: A and B are two independent variables.)

a) 0.25

b) 2 / 3

c) **0.75**

d) 0.5

Solution: The right answer is **c**). The joint distribution of variable A and B is represented as a square as indicated in the figure below. The area responding to $1 < A + B < 3$ is highlighted in shadow red. The area of the square and the area of the red part are 4 and 3, respectively.

$$\text{Math.random()} * 2 + \text{Math.random()} * 2$$

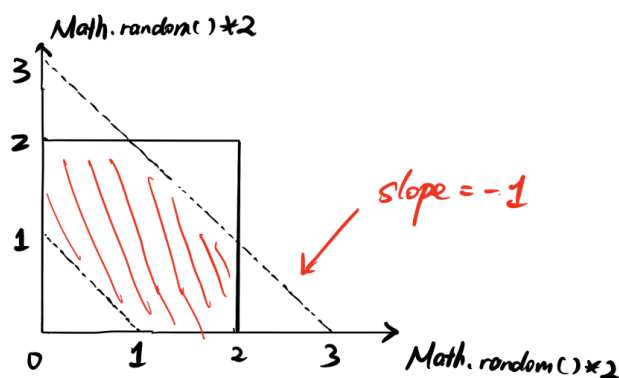


Figure 11: Week11-Q10

Quiz in Week 12

Q7 What would be the length of variable a after executing the following Javascript code?

...

```
var a = [0, 1];
for (var i = 0; i < 5; i++)
  a[i + 2] = a[i + 1] + a[i];
```

...

a) **7**

b) 6

c) 5

d) 8

Solution: The right answer is **a**). The code runs as follows:

$$a[2] = a[1] + a[0] = 1$$

$$a[3] = a[2] + a[1] = 2$$

$$a[4] = a[3] + a[2] = 3$$

$$a[5] = a[4] + a[3] = 5$$

$$a[6] = a[5] + a[4] = 8$$

Therefore, there are seven elements in array a.

Q8 Which of the following is not a possible value of the variable a after executing the following Javascript code?

...

```
var a = [];
var stop = false;
```

```
while (stop == false){
  var v = Math.floor(Math.random() * 6);
  if (v == 5 || a.length == 4)
    stop = true;
  a[a.length] = v;
}
""
```

- a) **[2,0,5,3]** b) [2, 0, 2, 3, 0] c) [3, 5] d) [2, 0, 4, 5]

Solution: The right answer is **a)**. When v equals 5, the 'stop' flag will be true, and 5 will be the last element of the array a . Therefore, 3 will not appear after 5 in the array a .

Q10 What is the expected sum of all the elements in the array a after executing the following Javascript code?

```
""
var a = [];
for(var i = 0; i <4; i++)
  a[i] = Math.random() * i * i;
""
```

- a) **7** b) 3 c) 4 d) 11

Solution: The right answer is **a)**. The array a will have 4 elements: $a[0]$, $a[1]$, $a[2]$, and $a[3]$.

$a[0] = \text{Math.random()} * 0 * 0 = 0$ (since anything multiplied by 0 is 0)

$a[1] = \text{Math.random()} * 1 * 1 = \text{Math.random()}$

$a[2] = \text{Math.random()} * 2 * 2 = 4 * \text{Math.random()}$

$a[3] = \text{Math.random()} * 3 * 3 = 9 * \text{Math.random()}$

Considering the expected value of Math.random() is 0.5, the expected values for each element in the array are:

$E(a[0]) = 0$ $E(a[1]) = 0.5$ $E(a[2]) = 4 * 0.5 = 2$ $E(a[3]) = 9 * 0.5 = 4.5$ Now, to get the expected sum of all elements in the array, we add the expected values of each element:

$E(\text{sum}) = E(a[0]) + E(a[1]) + E(a[2]) + E(a[3]) = 0 + 0.5 + 2 + 4.5 = 7$

So, the expected sum of all elements in the array a is approximately 7