Algorithm assignment #2

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P1.

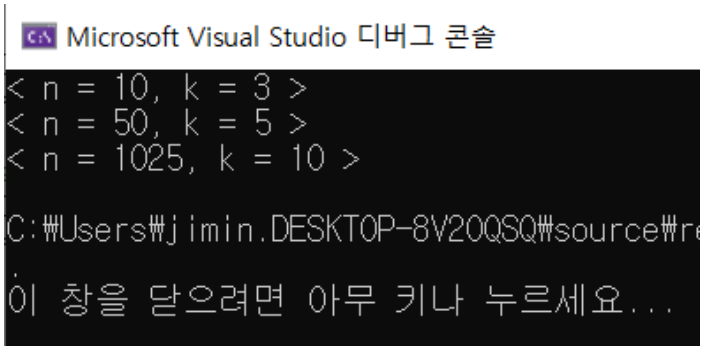
- **code**

```
#include <stdio.h>

int power(int x, int n) {
	int y = 0;
	if (n == 0) {
		return 1;
	}
	if (n % 2 == 1) { // n is odd
		y = power(x, (n - 1) / 2);
		return x * y * y;
	}
	else { // n is even
		y = power(x, n / 2);
		return y * y;
	}
}
int main() {
	int arr[3] = { 10, 50, 1025 };
	int k;
	for (int i = 0; i < 3; i++) {
		k = 0;
		while (power(2, k) <= arr[i]) {
			k++;
		}
		printf("< n = %d, k = %d >₩n", arr[i], k - 1);
	}

}
```

- **result**



P2.

- **code**

```c
#define _CRT_SECURE_NO_WARNINGS
#include <stdio.h>
#include <stdbool.h>
#include <stdlib.h>
#include <string.h>
#define MAX_NUM 100

void isPalindrome(char* word) {
    int len = strlen(word);

    if (len <= 1) {
        fprintf(stderr, "%s is not allowed. Please enter at least two characters.", word);
        exit(1);
    }

    bool isPalindrome = true;
    for (int i = 0; i < len / 2; i++) { // Repeat from 0 to half the length of the string
        if (word[i] != word[len - 1 - i]) {
            isPalindrome = false;
            break;
        }
    }

    if (isPalindrome == true) {
        printf("%s is palindrome. ", word);
    }
    else {
        printf("%s is not palindrome. ", word);
    }
}

int main()
{
    char word[MAX_NUM], word2[MAX_NUM];

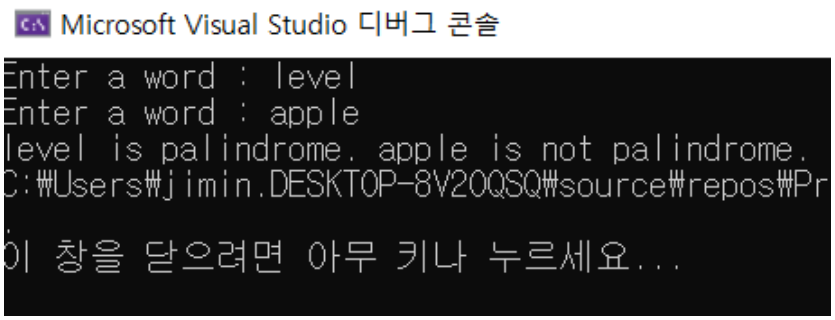
    printf("Enter a word : ");
    scanf("%s", word);

    printf("Enter a word : ");
    scanf("%s", word2);

    isPalindrome(word);
    isPalindrome(word2);

    return 0;
}
```

- **result**



P3.

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

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

1) (x > y) ? x : y

   (3 > 2) ? 3 : 2

   Since (x > y) is true, the one of the left is the result. So, output is 3.

2) (y > x) ? x : y

   (2 > 3) ? 3 : 2

   Since (y > x) is false, the one of the right is the result. So, output is 2.

3) (3 > z) ? 2 : z

   (3 > 5) ? 2 : 5

   Since (3 > z) is false, the one of the right is the result. So, output is 5.

Therefore, the output of the following code is 5.

P4.

