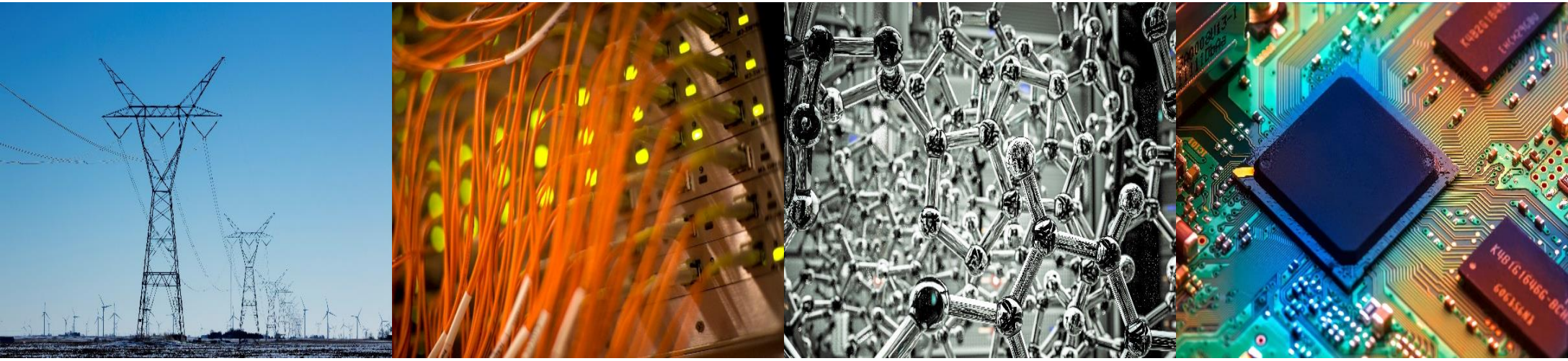
ECE 220 Computer Systems & Programming

Lecture 11 – Problem Solving with Pointers and Arrays

October 3, 2024



- Quiz3 is next week
- MT1 regrade request deadline is this Sunday

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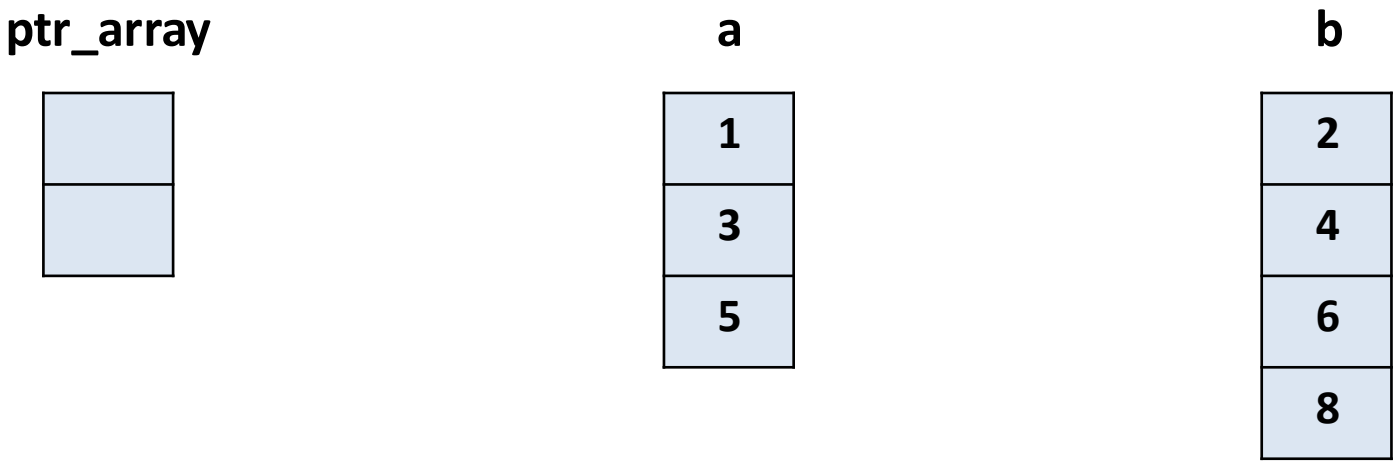
Exercise: implement a function that transpose a 2-D matrix

```
#define ROW 2 /* row size */
#define COL 3 /* col size */
void transpose(int in_matrix[ROW][COL], int out_matrix[COL][ROW]){




}
```

```
#define ROW 2 /* row size */
#define COL 3 /* col size */
void transpose2(int *in_matrix, int *out_matrix){




}
```


