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Where Does Bias Come From?

Prasanna (Sonny) Tambe, Associate Professor of Operations, Information and Decisions

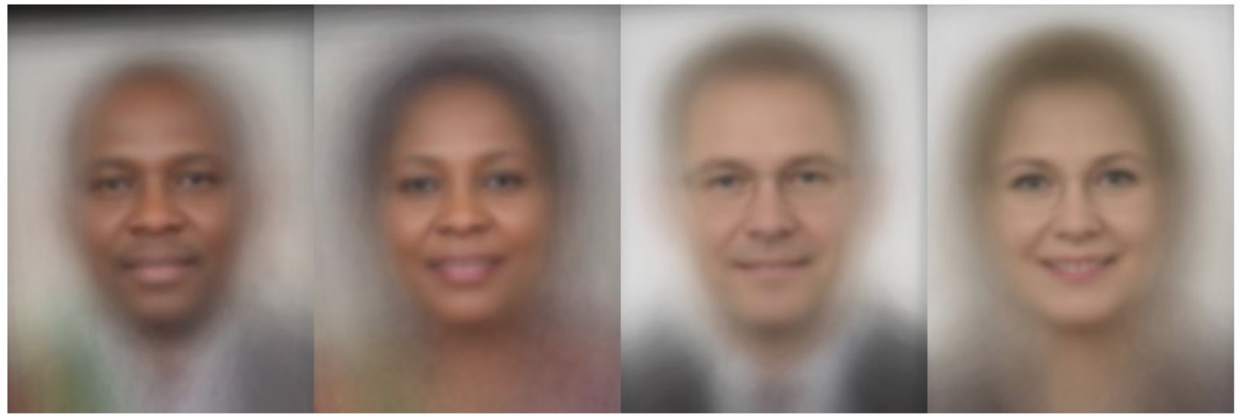
Where Does Bias Come From?

- Machine learning algorithms learn the best mapping from the training data
- If prior decisions encode historical bias, algorithms will necessarily learn to be biased as well

Example: Data Adequacy Bias

- Bias does not have to be intentional
- The lack of training data for some populations leads to poor predictive performance for certain groups

Gender Classifier	Darker Male	Darker Female	Lighter Male	Lighter Female	Largest Gap
Microsoft	94.0%	79.2%	100%	98.3%	20.8%
FACE++	99.3%	65.5%	99.2%	94.0%	33.8%
IBM	88.0%	65.3%	99.7%	92.9%	34.4%



Machine Learning Bias

- Bias happens all the time, even inadvertently
- Example: STEM job advertisements

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Bias is Difficult to Manage

Prasanna (Sonny) Tambe, Associate Professor of Operations, Information and Decisions

Machine Learning Bias

- Bias is difficult to manage
  - Involves value judgements, which requires a holistic view

Machine Learning Bias

Example: Propublica/Northpoint

- Northpoint used algorithms to make bail decisions
- Propublica reported that black defendants were being unfairly detained
- Northpoint said that among those who actually went on to offend, they were being detained equally
- Is it worse to let the guilty go free or unfairly punish the innocent?
  - Blackstone's ratio

