**Machine Learning Engineer Nanodegree**

**Capstone Proposal**

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**Proposal**

**Domain Background**

This project investigates a Speed Dating dataset from Kaggle. The dataset was compiled by two professors from Columbia University's Business School. Information including demographics and preferences of attraction were collected from participants during weeknight evenings in the years 2002 through 2004. Moreover, the study aimed at reproducing a business model that Speed Dating services use and chose similar environments to hold these events (e.g. popular bars near universities).

During the events, daters had a four minute "first date" with every other participant of the opposite sex. At the end of each four minute "date", participants were asked if he, or she, would date that person again. Participants were also asked to rate his, or her, date on six attributes: Attractiveness, Sincerity, Intelligence, Fun, Ambition, and Shared Interests.

In addition, the dataset includes a questionnaire that gathered data from participants at different points in the process. These fields include: demographics, dating habits, self-perception. Other data include what features of attraction participants think people find valuable in a mate. These attraction preferences were asked at the start of the event, half way through the event, a day after the event and three weeks after the event.

Finally, the dataset yielded a paper published by the same professors mentioned above, that is, Ray Fisman and Sheena Iyengar (Gender Differences in Mate Selection: Evidence From a Speed Dating Experiment). The mentioned Columbia professors also published another paper to use as a benchmark for the results of this project (Racial Preferences in Dating). The rest of project will explore the mentioned dataset.

**Problem Statement**

One finding to verify with the papers written by the Columbia professors is that men value physical attractiveness of a partner more than women do. Another is that women place a greater weight on intelligence than men do. Finally, this project will try to do two things:

1. The first task at hand is to investigate the types of clusters that males and females fall into, respectively. These clusters will be based off interests that males and females state in the questionnaire at the start of the event. The goal is to see if, for instance, taking one male from a night clubbing cluster, pertaining to men, matches with a female from the night clubbing cluster pertaining to women.
2. The other task is to generalize a model to predict if one male and one female match with each other.

The metric to evaluate the chosen for model will be f1score. This metric measures how the model makes a correct decision. f1score also takes into consideration the number of times that one male and one female do not match. f1score, hence, is a good choice as it is a harmonic mean of how people match and do not match.

**Datasets and Inputs**

The dataset file, Speed Dating Data, has 8378 data points with 195 different features. There were 551 people involved in the dating event with the population being divided into 274 women and 277 men. For the sake of brevity, the reader is invited to consult the Data Key file included with the dataset. The Key file gives the exact number of participants for each of the 21 'wave' events. Moreover, the Data Key file gives a thorough overview for what the allowed values for each field are.

The first attributes that will be explored at the start of the project include 'iid', 'gender', 'wave', 'attr', 'intel', 'fun', 'amb', and 'shar'. 'iid' uniquely identifies each participant in the event and is useful for querying unique members. 'gender' helps to query by gender. 'wave' number also helps in querying in what wave an individual participated. The features of interest are: 'attr', physical attractiveness; 'intel', intelligence; 'fun', how fun a person is; 'amb', ambition; and 'shar', shared interests. Each of these features of attractiveness are rated in one of two ways:

1. ratings based off a scale ranging from 1 to 10.
2. daters are asked to distribute 100pts to the six features of attraction in the manner he or she feels is most important.

Other things to note: features of attraction with extensions "1\_1" relate to a corresponding features at the start of the event (e.g. 'attr1\_1' is data referring at the start of event). Likewise "1\_s" refers to halfway through the event ('attr1\_s' refers to data halfway through the event). "1\_2" refers to the day after the dating event ('attr1\_2' data referring to halfway through the event). "1\_3" refers to three weeks after the event ('attr1\_3' data referring to halfway through the event). These extensions are important to see, if after various dates, daters change their outlook on stated preferences of attractions with respect to the beginning, middle, day after, or three weeks after the dating event.

**Solution Statement**

To verify that men value physical attraction, I will be taking a subset of the original dataset. The subset in mind identifies each person uniquely by 'iid'. Based off this subset, my approach will be to make two more subsets: one for males and another for females. At this point, data will need to cleaned in the sense that missing data points will need to be filled, or dropped, if not within the Data Key file's allowed range for each feature. Once cleaning is done, I will normalize the features of attraction being investigated. The features of attraction will be divided into four categories:

1. how individuals rated relevant features of attraction at the start of the event.
2. how individuals rated relevant features of attraction halfway through the event.
3. how individuals rated relevant features of attraction a day after the event.
4. how individuals rated relevant features of attraction three weeks after the event.

After these features are normalized, the resulting dataset will be used to create a histogram to investigate how preferences of attractions change over the course of the speed dating event. Basic statistics suffice to show if there is an overwhelming preference for a feature for each gender.

The clustering aspect of the solution will involve using the mentioned subsets formed above. I will be using K-means clustering with a Euclidean metric to determine distances between points. Moreover, my solution will use trial and error to find how many centroids are optimal for clustering. Afterwards, I will develop a model to determine matches between clusters and use f1score to evaluate error.

**Benchmark Model**

The benchmark model that my project will be compared against is a compilation of two linear models. Fisman and Iyengar proposed several models to determine decisions of participants based off what daters believed important. In fact, looking through the attached article. "Gender Differences in Mate Selection: Evidence from a Speed Dating Experiment," shows that the two authors created new features by using old features and defined a decision variable as a weighed mean of new features. The formulae that will be investigated from the author's papers are:

1. the Decision function dependent on attractiveness, ambition, and intelligence.
2. the Decision function dependent on new features formed from ratings received from a dater's partner and self rating of the dater.

Finally, the author summarized results for both these Decision function in tables with various statistics: AVG, STD, R2, and so on.

**Evaluation Metrics**

*(approx. 1-2 paragraphs)*

In this section, propose at least one evaluation metric that can be used to quantify the performance of both the benchmark model and the solution model. The evaluation metric(s) you propose should be appropriate given the context of the data, the problem statement, and the intended solution. Describe how the evaluation metric(s) are derived and provide an example of their mathematical representations (if applicable). Complex evaluation metrics should be clearly defined and quantifiable (can be expressed in mathematical or logical terms).

**Project Design**

*(approx. 1 page)*

In this final section, summarize a theoretical workflow for approaching a solution given the problem. Provide thorough discussion for what strategies you may consider employing, what analysis of the data might be required before being used, or which algorithms will be considered for your implementation. The workflow and discussion that you provide should align with the qualities of the previous sections. Additionally, you are encouraged to include small visualizations, pseudocode, or diagrams to aid in describing the project design, but it is not required. The discussion should clearly outline your intended workflow of the capstone project.