AI FOR DRUG DISCOVERY, BIOMARKER DEVELOPMENT AND ADVANCED R&D LANDSCAPE OVERVIEW

Comparative Industry Analysis and Classification Framework

1 June 2019

DEEP KNOWLEDGE ANALYTICS
PHARMA DIVISION

www.ai-pharma.dka.global

AI for Drug Discovery, Biomarker Development and Advanced R&D Landscape / 2019 Q1

Companies - 150
Investors - 350
Corporations - 50

AI for Drug Discovery, Biomarker Development and Advanced R&D
1 June 2019

Comparative Industry Analysis & Classification Framework
Comparison of 20 Leading AI for Drug Discovery Companies

Introduction

Comparative Industry Analysis & Classification Framework delivers a comparison of 20 leading AI for Drug Discovery companies according to their number of patents, scientific publications, ratio of AI experts to total number of employees, levels of core AI in R&D, levels of specialized AI expertise (e.g. advanced deep learning vs. basic machine learning), levels of expertise in biology and computational chemistry, partnerships with leading Pharma and Tech corporations, in conjunction with their overall levels of funding and other metrics to deliver tools for a realistic and quantitative comparison of present-day and future value of the companies, which could be used to support more effective due diligence processes.

Funding: by comparing the levels of funding that each company has acquired compared to its level of scientific validation (according to number of patents, publications and ratio of AI experts), it can deliver a sense for the ratio of efficiency of funding compared to the generated technical and scientific IP of each company.

Classification of Combined AI and Biochemistry Expertise: this section classifies each of the top 20 AI-companies according to their use of AI as a core part of their R&D operations, and their levels of expertise in biology and chemistry.

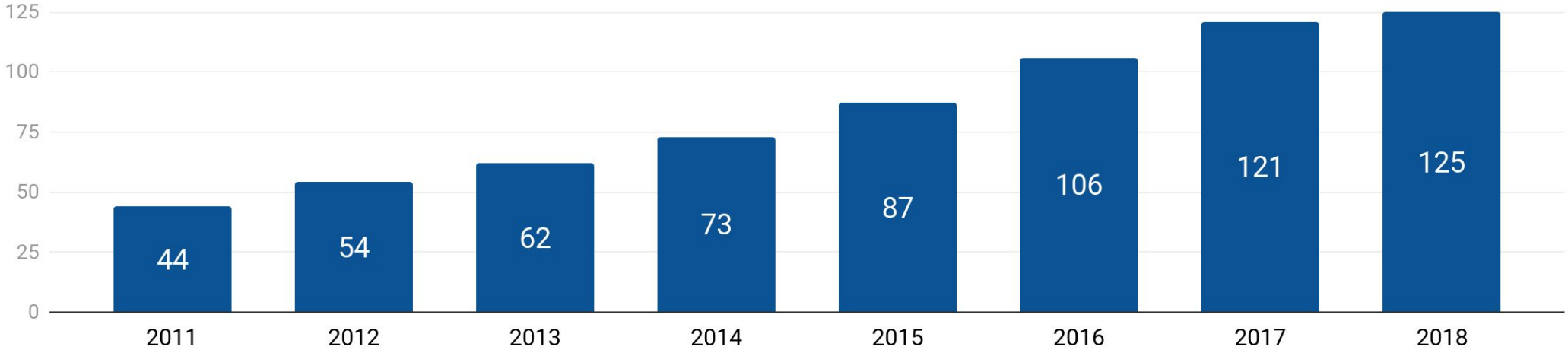
Classification of AI Expertise: this section presents a classification framework that categorizes companies according to major levels of AI asset classes, and applications of specialized Ai-techniques. This framework takes into account the total ratio of AI specialists, the number of separate AI applications, the number of visible AI applications, and whether or not they are utilizing Deep Learning as a part of their products, services or core R&D.

This comparative analysis is an add-on to our 110-page Q1 2019 report released in April 2019,, which marked the fourth installment in a series of reports on the topic of the Artificial Intelligence in Drug Discovery Industry that Deep Knowledge Analytics has been producing for more than 1 year now.

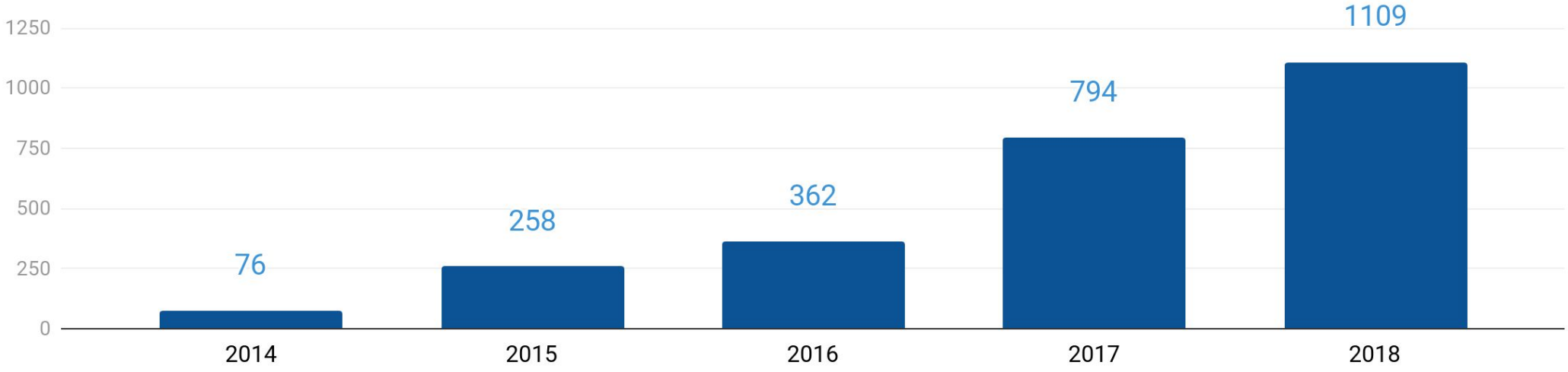
The present comparative analysis is for internal purposes only. Its overall goal is to identify the leaders of the industry and to provide a framework for independent and reasonable assessment, and a framework for effective companies comparison. In May 2019, we will release the next edition of this comparative analysis, with an additional number of parameters to extend the accuracy of the tools for evaluation of investment targets.