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Bias is Complicated to Fix

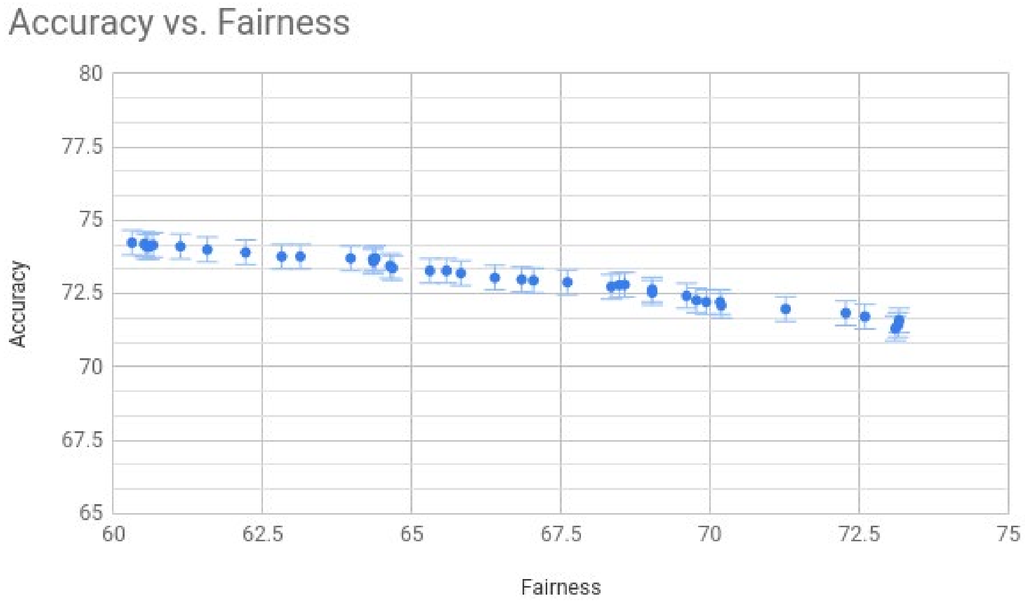
Prasanna (Sonny) Tambe, Associate Professor of Operations, Information and Decisions

Bias is Complicated to Fix

- When we think about resolving bias, it can come at the cost of affecting other performance metrics we care about, like accuracy
- Satisfying conceptions of fairness for some groups requires sacrificing it for others

Model	Accuracy	Fairness Value
Removal of Sensitive Attribute	77	38
fairNN	71	70

Implementation of fairNN: Fairness value almost doubled, but accuracy did decrease.



95% confidence interval plot for accuracy vs fairness

Bias is Complicated to Fix

- Getting better training data is hard

Bias is Complicated to Fix

