Exercise class 10

Introduction to Programming and Numerical Analysis

Class 3

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Algorithms!

Problem set 6

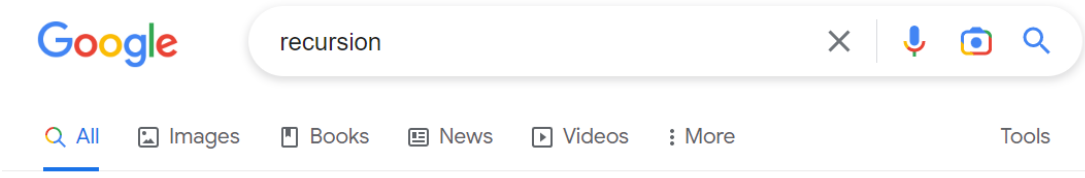
Algorithms!

An algorithm is an unambiguous description of how to solve a problem - or a **recipe** for the solution.

Examples of algorithms you've seen so far:

- Grid search optimization
- Random number generators
- Numerical solvers use algorithms...
- You could call the split-apply-combine approach an algorithm...

On recursion...



On recursion

Consider the Fibonacci sequence - The next number in the sequence is the sum of the two previous numbers:

$$
\begin{aligned}
F(0) &= 0 \\
F(1) &= 1 \\
F(n) &= F(n-1) + F(n-2) \quad \text{if } n > 1
\end{aligned}
$$

For $n > 1$, the function F is defined in terms of it self.

Problem set 6

The problem set consists of six increasingly difficult problems.

Plan for today:

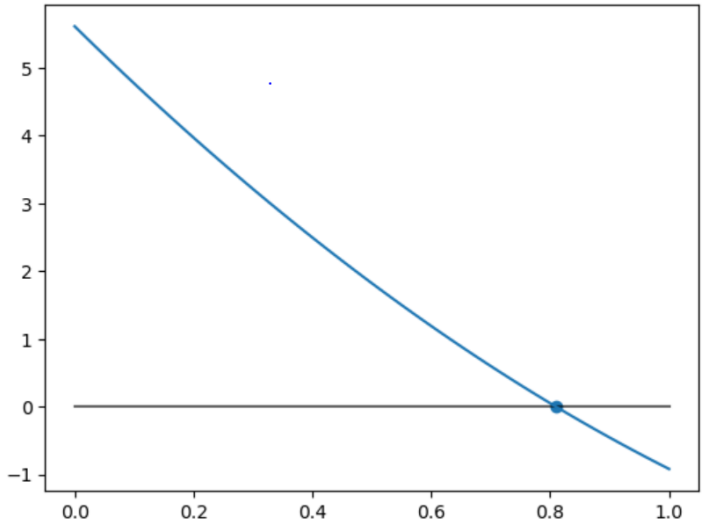
- Now-16.00: You solve problem 1-3
- 16.00-16.15: Break
- 16.15-16.25: We go through solutions + tips for problem 4+5
- 16.25-16.50: You solve problem 4+5
- 16.50-17: Solutions for Problem 4+5

Tip: If you get stuck, try to solve the problem in *pseudo-code* - that may help you get your thoughts in line.

Problem set 6

Problem 4: Bisection root finder. No corresponding code from lectures, but the algorithm is written in **pseudo-code**. Intuition on next slide...

Intuition for bisection



Problem set 6

Problem 5: Sieve of Erastothenes algorithm for finding prime numbers.

A prime number is a natural number greater than 1 that is not a product of two smaller numbers.

Consequently, any number that is not prime *is* a product of two smaller numbers - so we eliminate all numbers, that are a product of two smaller numbers.

Sieve: step 0

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

Sieve: step 1

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

Sieve: step 2

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

Sieve: step 3

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

Sieve: step 4

	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

Next time...

Video lectures:

- Linear equation systems
- Non-linear equations
- Symbolic math

Exercises

- Problem set 6: The Solow model

Also remember to hand in your data project on April 16th!