Chapter 3

Abductive inference- an evidential approach

3.1 Abduction as plausible reasoning

Abductive inference is typically relied upon in imperfect domains, in the face of incomplete or inconsistent information as well as in cases where the domain does not provide a strong theory. As such, it is frequently used both in everyday and in expert-level reasoning and is consistently stated to be practiced by scientists, detectives, and physicians. It is ubiquitous in daily life, although we may not be aware of employing it. For example, upon seeing your neighbour walk into his house wet, you may immediately think he has been swimming. However, swimming is not the only possible reason for one being wet. That is, your conclusion involving swimming is not guaranteed to be true. There could certainly be other reasons such as that he walked home in the rain without an umbrella, somebody poured water on him from the window of a building when he was passing by, or children sprayed him with a hose. One of these possible explanations will be the right one this time. Such reasonings that make up everyday life seems of a common-sense type. People reason quickly, even when there exist several alternative conclusions that one may have adopted. They do not perhaps even need enumerating and considering all possibilities in order to come up with one. You may, for example, immediately adopt the “he was swimming” explanation if there is a swimming pool in the backyard, and he was wearing a swimming suit.

3.2 History of Abduction

Similarities and discrepancies between different forms of inference have long been investigated in philosophy. The word abduction was first used by Peirce [Peirce 58] in order to define a distinct inference type which can be traced back to Aristoteles.

Even though the roots of abduction trace so far back, its definition and the scope is still controversial and usually vague. Peirce himself, who used the term “abduction” as a distinct type of inference for the first time, gave expressions belonging to two different views, which will later (section 3.3.2) be referred to as the ‘evidential’ and ‘methodological’ views. Thus, his writings present two different accounts of abductive inference. However, he did not make clear the distinction between his two motivations underlying each account. Neither did he make a connection between his two approaches. His two accounts, therefore have commonly been interpreted as conflicting alternatives, labelled as Peirce’s ‘early’ and ‘late’ accounts.
Studying the **logic of argument** and the **logic of scientific inquiry** are two important tasks that philosophers for a long time have been involved in [Burks 77]. The logic of argument “treats rules for deriving conclusions from premises and relating evidence to hypotheses and theories, judging these rules to be valid or fallacious, correct or incorrect, reliable or unreliable” [Burks 77, p 16]. The logic of scientific inquiry on the other hand, studies how these rules are useful within a larger scope (i.e., their function within an overall process). This approach evaluates these rules in terms of applicability, simplicity, and utility in the scientific inquiry process [Feibleman 72]. We have noticed that abductive inference has been referred to in discussions related both to the ‘logic of argument’ and to the ‘logic of scientific inquiry’.

In AI, abductive inference was taken up in 1973 by Pople, in the context of diagnosis, and has gained increasing interest since then. The first examples of the computation of abduction were highly logic oriented [McDermot 88.]. Later other approaches emerged. For example, the mental models of Johnson-Laird and Minsky’s schema-based approaches influenced the way researchers modelled abduction. Our approach is analogy based, and in this respect is similar to Holyoak and Thagard’s view [Holyoak 95].

### 3.3 The link between philosophical and computational accounts of abductive inference

The philosophy of mind is mainly interested in understanding how the mind works. In particular, the flexibility and quick reasoning of humans in everyday events have attracted many philosophers. Abductive inference was assumed to be the only type of inference which could explain some kinds of everyday problem solving. Philosophers who studied the method of scientific inquiry states that science also involves abductive inference.

Computer science and, in particular, artificial intelligence, has recently been concerned with abductive inference, especially in connection with expert-level reasoning. Our interest in abductive inference is mainly from a computational point of view. However, we realize that in order to achieve our goal related to abductive inference, we need to investigate the philosophical accounts of this type of inference, since philosophy elaborated both the nature of abductive inference and its use within a larger context, under the head of the ‘logic of argument’ and the ‘logic of inquiry’ respectively.

#### 3.3.1 The computational point of view

As we expressed in chapter 1, our goal is to study the use of contextual knowledge in problem solving, particularly in diagnostic domains. Our ultimate aim is to model and implement context effects in diagnostic problem solving.

Our interest in abductive inference is mainly motivated by investigating its role in diagnostic reasoning. Abduction is the mainstay of diagnostic problem solving. As such, the research task of investigating the use of context knowledge in abductive inference can be considered as a subtask of investigating the use of contextual knowledge in diagnosis.

