CS 305
Design and Analysis of Algorithms

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Today's Topics

- Questions / Comments?
- Reminder of Indicator R.V.s and Expected Value properties
- Continue our application of indicator random variables to analyze the expected running time of Randomized Quicksort
- Decision trees
- Lower bound running time on comparison sorts
- Start Counting Sort if there's time

```
PARTITION (LIST, START, END)
1a. RANDIDX ← RAND(START, END)
1b. SWAP(LIST, END, RANDIDX)
1c. PIVOT ← END
2. LASTLHS ← START - 1
3. FIRSTUNK ← START
4. WHILE FIRSTUNK < END
5.     IF LIST[FIRSTUNK] < LIST[PIVOT]
6.         LASTLHS++
7.         SWAP(LIST, LASTLHS, FIRSTUNK)
8.     FIRSTUNK++
9. SWAP(LIST, PIVOT, LASTLHS+1)          // PUT PIVOT ELEMENT
10. RETURN LASTLHS+1                     // IN CORRECT PLACE


QUICKSORT(LIST, START, END)
1. IF START < END
2.     PIVOT ← PARTITION(LIST, START, END)
3.     QUICKSORT(LIST, START, PIVOT-1)
4.     QUICKSORT(LIST, PIVOT+1, END)
```

Expected Value and Indicator Random Variables

Expected Value E[.]

X, X1 and X2 are random variables

$X = X1 + X2$

$E[X] = E[X1] + E[X2]$

$E[cX] = cE[X]$, where c is a constant scalar

Indicator Random Variable X_A

S is sample space, A is an Event

$X_A = 1$ if A occurs, 0 if A doesn't occur

$E[X_A] = P(A)$ the probability that A occurs