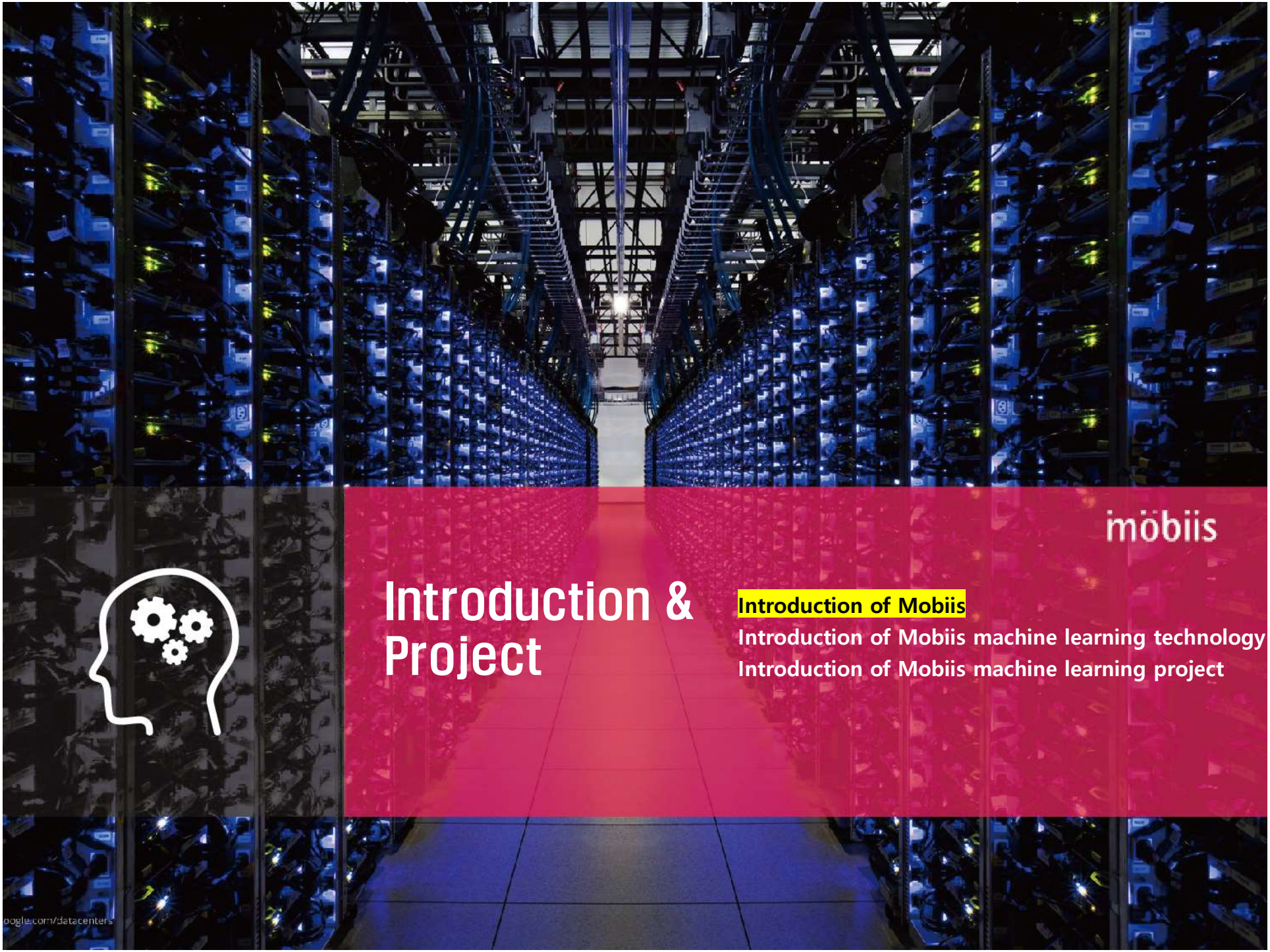
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01 History

mobiis

Business start

2000.04 Mobiis, established as a joint development company of Samsung Electronics

2003.04 Technical Support Agreement with Renesas Technology Corporation in Japan

2004 Selected as a joint development Company of LG Electronics

2008 Design and manufacture of new IP videophone for Korean Telecommunications Company KT

Transformation period

2010 Completion of development of EPICS-embedded Stepping Motor Controller

2010 Selected as a development support industry by the Korean Ministry of Knowledge, Economy

2012 Framework Contract for ITER CODAC Services(2012~2015)

2012 Selected as a Pohang Accelerator Research Institute joint technology development company

2013 Delivery of RAON LLRF Prototypes

2013 Contract for ITER Central Interlock System(2014 ~ 2021)

Growth period

2014 Contract for PAL-XFEL Low Level RF Controller (57 units)

2014 Contract for PAL-XFEL Undulator Controllers (24 units)

2014 Contract for PAL-XFEL Solid Amplifiers

2014 Framework Contract for ITER CODAC Services (2015 ~ 2017)

2016 Contract for ITER Central Control System Phase 2

2016 Win the Ministry Award of Science, ICT, and Future Planning

2017 Listed on KOSDAC (Technology Exception)

2017 Selected for 2nd ATC Project (Ministry of Trade, Industry and Energy)

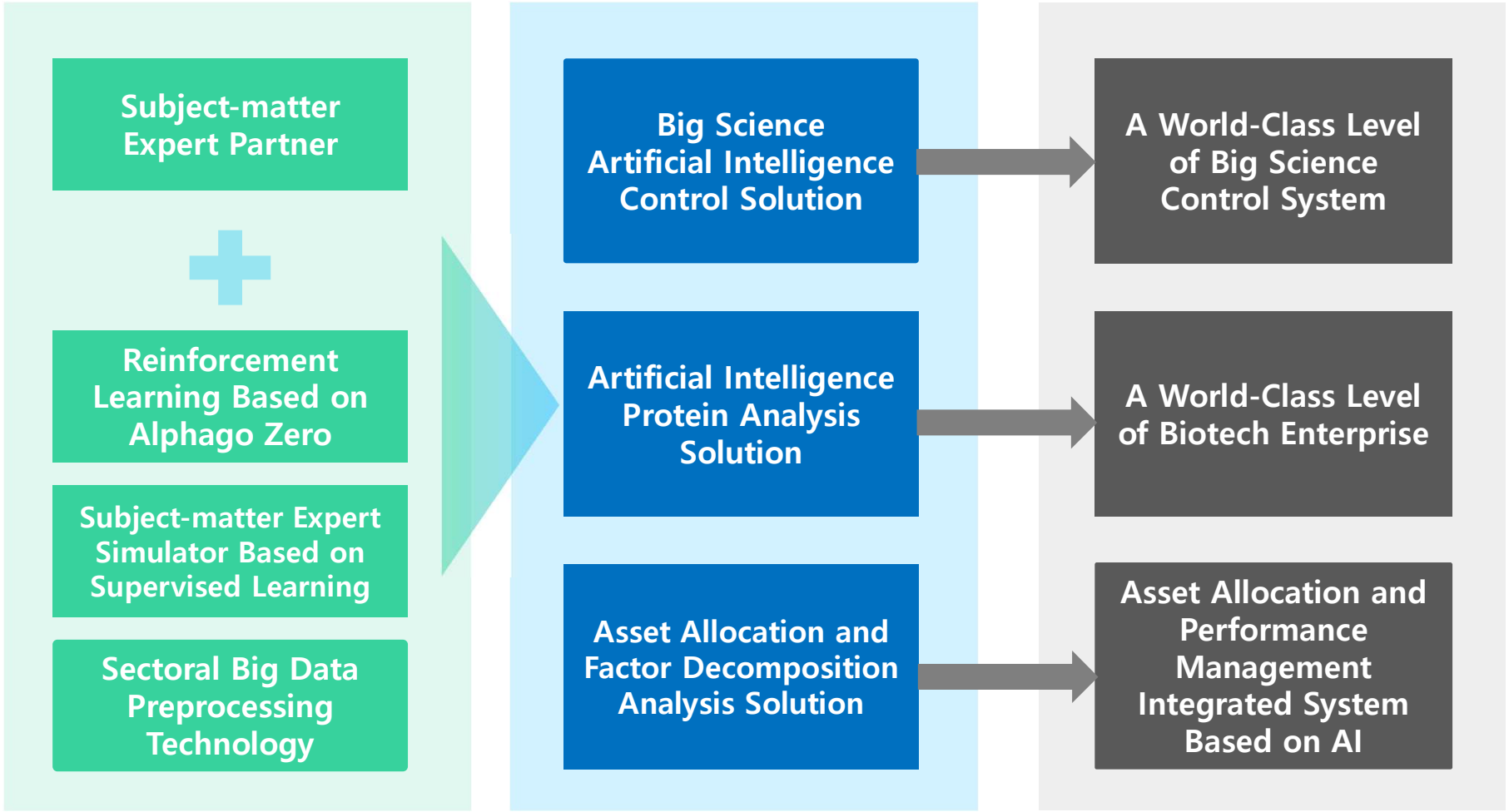
2000 | 2001 | 2003 | 2005 | 2008 | 2010 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017~

Technology	Business Industry	Market Position
Possess uniquely Super Precision control & System Design Technology based on EPICS	" Big Science "	" Sole in Korea"
	 Accelerator Control System	Possess uniquely total solution of Accelerator Control System In Korea
	 Nuclear Fusion Control System	Possess uniquely control system Of Nuclear Fusion (ITER) In Korea
	 Intelligence Control Solution	New business in Machine Learning technology

01 Vison of MOBIIS Machine Learning

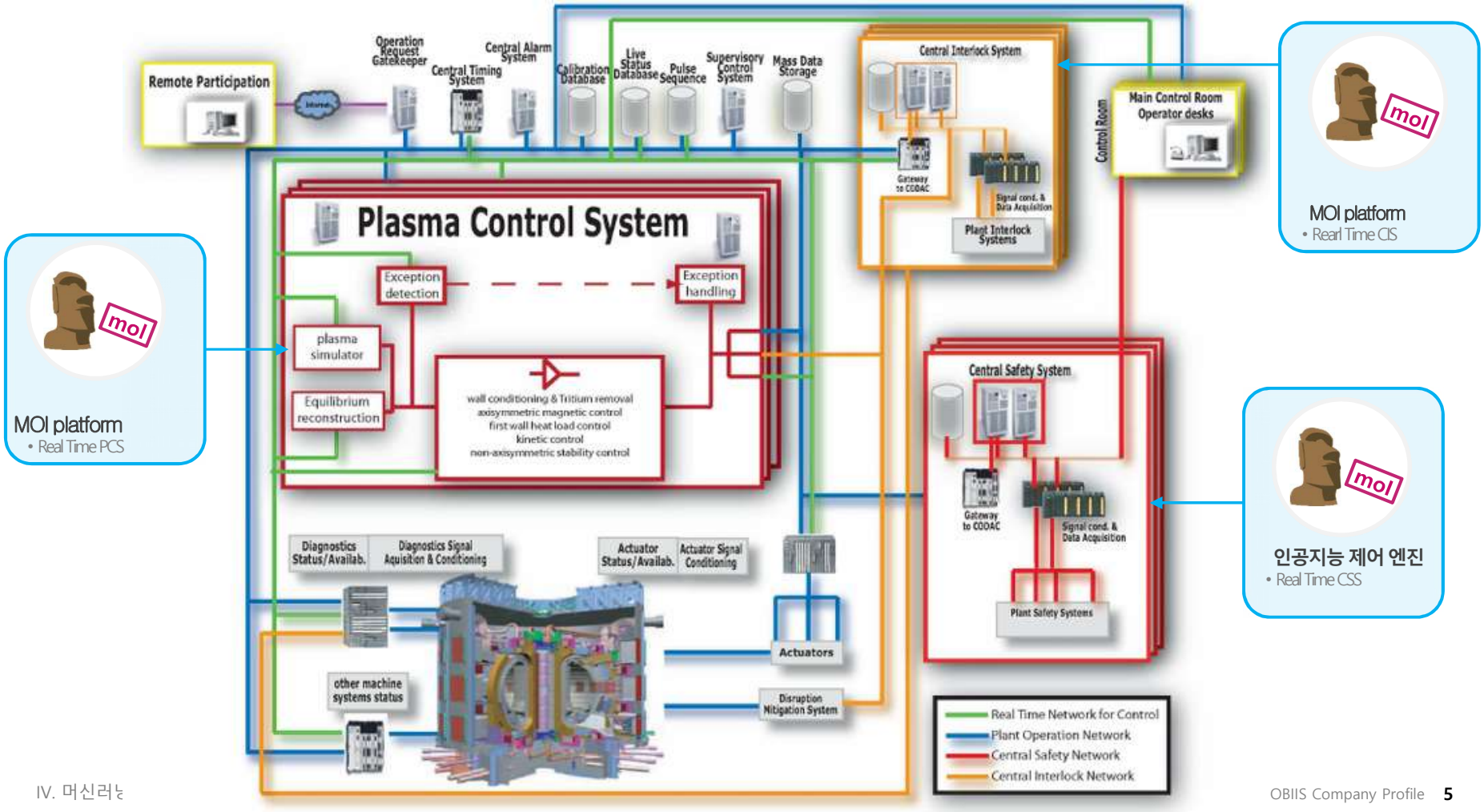
mobiis

- Mobiis has the goal to commercialize a world-class level artificial intelligence technology by applying the technology to these four high-tech fields as follows. .



02 Machine Learning Business – Nuclear Fusion

- Mobiis applies artificial intelligence control engine to parts of nuclear fusion control system, searches for the optimal control variable, and offers the system for precise and fast control.



02 Machine Learning Business – Accelerator

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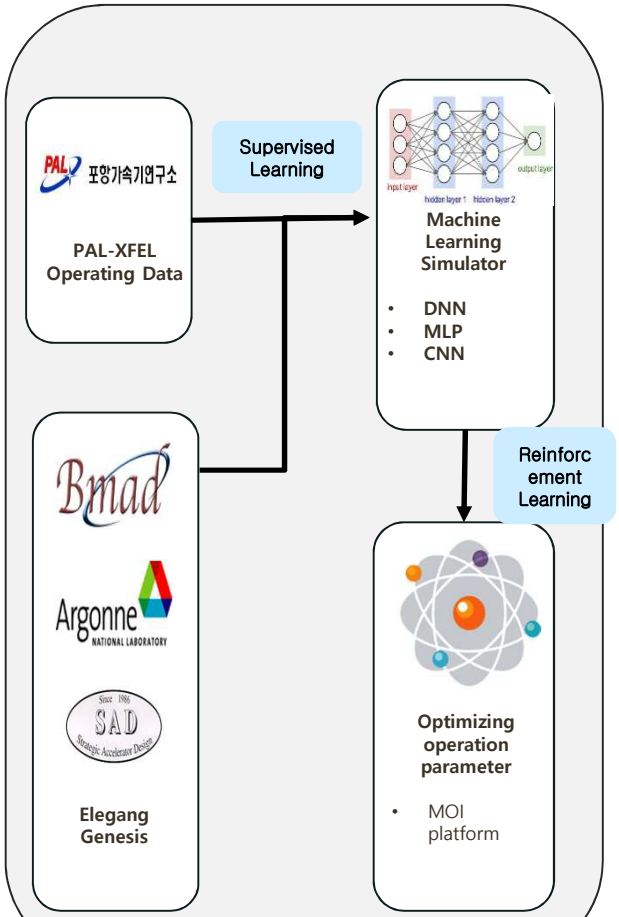
- In the world, the market for medical and industrial accelerator is expected to growth more actively, not just only for the big accelerator. Mobiis is supposed to offer precise artificial intelligence control system to all kinds of accelerator.

단위 : 억원

Category		Market	Control Market
Domestic	Heavy Ion	15,000	2,250
	Heavy Particle	1,950	293
	Heavy Particle	4,500	675
	XFEL		100
Global	Small Accelerator	100,715	15,107
	ILC	90,000	13,500
Total		212,165	31,925

- **Accelerator Control System : 30 billion USD**

Market Size



Ongoing Project

Fermilab

SLAC NATIONAL ACCELERATOR LABORATORY

CERN

- **Control system for optimizing parameter by machine learning**

Future Plan

02 Machine Learning Business – Bio

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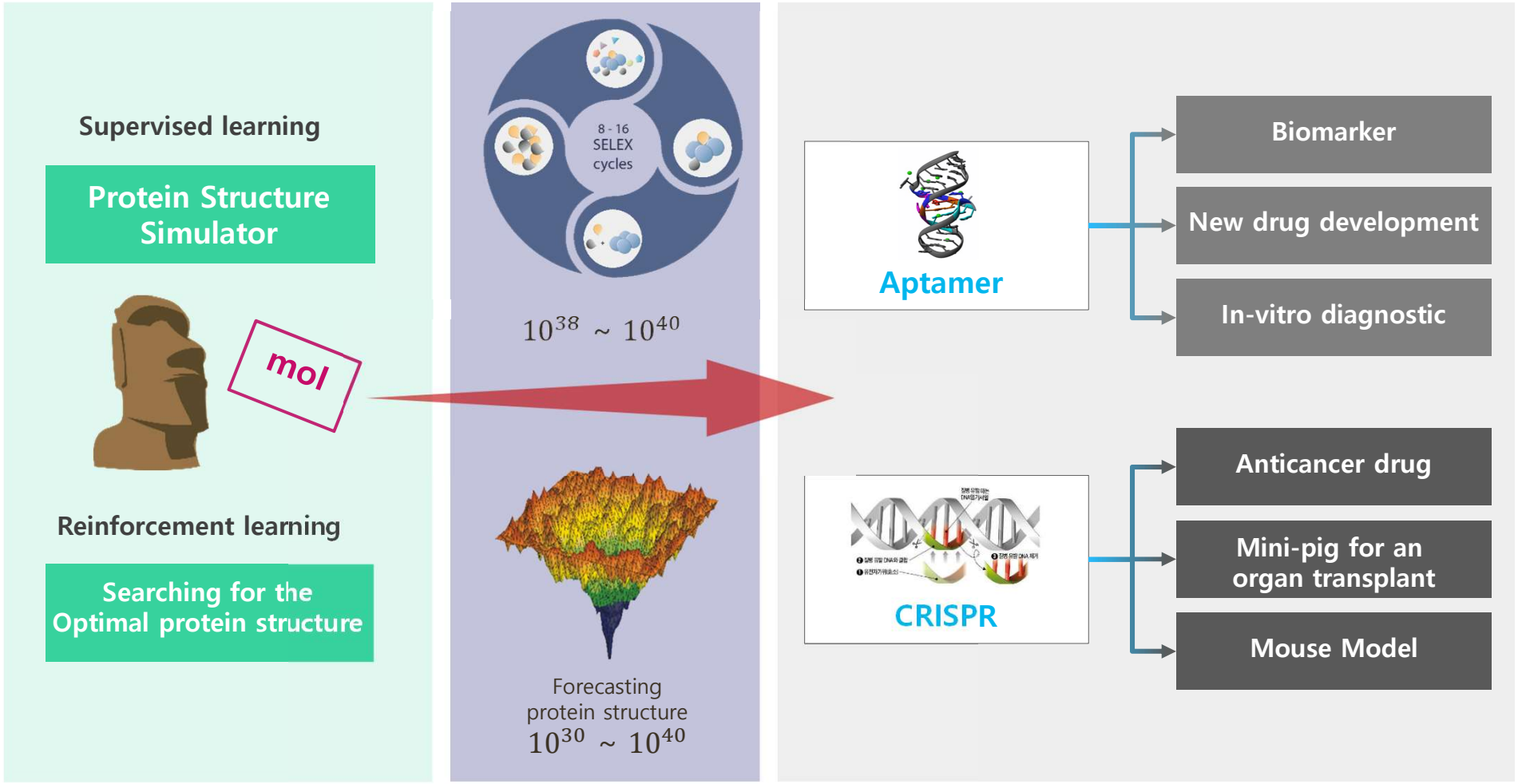
- Applying Mobiis' artificial intelligence protein analysis engine to the bottleneck in development of CRISPR and Aptamer, Mobiis offers the solution to search for the optimal library.

