Argument Mapping in Intelligence Analysis

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Abstract

The purpose of this article is to look at argument mapping in intelligence analysis and make suggestions for improvements in terms of analytic rigor and clarity, as well as justification when there is time to evaluate the boxes. Argument mapping is described in a similar way in the intelligence literature, but somewhat differently compared to philosophical literature and there are some things that are questionable or need to be clarified. It is also not clear what should be included in terms of analysis of competing hypotheses (ACH) or Bayesian analysis, for instance. The point of argument mapping is clarity of structure. Therefore, there should be a main claim or main hypothesis at the top, which is not an argument for something else in the tree, and which is argued for in the tree. ACH and Bayesian analysis should be performed before the argument map in order to find main hypotheses for separate trees. Even if it might be possible to put numbers on some boxes in the tree, doing it on all boxes might produce misleading results, depending on what they contain. The argument tree should be as clean as possible. Without numbers and likelihoods, we might use the notion of justified belief when investigating the tentative judgments so common in intelligence analysis.

Keywords: Argument Mapping, Intelligence analysis, analytic rigor, Bayesian analysis

Mapeo de argumentos en el análisis de inteligencia

Resumen

El propósito de este artículo es examinar el mapeo de argumentos en el análisis de inteligencia y hacer sugerencias para mejorarlo en términos de rigor y claridad analítica, así como para justificarlo cuando haya tiempo para evaluar las casillas. El mapeo de argumentos se describe de manera similar en la literatura de inteligencia, pero de manera un poco diferente en comparación con la literatura filosófica

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y hay algunas cosas que son cuestionables o que deben aclararse. Tampoco está claro qué se debe incluir en términos de análisis de hipótesis en competencia (ACH) o análisis bayesiano, por ejemplo. El objetivo del mapeo de argumentos es la claridad de la estructura. Por lo tanto, debe haber una afirmación principal o hipótesis principal en la parte superior, que no sea un argumento para algo más en el árbol, y que se defienda en el árbol. El ACH y el análisis bayesiano deben realizarse antes del mapa de argumentos para encontrar hipótesis principales para árboles separados. Incluso si fuera posible poner números en algunas casillas del árbol, hacerlo en todas las casillas podría producir resultados engañosos, dependiendo de lo que contengan. El árbol de argumentos debe ser lo más limpio posible. Sin números ni probabilidades, podríamos utilizar la noción de creencia justificada al investigar los juicios tentativos tan comunes en el análisis de inteligencia.

Palabras clave: Mapeo de argumentos, análisis de inteligencia, rigor analítico, análisis bayesiano

情报分析中的论证导图

摘要

本文旨在研究情报分析中的论证导图，并提出改进建议，以提高分析的严谨性和清晰度，以及论证（当有时间评价导图框时）。论证导图在情报文献中的描述方式类似，但与哲学文献相比略有不同，并且有些内容值得怀疑或需要澄清。还不清楚的是，在竞争性假设分析(ACH)时 应该包括哪些内容，例如贝叶斯分析。论证导图的重点是结构的清晰度。因此，首要方面在于有一个主张或主要假设，它不是论证树中其他内容的论证，而是论证树中论证的内容。ACH和贝叶斯分析应在论证导图之前执行，以便为单独的论证树找到主要假设。即便可以在论证树中的某些框上放置数字，但对所有框都这样做可能会产生误导性结果，这具体取决于它们包含的内容。论证树应该尽可能清晰。如果没有数字和可能性，我们可能会在调查“情报分析中常见的暂定判断”时使用合理信念的概念。

关键词：论证导图，情报分析，分析严谨性，贝叶斯分析

Introduction

Intelligence analysis is a professional field which is influenced by several academic disciplines, such as philosophy (Hendrickson, 2018, 43).[1] At the core of intelligence analysis we find concepts and abilities concerning critical thinking, reasoning and dealing with inferences in a proper manner, where the philosophical influence is clear. Many researchers in the field stress the importance of critical reasoning in intelligence analysis (e.g., Clark 2020,[2] Hendrickson 2018). Examples of this is to describe critical thinking in intelligence analysis as the need to think "critically" and "logically" and having a "fierce commitment to objectivity," "having good instincts" as well as "a broad perspective on the world and appreciation of history" (Clark 2020, 71). But what does it actually mean to think critically, logically and having a fierce commitment to objectivity? The difficulty is to perform critical thinking in a systematic, transparent way. We need ways to check not only in oneself, but also analysts in group settings where there is a risk that a dominant personality in a room takes over, a phenomenon which might obscure the good instincts mentioned above, in favor of other attributes.

The question is how to ensure objectivity and awareness of bias.[3] Some sort of analytical method(ology) is crucial to use those core abilities in a systematic way. In the literature on intelligence analysis there are several methods that deal with this, such as analysis of competing hypotheses (ACH), Bayesian methods and Lockwood's LAMP-method. However, not all of them—like argument mapping—are presented in an entirely clear way.

Clark's summarized list from J.Y.F Lau[4] and Robert Ennis suggests ten abilities of a critical thinker.[5] It is a place to start, but also an example of something that might seem helpful at first glance, but is lacking in substance when scrutinized. Clark shows that we are encouraged to approach a problem or an issue with an "open mind" and to be "well informed," to "examine our beliefs and values," to analyze problems systematically. We are advised to develop a *model* of the problem, generate hypotheses and test them, judge the credibility of sources, determine the quality of an argument, including the acceptability of its reasons, assumptions and evidence, as well as evaluating the evidence for and against a hypothesis, develop and defend one's conclusions (Clark 2020, 72). He suggests that the simplest way

1 Hendrickson argues that something needed in order to achieve more maturity is to develop" more robust reflection on its score concepts and values" (Hendrickson 2018; 43).

2 Robert M. Clark (2020) Intelligence Analysis. A Target Centric Approach. CQ Press, California.

3 For an in-depth analysis, see Whitesmith, Martha. (2022). *Cognitive Bias in Intelligence Analysis – Testing the Analysis of Competing Hypotheses Method*. Edinburgh: Edinburg University Press.

4 J.Y.F. Lau. (2011). An introduction to critical thinking and creativity: think more, think better. New York, NY: Wiley.

