IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

WOLFRAM ALPHA

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Abstract : Wolfram Alpha is a question-answering system created by Wolfram Research. It is an online service that directly responds to factual inquiries by computing the answer from structured data rather than delivering a list of documents or web pages that may contain the answer as a search engine could. Stephen Wolfram introduced it in March 2009, and it was released to the public on May 15, 2009. Wolfram Alpha is almost more of an engineering achievement than a scientific one: Wolfram has broken down the set of factual questions we might ask, as well as the computational models and data required to answer them, into basic building blocks — a sort of basic language for knowledge computing if you will. Then, with these building pieces in hand, his system can compute with them — breaking down problems into the basic building blocks and computations required to solve them, and then building up computations and computing the answers on the fly. A text box allows users to submit queries and calculation requests. Wolfram Alpha then uses a core knowledge base of vetted, structured data to compute and infer answers and appropriate visualizations. Thus, Alpha is distinct from semantic search engines, which index a vast number of answers before attempting to match the question to one of them. Wolfram Alpha is based on Mathematica, Wolfram's previous flagship product, which includes computer algebra, symbolic and numerical computing, visualization, and statistics. It is well suited to answering mathematical queries with Mathematica running in the background. The solution is usually presented in a human readable format.

IndexTerms - Mathematica, Wolfram Alpha, search engine, computation

I. INTRODUCTION

Wolfram Alpha is a question-answering system created by Wolfram Research. It is an online service that directly responds to factual inquiries by computing the answer from structured data rather than delivering a list of documents or web pages that may contain the answer like a search engine could. Stephen Wolfram introduced it in March 2009, and it was released to the public on May 15, 2009. The long-term goal of Wolfram Alpha is to make all systematic knowledge instantly computable and available to everyone. We want to be able to collect and curate all objective data, implement every known model, technique, and algorithm, and compute anything that can be computed about anything. Our goal is to rely on scientific advances and other knowledge systems to create a single source for conclusive answers to factual questions that anybody can trust. Many people were startled when Wolfram Alpha, which was released to the public in May 2009, did not function like Google or any other search engine. This is because Wolfram Alpha is a computational knowledge engine, not a search engine. Wolfram Alpha is far from ideal at this time, but it is already a tool that might be useful in the day-to-day work of a typical college student, and it is only going to become better.

II. LITERATURE SURVEY

The Literature survey offers the review of the literature on wolfram alpha in various fields. Unlike other search engines, Wolfram Alpha focuses on factual knowledge, particularly public knowledge. Mathematics and statistical analysis, chemistry, geography, technology, and socioeconomic statistics are just a few of the subjects covered.

Veronika Rihova, Eva Jilkova and Jan Wossala discussed on the concept of “WOLFRAM ALPHA IN MATHEMATICS AND ECONOMICS”. They focuses on evaluating the quality of teaching economic subjects using the Wolfram Alpha comprehensive online tool in the area of financial mathematics. The authors use the method of a questionnaire survey which confirmed the usefulness of this system within the innovative concept of modern teaching. At present, many people face debt, young people in

particular, and therefore enhancing financial literacy is very important. Wolfram Alpha also plays one of the key roles here as it contributes to building up student financial literacy.

Wan Nur Shaziayani Wan Mohd Rosly, Sharifah Sarimah Syed Abdullah and Fuziatul Norsyiha Ahmad Shukri make a research in "The uses of Wolfram Alpha in Mathematics". Wolfram Alpha is ideal for the sort of math that Google's calculator and most other calculator websites couldn't solve the questions given. It even provides graphs that help students understand the mathematical concept itself. According to Flanagan (2008), many educators use a variety of technologies to enhance student interest and achievements.