- Who should even be dealing with bias?
- New positions
  - Chief data officers
  - AI councils

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Some Approaches to Fixing Bias

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Some Approaches to Fixing Bias

- Improve training data
  - Change labels (e.g. more positive outcomes for protected groups)
  - Adding weights so that some observations are more important than others
- More information
  - Pipeline diversity
  - Interpretable models
  - Google’s nutrition cards for machine learning
- Training engineers/developers
- AI councils

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What is Explainable AI?

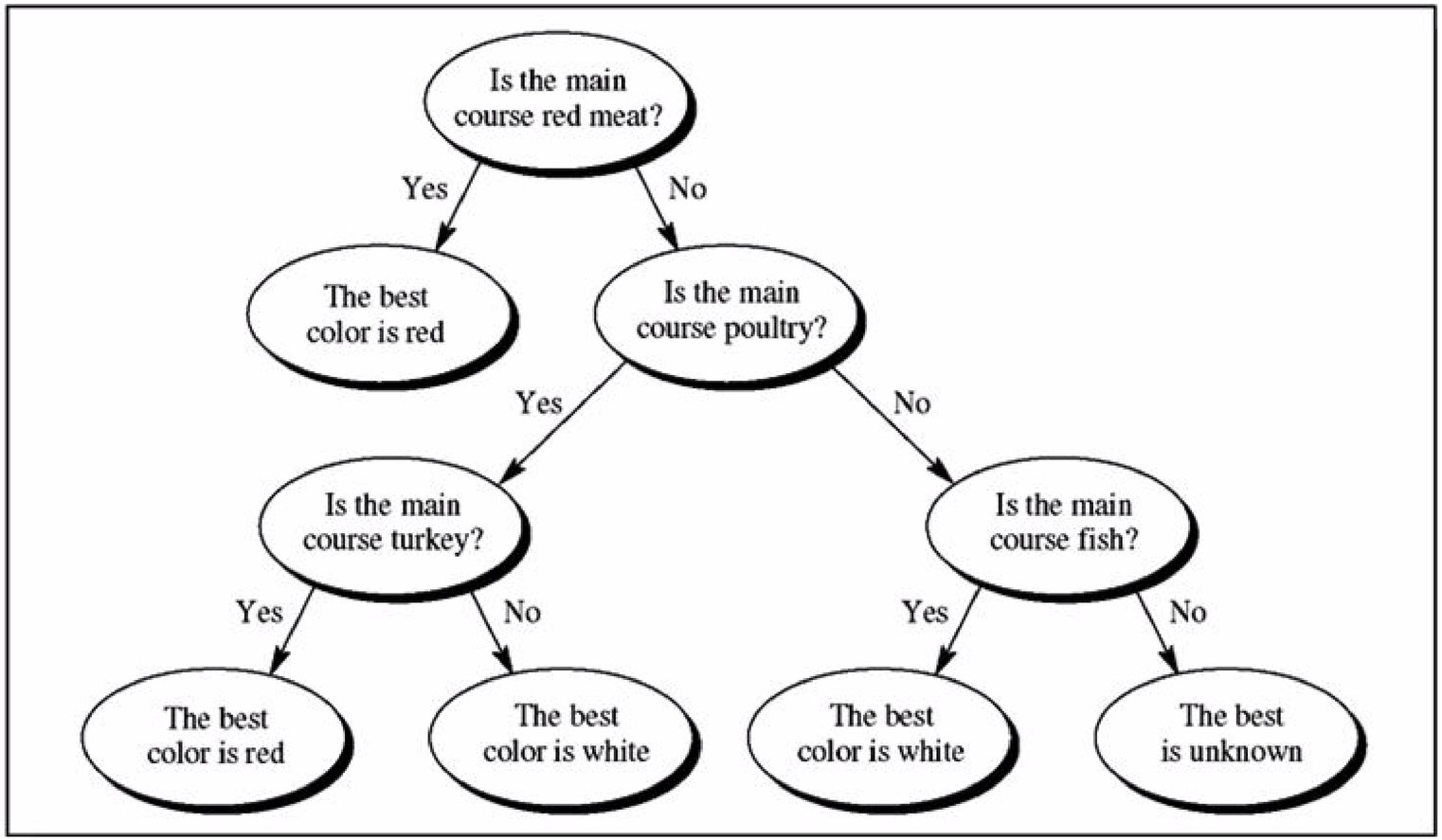
Prasanna (Sonny) Tambe, Associate Professor of Operations, Information and Decisions

