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Transformative intelligence

Knowledge Elicitation and its applications

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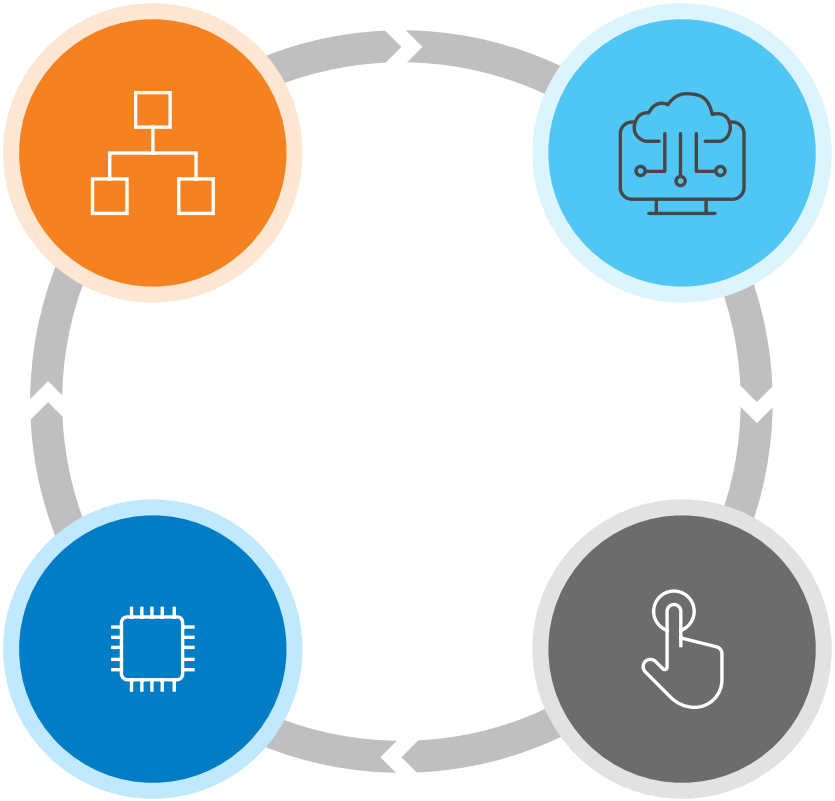
Industry Demand in Machine Learning Space



Learn to Classify

Achieved greater success in learning to classify in a probabilistic manner

Learn to Reason

In focus, causal inferential based learning

Long-life Machine Learning

Trending, learning for multiple tasks over time transfer prior knowledge when learning new tasks

Interactive Machine Learning

Machine learning systems that interact with end-users

Transfer Learning/Knowledge Elicitation

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Outline

Introduction to Knowledge Elicitation in a machine learning framework

How we are leveraging these concepts in our products and solutions

Course5 application of Knowledge Elicitation

- Transfer Learning in Bayesian Network Modeling
- Course5 Integrated Marketing Measurement & Optimization

About Course5 Intelligence

We drive **Digital Transformation** for businesses through **Analytics, Insights, and Artificial Intelligence.**

Multi-faceted talent with 1200 personnel across global locations enables our clients to make the most effective strategic and tactical moves related to **customers, markets, and competition.**

Course5 offices

- Washington, USA
- London, UK
- Dubai, UAE
- Mumbai/Airoli, India
- Bengaluru, India

Satellite offices

- San Francisco, CA, USA
- Vancouver, Canada
- Toronto, Canada
- New York, USA
- Raleigh, NC, USA

Partner sites

- Singapore
- Beijing, China

OUR IMPACT

- $10bn+ impact for client organizations to date
- Real time understanding of customers & markets and enablement of digital business models
- 360 analysis, providing deep insights and decision-making support
- End-to-end solutions – delivering top line and bottom line business impact

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Knowledge Elicitation

A concept which leverage human expertise into a machine learning process

To account of **aspects** which are not feasible to measure and quantify into a mathematical models

Opens up new opportunities by interpreting, otherwise black box machine learning process

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Transfer learning

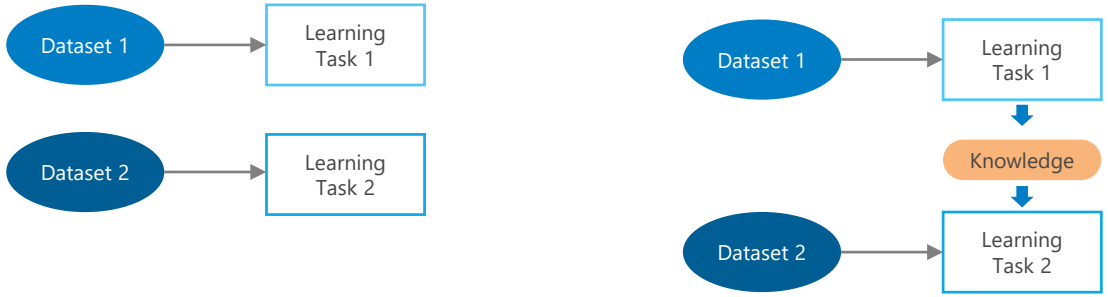
It is desirable to use data and knowledge from similar cases; a technique known as “transfer learning”

- C++ >Java
- Maths/Physics > Computer Science/Economics

Current ML VS **Transfer Learning**

Isolated, single task learning:

Learning of new tasks relies on the previous learned tasks



What

which **part of the knowledge** can be transferred from the source model to the new model

When

To improve new task performance/results and **not degrade them**.