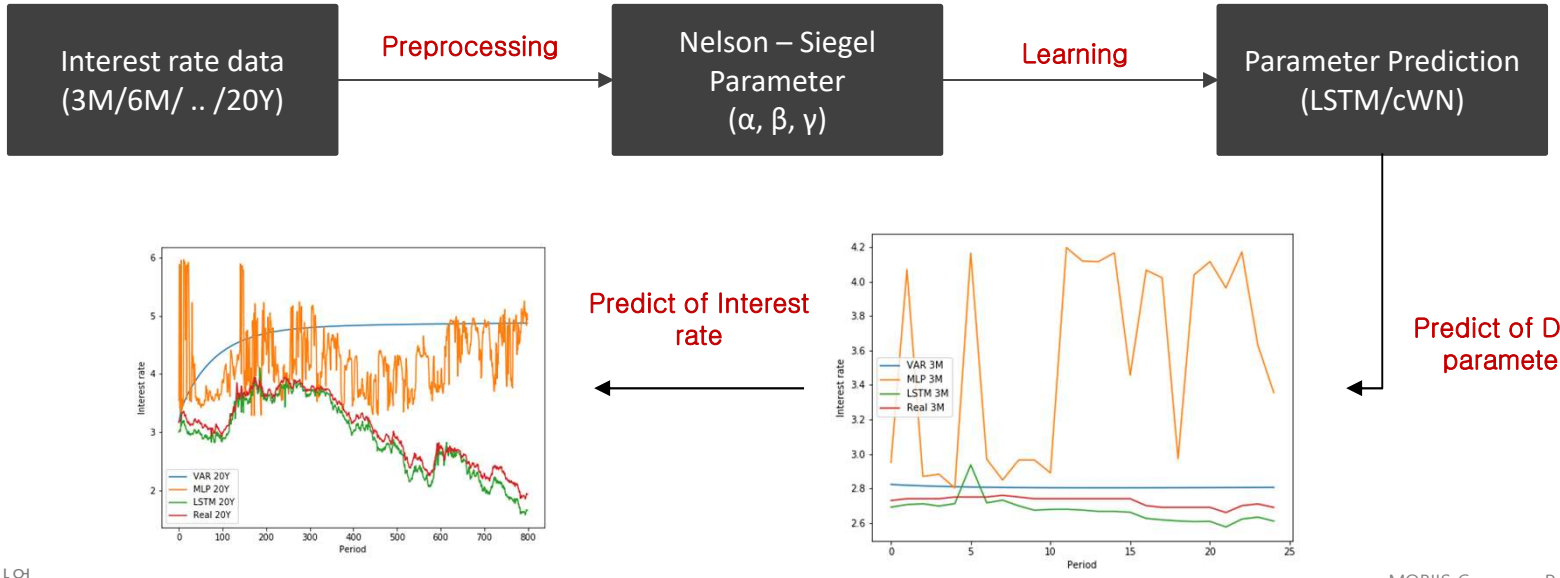


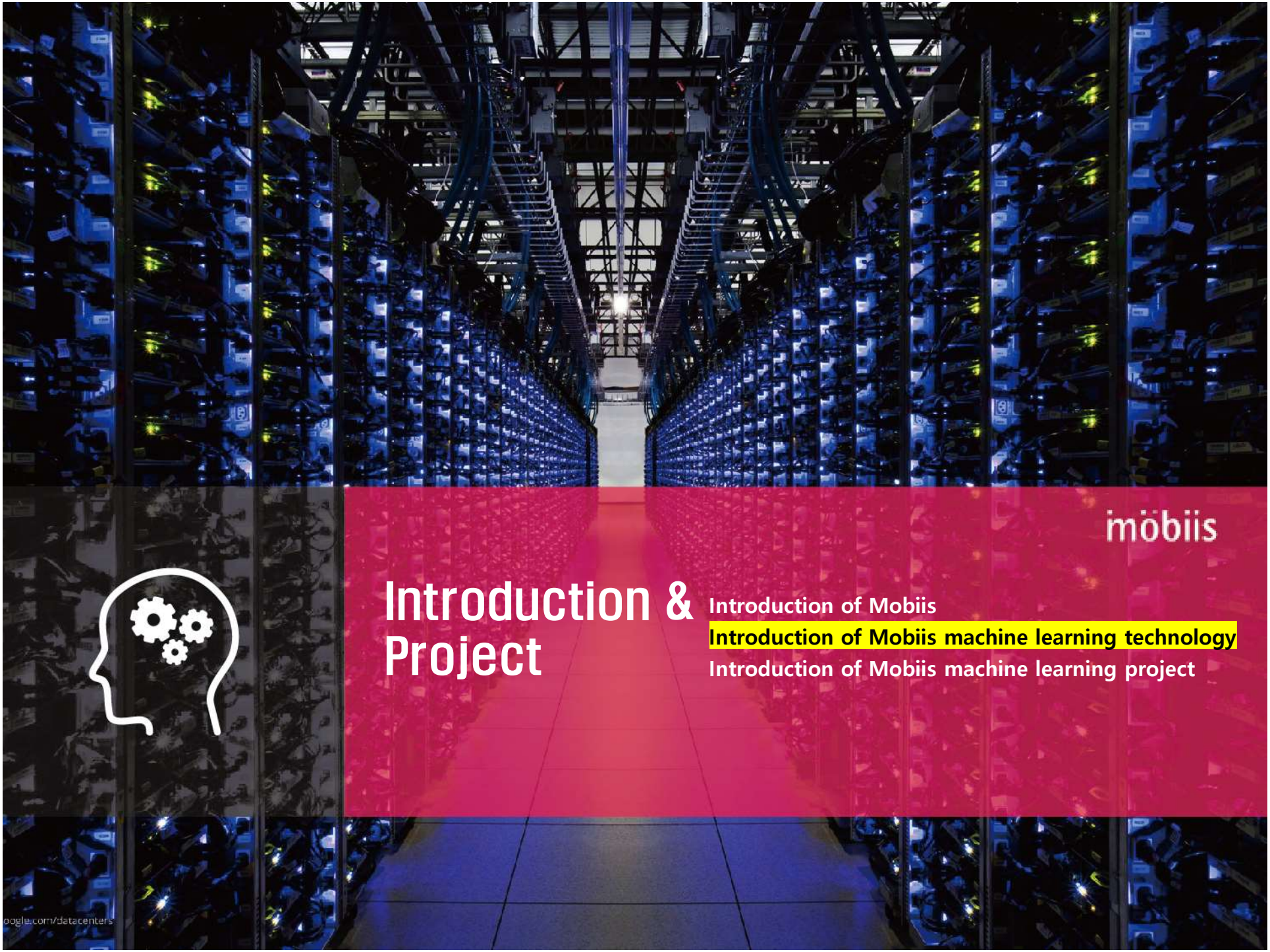
MOI Solution | Bottle Neck | The CRISPR and Aptamer technology

02 Machine Learning Business – Finance

- Our business applies artificial intelligence model to the parts of asset allocation and factor decomposition in the asset management system of financial companies.
- It offers more reliable analysis information than the traditional method of factor decomposition and increases the efficiency of asset management with feedback.
- It gives more rational and accurate benchmark by applying reinforcement learning model to the asset allocation system used for the benchmark of asset distribution and reflecting various market scenario and condition.

Data Preprocessing

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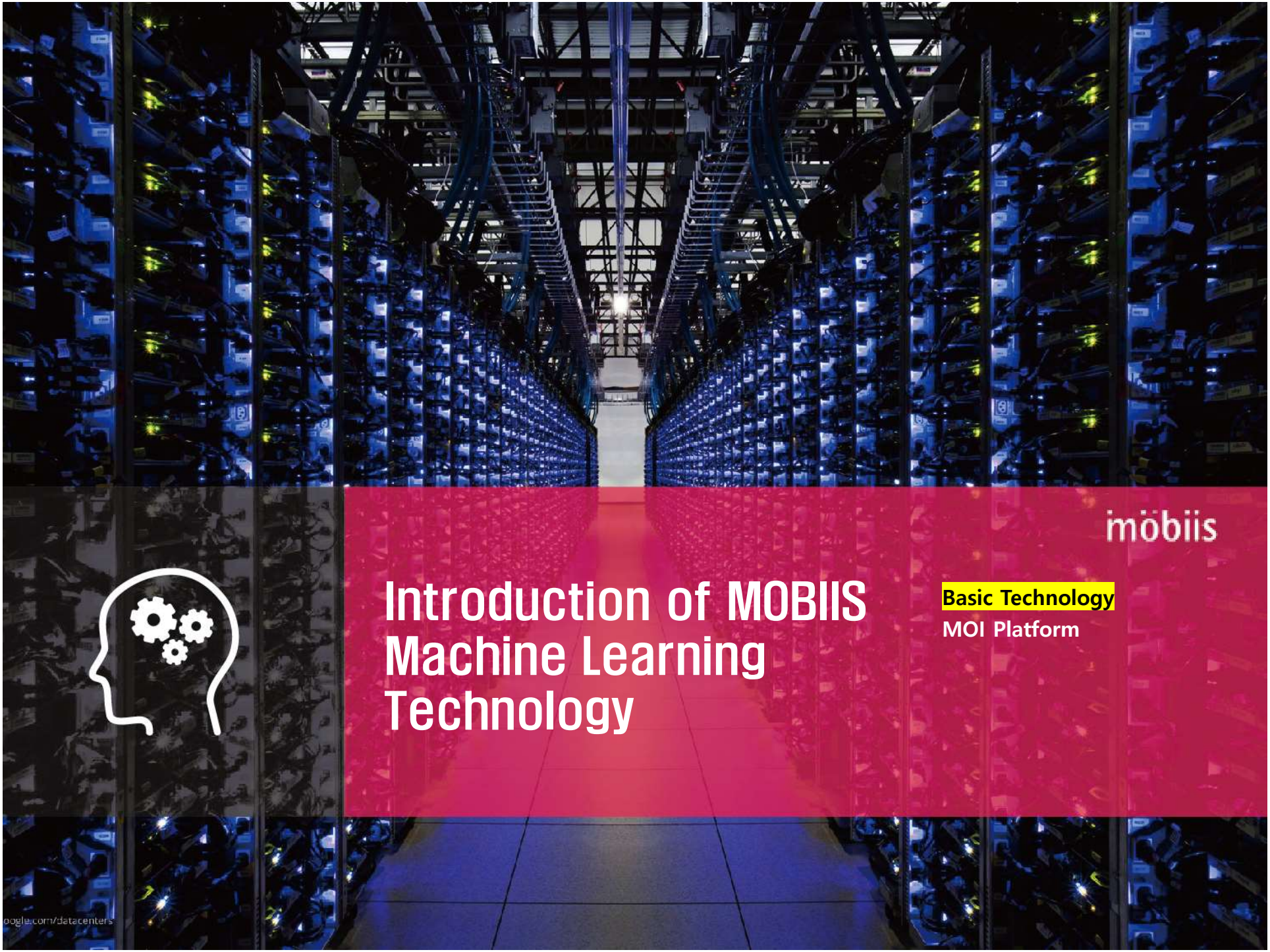

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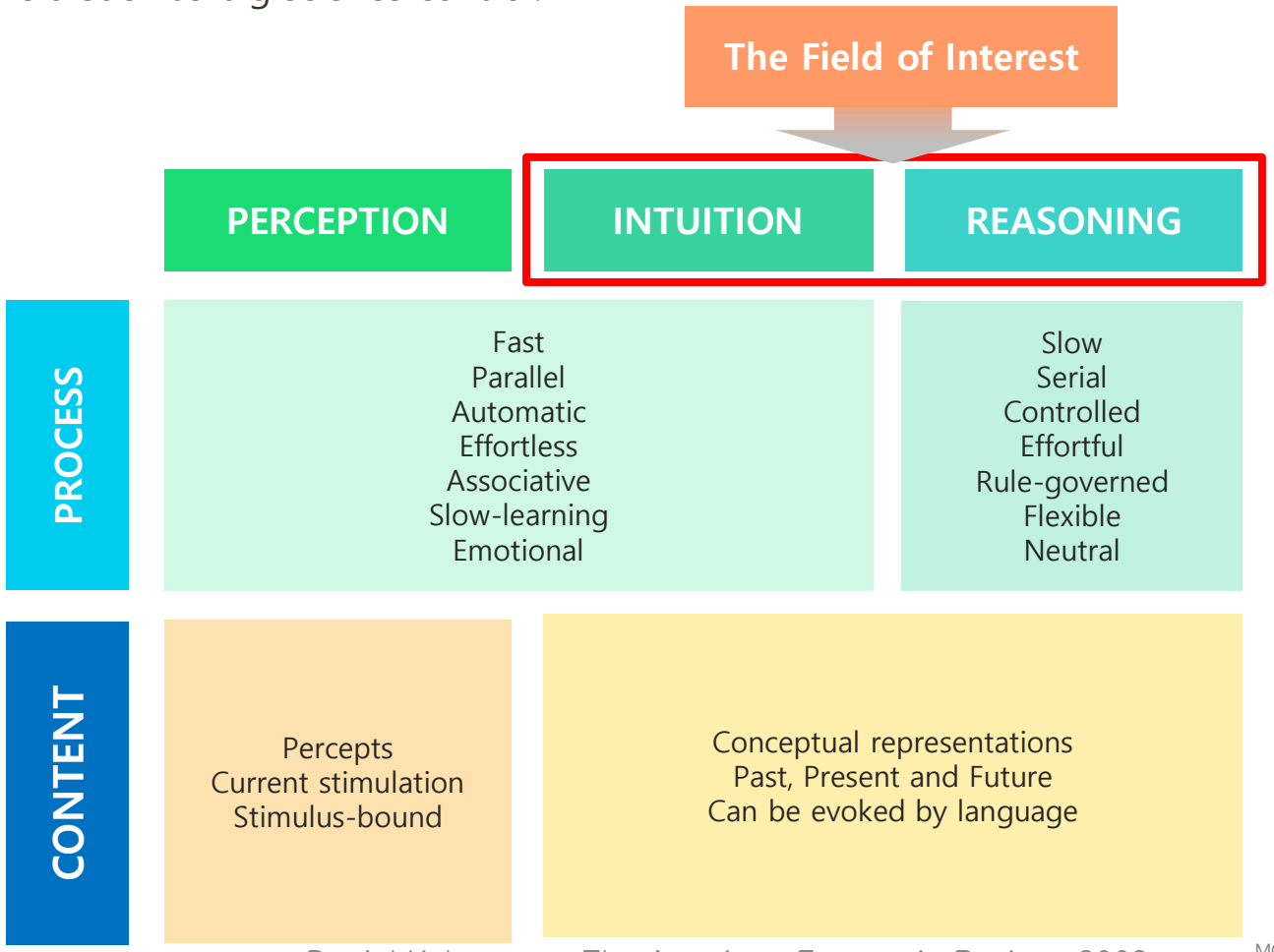
Introduction of MOBIIS Machine Learning Technology

Basic Technology

MOI Platform

MOBIIS Interest

- Many AI research enterprises in Korea focus on the field that replaces human perception, such as voice recognition, image recognition, and natural language processing, which is easily adapt to real life. However, Mobiis is concentrating on researching and developing technology that substitutes for human experts' intuition and deduction in the high-tech research field such as big science control.



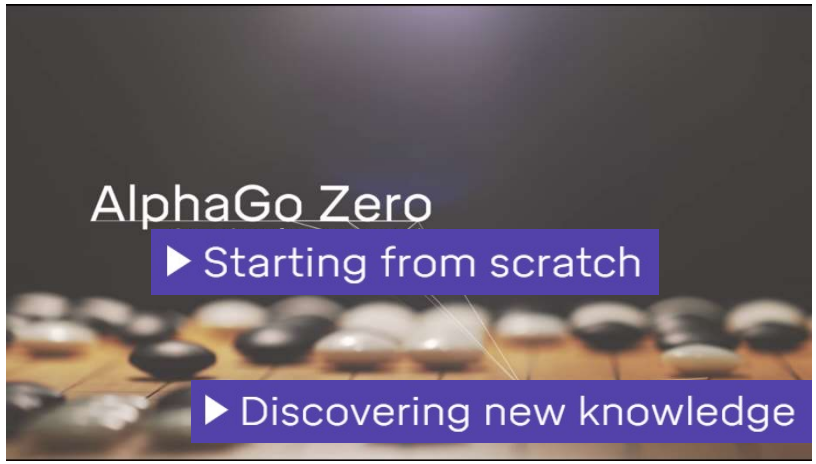
Daniel Kahneman, The American Economic Review, 2003

Basic Idea

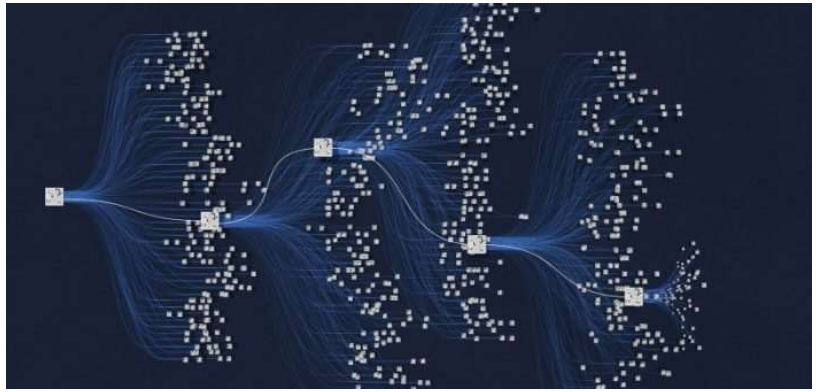
mobiis

- **Tabula rasa, which doesn't learn the know-how of human experts**

Accelerator control system, nuclear fusion control system, and CRISPR/Aptamer development have the problem which is associated with optimizing more combinations then Go; this field has a complicated interlink but the implicit abstract rules as well, such as standard procedure of Go. Applying the methods used in Alphago Zero, we can use General AI in this field.



