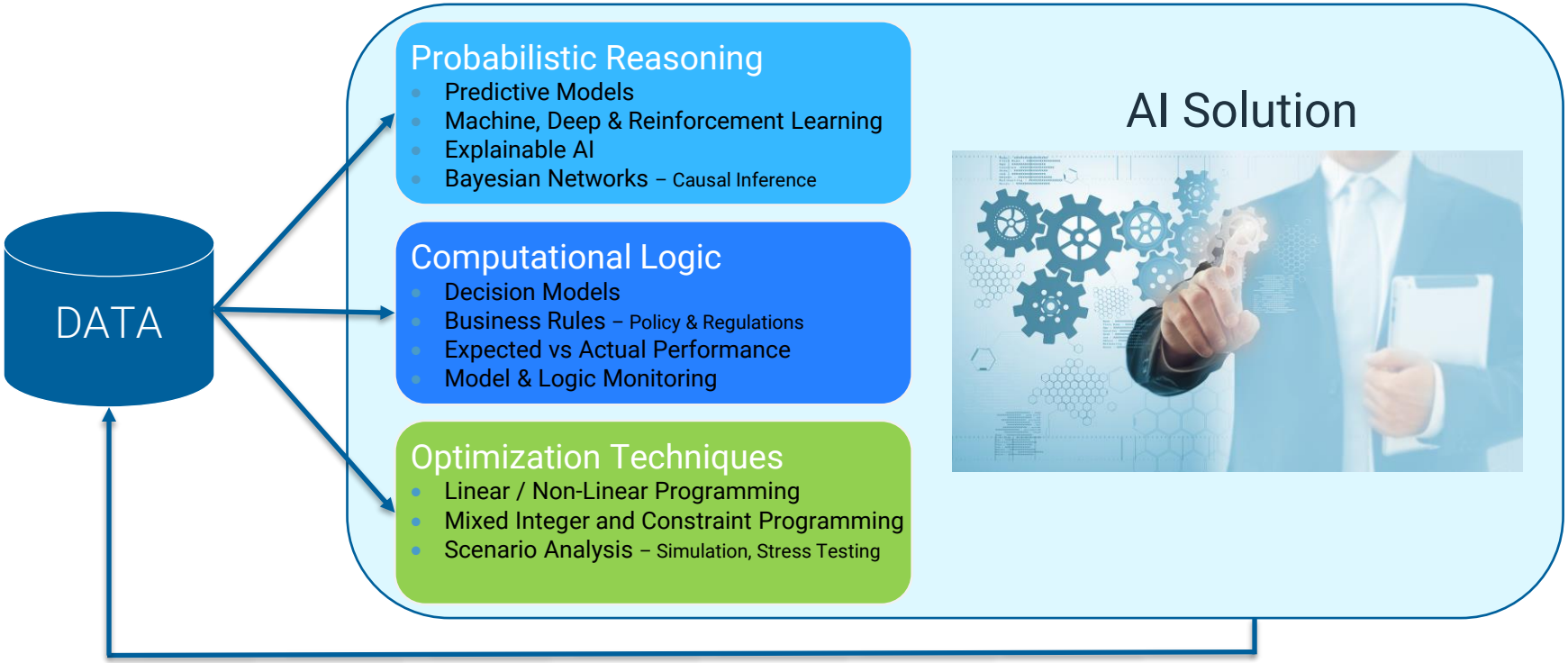
Optimization in Enterprise AI Solutions

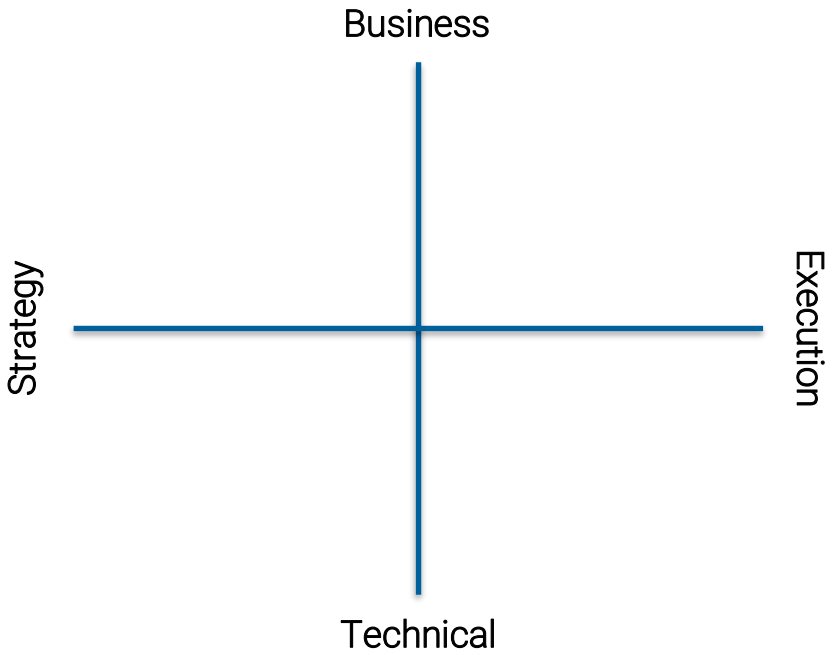
CO@Work 2020

Oliver Bastert
VP, Product Management, FICO

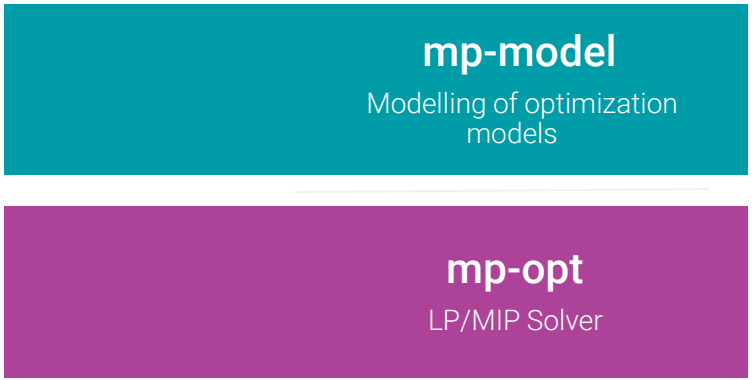


My Job

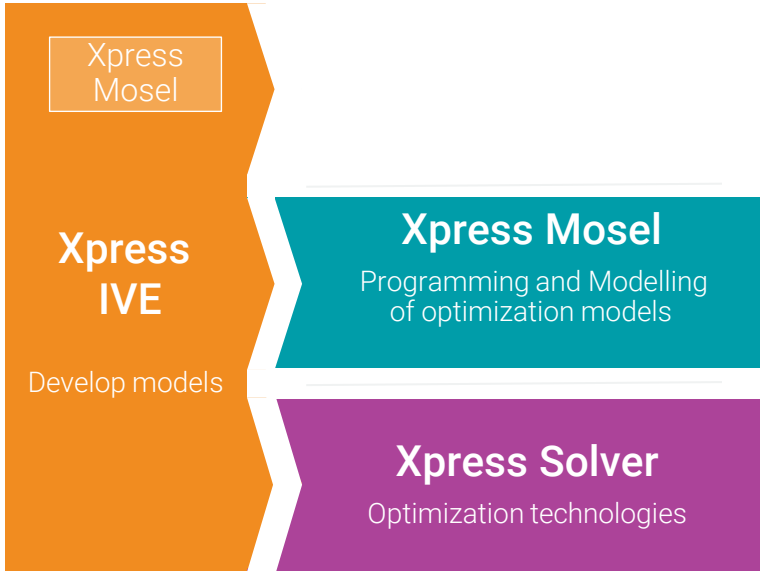
https://pragmaticinstitute.com/product/framework/



