Note: not all of these are feasible for an exam. These questions are designed to cover the spectrum of knowledge you should have at this point.

1. Discuss the 3 dimensions that are used in the 2022 ACM TOSEM review of SE4AI to classify AI systems.

2. Discuss the advantages and disadvantages of using AI systems to fulfill selected use cases in an engineered system.

3. Discuss the stages of the AI system life-cycle, as per Microsoft's internal study (discussed in class).

4. Explain the AI pipeline architecture, and the reasons it is used.

5. Assuming an AI pipeline follows the stages of the life-cycle from (3), discuss the expected inputs and outputs of each stage of the pipeline.

5. Compare and contrast supervised learning, unsupervised learning, and reinforcement learning

6. Explain the three different levels of data fusion

7. Compare and contrast how each knowledge area in the Software Engineering Body of Knowledge is realized for general software versus SE4AI.

8. Develop a use case diagram for an app of your choice.

9. Select a use case from (8) to be implemented via an AI system. Complete an ML Canvas for that use case.

10. Write a short Python program to accept a labelled dataset, and perform a one-hot encoding on the class labels

11. Let's define an outlier as any data point that lies more than three standard deviations away from the mean of the dataset. Write a short Python program to identify any such points in an unlabeled pandas dataframe with only one attribute.

12. Write a short Python program to perform mean-value imputation in a pandas dataframe

13. Write a short Python program to perform a stratified partitioning of a pandas dataframe, with the sizes of the partitions as an input variable.

14. What is the convex hull of a class? Draw an example.

15. How can we mathematically prove whether two classes are linearly separable or not?

16. Design a 2-layer TLU network to implement the switching function

$F(x,y,z) = (x \wedge \neg y \wedge \neg z) \vee (\neg x \wedge \neg y \wedge z) \vee (x \wedge y \wedge z) \vee (\neg x \wedge y \wedge \neg z) \vee (x \wedge y \wedge \neg z)$

17. Plot an error surface for a TLU (with a floating threshold as a parameter) for the dataset below:

$Y(0) = 2$
$Y(1) = 1$
$Y(2) = 0$

You may assume that the inputs x and outputs y are both drawn from the set {0,1,2}. Plot the error surface for weights and thresholds both running from -2 to +2.

18. Compute the induced local field ν for a single neuron with inputs (2,1) and weight vector (-2.5,1,1)