Self-Play



	Number of cases
Go	$< 2 * 10^{170}$
Big Science	$< 10^{100}$
Bio	$< 10^{40}$
Asset Distribution	$< 10^{30}$

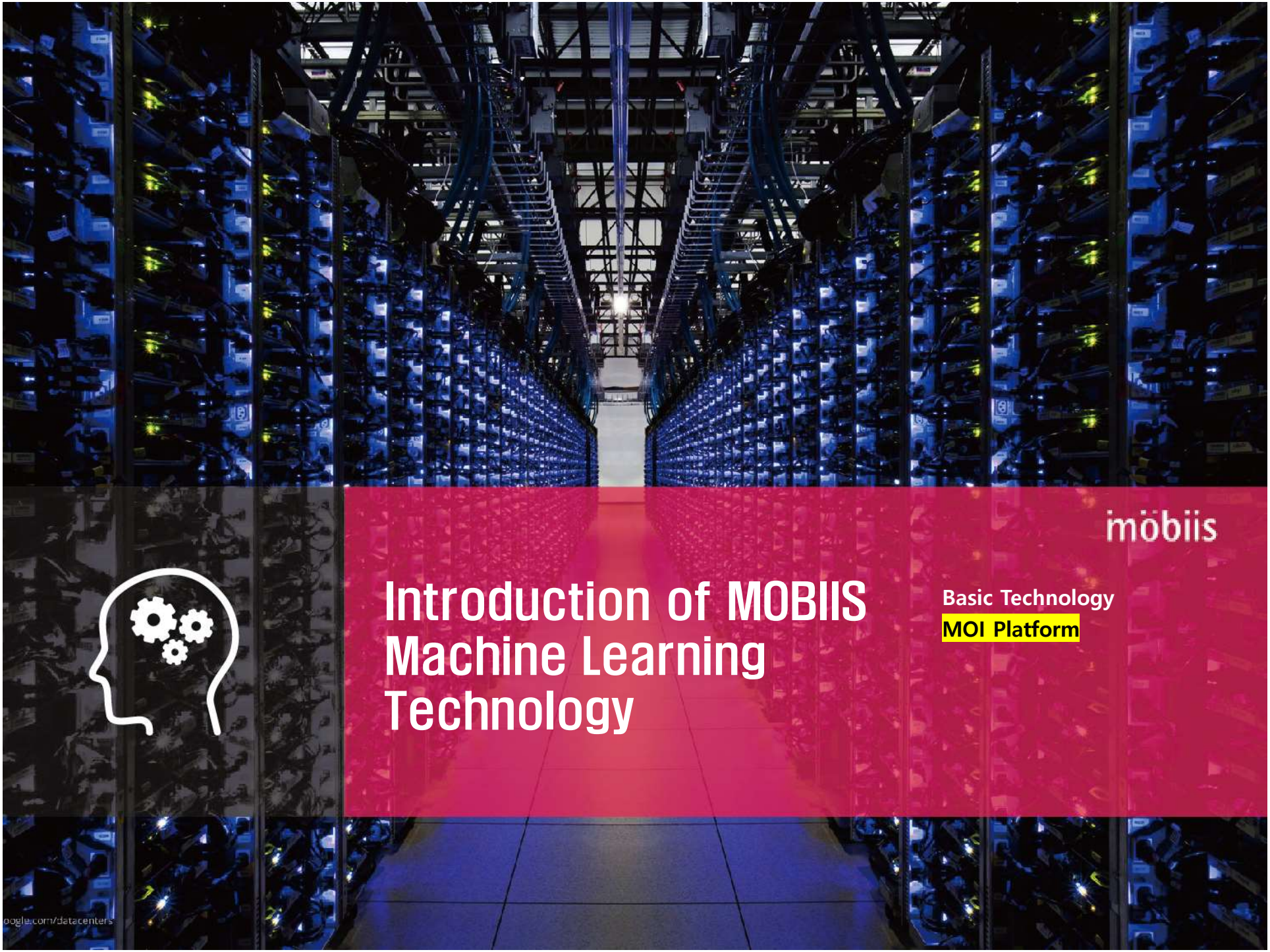
Machine Learning – Mobiis' Approach

- In the field of Big Science Control System, such as accelerator and nuclear fusion, human experts are difficult to find the optimal control variable due to the complexity of physics model and too many number of combinations(> 10^{100})
- Our business is optimizing by the estimation based on partial simulations and operational know-how during the long period.

AlphaGo Zero Algorithm

MCTS + Reinforcement Learning +Deep-Learning

- The version of Alphago Lee of Deepmind that played against Lee Sedol in 2015 searched the high-probability winning moves by using human experts' data larger than 10 million games and artificial intelligence technologies based on image recognition.
- Alphago Zero, which is published in Nature on Octbor 2017, won Alphago Lee by not using big data of human experts but only basic rules and its simulation.
- General AI technology can be used in the field that rule exists but optimization is impossible due to many number of combinations.



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Introduction of MOBIIS Machine Learning Technology

Basic Technology

MOI Platform

05 MOI Platform

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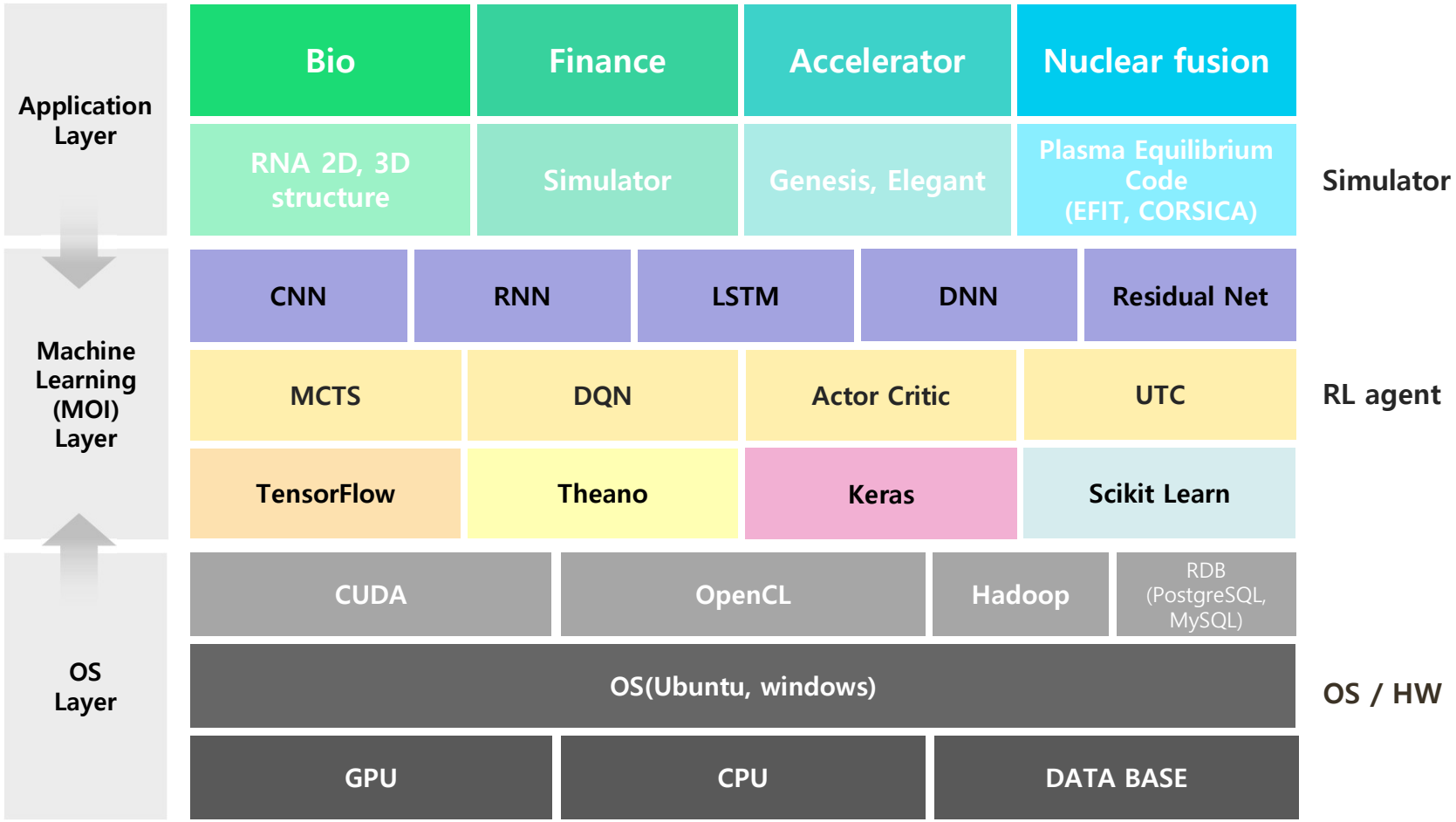
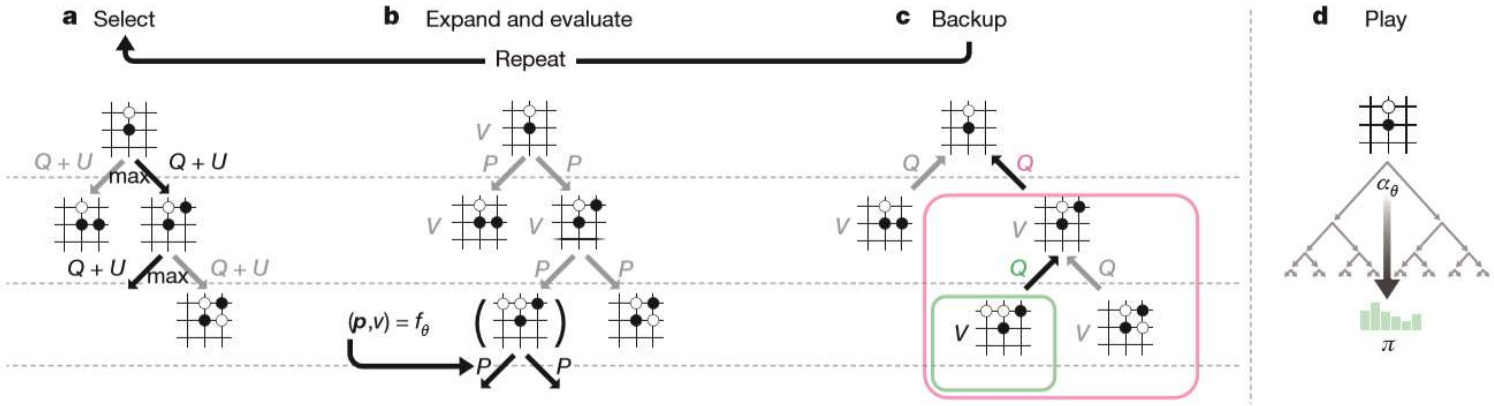
- Mobiis finished the development of artificial intelligence platform MOI. We are performing various projects by interconnecting with our GPU machine, Amazon Web Service, and Google Cloud Platforms.



MOI Platform Algorithm

- The method of Alphago Zero is not to calculate the optimal moves based on knowledge of human experts, but to make simulated database by self-play and optimize based on it.
- In order to optimize MCTS algorithm, this method shows that dataset by self-play can be evaluated from random level to the expert's level using Policy Network and Value Network.



MOI Platform Algorithm

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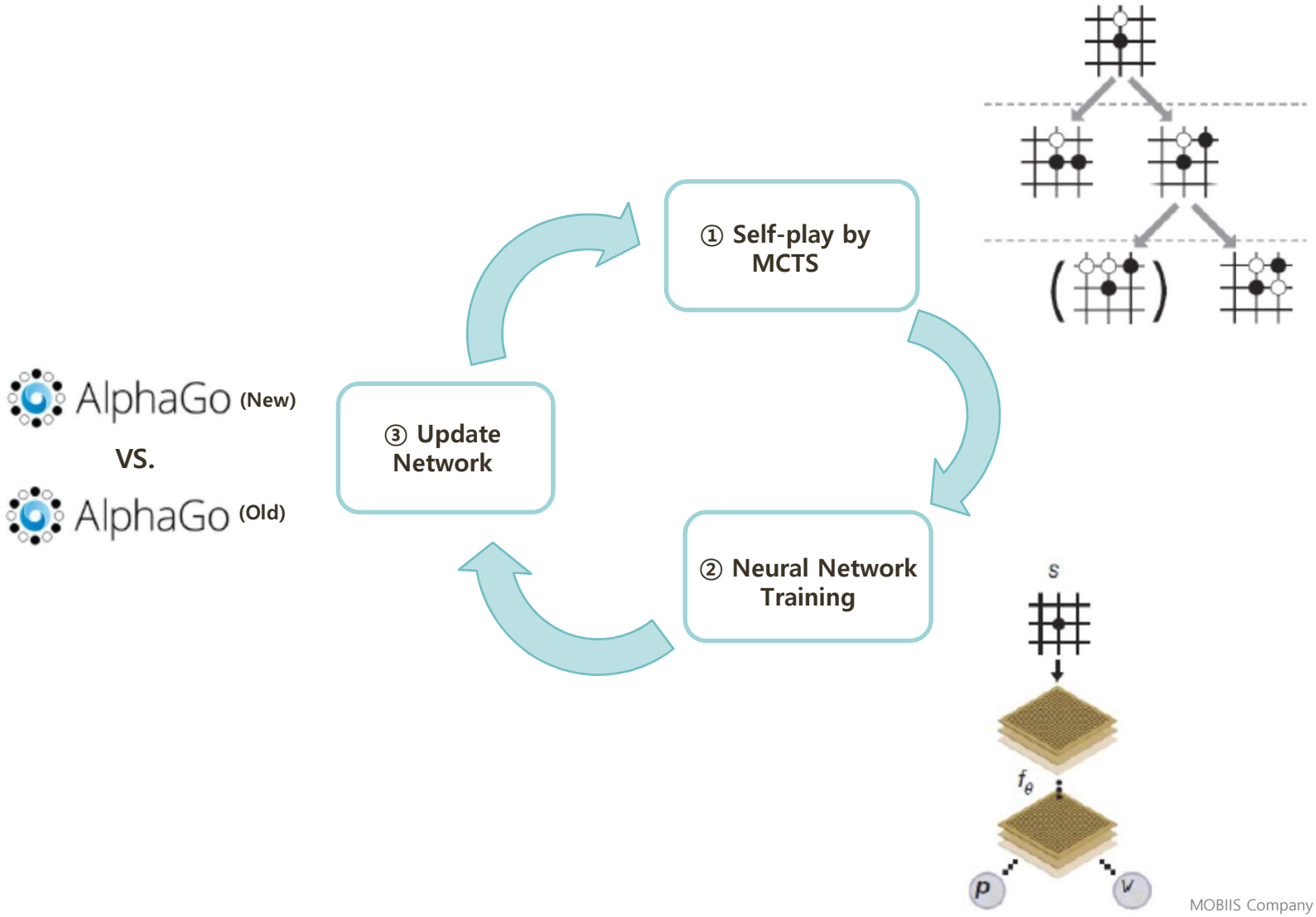
- The whole reinforcement learning process of Alphago zero, which is the base theory of Mobiis, is summarized as follows.



MOI Platform Operation

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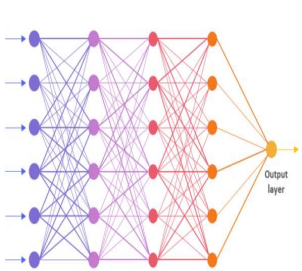
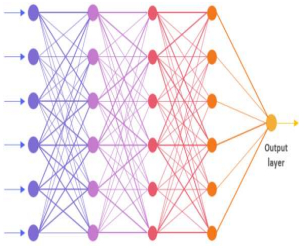
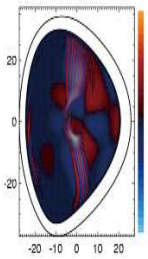
Medicine Simulator

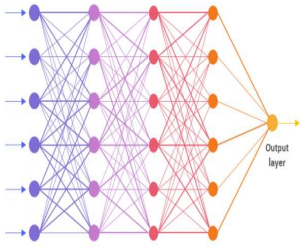


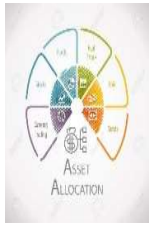
Big Science Simulator





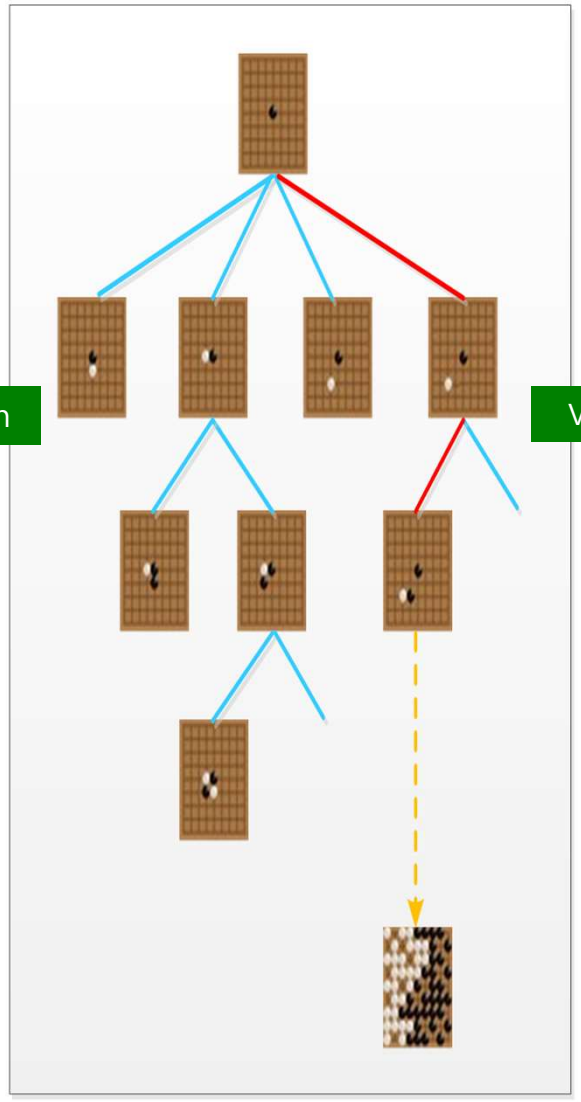
Asset Management Simulator





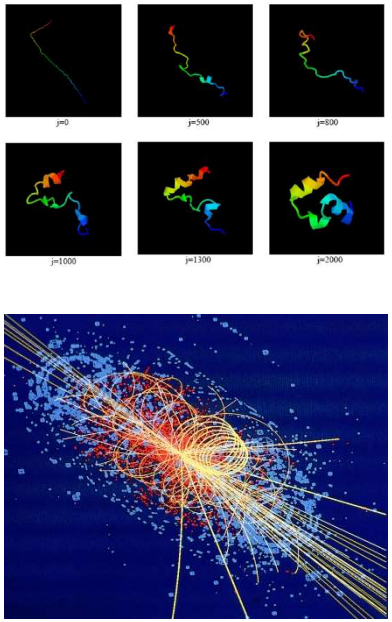
Data preprocessing in several fields and simulator manufacture