- **code**

```
#include <stdio.h>
#include <stdbool.h>

void binary_search(int* num, int n, int key) {
	int low = 0;
	int high = n-1;
	int mid;
	bool keyinlist = false;

	while (low <= high) {

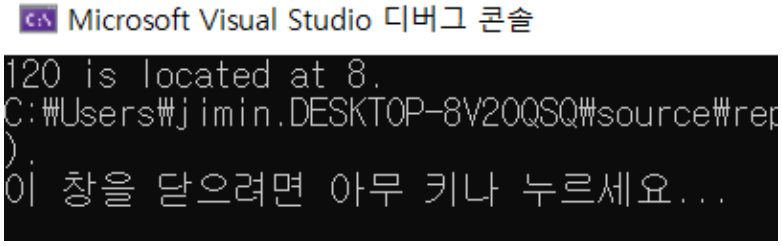
		mid = (low + high) / 2;

		if (num[mid] > key) {
			high = mid - 1;
		}
		else if (num[mid] < key) {
			low = mid + 1;
		}
		else {
			printf("%d is located at %d.", key, mid+1);
			keyinlist = true;
			break;
		}
	}
	if (!keyinlist) {
		printf("The key is not in the list.");
	}
}

int main() {
	int num[9] = { 12, 34, 37, 45, 57, 82, 99, 120, 134 };
	int key = 120;

	binary_search(num, 9, key);
}
```

- **result**



P5.

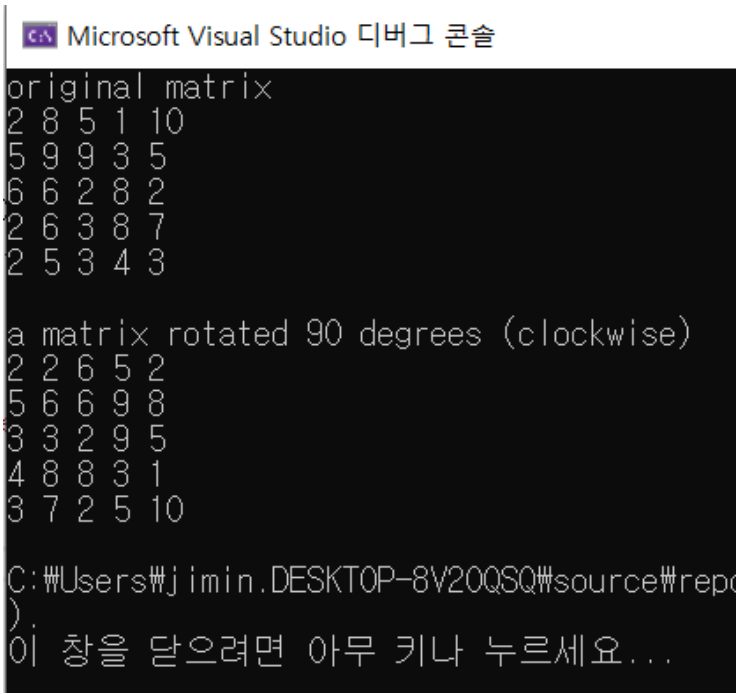
- **code**

```
#include <stdio.h>
#include <stdlib.h>

int main() {
	int matrix[5][5];
	printf("original matrix₩n");
	for (int i = 0; i < 5; i++) {
		for (int j = 0; j < 5; j++) {
			matrix[i][j] = (rand() % 10) + 1;
			printf("%d ", matrix[i][j]);
		}
		printf("₩n");
	}

	printf("₩na matrix rotated 90 degrees (clockwise)₩n");
	int temp[5][5];
	for (int i = 0; i < 5; i++) {
		for (int j = 0; j < 5; j++) {
			temp[i][j] = matrix[4 - j][i];
			printf("%d ", temp[i][j]);
		}
		printf("₩n");
	}
}
```

- **result**



P6.