5 Robert Ennis. (1993). Critical thinking assessment, Theory into practice 32, no. 3.

of approaching an intelligence issue is by applying "logical thinking" (Clark 2020, 72). The question is what logical thinking means—whether it is a question of making proper inferences, and in that case, what the inferences are based on. The premises from which inferences are made might be questionable, and in such cases just engaging in logical thinking would not be sufficient. Another question is whether logical thinking might help evaluating a source, which might seem counterintuitive at a first glance.

So, the question is how critical, logical thinking is done in a systematic way, and specifically in the context of intelligence analysis. One way to systemize critical, logical thinking is by using a technique or method called *argument mapping*—to structure arguments in reasons and premises, placing them in boxes, indicating what are facts, hypotheses, assumptions, or value judgments, for instance. It is a way to have oversight of the information at hand. It is easier to focus and properly evaluate the evidence, the reasons for believing some main claim or hypothesis. It is easier to see overall weaknesses, or if one has focused too much or too little on certain boxes. It also points to the need for a proper method for evaluating what is inside each box.

Argument mapping is one of many methods in intelligence analysis, where the roots in philosophy are clearly visible. Evaluating the reasons in the boxes is an epistemological question, and argument mapping in itself the backbone of analytic philosophy. Hendrickson points out that the philosophical roots go as far back as Parmenides, whose ideas in this area were developed in different ways by Socrates, Plato and Aristotle (Hendrickson 2018). That is not surprising, since the core in both activities—philosophy and intelligence analysis—constitutes of critical reasoning which need to be systemized. So, the structuring, the reasoning as well as the evaluation has its roots in philosophy. A modern classic in this field is Stephen E. Toulmin's *The Uses of Argument*, first published in 1958, where he—among other things—discusses the layout of arguments in terms of claims, data and warrants.

The argument map can be considered a visualization of this. Arguments can be structured as a tree with the thesis—a statement one wishes to defend—at the top, above specified arguments for and against this thesis, so called pro- and contra arguments. There are also premises, sometimes hidden assumptions, which strengthens the credibility or relevance of each argument. After constructing the tree, the arguments can be valued in terms of relevance and credibility. By doing this, it is possible to discern the strengths and weaknesses of the reasoning in favor of or against a certain claim. Such trees have been somewhat modified by the intelligence community by argument mapping, which is often computerized for assistance, and where sometimes calculations are made.

Argument mapping is described in a similar way in the intelligence literature, but somewhat differently compared to philosophical literature and

there are some issues that are questionable or needs clarification. It is also not clear what should be included in terms of alternative hypothesis analysis or Bayesian analysis, for instance. The purpose of this article is to look at argument mapping in intelligence analysis and make suggestions for improvements in terms of analytic rigor and clarity, as well as justification when there is time to evaluate the boxes.

Background and Benefits

Hendrickson lists three candidates for being overall paradigms of reasoning for intelligence analysis (IA) (2018, 43):

(i) *the structural approach* (reasoning in IA as the use of structured analytic techniques by subject experts)

(ii) *the informal logical approach* (reasoning in IA as the construction and assessment of arguments (inferences from premises to conclusions)—argument mapping,[6] which is used in intelligence training programs including CIA and DIA, has been adapted with a focus on constructing and evaluating arguments, with the conclusion or thesis at the top, supported by layers of inferences from premises and the inferences from sub premises to support the premises (Wigmore,[7] Toulmin,[8] van Gelder,[9] Heuer and Pherson,[10] Tecuci et al.,[11] Rieber and Thomason[12]).

(iii) the *Elements of the Mind approach* (reasoning in IA as thinking standards applied to the elements of thought to develop positive mental habits) (Hendrickson 2018).[13]

The importance of objectivity and proper reasoning (and the argument map) is present in the analytic tradecraft standards, which includes (the summary is from Mandel, 2022):

6 According to Hendrickson the structural approach is the main established paradigm of reasoning inside intelligence analysis (Hendrickson 2018, 46), and the logical approach the main established paradigm of reasoning outside of intelligence analysis. According to Hendrickson argument mapping has become more popular with the development of software, for example Rationale and its surrounding advocates like Tim van Gelder and the AUSTHINK group.

7 Wigmore, John Henry, "*The Principle of Judicial Proof,*" Littleton, CO: Fred B Rothman & Company, 1998.

8 Toulmin, Stephen, "*The Use of Argument,*" New York: Cambridge University Press, 2003.

9 Van Gelder, Timothy, "The Rationale for Rationale," *Law, Probability and Risk* 6 (2007): 23-42.

10 Heuer, Richards J & Pherson, Randolph H, "Structured Analytic Techniques for Intelligence Analysts," Thousand Oaks, CA: CQ Press, 2010.

11 Tecuci, Gheorghe, Schum, David A., Marcu, Dorin, & Boicu, Mihai, "*Intelligence Analysis as Discovery of Evidence, Hypothese and Arguments*," New York: Cambridge University Press, 2016.

12 Rieber, Steven & Thomason, Niel, "Creation of a National Institute for Analytic Methods," *Studies in Intelligence*, 49, 4 (2005).

13 Hendrickson, Noel, "*Reasoning for Intelligence Analysts,*" Rowman & Littlefield, 2018. He argues that there might be a fourth: the disciplinary approach, which would have been a sort of default position prior to recent work in intelligence analysis (Hendrickson 2018, 43).

(a) "properly describ(ing) quality and reliability of underlying sources,"

(b) "properly caveat(ing) and express(ing) uncertainties or confidence in analytic judgments,"

(c) "properly distinguish(ing) between underlying intelligence and analyst's assumptions and judgments,"

(d) "incorporat(ing) alternative analysis when appropriate,"

(e) "demonstrat(ing) relevance to U.S. national security,"

(f) us(ing) logical argumentation,

(g) "exhibiting consistency of analysis over time, or highlight(ing) changes and explain(ing) rationale," and

(h) "mak(ing) accurate judgments and assessments"

Those mainly supported by argument mapping would be (c), (d), (f) and (h). Properly distinguishing between underlying intelligence and analysts' assumptions and judgements (c) is facilitated with an argument map. It can demonstrate which boxes are properly supported, which are relevant, point to hidden assumptions that should be spelled out and reasoned on further, as well as indicating where the main disagreements between analysts can be found. This also facilitates issues concerning objectivity and bias. Incorporating alternative analysis when appropriate (d) might be associated with, for instance, Bayesian analysis and reasoning, since there is reason to believe that the argument map should contain just one main claim, in order to keep the clarity. BA might be preferable to use before an argument tree is made, but we will return to this. The argument map will show where a (hypo)thesis/main claim has good support or not, and that another (hypo)thesis or main claim should be put in another argument map. Using logical argumentation (f) is already mentioned.