Maria Gabriela Campuzano make a research in "Learning Analytic Geometry with the aid of Wolfram Alpha". The active use of ICT in math education has well-known benefits, such as the creation of interactive learning environments, increased monitoring, and thorough feedback. The goal of this is to see how beneficial Wolfram Alpha is in terms of academic achievement and student attitudes toward it when learning analytic geometry. Wolfram Alpha was chosen because it has a nice visual representation, provides step-by-step answers, provides detailed results, and is simple to use. Students were divided into experimental and control groups using a quasi-experimental design. Two sample t-tests were used to compare the results of the pre and post tests.Students' perceptions of utilising Wolfram Alpha were gathered via questionnaires and analysed using descriptive statistics. During the disruption of face-to-face classes due to COVID spread, research was applied to an online pre-calculus course. According to the findings, Wolfram Alpha increases students' academic performance by creating pleasant and interactive environments in which students can profit from the usage of ICT in a variety of ways. Students are enthusiastic about this tool and believe it should be included in all pre-calculus classes. Teachers should think about using Wolfram Alpha in their math classes.

III. PROBLEM STATEMENT

A search engine is not Wolfram Alpha. Perhaps it will one day, but for now, it is a computational knowledge engine, as its tagline suggests. However, it appears to be similar to Google in that it delivers answers, therefore most users will try to use it as a search engine, which does not always produce good results. It will give you better responses once you start asking it the proper questions. Here are some pointers to help you get out of that "search engine" mindset and start using Wolfram Alpha to its full potential.

a) COMPLEX QUERIES

Because most search queries are straightforward, Google understands what you're looking for. If you offer it a lot of information, it will become confused. Google searches don't calculate, which is where Wolfram Alpha comes in. It doesn't care how many arguments you give it; it's the same way that a calculator doesn't care if you're adding two or fifty numbers. As a result, concatenating several arguments in a query frequently yields excellent results.

b) LOCALIZATION

Google can produce regionalized versions of its services or even serve you different results based on your location. It cannot, however, compel every website to follow suit. Wolfram Alpha, for the most part, does not rely on other websites for the data it provides, so its localization is more accurate.

c) PRECISION

Most reviewers' first query on Wolfram Alpha was to type in their name, and they got terrible results. That is, in fact, a good thing. Because you're unlikely to be in WA's database, it doesn't try to conjure up a result out of thin air; instead, it just states that it has no information on you. This improves Google's ability to search the web, but it also gives Wolfram Alpha a distinct advantage: precision. You don't have to be concerned about getting incorrect information; Wolfram Alpha will either give you the correct response (depending on the correctness of its index) or no answer at all. This could have a significant impact on how we conduct searches. We're accustomed to estimating answers, so we frequently round numbers to increase our chances of discovering an answer. You can write in highly specific searches on Wolfram Alpha, which can save you a lot of time.

d) CALCULATION

One way to think of Wolfram Alpha is as if someone gathered all of the many calculators that were strewn across the internet and gathered them in one spot. Google has dabbled in this, adding currency conversion and other simple computations to its search service, but WA is so superior in this aspect to Google that you'll use it in your daily life.

e) COMPARISON

The Google mindset – or, as we like to call it, the search engine mindset – prevents you from asking certain questions because you know you won't get a response. You wouldn't think to look for a comparison of sales tax rates in five US cities, but Wolfram Alpha makes it easy. Furthermore, if you need to compare two statistics or data sets, you may either hope that Google has indexed a site that contains exactly what you need, or you can make the comparison yourself. Not so with WA, where you can quickly compare many data samples and obtain not only findings but also use graphs, ratios, tables, and historical data comparisons.

OBJECTIVES:

- Make expert-level information and skills accessible to everyone.
- It aims to collect and curate all objective data, implement every known model, technique, and algorithm, and compute anything that can be computed about anything.
- Accept entirely free-form input and act as a knowledge engine that generates powerful findings and deliver them.

IV. METHODOLOGY

HOW DOES ALPHA WORKS?

Wolfram Alpha is a computer program that calculates answers to queries. It achieves this by incorporating built-in models of domains of knowledge, complete with data and algorithms that reflect real-world knowledge. It comprises formal models of much of what we know about science, for example, as well as enormous amounts of data about various physical laws and properties, as well as data about the physical world. A text box allows users to submit queries and calculation requests. Wolfram Alpha then uses a core knowledge base of vetted, structured data to compute and infer answers and appropriate visualizations. Alpha differs from semantic search engines in that it indexes a huge number of answers before attempting to match the question to one of them.