- **code**

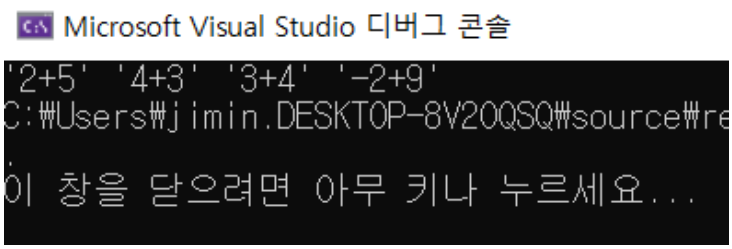
```
#include <stdio.h>

void pairSum(int arr[], int num, int length) {
    for (int i = 0; i < length; i++) {
        for (int j = i + 1; j < length; j++) {
            if (arr[i] + arr[j] == num) {
                printf("'%d+%d' ", arr[i], arr[j]);
            }
        }
    }
}

int main() {
    int arr[10] = { 2,4,3,5,6,-2,4,7,8,9 };
    int length = sizeof(arr) / sizeof(int);
    pairSum(arr, 7, length);

}
```

- **result**



P7.

- **code**

```
#include <stdio.h>
#include <stdlib.h>
#include <windows.h>

int main(void) {

	int matrix[30][10];
	for (int i = 0; i < 30; i++) {
		for (int j = 0; j < 10; j++) {
			matrix[i][j] = (rand() % 5) + 1;
		}
	}

	int matrix2[10][50];
	for (int i = 0; i < 10; i++) {
		for (int j = 0; j < 50; j++) {
			matrix2[i][j] = (rand() % 5) + 1;
		}
	}

	LARGE_INTEGER Frequency, start_ticks, end_ticks, diff_ticks;

	QueryPerformanceFrequency(&Frequency);
	QueryPerformanceCounter(&start_ticks);

	int result1[30][50] = { 0, };

	for (int i = 0; i < 30; i++) {
		for (int j = 0; j < 50; j++) {
			for (int k = 0; k < 10; k++) {
				result1[i][j] += matrix[i][k] * matrix2[k][j];
			}
		}
	}

	QueryPerformanceCounter(&end_ticks);

	diff_ticks.QuadPart = end_ticks.QuadPart - start_ticks.QuadPart;
	double duringtime = (double)diff_ticks.QuadPart / (double)Frequency.QuadPart;
	printf("running time (ordinary multiplication) : %f₩n", duringtime);

	for (int i = 0; i < 30; i++) {
		for (int j = 0; j < 50; j++) {
			printf("%d ", result1[i][j]);
		}
		printf("₩n");
	}

	LARGE_INTEGER Frequency2, start_ticks2, end_ticks2, diff_ticks2;

	QueryPerformanceFrequency(&Frequency2);
```

```
QueryPerformanceCounter(&start_ticks2);

int a[15][5], b[15][5], c[15][5], d[15][5];
for (int i = 0; i < 15; i++) { // split matrix
        for (int j = 0; j < 5; j++) {
                a[i][j] = matrix[i][j];
                b[i][j] = matrix[i][j + 5];
                c[i][j] = matrix[i + 15][j];
                d[i][j] = matrix[i + 15][j + 5];
        }
}

int e[5][25], f[5][25], g[5][25], h[5][25];
for (int i = 0; i < 5; i++) { // split matrix2
        for (int j = 0; j < 25; j++) {
                e[i][j] = matrix2[i][j];
                f[i][j] = matrix2[i][j + 25];
                g[i][j] = matrix2[i + 5][j];
                h[i][j] = matrix2[i + 5][j + 25];
        }
}

int f_h[5][25], g_e[5][25], e_h[5][25], g_h[5][25], e_f[5][25];
for (int i = 0; i < 5; i++) {
        for (int j = 0; j < 25; j++) {
                f_h[i][j] = f[i][j] - h[i][j]; // f-h
                g_e[i][j] = g[i][j] - e[i][j]; // g-e
                e_h[i][j] = e[i][j] + h[i][j]; // e+h
                g_h[i][j] = g[i][j] + h[i][j]; // g+h
                e_f[i][j] = e[i][j] + f[i][j]; // e+f
        }
}