Hendrickson mentions benefits like evidentiary connections being transparent for examination, and that it is easier to distinguish different lines of reasoning. This might help solve disputes in groups, but also to mitigate group think, if a variety of views are allowed and discussed open mindedly (Pherson and Heuer 2021, 175). Another benefit is that it might be easier to communicate one's conclusions and reasons to a client.

The main benefit of an argument tree is the overview provided by the structure, making it easier to spot exactly where weaknesses and disagreements are situated and if there are imbalances or if some arguments or premises should be added. It is easier to find weaknesses in arguments for as well as against the thesis or main claim. Pherson and Heuer point out that the visual representation of the argument helps with this since it is easier to spot the locations of disagreements, but they also suggest that it might mitigate against seeking easy answers to difficult problems—the problem of the so-called mental shotgun. They also argue that an argument map would be a good tool for dealing with issues of cause and effect and not con-

fusing correlation with causation (that the former implies the latter) (Pherson and Heuer 2021, 176). One of the major benefits, which is mentioned by Hendrickson, Wright, Clark and Pherson and Heuer, is that argument mapping might help with avoiding bias. (Wright et al. presents an argument mapper and suggest that it helps to avoid cognitive biases in analysts.)[14]

Since the argument map puts each evidence or reason in boxes, each box is examined carefully, and therefore—with this careful examination—it might be easier to spot bias. Bias can of course be avoided with the help of a group, but that is a two-edged sword, since there is a risk of group think or that a dominant person in the group influences the others or intimidates them. It can, for instance, be difficult to go against the "conventional wisdom" of a group (see, for instance, Bruce 2008).

Pherson and Heuer (2021, 176) also argue that this process can help analysts counter the intuitive traps of (i) ignoring base rate probabilities by encouraging the analyst to seek out and record all the relevant facts that support each supposition, or avoiding to overdraw conclusions from a small sample of data ((ii) overinterpreting small samples) or to continue to hold on to an analytic judgment when confronted with a list of evidence that contradicts the initial conclusion ((iii)rejecting evidence).

Number three is that it would improve critical thinking, probably in the sense that the reasoning is systemized, but criteria for evaluation of each box is necessary. Pherson and Heuer point out benefits for analysts in the argument maps such as the facilitation to organize one's thinking by showing the "logical relationships between various thoughts in a systematic way" (Pherson and Heuer 2021, 175). Various thoughts may include reasons for as well as against the thesis/hypothesis. They also write: (Pherson and Huer 2021, 175) (author's emphasis):

> An argument map also helps the analyst recognize assumptions and **identify gaps** in the available knowledge. The visualization of those relationship makes it easier to think about a complex issue and serves as a guide for **clearly presenting to others the rationale** for the conclusions. Having this rationale available in a visual form helps both the analyst and recipients of the report to focus on the key points rather than meandering aimlessly or going off on irrelevant tangents.
>
> When used collaboratively, Argument Mapping helps ensure that a variety of views are expressed and considered, helping mitigate the influence of Groupthink.
>
> An Argument Map is an ideal tool for dealing with issues of cause and effect.

14 Wright et al. (2017) Argument Mapper: Countering Cognitive Biases in Analysis with Critical (Visual) Thinking, iV17 Conference on Information Visualization 2017 (https://uncharted.software/assets/Argument%20Mapper_v17_25Sept2018_Uncharted.pdf)

> The process also helps analysts counter the intuitive traps of Ignoring Base Rate Probabilities by encouraging the analyst to seek out and record all the relevant facts that support each supposition.

Terms and Inferences in the Argument Map

There are some differences regarding the description or outlay of an argument map—in intelligence analysis, but also compared to philosophical argument trees.

Most descriptions in the intelligence literature have one statement at the top, mostly referred to as a hypothesis (or lead hypothesis). Pherson and Heuer mention that an argument map begins with a single hypothesis or a tentative analytic judgment (Pherson and Heuer 2021, 174).

Wright et al. (2017, 2) describe argument mapping like a tree consisting of hypotheses, sub-hypotheses, assumptions and evidence. They further state that the analyst should assess the credibility and relevance of each evidence item, and when assessments are made in terms of credibility and relevance" the inferential force or support for the upper-level hypotheses are automatically calculated," according to Wright.

Hendrickson describes argument mapping as a "visual diagram of an argument starting (at top) with its conclusion, and then moving through the progressively deeper levels of underlying support in the form of inferences from premises (and then inferences from subpremises to support the premises)" (Hendrickson 2018, 47). It begins with a conclusion in a box at the top. Below this box, on the left side, there are "potential reasons for accepting this conclusion" (Hendrickson 2018, 48), and on the right side potential objections. "Underneath the reasons for, and the objections to, the conclusion, there will be further reasons for that reason (or objection)" (Hendrickson 2018, 48). This is more like the philosophical descriptions. He points out that the approach has support from, for instance, J.H. Wigmore (1998) and Stephen Toulmin (2003) (Hendrickson 2018, 47).

Wright et al. describe how analysts can start by:

> "(…) compiling evidence, working with lists of evidence, and then arranging and linking evidence to support hypotheses and that in place of evidence analysts can use assumptions and note gaps. Evidence, assumptions, gaps and hypotheses are easily created, edited and moved in an argument map using drag and drop interactions or via efficient keyboard interactions. As the analyst evaluates evidence by assessing the evidence credibility and relevance, hypothesis and sub-hypotheses strength of support is continuously and automatically computed." (Wright et al. 2017, 2)

They say that multiple alternative hypotheses can be considered and compared at the same time (see Whitesmith

2022a regarding analysis of competing hypotheses).

The key concepts for the Argument Mapper tool according to Wright et al. include "1) deconstructing a hypothesis, 2) describing and associating evidence and assumptions, 3) setting evidence relevance in supporting the hypothesis, 4) setting evidence credibility, and 5) applying combining functions to evidence to determine if any or all evidence is needed to support the hypothesis. In the visualization, nodes represent hypotheses, evidence, assumptions or gaps. Nodes give a quick visual summary of content, type, and credibility assessment" (Wright et al. 2017, 2).