Amount of AI for Drug Discovery Companies
Amount of Investments in AI for Drug Discovery Companies

Number of AI Companies in Drug Discovery Sector

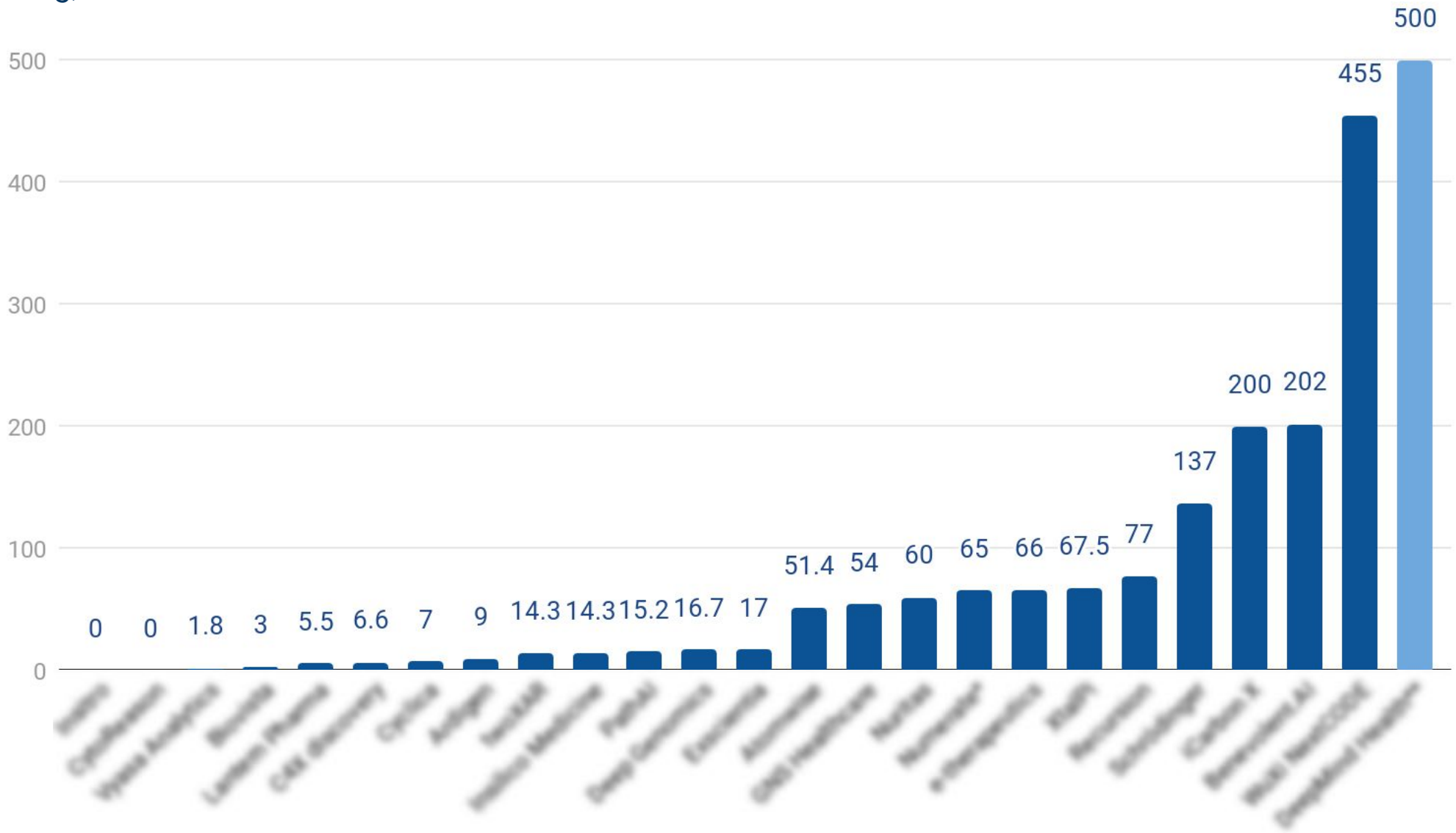


Amount of Investments in AI for Drug Discovery Companies (in millions USD) per Year



