

## HW 09 Practice Problems

**Due:** DO NOT SUBMIT

### Instructions:

- These practice problems are helpful to warm-up for the homework itself. They're great to discuss with course staff or class mates because **these problems are not to be handed in** so you may discuss ideas freely without worrying about academic integrity issues. Solutions will be provided immediately with the problems themselves.

### Problem 1 Sorting Intermediate Steps

#### i Insertion Sort

Below is an intermediate step of during insertion sort. The square in the middle separates the sorted and the unsorted array.

1 3 8  $\square$  2 7 6

How many comparisons (start from the left) will there be before inserting the next element to the sorted sub-array? How is the array going to look like after the next iteration?

#### ii Merge Sort You are about to merge the two sorted lists below into one sorted list.

$L_1$  : 1 2 7 12 15

$L_2$  : 0 3 4 18 20

List the indices of the first 5 comparisons in python notation (e.g.  $L_2[3] = 18$ ) Write the merged list after the merge operation is complete.

### Problem 2 Function Growth

There are three postage options in a town:

1. **Snail mail:** it takes 3 days for each letter to arrive by snail mail, only a single letter may be carried at one time.
2. **Carrier pigeon:** a single carrier pigeon takes 8 days to deliver some mail. A carrier pigeon may carry half of the remaining mail rounded down or a single letter, whichever is larger. For example, if 14 letters are sent then:
  - the carrier pigeon will carry 7 letters on the first trip (7 remaining)

- the carrier pigeon will carry 3 letters on the next trip (4 remaining)
- the carrier pigeon will carry 2 letters on the next trip (2 remaining)
- the carrier pigeon will carry 1 letter on the next trip (1 remaining)
- the carrier pigeon will carry 1 letter on the next trip (0 remain)

So it will take 5 trips (40 days) to deliver all the mail.

3. **Pony express:** In 60 days the pony express can deliver any amount of letters.

- Which shipping method offers the quickest delivery of 7 letters? How many days will this method take?
- Which shipping method offers the quickest delivery of 29 letters? How many days will this method take?
- What is the smallest amount of letters which must be sent such that the pony express becomes faster than snail mail?
- What is the smallest amount of letters which must be sent such that the carrier pigeon becomes faster than snail mail?
- What is the smallest amount of letters which must be sent such that the pony express becomes faster than the carrier pigeon mail?