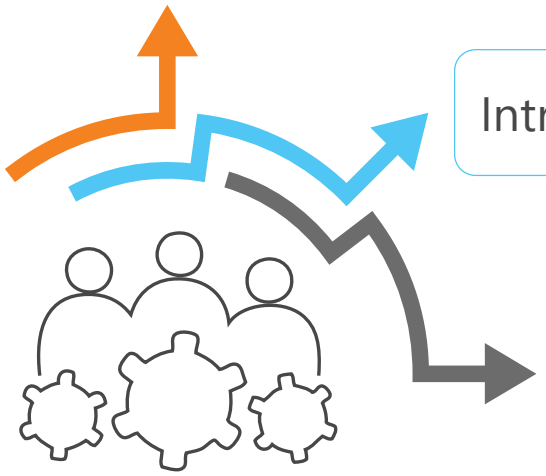
How

Identifying ways of actually transferring the knowledge across domains/tasks

How we are adopting knowledge elicitation and transfer learning

We are building one type of model (source domain) and transferring knowledge gained into another type of model (target tasks) to

Account for unobserved variables (nodes) which are not feasible to be observed (instance transfer learning)



Introduce right interventions in the model to measure “true” impact of variables

To allow counter factual inference which otherwise not feasible

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Applications of marketing measurement

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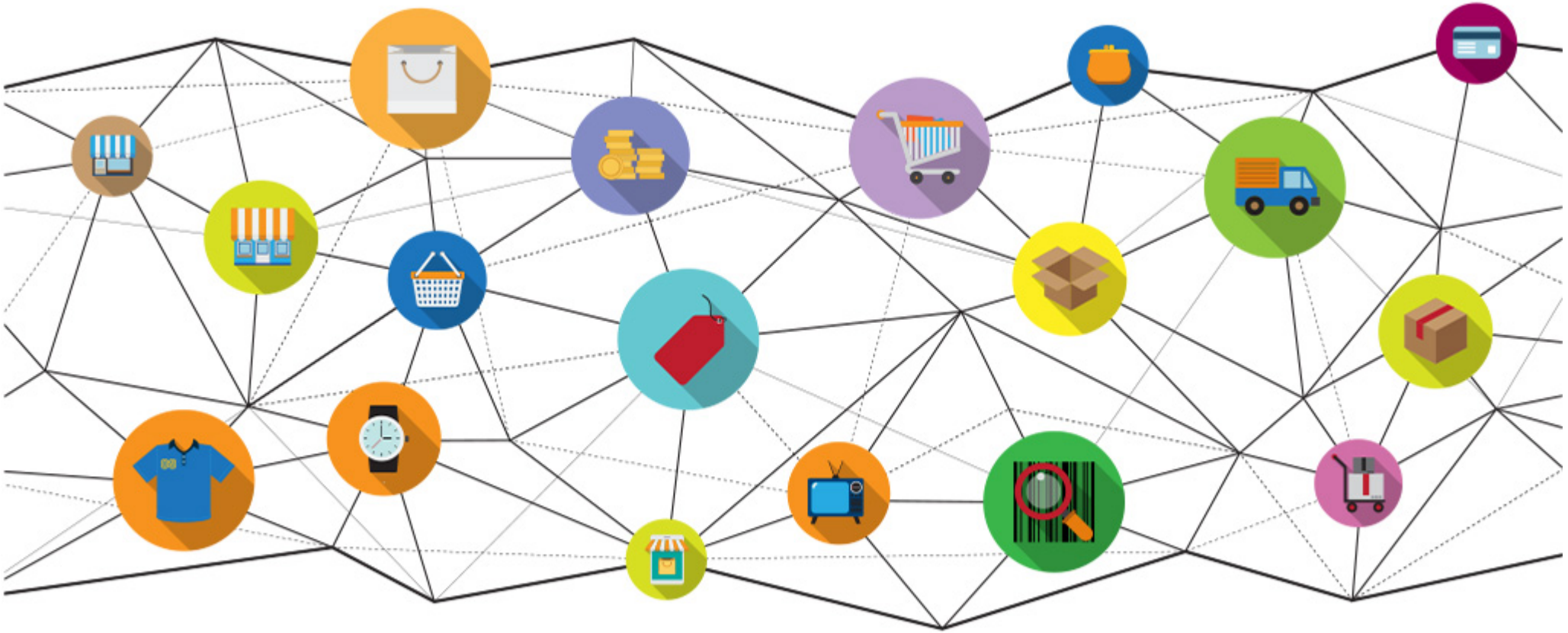
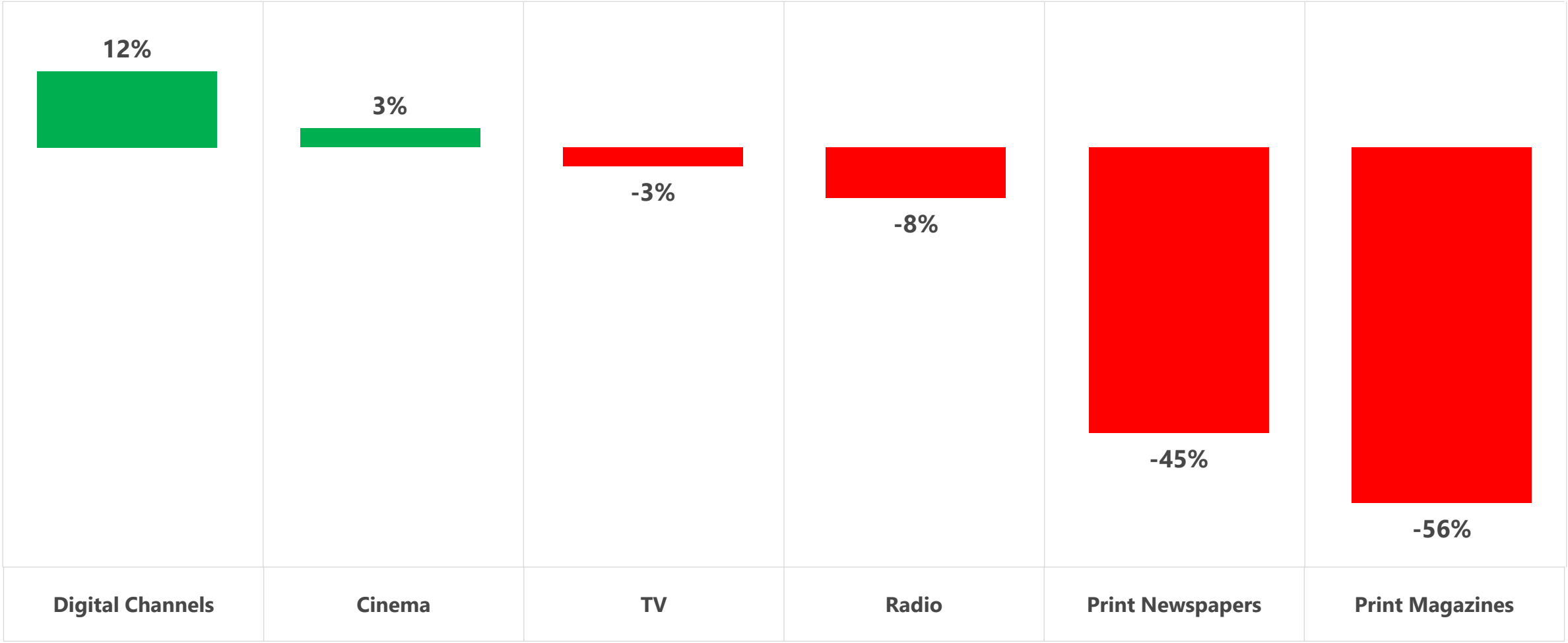
Consumer Purchase Journeys in Digital World

