AI in Industry

An Oddball

This is a strange course

For most courses, it's easy to figure out what to expect:

- "Fundamentals of Artificial Intelligence and Knowledge Representation"
- "Introduction to Algorithms and Programming"
- "Statistical and Mathematical Methods for Artificial Intelligence"
- "Machine Learning"
- "Deep Learning"
- "Combinatorial Decision Making and Optimization"
- ...

...But what for something called "AI in Industry"

What do we mean by "industry"?

Industry

This is industry

Industry

This is also industry

Industry

This is also industry

Industry

This is also industry

Industry

We will talk about industry in a broad sense:

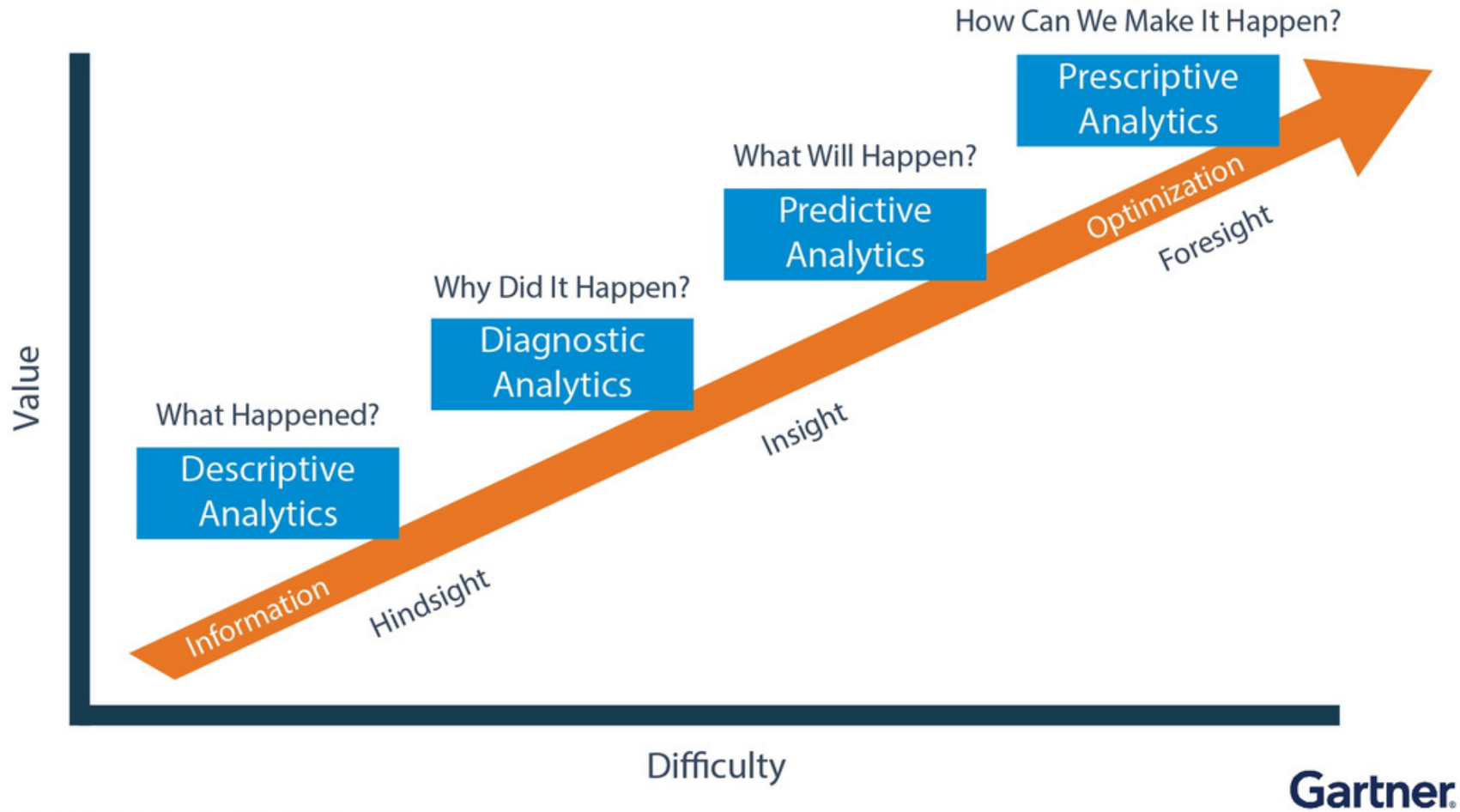
- Factories of course, but also...
- Transportation companies
- Power systems
- Healthcare
- Product design
- Smart cities
- Policy management
- ...