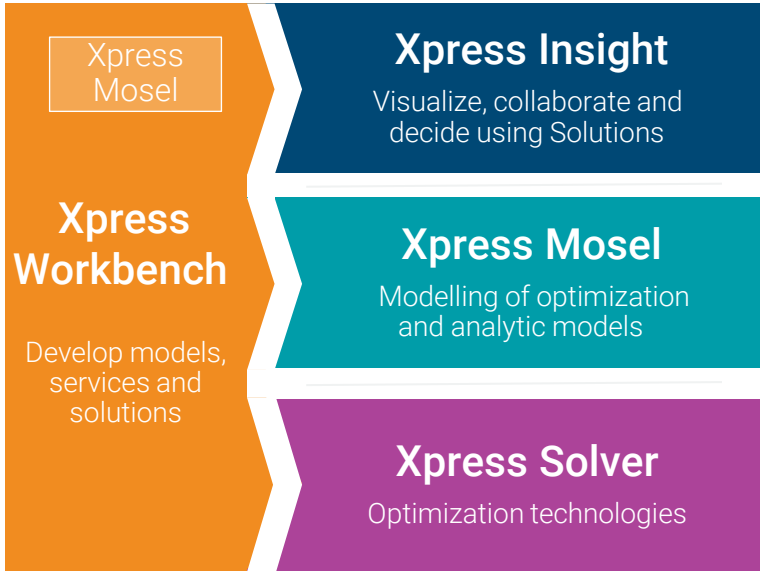
FICO Xpress Optimization – 1983-1986



FICO Xpress Optimization – 2001-2004



FICO Xpress Optimization – 2008-2012

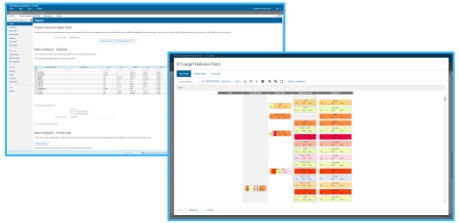


Xpress Technology

- Xpress Insight – Rapidly deploy analytic & optimization models as powerful applications
- Xpress Mosel – Integrated modelling and programming language
- Xpress Solver - Provides optimization algorithms and technologies to solve linear, mixed integer, non-linear and constraint programming problems
- Xpress Workbench – IDE for developing optimization models, services, and solutions

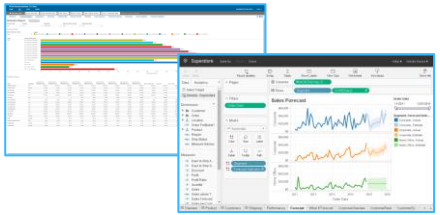
FICO Xpress Insight

Data, Model & Decision Analysis



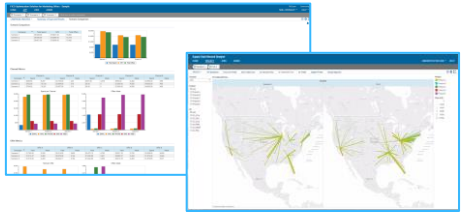
- Single point of truth for data
- Data & model profiling
- Decision impact analysis

Integrated BI, Reporting & Dashboards



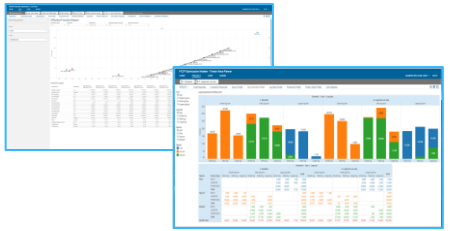
- Standardized KPI evaluation & reporting
- Tailored tables, charts, maps and dashboards

Decision Support



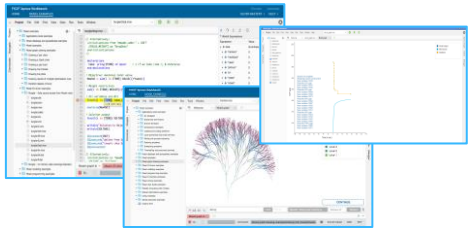
- What-if analysis
- Side-by-side comparison
- Built-in scenario management
- Workflow support by user-defined authorities

Simulation & Stress Testing



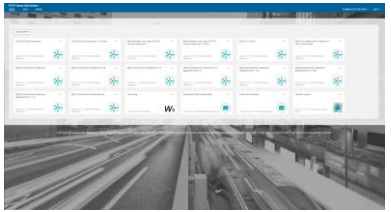
- Basic-to-advanced simulation of baseline & challenger decisions
- Easily apply stress factors & change assumptions
- Sensitivity analysis

Mathematical Modelling & Optimization



- Access broadest range of industry-leading solvers
- Utilize mathematical modelling language Mosel or Python or …

Built-in User & Solution Management

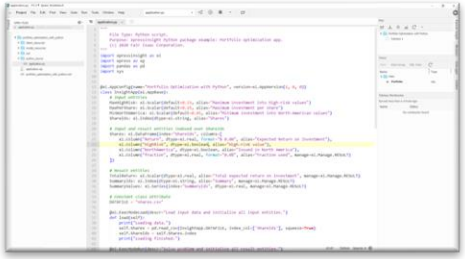


- Built-in & LDAP user management
- Easily publish & manage different solutions
- Governance

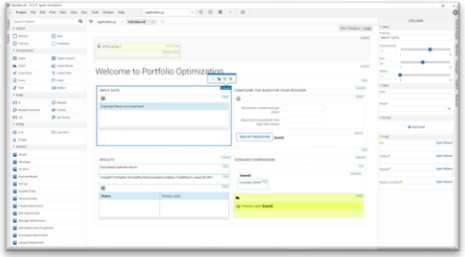
The App Development Workflow to Deploy Analytic Models

