Algorithm Class

Assignment 2

창의ICT공과대학 소프트웨어학부

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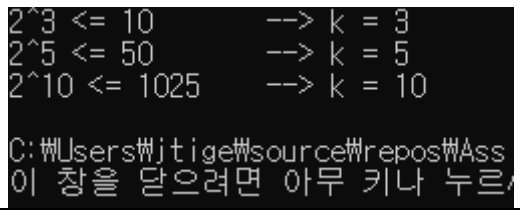
1) [Programming] Write a program that takes a number n and displays the largest positive integer k satisfying the following equations: 2^k <= n. Display the results for three different n's: 10, 50, and 1025.

Ans.

```
// Code
#include <stdio.h>
#include <assert.h>

int log2(int num);

int main() {
	int num[] = { 10, 50, 1025 };
	int k, i;

	for (i = 0; i < sizeof(num)/sizeof(int); i++) {
		k = log2(num[i]);
		printf("2^%d <= %d ₩t--> k = %d₩n", k, num[i], k);
	}

	return 0;
}

int log2(int num) {
	int k = 0;
	assert(num > 1);
	while (num >= 2) {
		num /= 2;
		k++;
	}
	return k;
}
```

Result



Pseudo code 1

```
procedure log2(n: interger n > 1)
if n < 2 then
        return 0
else
        return log2(floor(n/2)) + 1
```

It is equivalent to following code.

Pseudo code 2

```
procedure log2(n: interger n > 1)
k := 0

while n > 1 do
        n := floor(n/2)
        k := k + 1
```

Analyze Time complexity

Let n is input integer.

$$T(n) = T(n/2) + O(1)$$

$$f(n) = c, a = 1, b = 2$$

$$f(n) = n^{log_b a} \times lg^k(n) = n^{log_2 1} \times lg^0(n)$$

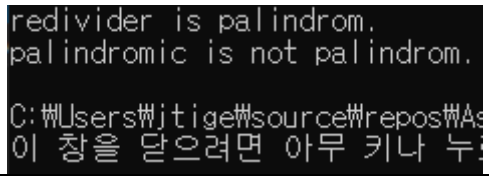
$$k = 0$$

$$\therefore T(n) = O(log\ (n))$$

2) [Programming] Palindrome refers to words that have the same results when we read from the beginning and read from the end, such as level, bob, and radar. Write a function that determines if the given word is palindrome or not. Display the results when you put two different words (one is palindrome and the other is not).

```
// Code
typedef enum {false, true} bool;

bool isPalindrome(char *str) {
        int start = 0;
        int end = strlen(str) - 1;

        while (start < end)
                if (str[start++] != str[end--])
                        return false;
        return true;
}
```

// Result



Pseudo code 1

```
procedure isPalindrome(str, startIndex, endIndex)
if startIndex >= endIndex
        return true
else if str[startIndex] is not str[endIndex] then
        return false
else
        return isPalindrome(str, startIndex+1, endIndex-1)
```

It is equivalent to following code.

Pseudo code 2

```
procedure isPalindrome(str: string)
start := 1
end := str.length
```

```
while start < end do
        if str[start] is not str[end] then
                return false
        else
                start := start + 1
                end := end – 1
return true
```

Analyze Time complexity

Let n is the length of word.

$$T(n) = T(n-2) + O(1)$$

$$T(n) = O(n)$$

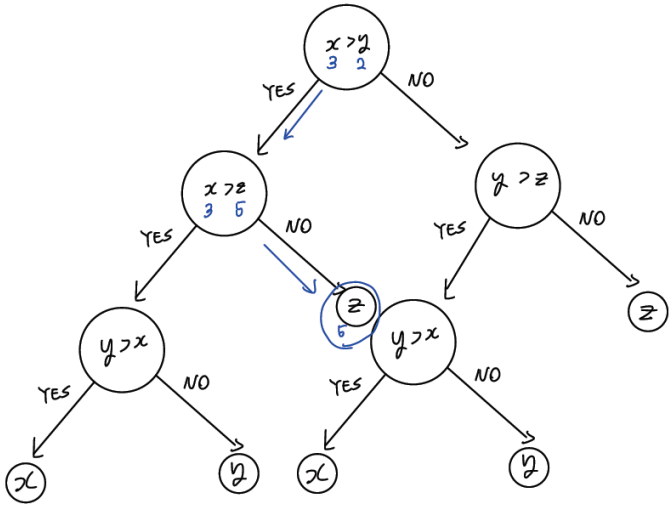
3) What is the output of the following code? (The code shows the partial lines in a complete program.)

int x = 3, y = 2, z = 5;

printf("%d₩n", ((x > y) ? x : y) > z ? ((y > x) ? x : y) : z);

Ans. 5

It can be represented in decision tree.



4) Use the Binary Search algorithm to search for the integer 120 in the following list (array) of integers. Show the actions step by step (by hand).

12 34 37 45 57 82 99 120 134

Ans.