Basically any activity that can generate value

What can AI do in this context?

Business Analytics

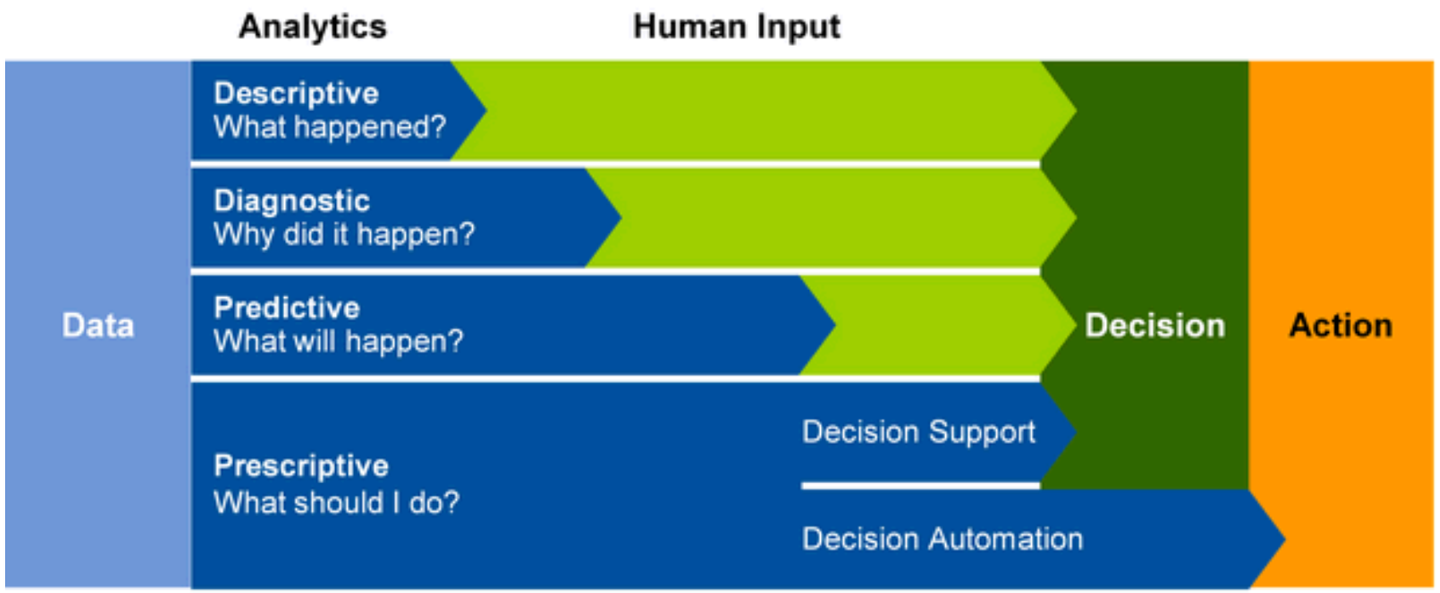
A good starting point: business analytics models



Source: Gartner Analytic Ascendancy Model (March 2012)

Business Analytics

In terms of how far we push automation:



Order and Chaos

This is simple and useful characterization

...But the truth is more like this!

