

# Artificial Intelligence: Exercise 3

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Week 2

1. Classify each of the following as examples of either inductive learning or deductive reasoning. Justify your answer.
  - (a) Using a combinatorial algorithm to find the shortest path on a map from one point to another.
  - (b) Using past experience at driving in the city to construct the shortest path from one point to another.
  - (c) Making a move in tic-tac-toe based on the outcomes of moves made in the past in similar positions.
  - (d) Classifying a machined slab as defective or non-defective by comparing its measurements with those of other defective and non-defective slabs.
  - (e) Classifying a machined slab as defective or non-defective by comparing its measurements with a set of ideal measurements.
2. Suppose that it is identified by an astute data scientist that spam emails often have the words “Free Money” embedded in them. Subsequently, the data scientist implements a system that identifies spam emails by removing all emails containing both these words. Discuss why this process involves both inductive learning and deductive reasoning.

## **Solution:**

1.
  - (a) Using a combinatorial algorithm to find the shortest path on a map from one point to another is an example for deductive reasoning. The knowledge is already represented as graph (the map). The shortest path algorithm is a general algorithm applicable to any graph and has proven mathematical properties. It is specialized here to the particular problem of finding the shortest path on a map.
  - (b) Using past experience at driving in the city to construct the shortest path from one point to another is an example for inductive reasoning. Here, the agent (driver) collects data by driving around and observing the time needed for the journey. There is no proof that the agent has found the shortest path and it is all based on collected data.

- (c) Making a move in tic-tac-toe based on the outcomes of moves made in the past in similar positions is again an inductive question. We collect data from similar situations and induce a rule to act in a new unseen situation. We have no proof that the action is optimal but we don't need a knowledge base at the beginning.
  - (d) Classifying a machined slab as defective or non-defective by comparing its measurements with those of other defective and non-defective slabs. This is deductive, We try to learn the distinction between defective and non-defective slabs by induction, i.e. by comparing many defective and non-defective examples-
  - (e) Classifying a machined slab as defective or non-defective by comparing its measurements with a set of ideal measurements. This is a deductive approach. We know already what the difference is and we have formulated a rule to classify the slabs. This rule is not induced from the data.
- 2.
- Inductive part: The pattern that spam emails contain often the word "Free money" is an inductive process. We have observed many mails and observed that this pattern seems to be a characteristic feature of spam mails. This is a primitive statistical observation and we can not be sure that the pattern might not appear in a non-spam email.
  - Deductive part: We formulate a rule that the occurrence of the word "Free money" should lead to a classification of the the email as spam. This rule is a simple knowledge base.