CSE 12 – Basic Data Structures and Object-Oriented Design Lecture 10

Paul Cao and Greg Miranda, Winter 2021

This lecture is being recorded

Announcements

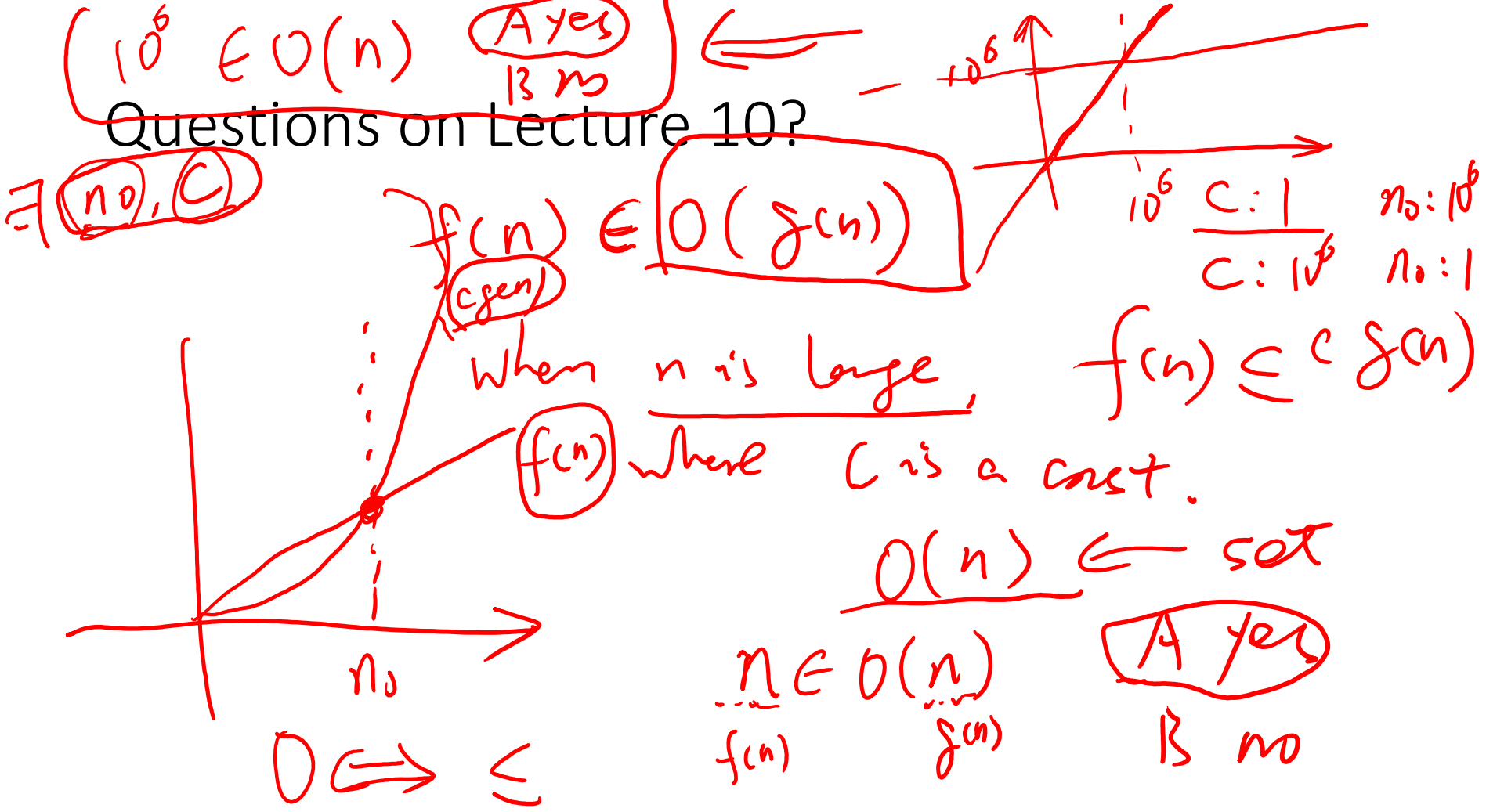
- Quiz 10 due Monday @ 8am
- Survey 4 due Friday @ 11:59pm
- PA3 due tonight @ 11:59pm
- Exam 1 on Friday (no class)
  - Released @ 8am on Friday 1/29
  - Closes @ 10am on Saturday 1/30
  - More details on Piazza