Explainable AI

- Explainable AI relates to using methods where how and why the algorithm arrived at the results can be understood by human experts
- This contrasts with some types of machine learning that operate more like a “black box” (e.g. deep learning)

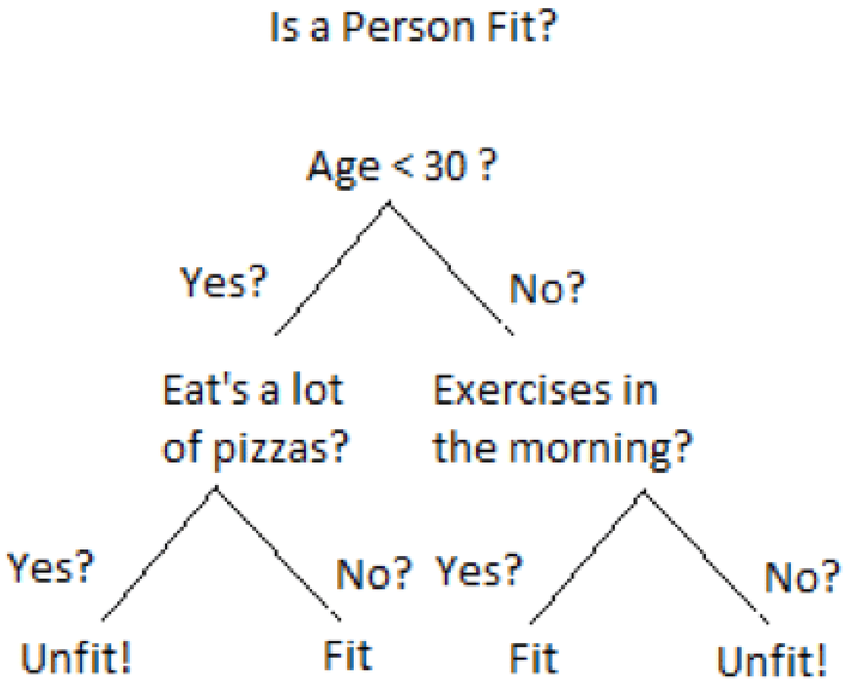
Explainable AI

- Rule-based systems are easy to explain



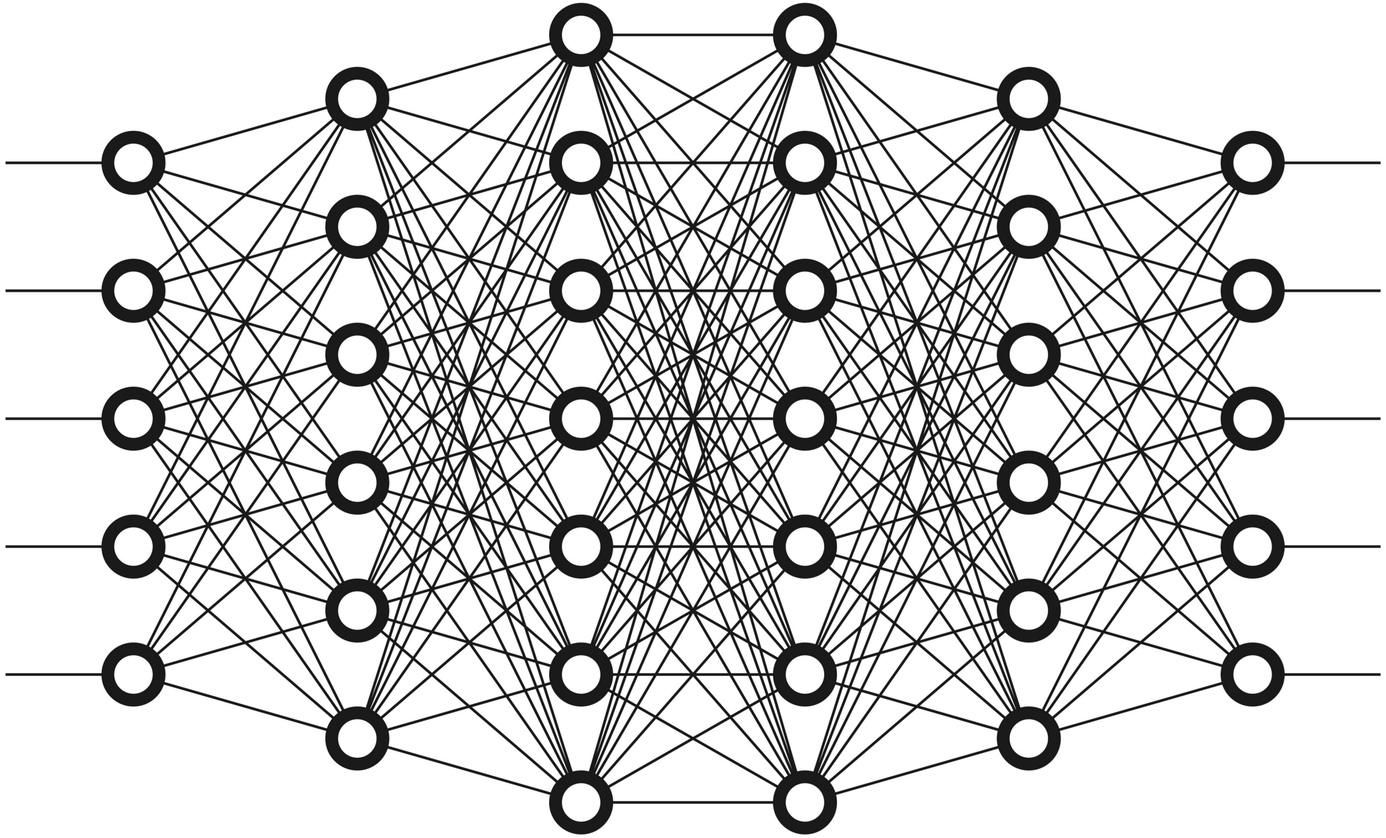
Explainable AI

- Machine learning decision tree output is also relatively easy to explain



Explainable AI

- Deep learning output can be much more difficult to explain



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Examples of When Interpretability is Important

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Explainability, or Interpretability

- In some business contexts, being able to understand why the algorithm comes to a decision it does really matters

Importance of Interpretability in HR

- Many guidelines and legal protections require HR organizations or departments to clearly document how they come to decisions
  - Equal Employment Opportunity Commission (EEOC) rules