Order and Chaos

Industrial applications are complicated

- The problems are not well defined
- Similar techniques may be applied in multiple settings
- ...And with different names
- Classical tasks typically only part of the whole problem
- It is often necessary to combine problems/techniques
- ...

A common opinion:
try something, then add tweaks untile the problem is solved

Order and Chaos

...But this is evil!

Order and Chaos

...But this is evil!

Specifically, it reaches a plateau real quick:

- If you get lucky, you solve your problem and you do it fast
- But more often than not:
  - You fail, and you don't understand why
  - You end up with a much messier solution than needed
  - You approach works on test data, but not in the field

More critically, you do not really improve your knowledge and skill

Our goal will be to bring a measure of order to the chaos

Which is actually impossible, but still the right goal to pursue

What to Expect

How I am Going to Play It

I am going to follow a few guiding principles

How: Examples! I.e. Use Cases

- Every few lectures we will introduce a new use case
- They will be simplified industrial problems
  - Real industrial problems would take too much to tackle
  - ...Not to mention they are subject to NdAs ;-)
- They will nevertheless be representative
- Some uses cases will be covered in seminars by industrial partners

How I am Going to Play It

I am going to follow a few guiding principles

What: techniques, best practices, formalization

- Mostly: how to methodically tackle a new problem
- But we will also introduce new techniques
- ...Ways to apply known techniques
- ...Ways to combine known techniques
- ...Some (light) software engineering
- ...And how to formalize problems and ideas

How I am Going to Play It

I am going to follow a few guiding principles

Why: you should be able to handle real world problems and do it better than most

- Problems/solutions are often poorly understood
  - Formalizing is the first step towards understanding
- Different problems call for different tools
  - Using (say) ML for everything is just inefficient
- Many people can apply "boilerplate", mainstream AI method
  - ...But much fewer are capable of combining them

On the Art of Cooking

At some point, the course will start feeling like a cookbook

When you get there, there is one thing you should remember

On the Art of Cooking

Most people read cookbooks to follow recipes

On the Art of Cooking

...But true chefs read cookbooks to find ideas

Two Parts

The course can be roughly divided in two parts

In the first part we will (mostly):

- cover simpler techniques
- make sure that we use known tools properly
- learn to look at a problem as a whole

In the second part we will:

- cover more advanced techniques
- bend known techniques so as to make them behave as we wish
- learn how to combine heterogeneous information
- learn how to combine heterogeneous techniques

Technical Information

Teachers

Teacher:

- Michele Lombardi (michele.lombardi@unibo.it)
- Office:
  - Phone: 051 2093270
  - Close to teaching room 5.7 (look for a yellow door)
  - Reception hours: on appointment (send an email)

Tutor:

- Luca Giuliani (luca.giuliani13@unibo.it)
- Assistance with projects and questions
- Reception hours: on appointment (send an email)

Course Material

Reference: course web site on virtuale.unibo.it

- Jupyter notebooks
  - Distributed via gihub, using Docker containers
  - You should try installing Docker (there are instructions on the course web site
- PDF notes (also included in the container)
- Recorded lectures (links on the web site)

This course changes (a bit) every year

- The good part: the course will grow with you
- The bad part: lecture material will typically arrive one/two days early at most

Exam

The exam will consist of a project:

- You can propose a topic
- ...Or pick one from the list on https://lia-unibo.github.io/
- In both case, the topic must be discussed with the teacher before starting
- Groups of 1-3 students tend to work best

An advice: wait until at least mid course before choosing

The students will need to:

- Deliver the project code
- Give a presentation
- Be prepared to discuss their work

Exam

The evaluation

- Will not focus on how successful your results
- ...But on how you reached them
- This means I will evaluate
  - Why you made the choices you made
  - How you have interpreted the results
  - What you can infer

Exam

About the optional 3 credits project

- Usually, this will be a follow-up of the exam work
- Same structure for the evaluation
  - I.e. code, presentation, and discussion
- But there are no grades
  - Usually, when you present it means you already passed
  - ...I'll stop you earlier if this is not the case ;-)