INT404: ARTIFICAL INTELLIGENCE PROJECT

TOPIC: Reasoning System (for Weather)

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ABSTRACT

In information technology a reasoning system is a software system that generates conclusions from available knowledge using logical techniques such as deduction and induction. Reasoning systems play an important role in the implementation of artificial intelligence and knowledge-based systems. By the everyday usage definition of the phrase, all computer systems are reasoning systems in that they all automate some type of logic or decision. In typical use in the Information Technology field however, the phrase is usually reserved for systems that perform more complex kinds of reasoning. The project presents a model-based approach to diagnostic reasoning in weather. A process model is defined on the levels of static elements, dynamic elements and reasoning control. Static elements, facts, hypotheses and different types of disease knowledge, are identified and variations relevant for hypotheses generation are described. Dynamic elements correspond to actions, which in turn modify static elements, but are also controlled and started by the expressions of the static elements. Hypothesis generation starts with the assessment of a given set of facts. According to their priorities, facts are used for the construction of a diagnostic differential: new hypotheses are considered, existing hypothesis refined or excluded. The purpose of hypotheses generation is to establish a complete diagnostic differential with disjunctive explanations which explain a given set of facts.

INTRODUCTION

From the very earliest moments in the modern history of the computer, scientists have dreamed of creating an 'electronic brain'. Of all the modern technological quests, this search to create artificially intelligent (AI) computer systems has been one of the most ambitious and, not surprisingly, controversial.

It also seems that our scientists were captivated by the potential of such a technology might have in reasoning industry. With intelligent computers are able to process vast stores of knowledge, the hope was that they would become perfect 'Informer in a box', assisting or surpassing meteorologist with tasks like daily analysis. With this motivation, scientists created a research program for a new discipline called Artificial Intelligence in weather.

Reasoning system distinguishes from traditional technologies in weather it gives us an ability to gain information and process it and give a well-defined output to the end user. AI does this through machine learning algorithm. These algorithms can recognize patterns in behavior and create their own logic. In order to reduce the margin of error, AI algorithms need to be tested repeatedly. Reasoning system algorithms behave differently from humans by two ways: one is that algorithms are literal, they can't adjust itself and only understand. And second algorithms are black boxes, it can predict extremely precise.

Weather forecasting is the process of providing reliable prediction about the future weather within a given interval of time. Forecasters adopt a model of reasoning that can be mapped onto an integrated conceptual framework. The process of producing weather forecast is rather complex and should be represented as a linear workflow in which several steps are taken. The initial step consists in gather data from scratch, and can be derived by many heterogeneous sources.

Data gathered by sensor networks and other sources are used in a few ways:
1. To provide the basic data to run the weather forecast models
2. To help to evaluate the results of a weather forecast model run

3. To habilitate the forecaster to build a conceptual scenario of the actual weather

4. To estimate the quality of NWP system for verification

In general, data gathering produces scratch unfolded data, consisting in measures of the observational variables in points. These can either be real measures taken from sensors, or the results of a run time data entry. Essentially, the output of a model consists of a set of four-dimensional matrices, each entry of these matrices being a scalar or vectorial measure, valued in a geographic referential point and in a given instant of time.

The measures used in all the models currently considered in literature are:

• Humidity (scalar);

• Air pressure (scalar);

• Temperature (scalar);

• Wind speed (vectorial).

The forecast models are formed by two classes of matrices:

(1) analysis and

(2) provisional

Models are classified also in two types

(a) global and

(b) local

The analysis matrices derive from two sources:

• Meteorological stations at land;

• Satellites.

The analysis matrices of local and global models assign one value of the associated variable to an instant of time that represents either a direct measure of the value of the variable obtained by some of the main sources above mentioned, in that point, or an indirect measure obtained by employing an expansion model for other measures taken by any information source in the near vicinity of the measured point.

