Contents

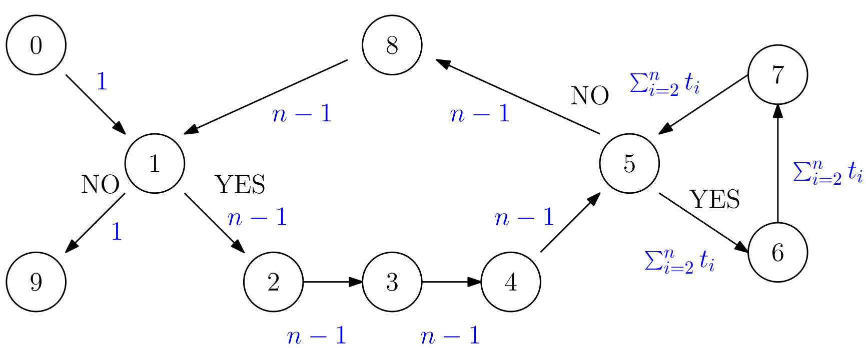
1 Lecture 2

1.1 Agenda

1.1.1 Order Growth

2 Insertion Sort

- Flow graph (directed graph)



c_0	1
c_1	n
c_2	$n-1$
c_3	$n-1$
c_4	$n-1$
c_5	$\sum_{i=2}^{n} t_i + n - 1$
c_6	$\sum_{i=2}^{n} t_i$
c_7	$\sum_{i=2}^{n} t_i$
c_8	$n-1$
c_9	1

$$T(n) = \Big(\sum_{i=2}^{n} t_i\Big) \cdot (c_5 + c_6 + c_7) + n \cdot (c_1 + c_2 + c_3 + c_4 + c_5 + c_8) + (c_0 - c_2 - c_3 - c_4 - c_5 - c_8)$$

3 Big-Oh Notation

$$f(n) = O(g(n))$$

$$O(g(n)) = \{f(n) \mid \exists c > 0, n_0 > 0, \ \ \forall n \geq n_0, \ \ 0 \leq f(n) \leq c \cdot g(n)\}$$

- $O(g(n))$ is a set of functions.

3.0.1 True/False

- $n = O(n^2)$
- $n^2 = O(n)$
- $4n^2 + 100n + 500 = O(n^2)$
  - True, but how do you prove? What values of c and n_0?
  - $(604, 1)$, $(19, 10)$, $(5.05, 100)$
- $1000000 = O(1)$

4 Big-Omega Notation

$$f(n) = \Omega(g(n))$$

$$\Omega(g(n)) = \{f(n) \mid \exists c > 0, n_0 > 0, \ \ \forall n \geq n_0, \ \ 0 \leq c \cdot g(n) \leq f(n)\}$$

4.0.1 True/False

- $n = \Omega(n^2)$
- $n^2 = \Omega(n)$
- $4n^2 + 100n + 500 = \Omega(n^2)$
  - True, but how do you prove? What values of c and n_0?
  - $(4, 1)$
- $1000000 = \Omega(1)$

5 Theta Notation

6 Going back to Insertion Sort

- Worst-case running time
- Best-case running time

7 Small-Oh notation

- limiting values
- Examples

8 Small-omega notation

- Examples

9 Properties

- Transitivity
- Reflexivity, O, Ω, Θ
- Symmetry Θ
- Transpose Symmetry, $O \leftrightarrow \Omega$, $o \leftrightarrow \omega$