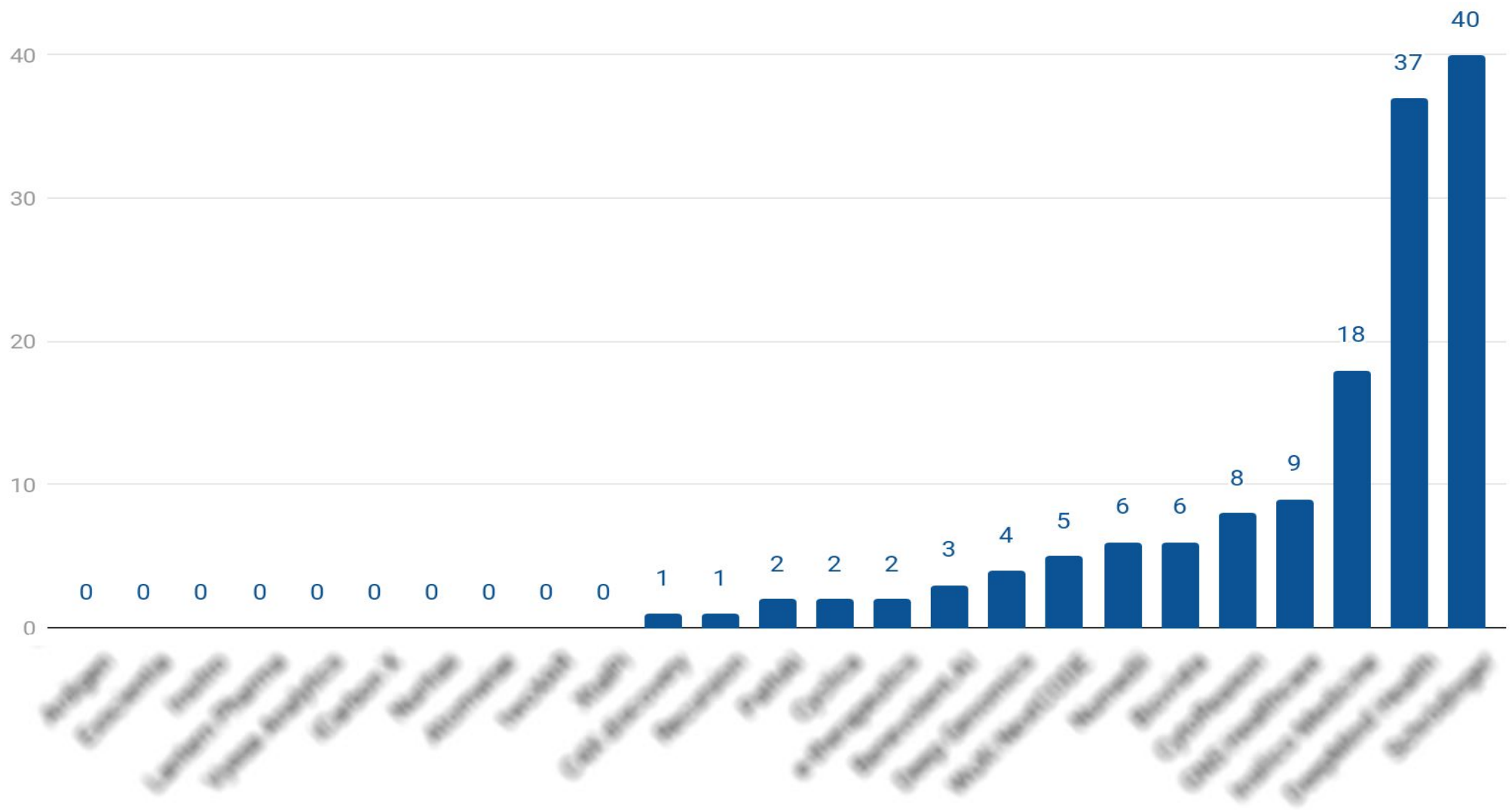
Comparison of Top-25 AI for Drug Discovery Companies

Funding, in millions USD



Comparison of Top-25 AI for Drug Discovery Companies

Number of Patents



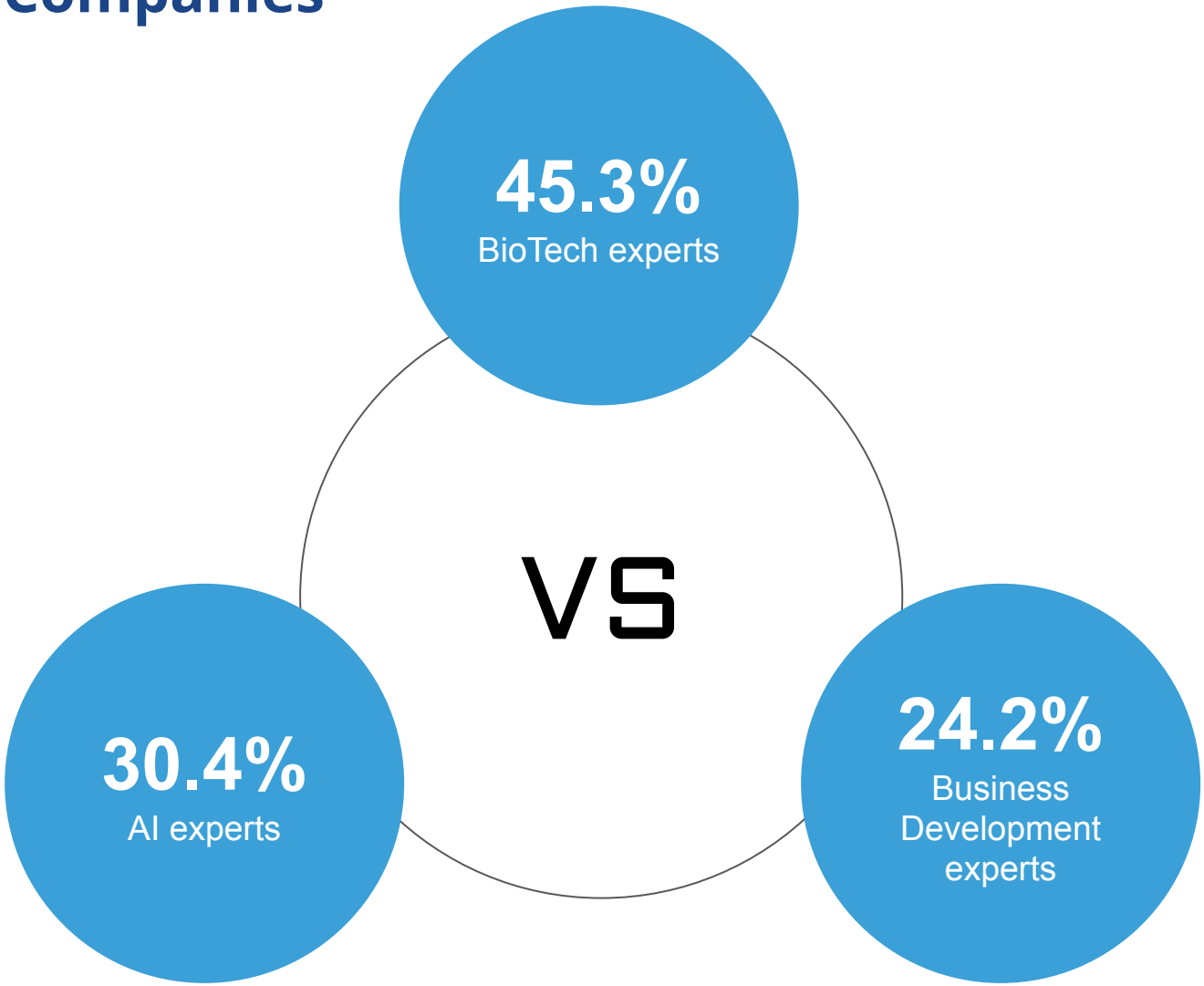
Comparison of Top-25 AI Companies: Level of Scientific Validation