Inefficiency is a well-known problem in computational models of abductive reasoning. In this research we attempt to lay the groundwork for improving the computational models of abduction by augmenting them with the notion of context.
For the purpose of developing a computational account, we study abductive inference at the knowledge level. Alan Newell distinguished between two levels of modelling in knowledge-based systems: knowledge level and symbol level [Newell 82]. A knowledge level model is a high level description of the behaviour of a system, and the types of knowledge needed for such a behaviour.

At the knowledge level, a knowledge-based system is generally described in terms of three types of concepts, i.e., domain knowledge, tasks and methods. An analysis should be made concerning what to model and how to model regarding abductive inference at the knowledge level.

Intelligent behaviour can be explained in terms of two main components, the content and the process. Any knowledge-based system which can exhibit intelligent behaviour needs explicitly to represent these two components as well. The content includes the static aspects while the process reflects the dynamic aspects of a particular type of problem solving intended to be modelled at the knowledge level. The necessity of the link between content (the domain knowledge) and process (the method, the strategy) has been emphasized both in AI and in various fields of cognitive psychology. For example, educational psychologists studying medical curricula and the development of expertise emphasize that the knowledge content should be learned in connection with the procedure that uses it. The link between the content and the process has been given prominence in our model at the knowledge level. We realise this link on the basis of a task-centered approach, where a task constitutes a media where the content and the process are coupled.

Modelling the diagnostic task includes modelling all its subtasks. In our view, abductive inference is one subtask of the diagnostic task. Tasks are described at the knowledge level in terms of content-related concepts (such as input and output of the task), and the process-related concepts (such as method and strategy). Figure 3.1 illustrates how a task connects the content to the process in which it is used for the accomplishment of the task.

Our approach to abductive inference is from a computational point of view. That is, we are concerned with the issues of modelling and implementing abductive inference in relation to development of knowledge-based systems that support solving complex, real world

![Diagram](image-url)
problems. The interest of the computational approach in the notion of inference lies in that it is a building block of an intelligent artifact that is ultimately to be developed. After a survey of philosophical accounts of abductive inference, we found interesting connections between a possible computational account of abductive inference and its philosophical accounts provided in the literature. Even though the motivations behind philosophy and AI are different, we were able to utilize a philosophical account of abduction in developing a computational model of abductive inference. In chapter 5 we try to point to these possible links between various philosophical accounts of abduction and our computational account. We describe how philosophical approaches have provided us tools when developing a computational account involving contextual aspects. We propose that one of the two main approaches to abductive inference in philosophy, which recently has been referred to as the evidential approach, provides us with abductive patterns which we utilize when analysing content-related aspects of abductive inference. On the other hand, the other main approach, namely the methodological approach, provides a basis for investigating the process-related aspects of abductive inference. The evidential and the methodological approaches are elaborated, respectively, in this and the next section.

3.3.2 The philosophical point of view
We reviewed various philosophical accounts of abduction in pursuit of its definition/description, scope, and function. When doing this, we made an attempt to impose a structure on the tangled accounts by extracting the motivations around which these accounts can be clustered. We will partly explain the diversity of accounts in the literature by emphasizing the existence of two rather different main motivations which remained mostly implicit until recently. These motivations conveyed/expressed themselves respectively in what Fann [Fann 70] calls the evidential and the methodological approaches. These motivations also provide a criterion to evaluate the existing accounts, reflect the aspects of abduction that may mean something with regard to the question of what fails in these accounts, and guide the development of a better account.

Of these, the former view studies inference in isolation, while the latter studies it in the context of an overall application task (i.e., complex real world problems). The evidential view, abductive inference is a justification pattern [Flack 96]. The methodological view, on the other hand, investigates abductive inference as information processing and deals with its use in complex tasks such as problem solving (e.g., diagnosis) or question answering. As such, the methodological view is concerned with the specific role and use of any particular inference type in a particular complex task, in combination with other inference types that are utilized in the same task. In a sense, the evidential approach adopts a static view, and the methodological approach a more dynamic one.

3.4 Inference as an evidential process
In philosophy, an inference is defined in terms of premises and a conclusion. In our interpretation this corresponds to input and output of a task description at the knowledge level. The philosopher’s intention to classify inference types has inspired an extensive abduction study. The underlying reason for classifying inferences was the desire for understanding the nature of various inference types. Inferences are classified first according to the differ-
ent aspects of the conclusions they draw. That is, the motivation was to classify inferences with respect to their conclusions. However, researchers adopting this goal focused on different characters of the conclusion, and accordingly classified inference types along different criteria, such as ‘validity’ or ‘productiveness’ of the conclusions.

