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Exercise session 3, 02 October, 2019

Numerical Methods in Informatics (L + E)

Exercise 1-2
Homework correction

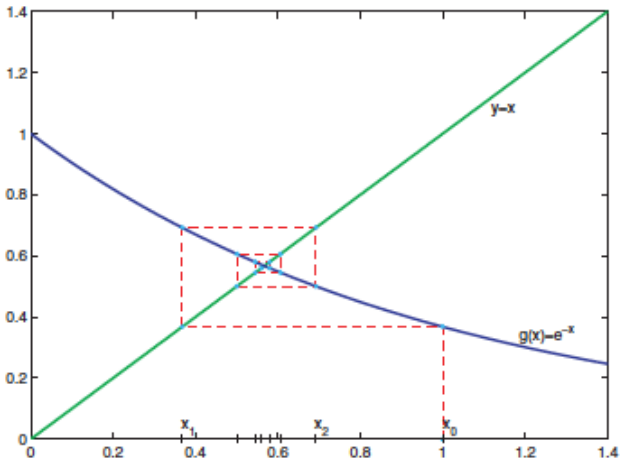
Exercise 3
Additional exercise 3 in homework. Show once again how to retrieve the order of convergence from the errors in consecutive iterations:

- define $e^{(k)} = |x^{(k)} - x|$, with x exact solution,
- assume $e^{(k+1)} \approx C \left(e^{(k+1)}\right)^p$
- compute $p \approx \dfrac{\log e^{(k+1)} - \log e^{(k)}}{\log e^{(k)} - \log e^{(k-1)}}$
- plot, with different p values

Notes: do not look at only one values, wait for some iterations before computing p, etc...

Exercise 4
Compute the zero of the function $f(x) = \exp(-x) - x$, using the iteration function $g(x) = \exp(-x)$. What can you say about convergence? (see Lecture slides, page 20)

- existence of the fixed point: we can find an interval $[a, b]$ in which $g(x)$ is continuous and where $g(x) \in [a, b]$ $\forall x \in [a, b]$ (e.g. $a = 0$, $b = 1$).
- convergence of fixed point iterations: we can find $L < 1$ for which the Banach Fixed Point Theorem is fulfilled, or $|\phi'(\alpha)| < 1$. The convergence is linear.



From: Ascher, Greif. *A First Course in Numerical Methods*, p. 47.

Exercise 5 The following data are related to the life expectation of citizens of two European regions:

Year	2000	2005	2010	2015
Eastern Europe	67.7	68.5	70.9	72.8
Western Europe	78.3	79.6	80.7	81.5

Data from: ourworldindata.org/life-expectancy

Use the interpolating polynomial of degree 3 to estimate the life expectation in 2003, 2011 and 2021.
Notes: you can compare different way to compute the polynomial coefficients