COMPANY	SCIENTIFIC PUBLICATIONS COVERING AI FOR DRUG DISCOVERY	NUMBER OF AI EXPERTS ON THE TEAM / TOTAL NUMBER OF EMPLOYEES	PUBLIC TALKS ON AI FOR DRUG DISCOVERY	VALIDATION
[illegible]	-	18/65	+	N/A
[illegible]	+	6/30	+	N/A
[illegible]	+	34/150	+	N/A
[illegible]	+	1/18	+	+
[illegible]	-	5/50	+	+
[illegible]	-	7/26	+	+
[illegible]	+	3/20	+	+
[illegible]	+	11/33	-	N/A
[illegible]	+	314/683	+	N/A
[illegible]	+	5/23	+	N/A
[illegible]	+	4/26	+	+
[illegible]	+	26/101	-	N/A
[illegible]	-	22/100	+	N/A

Comparison of Top-25 AI Companies: Level of Scientific Validation

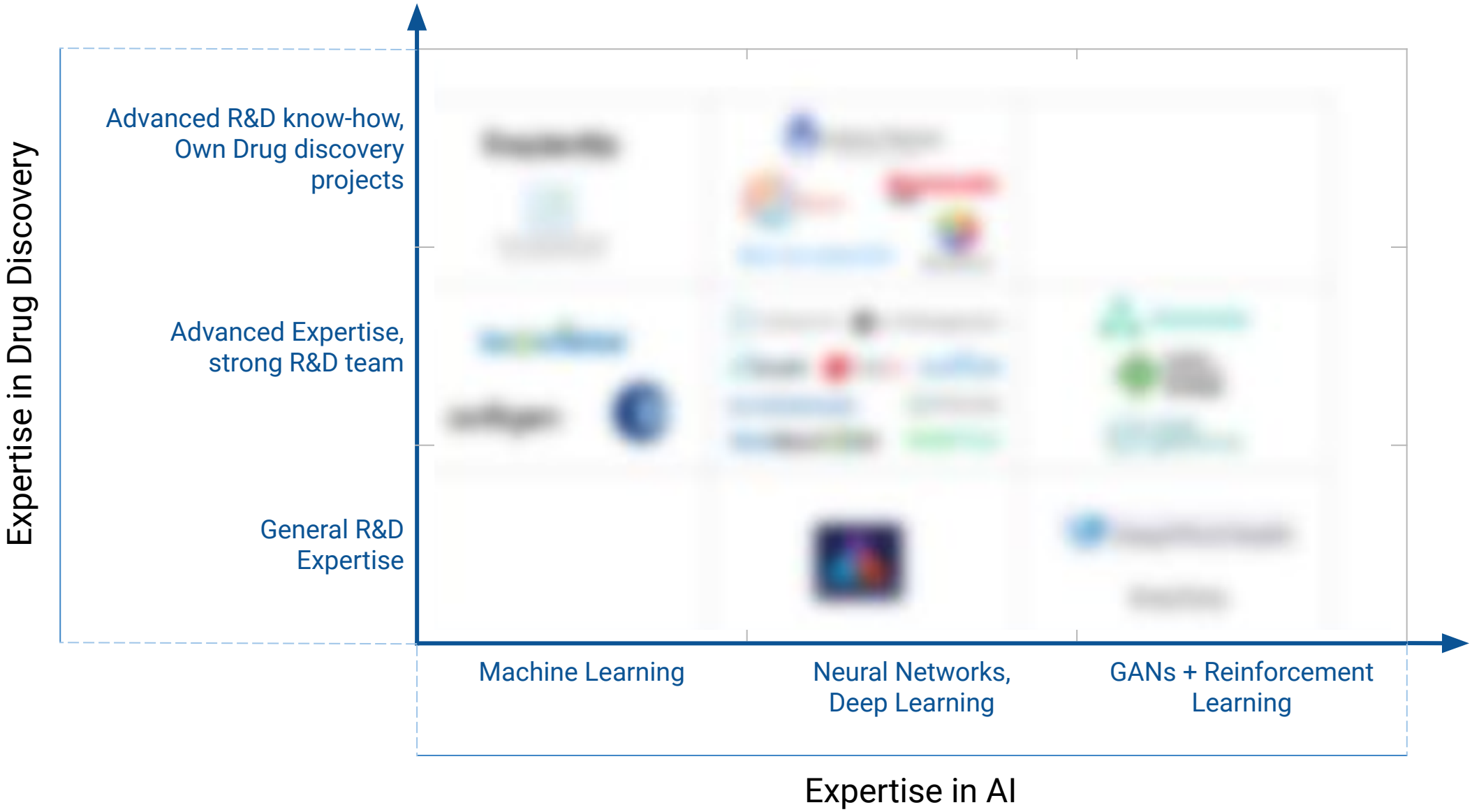
COMPANY	SCIENTIFIC PUBLICATIONS COVERING AI FOR DRUG DISCOVERY	NUMBER OF AI EXPERTS ON THE TEAM / TOTAL NUMBER OF EMPLOYEES	PUBLIC TALKS ON AI FOR DRUG DISCOVERY	VALIDATION
[illegible]	+	16/46	+	+
[illegible]	-	7/21	+	-
[illegible]	-	2/7	+	+
[illegible]	-	4/16	+	+
[illegible]	-	4/43	+	+
[illegible]	+	58/25	+	+
[illegible]	+	14/105	+	+
[illegible]	+	37/370	+	-
[illegible]	+	4/18	+	+
[illegible]	-	3/11	+	-
[illegible]	+	13/232	+	+
[illegible]	-	3/33	+	-