details

Topics

- Questions on Lecture 10?
- Big O

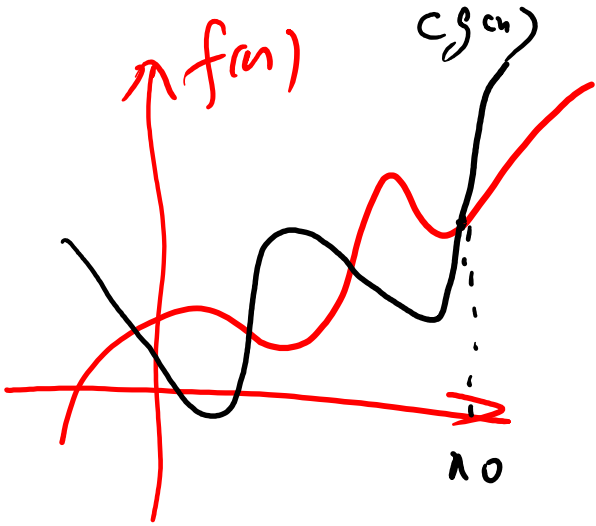
Questions on Lecture 10?



Let f(n) = 100

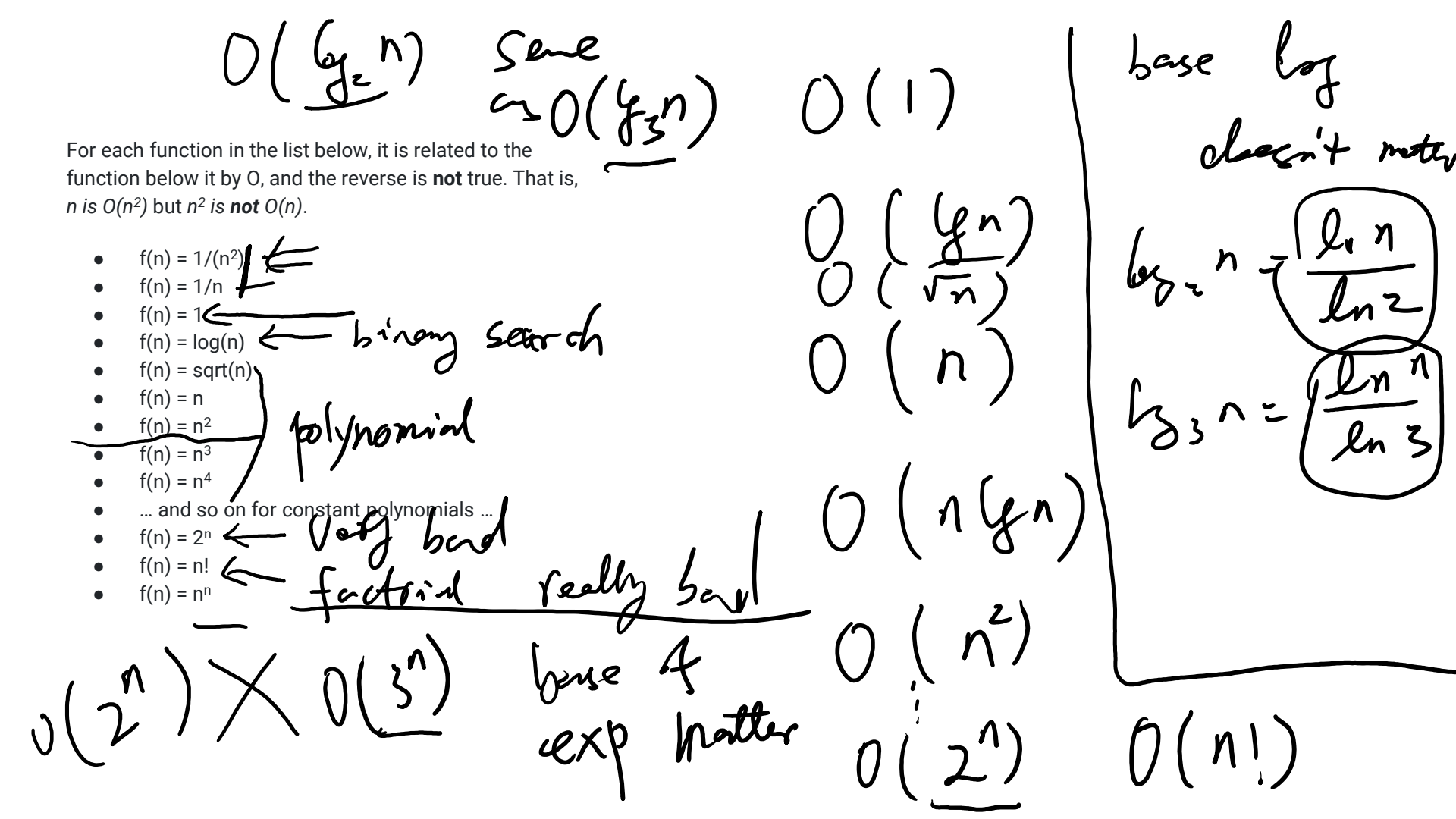
- Which of the following is NOT a correct bound?