Xpress Workbench

Modelling



UI design – View Designer

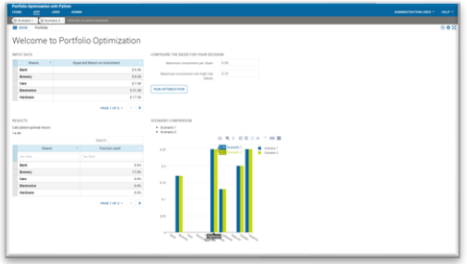


One Collaborative Platform

+

Xpress Insight

App deployment

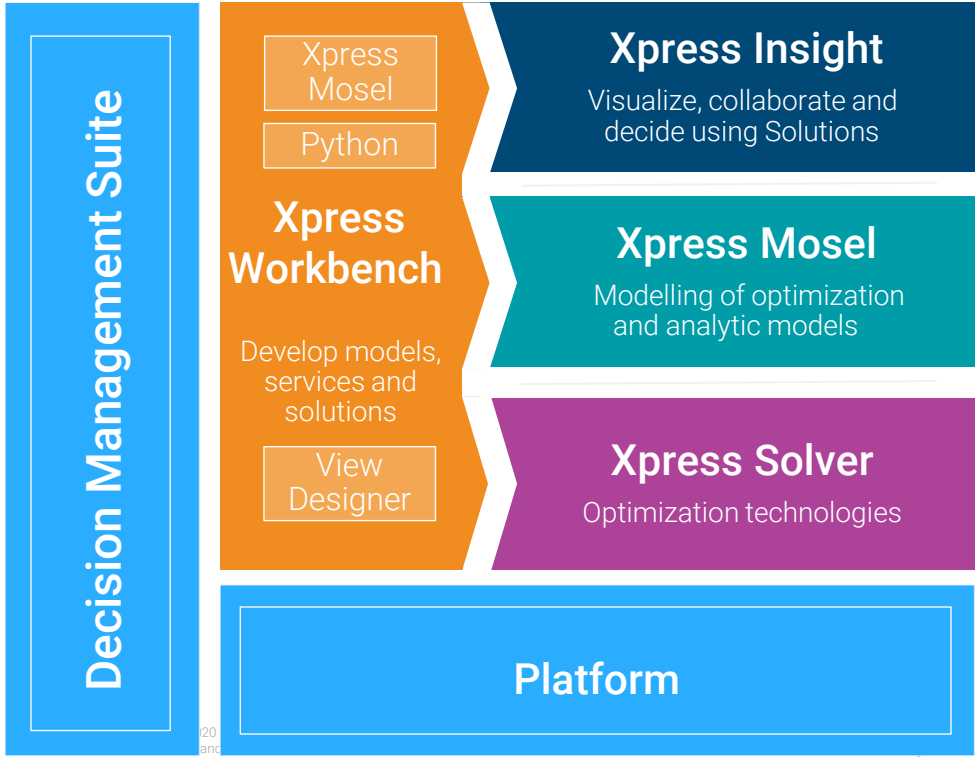


One Click Publishing

=

Enterprise ready advanced analytic applications

FICO Xpress Optimization – 2013 – now



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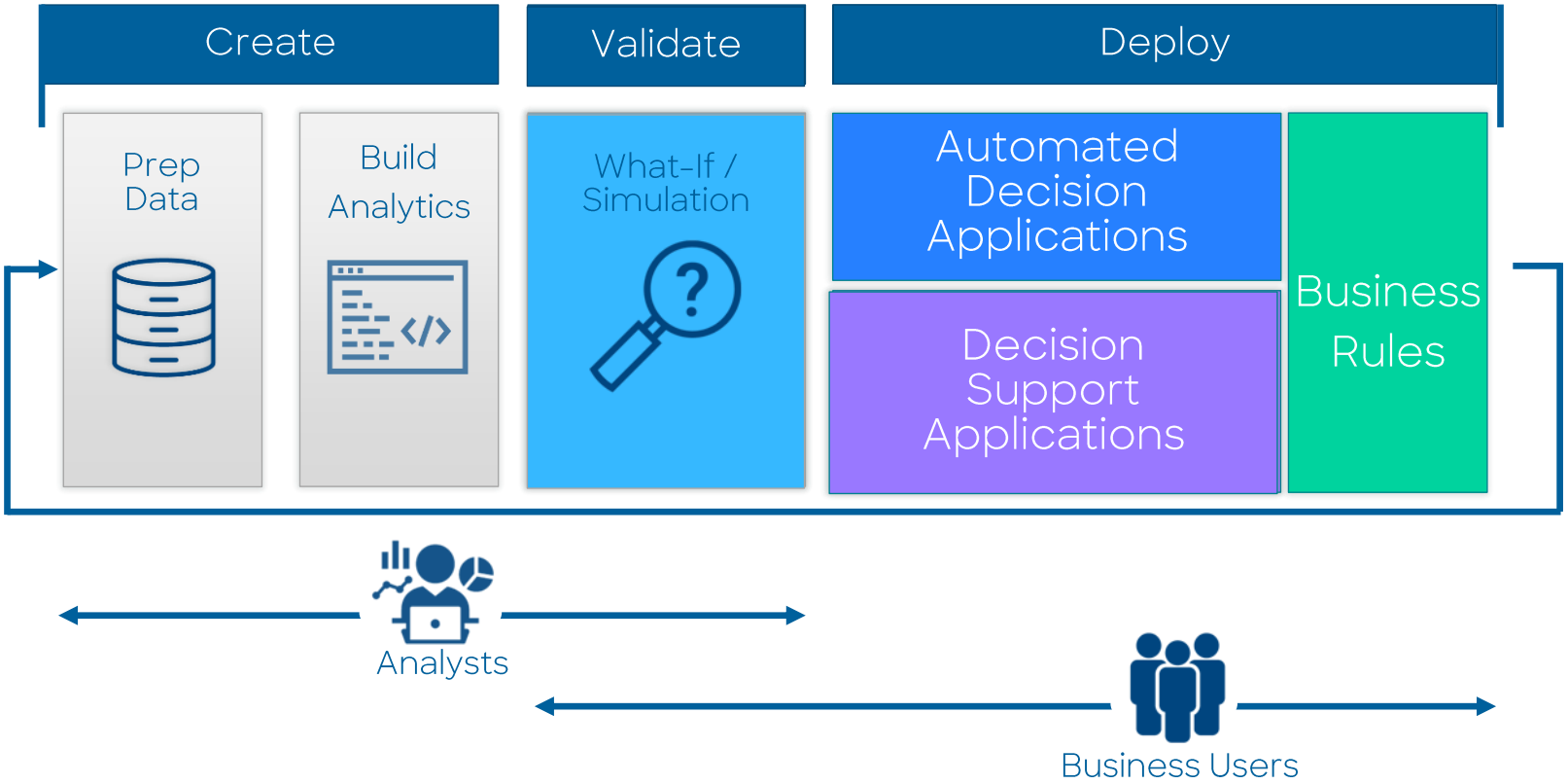
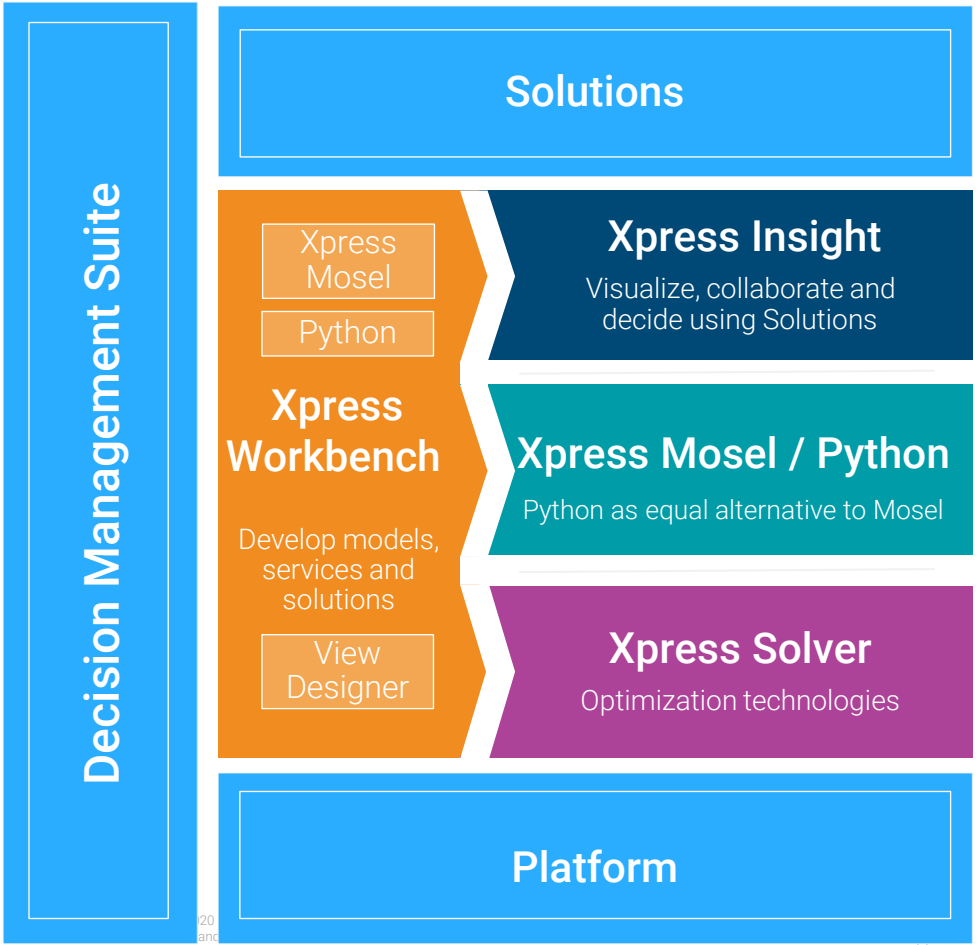
Analytic Deployment Process Flow Diagram