Pointer Array vs. Pointer to an Array

```
/* declare two integer arrays */
int a[3] = {1,3,5};
int b[4] = {2,4,6,8};

int *ptr_array[2];
ptr_array[0] = a;
ptr_array[1] = b;
```



Search Algorithms

Linear Search: search from the beginning of the array until item is found

Binary Search: (for a ***sorted*** array in ascending order)

1. find the **middle** of the array and check if it's the search item;
2. search first half of the array if the search item is smaller than middle, else search the second half;
3. repeat steps 1 & 2 until search item is found.

Search for 23 in a sorted array	**2**	**5**	**8**	**12**	**16**	**23**	**38**	**56**	**72**	**91**
23 > 16 (middle), search second half	**L**									**H**
	2	**5**	**8**	**12**	**16**	**23**	**38**	**56**	**72**	**91**
23 < 56 (middle), search first half						**L**				**H**
	2	**5**	**8**	**12**	**16**	**23**	**38**	**56**	**72**	**91**
23 == 23 (middle), return 5 (index of 23)						**L**	**H**			
	2	**5**	**8**	**12**	**16**	**23**	**38**	**56**	**72**	**91**

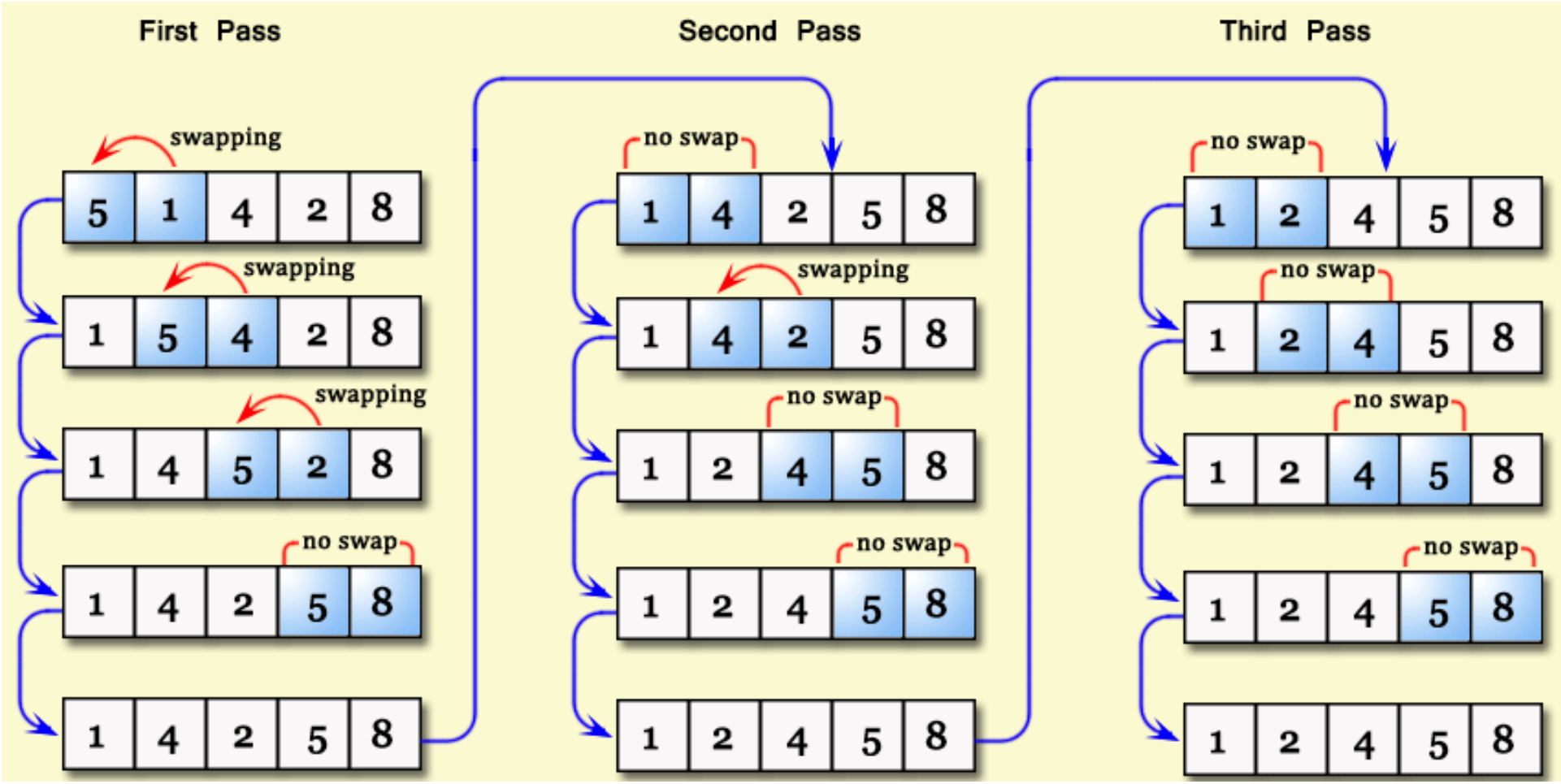
Exercise: implement an iterative function that performs binary search