In this section we review inference classifications that have been constructed by an evidential view. The selection of the different accounts to be included in the review is made in order to structure the variety of inference accounts as found in the literature. We organise and present different approaches according to the criteria on which they founded their distinction. We lay special stress on codifying the criteria that governed each classification. So, the following subsections are arranged according to the classification criteria.

### 3.4.1 Classifying inferences according to validity of conclusions they draw

A ‘traditional’ classification of inferences (i.e., before Peirce) is concerned with the ‘correctness’ of the conclusions drawn by different types of inference. This approach classifies inferences based on their ability to draw ‘secure’ conclusions. Hence, inferences are partitioned into sound and fallible types. In this account, only deductive inferences were sound and inductions were fallible. Abduction was not yet recognized and therefore did not occur in this classification. So, the main - and perhaps the only- concern was a conclusion’s degree of certainty.

### 3.4.2 Classifying inferences according to productiveness of conclusions

In his early work, Peirce also classified inferences. He emphasized, however, the conclusion’s “value in productiveness” [Peirce 58, 8.384]. The subject matter was the question of whether an inference creates new ideas. Peirce classified induction and abduction as “ampliative” inferences, which create new ideas, and the deduction as “explicative”, which does not. The difference between the two ampliative inference types was that abduction hypothesizes unobservable entities from observed ones induction creates generalizations on the basis of some examples. The three distinct forms of reasoning are exemplified as follows (the example can be considered a classic and traces back to Aristotle):

#### Deduction:

- All beans from this bag are white. (rule)
- These beans are from this bag. (case)
- Therefore, these beans are white. (result) (I)

Deduction is the inference of result from the rule and the case.

#### Induction:

- These beans are white. (result)
- These beans are from this bag. (case)
- Therefore, all the beans from this bag are white. (rule) (II)
Induction is the inference of *rule* from *case* and the *result*. In Peirce’s statements, “Induction is where we generalize from a number of cases of which something is true, and infer that the same thing is true of the whole class. Or, where we find a certain thing to be true of a certain proportion of cases and infer that it is true of the same portion of the whole class” [Peirce 58, 2.624]

Hypothesis (abduction):
All the beans from this bag are white. (rule)
These beans are white. (result)
Therefore, these beans are from this bag. (case) (III)

Abduction is the inference of *case* from *rule* and the *result*. Peirce labelled this inference also ‘hypothesis’ or ‘retroduction’. Again in Peirce’s words, “Hypothesis is where we find some surprising fact which would be explained by supposing that it was a case of a certain general rule, and thereupon adopt that supposition. This sort of inference is called ‘making a hypothesis’” [Peirce, 2.623].

Peirce’s classification of inference types according to this view is illustrated in figure 3.2. In this view hypothesis and induction are both ampliative inferences, nevertheless each has its own logical form. We will see in the next chapter how Peirce modifies his abduction account when he adopts a methodological view. In AI terminology, we may say that his classification can be related to the notion of ‘knowledge refinement and extension’ or ‘development of a domain theory’ which is an important characteristic of problem solving with an incomplete domain theory. Denecker et.al, in their paper on the difference between abduction and induction, argue that the former “derives concrete hypotheses representing scenario knowledge while the second derives general theories representing general domain knowledge” [Denecker 96]. They grounded their argument on that human experts organise their knowledge in a hierarchy, where the most abstracts are at the top and the most concrete ones are at the bottom level in the knowledge hierarchy. They propose that abduction generates hypotheses taking place at the bottom level while induction generates hypotheses referring to knowledge at the upper levels in the knowledge hierarchy.

![FIGURE 3.2 Peirce's first classification of inferences](image)

**3.4.3 Classifying inferences according to the explainability of their conclusions**

In the ‘abduction community’ there is an ongoing discussion about what an abduced conclusion explains. Some researchers consider inductive generalizations as abductive conclusions. The basis for this is the argument that such generalizations *explain* the evidence
on which they are based. So, we may consider the notions of ‘explanation’ and ‘explaining’ as important in this respect. Consequently, we may consider the conclusion’s ability to explain the premises as another dimension along which inferences are categorized. However, there are various approaches as to how these notions guide a classification of inference. According to Harman [Harman 65] and Josephson [Josephson 94; Josephson 96], a conclusions’s ability to explain the premises is vital when deciding which inferences have an abductive character. Harman identified ‘enumerative induction’, and Josephson the ‘inductive generalization’ as a specific type of abductive inference. However, they disagree on what ‘explaining’ means regarding the relationship between the premises and the conclusion. As this is an issue that must be elaborated for better understanding the nature of abductive inference, we will take it up in section 3.4.4.