AI Experts vs BioTech Experts vs Business Development Experts In Top-25 AI-Companies



Most of the 150 AI-companies operating in the AI for Drug Discovery space on average have 15% of the stuff which can be considered as AI-experts. In the case of leading 25 AI-companies this bar raises up to 30% of the total amount of stuff. We might consider that the most balanced companies should be proportioned as 33% - AI experts, 45% Biotech experts, 24% - Business development specialists.

Comparison of Top-25 AI for Drug Discovery Companies
Expertise in Drug Discovery R&D / AI



Classification of AI Applications for R&D and Drug Discovery Process

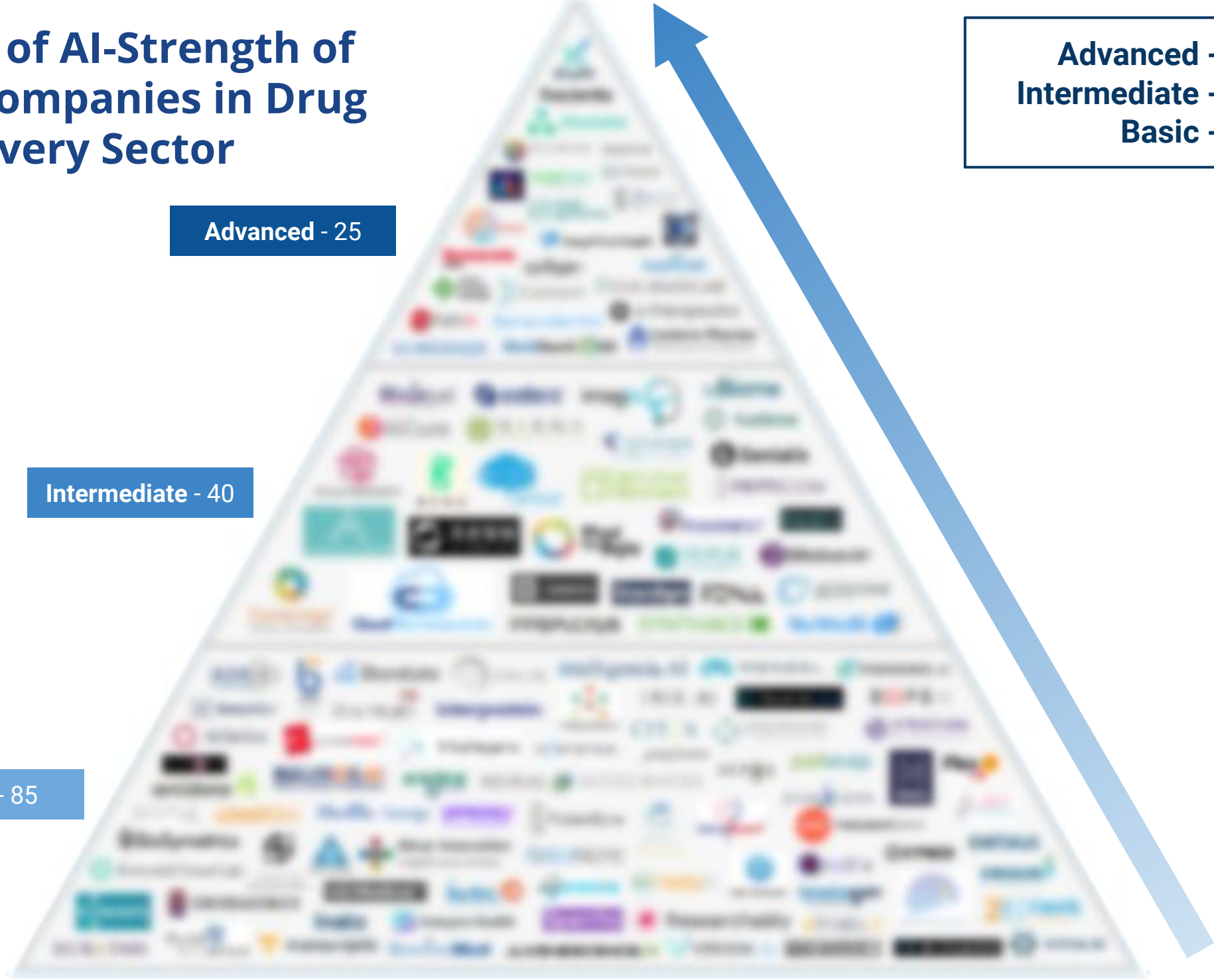
Hypothesis Knowledge Discovery	Target ID Biology	Compound Generation	Compound Binding	ADME Tox	Clinical Trials	Personalized Medicine	Real World Insights