Evaluation

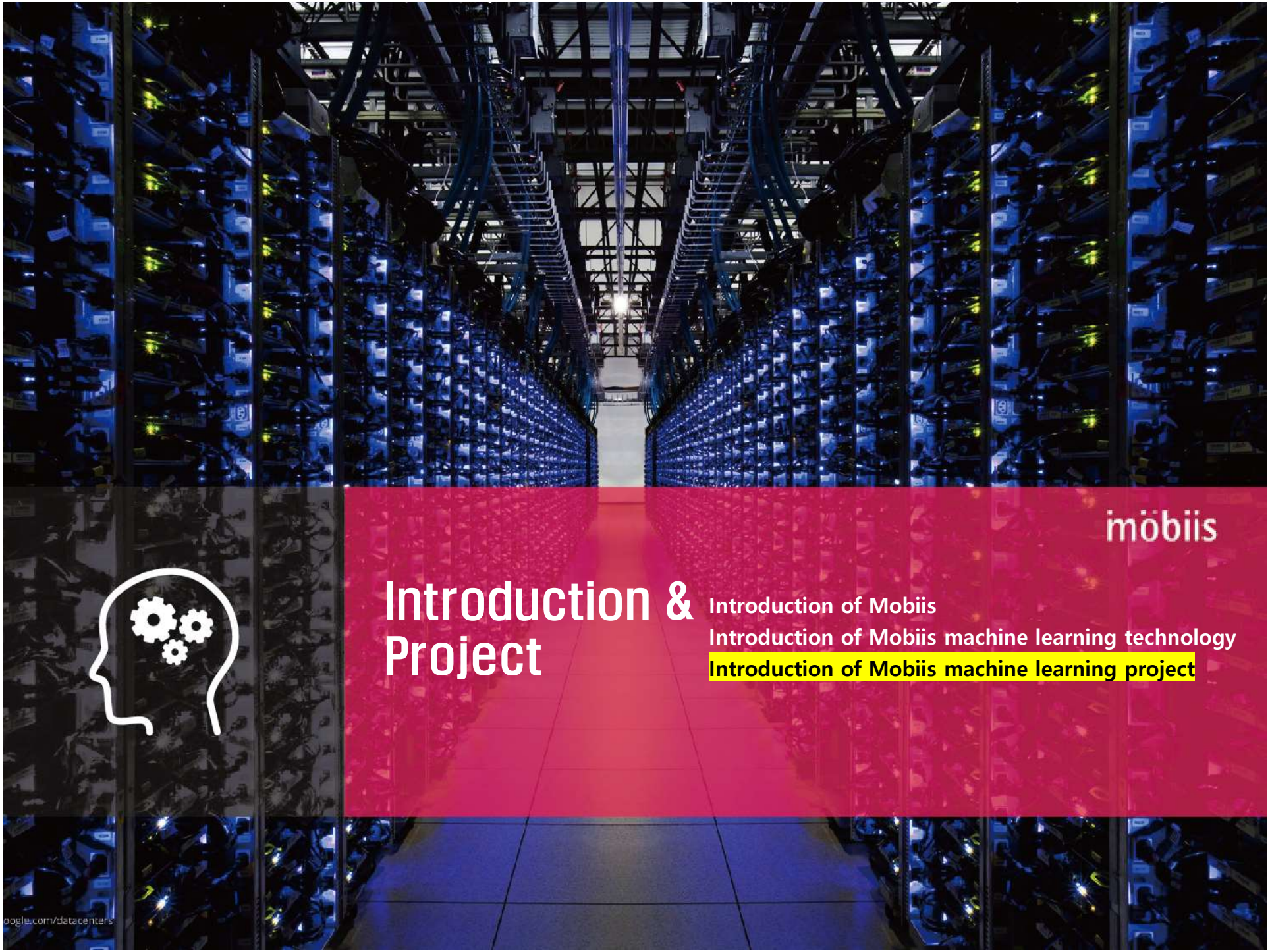


Reinforcement Learning using simulator

Validation



The verification through real data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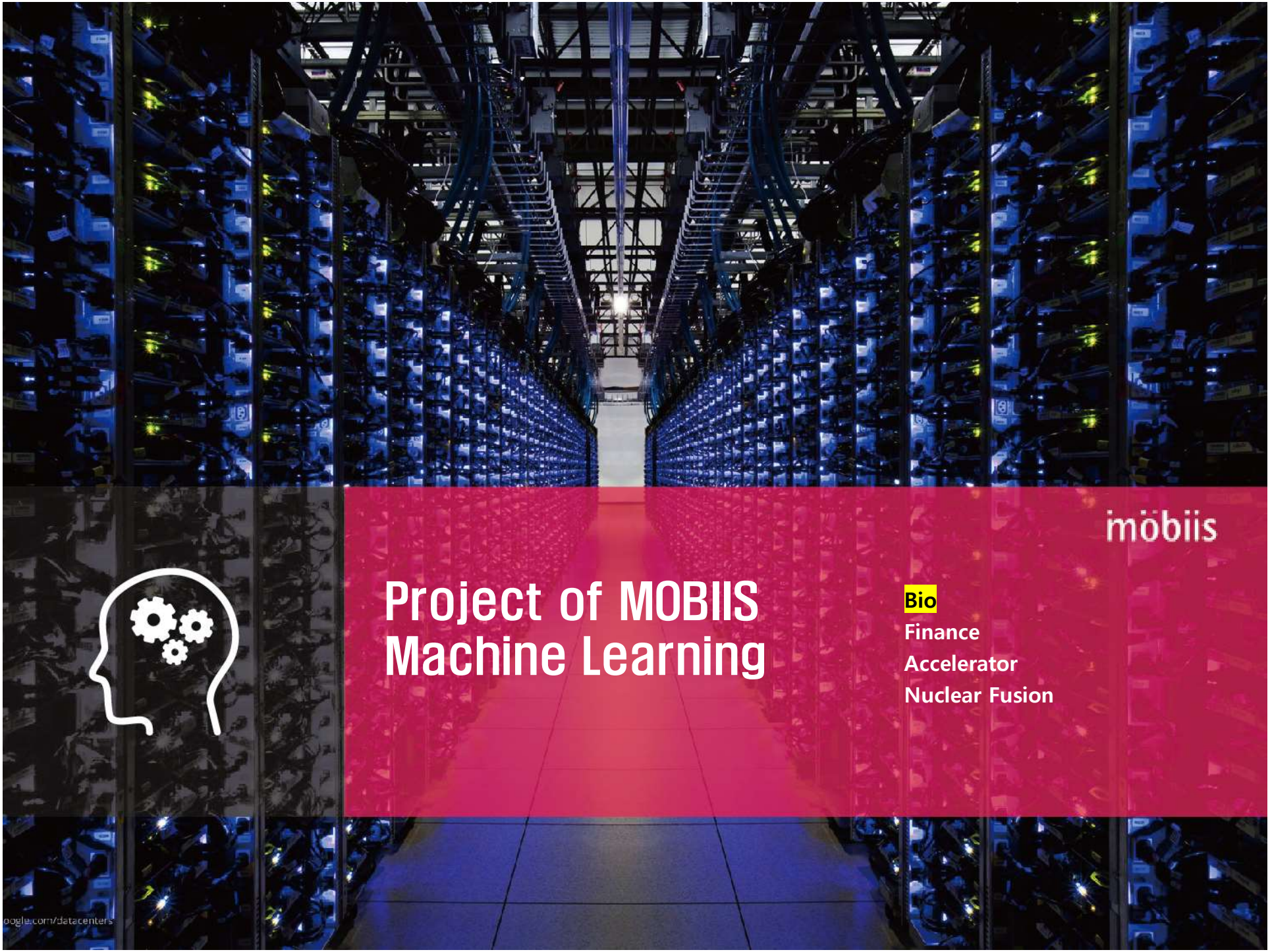
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Accelerator
Nuclear Fusion
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The Problem of CRISPR

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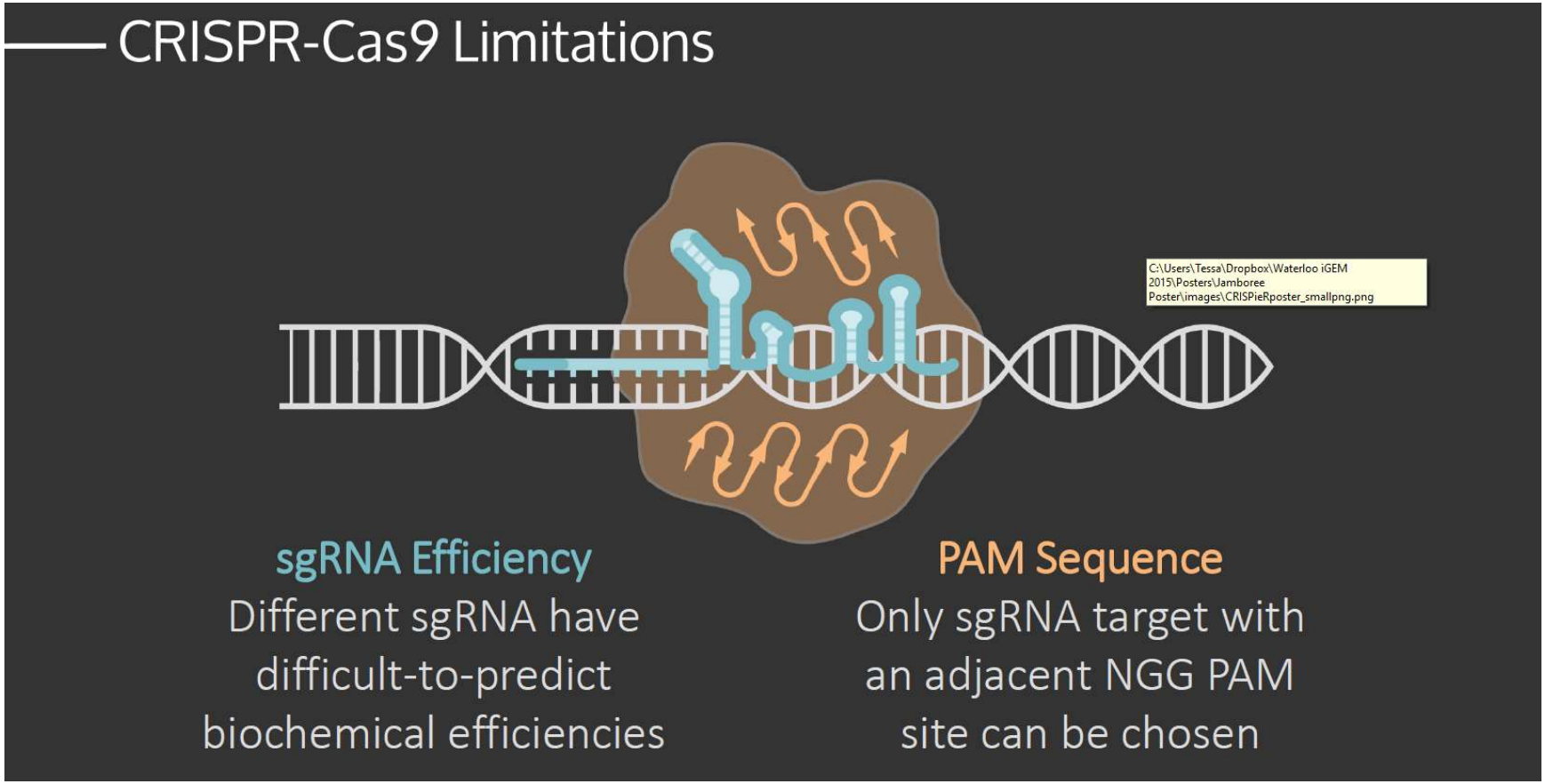
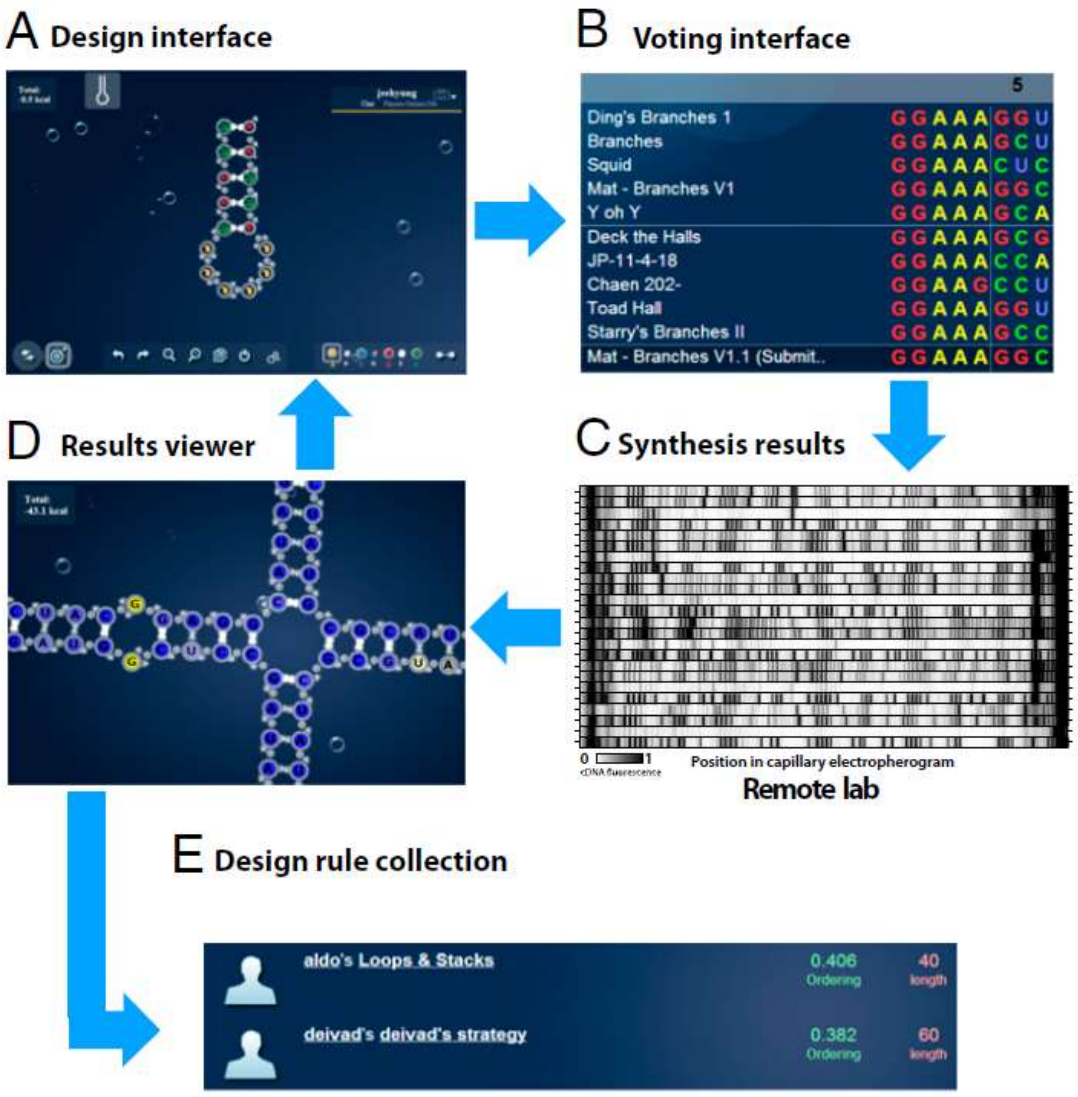


<Optimized sgRNA design to maximize activity and minimize off-target effects of crisPr-cas9 >

Other Approach : Eterna Game Approach – Citizen Scientist

www.eternagame.org

Other Approach : Eterna workflow



Problem of RNA Secondary Structure Prediction

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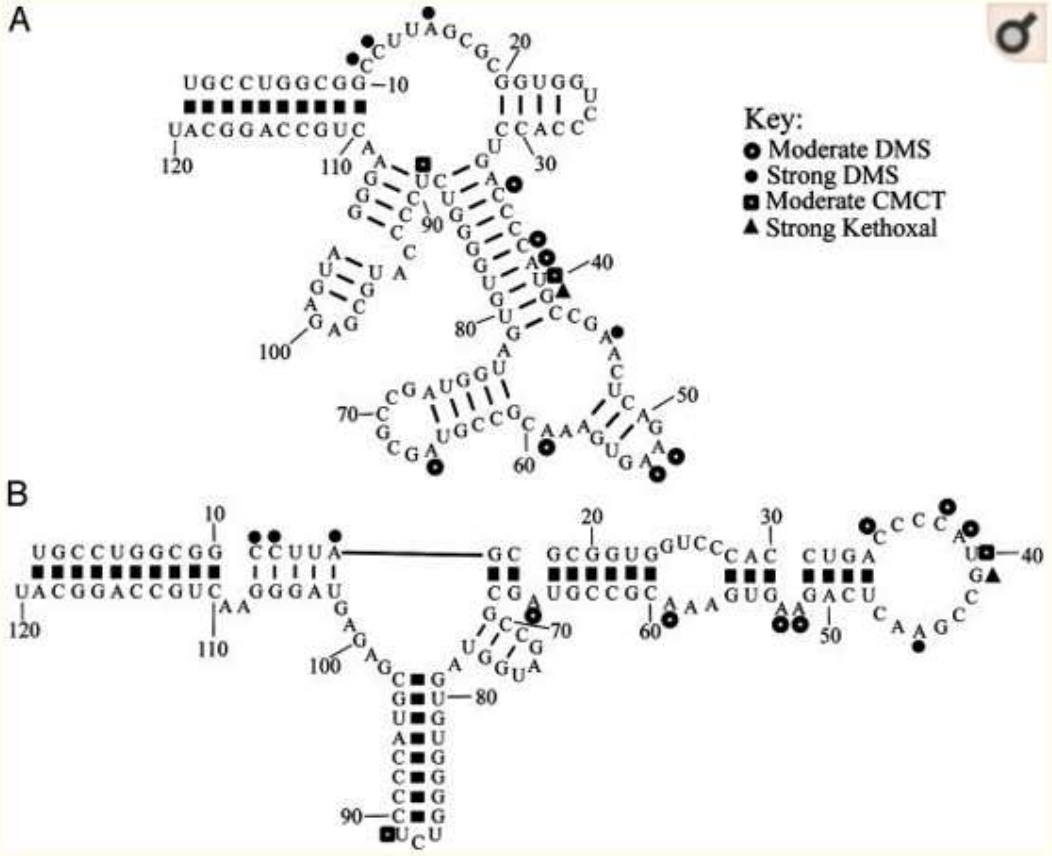

Fig. 1.