FICO Xpress Optimization – the most complete Optimization software



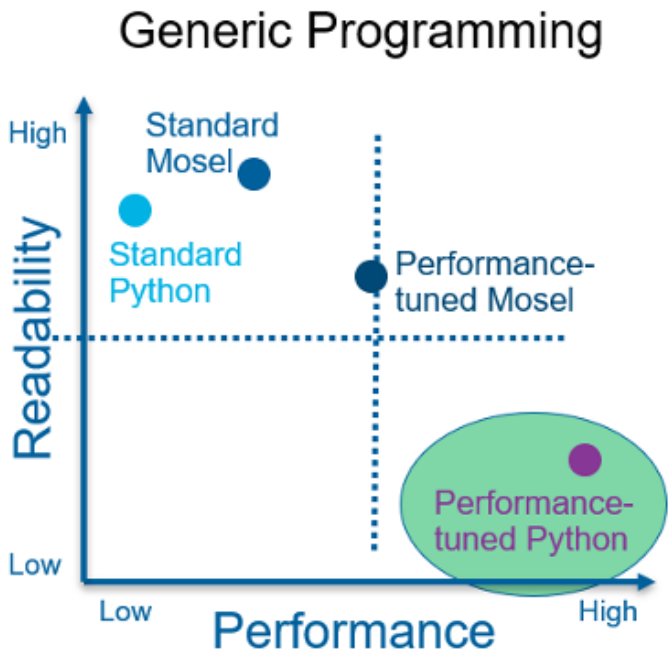
- Python
  - Python for Insight development
  - APIs to all solvers
  - Integration of Mosel and Python

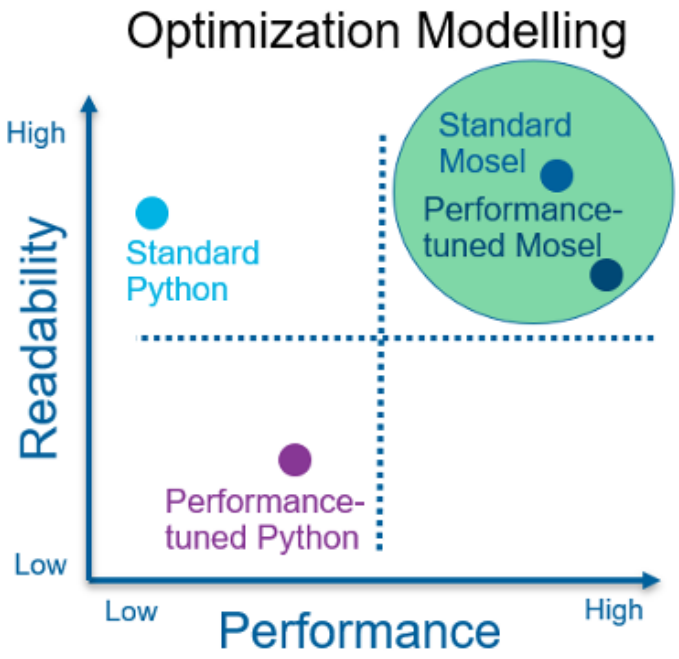
Blog
https://community.fico.com/s/blog-post/a5Q2E000000PwwQUAS/fico2256

On demand webinar for Insight development with Python
https://www.fico.com/en/latest-thinking/demand-webinar/easy-deployment-python-models-web-applications-xpress-insight

Modeling language or Python

https://community.fico.com/s/blog-post/a5Q2E000000YM5tUAG/fico2058





35+ Years of Business Transformation with FICO Xpress Optimization

Solving

1983:	LP solver running on PCs
1992:	Parallel MIP (1997 on distributed PC/Linux networks)
1995-96:	Commercial branch and cut algorithm
1998:	Bound switching in dual simplex
2003:	Lift-and-project cuts
2009:	Parallel MIP heuristics
2010:	LP/MIP solver crosses 64-bit coefficient indexing threshold
2013:	Automatic solver selection for NLP
2014:	Parallel simplex
2016:	Task-based parallel MIP
2017:	Barrier warm start and parallel crossover, parallel black box optimization
2020:	Learning to Scale

Cloud based since 2015

Modeling

1983:	General purpose algebraic modeling language (mp-model)
2001:	Algebraic modeling language combining modeling, solving, and programming (Mosel)
2005:	Profiler and debugger for a modeling language
2005:	User-controlled parallelism at the model level
2010:	Algebraic modeling language supporting distributed computing
2012:	Remote invocation without local installation
2014:	Parallel profiler and debugger; robust optimization
2015-16:	Analytic integration, security, speed
2017:	Free and open Mosel
2018:	Full integration with ML through R and Python
2019:	Rearchitected Mosel 5