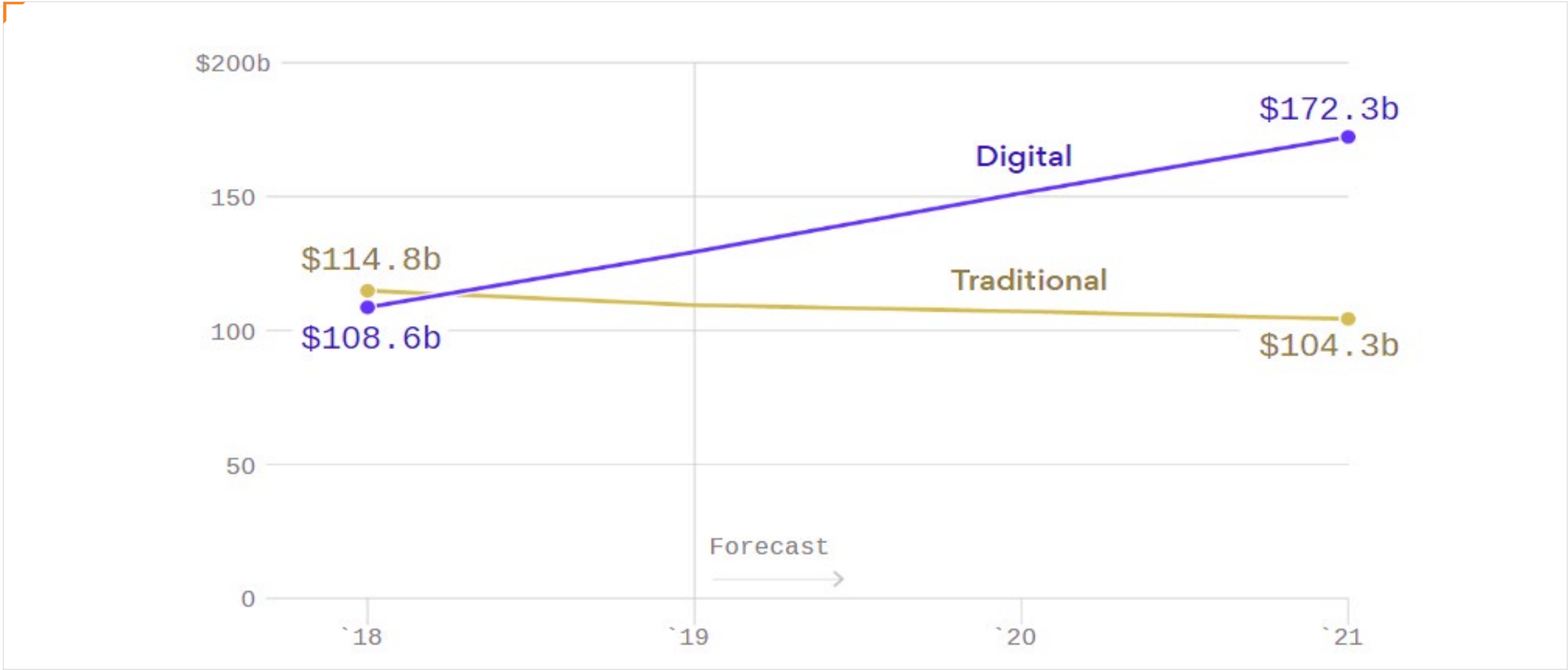


Change in Traditional Media Consumption 2011-2018



Published on Marketing Charts.com in June 2018

U.S. Digital vs. Traditional annual AD Spending



Adapted from eMarket; Note: Forecast as of February 2019; Chart: Andrew Witherspoon/Axiosv

