

Trade-off Analytics using IBM Bluemix and Watson services

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Abstract:

Decision making has always been a crucial part in any organization or in fact, in any area of life. A decision maker is often faced with multiple objectives while making choices. These choices can be conflicting or similar in nature. It is therefore helpful to have certain tools and techniques to help with informed decision-making. The purpose of this project is to explore the usability and effectiveness of IBM Watson trade-off analytics to help users in the decision making problem of selecting best product (such as cars, electronic gadgets, etc.) we will explain how tradeoff analytics can help the user make better decisions from the variety of options available, considering multiple criteria while making the choice. These criteria will be set according to the user's preferences and can be opposing or similar to each other. The cognitive abilities of trade-off analytics service will provide the users with a set of optimal alternatives and their respective trade-offs. These tradeoffs and options can then be explored and analyzed and best option can be decided on, thus leading to informed decision making.

Keywords: IBM Bluemix & Watson Analytics

1. INTRODUCTION

A **Tradeoff** is a situation that involves losing one quality or aspect of something in return for gaining another quality or aspect. More colloquially, if one thing increases, some other thing must decrease. Tradeoffs can occur for many reasons, including simple physics (into a given amount of space, you can fit many small objects or fewer large objects). The idea of a tradeoff often implies a decision to be made with full comprehension of both the upside and downside of a particular choice, such as when a person decides whether to invest in stocks (more risky but with a greater potential return) versus bonds (generally safer, but lower potential returns).

In computer science, tradeoffs are viewed as a tool of the trade. A program can often run faster if it uses more memory (a space-time tradeoff). Consider the following examples:

- By compressing an image, you can reduce transmission time/costs at the expense of CPU time to perform the compression and decompression. Depending on the compression method, this may also involve the tradeoff of a loss in image quality.
- By using a lookup table, you may be able to reduce CPU time at the expense of space to hold the table, e.g. to determine the parity of a byte you can either look at each bit individually (using shifts and masks), or use a 256-entry table giving the parity for each possible bit-pattern, or combine the upper and lower nibbles and use a 16-entry table.
- For some situations (e.g. string manipulation), a compiler may be able to use inline code for greater speed, or call run-time routines for reduced memory; the user of the compiler should be able to indicate whether speed or space is more important.

IBM Bluemix is a cloud platform as a service (PaaS) developed by IBM. It supports several programming languages and services as well as integrated DevOps to build, run, deploy and manage applications on the cloud. Bluemix is based on Cloud Foundry open technology and runs on SoftLayer infrastructure. Bluemix supports several programming languages including Java, Node.js, Go, PHP, Swift, Python, Ruby Sinatra, Ruby on Rails and can be extended to support other languages such as Scala through the use of buildpacks.

IBM Bluemix includes IBM's Function as a Service (FaaS) system, or Serverless computing offering, that is built using open source from the Apache OpenWhisk incubator project largely credited to IBM for seeding. This system, equivalent to Amazon Lambda or Google Cloud Functions allows calling of a specific function in response to an event without requiring any resource management from the developer. IBM Bluemix makes it easy for you to implement, host, and scale services and apps. You can focus on your application logic and application design

WATSON SERVICE: Watson Analytics is a smart data analysis and visualization service you can use to quickly discover patterns and meaning in your data – all on your own. With guided data discovery, automated predictive analytics and cognitive capabilities such as natural language dialogue, you can interact with data conversationally to get answers you understand. Tradeoff analytics is one of the Watson analytics service.

Tradeoff analytics applies decision analytics technology enabling users to avoid choice overload when making complex decisions involving multiple, conflicting goals, when you make decisions, how many factors are considered! How do you when you've identified the best options! With tradeoff analytics, you can avoid lists of endless options and determine the right option by considering multiple objectives.

Users of tradeoff analytics applications specify decisions criteria by selecting objectives and preferences. Developers of such applications specify the available options and their characteristics. The service filters out less attractive options to encourage user's explorations of the remaining optimal candidates. In this way, the service helps decision makers consider only the goals that matter most and only the best candidates to make a final, informed decision.

1.1 EXISTING SYSTEM

Decision making has always been a difficult task, even in earlier times. There have been many decision making software which helps business people in making some decisions. Most DM (Data Mining) software is based on multi-criteria decision making (MCDM). MCDM involves evaluating and combining alternatives' characteristics on two or more criteria or attributes in order to rank, prioritize or choose from among the alternatives.

