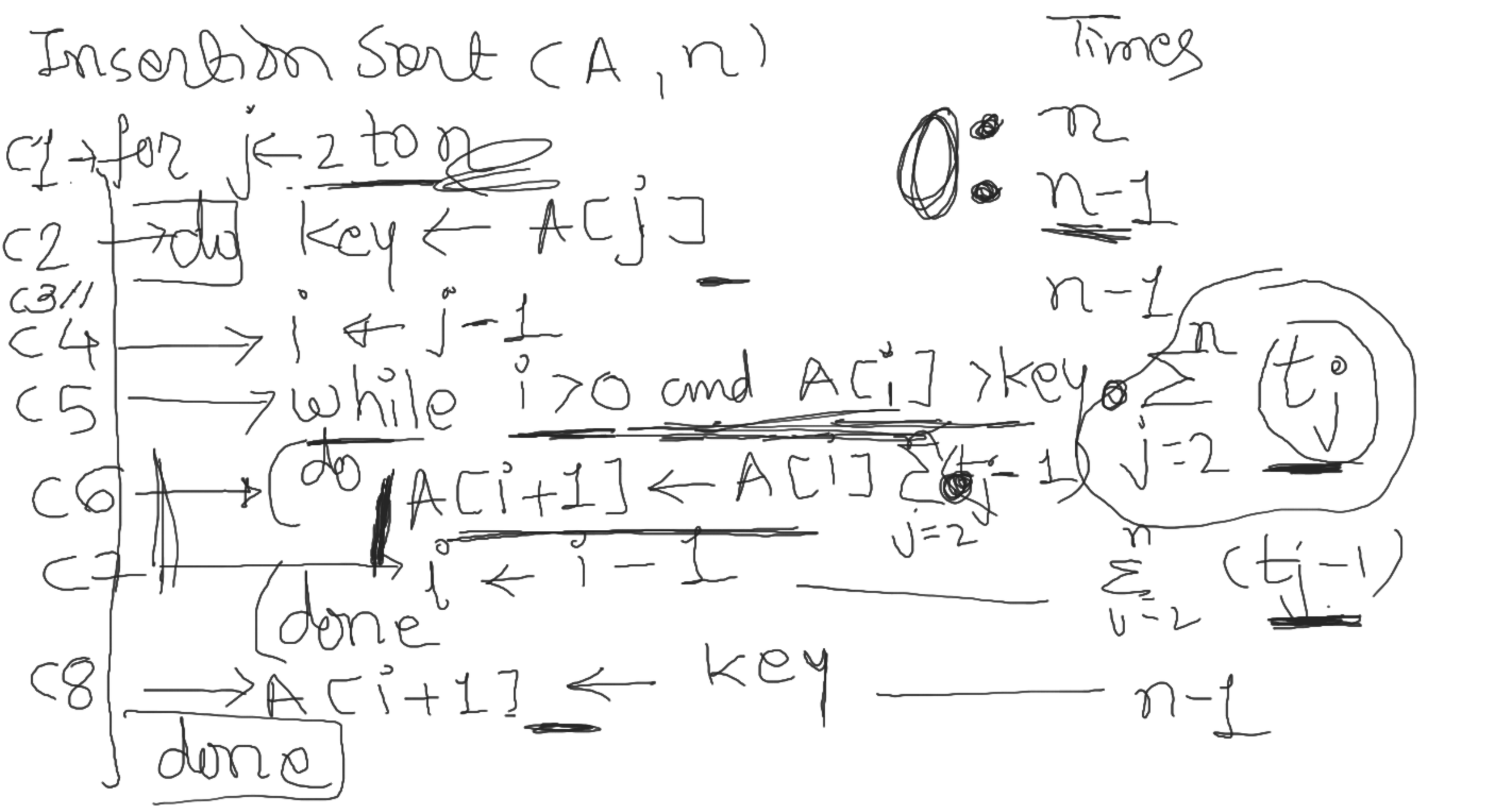
Insertion Sort

Analogy: 1) students standing row
2) sorting a hand of cards


Insertion Sort (A, n)
Times
c1 → for j ← 2 to n
c2 → do key ← A[j]
c3 → i ← j - 1
c4 → while i > 0 and A[i] > key
c5 → do A[i+1] ← A[i]
c6 → i ← i - 1
c7 → done
c8 → A[i+1] ← key
done
n
n-1
n-1
Σ (tj) j=2 to n
Σ (tj - 1) j=2 to n
n-1

Insertion Sort

$$T(n) = c_1 n + c_2(n-1) + c_4(n-1)$$

$$+ c_5 \sum_{j=2}^{n} t_j + c_6 \sum_{j=2}^{n} (t_j - 1)$$

Rear Next Slide

$$+ c_7 \sum_{j=2}^{n} (t_j - 1) + c_8(n-1)$$

Best Case

$$= c_1 n + c_2(n-1) + c_4(n-1)$$

$$+ (5(n-1) + c_6(0) + c_7(0)$$

$$+ c_8(n-1)$$

$$\sum_{j=2}^{n} j = \frac{n(n+1)}{2} - 1$$

$$\sum_{j=2}^{n} (j-1) = \frac{n(n-1)}{2}$$

$$= c_1 n + (c_2 + c_4 + c_5 + c_8)(n-1) \quad \Theta(n)$$

Best Case

Worst Case

$$= \_\_\_\_ + c_5\left(\frac{n(n+1)}{2} - 1\right) +$$

$$c_6\left(\frac{n(n-1)}{2}\right) + c_7\left(\frac{n(n-1)}{2}\right) +$$

$$= \left(\frac{c_5}{2} + \frac{c_6}{2} + \frac{c_7}{2}\right) n^2$$

$$+ (c_1 + c_2 + \cdots) n$$

$$- (c_1 + \cdots)$$

Insertion sort

worst case

$O(n^2)$

Assignment

Perform mathematical analysis of selection sort.

Both worst Case

Best Case.