Current Marketing Measurement Models

Top-down

Marketing Mix

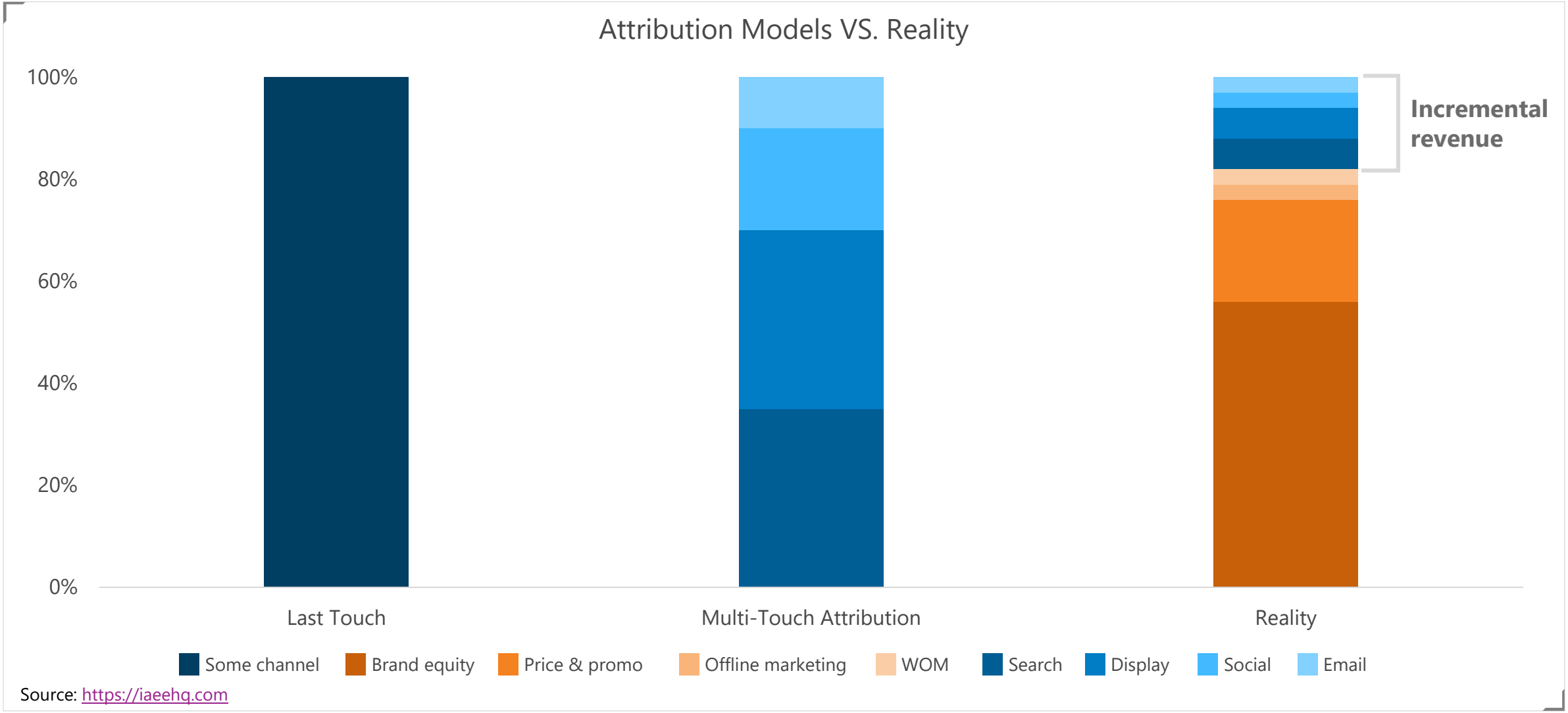
Useful for the strategic planning by brand, geo etc., budget allocation and optimal channel mix

Bottom-up

Tactical media buying, campaign execution in right channel and optimization

Digital Attribution

Incorrect digital media measurement



Source: https://iaeehq.com

In Summary

Key Challenges

- Complex consumer journeys
- Industry is biased towards digital channels
- Disparate data sources
- Models are separate and used in silos
- Incorrect attribution and declining ROI

Enables dynamic campaign effectiveness and align with overall marketing strategy

Course5 Integrated Marketing Measurement Solution is a **continuously evolving marketing solution,** that brings a top-down and bottom-up meta intelligence to marketing insights.

Aggregate static data model and individual user level configurable models

=

Doesn't provide granular insights at customer groups

MMM

Historical aggregate spend patterns and correlate with sales over time

+

Doesn't account offline channels hence biased

Digital Attribution

Individual customer journeys (digital path) lead to conversion mostly real time data

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How we are integrating best of both?