DM software employs a variety of MCDM methods, popular examples include

- Aggregated Indices Randomization Method (AIRM)
- Analytic Hierarchy Process (AHP)
- Analytic network process (ANP, an extension of AHP)
- Elimination and Choice Expressing Reality (ELECTRE)
- Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH)
- Multi-attribute global inference of quality (MAGIQ)
- Potentially All Pair wise Rankings of all possible Alternatives (PAPRIKA)
- Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE)
- Evidential reasoning approach for MCDM under hybrid uncertainty

There are significant differences between these methods and, accordingly, the DM software implementing them. Such differences include:

1. The extent to which the decision problem is broken into a hierarchy of sub problems;
2. Whether or not pair wise comparisons of alternatives and/or criteria are used to elicit decision-makers' preferences;
3. The use of interval scale or ratio scale measurements of decision-makers preferences;
4. The number of criteria included;
5. The number of alternatives evaluated, ranging from a few (finite) to infinite;
6. The extent to which numerical scores are used to value and/or rank alternatives;

7. The extent to which incomplete rankings (relative to complete rankings) of alternatives are produced;
8. The extent to which uncertainty is modeled and analyzed.

There are some major limitations of DM software's, they are:

Difficulty in Quantifying All the Data it's difficult to analyze intangible or indefinable data. In reality, some values cannot be very specific and defined in numbers. Even though a DSS may quantify some of these aspects, the end result must be duly considered by the decision makers.

Unaware of Assumptions: As a decision maker, you may not be fully aware of the assumptions that a decision support system has considered when analyzing data for a specific problem.

System Design Failure: Decision support systems are designed to the specific needs of a decision maker. If you don't know what you want a DSS to do or how it should help you, it will be difficult to design a system that fits your needs.

Difficulty in Collecting All the Required Data: As a decision maker, you must realize that it's not possible to capture all of the related data mechanically. While some data is difficult to record, some cannot be recorded at all. Therefore, the value presented by a DSS may not be 100% true.

1.2 PROBLEM DEFINITION

When trying to make a good decision, a person must weigh the positives and negatives of each option, and consider all the alternatives. For effective decision making, a person must be able to forecast the outcome of each option as well, and based on all these items, determine which option is the best for that particular situation, which is a very difficult task. Designing and developing a web application using trade off analytics to help the user to make better choice among variety of options available in electronic gadgets and cars, considering multiple criteria while making the decision.

1.3 PROPOSED SOLUTION

The Tradeoff Analytics service makes its interface available as a client library, the Tradeoff Analytics widget. The interface provides a guided experience to help users solve their decision problems. It offers a step-by-step approach that breaks down the decision-making process into simple actions that include helpful visualizations.

1. **Select Criteria** As a user, you are part of creating the input to the service API. You select the criteria, or define the objectives, that allow the service to analyze the problem and present an interactive visual display of the best candidate options. The interface follows Ben Shneiderman's famous visual information-seeking mantra: "Overview first, zoom and filter, then details-on-demand".
2. **Overview + Add for Comparison.** The service analyzes your options and presents the best candidates on map visualization. The map provides an overview of where each option lies in terms of its strengths against the various objectives. You can filter objectives on the visualization to focus on different considerations. You can examine option details and add up to six candidates of

interest for comparison in the next step. You can also use an alternative table view to examine both the best candidates and those that are excluded.

3. **Compare + Finalize.** Selecting a few options in the previous step reduces your pool of candidates to a manageable size. Based on your selections, the interface presents a parallel coordinates visualization that allows you to perform detailed comparisons between the remaining candidates. You can also access an alternative table view to explore your chosen candidates. After comparing and understanding the tradeoffs among the candidates, you can make a final selection with confidence in your decision.

1.4 OBJECTIVES

To create web application using IBM Bluemix and Watson analytics has the following objectives:

- To create the web application for Tradeoff Analytics
- To explore the options recommended by the service by using its novel graph and table visualizations of IBM Bluemix and Watson Services.
- To use filters to narrow down the options.
- To add a few candidates for further comparison.
- To examine the service's insights regarding good tradeoffs that might have been missed.
- To compare all candidates in detail and reach a final decision.