A. f(n) is $O(2^n)$
B. f(n) is $O(n^2)$
C. f(n) is $O(n)$
D. f(n) is $O(n^{100})$
E. None of these



For each function in the list below, it is related to the function below it by O, and the reverse is **not** true. That is, *n is $O(n^2)$* but *n^2 is **not** $O(n)$*.

- f(n) = $1/(n^2)$
- f(n) = 1/n
- f(n) = 1
- f(n) = log(n)
- f(n) = sqrt(n)
- f(n) = n
- f(n) = n^2
- f(n) = n^3
- f(n) = n^4
- … and so on for constant polynomials …
- f(n) = 2^n
- f(n) = n!
- f(n) = n^n



Let $f(n) = 3n^3 + 2n + 7$

dominant term

remove constant coeff

- Which of the following is a correct bound?

A. f(n) is O(log(n))
B. f(n) is $O(n^2)$
C. f(n) is O(n)
D. f(n) is $O(n^3)$
E. None of these

```
void printAllElementOfArray(int[] arr) {
    for (int i = 0; i < arr.legnth; i++) {
        printf("%d\n", arr[i]);
    }
}
```

- Which of the following is a correct bound?

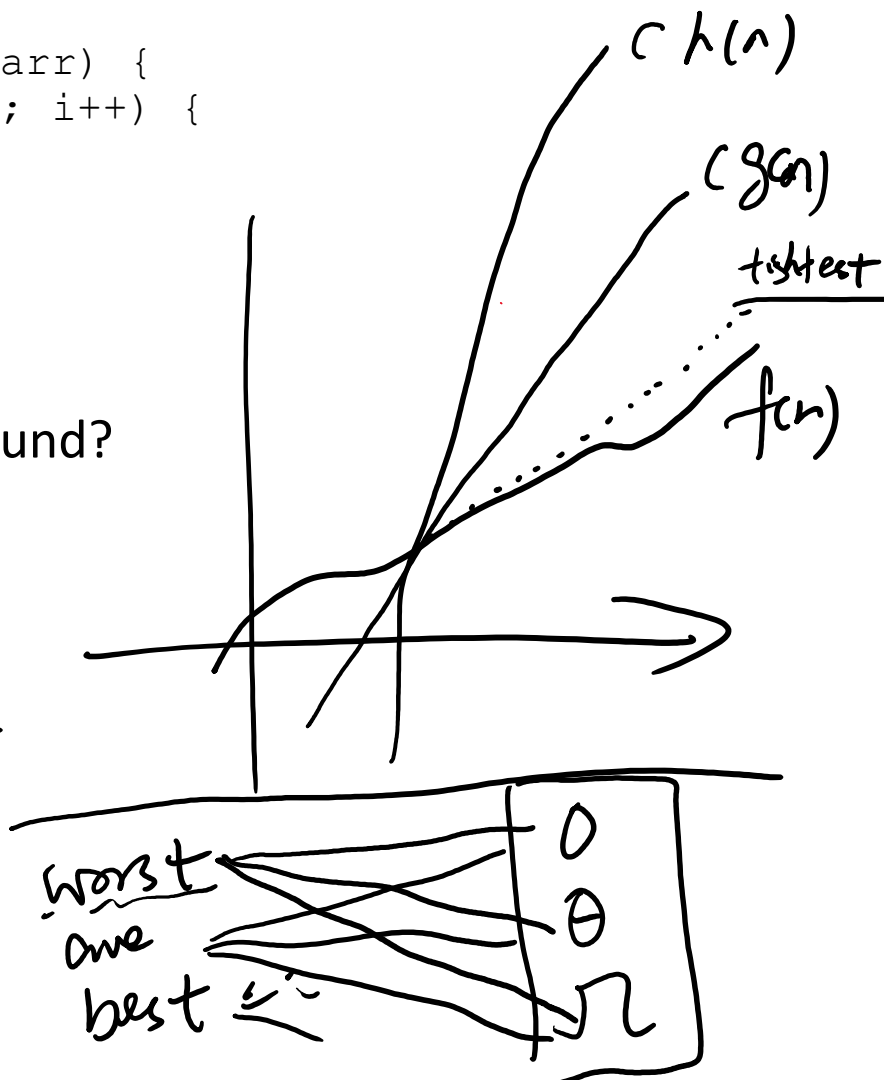
A. f(n) is O(log(n))

B. f(n) is $O(n^2)$

C. f(n) is O(n) — tight bound

D. f(n) is $O(n^3)$

E. More than one of these



```
void printAllPossibleOrderedPairs(int arr[]) {
    for (int i = 0; i < arr.length; i++) {
        for (int j = 0; j < arr.length; j++) {
            printf("%d = %d\n", arr[i], arr[j]);
        }
    }
}
```

$$\sum_{n}\sum_{n} 1 = n^2$$

- Which of the following is a correct bound?