This function takes two arguments: a pointer to the sorted array (in ascending order) and the search item. If the search item is found, the function returns its index in the array. Otherwise, it returns -1.

```
#define SIZE 10
int binary_search(int array[], int item){




}
```

Sorting Algorithms (http://visualgo.net/sorting)

Bubble Sort: 1. compare items next to each other and swap them if needed;
2. repeat this process until the entire array is sorted.



Exercise: implement a function that performs bubble sort

This function takes one argument: a pointer to the array. Note: you can use the swap function: void swap(int *x, int *y);

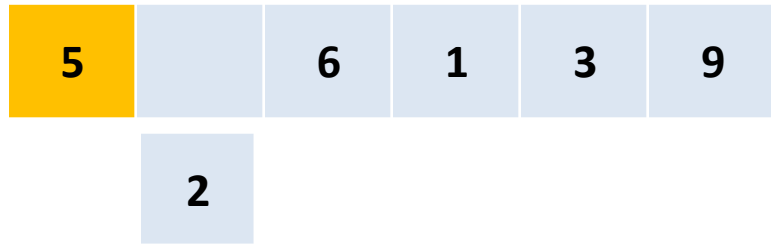
```
#define SIZE 5
void bubble_sort(int array[]){
   /* declare necessary variables */

   do{
      /* initialize the "swap" indicator */

      /* go through the entire array to compare and swap adjacent
         elements */









   }while(                              );
   /* go through the entire array again if there's a swap */
}
```

Insertion Sort:

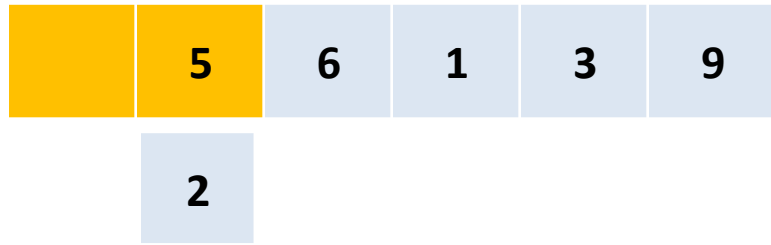
1. remove item from array, insert it at the proper location in the sorted part by shifting other items;
2. repeat this process until the end of array is reach.

Step 1: assume first item is ”sorted”

Step 2: remove the next item from array



Step 3: since 5>2, shift 5 to create space



Step 4: insert 2 into the empty space

Quick Sort: also called divide-and-conquer

1. pick a pivot and partition array into 2 subarrays;
2. then sort subarrays using the same method.