2. BACKGROUND THEORY

The state of multiple criteria decision support software. Many methods and approaches have been proposed in the literature to handle multiple criteria decision analysis, and there is an abundance of software that implements or supports many of these approaches. The review is structured around several decision considerations when searching for appropriate available software. Weistroffer, HR, and Li, Y, "Multiple criteria decision analysis software", Ch 29 in: Greco, S, Ehrgott, M and Figueira, J, eds, *Multiple Criteria Decision Analysis: State of the Art Surveys Series*, Springer: New York, 2016 [1].

DM software can assist decision-makers "at various stages of the decision-making process, including problem exploration and formulation, identification of decision alternatives and solution constraints, structuring of preferences, and tradeoff judgments. The purpose of DM software is to support the analysis involved at these various stages of the decision-making process, not to replace it. DM software "should be used to support the process, not as the driving or dominating force. DM software frees users "from the technical implementation details [of the decision-making method employed], allowing them to focus on the fundamental value judgments". Nonetheless, DM software should not be employed blindly. "Before using software, it is necessary to have a sound knowledge of the adopted methodology and of the decision problem at hand." Oleson, S (2016), "Decision analysis software survey", *OR/MS Today* [2].

Decisions involve many intangibles that need to be traded off. To do that, they have to be measured alongside tangibles whose measurements must also be evaluated

as to, how well, they serve the objectives of the decision maker. The Analytic Hierarchy Process (AHP) is a theory of measurement through pairwise comparisons and relies on the judgments of experts to derive priority scales. It is these scales that measure intangibles in relative terms. The comparisons are made using a scale of absolute judgments that represents, how much more, one element dominates another with respect to a given attribute. The judgments may be inconsistent, and how to measure inconsistency and improve the judgments, when possible to obtain better consistency is a concern of the AHP. The derived priority scales are synthesized by multiplying them by the priority of their parent nodes and adding for all such nodes. An illustration is included. Thomas L. Satty [3].

Lindblom argued that means and ends are intertwined. Decision making is not a discrete event; rather, it becomes a step-by-step process, considering incremental changes from the status quo toward problem solving rather than decision making toward the achievement of a specific goal. For him, decision making is an evolutionary process, not a revolutionary one. The increment list view is also akin to “learning by doing” (E. Carayannis and Stokes 2000). It puts emphasis on the implementation of a decision rather than the analytical step that precedes the decision but focuses on continuous learning from the decision implemented and multiple feedback loops and decision adjustments, so as to reach the intended goal.

The individual differences perspective places the emphasis on individual decision making, rather than on organizational or group decision making. Keen and Morton (1978) showed that managers use different methods and come to different conclusions, not based on a rational choice but because of their personality, management style, and experience. As most decisions are perceived to emanate from a group decision-making process and a process that could be standardized” for use within an organization, so as to have it move in one direction, this strings if research has not received as much attention as other decision-making theories and perspectives.

3. SYSTEM OVERVIEW

Figure.1 shows the design phase begins when the requirement specification for the software to be developed is available. The design of the system is essentially a blueprint or a plan for the solution to the system. The system comprises of different components with clearly defined behavior or services to its environment.

System design is a modeling process, which allows user to create a new system. It is a transition from user’s view to programmers’ or database person’s view. It acts as a bridge between the required specification and implementation.

