Emerging Technologies for Effective Teaching & Learning

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Next Education™
Transforming Education

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Introduction to Learning Analytics

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Activity 1 – Think-Pair-Share

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Consider a teacher who has been teaching the same subject at the same grade for several years. Each year, she has kept record of the students' marks in various exams.

Think: Write down one way in which she can use the data to improve students' learning.

Pair: Along with your neighbour, come up with one more way.

Share: Share answers with entire class.

Activity 1 – Audience responses

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Note them here:

Or on board:

Learning analytics

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"Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs" - Wikipedia

SoLAR - Society of Learning Analytics Research

- LAK Conference, Journal, and LA summer institute
- Link: https://solaresearch.org/

Handbook of Learning Analytics –https://solaresearch.org/hla-17/

Key application – Adapting Instruction

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Learner data is typically used to identify:

- Topics that are ‘difficult’ for learners
- Topics in which many learners have misconceptions
- Performance trends across groups over a period of time

In order to adapt instruction and provide:

- Remedial content or treatment
- Informed intervention for specific groups / topics
- Personalized learning

Stakeholders in LA

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- Learner
- Teacher
- Researcher
- E-learning systems Developer
- Institute Head Ministry

Academic Analytics (Business Intelligence): LA applied to educational data at institute/regional/national level

- ‘How to improve overall board exam performance in my school?’

Types of Learning Analytics

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LA is also defined as Analytics applied on learning data. Hence we can apply the types of data analytics to LA also

- Descriptive
- Diagnostic
- Predictive
- Prescriptive

Descriptive analytics

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Describe (represent) the data

- Attendance, Performance over years
- Reporting using visuals
  - Pie charts, histogram, line graphs or scatter plots.
- Dashboard

Example

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Consider the data as shown:
the total marks and attendance record of a number of students

Student ID	Total Marks	Attendance
1	83	70
2	65	40
3	45	75
4	76	56
5	81	85
6	54	46
7	90	90
8	65	60
9	76	70
10	45	50
11	87	85
12	49	50

Descriptive Analytics

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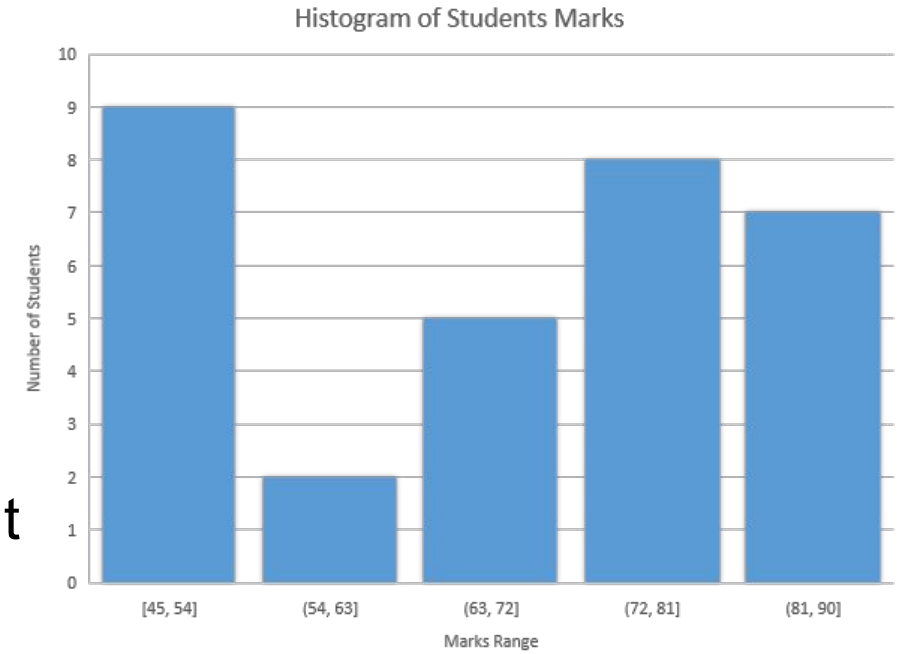
If you want to check students' performance, you can use a Histogram

Histogram indicates more students are in 45 to 54 range
It also shows that 15 students out of 31 students scored more than 72 marks.



Diagnostic analytics

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Find out why “X” happened
For example, why a student dropped out of the course.
Why a student failed in an exam etc.