Business User Enablement

2012:	Xpress Insight first released
2013:	Xpress Insight + Tableau®
2015:	VDL for fast configuration
2016:	Xpress-Workbench first released
2017:	Web-based optimization model and solution development
2019:	Drag & Drop UI development
2020:	Python for app development

https://community.fico.com/s/optimization-blog

Examples and Case Studies

The World is non-linear

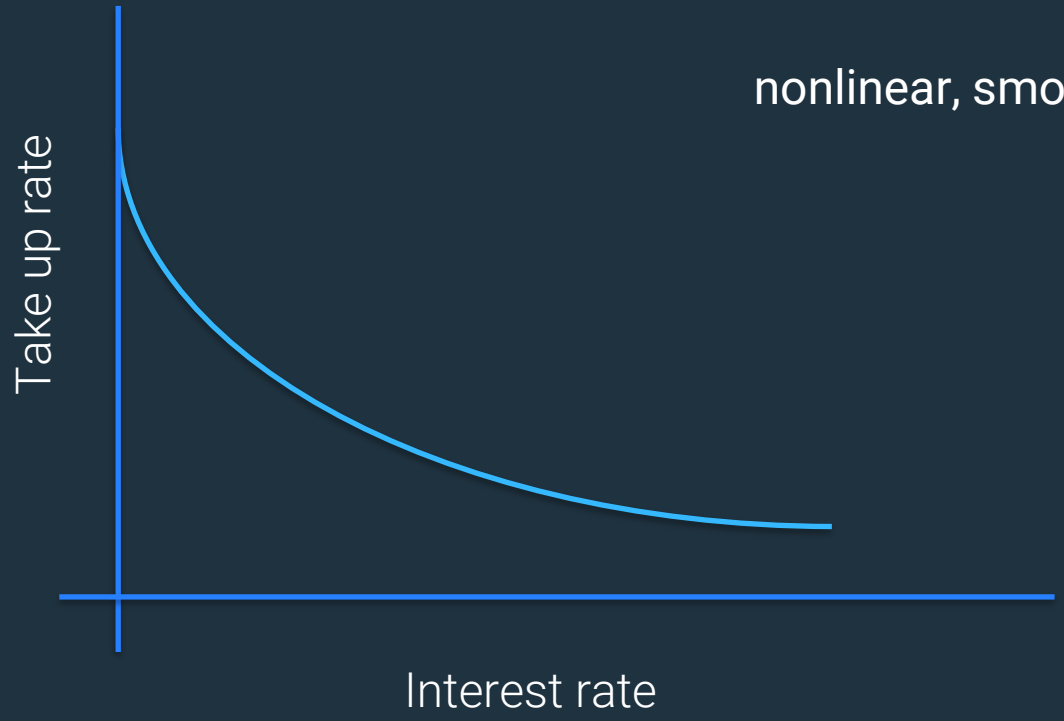
Example non-linear problems solved with Xpress

- Pricing Optimization
- Portfolio Optimization
- Risk Management
- Blending
- Chemical processing
- …

Technology

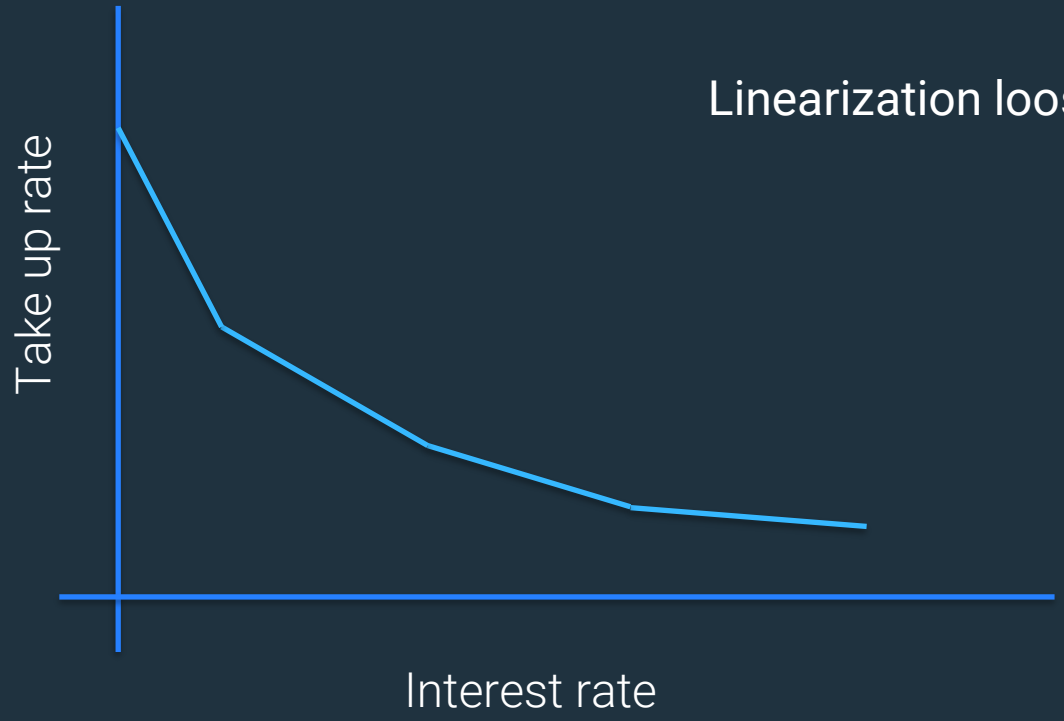
- Combination of first order (successive linear programming) and second order (interior point) nonlinear solvers
  - Easy to use modeling modules
  - Fast and accurate derivatives engines
  - User functions / Black box optimization