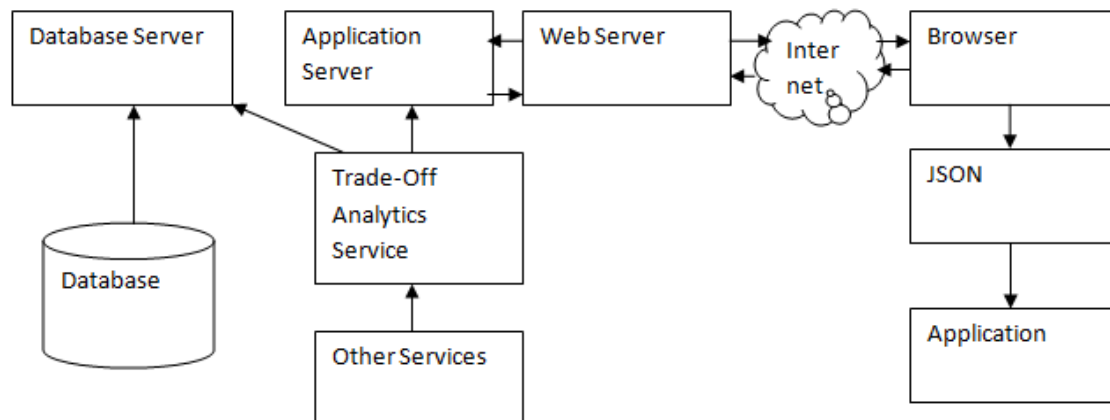


Figure 1. Architecture diagram for Trade-off Analytics

3.1: Tradeoff Module

```
/ Init App
```

```
var app = express();
```

```
var express = require('express');
```

```
tradeoffAnalyticsConfig = require('./tradeoff-analytics-config');
```

```
var app = express();
```

```
app.use('/', express.static(__dirname + '/public'));
```

//For local development, copy your service instance credentials here, otherwise you may omit

this parameter

```
var serviceCredentials = {"url": "https://gateway.watsonplatform.net/tradeoff-  
analytics/api",
```

```
"username": "e2c3528e-ddc3-4de4-9fdf-55780e56f9f2",
```

```
"password": "taZHKwjGAfSB"
```

```
}
```

//When running on Bluemix, serviceCredentials will be overridden by the credentials obtained from

```
VCAP_SERVICES tradeoffAnalyticsConfig.setupToken(app, serviceCredentials);
```

//View Engine

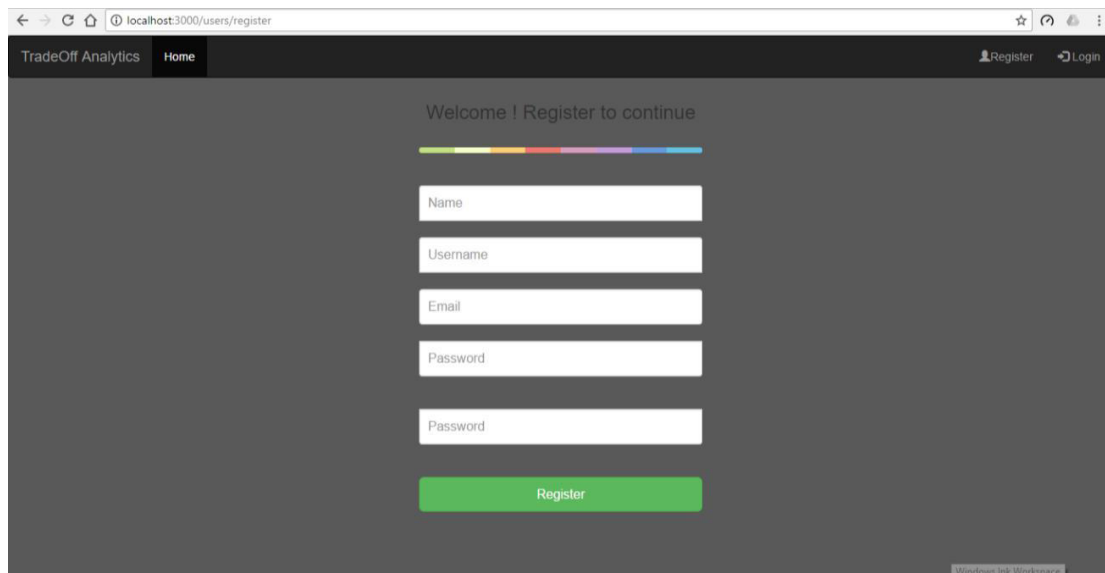
```
app.set('views', path.join(__dirname, 'views'));
```

```
app.engine('handlebars', exphbs({defaultLayout:'layout'})); app.set('view engine', 'handlebars');
```

//BodyParser Middleware

```
app.use(bodyParser.json());
app.use(bodyParser.urlencoded({ extended: false }));
app.use(cookieParser());taClient.subscribe('compareClicked', function(ops) {
console.log('comparing options:' + ops.map(function(op){return op.name;});
});
taClient.subscribe('problemResolved', function(dillema) {var opOps =
dillema.resolution.solutions.filter(function(s){return s.status=='FRONT';});
console.log('Problem Resolved. ' + opOps.length + ' Top options.' ); });
var clk = taClient.subscribe('optionClicked', function(op) { console.log('Clicked. '+
op.name);
});
```

4. SNAPSHOTS.



The screenshot shows a web browser window with the address bar displaying 'localhost:3000/users/register'. The page has a dark grey background and a white navigation bar at the top with 'TradeOff Analytics' and 'Home' on the left, and 'Register' and 'Login' on the right. The main content area features a registration form with the following elements:

- A header: 'Welcome | Register to continue' with a horizontal bar of colored dashes below it.
- Five input fields: 'Name', 'Username', 'Email', 'Password', and another 'Password' field.
- A green 'Register' button at the bottom of the form.