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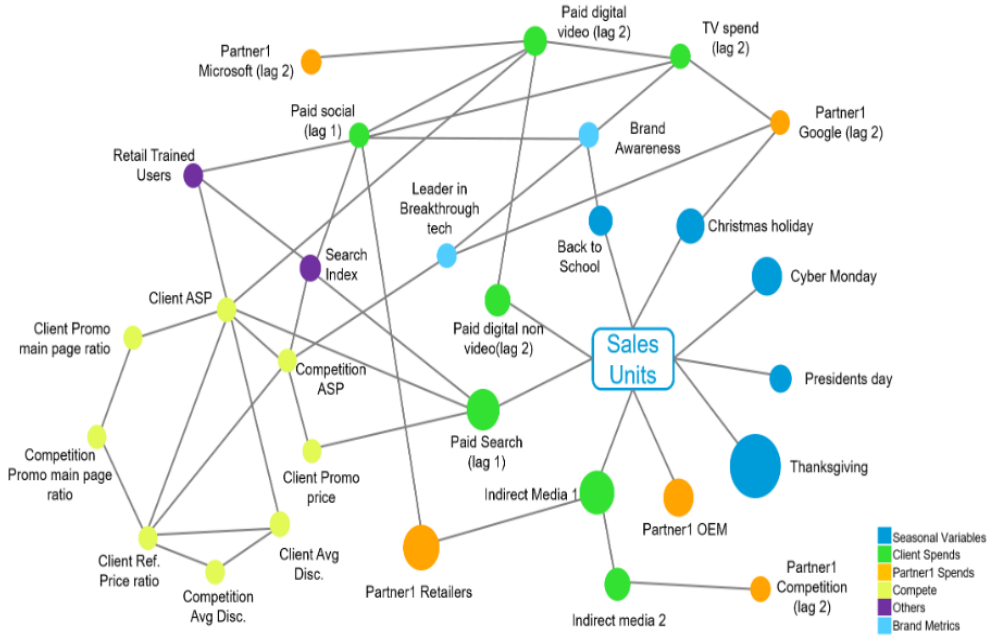
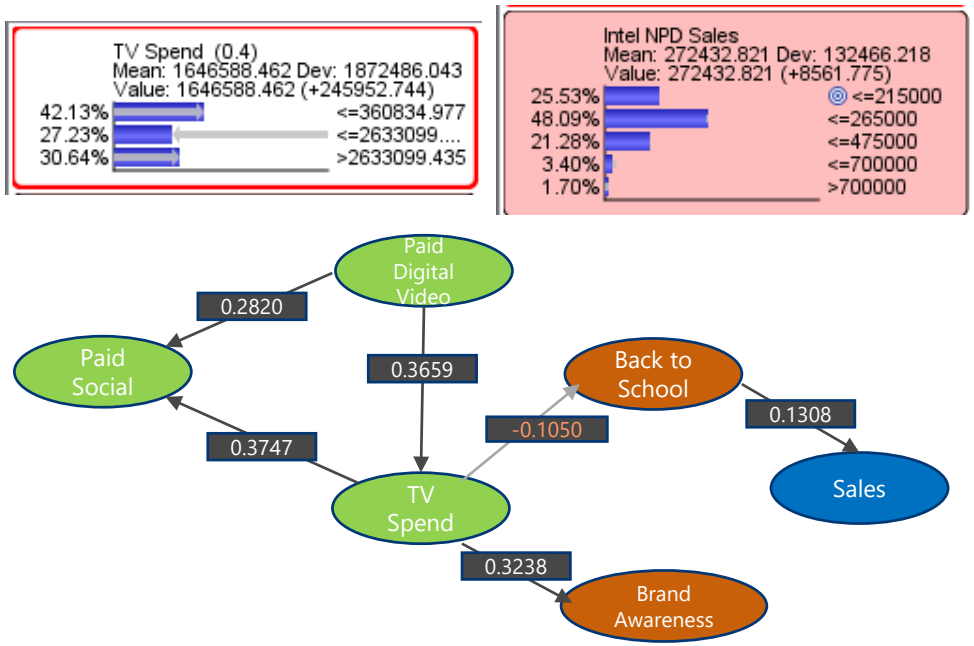
Build Holistic MMO using Bayesian Network Modelling