The first thing to discuss is the term for the main claim, which in the intelligence literature is often called hypothesis or lead hypothesis.

In philosophical literature, the statement at the top is often called a thesis (or contention). A thesis is a statement one is arguing for—a statement for which one provides reasons, but also present reasons against. A hypothesis is, looking at the etymology, an "under"-thesis. A hypothesis can be derived from the thesis and can be tested. If an observation or statement is "all ravens are black," a hypothesis might be "there are no white ravens." If a white raven is observed, the hypothesis is falsified.[15] But this is a simplification of a discussion in philosophy of science which we will not get into here. The main point is that the term hypothesis is not always used in this strict sense, but rather as a tentative statement, a suggestion. Since it is mainly called a hypothesis, it might be better to continue with that, but where it is relevant in this article the term "main claim" or "(hypo)thesis/main claim" is used, to indicate that it is the *main claim of the argument map* (since some descriptions of argument maps have hypotheses in the boxes below the main claim). This corresponds to Toulmin's notion of claim or conclusion (Toulmin 2003, 90). The most important thing is that the main claim—whether it is called thesis or hypothesis or something else—is not an argument for something else in the argument map or tree at hand. Note that a thesis can be normative, while a hypothesis—in a strict sense—is not.

That is, in spite of what we call it, an argument tree or map has a main claim at the top, something that is argued for, and is not an argument for something else (Björnson et al. 1994, 2009).[16] We might call it a hypothesis, something we are testing in an intelligence environment, but the most important thing in order to have a tree that is as clear as possible, is that we use

15 According to Popper we cannot conclusively affirm a hypothesis, only conclusively negate it. We can also formulate a null hypothesis: no causative relationship between variables (Popper, K. R. (1959). *Logic of scientific discovery*. London: Hutchinson).

16 Björnson et al. describes a thesis in the following way. A claim or contention (påstående), T, is a thesis in an argumentation if there is at least one other claim in the argumentation which is intended to strengthen the tenability (hållbarhet)) of T while at the same T is not intended to strengthen or weaken the tenability (hållbarhet) for any other claim in the argumentation (Björnson et al. 1994).

the definition of thesis—that the thesis/hypothesis is not an argument for anything else in the tree. The reason for this is to increase clarity so we do not end up with two or more trees in one, which might be the case if the main claim is also an argument for something else in the tree. Clarity is the main benefit of the argument map, which we saw in the section on background and benefits. It is important to note that there are other methods that might help with alternative hypotheses, like ACH, Bayesian methods and Jonathan S. Lockwood's LAMP-method, where the analyst considers pairs instead of all possible alternatives (Lockwood 2013). Singh has explored LAMP within a Bayesian probabilistic framework (Singh 2013). But the purpose of this article is to clarify the argument mapping—not focusing on choosing among hypotheses. The purpose here is to clarify further and describe the tree, what happens in the tree, and the benefits of it.

Next to examine are the conclusions or inferences, and whether they are deductive, inductive or abductive. First, we need to know if we are talking about arguments or premises. The entire setup of an argument map can be called an argument. There, the arguments are called premises instead of pro- and contra arguments and the conclusion is at the bottom. It is questionable whether these are different activities—to formulate a main claim and then put boxes underneath or take all the evidence and see what it leads to, and whether one should do both, one before the other.

In argumentation analysis, the point is to investigate the reasons to believe something (Björnsson et al. 1994, 2009). In logic, the point is look at premises and the validity of the conclusion.

There can be pro-arguments of the first (intended to support the tenability/credibility of the thesis) or second (intended to support other arguments) order.

> T: x should be allowed (normative)
>
> P1: x is entertaining
>
> C1: x is dangerous
>
> C1C1: x is not more dangerous than y and z, which are allowed

A premise in this type of tree is a statement that is intended to increase the relevance of the arguments.

Sometimes arguments P2 and P3 must be valid or well founded (tenable) in order for P1 to be tenable. It is possible to write premises as prP1 (premise for pro argument 1) but premises can be put in separate boxes and also be evaluated separately.[17] For more about relevance and credibility, see Tecuci et al. (2016, 69).

Inferences

Other terms in the descriptions of argument maps concern inductive, deductive and abductive reasoning.

17 Björnsson et al. argued in 1994 that a statement prP is a premise for P if prP is intended to increase the relevance in P for T; in the 2009 edition they use the term relevance argument instead of premise.

According to Hendrickson, to reason with an emphasis on informal logic is to focus on identifying inferences, evaluating the structure of inferences and evaluating the quality of the underlying premises. He suggests that this is usually done with deductive inferences or inductive generalizations (Hendrickson 2018, 47). He argues that making accurate judgments and assessments (h) will be helped by the clarity of the argument tree and occasionally, some basic ideas about statistical/probabilistic inference is explored (using the core axioms of probability theory). It seems clear that the overview will help, but evaluation of the boxes themselves needs to be investigated further, which we will get back to.

Tecuci et al. have proposed an argument mapping framework which deals with the distinction between deductive, inductive and abductive reasoning in order to support hypothesis formulation—that is, to formulate the main claim—as well as evaluation (Tecuci et al. 2016; 17). They suggest that the informal logical approach can be seen as a top-down approach in which existing academic theories (best principles) are applied to try to meet intelligence challenges. It is, however, the premises which decide what sort of inference one can make. Deductive: S is a man; all men are mortal S is mortal. Inductive: most x are y, z is x -> z is y.

It seems, however, that in the context of intelligence analysis it is less a question of testing the validity of the inference from premises, in a strict sense, but rather looking at the pro- and con- arguments in terms of their being relevant and tenable. It is in most cases not a question of whether the inference is inductive or deductive (if the premises are true, the conclusion is necessarily true in deductive reasoning)—and for the most part it will be inductive. The main point of the argument tree is to look at the arguments, the reasons for the thesis, and evaluate those from the truth of the premises. A way to do this is to turn the tree around.

An important part of the argument map is finding or formulating the (hypo)thesis/main claim. This can be done by abductive reasoning according to some—to move from evidence to a hypothesis and use imaginative thinking, which is not possible when engaging in inductive or deductive reasoning. Note that it is important to separate inferences from methods, though, and abductive reasoning can be viewed as a method.

Wright et al. describes how analysts can work both top down as well as bottom up, or a mixture. That is, either from hypotheses to evidence, which they call deductive reasoning (but as just mentioned: it is important to distinguish between deductive logic and deductive method), or from evidence to hypotheses, which they call abductive reasoning (Wright et al. 2017, 2).