The browser's address bar and navigation icons are visible at the top. A 'Windows Ink Workspace' watermark is present in the bottom right corner of the browser window.

Fig 2: Registration form for User

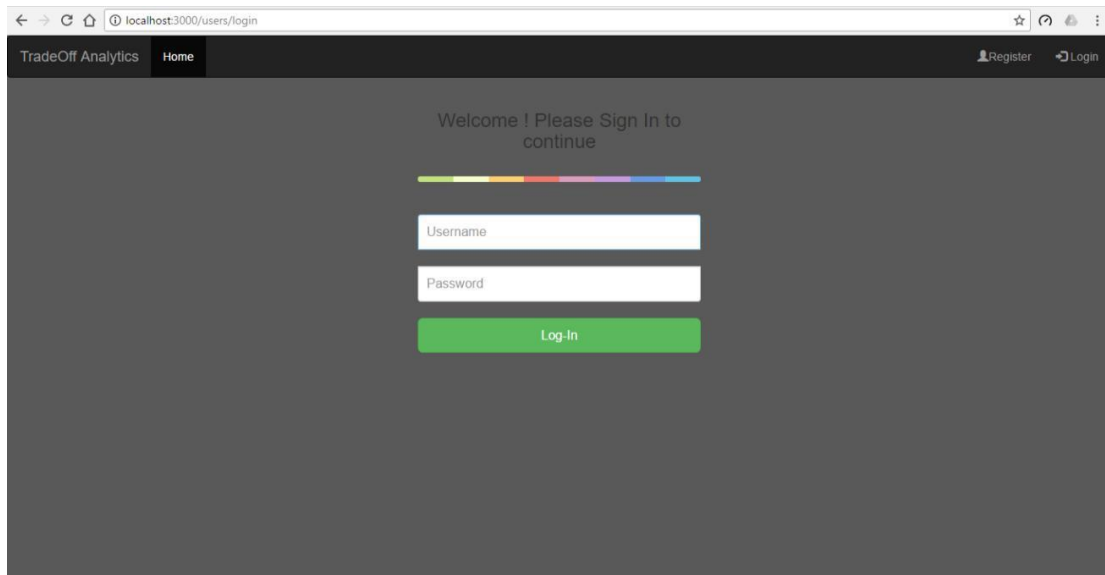