To guess and print applied Natural Language Generation (NLG), the domain of weather forecasting is very popular and has been used to test the effectiveness of several text generation techniques. Many techniques have been proposed and applied to automated generation of weather forecast texts. Such techniques include knowledge intensive approaches in which explicit rules are elicited from domain experts and corpus analysis at different stages

of the text generation process. Machine learning models, especially statistical methods, have also been used to design systems that learn generation models introspectively from the corpus. The use of machine learning to build text generation models is knowledge-light.
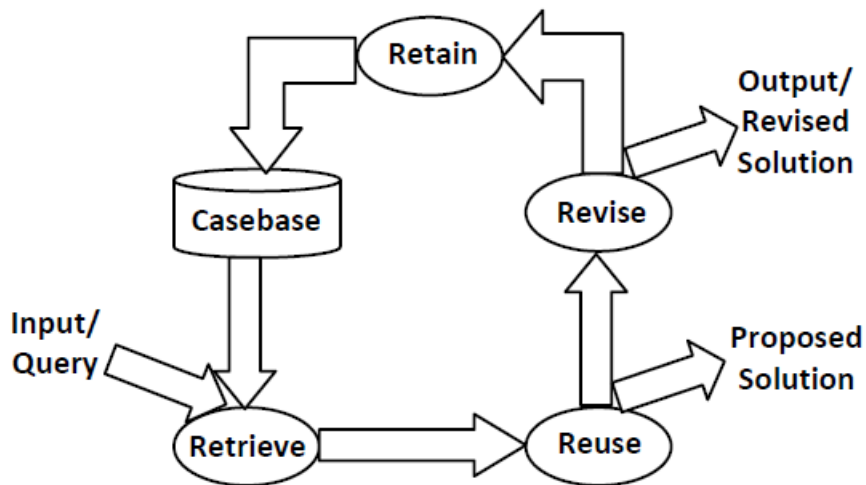
Reasoning systems come in two modes: interactive and batch processing. Interactive systems interface with the user to ask clarifying questions or otherwise allow the user to guide the reasoning process. Batch systems take in all the available information at once and generate the best answer possible without user feedback or guidance.

<u>LITREATURE REVIEW</u>

General Terms

Artificial Intelligence, Information Systems, Problem-Solving

Keywords

Weather forecast, Text Reuse, Text Generation, NLG, ARIMA

Weather forecasting has been one of the most challenging difficulties around the world because of both its practical value in popular scope for scientific study and meteorology. Weather is a continuous, dynamic, multi-dimensional chaotic process, and data-intensive and these properties make weather forecasting a stimulating challenge. It is one of the most imperious and demanding operational responsibilities that must be carried out by many meteorological services all over the globe. Various organizations / workers in India and abroad have done demonstrating using supported time series data manipulation.

Numerical weather prediction is the prediction of weather phenomena by the numerical solution of the equations governing the motion and changes of condition of the atmosphere. Numerical weather prediction techniques, in addition to being applied toshort-range weather prediction, are used in such research studies as air-pollutant transport and the effects of greenhouse gases on global climate change. The first operational numerical weather prediction model consisted of only one layer and therefore it could model only the temporal variation of the mean vertical structure of the atmosphere. Computers now permit the development of multilevel (usually about 10–20) models that could resolve the vertical variation of the wind, temperature and moisture. These multilevel models predict the fundamental meteorological variables for large scales of motion

Things done in history in the field of Reasoning System for weather: -

The various methodologies viz. statistic decomposition models, Exponential smoothing models, ARIMA models and their dissimilarities like seasonal ARIMA models, vector ARIMA models using flexible time series, ARMAX models i.e. ARIMA with following informative variables etc., which has been

used for forecasting purposes. Many trainings have taken place within the analysis of pattern and circulation of rainfall in many regions of the world. Totally altered time series methods with different purposes are used to investigate weather information in many different literatures. Accurate and timely weather forecasting is a major challenge for the scientific research. Weather prediction modelling involves a combination of many computer models, observations and acquaintance of trends and designs. Using these methods, practically accurate forecasts can be made up. Regression is a statistical experimental technique and it must be widely used in many businesses, the behavioral sciences, social and climate recasting and many other areas.