A. f(n) is O(log(n))

B. f(n) is $O(n^2)$

C. f(n) is O(n)

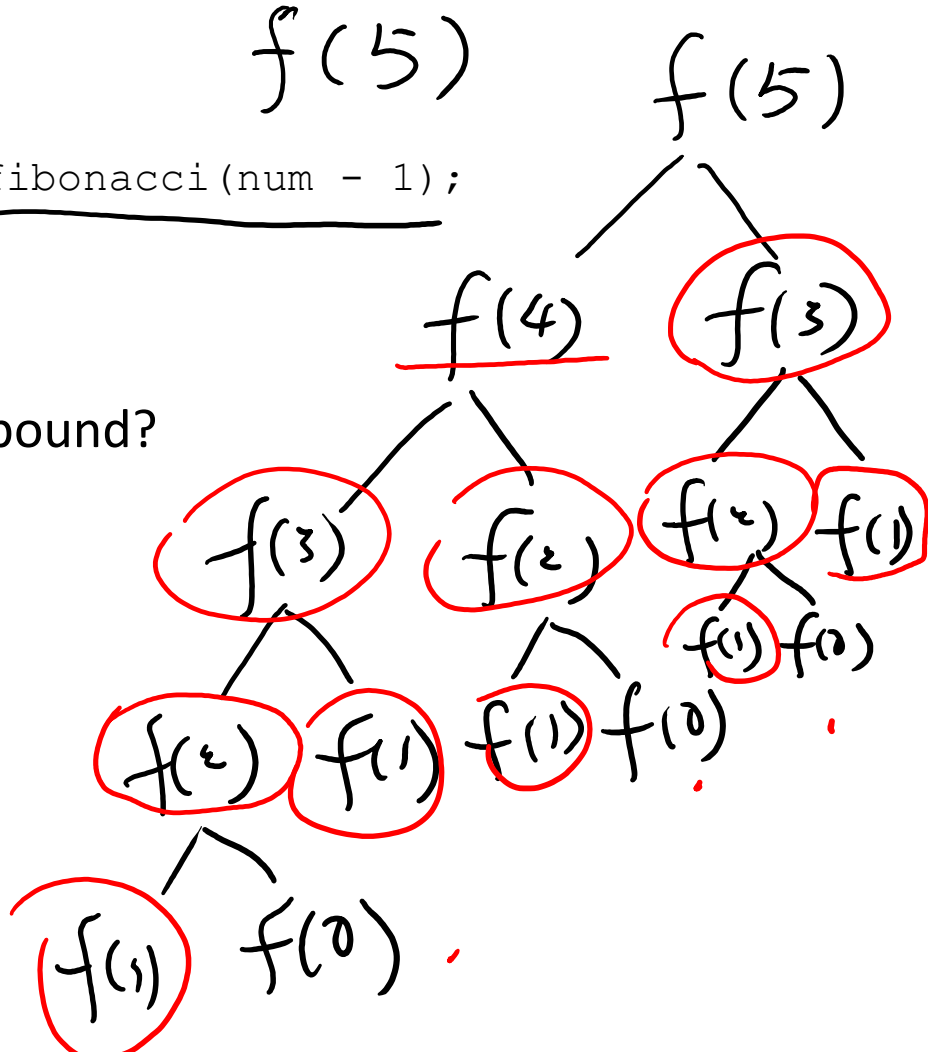
D. f(n) is $O(n^3)$

E. More than one of these

tightest

$O(n^2)$

```
int fibonacci(int num) {
    if (num <= 1) return num;
    return fibonacci(num - 2) + fibonacci(num - 1);
}
```



- Which of the following is a correct bound?

A. f(n) is $O(2^n)$

B. f(n) is $O(n^2)$

C. f(n) is $O(n)$

D. f(n) is $O(n^3)$

E. More than one of these

$2^n = 2 \cdot 2^{n-1}$

$f(n) = f(n-1) + f(n-2)$

$T(n-2) \leq T(n-1)$

$T(n) = T(n-1) + T(n-2) + C$

$T(n) \leq 2^{n-1}$

$\leq 2\,T(n-1) + C$

$T(n) \in O\left(\left(\frac{1+\sqrt{5}}{2}\right)^n\right)$

$\leq 2\left[2\,T(n-2) + C\right] + C$

$= 2^2 T(n-2) + 4C + C$

$\leq 2^{n-1} \cdot T(n-(n-1)) + \cdots$

$T(1)$

$O(2^n)$