They argue that analysts can "write down alternative hypotheses, deconstruct them into simpler problems, and link evidence and assumptions to them in argumentation structures that establish the relevance, credibility and inferential force of evidence" (Wright et

al. 2017, 2)—but that seems like different maps for each hypothesis. For clarity it would be preferable to focus on one map at a time. One might also wonder how a structure in itself can establish relevance and credibility, and we will return to that in the section on evaluation. Wright et al. use a scale for evaluation with the grading "no support, very low, low, medium, high and very high" (Wright et al. 2017, 2) or unassessed.

Clark points out that argument mapping "brings into the open and makes explicit the important steps in an argument and thereby makes it easier to evaluate the soundness of the conclusions reached" (Clark 2020, 199). He differs somewhat from other descriptions by suggesting that argument mapping is an analytic method for evaluating as well as combining evidence.

Clark describes the process by beginning with breaking down and organizing an issue into parts so that each one can be examined systematically, where one "identifies data requirements, state assumptions, define terms and concepts, and collect and evaluate relevant information" (Clark 2020, 199). After this, possible explanations or hypotheses will be formulated and evaluated based on empirical evidence. This way, information gaps can be identified. It seems, however, like two steps are needed: first, to identify the (hypo) thesis/main claim based on the information, and then place the information in the tree, or map. Alternative explanations would demand different trees, if it is a question of alternative hypotheses. To have several hypotheses in a tree would be counterproductive in terms of clarity.

Clark argues that this technique requires some practice to master and is time-consuming to apply. It is somewhat unclear if this difficulty concerns the process that happens before one makes the actual argument map, that is, when one is looking for the (hypo) thesis/main claim or structuring the information. Clark focuses on ACH and Bayesian methods for this, but as already mentioned, the LAMP-method can be used within a Bayesian probabilistic framework (Singh 2013).

One method in the category of structured argumentation is analysis of competing hypotheses (ACH) which Clark considers "one of the best-known structured argument techniques" (Clark 2020, 199; see Whitesmith (2022a) for analysis and evaluation of ACH). Clark points out that at any stage of the analytic process, it may be important to look at competing hypotheses, which can be (i) in the issue definition phase, (ii) in developing the target model, or (iii) identifying gaps in knowledge. The idea in ACH is to identify a set of hypotheses and systematically evaluating "raw intelligence for consistency or inconsistency with each hypothesis" (Ibid). Clark describes ACH as an analysis process that identifies an ideally complete set of hypotheses, and systematically evaluates data that are consistent or inconsistent with each hypothesis. Whitesmith points out that ACH "incorporates the central element of eliminative induction from Popper and Bacon's scientific methods: it seeks

to falsify rather than prove hypotheses" (Whitesmith 2022a, 65) and that "what ACD is attempting to do is identify the truth value of multiple hypotheses: to identify which hypothesis one would be most epistemically justified in believing to be true" (Whitesmith 2022a, 66).

Clark mentions Bayesian analysis as another, more complicated structured argumentation method, which deals with probabilities associated with observed events, and argues that the advantage with both these methods, is that one is able to reduce the risk of making analytic "miscalls," as Clark calls it. He claims, however, that the idea is to formulate hypotheses to answer a main question and then look at the evidence for each hypothesis. That sounds like different argument maps, but in any case, it is preferable to formulate the (hypo)thesis/main claim as a claim rather than a question since the point is to investigate reasons for or against a claim. Confusion might arise when mixing "main questions" with hypotheses.

ACH is not appropriate for all types of analysis according to Clark. It is most often used to analyze potential intelligence gaps about "what is known, what is not known, and what you still need to know," but it is somewhat difficult to understand what that means. He also states that "the value of ACH is measured by the extent to which it helps you see the target from alternative perspectives, prods you to look for additional evidence you had not realized was relevant, helps you question assumptions, identifies the most lucrative future areas of investigation" (Clark 2020, 200). It seems, however, like it is the argument map that helps with that. It is unclear what function the argument map has in relation to ACH.

According to Pherson and Heuer, argument mapping is a method that can be used to put a single hypotheses to a test "through logical reasoning" (Pherson and Heuer 2011, 132). They argue that argument mapping is a logical follow-on to an ACH analysis, and it seems reasonable to believe that this is the best way to combine ACH and argument mapping, since the argument map is about clarifying and having overview over a single (hypo) thesis/main claim. They describe the argument map in the following way: "An argument map starts with a single hypothesis or tentative analytic judgment and then graphically separates the claims and evidence to help break down complex issues and communicate the reasoning behind a conclusion" (Pherson and Heuer 2011, 174).

They point out that ACH is a more general analysis of multiple hypotheses. They also suggest that argument mapping of a favored (by the ACH analysis) hypothesis "increases confidence in the result of both analyses" (Pherson and Heuer 2011, 132). It is, however, somewhat unclear what is meant by putting the single hypothesis through logical reasoning, because obviously this—logical reasoning—is not the only thing that happens in the argument map. It is not possible to evaluate what is in each box simply by logical reasoning, for instance. Another thing

worth noting is that they say that" It is a tree that starts with the conclusion or lead hypothesis, and then branches out to reasons, evidence, and finally assumptions. The process of creating the argument map helps identify key assumptions and gaps in logic" (Pherson and Heuer 2011, 174). It is slightly obscure regarding what "assumptions" mean, if it is premises supporting other boxes for increased relevance.