The *E. coli* 5S rRNA secondary structure predictions and chemical modification. Heavy lines indicate base pairs in the known secondary structure (76, 88). (*A*) The predicted lowest free energy structure without experimental constraints. (*B*) The structure predicted with constraints from chemical modification data specified.

RNA Secondary Structure Algorithm

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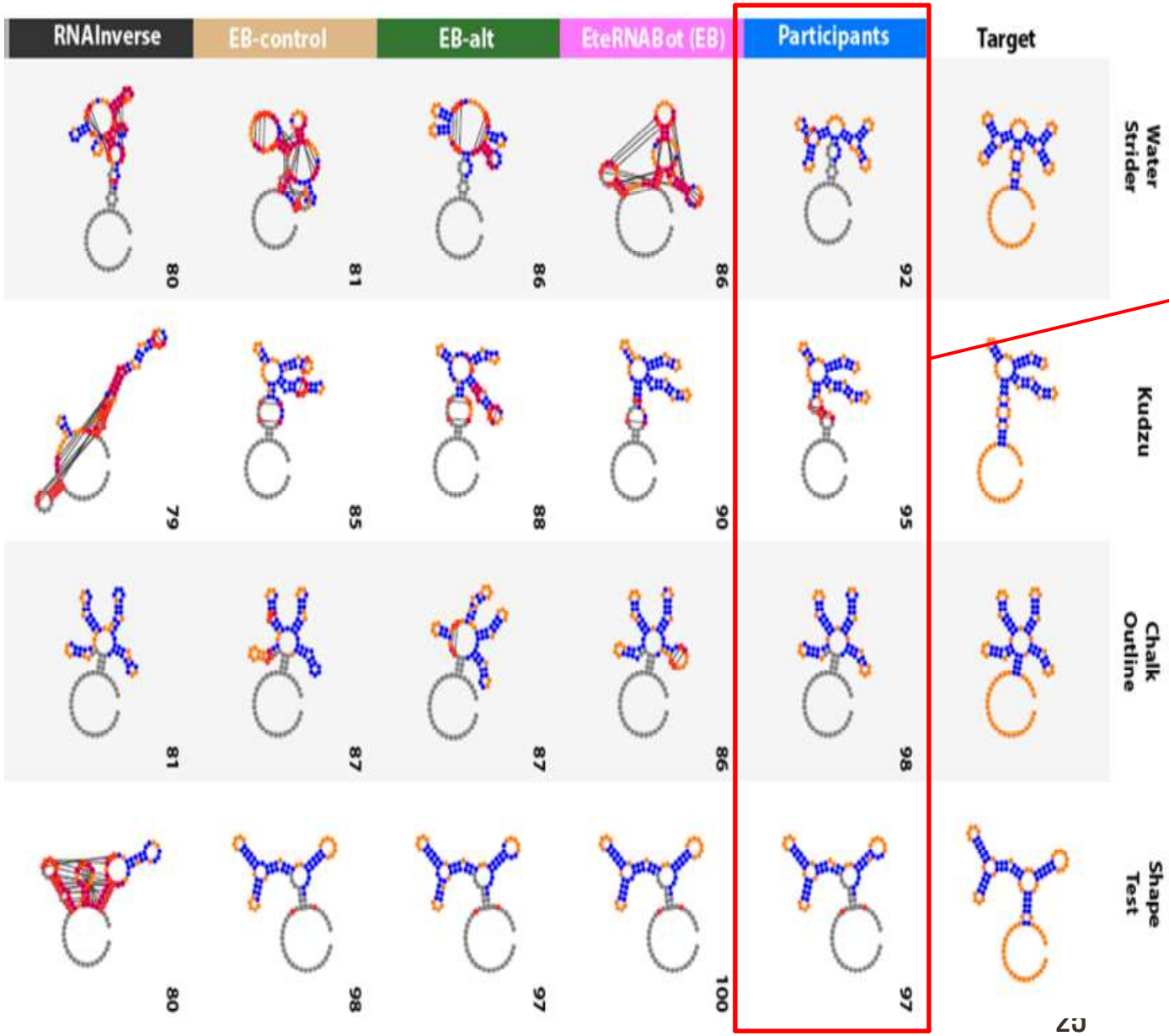
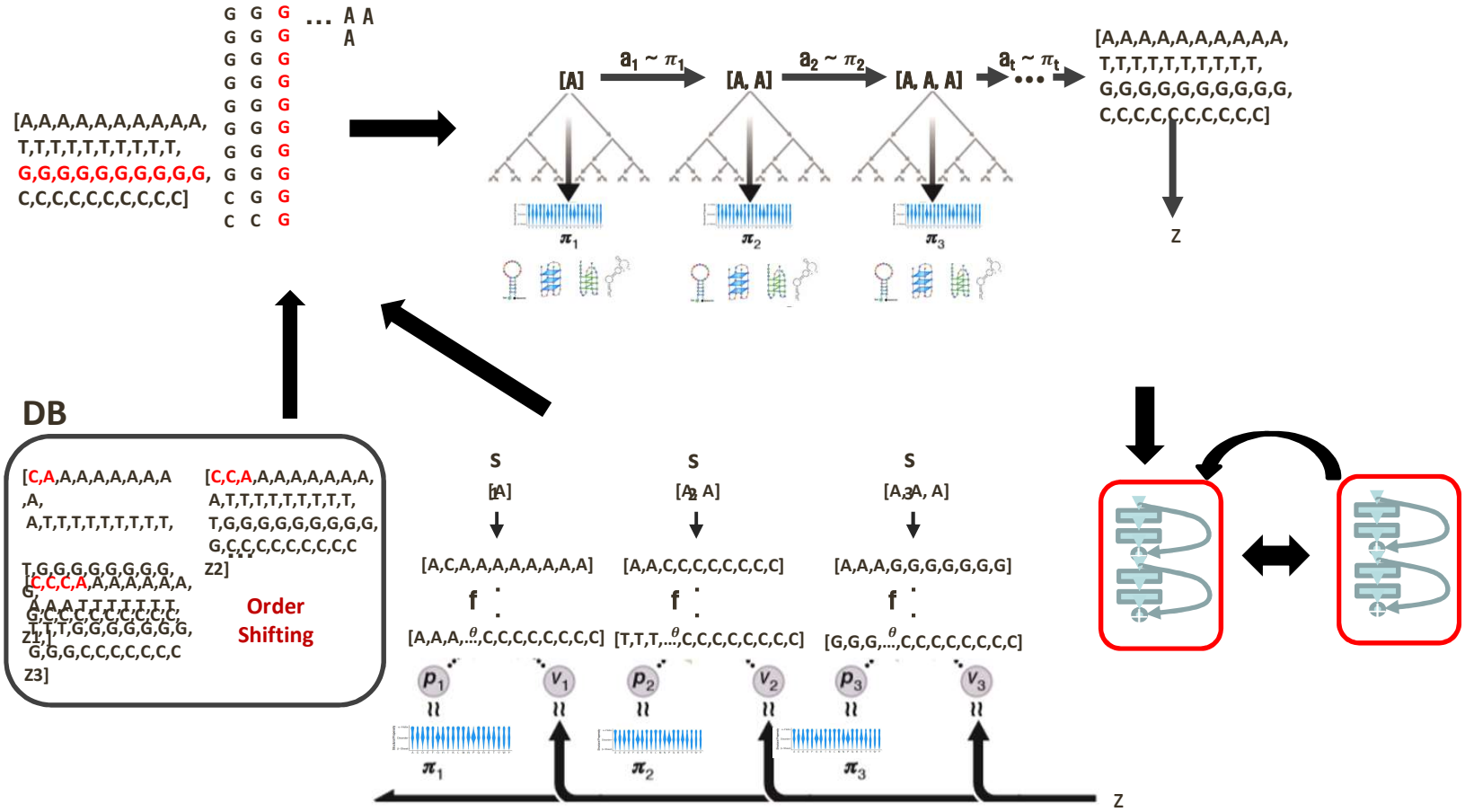


Eterna game participants

MOI platform for Bio



Machine Learning Simulator

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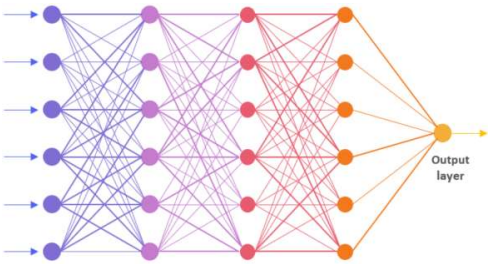
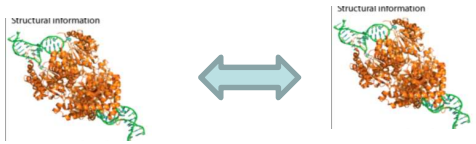
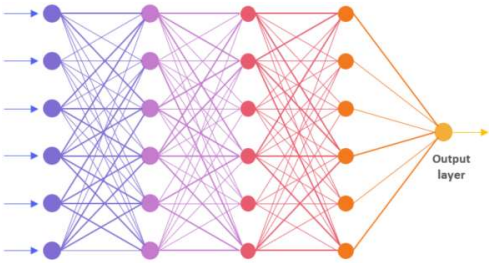
Secondary Structure Simulatior

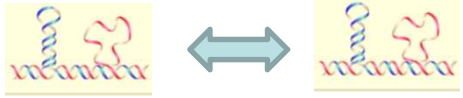


Learning of Bio Simulator

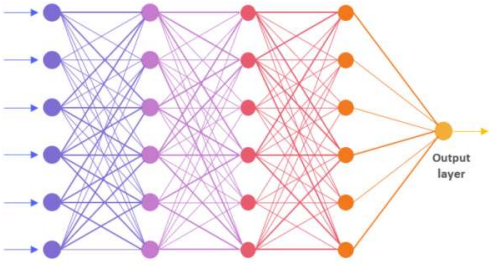


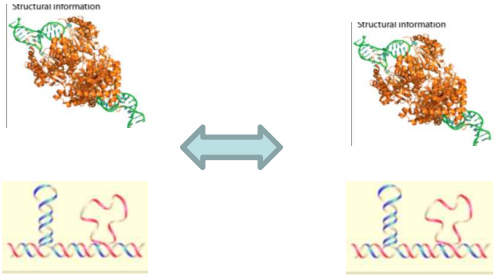
3D Structure Simulator





Known Bio DB





RNA Structure DB

Application Poject - Mouse as a Model Animal

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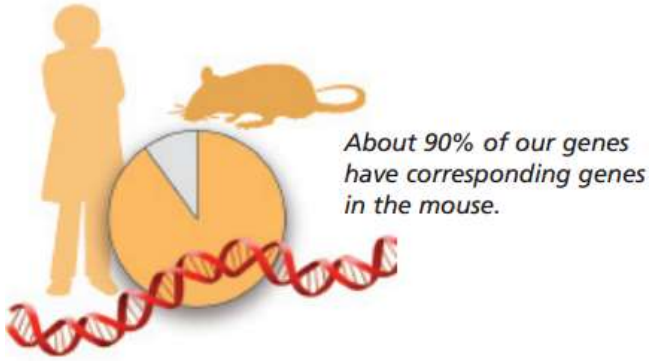
Same size genome: about 3.1 billion bp

One-to-one gene correspondence



High degree of genetic and physiologic similarity

Identical organs, tissues, and cells

High rate of breeding

Cost of maintenance

The technique for which this year's Nobel Prize is awarded makes it possible to modify nearly all mouse genes. The most common alteration is to eliminate a specific gene, thus creating a knockout mouse.

Genetically Modifiable → GEM
→ Mouse Models for Human Disease

28

Application Project – Mouse Modelling

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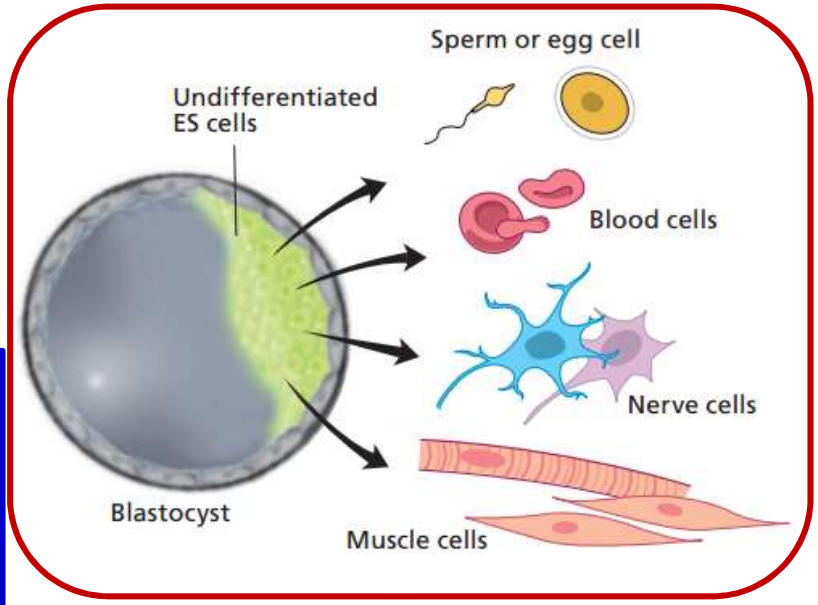
The Nobel Prize in Physiology or Medicine 2007

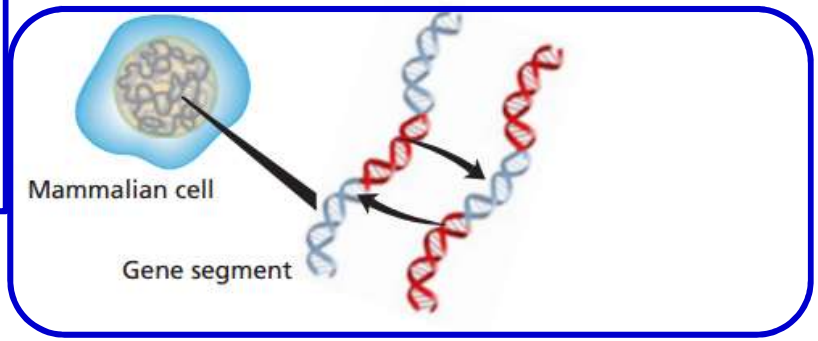

Photo: U. Montan
Mario R. Capecchi


Photo: U. Montan
Sir Martin J. Evans

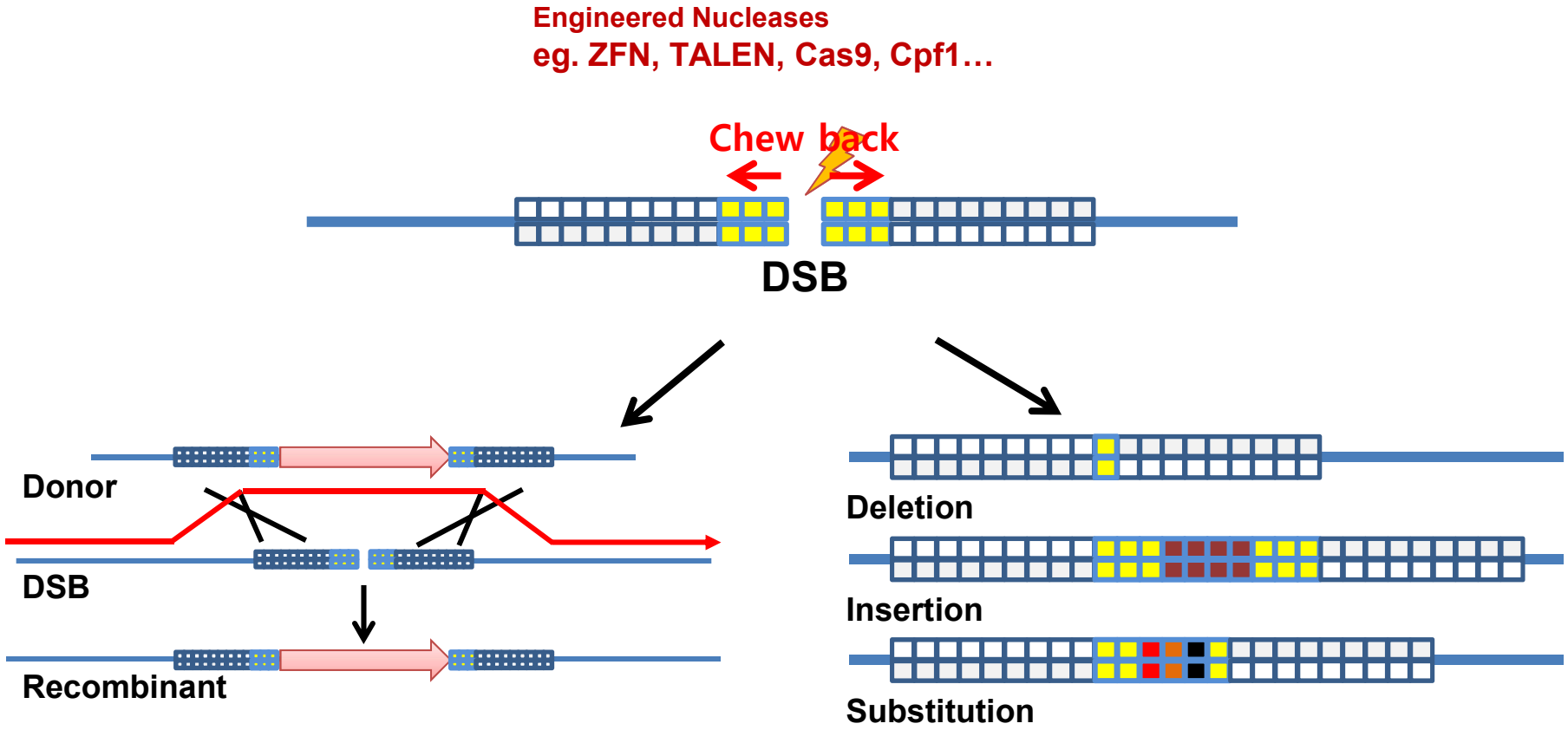

Photo: U. Montan
Oliver Smithies

The Nobel Prize in Physiology or Medicine 2007 was awarded jointly to Mario R. Capecchi, Sir Martin J. Evans and Oliver Smithies *"for their discoveries of principles for introducing specific gene modifications in mice by the use of embryonic stem cells"*.