FOUR PRIMARY COMPONENTS IN ALPHA:

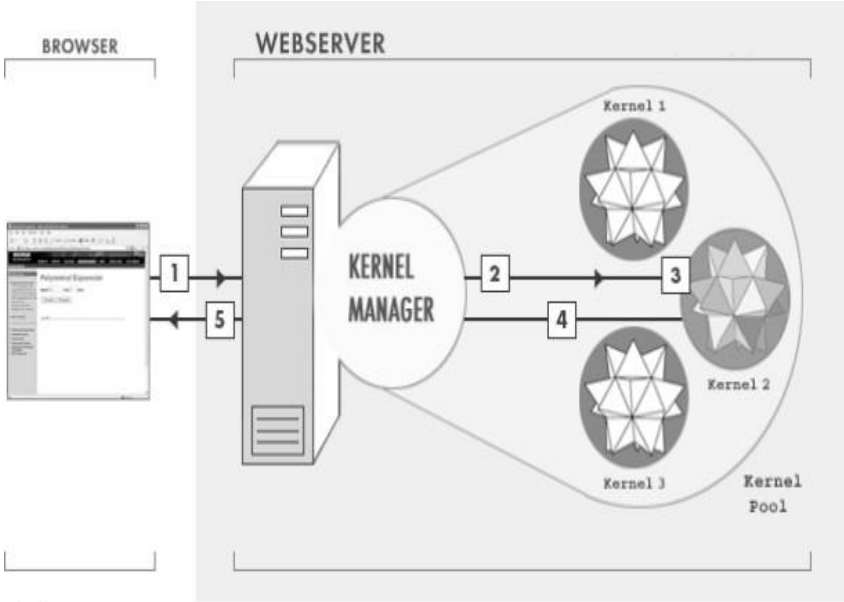
- **Data curation**: Alpha doesn't rely on the entire internet for information; instead, it relies on a well-managed database and a few reliable sources (Alexa and US Census info being among them). Data that does not change is maintained and categorized, while sources are asked regularly for current, relevant information.
- **Computation:** The heart of Alpha is made up of 5-6 million lines of Mathematica distributed over many parallel processors (10,000 in the production edition). They together encode a significant portion of all known algorithms and computer models. They can be used to solve theoretical issues (such as integration, series development, and airflow simulation) or to analyze specific data (weather prediction, tide forecasts, etc).
- **Linguistic components**: The example shows that a powerful (albeit far from flawless) natural language processing system is in use. This freeform language analysis is crucial to Alpha since a guidebook on how to use Alpha properly would be thousands of pages long without it (according to Wolfram).
- **Presentation:** Alpha's presentation is incredibly appealing to the eye. The data is presented in such a way that it is very easy to absorb what is being provided while also not being overpowering. Though the general structure is standard (individual data segments are organized into 'pods' on the page), the actual data displayed is highly customized to the query. It's easy enough for a child to operate.

Alpha concentrates on questions with clear answers or ones that can be computed directly. There will be the option of sidebar links to further resources in circumstances where there is doubt or controversy, or Alpha cannot compute sufficient answers (like Wikipedia). In comparison to Wikipedia, Alpha will not be accessible for everyone to add to, although Wolfram stated that contributing to Alpha's knowledge base would be a simple process. In Wolfram Alpha, Mathematica plays three important functions. First, its very general symbolic language provides the framework within which all of Wolfram Alpha's extensive knowledge and capabilities are represented and applied. Second, Mathematica's huge network of built-in algorithms provides the computational basis that allows the methods and models of so many domains to be implemented. Finally, Mathematica's capability as a software engineering and deployment platform allows us to take Wolfram Alpha's technical achievements and distribute them widely and reliably.
NKS was another key to Wolfram Alpha, in addition to Mathematica. In the implementation of Wolfram Alpha, several specific principles from NKS are applied, particularly those relating to algorithms discovered by exploring the computational universe. But, maybe, more importantly, the NKS paradigm was critical in conceptualizing Wolfram Alpha as a possibility.