How to model and solve loan pricing models



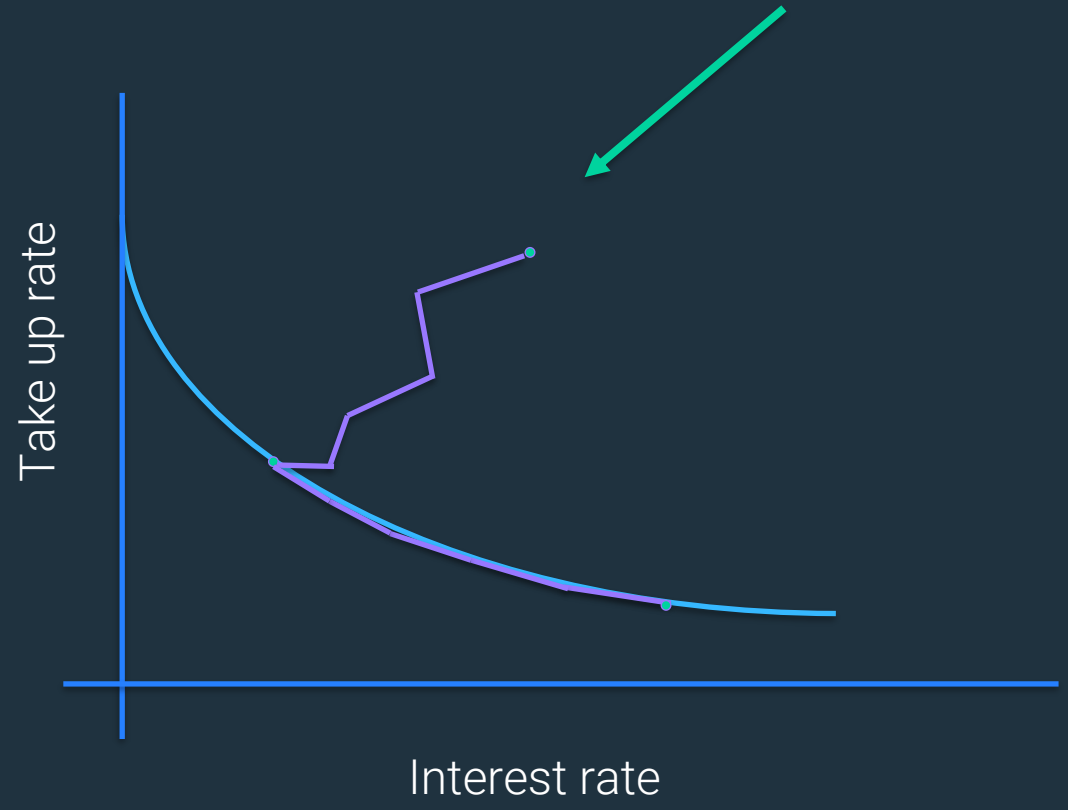
nonlinear, smooth, convex

How to model and solve loan pricing models

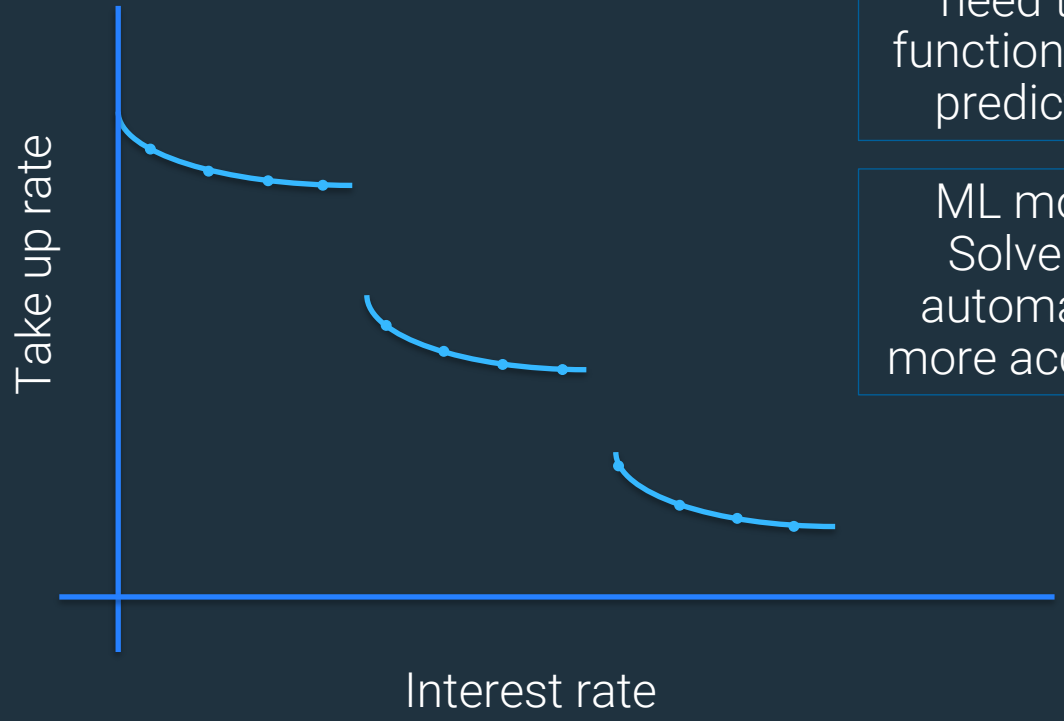


Linearization looses accuracy

How to model and solve loan pricing models



How to really model and solve loan pricing model



FICO Solvers don't need to know the functional form of the predictive models

ML models + FICO Solvers = Quicker automated process, more accurate solution

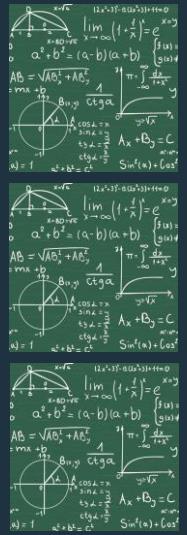
A Typical Deposits Pricing Model

Time Period T

Internal funds (by product)

External funds

Decision space: product parameters



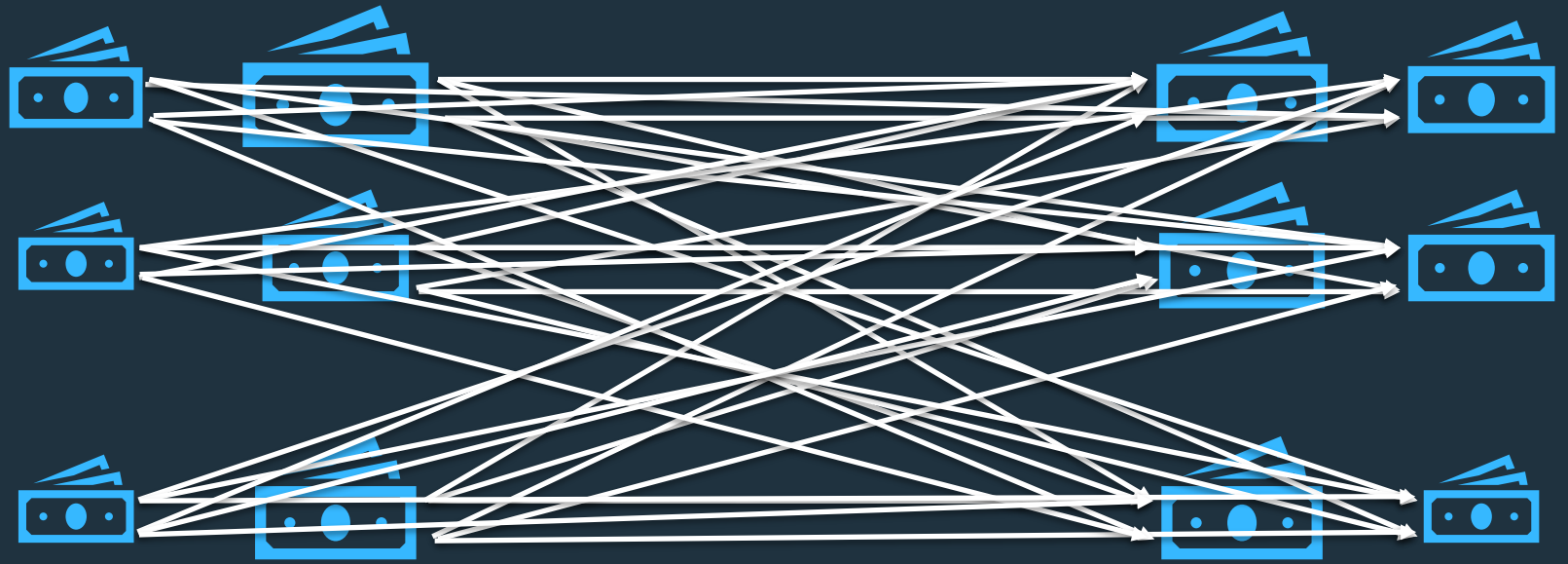
Statistical models predict flow of funds based on product