Application Project - Mutations Induced by Engineered Nucleases



Error-free/low efficiency

Homology-directed repair (eg. HR)

Error-prone/highly efficient

Non-Homologous End-Joining (NHEJ)

Application Project - Generation of Knockout Mice Using ES Cells

C57BL/6 (aaXX) x E3.5

Embryo Transfer

1 ~ 1.5 yr

2 ~ 3 mo.

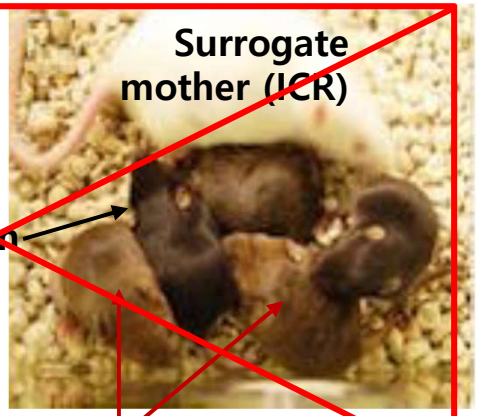
CD1 x 18 days

Vasectomy pseudo-pregnant

Chimeric Mice (aaXX or AAXx)

Sperm (aX, AX, or Ax)

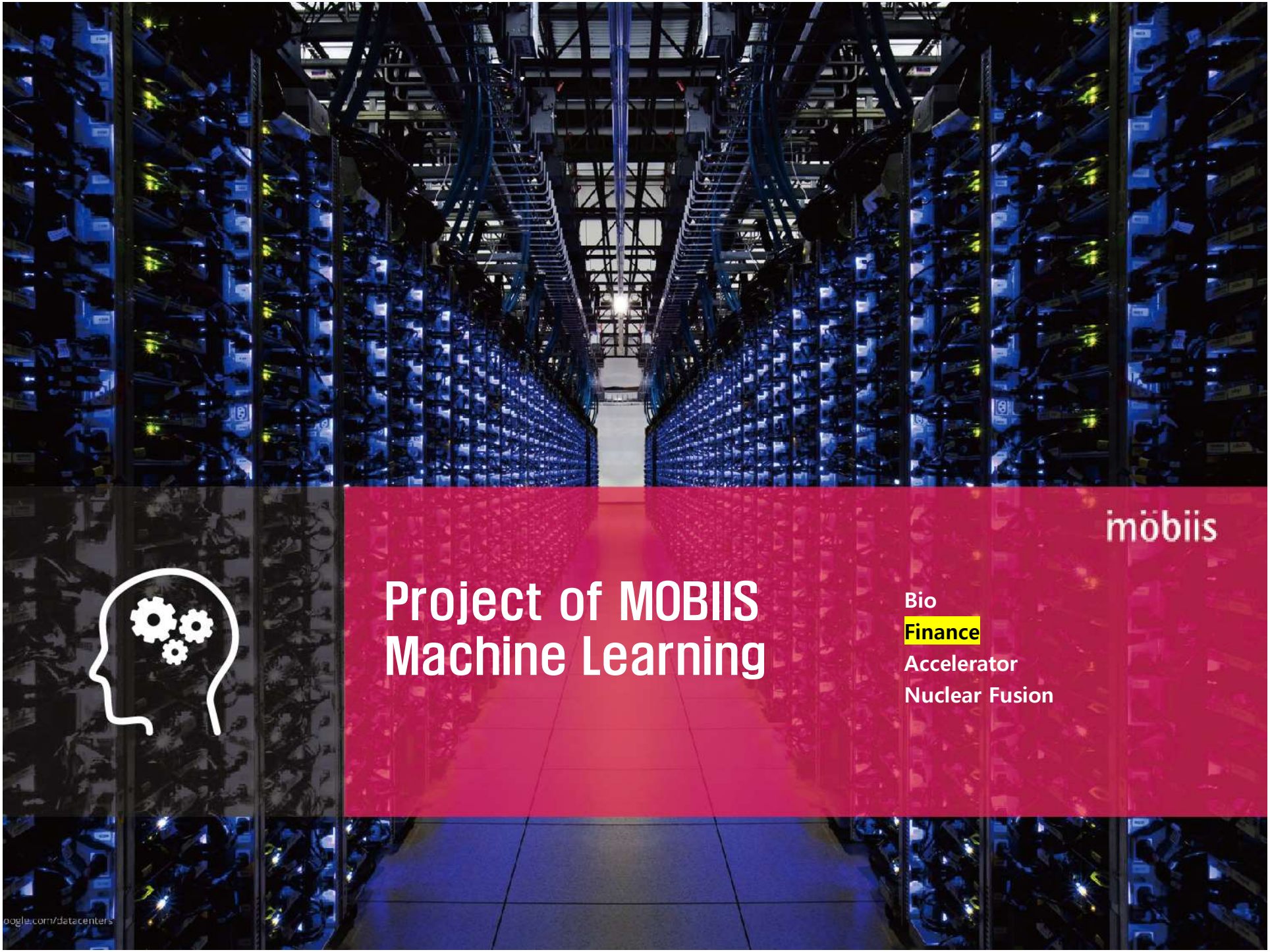
B6 egg (aX) x



Mixed genetic background

aaXX/aaXx

Pure genetic background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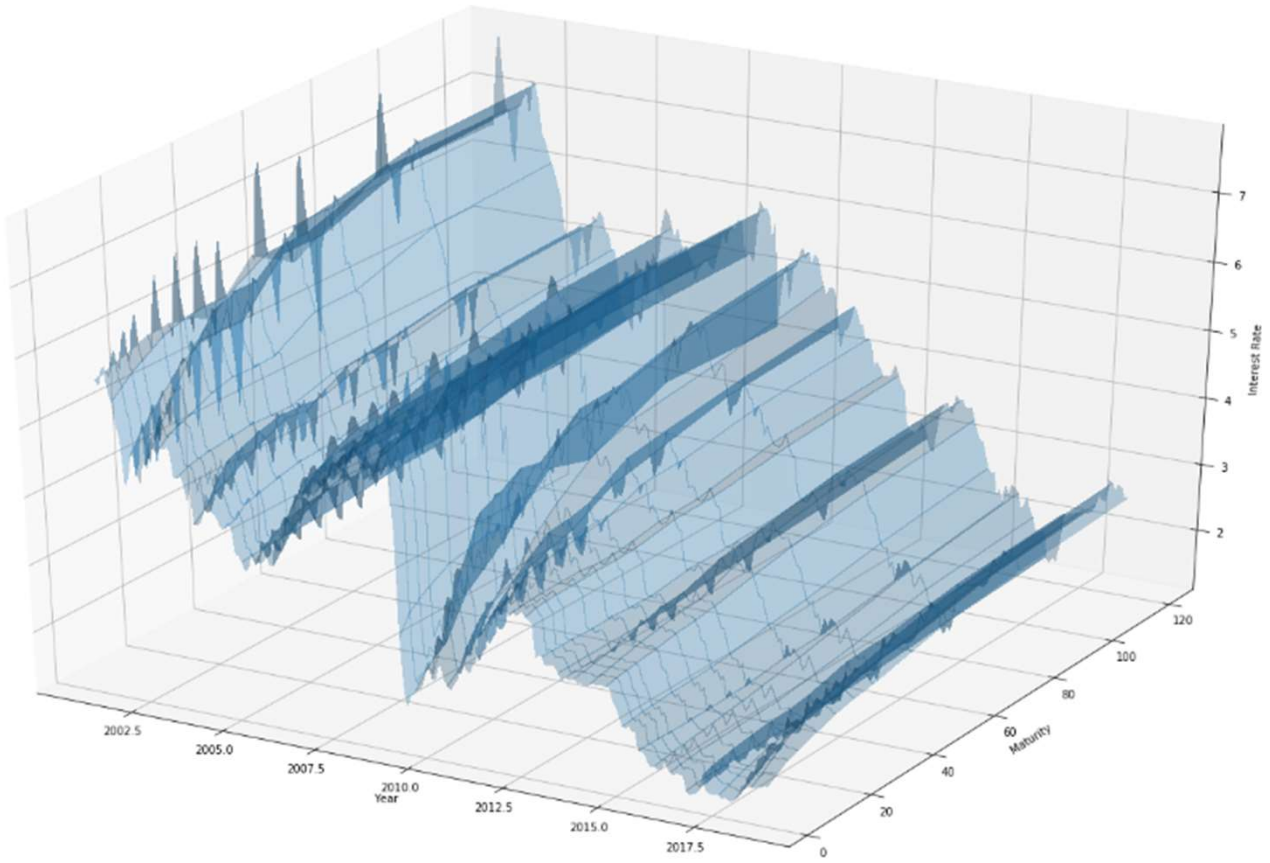
Problem of Yield Curve



Result of MOI Finance

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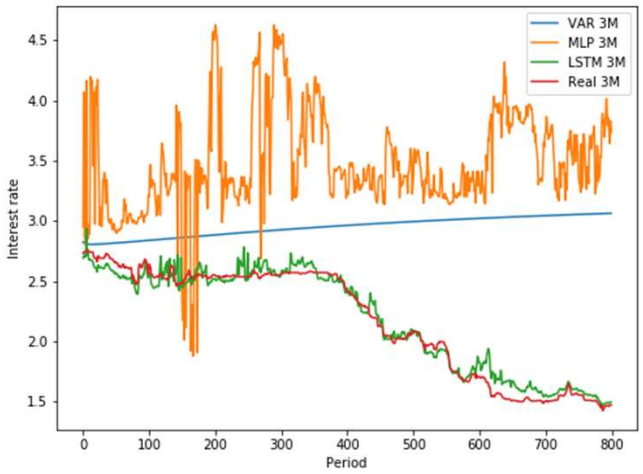
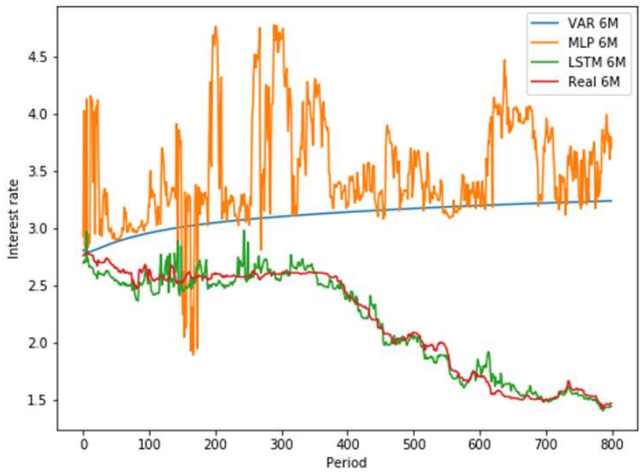
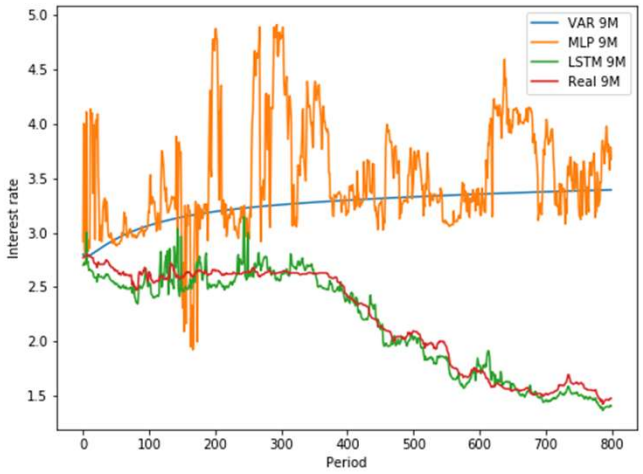
- 800days 예측 결과