Lunagariya et al. (2009) made an effort to verify the weather forecast from NCMRWF. Analysis was carried out weekly, seasonal as well as yearly basis using various numerical verification techniques like ratio score, usability analysis and correlation approach during 2006-07 and 2008-09. The forecasts were found within usability range for some parameters but for other parameter improvement is still possible.

The complexities in the relationship between rainfall and sea surface temperature (SST) during the winter monsoon (November-January) has been observed by Goutami Chattopadhyay *et al.* (2008). Evaluation is done statistically using scatter plot matrices and autocorrelation functions. Linear as well as polynomial trend equations were obtained and it was observed that the coefficient of determination for the linear trend was very low and it remained low even when polynomial trend of degree six was used. An exponential regression equation and an artificial neural network with extensive variable selection were generated to forecast the average winter monsoon rainfall of a given year using the rainfall amounts and the sea surface temperature anomalies in the winter monsoon months of the previous year as predictors. The artificial neural network was generated in the form of a multi-layer perceptron with sigmoid non-linearity and genetical algorithm based variable selection. Both of the predictive models were judged statistically using the Wilmot's index, percentage error of prediction and prediction yields. The statistical assessment revealed the potential of artificial neural network over exponential regression.

Dawid (1984) explain in his paper that the purpose of statistical inference is to make sequential probability forecast for future observation rather than to

express information about parameters. Therefore, there is a need of an approach which is better than statistical inference method. However, Glahn et. al. (1972) prove that Model Output Statistics (MOS) technique is an objective weather forecasting technique which consists of determining a statistical relationship between a predict and variable forecast by a numerical model at some projection time. It is the determination of the "weather related" statistics of a numerical model. Glahn has applied this technique, together with screening regression to the predication of surface wind, probability of precipitation, maximum temperature, cloud amount and conditional probability of frozen precipitation.

The implementation of ANN, an important Soft Computing methodology in weather forecasting has started by Hu (1964). Özelkan and Duckstein (1996) compared the performance of regression analysis and fuzzy logic in studying the relationship between monthly atmospheric circulation patterns and precipitation. Artificial Neural Network (ANN) to predict and classify thunderstorms. ANN has designed to forecasts the occurrence of thunderstorm in two geographical regions. Thus, it is concluded from the results that ANN can be effectively utilized for the prediction and classification of thunderstorm with appreciable level of accuracy. Rankovic, Divac, Nikola etc. showed that how ANN can be beneficial to control floods by ensuring safety of Dams. The safety control of dams is done by interpretation of these large sets of data is very important for dam health monitoring and it is based on mathematical models.

Basic Key steps weather reasoning system can do and fields where it can be used: -

- Basic knowledge of weather of the day.
- Which conditions lead to which kind of weather.
- It can act as a safety net to prevent natural disaster if detected like heavy storm or no rain.
- It can show future calamities that may occur.
- Helps in farming operations
- Helps in prevention planning for less damage

- Starting of different Industrial project
- Details about the weather in ocean help ships sale safely
- Helps power companies in business by helping people plan for power production and how much to be used in a day.
- Helps in transportation.
- Helps people to find where they could plan some future activities
- AI is less costly in long term
- AI learns by itself according to experiences and keep weather forecasting system well updated.
- However, weather system errors during the process can be documented and thought to be preventable.

