4. Modelling, Markov chains [10 points]

Transition probabilities in %	citizens	free farmers	bondsmen
citizens	80	0	20
free farmers	20	40	40
bondsmen	40	10	50

$$A^{50} = \begin{pmatrix} 0,65 & 0,05 & 0,3 \\ 0,65 & 0,05 & 0,3 \\ 0,65 & 0,05 & 0,3 \end{pmatrix}$$

In medieval times the free farmers became more and more dependent upon the landlords. They could only escape by hiding out in a town for one year. One said "Stadtluft macht frei." Prof. Mediavi researched the migratory movements of citzens, free farmers and bondsmen in Schwaben, a region in southern Germany. The transition matrix of his model is shown on the top left. The described period of **one** calculation is one decade.
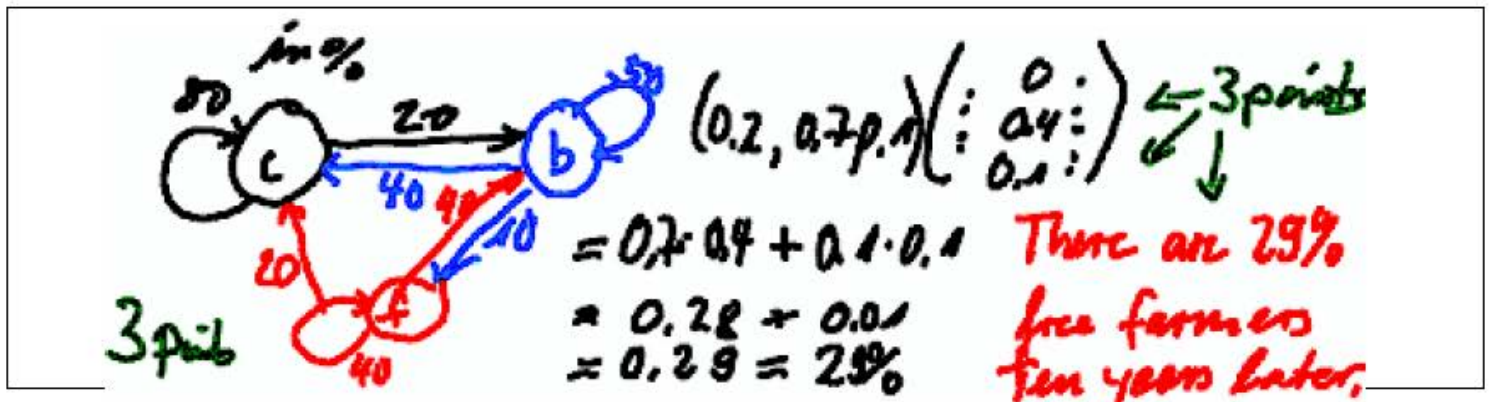
4.1   a) Draw the state graph.
b) When this trend startet in the Weser-mountains, a region in northern Germany, 20% citzens, 70% free farmers and 10% bondsmen lived there. What percentage of free farmers will be there after the next decade in the Weser-mountains according to Prof. Mediavi's model? (approach, tracable calculation, answer in a sentence)

Nur vom Prüfer auszufüllen

6P

| 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |

□ + 0,5

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

MC   **4.2**   **mc-question:** Which of the following statements are correct as an interpretation of the A^{50} (see top right)?

-1/0P ☒   The free farmers lost their livelihood due to bad harvests and higher tributes to the landlords.

-2/0P ☒   In the long term there is a 65% probability that only citizens will remain, a 5% probability that only free farmers will remain and a 30% probability that only bondsmen will remain.

2/0P ☑   In the long term, due to this model, 65% of the population will live as citzens, 5% as free farmers and 30% as bondsmen.

MC   **4.3**   **mc-question:** Prof. Mediavi, see task at the top, is a good historian. As a competent scientist, what would be his reaction if finding a source which shows that a century later there were mostly the same fractions of citizens, free farmers and bondsmen in the Weser-Mountains.

-2/0P ☒   He keep silent about the Weser-mountains and looks for another region which is closer to his model.

1/0P ☑   He researches the reasons why the free farmers in the Weser-mountains stayed their ground better than in Schwaben.

1/0P ☑   He extends and modifies his model so that he can take account of even more factors.