Importance of Interpretability in HR

- New data privacy laws
  - General Data Protection Regulation (GDPR) in the European Union
  - California Consumer Privacy Act (CCPA)
- Place restrictions on employer ability to use data provided by potential applicants
  - Need to be able to provide the logic that was used when arriving at a final decision

Investment in Explainable AI

- Companies, especially big tech, are increasingly invested in this issue
- Government, through various agencies, is also invested in providing resources to build more explainable AI systems for different industries

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Tradeoffs between Interpretability and Performance

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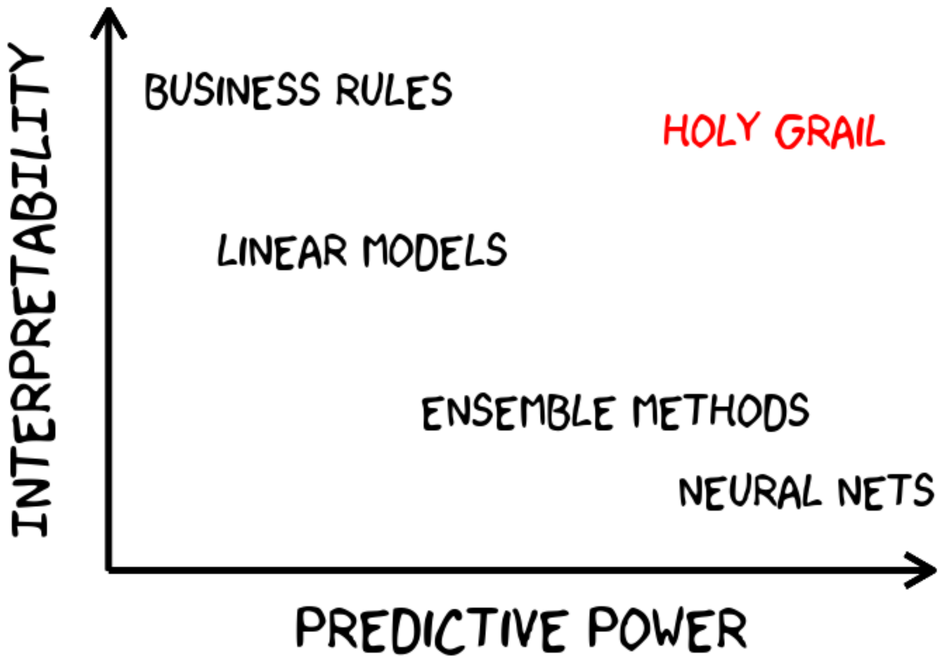
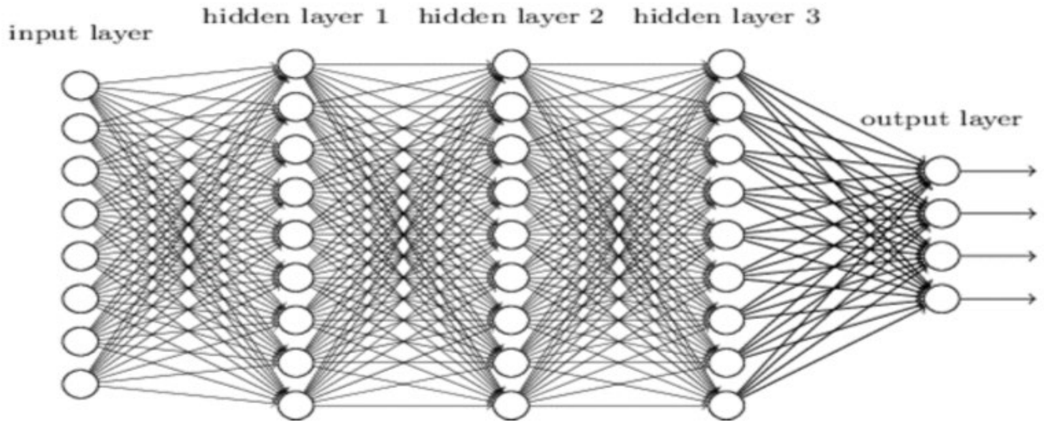
The Performance Penalty of Interpretability