Structural Learning using BNN



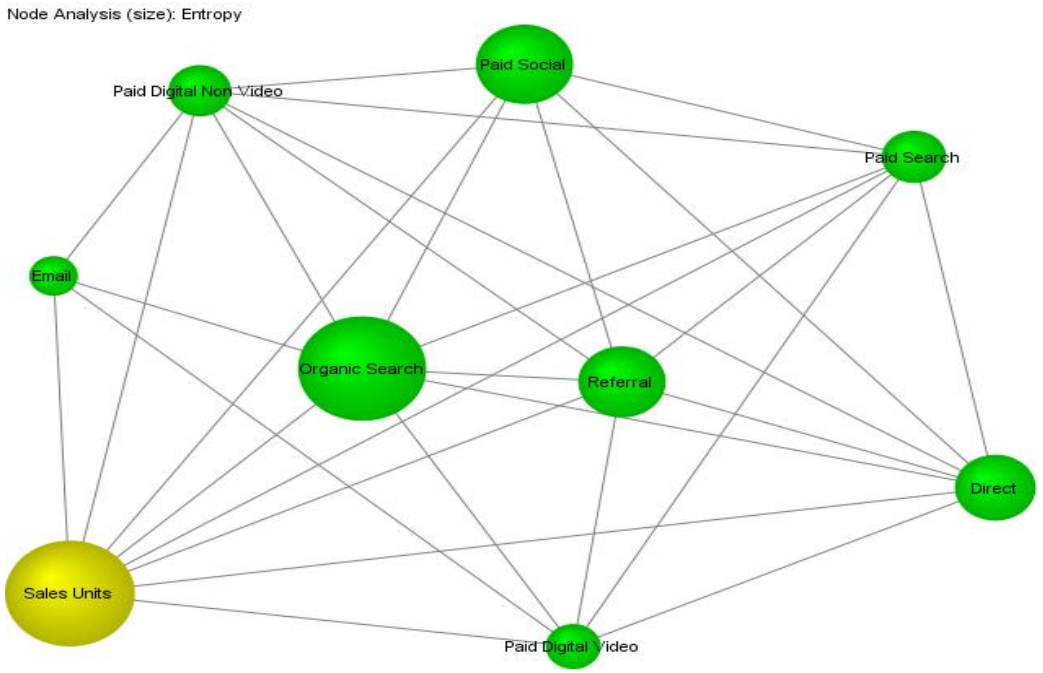
Knowledge discovery from BNN



Build Digital Attribution Network model

MTA

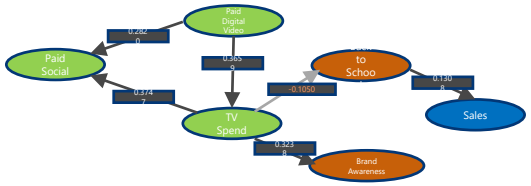
Digital Attribution using BNN



Channel	Contribution
Organic Search	59.9%
Referral	16.8%
Email	7.1%
Direct	5.8%
Paid Social	4.4%
Paid Digital Video	4.2%
Paid Digital Non Video	1.1%
Paid Search	0.6%

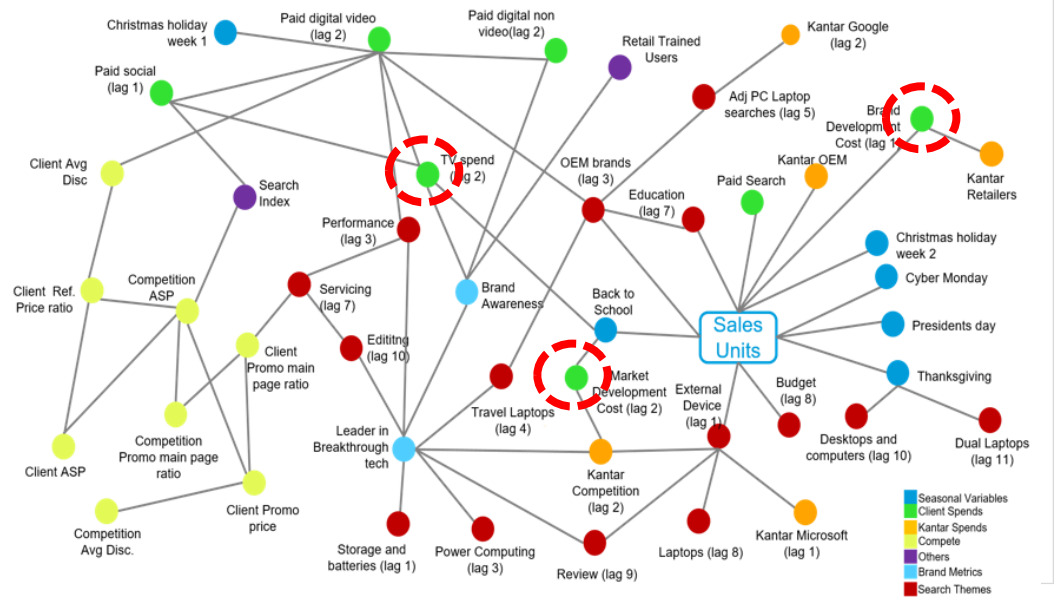
Build Attribution network model (including offline channel nodes) with the helps of a prior probabilities specified in network

Knowledge discovery from BNN



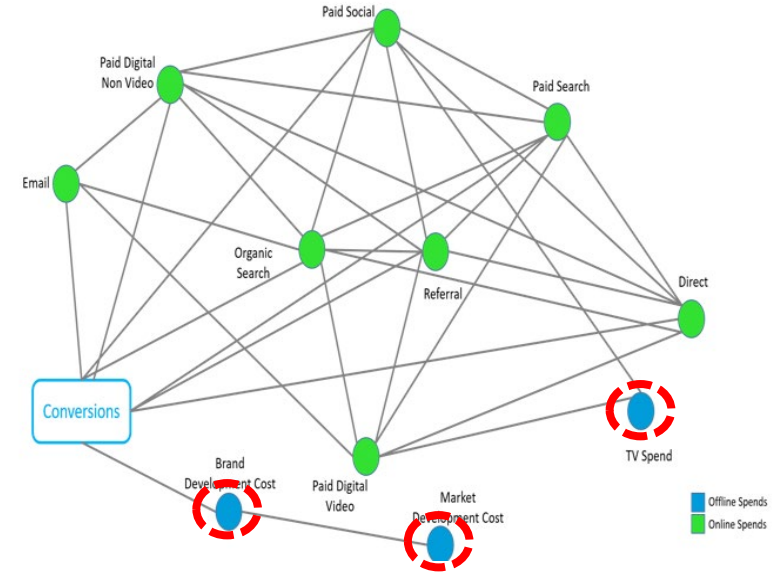
MMO

Structural Learning using BNN



IMM

The Network Represents how sales is interrelated with online as well as offline channels