There are other descriptions of argument maps (Wright et al.) where color codes and arrows are used, probably to help evaluation. Pherson and Heuer describes the argument map in the following way:

> An argument map starts with a hypothesis—a single-sentence statement, judgment or claim about which the analyst can, in subsequent statements, present general arguments and detailed evidence, pro and con. Boxes with arguments are arrayed hierarchically below this statement; these boxes are connected with arrows. The arrows signify that a statement in one box is a reason to believe, or not to believe, the statement in the box to which the arrow is pointing. Different types of boxes serve different functions in the reasoning process, and boxes use some combination of color-coding, icons, shapes, and labels so that we can quickly distinguish arguments supporting a hypothesis from arguments opposing it. (Pherson and Heuer 2021, 176)

Their suggestion contains the following step-by-step guide: (Pherson and Heuer 2021, 176-177):

> 1. Write down the lead hypothesis—a single sentence statement, judgment or claim at the top of the argument tree.
>
> 2. Draw a set of boxes below this initial box and list the key reasons why the statement is true along with the key objections to the statement.
>
> 3. Use green lines to link the reasons to the primary claim or other conclusions they support.
>
> 4. Identify any counterevidence that is inconsistent with the reason. Use red lines to link the counterevidence to the reasons they contradict.
>
> 5. Identify any objections or challenges to the primary claim or key conclusion, use red lines to connect the objections to the primary claim or key conclusions.
>
> 6. Identify any counter evidence that supports the objections or challenges. Use red lines to link the counter evidence to the objections or challenges it supports.
>
> 7. Specify rebuttals, if any, with orange lines. An objection, challenge, or counterevidence that does not have an orange-line rebuttal suggests a flaw in the argument.
>
> 8. Evaluate the argument for clarity and completeness, ensuring

that red-lined opposing claims and evidence have orange-line rebuttals. If the reason can be rebutted, then the argument is without merit.

The color coding seems convoluted and might provide false security. It is also unclear if they, in 7, mean the whole argument, or the boxes.

This may be clarified by specifying counterarguments and pro arguments for each box.

We have seen that common in the descriptions of argument mapping is the confusion of thesis and hypothesis, and the idea that methods like ACH and Bayesian could be used *in* the argument map. It may not be important what the main claim at the top is called, but in order to get the main benefits of the argument analysis, the main claim should not be an argument for something else in the map and is supported by other arguments in the tree. Perhaps it should be called main hypothesis, and the rest of the tree should avoid hypotheses in the true sense of the word. There is a discussion on what should be included in the map in terms of methods. The point of the argument tree is clarity, therefore, there should not be several hypotheses in it. An ACH, Bayesian or LAMP-method should be performed before an argument tree is constructed. If it is suitable to use Bayesian analysis in the tree, it is necessary to investigate what is inside the boxes. Numbers and Bayesian analysis in the tree will be discussed in the following section.

Evaluating Reasons and Evidence

The structure and visualization of the argument tree provide clarity and overview, but it is essential to have a method for evaluating the content in the boxes. One question is how such evaluation can be made, and whether one such method would be to put numbers on the boxes and sum up, producing some likelihood of the (hypo)thesis/main claim being true.[18]

Michael Schrage argues that security analysts should be required to assign numerical probabilities to their estimates and assessments "as both a matter of rigor and record" —that policymakers need to see how confident analysts are in the evidence and conclusions used to justify their decisions.[19]

Wheaton et al. (2010)[20] also put forward an argument for numbers in intelligence analysis. They argue that the type of traditional statistical analyses based on "normal distributions, structured data sets, linear regression analysis, null hypothesis testing and the

18 Whitesmith points out that "truth" should not be described in probabilistic terms, but what is relevant in this context is the level of epistemic justification (Whitesmith 2022, 66).

19 Michael Schrage, "What Percent is 'slam dunk?'" *The Washington Post*, February 20, 2005. https://www.washingtonpost.com/archive/opinions/2005/02/20/what-percent-is-slam-dunk/812c1bc6-2f25-4783-a2da-c1256a6d4031/ (accessed June 2022).

20 Wheaton, Kristian J., Lee, Jennifer, and Deshmukh, Hemangini. "Teaching Bayesian Statistics to Intelligence analysts: Lessons learned." *Journal of Strategic Security* 2, no. 1 (2010): 39-58.

like" (Wheaton et al. 2010, 40) is not normally considered appropriate for intelligence analysis, since the data there is "largely unstructured, often incomplete or deceptive, and rarely capable of interpretation by these scientifically acceptable methods" (Ibid). There are many problems that makes numerical analysis difficult or impossible.[21]

One method often recommended, however, is Bayesian analysis, which might be a good tool to weigh evidence according to Schrage. Wheaton et al. also refers to Bruce Blair of Center for Defense information, which advocates the Bayesian method, which would be good for handling beliefs about an unknown quantity before data is available and then modify the beliefs in light of new data (Wheaton et al. 2010, 40). Wheaton et al. argue that such a method should have applicability to intelligence problems. They argue that this method "provides the math that would allow analysts to update their current beliefs in a logically consistent and scientifically defensible way." The problem is that people do not seem to be natural Bayesians, and that it is difficult to teach. They wonder if Bayes can be simplified in a way that can be taught. Possibilities suggested by Gigenrenzer seem according to Wheaton et al. too complicated for everyday use in combat zones. "Such analysts need a simple, quick procedure; something that could be done on the back of an envelope and learned in an afternoon" (Wheaton et al. 2010, 49).

The problem with Bayesian method in an argument map is that not only is it difficult to use, as pointed out above, but it might not actually help with the point of the argument map. The idea of using an argument map is to value each separate box, and these are different in character.

First of all, it is important to realize that the content of the boxes in the argument map can consist of different things. That is, *reasons* can consist of different things. An argument or a premise for or against a thesis can, for instance, consist of a *fact*[22] (x is in fact missing from the warehouse, x was killed outside y), a *judgment* ("it is morally wrong to z," "it is bad to z"). Judgments can also be stated as facts if they are connected to democratic versions of naturalism (meta ethical term), of the sort "most people find z morally wrong according to survey 1," making it a fact, not a judgment. That would most often

21 See, for instance Richards J. Heuer, ed., *Quantitative Approaches to Political Intelligence: The CIA experience* (Westview Press, Boulder Colorado, 1978): 4-10.

22 Clark mentions that the U.S. government intelligence organizations have established a set of definitions to distinguish levels of credibility of intelligence. Fact: verified information, something known to exist or to have happened Direct information: information that is most likely factual because of the nature of the source (imagery, signal intercepts, and similar concrete observations). Indirect information: information that may or may not be factual because of some doubt about the source's reliability, the sources lack of direct access, or the complex (nonconcrete) character of the contents (hearsay from clandestine sources, foreign government reports, or local media accounts.)" (Clark 2020; 187-188)/CIA Directory Intelligence, "A Compendium of Analytic Tradecraft Notes," February 1997, http://davebucklin.com/icfiles/OSS2000-01-23.pdf Accessed September 2023.

function as a premise, which in turn has the function of increasing the relevance of an argument. A reason can also be a judgment which is not an established fact (like the fact that it is x kilometers from a to b) but more like a non-value judgment ("x is most likely/probably stolen"). Such statements are central in intelligence analysis, and we need a way to deal with those in the argument tree.