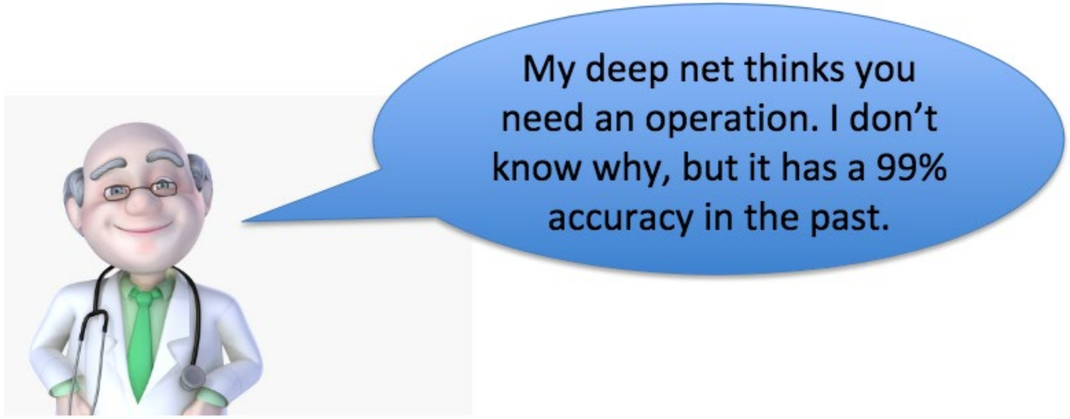
- There is generally a tradeoff between explainability and performance
- In practice, a precision prediction model often needs to be balanced by the ability to justify the model
  - Loan processing



The Performance Penalty of Interpretability

- When is explainability more important than accuracy?
  - User clicks or buying/selling assets — interpretability doesn't matter much
  - Promotions — interpretability matters a lot





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Some Approaches to XAI

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Some Approaches to Explainable AI

- SHAP: Separates out how much each feature is contributing to the output/prediction
- LIME: Can start with a model that's very complex and difficult to interpret and generate a simpler comparison model that is locally accurate
- Surrogate trees: Generates a simpler model (e.g. a decision tree) that mimics the performance of the more complex model and is easy to interpret
- Auto-encoders: Boils data down into a small set of features to make it easier to interpret

Some Approaches to Explainable AI

- There are initiatives led by a number of companies
  - IBM - Explainable AI 360
  - Microsoft - InterpretML
  - H2O - Driverless AI

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What Problem Can the Blockchain Solve in HR?

Prasanna (Sonny) Tambe, Associate Professor of Operations, Information and Decisions

What Problems Can the Blockchain Solve in HR?

- AI solutions require massive amounts of data
- Potentially new business models using fine-grained data to predict match quality and performance
- At the same time, there are growing concerns about ownership and privacy of data
- Blockchain could help solve this problem
  - It is a way for two parties to exchange information without the need for a third-party to own or hold the data

Questions Emerging Around Where Data is Best Stored

- Why can’t we just trust third parties to keep our records safe for us?
  - Growing regulatory issues (e.g. GDPR)
  - Market failure where the right incentives for commercial investment do not exist
  - Concerns about use and abuse of personal data

Potential of Blockchain

- Blockchain is a data storage technology that is immutable
  - Transactions cannot be changed once confirmed, and therefor it is the “truth”
- It does not require a central authority/owner for verification
- Has the potential to be the data storage solution that ties private data together with AI prediction

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Why is the Blockchain so Transformative?

Prasanna (Sonny) Tambe, Associate Professor of Operations, Information and Decisions

Why Do We Need an Alternative?

- Limitations to how a database/spreadsheet works
  - Digital bits can be written and rewritten
  - The validity of any information stored in a database requires trust between counterparts
  - Requires a centralized and trusted broker
- This means we need to rely on institutions to hold highly personal data and this may not be acceptable

What the Use of Blockchain Offers

- Blockchain is a software protocol that achieves trust algorithmically, so a third party is not needed
- Individuals can own personal data and companies can use it for HR analytics, and the data can be trusted

Why is a Change to Database Technology so Important?