Time Period T+1

Internal funds (by product)

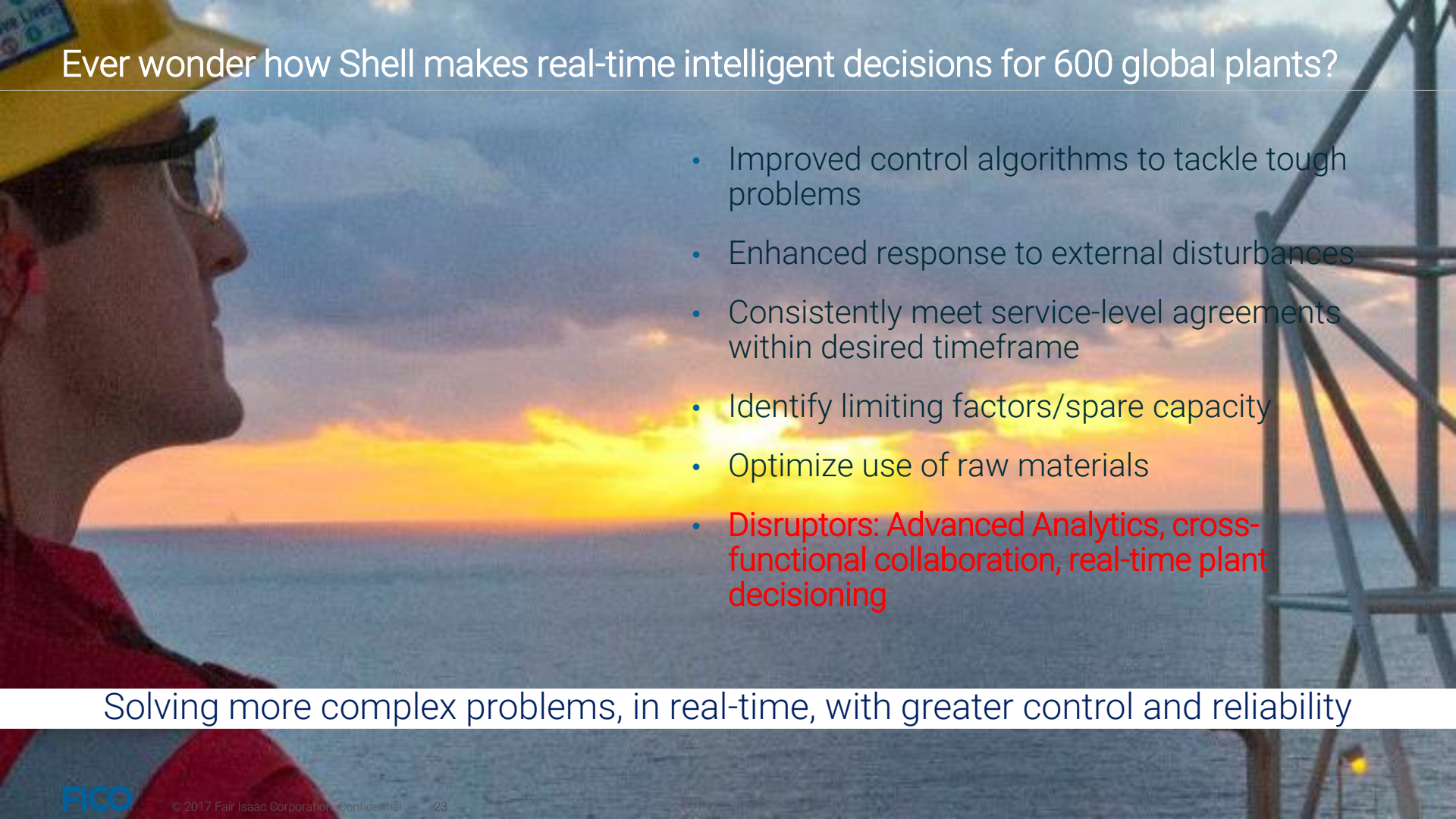
External funds

A Typical Deposits Pricing Model is huge



Why we are so good at this

Ever wonder how Shell makes real-time intelligent decisions for 600 global plants?



- Improved control algorithms to tackle tough problems
- Enhanced response to external disturbances
- Consistently meet service-level agreements within desired timeframe
- Identify limiting factors/spare capacity
- Optimize use of raw materials
- Disruptors: Advanced Analytics, cross-functional collaboration, real-time plant decisioning

Solving more complex problems, in real-time, with greater control and reliability

Energy Price Forecasting

Simulating Global Energy Networks

Leading European Energy Company

Objective

Most accurate **network model** and price forecasting for

- Day ahead power trading
- Long term gas contracting
- Scenario evaluation for risk mitigation and understanding price sensitivities

Results

- Used in the Trading Room running constantly on hundreds of cores for day ahead trading.
- Collaborative analyst application used across several locations for long term contracting.
  - Considerations for decades ahead

Captive Auto Lender – Leading Global Automobile Company

Structure the Best Deals for its Customers

Auto Lender

Objective

- Evolve past manual financing to drive better results
  - Maximize profit
  - Reduce decline rates
  - Increase consistency across dealerships

Results

- System can generate up to 10 diverse, preapproved and profitable deal structures in real-time using optimization
- Alternative deal structures are helping reduce annual losses by up to $12 million
- Faster loan negotiations, lower labor costs, up to $3 million savings per year
- Enhanced transparency drives reduced risk of audits and penalties
- Increased loan approval rates drive better deal and customer satisfaction

"Alternative deal structures are helping convert missed opportunities into deals that maximize profitability. Revenues are also increasing, based on improved loan-to-value rates, multiple payment lengths and specific terms."

Ken Kertz, Auto Segment Leader, FICO

Ever wonder how Toyota avoided millions in losses from late payers?

- Avoided 6,000 repossessions
- Prevented 150 skips
- 10,000 customers did not roll to 60+ days late
- 50,000 customers maintained their good credit standing
- Disruptors: Advanced Analytics, defining the journey before the data, collections as customer service, rich mix of predictive analytics, cross-departmental collaboration