How likely is it that x is *stolen* from the warehouse? Can there be another, less alarming explanation? What is the evidence? One idea is to use the term tentative judgments and suggest that they (or use legal terms—reasonable doubt) would demand a special kind of evaluation. That is, reasons to believe the non-value/tentative judgments.

The point of the argument map is to have an overview and structure, and in order to do that it is important to separate facts, assumptions (premises), value judgments and tentative judgments. Often the main tentative judgment or claim is the (hypo)thesis/main claim in the tree, and what is to be explored by way of looking at the reasons which in turn are tentative.

Heuer deals with evaluation in analysis of competing hypothesis (ACH). In one table there is a list of evidence, sorted in source type, which can be inference, assumption, intel reporting, HUMINT, liaison, lack of intel reporting despite vigorous search, and contrarian hypothesis. These are evaluated in terms of credibility and relevance, with a scale of low-medium-high (Heuer 1999, 77-88).[23]

Tecuci et al. (2009, 34) argue that when the analyst must rate from low to high, if the relevance arguments are not specifically constructed, they cannot be subjected to any form of critical reasoning. They write about assessing the likelihood of different hypotheses. ACH is about which hypothesis is most likely, and there a Bayesian analysis might help. Evaluation in terms of low-high might not help, but Tecuci et al. point out that the problem with such an approach is that "numbers applied to hypotheses will have little meaning in the absence of any specific relevance arguments, considerations of credibility and competence attributes for different sources of evidence, and characteristics of evidence itself" (Tecuci et al. 2009, 35). In that sense, Good's extension of ACH may do more harm than help because it may provide analysts with a false sense of confidence rather than encouraging them to give more careful attention to the arguments necessary to justify their conclusions regarding the competing hypotheses" (Ibid).

This points to the difficulty in assigning numbers to the boxes and start counting. The result from a Bayesian analysis, might be "the chance of x happening or being true is 32%" but one question is how much we can trust the numbers that were put in.[24] In some cases, it might work, but with other types of items, it is more difficult. The

23 Richards J. Heuer, Psychology of Intelligence Analysis (Washington D.C., Center for the Study of Intelligence, Central Intelligence Agency, 1999), pp. 77-88.

24 Thanks to Pelle Matz for discussing this with me.

ACH should be performed before the argument tree, even if one is dealing with tentative judgments.

Dhami and Mandel (2021)[25] write about words or numbers and the communication of probabilities in intelligence analysis. They propose that the benefits using numeric probabilities outweigh their drawbacks, referring to Wallsten and Budescu (1995) who suggest that linguistic probabilities should be preferred" when the underlying uncertainty in a task is epistemic or internal (i.e., based on one's knowledge)" (Dhami and Mandel 2021; 552), and that there is some support for this view. Zimmer (1984) has shown that people process information verbally through argumentation and" so asking them to respond in the verbal mode (as opposed to the numeric mode) requires less cognitive effort and makes them less susceptible to bias and unreliability" (Dhami and Mandel 2021, 552). People might understand numeric probabilities better in the sense that 70 % is 70 % but perceptions of "high" or "very high" might differ.

Research indicates that those *communicating* information prefer linguistic probabilities while those *receiving* it prefer numbers. The problem seems to be that it is difficult to quantify, that is, put numbers on one's uncertainty. Dhami and Mendel do not argue that it would be wrong to use numeric probabilities for the reason that it would convey a false sense of precision. They argue that "numeric probabilities can be stated as precisely or imprecisely as a sender intends them to be" (Dhami and Mandel 2021, 557).

Clark argues, regarding evidence, that "The fundamental task in weighing evidence is determining its credibility, and by that he means its completeness and soundness" (Clark 2020, 180). The term completeness may indicate evidence put together, and that is not exactly the purpose of the argument map. It might, however, be used as a structure for a subsequent calculation of the boxes if one wishes to do so, but it appears important to properly deal with the different features of the items in the boxes.

Bayesian analysis is one method for combining evidence, but a question is how that would work in an argument map.

Schrag et al. point out that traditional argument maps do not take probabilities or probabilistic judgments into account. The question is if they should. Schrag et al. generate Bayesian networks from argument map specifications in order to compute probabilities for every node in the argument map. But not all pro- or con arguments have to do with probabilities, such as value judgments, for instance. Or matters of fact. That is, some nodes may be calculated in terms of probabilities, but not all, or they will provide results in numbers that might be misleading or misrepresenting what is going on.

Once again it is important to distinguish between different kinds of

25 Mandeep K. Dhami and David R. Mendel. (2021). Words or numbers? Communicating probability in intelligence analysis. *American Psychologist*, vol 76, no 3, 549-560.

items in the boxes.

Wheaton et al. argue that intelligence analysts traditionally develop their judgments about the likelihood of a given situation's outcome using *ad hoc* methods that consider probabilistic notions but do not necessarily implement mathematically sound probabilistic reasoning. Bayesian network inference propagates beliefs in all directions according to Wheaton et al.—not just up from leaf nodes towards root hypotheses, but also back down, in a process that is generally considered too complex, except for small pedagogical examples (Wheaton et al. 2010).

An argument map is generally used when a thesis/main hypothesis is chosen, followed by investigating arguments pro and con. The thesis will not change by calculating, but perhaps the likelihood of the thesis being true (or the level of epistemic justification for the thesis) and reasons to investigate another thesis.

Wheaton et al. argue that even though Bayesian analysis can be a good tool for fitting new intelligence into an existing model, it is difficult to teach as well as apply (Wheaton et al. 2010). Even though there are software packages making Bayesian analyses more accessible, it is something that might be done together with an alternative hypothesis analysis. That is, not in an actual argument map, with a thesis and arguments. The reason for this is that the core of the argument map is something else—about clarifying and focusing and evaluating each box which consist of different things, where not everything can or should be assigned a number.

What is important here is evaluating each separate box—each piece of evidence. Tenability or credibility and relevance are the first basic categories, but another question is how to value the tenability/credibility? Toulmin discusses backing, modal qualifiers and rebuttals (Toulmin 2003, 93-95).

When examining tentative judgments, there will often be a need to evaluate the credibility of sources for some boxes. Clark suggests that when evaluating the source, one needs to look at competence, access and vested interest or bias. This leads us to the notion of justified belief.