V. TOOL

MATHEMATICA:

Mathematica is a computational software tool used in the domains of science, engineering, mathematics, and other technical computing. It was created by Wolfram Research in Champaign, Illinois, and was imagined by Stephen Wolfram. webMathematica is built using two common Java technologies: Java Servlet and Java Server Pages (JSP). Servlets are Java programs that run in a Java-enabled web server, commonly referred to as a "servlet container" (or sometimes a "servlet engine"). There are a variety of servlet containers available, each of which may run on a variety of operating systems and architectures. They can also be used with other web servers, such as Apache. Webmathematica allows a website to offer HTML pages with added Mathematica commands. When one of these pages is requested, the Mathematica instructions are evaluated and the computed result is displayed. This is accomplished using the normal Java templating technique, JavaServer Pages, and special tags; examples of these tags are provided later in this section. The request/response standard used by web servers is used by web Mathematica technology. HTML forms, applets, javascript, and web-enabled programs can all provide input.
Data files can also be sent to a web Mathematica server for processing. . HTML, pictures, Mathematica notebooks, MathML, SVG, XML, PostScript, and PDF are all examples of output formats. Working with all of these distinct technologies is demonstrated in this user guide. To manage the many different ways of working with Mathematica computations, web Mathematica includes a vast library of Mathematica commands. The kernel manager, which calls Mathematica in a reliable, efficient, and secure manner, is a crucial aspect of web Mathematica. The manager manages a pool of one or more Mathematica kernels, allowing it to handle multiple requests at once. The diagram below depicts the operation of a web Mathematica portal.



1 Browser sends request to web*Mathematica* server.

2 web*Mathematica* server acquires *Mathematica* kernel from the pool.

3 *Mathematica* kernel is initialized with input parameters, it carries out calculations, and returns result to server.

4 web*Mathematica* server returns *Mathematica* kernel to the pool.

5 web*Mathematica* server returns result to Browser.

VI. REPRESENTATION MODELS

The output is organized into rectangular areas known as pods, each of which generally corresponds to one result category. There are five pods in the output shown below. Each pod has a title ("Input" is the first pod's title), as well as content, which is usually a GIF image. Additional capabilities may include a copyable plaintext representation that shows in a popup when you hover your mouse over the image, as well as JavaScript buttons that change the pod with alternative information in an AJAX-style process.
Sub pods contain the real content pods. The screenshot's "Alternative representation" pod features three sub pods, each of which displays a distinct mathematical identity for p. Each sub pod is a distinct result with its image on the page. Every pod, by convention, has at least one sub pod, therefore pods with only one result have that result in a sub pod. The content of each sub pod on the Wolfram Alpha site is usually an image. The majority of the results are available in alternate formats, such as various textual representations. The API allows users to request any combination of these representation kinds.

OUTPUT FORMATS:

a. VISUAL REPRESENTATIONS

The results are exhibited as GIF pictures on the Wolfram Alpha interactive website. This makes it possible to format mathematical calculations, tables, and, of course, visuals in a meaningfuland appealing manner. If you want such "pictures" of the output when using the Wolfram Alpha API, you have two options.

b. TEXTUAL REPRESENTATIONS

You might not be pleased with photos of output in some circumstances, preferring instead a structured textual description of each sub pod. You can then format it as needed or take it apart to retrieve only the information you need. A plot of a mathematical function, for example, will not have a plaintext representation but rather have a Mathematica Input representation.

VII. CONCLUSION

The Wolfram Alpha knowledge engine is an excellent tool for anyone who has to do serious calculations or wants to do frivolous computations. It is one of our most outstanding systems todate, and it will prove to be an extremely useful tool. Many of the calculations would have beeneliminated with just one search query, and the graphs reveal tendencies that would have taken considerably longer to discover otherwise. Wolfram Alpha is a fantastic system. Wolfram| Alpha is entertaining to use and presents a new way of accessing the information on the Internet. It may be beneficial for mathematical and scientific study in its current state.This intriguing initiative, however, poses no threat to Google until it gathers a lot more data and learnsto handle more complex user requests. In this situation, instead of stones, David is throwing equations at Goliath, which may look spectacular but won't kill any giants. Wolfram Alpha is at the forefront of search engine development. While it does not competedirectly with Google or Yahoo, it can significantly improve your web browsing experience. Alpha is the program to use if you want a direct answer without having to trawl through a lengthy list of potentially shady websites.

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