3.4.3.1 Harman’s view
Harman states that the ‘inference to the best explanation’ corresponds approximately to what Peirce has called abduction. In his work on “inference to the best explanation” [Harman 65] he analyses, for example, the common characteristics of how a detective and a scientist reason. He states “when a detective puts evidences together and decides that it must have been the butler, he is reasoning that no other explanation which accounts for all the facts is plausible enough or simple enough to be accepted”. Or, “when a scientist infers the existence of atoms and subatomic particles, he is inferring the truth of an explanation for various data which he wishes to account for”. He proposes both detectives’ and scientists’ inferences as instances of the inference to the best explanation. Another type of inference, which he also considers a special case of inference to the best explanation, is enumerative induction. Enumerative induction “infers from observed regularity to universal regularity or at least to regularity in the next instance” [Harman 68]. His reason for accounting enumerative induction as a special kind of inference to the best explanation is that it infers “from the fact that a certain hypothesis would explain the evidence, to the truth of that hypothesis” [Harman]. His classification is illustrated in figure 3.3.

![Figure 3.3 Harman's classification of inference types. The criterion is hypothesis’explainingability’ of the evidences.](image)

In Harman’s approach we may also find the traces of a methodological approach, since it investigates abductive inference as an explanatory inference which is invoked when an explanation of surprising observations is required, for example, in cases of detective and scientific reasoning. As we will see in the next chapter, Peirce also adopted a methodological view when he intended to study the method of scientific inquiry. The notion of “infer-
ence to the best inquiry” is important from a particular aspect: it implicitly refers to the scope of abductive inference. It implies that abductive inference covers the whole explanation process. As will be seen in the next chapter, Peirce’s methodological account differs from Harman’s in this respect.

3.4.3.2 Josephson’s view

A working definition of Josephson’s abductive inference is “inference to the best explanation”. In our interpretation this is a rather general and vague definition of abductive inference which includes the whole process of explaining the surprising observations. As such, its scope is very broad and includes different types/forms of reasoning as well as actions in the physical world. In fact, in Josephson’s approach the two main forms of inference are abduction and prediction. Prediction comprises the process of inferring the expectations from a hypothesis. Deduction is viewed as a type of prediction task, and induction as an abductive type (see figure 3.4). On the other hand, prediction can be evoked as a subtask of abduction, and prediction can evoke abduction as a subtask. For example, hypothesis verification is a subtask of abduction and is performed through prediction. Prediction uses abduction for assessing the situation. Josephson’s version of abduction has the following pattern:

D is a collection of data (facts, observations, givens)
H explains D (would, if true, explain D)
No other hypothesis can explain D as well as H does
Therefore, H is probably true

As can be seen from his justification pattern, Josephson augments the pattern of abductive inference by adding the ‘assumption’ that ‘no other hypothesis can explain D as well as H does’. When compared with Peirce’s abduction pattern, from a knowledge level view, this pattern is superior to Peirce’s as it is better specified. According to this pattern, justification of the conclusion is based on two conditions; the ability of conclusion (H) to explain the premises (D), and that the H explains D better than other possible inferable conclusions do. In a later chapter, we will, however, illustrate why this pattern does not adequately describe abductive inference.
3.4.4 What does an abductive conclusion explain?

What makes Harman think that enumerative induction, and Josephson that inductive generalization are specific types of abductive inference? Similarly, what is common to the tasks of story understanding and diagnosis, with respect to being involved in abductive inference? The notion of “explanation” seems to be at the heart of an answer that may be satisfactory. However, there are disagreements as to what explains what in abductive inference. Harman describes ‘inference to the best explanation’ as the inference ‘from the fact that a certain hypothesis would explain the evidence, to the truth of that hypothesis’ [Harman 65]. So, in his view, for an inference to be abductive, the hypothesis should explain the evidence. This view has been criticized by Ennis [Ennis 68], and recently by Josephson. The discussion emerged partly because different meanings were attributed to the notion of explanation, by Harman and the others. Also the explicit references are not made with regard to ‘what is it that explains’ and, more importantly, ‘what is being explained’.