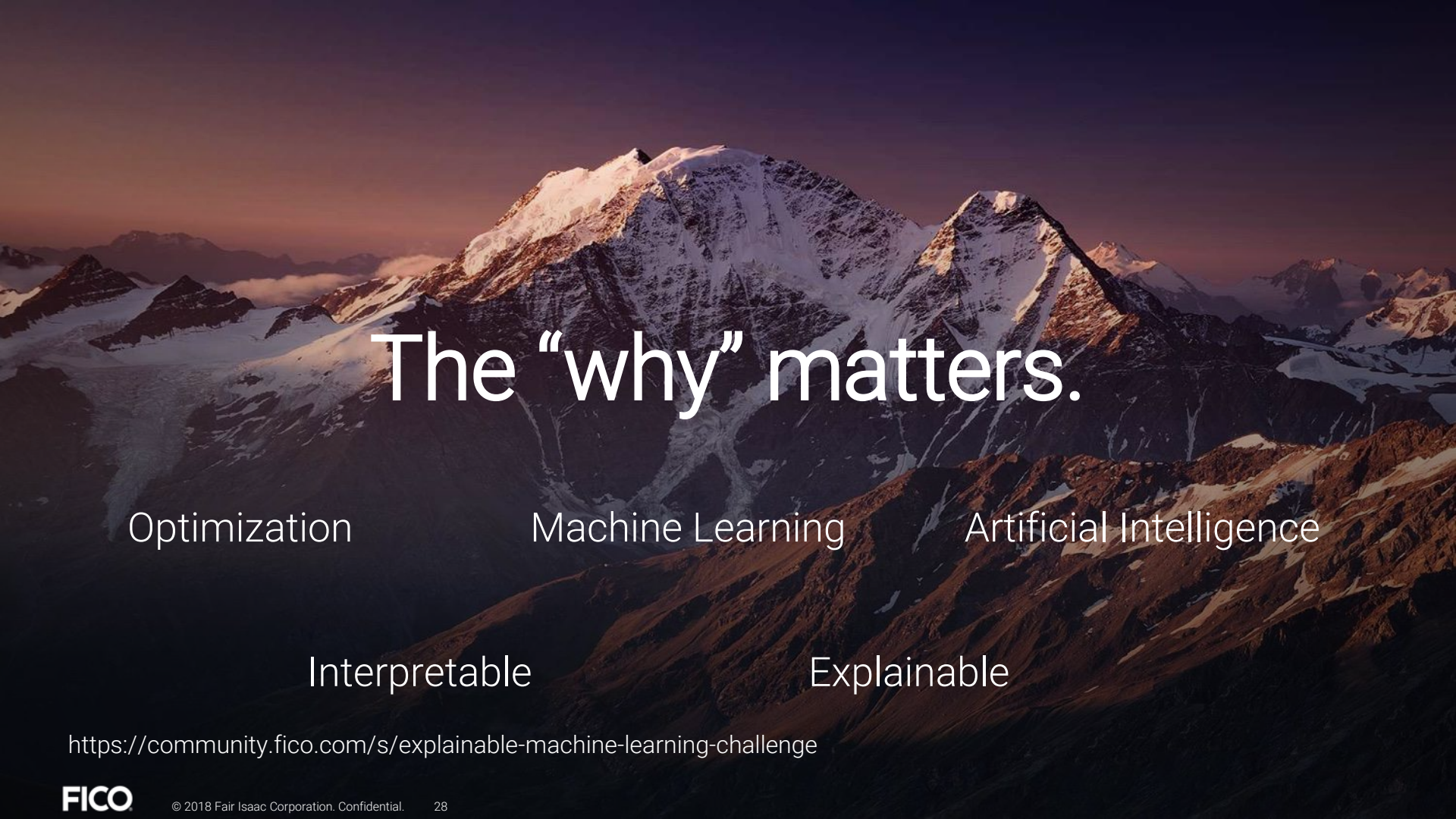
Toyota achieved a 9% portfolio growth with **no** increase in collection costs

GDPR and Optimization

Any Profiling require explanations available to users

... such processing should be subject to suitable safeguards, ... and the right ... to obtain an explanation of the decision reached ...

Profiling is “any form of automated processing of personal data … to analyse or predict … that natural person’s performance at work, economic situations, health, personal preferences, interests, reliability, behaviour, location or movement”



Case Study – Southwest Airlines

Decision Optimization

Challenge

- Improve customer experience, enhance employee engagement and streamline operations to maximize revenue as the company grows and expands into new markets.

Solution

- FICO® Xpress Optimization, FICO® Xpress Insight, FICO® Blaze Advisor

Results

- Decreased costs by $19MM/yr optimizing fuel tankering strategies
- Reduced fuel costs by $20 MM/yr by optimizing fuel contracts process
- Increased on-time flight performance by 10-15% for weather-related disruptions
- Increased overall on-time flight performance by 2%
- Decreased salary expenses by $10 MM/yr by reducing unearned/overtime pay for pilots and flight attendants
- Increased the number of consistent lines for pilots by 15%, which increases crew satisfaction

Case Study – Grupo Fleury

Grupo Fleury applies advanced analytics to enhance demand forecasting

Challenge

- Improve demand forecasting and resource allocation process

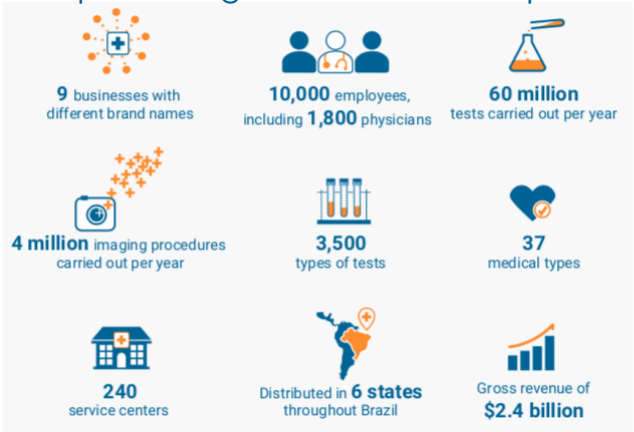
Solution

- FICO® Forecaster, built on the FICO® Xpress Insight platform

Results

- Significantly reduced forecast creation time
- Automated incorporation of new units and services into the platform
- Increased the granularity of the forecast from month/service to day/exam
- Reduced mean absolute percentage error by 10% overall
- Reduced costs through more efficient resource allocation
- Increased the accuracy of the forecast by 10%

A complex diagnostic medical practice



Get Xpress

Xpress Community License

FICO Xpress

- Community License is available to every user.
- Usage is restricted to personal use in commercial and non-commercial environments.
- It includes solvers for all problem types, the Workbench IDE, Mosel and Insight.
- Certain size and feature restrictions apply, for example #rows+#constrains <=5000
  - See the license overview for details

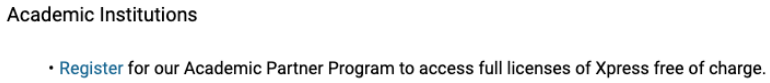
- Download at http://subscribe.fico.com/xpress-optimization-community-license
- Support via the Xpress community at https://community.fico.com/community/fico-optimization-community
- Or the weekly Xpress Hour https://community.fico.com/s/events#a9U80000000CeTbEAK
-

Academic Partner Program

FICO Xpress

- Special program for degree awarding academic institutions and CO@Work participants
- Academics and their students may use Xpress for educational purposes
- Two levels of membership:
  - **Standard**: Free 1-year membership
  - **Premium**: Additional benefits for a small charge of $800 per 2-year membership period.
- Register at http://www.fico.com/app

- Browse to the Academic Partner Program registration page



- Please fill in CO@Work for “Course” and submit your details

Xpress Mosel – Insight Tutorial Videos

- 18 Xpress-Mosel 101 Tutorial Videos available on Youtube
  - Mosel basics
  - Workbench basics
  - Insight Connection
  - Advanced Topics
- 11 Xpress-Insight 101 Tutorial Videos available on Youtube
  - Insight Basics
  - VDL views
  - Tableau Connection
  - Advanced Views
- Start here: https://www.youtube.com/watch?v=iGMhjLi09uw

Thank you!