Fig 3: Login form for User

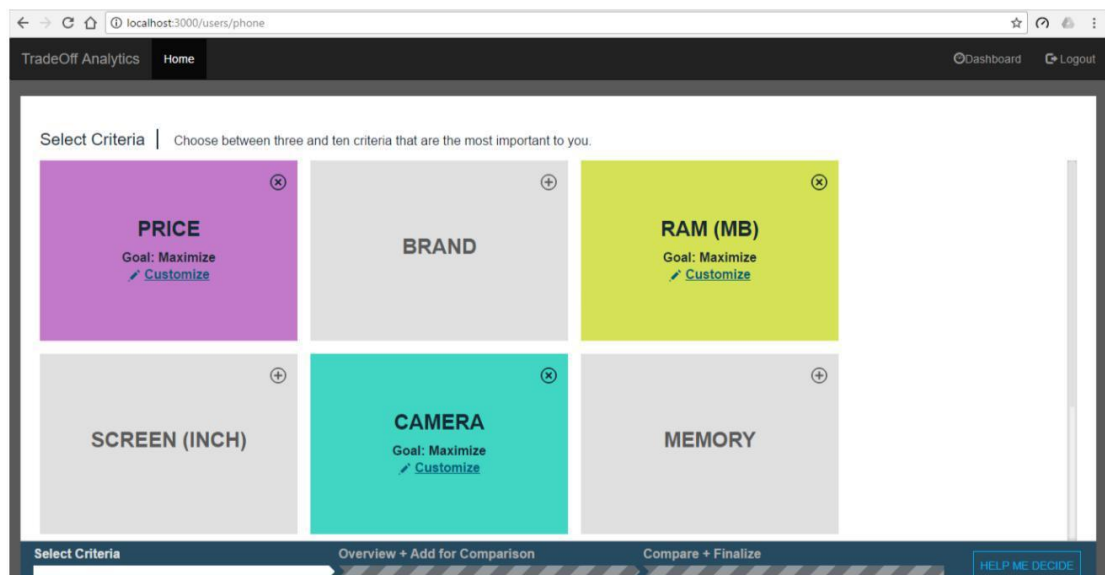


Fig 4: Criteria selected based on which the product has to be selected

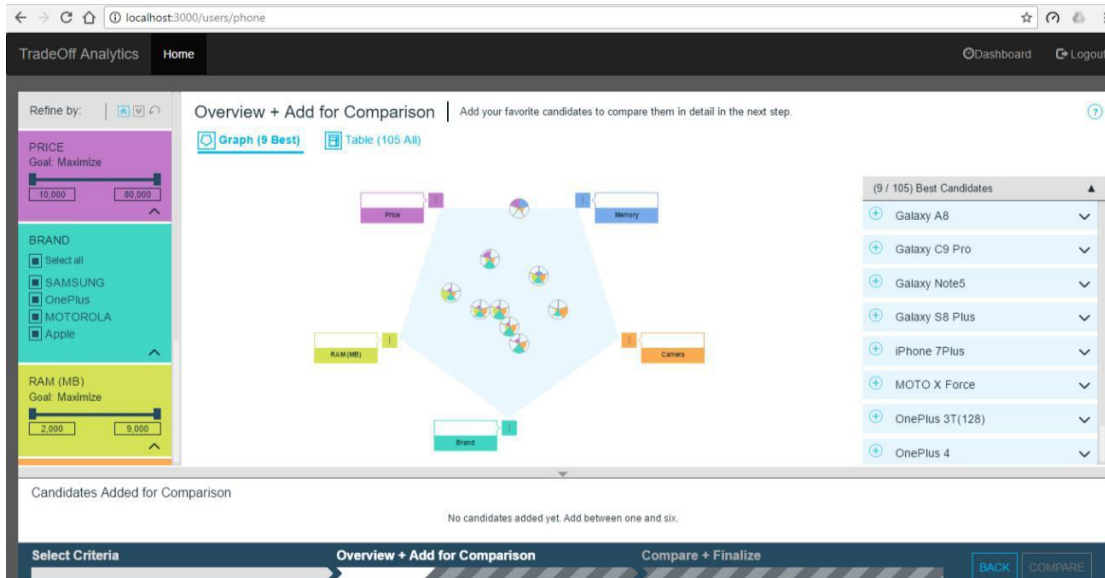
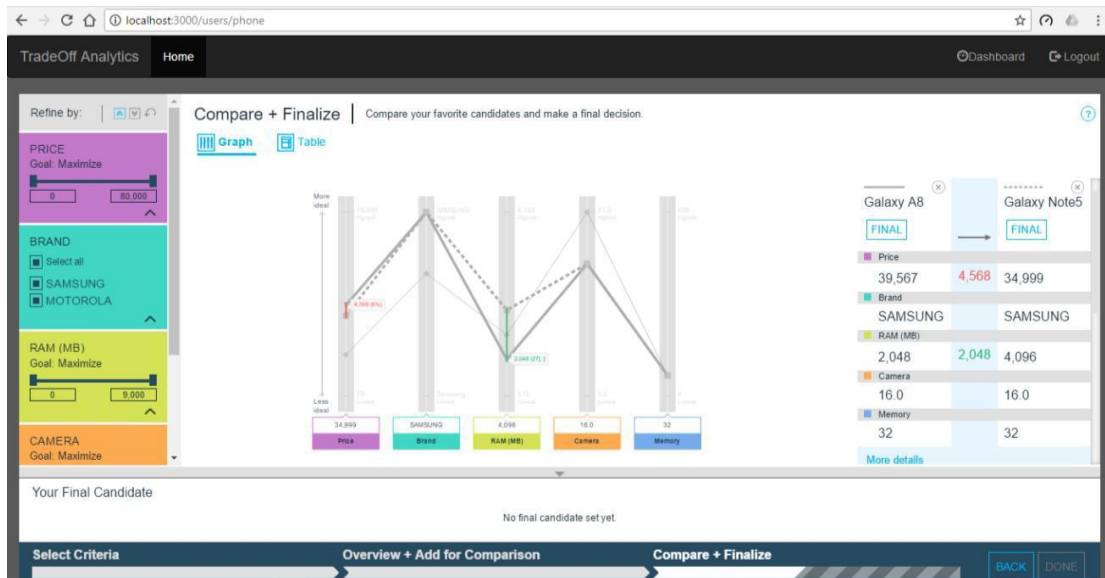