Level of AI-Strength of 150 Companies in Drug Discovery Sector

Advanced - 25

Intermediate - 40

Basic - 85



Advanced - 25
Intermediate - 40
Basic - 85

“Advanced AI” Group

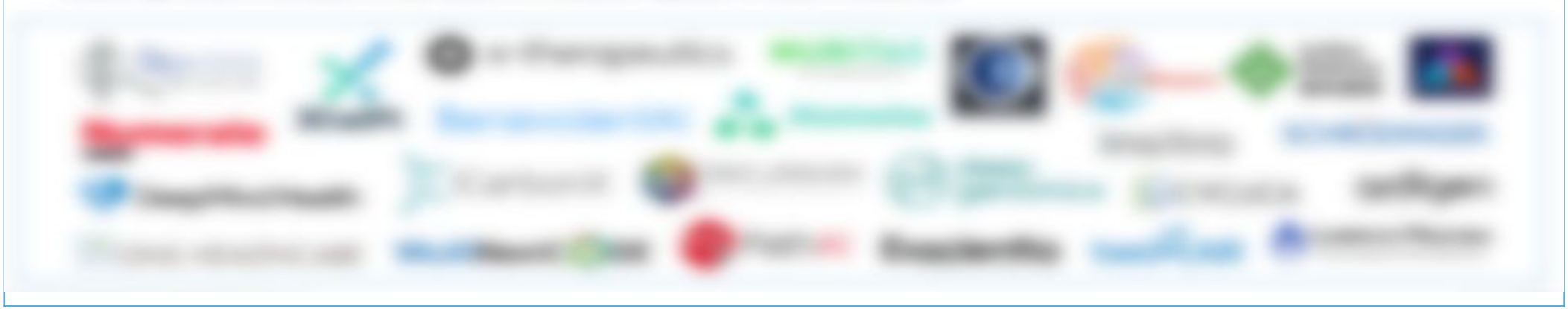
The companies in this section are active in the field of Drug Discovery and basic research. The following criteria have been used to attribute companies to the list of top 25 AI companies in Drug Discovery,

1. **Significant amount of patents and peer-reviewed articles in the domain of pharmaceutical research and AI technologies:** companies in this category are demonstrating significant advances in the application of AI to drug discovery tasks, which is reflected in a high number of research publications, public presentations and press-releases, patents. They usually have strong expertise both in drug discovery and development and in theoretical and practical aspects of AI technology.

2. **High ratio of AI specialists to other employees**: companies in this category typically have a decent number of employees with background in AI/ML/DL, which allows generating unique know-how and intellectual property. Importantly, these companies have strong interdisciplinary teams uniting AI and life science experts.

3. **Direct collaborations with some of the 50 Pharma and Tech Corporations:** an important indicator for a company to be included in this category is the availability of official research collaborations with some of the top 50 Pharma and Tech corporations, where they provide advanced know-how in AI-driven drug discovery.

4. **High level of AI tech promotion:** companies in this category are typically active presenters in high profile public events, discussions and forums; they appear in news and media regularly. They contribute significantly to promoting AI-driven approach to drug discovery and basic biology, educating the public by specific use cases, and establishing best AI adoption practises.