Some disadvantages weather reasoning system cannot perform: -

- Cannot detect fog
- Cannot detect wind independently
- Not entirely reliable
- Requires expertise to qualify that data provided is correct.
- Regular checks required
- Relies on intense data sets
- Weather changes all the time
- A single coding error can make a disaster

Conclusion

There are many different AI techniques available which are capable of solving a variety of analysis and surveillance problems. However, in spite of earlier optimism, weather Forecasting AI technology has not been embraced independently with enthusiasm. One reason for this is the attitude of the meteorologist towards technology being used in the decision-making process. Paradoxically, there is no qualm in accepting the results generated from an auto-analyzer or images produced by satellites with system commands. However, it is the obligation of researchers active in this field to produce evidence that these techniques work on a practical level in a great way. The need to undertake more randomized controlled studies to prove the efficacy of AI systems in weather forecasting is, therefore, vital. There is compelling evidence that AI can play a vital role in assisting the everyone in need to deliver their role and work uninterrupted and be pre-ready for all future occurrence's in the 21st century. There is no doubt that these techniques will serve to enhance and complement the 'weather reasoning system intelligence' in the future.

Proposed Methodology

Reasoning System in weather

Reasoning System in weather correspond to the most common type of AI system in routine data analytical use. They are defined as systems with the ability to capture expert knowledge, facts and reasoning techniques to help care providers in routine work. Reasoning System attempt to mimic meteorologists by applying inference methods to help in decision support or problem solving. Weather Reasoning System can manage data to come up with reasoned conclusions.
Uses of Reasoning System in weather include image interpretation, diagnosis support and alarms generation, among other utilities.
Took common conditions like no rain, high temperature, low humidity, wind speed and locality entered by the user which will lead him to the conclusion of the weather condition of that region.
All the details and occurrence's will be informed to user.
The data of the user will be stored in one file which is done by the usage of file handling.

Result and Discussion

```python
from time import strftime

import random

print("\t\t\t\t\t\tREASONING SYSTEM ON WEATHER FORECAST\n")


y = strftime('\t\t\t%d-%A-%Y                    %H:%M:%S %p\n')

print(y)

print("Enter the weater details as asked below:\n")

city = input("CITY YOU LIVE IN: ")

city = city.upper()


# _*_YESTERDAY_*_

y_temp = float(input(f"What was the avg temp in {city} last day: "))

rain = input(f"Is was raining yesterday in {city} [Y/N]: " )

if rain == "Y" or rain == "y":

    y_rain = True

else:

    y_rain = False


# _*_TODAY_*_

t_temp = float(input(f"What was the avg temp in {city} today: "))

rain = input(f"Is it raining today in {city} [Y/N]:" )
```

```python
if rain == "Y" or rain == "y":
    t_rain = True
else:
    t_rain = False


# _*_TOMORROW_*_
print("\n#########_____TOMORROW'S WEATHER PREDICTION_____########\n")


print("\n\t\t\t\t ::::::Weather in {city} will be::::::\n")
avg_tm_temp = random.uniform(20,36)


print(u"\t\t\tTemperature(in \N{DEGREE SIGN}C )\t\t\tWind\t\t\t\tHumidity\n")
m_tm_temp = random.randrange(18,25,2)
a_tm_temp = random.randrange(25,40,2)
n_tm_temp = random.randrange(20,30,2)


wind = ["E","W","N","S","NE","NW","SE","SW"]


m_w_speed = random.randrange(0,20,2)
a_w_speed = random.randrange(0,20,2)
n_w_speed = random.randrange(0,20,2)
```

```python
if a_tm_temp <30:

    humidity = random.randrange(20,30,2)

elif a_tm_temp > 30:

    humidity = random.randrange(30,40,2)


print("Morning:\t\t",m_tm_temp, u"\N{DEGREE
SIGN}C","\t\t\t\t",random.choice(wind),"
(",m_w_speed,"Km/h)","\t\t\t",humidity,"%")

print("Day    :\t\t",a_tm_temp, u"\N{DEGREE
SIGN}C","\t\t\t\t",random.choice(wind)," (",a_w_speed,"Km/h)")

print("Night :\t\t",n_tm_temp, u"\N{DEGREE
SIGN}C","\t\t\t\t",random.choice(wind)," (",n_w_speed,"Km/h)")


if y_rain and t_rain:

    tm_rain = random.uniform(30,45)

    print("\nRain  :", round(tm_rain,2), "%")

elif y_rain and not t_rain:

    tm_rain = random.uniform(15,25)

    print("\nRain  :", round(tm_rain,2), "%")

elif not y_rain and t_rain:

    tm_rain = random.uniform(20,35)

    print("\nRain  :", round(tm_rain,2), "%")

elif not y_rain and not t_rain and avg_tm_temp <= 25:

    tm_rain = random.uniform(10,15)
```

```python
        print("\nRain  :", round(tm_rain,2), "%")
    elif not y_rain and not t_rain and avg_tm_temp > 25:
        tm_rain = random.uniform(0,5)
        print("\nRain  :", round(tm_rain,2), "%")


    if humidity > 30 and 25 < tm_rain < 35:
        print("\nWeather : Haze\t\t\tAverage Temperature will be:",
    round((m_tm_temp+a_tm_temp+n_tm_temp)/3,2),u"\N{DEGREE
    SIGN}C\n")
    elif tm_rain >= 35:
        print("\nWeather : Cloudy\t\t\tAverage Temperature will be:",
    round((m_tm_temp+a_tm_temp+n_tm_temp)/3,2),u"\N{DEGREE
    SIGN}C\n")
    elif  a_tm_temp >=35 and tm_rain <20:
        print("\nWeather : Sunny\t\t\tAverage Temperature will be:",
    round((m_tm_temp+a_tm_temp+n_tm_temp)/3,2),u"\N{DEGREE
    SIGN}C\n")
    else:
        print("\nWeather : Clear\t\t\tAverage Temperature will be:",
    round((m_tm_temp+a_tm_temp+n_tm_temp)/3,2),u"\N{DEGREE
    SIGN}C\n")


    if y_temp > 30  and t_temp >30 and a_tm_temp >30:
        print(f"There is chances of DROUGHT in your city {city}")
    elif y_rain and t_rain and tm_rain > 30:
```

```
        print(f"There is chances of FLOOD in your city {city}")
```