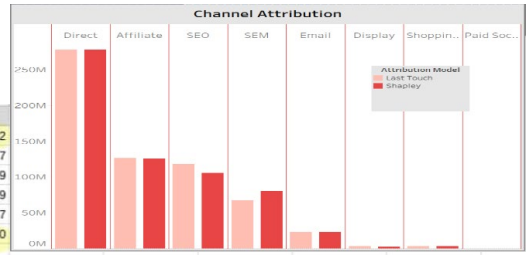
Relative importance of offline and online channels in IMM

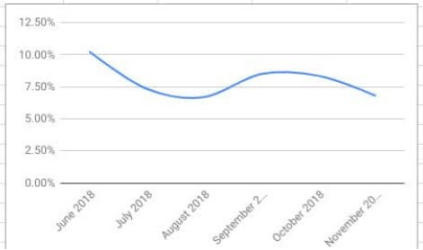
Channel	Digital Attribution (standard)	True Contribution (IMM)	Inflation in standard models
Organic Search	59.9%	28.24%	-31.66%
Referral	16.8%	7.60%	-9.20%
Email	7.1%	3.40%	-3.70%
Direct	5.8%	2.67%	-2.67%
Paid Social	4.4%	2.04%	-2.36%
Paid Digital Video	4.2%	1.35%	-2.85%
Paid Digital Non Video	1.1%	0.47%	-0.63%
Paid Search	0.6%	0.16%	-0.44%

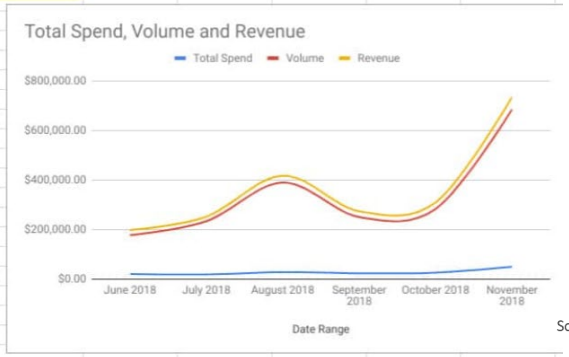
Key Benefits across industry applications

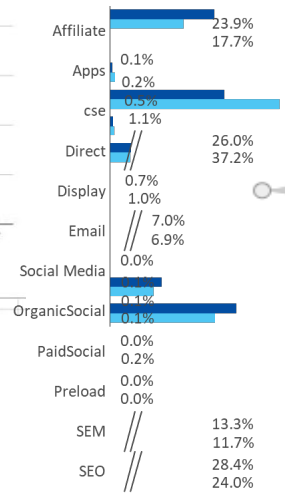
Better ROI

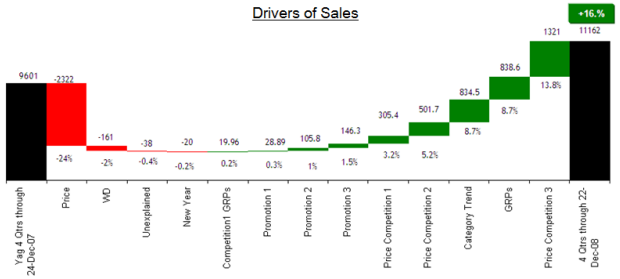
Date Range	Total Spend	ROAS	ACOS	Volume	Revenue
November 2018	$49,974.33	1469.95%	6.80%	$684,625.19	$734,599.52
October 2018	$25,840.01	1195.72%	8.36%	$283,135.36	$308,975.37
September 2018	$23,251.71	1176.34%	8.50%	$250,267.58	$273,519.29
August 2018	$27,957.30	1494.15%	6.69%	$389,765.69	$417,722.99
July 2018	$18,537.39	1360.26%	7.35%	$233,620.18	$252,157.57
June 2018	$20,231.77	975.17%	10.25%	$177,062.13	$197,293.90