- The raw data is processed, then relevant features are extracted for analysis.
- Pattern Mining, correlation or regression techniques are used

Diagnostic Analytics

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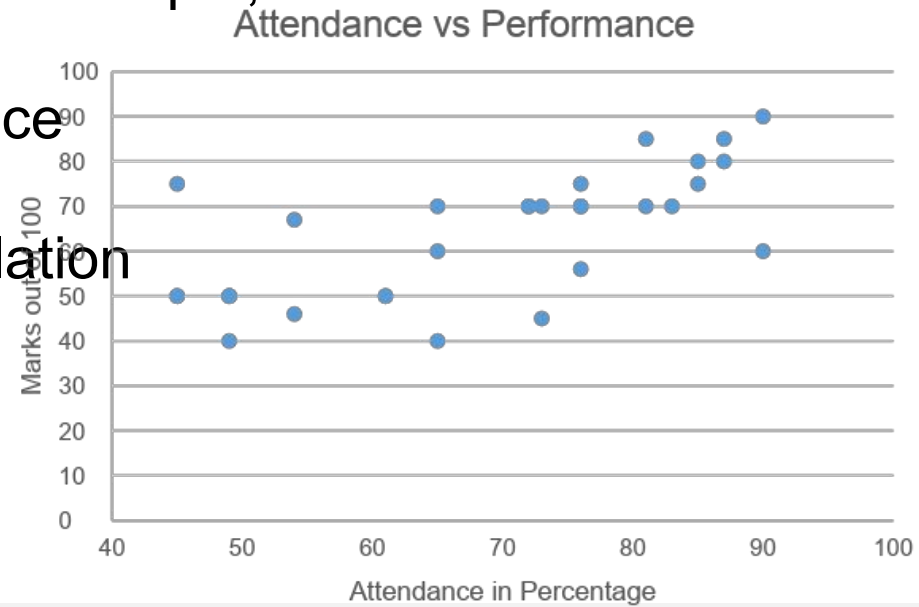
Suppose we want to check - why 11 students got less than 63 marks?

We can collect more data - for example, attendance of the students.

Plot Attendance vs Performance



There seems to be a linear relation

-Correlation coefficient 0.68

- Medium to strong correlation

- Pattern Mining, Process Mining

Predictive analytics

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Develop Models to Predict what will happen next (in future)

- Which course will have less number of registrations?
- Which student's will not complete the course?
- What will be the performance of a student in next question?

- Prediction is done based on data from past events
- Tools available for teachers and other stakeholders
- ML methods are used.
  - Naive Bayes, SVM, Decision Trees etc.

Predictive Analytics

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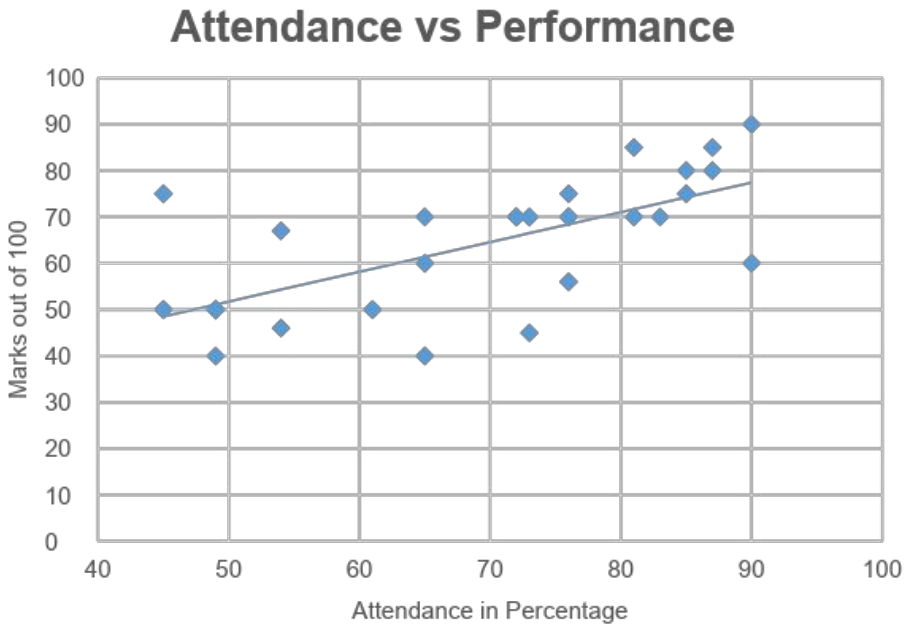
Prediction is done based on data from past events
Model from past data and use it to predict for new data
Linear Regression Model

$$Y = 0.64x + 19.6$$

Can predict the performance of a student with 60% attendance

-Machine Learning Classifiers



Prescriptive analytics

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Scaffolding to help the students to achieve their learning goal.

