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MA-INF 4201 - Artificial Life
Exercise Sheet 5

Assignment 31

Let P_s be the population at start, and P_e be the end population. From the lecture we derive the exponential growth after one year as: $P_e = P_s\left(1 + \frac{1.7}{100}\right)$. After n years we have a population of: $P_e = P_s\left(1 + \frac{1.7}{100}\right)^n$. Since we seek $P_e = 2P_s$, we obtain

$$\begin{aligned}
2P_s &= P_s\left(1 + \frac{1.7}{100}\right)^n && \Leftrightarrow\\
2 &= \left(1 + \frac{1.7}{100}\right)^n && \Leftrightarrow\\
\log(2) &= \log\left(1 + \frac{1.7}{100}\right) n && \Leftrightarrow\\
n &= \frac{\log(2)}{\log\left(1 + \frac{1.7}{100}\right)} && \Rightarrow\\
n &\approx 41.12(a)
\end{aligned}$$

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Assignment 32

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Assignment 33

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Assignment 34

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Assignment 35

Suppose the limit exists and call it a: $\lim_{n\to\infty} \frac{F_{n+1}}{F_n} = a$. Then:

$$\begin{aligned}
a = \lim_{n\to\infty} \frac{F_{n+1}}{F_n} &= \lim_{n\to\infty} \frac{F_n + F_{n-1}}{F_n} = 1 + \lim_{n\to\infty} \frac{F_{n-1}}{F_n} = 1 + \frac{1}{a}\\
&\Rightarrow 0 = a^2 - a - 1
\end{aligned}$$

Using the midnight equation we obtain the solutions: $\frac{1\pm\sqrt{5}}{2}$.

The program implemented in Python is found in the file `fib.py` and takes the number of iterations as parameter `-n`. ■

Assignment 36

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