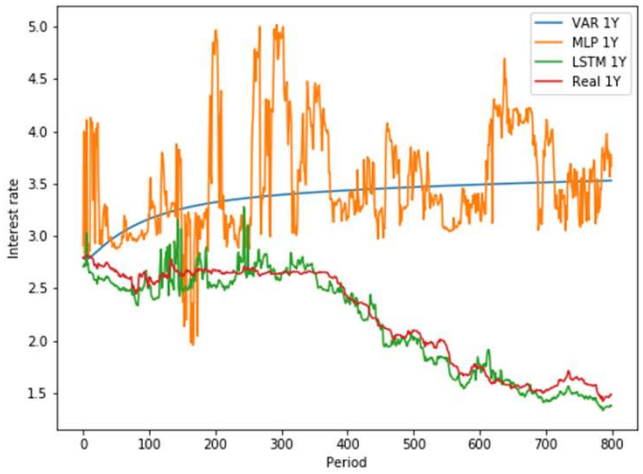
3M



6M



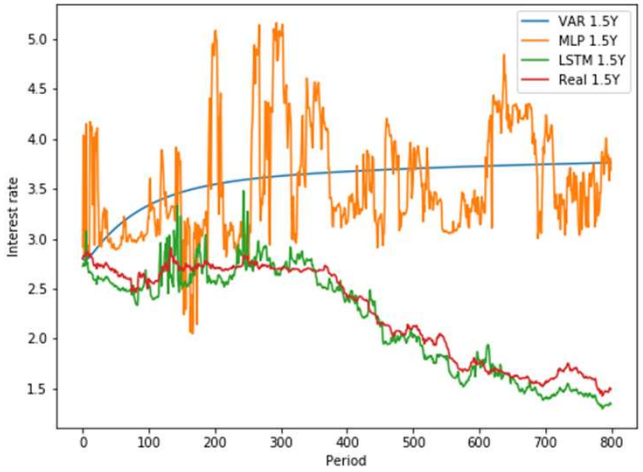
9M



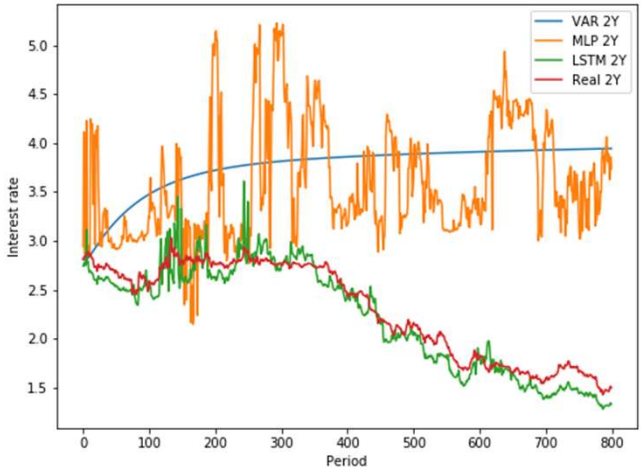
1Y

Result of MOI Finance

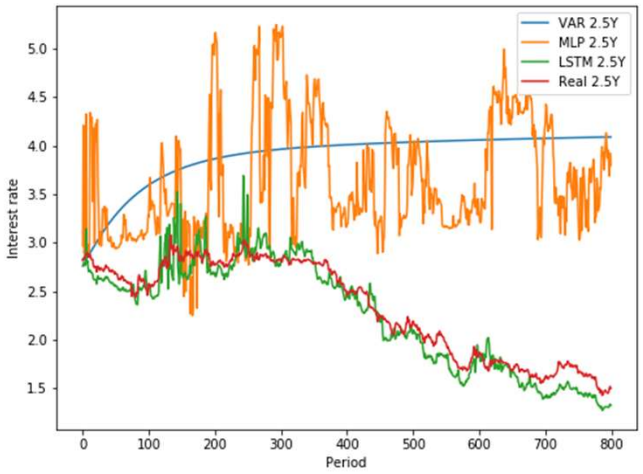
- 800days Prediction



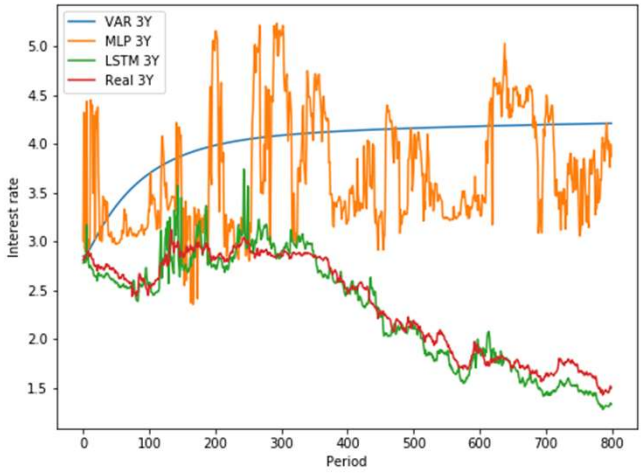
1.5Y



2Y



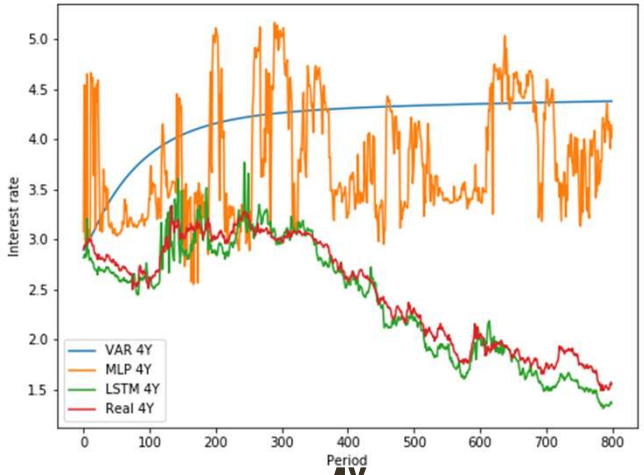
2.5Y



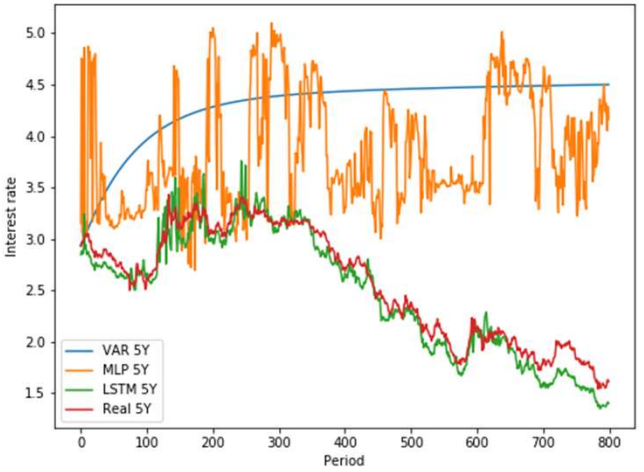
3Y

Result of MOI Finance

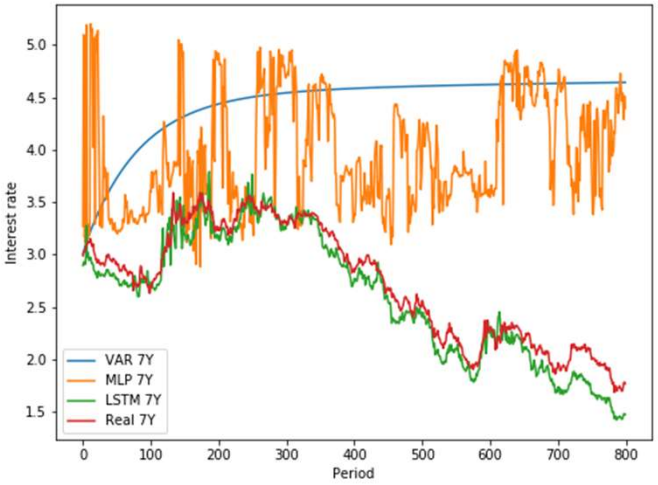
- 800days Prediction



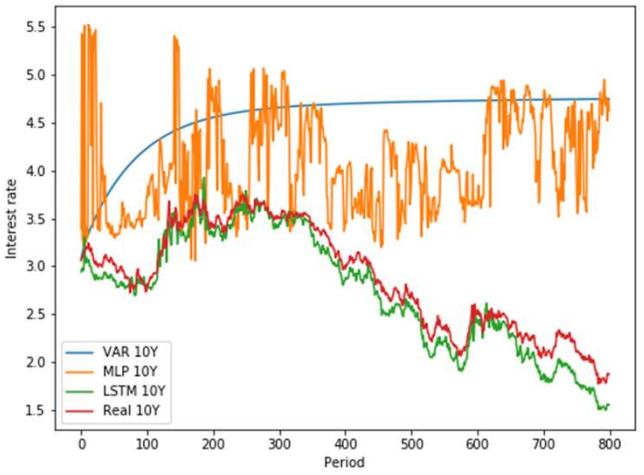
4Y



5Y



7Y



10Y

Result of MOI Finance

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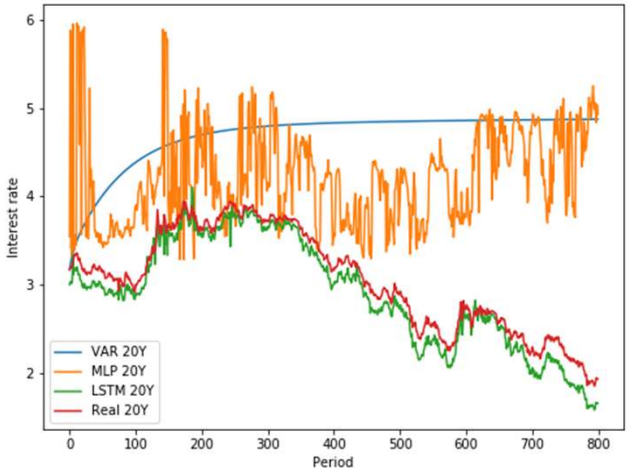
- 800days Prediction



20Y

Result of MOI Finance

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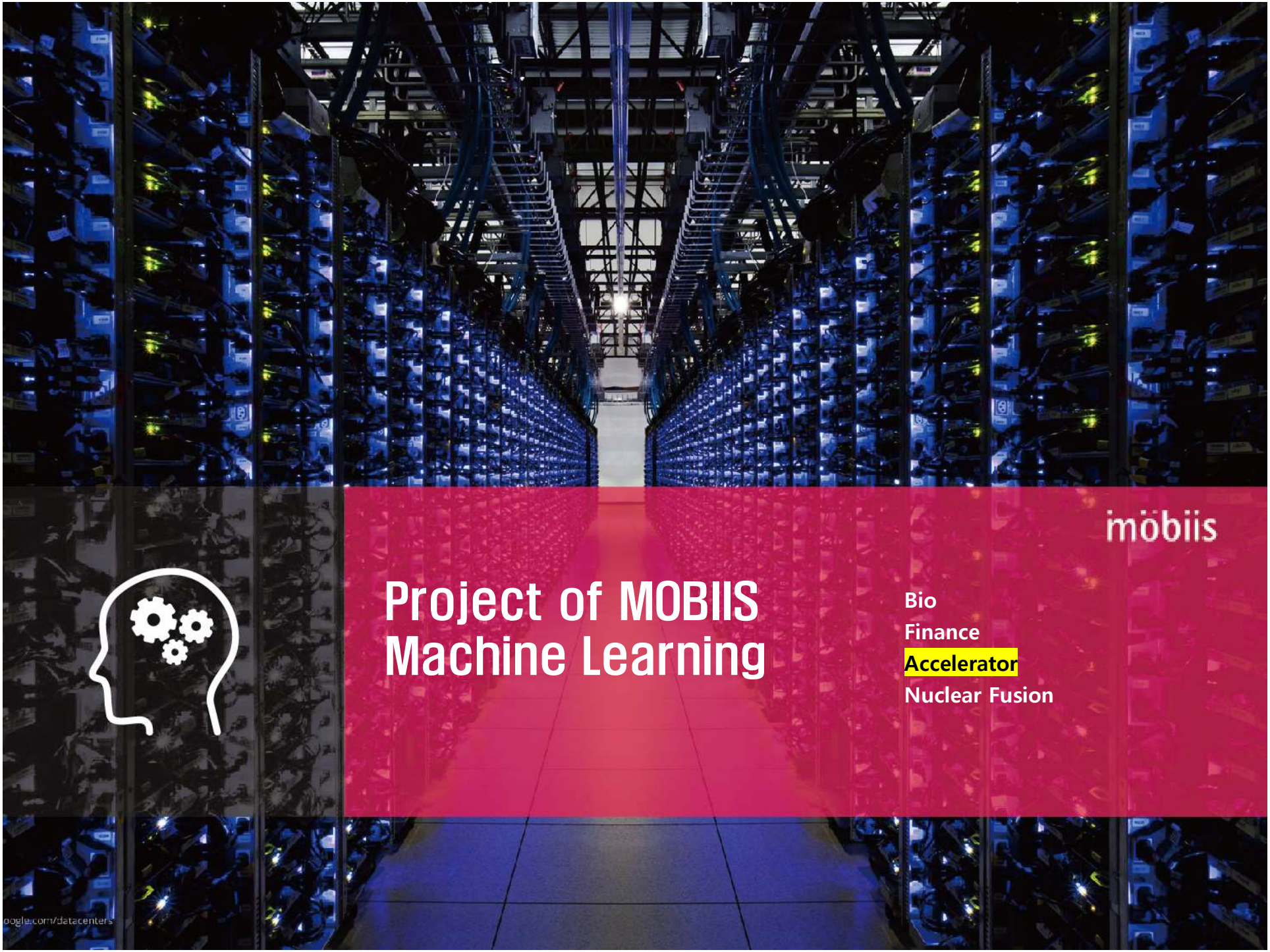
- 800days Prediction result by MSE

	VAR	MLP	LSTM
3M	0.87452	2.14428	0.00569
6M	1.14038	2.15576	0.00717
9M	1.40278	2.17548	0.01030
1Y	1.66920	2.21569	0.01385
1.5Y	2.15136	2.27984	0.01961
2Y	2.55786	2.3335	0.02251
2.5Y	2.90099	2.38392	0.02248
3Y	3.20976	2.45153	0.02075
4Y	3.40230	2.36073	0.02217
5Y	3.53483	2.32076	0.02004
7Y	3.48265	2.18180	0.02412
10Y	3.34092	2.07190	0.02722
20Y	3.20294	2.06010	0.02591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Introduction of ATC Project

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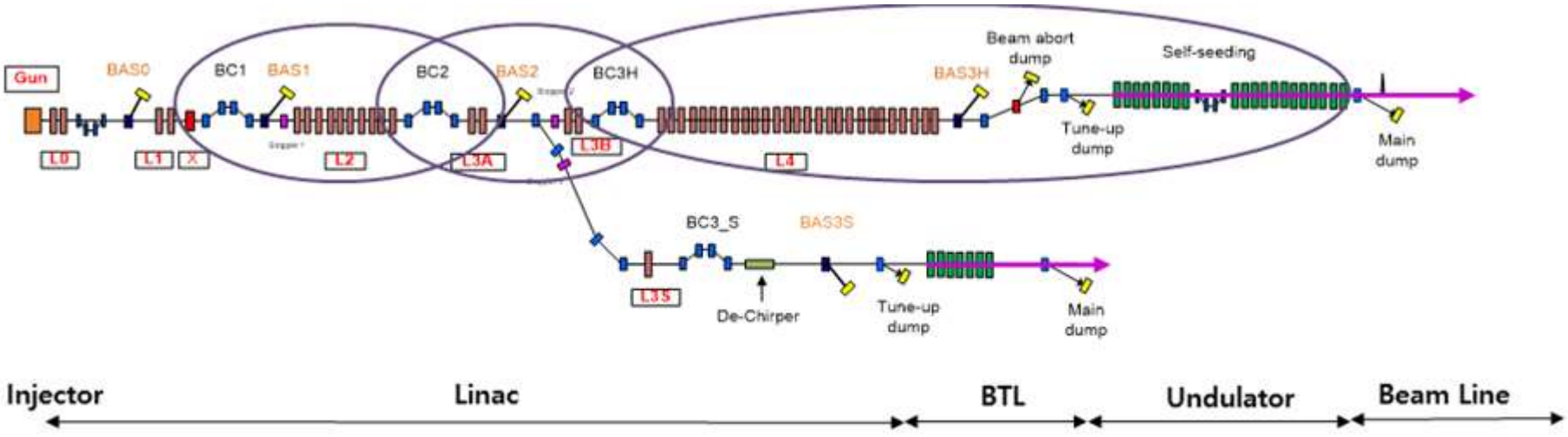
1. Project Name : Advanced Technology Center Project
2. Resource : MOBIIS (11 man) / PAL-XFEL (4 man)
3. Total Project Period : 2015/6/1 ~ 2020/5/31 (5 Year)
4. Current Period : 4th year
5. Business Expense : 50 million USD

Problem of Optimizing accelerator control

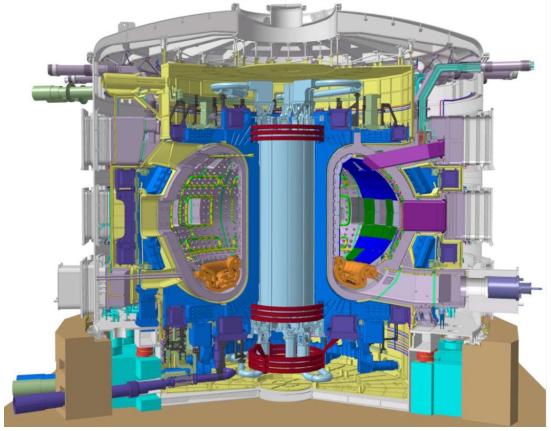


Very Difficult to optimize control parameter

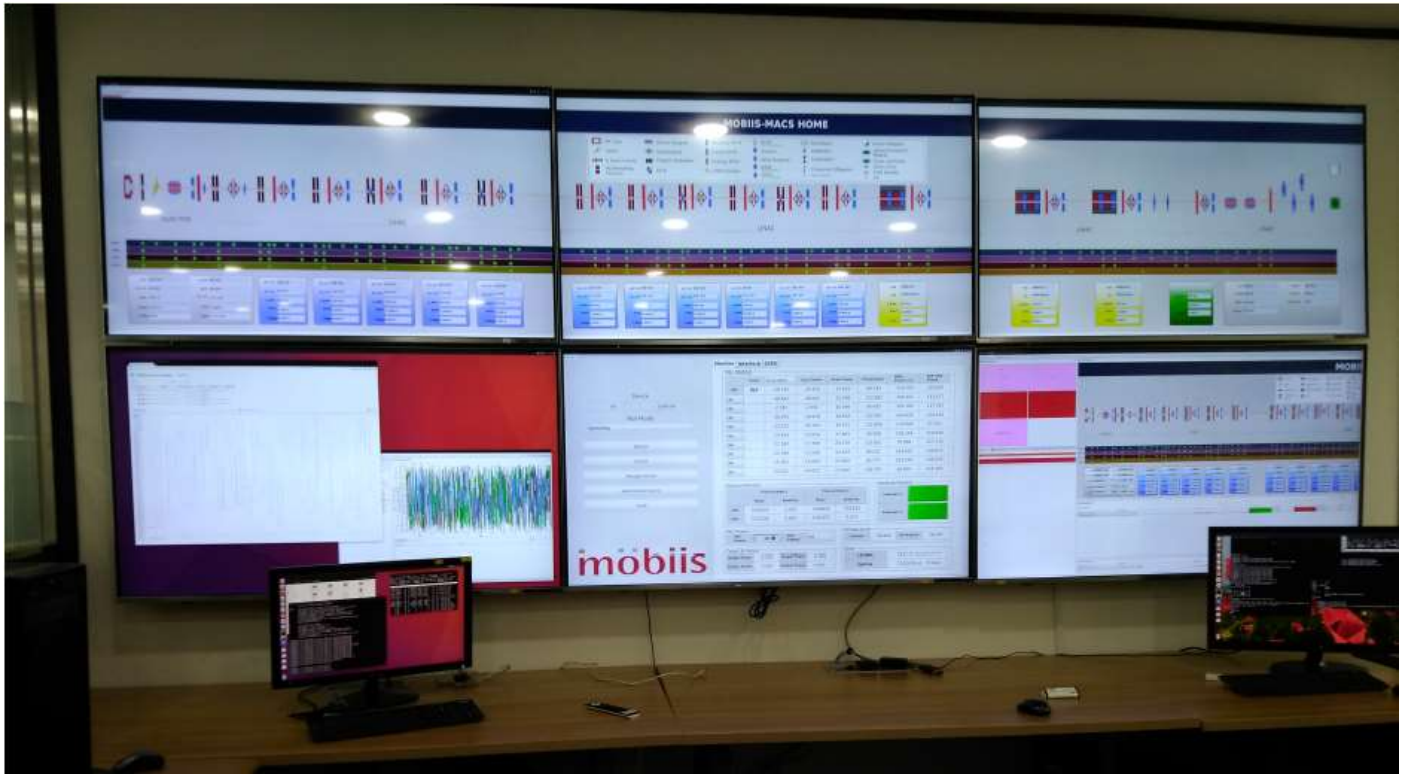
- Facility ~km ↔ Electron Beam ~nm
- Operation ~day ↔ Pulse ~femto-sec.

- 1 million control parameter

ITER



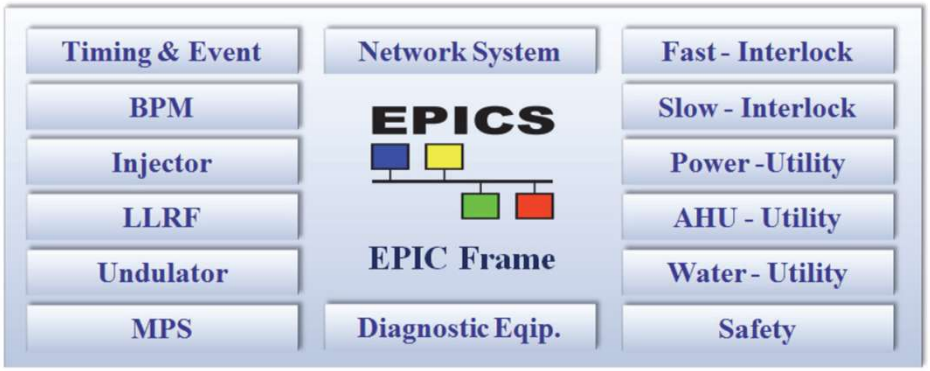
Accelerator Demonstration System

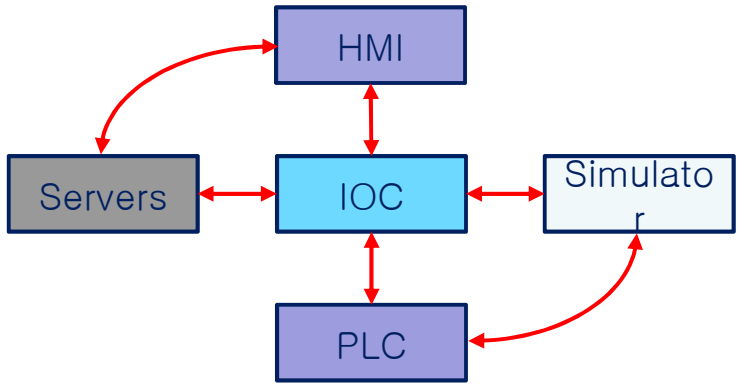


Accelerator Demonstration System

Servers & Synchronization System

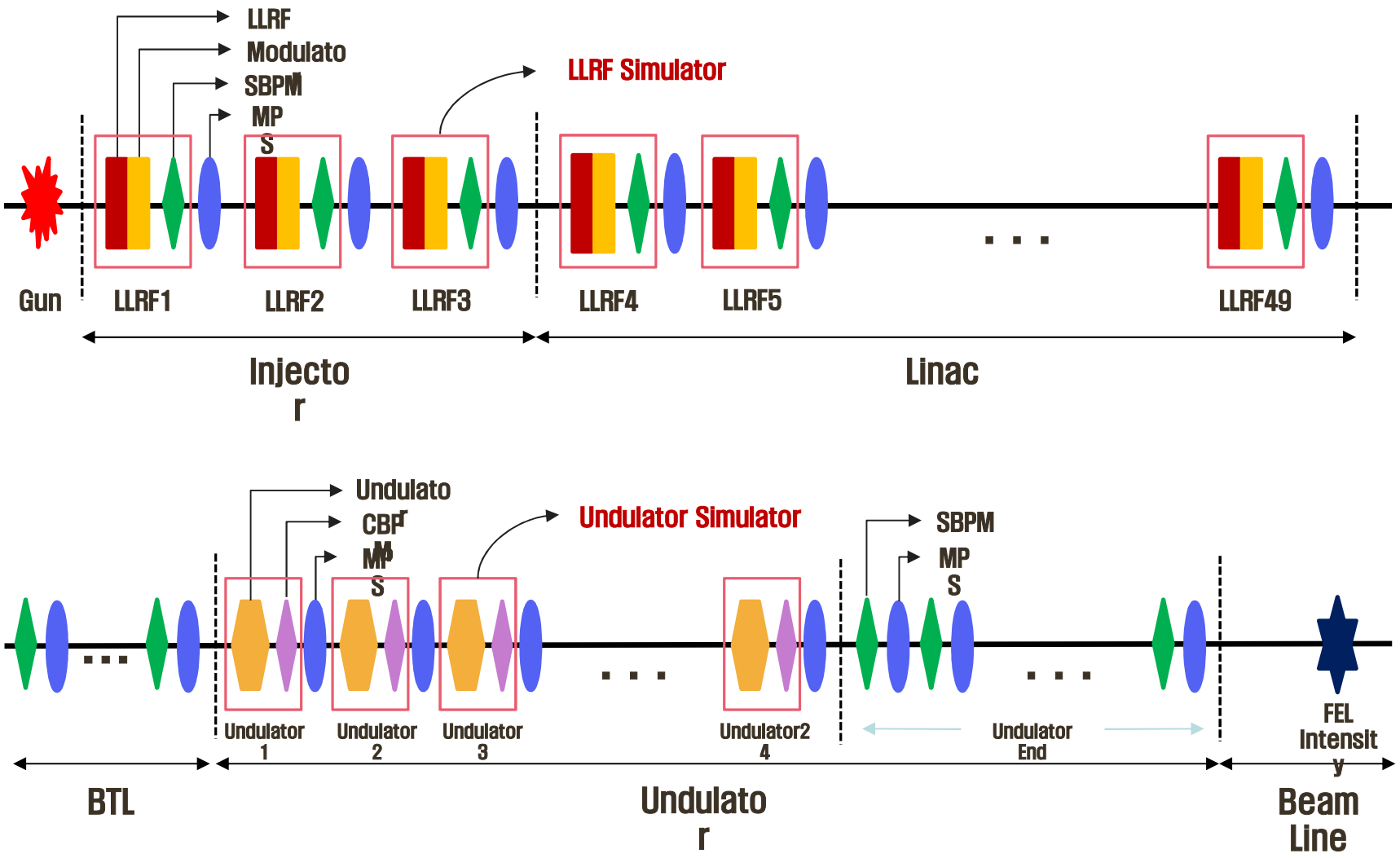
Accelerator System Architecture





	내용	Language	Coding Line
HMI	CSS, MEDM etc.	Java, Python, Matlab, etc.	~60,000
Servers	Alarm, Archiving, Scan, Authentification, Olog, etc.	Java, MySQL, Glassfish, Tomcat, etc.	~60,000
IOC	Device Driver, Firmware	C, C++	~80,000
PLC	Siemens, Beckhoff, AB, etc.	Ladder, Structured Language	~30,000
Simulato r	Beam Dynamics, Device Emulation	C, C++, Matlab, etc.	~10,000