- Databases are the “factory floor” of information-based businesses
  - Requires a centralized and trusted broker
- Massive amount of economic value in trust-brokering
  - Car rentals, hotels
- Disintermediation of the need for trust institutions
  - Government issued IDs and failed nation states
- In HR, many institutions exist, at least in part, so you can trust that they are truthfully maintaining databases
  - Universities
  - Learning platforms

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How Does the Blockchain Work?

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How Does the Blockchain Work?

- The blockchain can be viewed as a ledger/spreadsheet
- For it to be the “truth” we need to know:
  - That the transaction (information) was verified by each of the counterparts (source/determination)
  - That the transaction entry was subsequently never falsified, updated, or deleted
- If we know these two things, we can be sure that the information is correct

How Does the Blockchain Work?

- Identical copies of this ledgers are stored across all participating “nodes” of the network
  - Information (transactions) are recorded (differences) in a sequential chain of blocks, hence the name
  - Each block holds changes in the world since the last block
  - The current state of the world is computed by summing up all the blocks

Blockchain Design Points

- Any transactions between two parties are verified using “PGP encryption”
  - These transactions are then /confirmed/ by the network and stored in this chain of blocks
- Blockchain is designed in a way that makes it exceedingly difficult to try to fake data or cheat the system
  - Doing so requires solving a problem that requires massive (prohibitive) computational resources
  - Because of this, it is a data storage technology that prevents faking or rewriting entries
  - If it is written in the blockchain, it must be true (within reason)

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What are Some Emerging HR Applications?

Prasanna (Sonny) Tambe, Associate Professor of Operations, Information and Decisions

Emerging HR Applications

- Can broker between the world of HR data with the use of machine learning for prediction
  - On-tap credentialing
  - Instant payroll across national borders

Emerging HR Applications

- A number of firms emerging around the use of blockchain for HR data
  - Credentialing
  - Payroll
  - Performance evaluations

Emerging HR Applications

- Potential for new business models
  - Wearable data
  - Code check-ins
  - Skill-based credentials

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Effects of AI

Peter Cappelli, George W. Taylor Professor of Management and Director of Wharton's Center for Human Resources

Predicting the Future

- Actuarial science
- Economic forecasting — assumes the future will look like the past
  - If the future does not look like the past, the forecasting models won't work very well
- Asking people — polling, market research
- Expert judgement questions (Phil Tetlock 2017; Tetlock and Gardner 2018)
  - People who are confident, deep subject matter experts, and are guided by theory do worse
  - People who do better question assumptions, consider counter arguments, look for similar situations elsewhere

Where Do the Predictions Come From?

- Competition for “eyeballs” in private sector
- Money wins
- Some examples of predictions that are more hype than substance:
  - Early 2000’s – the coming labor shortage
  - The “millennials”
  - Driverless trucks

What Have the Effects Been of IT?

- Biggest changes come when technology pushes management to make different decisions about work organizations
- IT is not designed to eliminate jobs, but to introduce new functions that didn’t exist before
  - Online shopping recommendations

What Have the Effects Been of IT?

- Effects of applying IT to existing jobs, don’t necessarily eliminate those jobs
  - Even in the context of robotics
  - Low skill jobs are still around because labor is cheap
  - Driverless cars
- Simply because things are possible to do with robotics and artificial intelligence doesn’t mean that there is a market for it, or that it will be cheap enough to do

Is AI Different?

- Data science can focus on one task
  - Radiologists
  - Driverless trucks
- Management decisions matter enormously
  - Numerically controlled machines (CNC machines) and the use of computers in engineering decisions
- The big impact on jobs and productivity comes when managers use the IT to restructure how work is organized

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Course Conclusion

Peter Cappelli, George W. Taylor Professor of Management and Director of Wharton's Center for Human Resources

Conclusions

- Data science is a different approach to solving problems and making decisions
  - Puts priority on making more accurate predictions
  - Not necessarily fair, explainable, or consistent with other goals
- The challenge in applying these tools to managing people is about balance
- Artificial intelligence and data science will push other changes in the way we manage employees and work, which could matter just as much as the data science itself
  - Collecting more data, measuring, and analyzing
  - Fresh eyes looking at old problems

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