Top-20 AI for Drug Discovery Investors

Sequoia Capital
Menlo Park, California, US

Andreessen Horowitz
Menlo Park, California, US

Felicis Ventures
Menlo Park, California, US

Draper Associates
Menlo Park, California, US

Khosla Ventures
Menlo Park, California, US

Amgen Ventures
San Francisco, California, US

Data Collective DCVC
San Francisco, California, US

500 Startups
Mountain View, California, US

Y Combinator
Mountain View, California, US

GV
Mountain View, California, US

StartX
Palo Alto, California, US

AME CLoud Ventures
Palo Alto, California, US

San Francisco

Mountain View

Palo Alto

Refactor Capital
Burlingame, California, US

Menlo Park

California

OS Fund
N/A, California, US

General Catalyst
Cambridge, Massachusetts, US

SOSV
Princeton, New Jersey, US

Tencent
Shenzhen, China

WuXi AppTec
Shanghai, China

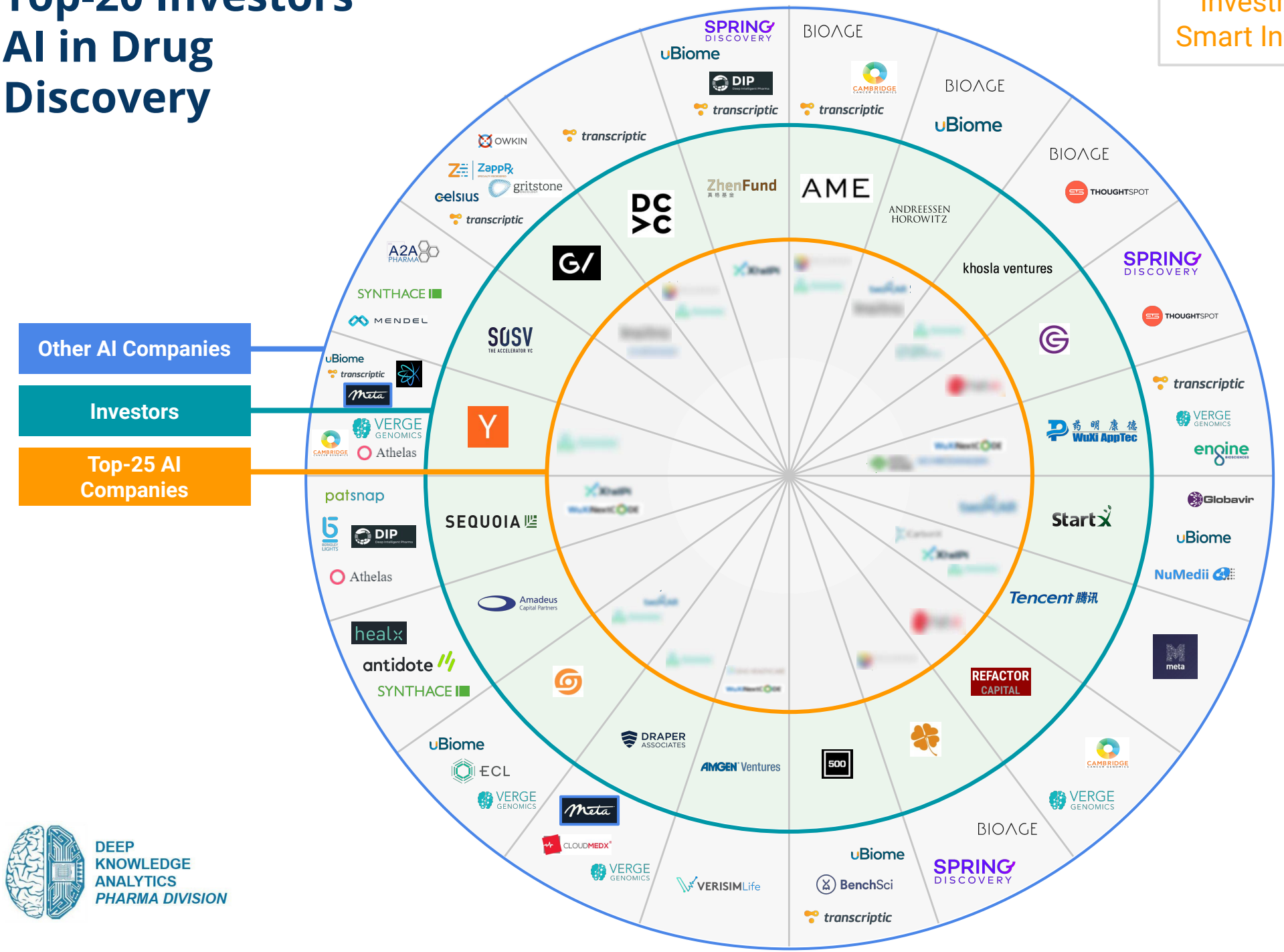
ZhenFund
Beijing, China

Sequoia Capital China
Beijing, China

Amadeus Capital Partners
Cambridge, United Kingdom

Top-20 Investors AI in Drug Discovery

Investments vs Smart Investments



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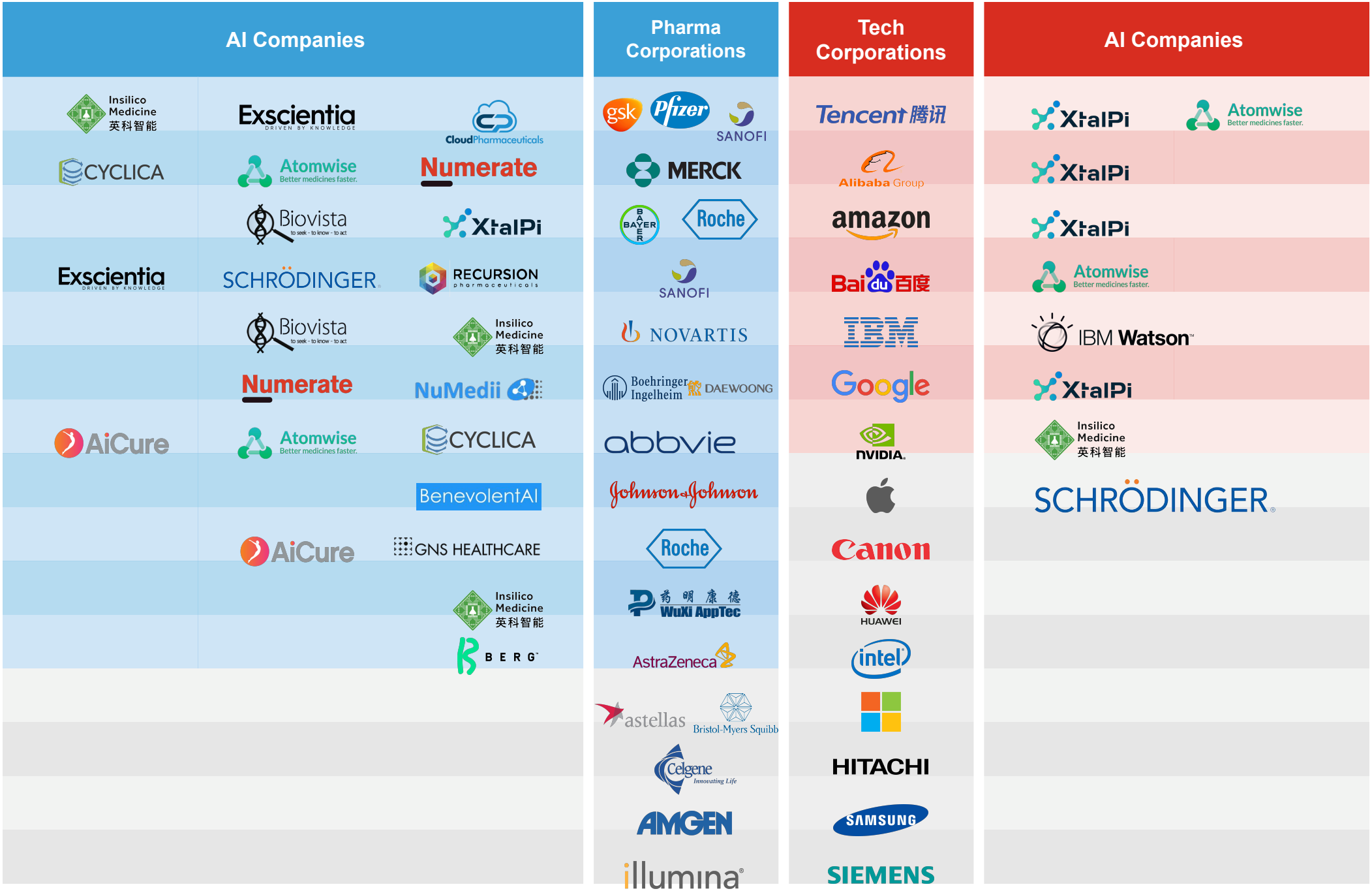
Top-20 Investors in 150 AI-Companies