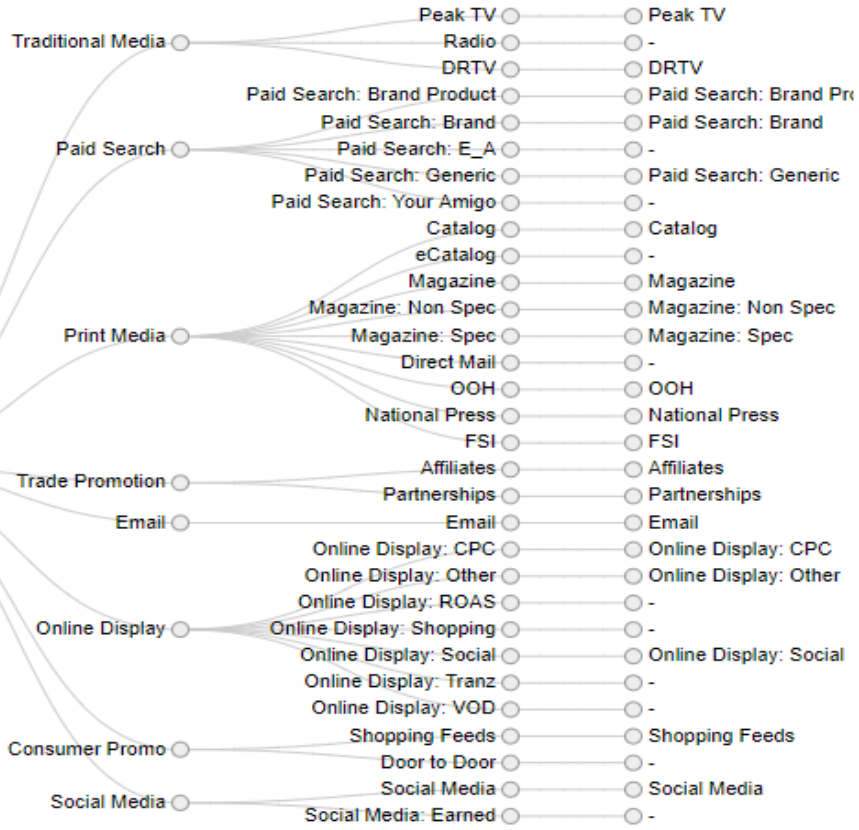








Purchase Path



In Summary

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Key Benefits of IMM

- Unified measurement provides holistic insights
- Able to handle disparate data very well
- Learnings from one model is transferred into another model
- Accurate attribution accounting for mediating variables
- The model insights are actionable in real time campaign management

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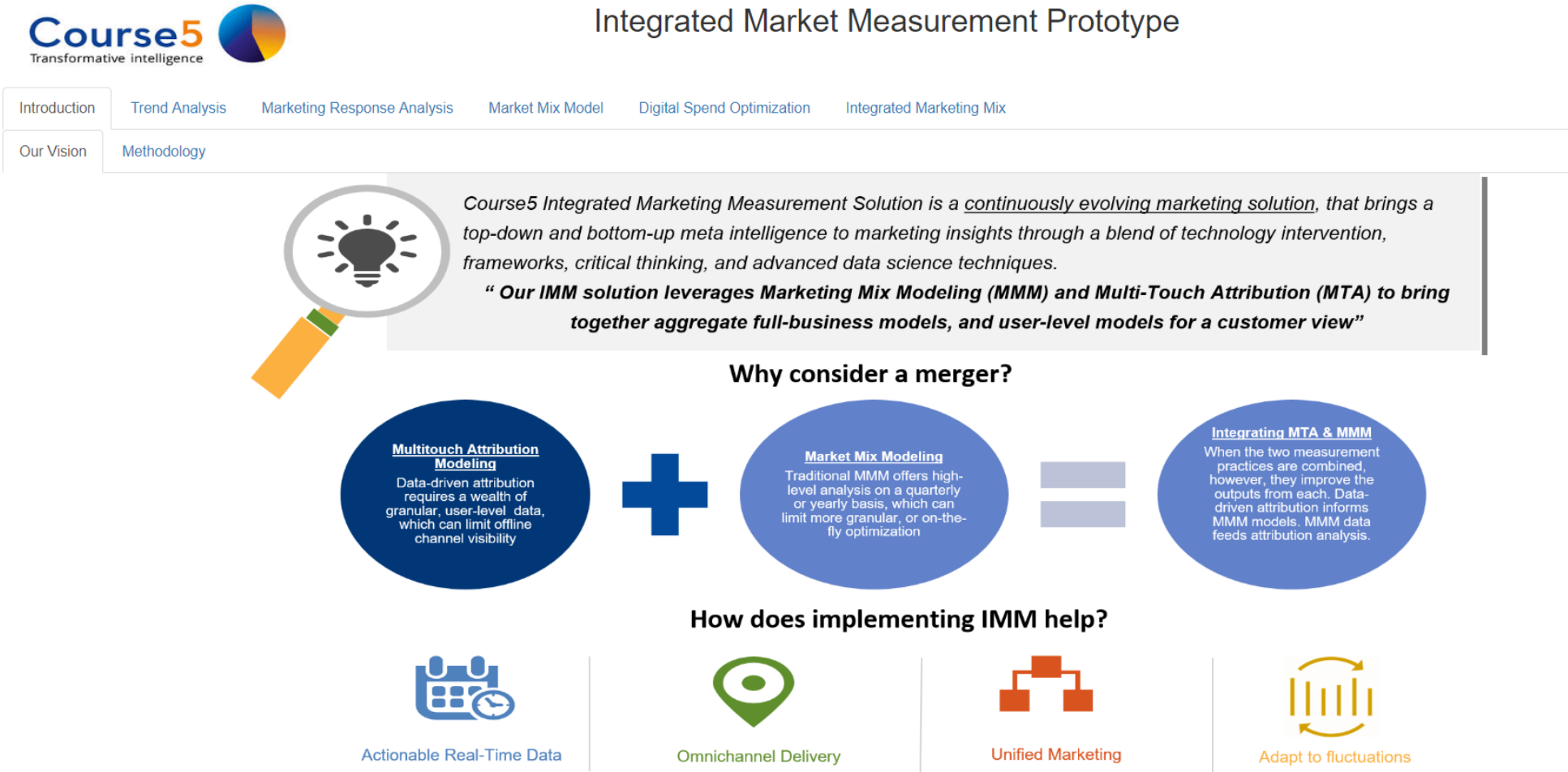
Integrated Marketing Measurement platform demo

https://course5intelligence.shinyapps.io/integrated_marketing_mix/



The surest kind of knowledge is what you construct yourself.

~ Judea Pearl, The Book of Why: The New Science of Cause and Effect

THANK YOU

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