3.4.4.3 What does “inference to the best explanation” explain?

Harman writes “I claim that, in cases where it appears that a warranted inference is an instance of enumerative induction, the inference should be described as a special case of another sort of inference, which I shall call ‘the inference to the best explanation’” [Harman 65]. In his account, enumerative induction “infers from observed regularity to universal regularity”, and has the form: From the fact that all observed A’s are B’s we may infer that all A’s are B’s. Harman describes ‘inference to the best explanation’ as the inference “from the fact that a certain hypothesis would explain the evidence, to the truth of that hypothesis”. He notes that this rule makes the reasoner able to select the best explanation among several possible ones, thus abductive inference provides a way to determine when a hypothesis is better than another, or when it is best.

Though Harman argued first that inductive generalizations should explain the evidence, he later accepted that it was a mistake to say that “induction always infers an explanation of one’s evidence” [Harman 68] and modified his view on an answer to Ennis’ critics, where he attributed his mistake to the ambiguity of ‘explanation’.

Ennis agrees that warrantability of enumerative induction depends on, as Harman notes, a number of factors other than observed regularity, but strongly argues that “the enumeratively induced proposition should be the best explanation” of the evidence. Ennis noted that ‘All A’s are B’s’ together with ‘S is an A’ does explain why the belief that S is a B is justified, but does not always account for the fact that S is a B. Sometimes it does and sometimes it does not, depending on its content [Ennis 68]. So, he argues that enumerative inductions do not necessarily explain the evidences. They explain why the reasoner believes that the hypothetical generalizations are true.

Josephson agrees with Ennis in this objection. In his view, the relationship between a sample and a generalization, and that between an effect and a cause is not the same. Nonetheless, he claims that there is an explanatory relationship between an inductive generalization and the samples on which it is based. The difference is that the relationship between a sample and a generalization involves a frequency consideration, while the relationship between an effect and a cause is a causative one.
Josephson notes that

"All A’s are B’s” cannot explain why “This A is a B” because it does not say anything at all about how its being an A is connected with its being a B. The information that “they all are” does not tell me anything about why this one is....A generalization helps to explain the events of observing its instances but it does not explain the instances themselves.

The word ‘explanation’ is actually rather ambiguous, as Harman says.

### 3.4.5 Ambiguity of the term ‘explanation’

Clarification of the meaning of ‘explanation’ is important from a computational view of abductive inference. There may be various types of explanations of a surprising fact, such as structural or causal ones. However, in general only one type of explanation is relevant and useful for a certain task. At any time, only a particular meaning of a surprising fact is sought. This aspect is emphasized by Leake [Leake 95]. He illustrates that the relevance of an explanation is dependent on several factors, the needs of the explainer being one of the most important ones.

It seems that various interpretations of the meaning and the scope of the notion ‘explanation’ or ‘explaining’ has caused disagreements regarding the relationship between abduction and induction. The difficult question was what an inductive generalization explains, i.e., how this ‘explaining’ is different from explaining a set of effects by finding their cause.

So, despite its ubiquitous usage both in everyday life and in science, the word ‘explanation’ is by no means precisely defined. Achinstein’s book on ‘the nature of explanation’ contributes to a better understanding of this concept. We distinguish between its two usage, namely as the act of explaining, and the product of explaining. The act of explaining involves utilizing various relations connecting explanata and explanandum, via other concepts. Explanandum represents the phenomenon to be explained, and explanata is the phenomenon that embodies this explanation.

#### 3.4.5.4 The ‘relationship’

We may consider an explanation (the chain) as a relation between the conclusion and the premises, for example the hypothesis and the observations. In abductive inference, the reasoner formulates a hypothesis so that the observations are connected to the hypothesis by certain types of relations. The relations may be structural, causal, or functional if the observations are facts. If the observations are samples and the hypothesis is a generalization, then the relation is somewhat different. This difference we intend to illustrate by relying on the notion of ‘meaning’.

**Meaning, intension and extension.** For us, explaining something is giving it a meaning. The ‘meaning’ of a concept is captured by its consequences, according to Peirce’s view of ‘pragmatism’.

The term ‘intention’ derives from Frege’s term ‘sense’. His usual example is that the two concepts ‘morning star’ and ‘evening star’ do not have the same meaning, even though they denote the same object [Maida 85]. The difference between intension and extension
is referred to as the one between sense and reference. Some words with the same exten-
sional representation may be represented by more than one node in a conceptual graph,
each of which represents different intensional concepts [Woods 75].