Variables Used:

y_temp : Yesterday's Temperature   t_temp : Today's Temperature

tm_temp: Tomorrow's Temp   a_tm_temp: Tomorrow's day temp

m_tm_temp: Tomorrow's morning temp and so on.

OUTPUT:

```
In [95]: runfile('E:/Study Material/LPU SEM4/AI INT-404/Reasoning-System-On_Weather.py',
wdir='E:/Study Material/LPU SEM4/AI INT-404')
                        REASONING SYSTEM ON WEATHER FORECAST

        08-Wednesday-2020                              02:20:12 AM

Enter the weater details as asked below:


CITY YOU LIVE IN: Pune

What was the avg temp in PUNE last day: 32

Is was raining yesterday in PUNE [Y/N]: Y

What was the avg temp in PUNE today: 23

Is it raining today in PUNE [Y/N]:Y

#########_____TOMORROW'S WEATHER PREDICTION_____#########


              :::::::Weather in {city} will be:::::::

          Temperature(in °C )          Wind                Humidity

Morning:         20 °C            N  ( 0 Km/h)              26 %
Day    :         25 °C            NE ( 10 Km/h)
Night  :         26 °C            SW ( 8 Km/h)

Rain  : 43.84 %

Weather : Cloudy          Average Temperature will be: 23.67 °C

There is chances of FLOOD in your city PUNE
```

Work Distribution

NAME	Reg No (roll no)	Work Done
Shubham Kumar Singh	11811167 (37)	Content Searching and Report
Sanket Kumar	11811101 (38)	Program & LOOM
Devdeep Dutta	11811153 (39)	Program & Report
Mukesh Gupta Teli	11811044 (40)	Ideas and Report

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