Justified Belief in Intelligence Analysis

There is a vast discussion in philosophy on what is involved in *knowing* a fact. As Mathias Steup and Ram Neta point out in *The Stanford Encyclopedia of Philosophy*,[26] one might be intellectually unimpeachable in believing that one's birthday is May 4 if it says so on one's birth certificate and medical records, and one's family have celebrated one's birthday on that date since one was born. But they argue that one's belief might still be false, due to some error in time-keeping at the time of birth. What does philosophy

26 Steup, Matthias and Ram Neta, "Epistemology," *The Stanford Encyclopedia of Philosophy* (Fall 2020 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/fall2020/entries/epistemology/>.

say about this, and about justification as a condition for knowledge? What sort of justification is needed in order to say that *Luke knows p*?

In philosophy, the classical definition of knowledge is that it consists of *justified true belief*, which can be described like this: Luke knows p "if and only if" (meaning that the conditions that follows are sufficient and necessary—iff for short) (i) Luke *believes* that p, (ii) p is *true*, and (iii) Luke is *justified* in believing p. The most interesting condition or criterion in this context, is the third, so we will look more closely at (iii) and connect it to intelligence production. Truth is of course important, but the concept of truth also represents a vast discussion in philosophy, and in this context, it is more fruitful to be pragmatic, and look at justification (for action). It should also be noted that this definition of knowledge concerns propositional, factual and theoretical knowledge (Jerkert 2019, 224).

An important question is how ideas on justification be transferred to and used in intelligence analysis. Martha Whitesmith (2022b) examines how theories for establishing justification for beliefs (evidentialism, process reliabilism, and indefeasibilism) can be utilized for practical use in intelligence analysis, specifically (ACH).

When it comes to justification, the main distinction is between foundationalism and coherentism. The idea in foundationalism is that justified beliefs are based on foundations – basic beliefs—and that other beliefs rest on those basic beliefs. According to coherentism, there are no basic beliefs. Knowledge and justification are structured more like a web. Steup and Neta point out that when beliefs originate in sources like "desires, emotional needs, prejudice and different kinds of biases" […] they don't qualify as knowledge even if true. For true beliefs to count as knowledge, it is necessary that they originate in sources we have good reason to consider reliable" (Steup and Neta 2020). Examples of such sources would, according to Steup and Neta, be *perception, introspection, memory, reason* and *testimony*. Memory, reason and testimony would be the most relevant in this context.

With our *memory* we can retain knowledge already required, but our memory is fallible. Steup and Neta suggest that we distinguish between the following: remembering that *p* (which entails the truth of *p*) and *seeming* to remember that *p* (which does not entail the truth of *p*). Here the question is whether one has reason to believe that one's memory is reliable.

Regarding *reason*, there is something called *a priori*—that justification can be a priori, and this means that one is justified in believing something without any experience. This is sometimes referred to as a priori knowledge (Steup and Neta 2020) and it does not normally involve introspective or memorial experiences like being hungry, but from reason alone. That would mean that experiences include perception, introspection and memory. Examples of a priori knowledge would be conceptual truths (such as "All bachelors are un-

married"), and truths of mathematics, geometry and logic (Steup and Neta 2020).

Justification and knowledge are called "a posteriori" or empirical if it is not a priori.[27]

Testimony is different from the sources mentioned above, in that it does not have a cognitive fallacy of its own. When we know p because of a testimony, it is because someone said p. Steup and Neta point out that this should be understood widely, including talk and writings in blogs, articles, television, radio, and other media.

When it comes to testimonial sources there is something called the track record approach. We seem to accept testimonial sources as reliable, attributing credibility to them, unless we have reason to believe otherwise. It might be the case that a sign of reliability is that there is a long track record.[28] There is also another view—that one declares it a necessary truth that one is prima facie justified to trust a testimonial source.[29]

If we connect this to argument mapping, we might pick out the boxes with tentative judgments and make additional boxes, like testimony, and investigate that separately in terms of justification. The question is when a belief can be considered justified in the intelligence context, and whether it depends on, for instance, how many times a source has proven to be right in the past. Aviezer Tucker (2023) has explored Bayesian analysis connected to testimony.

Tecuci et al. discusses tangible evidence: objects of various kinds, or sensor records like those obtained by signals intelligence (SIGINT), imagery intelligence (IMINT), measurement and signature intelligence (MASINT) and other possible sources (Tecuci et al. 2016, 3). Testimonial evidence is obtained from human sources, also called human intelligence (HUMINT). They point out that the origin of one of the biggest challenges in assessing the believability of evidence" is that we must ask different questions about the sources of tangible evidence than those we ask about the sources of testimonial evidence" (Tecuci et al. 2016, 3.) They also say that "… we have evidence in search of hypotheses, hypotheses in search of evidence, and the testing of hypotheses all going on at the same time" (Tecuci et al. 2016, 5), which points to the need for argument mapping, in order to keep things clearer and more structured: "All evidence has three major credentials or properties: *relevance*, *believability* or *credibility*, and *inferential force or weight*" (Tecuci et al., 2016, 7). The question is to make proper evaluations

27 Some argue that there is no a priori knowledge, that all such knowledge is in fact empirical (Steup and Neta, 2020), but we do not need to go deeper into that here, but for our purposes recognize conceptual, mathematical and logical knowledge a priori.

28 See, for instance E. Fricker (1994) and M. Fricker (2007).

29 See, for instance, Lackey (2003 and 2008), and Lackey and Sosa (2006). According to Burge (1993) it is a necessary truth, knowable a priori, that trust in testimonial sources is prima facie justified.

of these properties and figure out when a belief is justified in the intelligence context.

Conclusion

The point of argument mapping is clarity of structure. Therefore, there should be a main claim or main hypothesis at the top, which is not an argument for something else in the tree, and which is argued for in the tree. ACH and Bayesian analysis should be performed before the argument map in order to find main hypotheses for separate trees. Even if it might be possible to put numbers on some boxes in the tree, doing it on all boxes might produce misleading results, depending on what they contain. The argument tree should be as clean as possible. Without numbers and likelihoods, we might use the notion of justified belief when investigating the tentative judgments so common in intelligence analysis. When is a belief justified in the intelligence context? That is for future research.

Malmgren (2006) has argued against this. Aviezer Tucker (2023) has explored Bayesian analysis connected to testimony.

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