Lyons [Lyons 83] states that the extension of a term is the class of entities that the term
defines, while properties defining the class constitute its intension. For example, the
extension of ‘tree’ is the set of all trees, while its intension is what a human conceives
when she classifies something as tree.

We may utilize the notions ‘intension’ and ‘extension’ in order to better understand what
lies under the intuitive notion of ‘explaining’. Clarification of ‘explanation’ is important
for the discussion of whether inductive generalisations are specific cases of abduction,
i.e., explanatory reasoning. An explanation can be either intensional or extensional. An
intensional explanation is made in terms of relations such as ‘causes’, ‘has-colour’, ‘pre-
disposes’, etc. On the other hand, an extensional explanation is expressed in terms of rela-
tions such as ‘has-instance’.

3.4.6 The relationship between abduction and induction
Consider the question “what does ‘apple’ mean to you?” An answer may be ‘a red, round,
hard fruit’. There may also exist other such fruits. So, you need to add more discriminating
features in your description, like that it grows on trees, tastes such and such, and so on.
Children may have a habit of using apples when they play war. For them, ‘apple is a hard
fruit used when fighting’. Another answer may be to show some apples and say ‘these are
apples’. So, depending on the interests of the questioner and the situation, ‘apple’ may
mean different things, and its meaning can be captured in different ways. It is well-known
that meaning is context dependent. That meaning is context dependent, and therefore there
may be several meanings of something, is important for our argumentation and under-
standing of the relationship between abduction and induction. The following are important
points for understanding this relationship:

1) The meaning of a thing may vary across situations.
2) From the components of meaning of something, one can ‘guess’ what the ‘something’
is, in a certain task context. This process calls for abduction.
3) The doctrine of pragmatism uses the notion of meaning for predicting the consequences
of a hypothesis. The consequences of a hypothesis collectively comprise the meaning
of the hypothesis. Usually only some of the consequences, i.e., parts of the meaning,
are known at hypothesis generation time.
4) The meaning of something in a certain task context consists of a number of other things
which have a special relation, or a set of special relations to that ‘something’
5) The implication of this is that if the reasoner is given parts of the meaning of a hypoth-
esis, and the types of relations between these parts and the hypothesis, the hypothesis
itself can be guessed.

The relation between the meaning of a hypothesis and the hypothesis itself is different in a
cause-to-effect type of inference than in an inductive generalization. We think the question
of whether these are of the same type of inference is not that important when the subject is
put in this way. What is more important is what the implications of this difference are for
the construction of a knowledge based system.
3.5 Conclusion

A knowledge-based system is a model of the behaviour that a natural expert displays in the real environment. A model, by definition, is an abstraction. An abstraction of the behaviour of a human expert involves decisions related to leaving out some features and aspects related to her behaviour. Accordingly, the design of a knowledge-based system involves decisions regarding details of both abstractions of the expert’s knowledge as well as abstractions for using that knowledge.

Two main tasks in constructing a knowledge-based system are

- the decisions related to computational techniques (e.g., forward chaining, backward chaining) and representational formalisms (e.g., rules, frames),
- the decisions related to what kind of behaviour the system should display, and the types of knowledge that are involved in generating such behaviour.

The early computational systems usually focused on the former issue. However, recently, and particularly after Newell’s explicit distinction between these two issues as two levels [Newell 82], much efforts has been devoted to the latter issue.

The evidential view of abductive inference, as stated in this chapter, is one of the two main views of abductive inference in philosophy. In the next chapter we elaborate on the other view, the “methodological” view, which may be considered as the study of abductive inference in a larger scope, with its relationships to other types of inference in complex problem solving situations. In philosophy this complex problem has, in general, been ‘scientific inquiry’. However, for our purpose, it is analogous to studying abductive inference for any other complex problem, for example diagnosis. First, regardless of whether the complex task is scientific inquiry or diagnosis, abductive inference should be described as a task at the knowledge level. Second, the uses of abductive inference in scientific inquiry, and in diagnostic as well as detective reasoning, have been commonly declared to be similar. In this way, the insight into abductive inference in scientific inquiry can largely increase our understanding of abductive inference in diagnostic problem solving.

In the next chapter, before starting to view abductive inference from a methodological view, we elaborate on how we can relate these philosophical views with the knowledge-based paradigm. In a sense, this will shed light on reasons for appealing to philosophical accounts of abductive inference when our ultimate goal is constructing a knowledge-based system involving abductive inference.