Fig 5: Gives the list of products based on the selected criteria and allows for further comparison



6: Graphical representation of detailed comparison

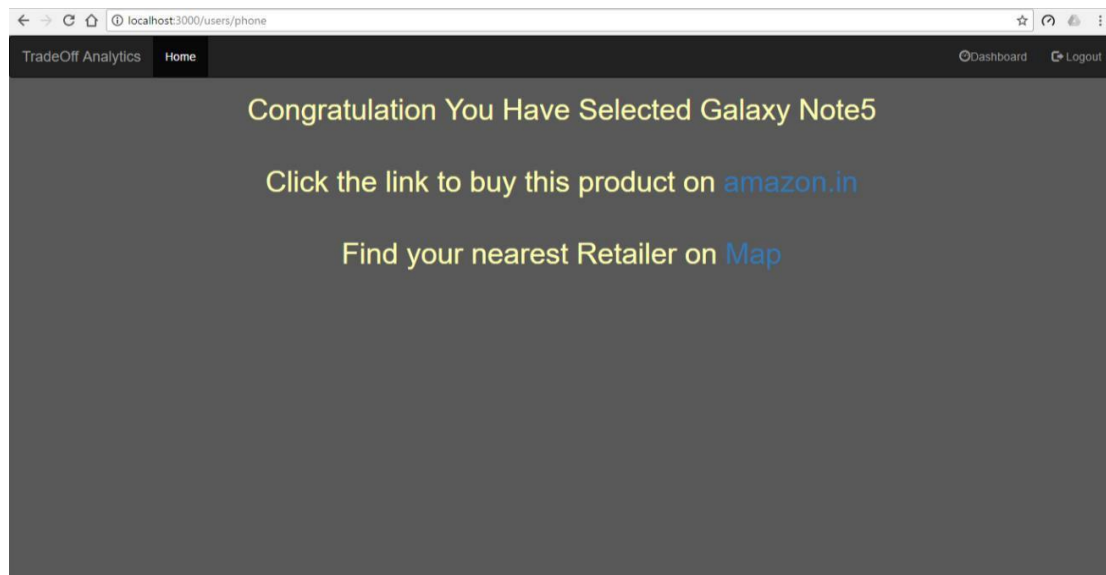


Fig 7: The final result of the selected product.

CONCLUSION

A decision-making approach mandates that information from multiple levels of analysis be collected and synthesized. The trade-offs and options are analyzed and best option can be decided on, thus leading to informed decision making. This project helps to explore the usability and effectiveness of IBM Watson trade-off analytics to help users in the decision making problem of selecting best product.

REFERENCES

- [1] Weistroffer, HR, and Li, Y, "Multiple criteria decision analysis software", Ch 29 in: Greco, S, Ehrgott, M and Figueira, J, eds, *Multiple Criteria Decision Analysis: State of the Art Surveys Series*, Springer: New York, 2016.
- [2] Oleson, S (2016), "Decision analysis software survey", *OR/MS Today* 43(5)
- [3] An exposition of the AHP in reply to the paper "remarks on the analytic hierarchy process" by Thomas L Satty
- [4] Ishizaka,A.;Nemery,P.(2013)."Multi-Criteria Decision Analysis".□
- [5] Belton, V, and Stewart, TJ, *Multiple Criteria Decision Analysis: An Integrated Approach*, Kluwer: Boston, 2002.
- [6] Figueira, J, Greco, S and Ehrgott, M, "Introduction", Ch 1 in: Figueira, J, Greco, S and Ehrgott, M, eds, *Multiple Criteria Decision Analysis: State of the Art Surveys Series*, Springer: New York, 2005.