- Personalization or Intelligent learning environment
- Predict the student's current learning state and provide feedback or help to achieve their learning goal

Activity 2 – Examine in your own context

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Along with your neighbour,

1. Revisit your answers for Activity 1. (strategies to improve learning)
2. What representation did you assume for the data items?
3. What correlations did you look for in your data?
4. What predictions did you make in order to come up with your strategy?
5. Reflect on the types of LA. – (see previous slides)
6. Map your answers above to the types of LA.
7. Share some answers with the class.

Activity 2 – Audience responses

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Note them here:

Or on board:

Scaling up LA – names of some techniques

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As the volume of data (number of learners, types of items) increases, doing analytics by simply inspecting the data becomes difficult, automated methods and AI techniques are required for the analytics.

Some names of techniques:

- Descriptive analytics – Filtering, Dashboards
- Diagnostic analytics – Pattern Mining, Classifiers, Regression Analysis
- Predictive analytics – Naïve Bayes, SVM, Decision Trees
- Prescriptive analytics – Adaptation Algorithms

Log Data

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Data Collection in MOOC

- Timestamp of each event/action
- Learner ID, Session ID, IPAddress
- Pages viewed
- Discussion
  - Comment – delete, reply, upvote
  - Thread – create, unfollow, delete, reply, update, visit
  - Forum search, follow a user
- Navigation
- Behaviours in Video – play, pause, seek, speed change, transcript

Data from MOOC

Raw Data

- {"username": “XXX", "event_source": "browser", "name": "seek_video", "accept_language": "en-US,en;q=0.9", "time": "2018-05-15T11:27:13.618189+00:00", … "context": {"user_id": 9583xx, "org_id": "IITBombayX", "course_id": "course-v1:IITBombayX+.., "ip": “xx.xx.64.13", "event": "{\"code\": \"wvF9OwAdCxA\", \"new_time\": 557, \"old_time\": 625.9213540286103, \"duration\": 832.68, \"type\": \"onSlideSeek\", \"id\": \"f5238968f3814cd19ec97ea710a37e8a\"}", "event_type": "seek_video"}

MOOC Raw data example

- {"username": “XXX", "event_source": "browser", "name": "textbook.pdf.page.scrolled", "accept_language": "en-us", "time": "2018-05-15T12:14:13.955573+00:00", "page": "https://courses.edx.org/...", "host": "courses.edx.org", …Introduction_to_Software_Engineering_IIT_Bombay.pdf", "context": {"user_id": 4244xxx, "org_id": "IITBombayX", "course_id": "course-v1:IITBombayX+CS101.1x+1T2018", "path": "/event"}, "ip": “xxx.yyy.164.3", "event": "{\"chapter\": .. Preamble_IIT_Bombay.pdf\", \"direction\": \"up\", \"page\": 3, \"name\": \"textbook.pdf.page.scrolled\"}", "event_type": "textbook.pdf.page.scrolled"}

Data Pre-processing

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- Raw Data should be converted into actions/events - Scripts
- Each action should contain
  - TimeStamp
  - UserID
  - SessionID
  - ActionName
  - Context of the Action – response to answer, page name, speed of video, forum title etc.

LA Tools – at a highly abstract level

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Some names of Machine Learning tools for LA: RapidMiner, Weka, Orange, Knime, …

Typical steps to be followed:

1. Input raw data (typically a spreadsheet, SQL, XML,..)
2. Select features to be extracted for analysis (drop-down menu)
3. Configure the analytics technique to be run (drop-down menu)
4. Get output data (values, probabilities, graphs)
5. Interpret output

Human Intelligence is crucial for meaningful configuration of the techniques to be applied on the data, and interpreting the output.

Take-away

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Strong reasoning + meaningful use of analytics tools

trumps

Sophisticated analytics tools + mediocre reasoning

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Thank you

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