int a_b[15][5], c_d[15][5], a_d[15][5], b_d[15][5], a_c[15][5];
for (int i = 0; i < 15; i++) {
        for (int j = 0; j < 5; j++) {
                a_b[i][j] = a[i][j] + b[i][j]; // a+b
                c_d[i][j] = c[i][j] + d[i][j]; // c+d
                a_d[i][j] = a[i][j] + d[i][j]; // a+d
                b_d[i][j] = b[i][j] - d[i][j]; // b+d
                a_c[i][j] = a[i][j] - c[i][j]; // a-c
        }
}

int p1[15][25] = { 0, };
int p2[15][25] = { 0, };
int p3[15][25] = { 0, };
int p4[15][25] = { 0, };
int p5[15][25] = { 0, };
int p6[15][25] = { 0, };
int p7[15][25] = { 0, };

for (int i = 0; i < 15; i++) {
        for (int j = 0; j < 25; j++) {
                for (int k = 0; k < 5; k++) {
```

```
                                p1[i][j] += a[i][k] * f_h[k][j]; // p1 = a*(f-h)
                                p2[i][j] += a_b[i][k] * h[k][j]; // p2 = (a+b)*h
                                p3[i][j] += c_d[i][k] * e[k][j]; // p3 = (c+d)*e
                                p4[i][j] += d[i][k] * g_e[k][j]; // p4 = d*(g-e)
                                p5[i][j] += a_d[i][k] * e_h[k][j]; // p5 = (a+d)*(e+h)
                                p6[i][j] += b_d[i][k] * g_h[k][j]; // p6 = (b-d)*(g+h)
                                p7[i][j] += a_c[i][k] * e_f[k][j]; // p7 = (a-c)*(e+f)
                        }
                }
        }

        int r[15][25];
        int s[15][25];
        int t[15][25];
        int u[15][25];

        for (int i = 0; i < 15; i++) {
                for (int j = 0; j < 25; j++) {
                        r[i][j] = p5[i][j] + p4[i][j] - p2[i][j] + p6[i][j]; // r = p5+p4-
p2+p6
                        s[i][j] = p1[i][j] + p2[i][j]; // s = p1+p2
                        t[i][j] = p3[i][j] + p4[i][j]; // t = p3+p4
                        u[i][j] = p5[i][j] + p1[i][j] - p3[i][j] - p7[i][j]; // u=p5+p1-p3-p7
                }
        }

        int result2[30][50];
        for (int i = 0; i < 15; i++) { // merge matrix
                for (int j = 0; j < 25; j++) {
                        result2[i][j] = r[i][j];
                        result2[i][j + 25] = s[i][j];
                        result2[i + 15][j] = t[i][j];
                        result2[i + 15][j + 25] = u[i][j];
                }
        }

        QueryPerformanceCounter(&end_ticks2);

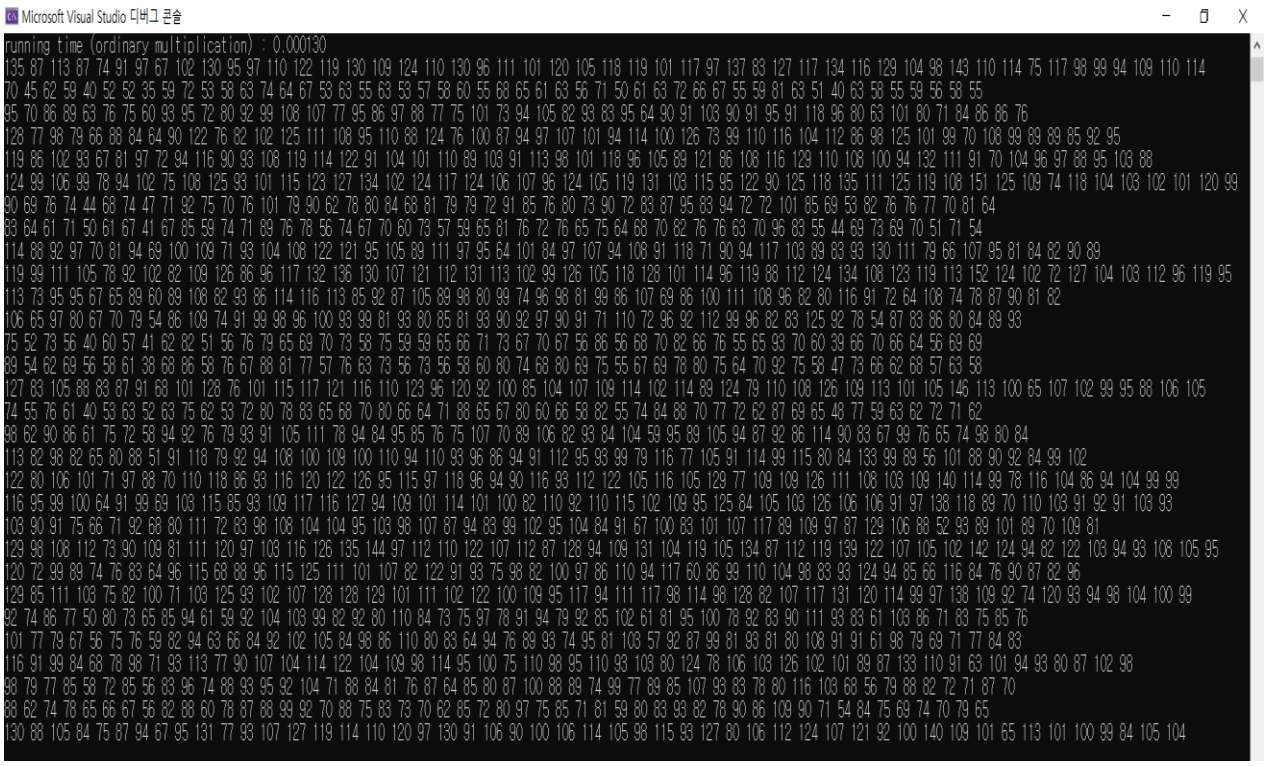
        diff_ticks2.QuadPart = end_ticks2.QuadPart - start_ticks2.QuadPart;
        double duringtime2 = (double)diff_ticks2.QuadPart / (double)Frequency2.QuadPart;
        printf("₩nrunning time (using the Strassen's idea) : %f₩n", duringtime2);

        for (int i = 0; i < 30; i++) {
                for (int j = 0; j < 50; j++) {
                        printf("%d ", result2[i][j]);
                }
                printf("₩n");
        }

        return 0;
}
```