Accelerator System Simulator



Accelerator System Architecture

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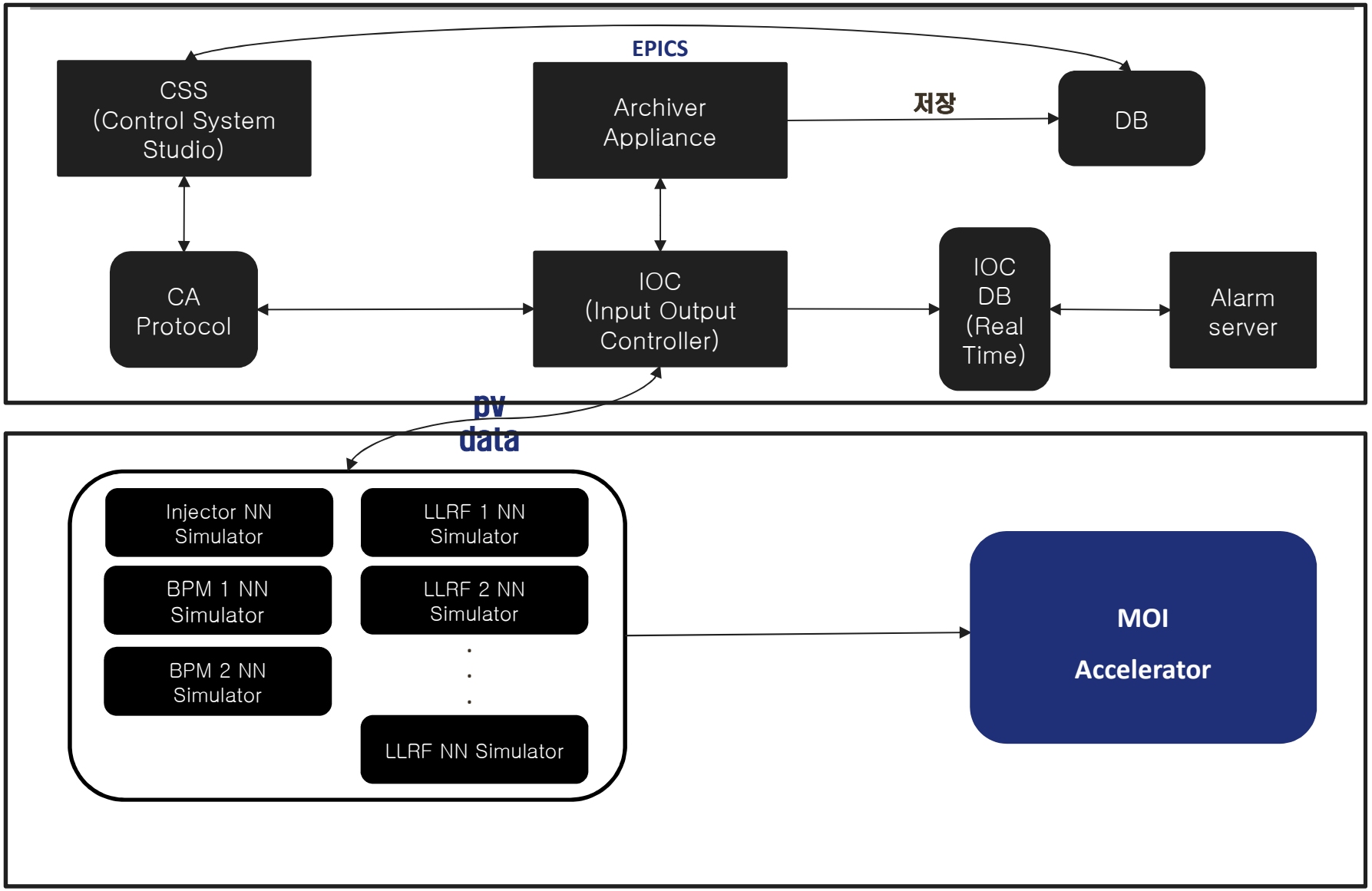

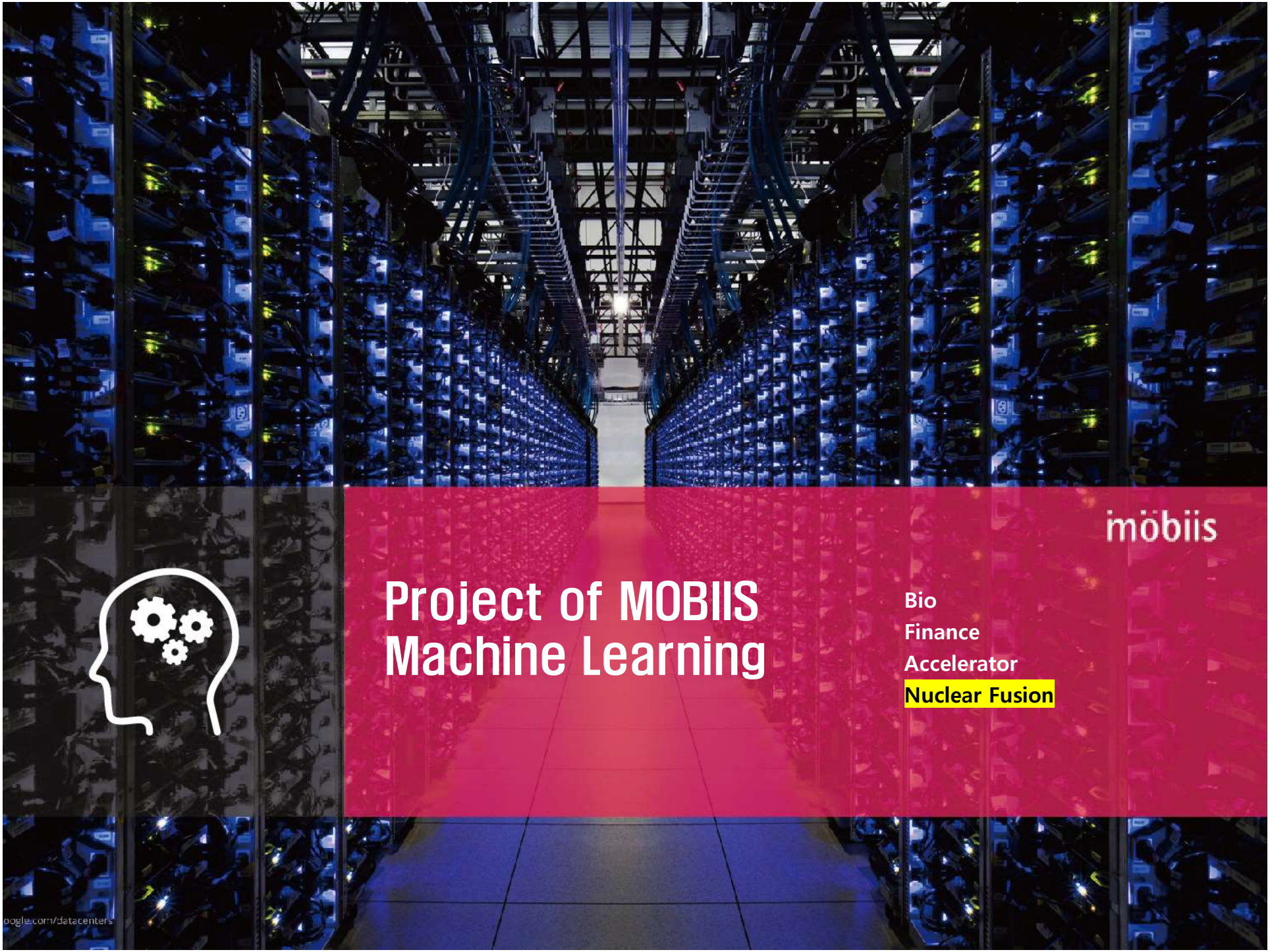
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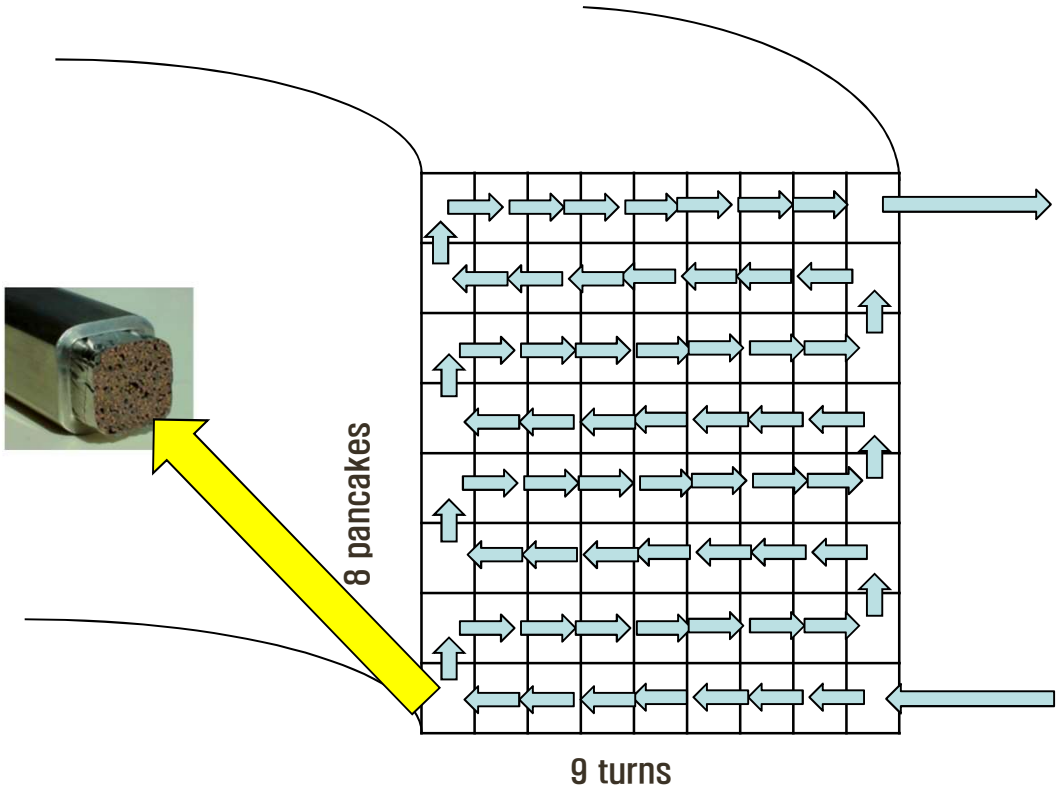
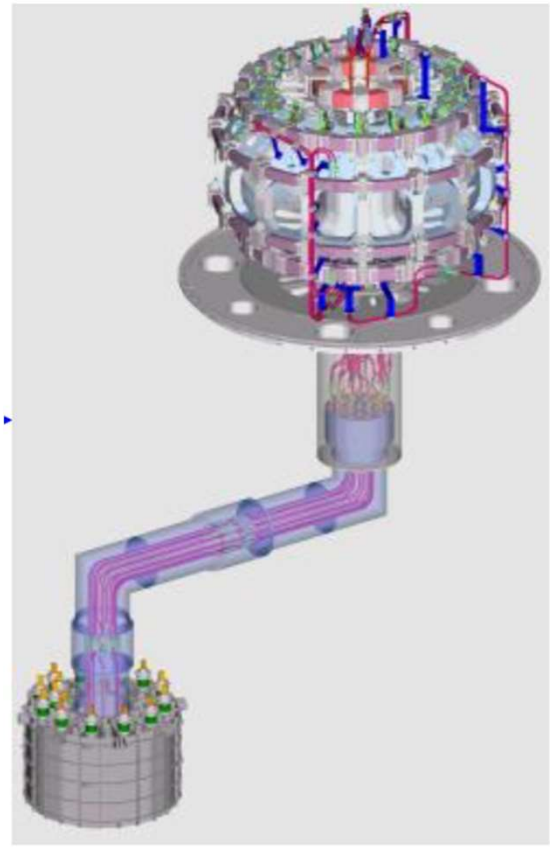
Problem of CIS

- KSTAR field coil current feeder system (i.e., power supply)
  - ✓ e.g., a PF coil case





Problem of CIS

- Why are we arguing over the form of coil positions?
  - ✓ Let's see manufactures of tokamak field coils
    - DIII-D

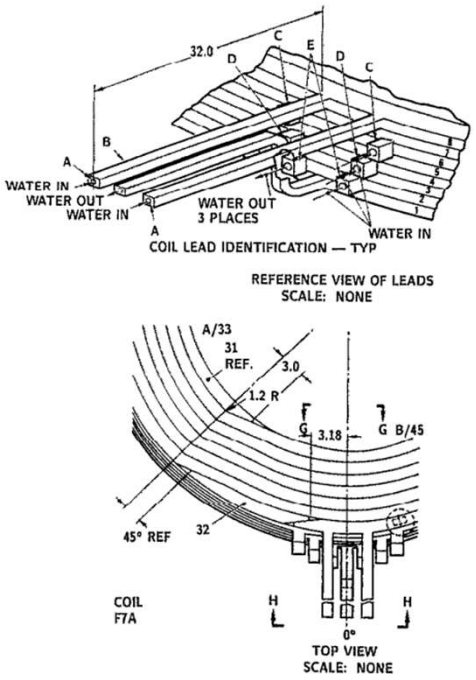


FIG. 20. Details of the current feed of coil F7A.

    - JT-60

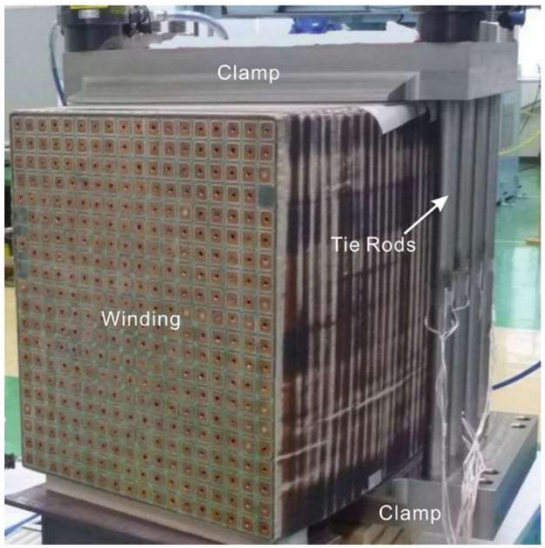


Fig. 5. Pre-compression test of clamp for the EF4 winding model with dumn conductor.

Fig. 4. Double pancake of EF4 coil after thermal curing.

    - Tore Supra

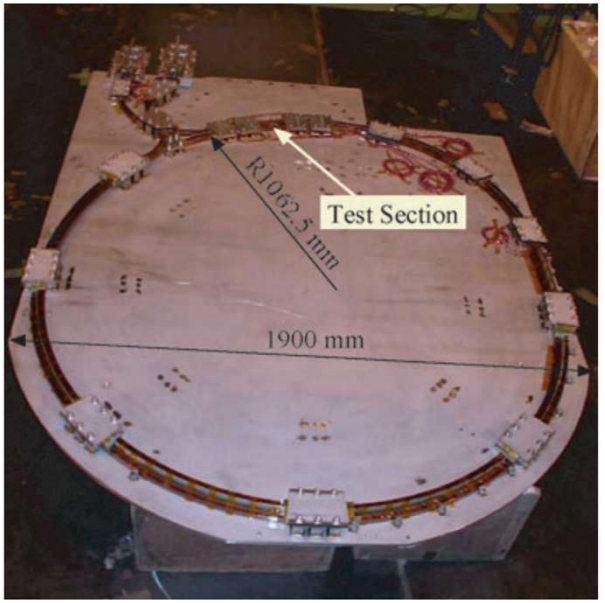
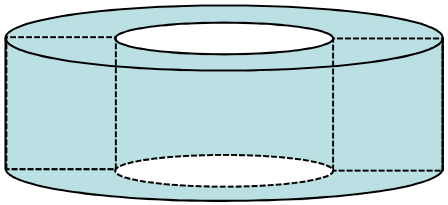


Figure 4. A Nb_3Al D-shaped double layer coil for the demonstration of a react-and-wind technique.

Model of Problem

- Let's position the spiral or concentric wires based on the previous two papers



- Our opinion is that there are various type of filling thin wires inside the coil all the way from side to side.
  - 1) case 1
  - 2) case 2
  - 3) case 3