1 June 2019

Top AI Companies	Investments overall	INVESTORS		Investments overall	Top AI Companies
	9	Y combinator	Sequoia Capital	9	
	8	SOSV	OS Fund	8	
	8	GV	Data Collective DCVC	8	
	8	AME Cloud Ventures	ZhenFund	7	
	6	Khosla Ventures	Andreessen Horowitz	6	
	6	Amadeus Capital Partners	WuXi AppTec	5	
	5	General catalyst	StartX	4	
	4	Refactor Capital	Tencent	4	
	4	Felicis ventures	Draper associates	4	
	3	Amgen ventures	500 startups	3	

AI for Drug Discovery Partnerships, Investments, Acquisitions

Q1 2019



- **Summary**
- **Deliverables of the Report**
- **Proposal for Cooperation**

AI for Drug Discovery and Biomarker Development sector has large potential to impact the whole biopharma industry essentially. Knowledge of the landscape of the market is crucial for the survival and development of every company operating in the market.

The key questions regarding implementation of AI for drug discovery and biomarker development include:

- **What are the major threats and opportunities facing biopharma corporations regarding AI development in the industry?**
- **What are the main players in AI for drug discovery field? How are they categorized and differentiated?**
- **How can different institutions benefit from the AI for drug discovery development?**

This is a 100+ page report delivering practical answers to these specific questions in order to optimize the short and long-term strategies of biopharma corporations and other institutions related to the industry, with a new updated edition being released each month, incrementally increasing the precision, practicality and actionability of its industry analysis. Each new edition will provide a more sophisticated, comprehensive and precise understanding of the challenges and opportunities provided by the development AI in biopharma industry, as well as what businesses such as pharma corporations and private biotech companies need to do in order to benefit, rather than stagnate, from the oncoming boom of AI in the industry.

It will deliver:

- Extensive analysis of the prospects of AI for Drug Discovery and Biomarker Development industry in terms of current trends
- 3-5-year forecasts providing information about the new game-changing biopharma instruments that will be market-ready by 2022-2025
- Practical guide to assemble the best possible tools and solutions allowing to benefit from the industry trends
- Overview of key market players in the AI for Drug Discovery and Biomarker Development landscape

The parties who gain early access to this report will have deep expertise on how their strategic agendas can be optimized and stabilized in order to manage the usage of AI for Drug Discovery, to surpass the challenges and to utilize the opportunities related to these novel biopharma trends.

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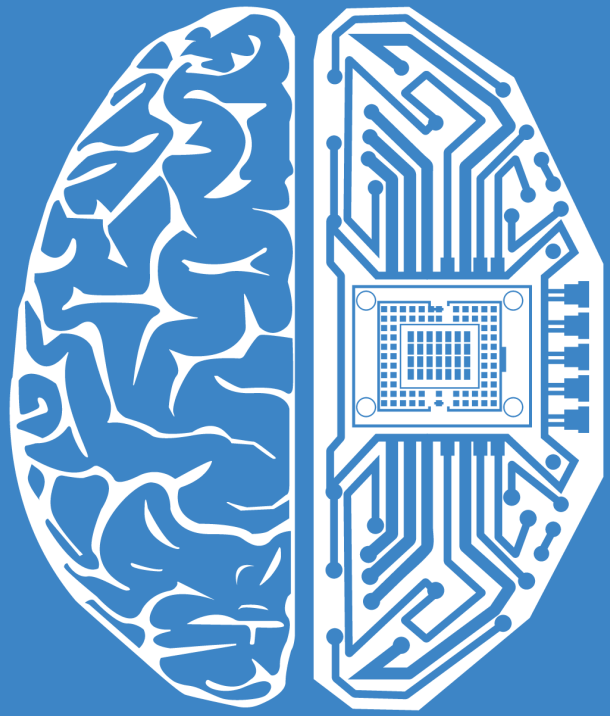

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