- **result (same result)**

Running time (ordinary multiplication) : 0.000130(ms)



Running time (using the Strassen's idea) : 0.000083(ms)

```
running time (using the Strassen's idea) : 0.000083
135 87 113 87 74 91 97 67 102 130 95 97 110 122 119 130 109 124 110 130 96 111 101 120 105 118 119 101 117 97 137 83 127 117 134 116 129 104 98 143 110 114 75 117 98 99 94 109 110 114
70 45 62 59 40 52 52 35 59 72 53 58 63 74 64 67 53 63 55 63 53 57 58 60 55 68 65 61 63 56 71 50 61 63 72 66 67 55 59 81 63 51 40 63 58 55 59 56 58 55
95 70 86 89 63 76 75 60 93 95 72 80 92 99 108 107 77 95 86 97 88 77 75 101 73 94 105 82 93 83 95 64 90 91 103 90 91 95 91 118 96 80 63 101 80 71 84 86 86 76
128 77 98 79 66 88 84 64 90 122 76 82 102 125 111 108 95 110 88 124 76 100 87 94 97 107 101 94 114 100 126 73 99 110 116 104 112 86 98 125 101 99 70 108 99 89 89 85 92 95
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89 54 62 69 56 58 61 38 68 86 58 76 67 88 81 77 57 76 63 73 56 73 56 58 60 80 74 68 80 69 75 55 67 69 78 80 75 64 70 92 75 58 47 73 66 62 68 57 63 58
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122 80 106 101 71 97 88 70 110 118 86 93 116 120 122 126 95 115 97 118 96 94 90 116 93 112 122 105 116 105 129 77 109 109 126 111 108 103 109 140 114 99 78 116 104 86 94 104 99 99
116 95 99 100 64 91 99 69 103 115 85 93 109 117 116 127 94 109 101 114 101 100 82 110 92 110 115 102 109 95 125 84 105 103 126 106 106 91 97 138 118 89 70 110 103 91 92 91 103 93
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88 62 74 78 65 66 67 56 82 88 60 78 87 88 99 92 70 88 75 83 73 70 62 85 72 80 97 75 85 71 81 59 80 83 93 82 78 90 86 109 90 71 54 84 75 69 74 70 79 65
130 88 105 84 75 87 94 67 95 131 77 93 107 127 119 114 110 120 97 130 91 106 90 100 106 114 105 98 115 93 127 80 106 112 124 107 121 92 100 140 109 101 65 113 101 100 99 84 105 104

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이 창을 닫으려면 아무 키나 누르세요.
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