CSC236 *Intro. to* the Theory of Computation

Lecture 5: Recurrences and D&C

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Course page:
http://www.cdf.toronto.edu/~csc236h/fall/index.html

Section page:
http://www.cdf.toronto.edu/~csc236h/fall/amir_lectures.html

review

- so far
  - different variants of induction
  - recurrence relations
  - introduced the application of recurrence relations to complexity of recursive algorithms
- this week
  - application of recurrence relations to complexity of Divide & Conquer algorithms

recursive algorithms

- normally reduce/split the problem to some problems of smaller size
  - ***factorial*(*n* - 1)** is smaller vs. ***factorial*(*n*)**
  - ***fib*(*n* - 1)** and ***fib*(*n* - 2)** are smaller vs. ***fib*(*n*)**
  - ***mergeSort*(*A*, *1st half*)** and ***mergeSort*(A, 2nd half)** are smaller vs. ***mergeSort*(*A*)**
  - ***binSearch*(x, *A*, *1st half*)** and ***binSearch*(x, A, 2nd half)** are smaller vs. ***binSearch*(x, *A*)**
- recurrences
  - towards the complexity of D&C Alg.

Example 61: *binSearch*

```
def binSearch(x, A, b, e):
    if b == e:
        if x == A[b]:
            return b
        else:
            return -1
    else:
        m = (b + e) // 2          # midpoint
        if x <= A[m]:
            return binSearch(x, A, b, m)
        else:
            return binSearch(x, A, m+1, e)
```


Example 61: *binSearch*

- a recurrence relation for complexity of *binSearch*

Example 61: *binSearch*

- guessing (roughly calculating) a closed form

Example 61: *binSearch*

- calculating a lower bound

Example 61: *binSearch*

- calculating a lower bound

Example 61: *binSearch*

- calculating an upper bound

Example 61: *binSearch*

- calculating an upper bound

notes:

notes: