UNITED STATES
PATENT AND TRADEMARK OFFICE

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AI in Biotechnology

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AI/ET Partnership Series #2

Background: Recent OCE studies

- USPTO IP Data Highlights report *Inventing AI: Tracing the diffusion of artificial intelligence with U.S. patents*, October 2020

  – Analysis of U.S. AI patenting 1976-2018

  – Diffusion of AI across technologies, inventor-patentees, organizations, and geography

- Release of AI Patent Dataset (AIPD), August 2021

  – AI-related PGPubs and patents through 2020

  – Extends *Inventing AI* data by two years

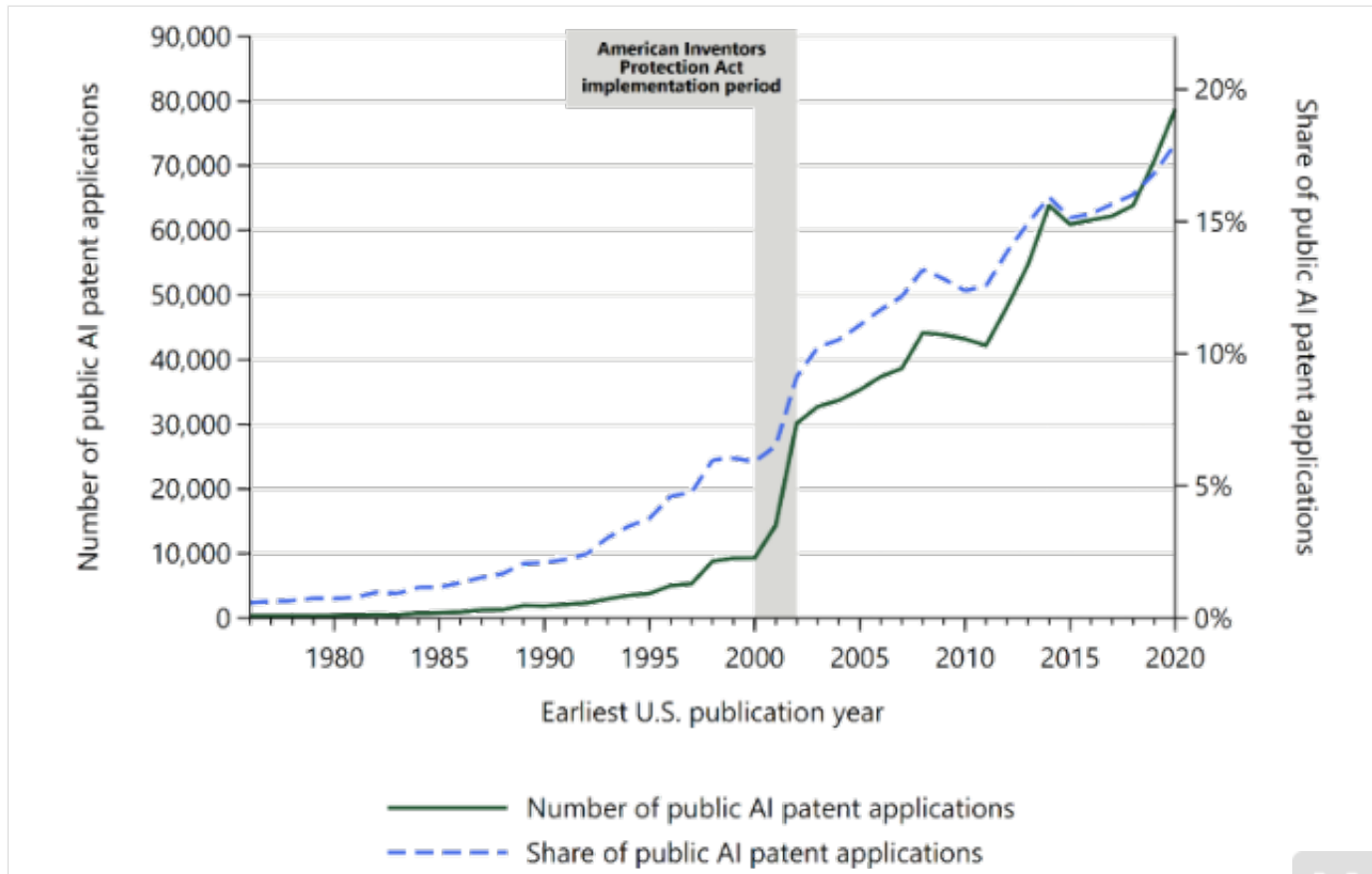- This analysis explores the use of AI in Biotechnology.

Definition of AI

Other definitions of AI are useful for AI policy making and operational processes at the USPTO. This definition of AI is from the *Inventing AI* report and is not the official definition used by the USPTO.

Volume and share of public U.S. AI patent applications, 1976–2020

The earliest U.S. publication year is either the year of the first pre-grant publication for a granted or, if there is no pre-grant publication, the year a granted patent was published.

Summary of *Inventing AI*

- Patents containing AI appeared in about 9% of all technology subclasses used by the USPTO in 1976 and spread to more than 42% by 2018.

- The percentage of inventor-patentees who are active in AI started at 1% in 1976 and increased to 25% by 2018; growth in the percentage of organizations patenting in AI has been similar.

- Most of the top 30 AI companies are in the information and communications technology sector, with some notable exceptions such as Bank of America, Boeing, and General Electric.

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Definition of Biotechnology AI

- Biotechnology defined as being within Technology Center 1600 (TC1600) – "Biotechnology and Organic Chemistry"

  – Included technologies: Isolated and recombinant proteins/enzymes, herbicides, drugs, bioinformatics, recombinant DNA and RNA, immunology, gene regulation, drug delivery, etc.

- A patent document is classified as **Biotechnology AI** if:

  – the document is AI in the AIPD, and

  – it is examined in TC1600.

- Note: excludes plant patents (not classified in the AIPD)

This definition of Biotechnology AI is used for purpose of this analysis only.
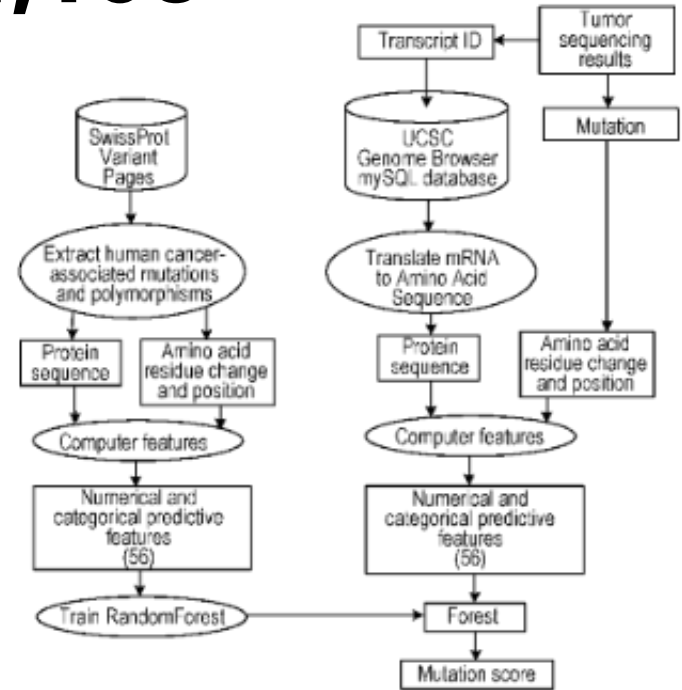
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Examples

U.S. Patent No. 10,704,108

Genetic Alterations In Isocitrate Dehydrogenase And Other Genes In Malignant Glioma

- Assigned to the Johns Hopkins University and Duke University

Bioinformatics software pipeline to compute mutation scores. A supervised machine learning prediction algorithm (RandomForest) is trained on ~22,000 annotated variants (cancer-associated mutations and polymorphisms) from the SwissProt variant pages. A total of 56 numeric and categorical predictive features are calculated for each variant.

Fig. 13

U.S. Application No. 17/265,708*

Machine learning for
determining protein
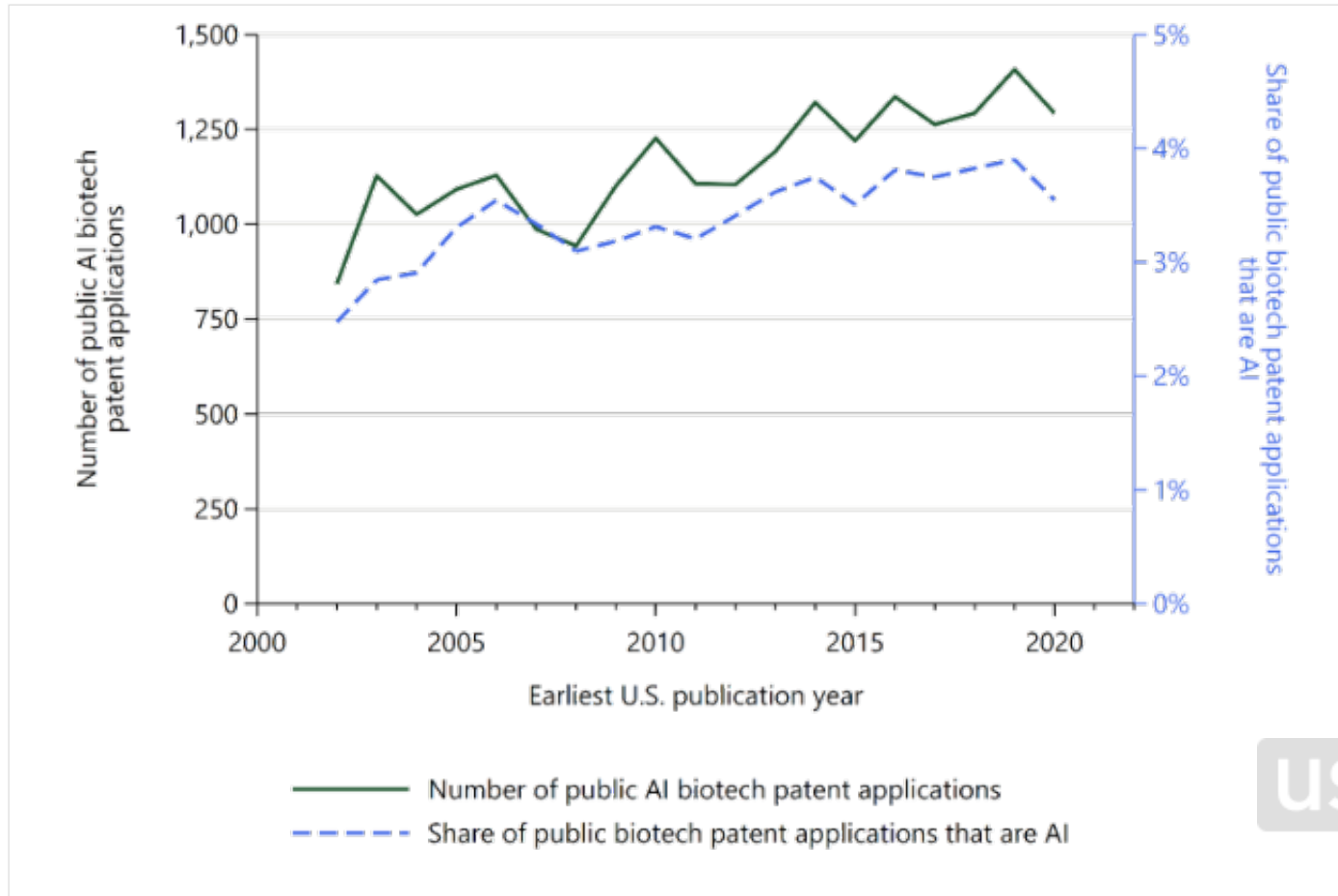structures

- Applicant: DeepMind
  Technologies Limited

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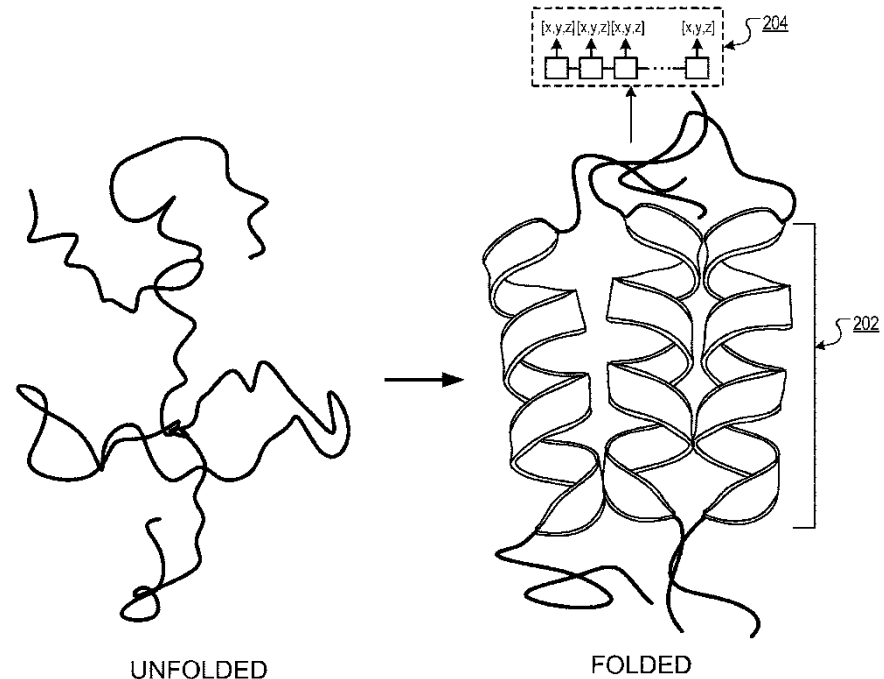
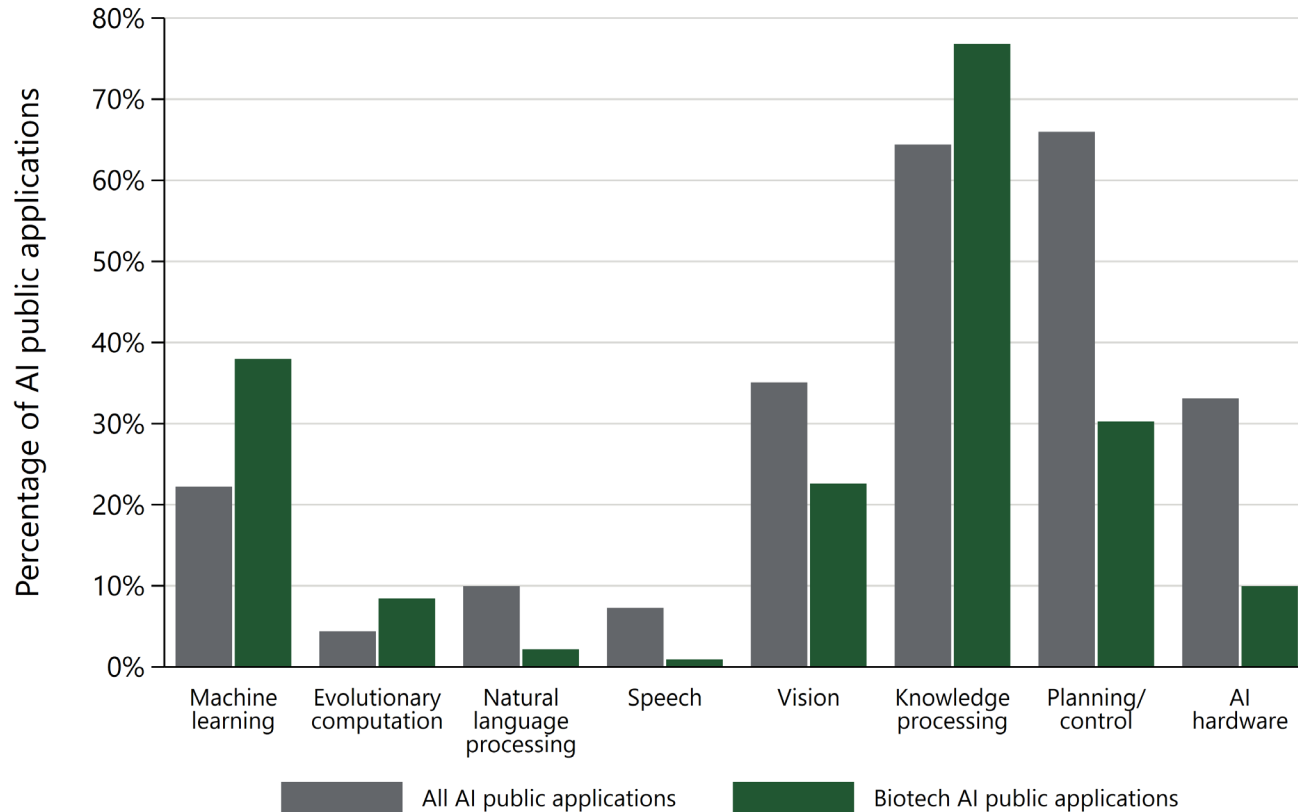* Not in the AIPD (outside the publication window of the dataset)

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Volume and share of public U.S. patent applications and patents

Volume and share of public U.S. Biotechnology AI patent applications, 2002–2020
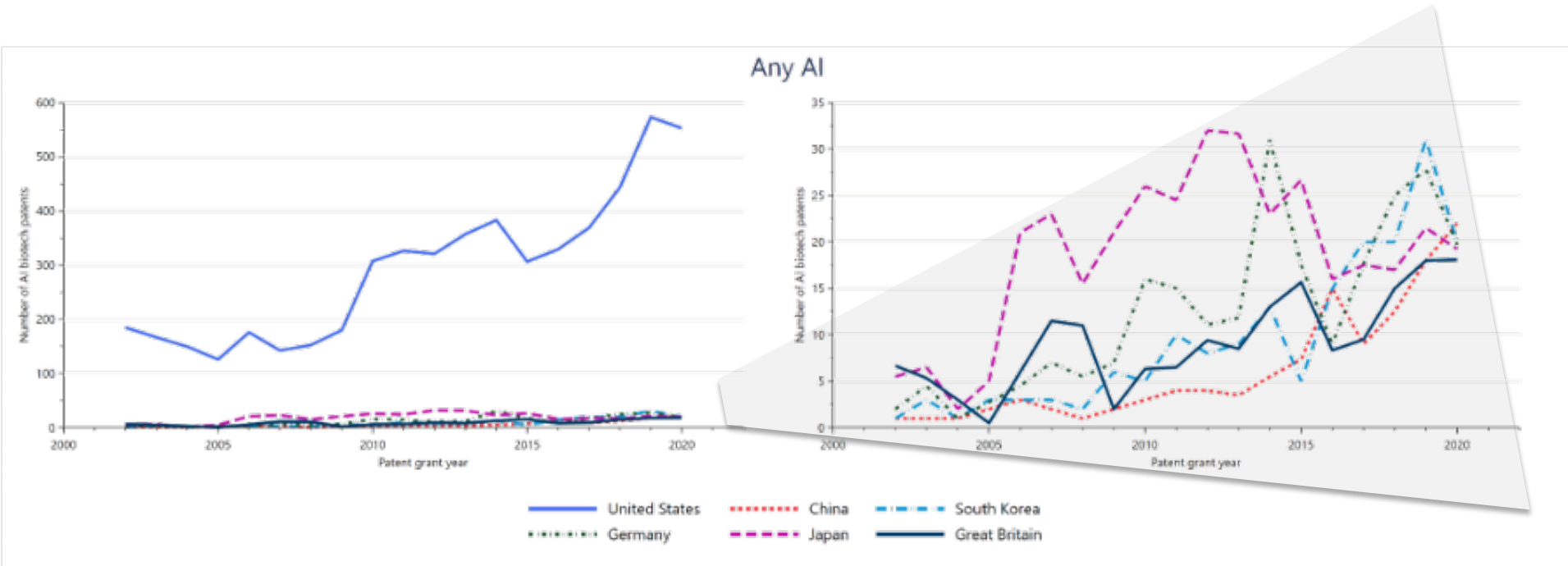

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Share of AI and Biotech AI public applications by AI technology component, 2020
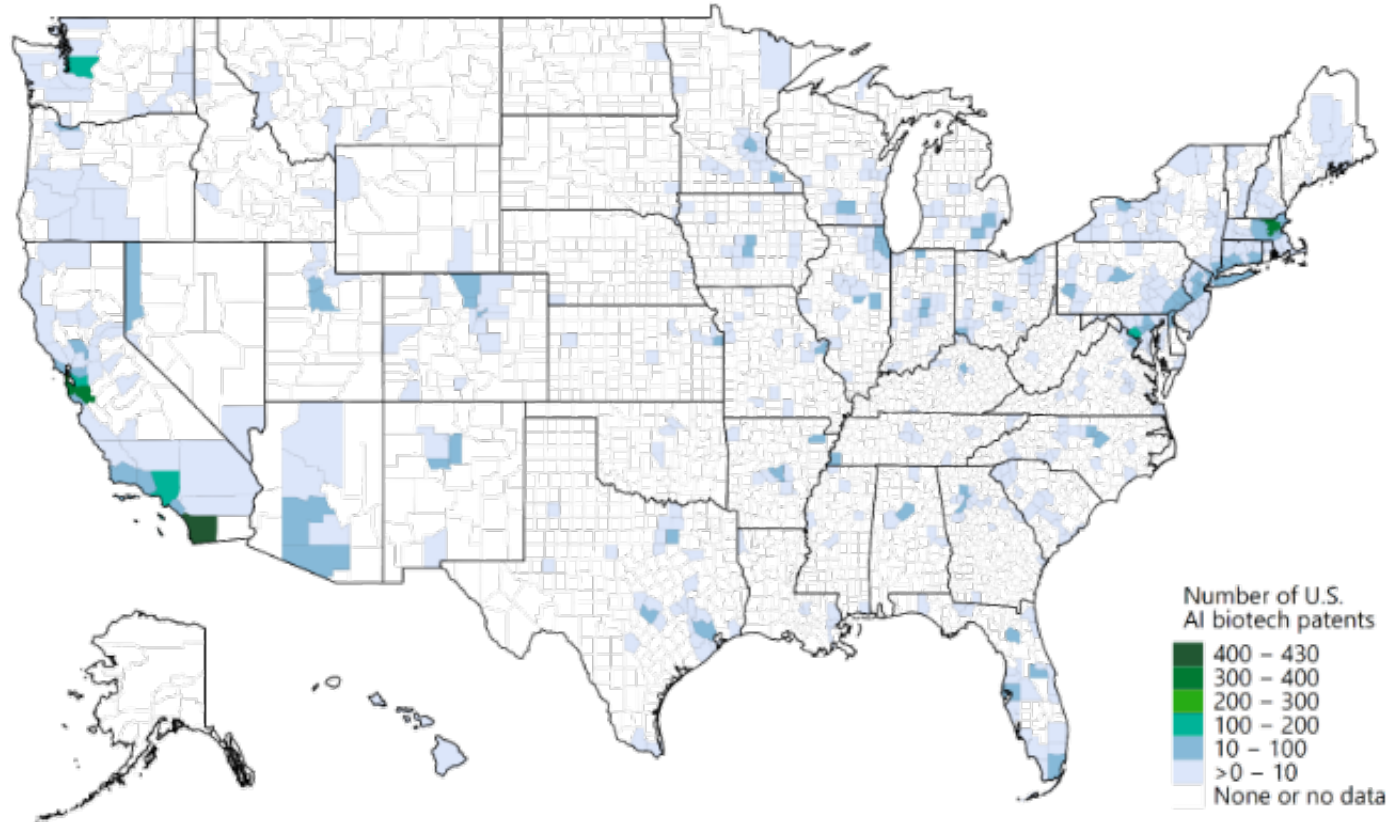
Based on earliest publication year CY2020.
Percentages are based on the number of public applications in an AI component out of those in any AI component.

Growth of U.S. and top 5 foreign country patent owners-at-grant (in 2020) of U.S. AI Biotechnology patents, 2002-2020

Count of U.S. Biotechnology AI patents by inventor-patentee location, 2002–2020
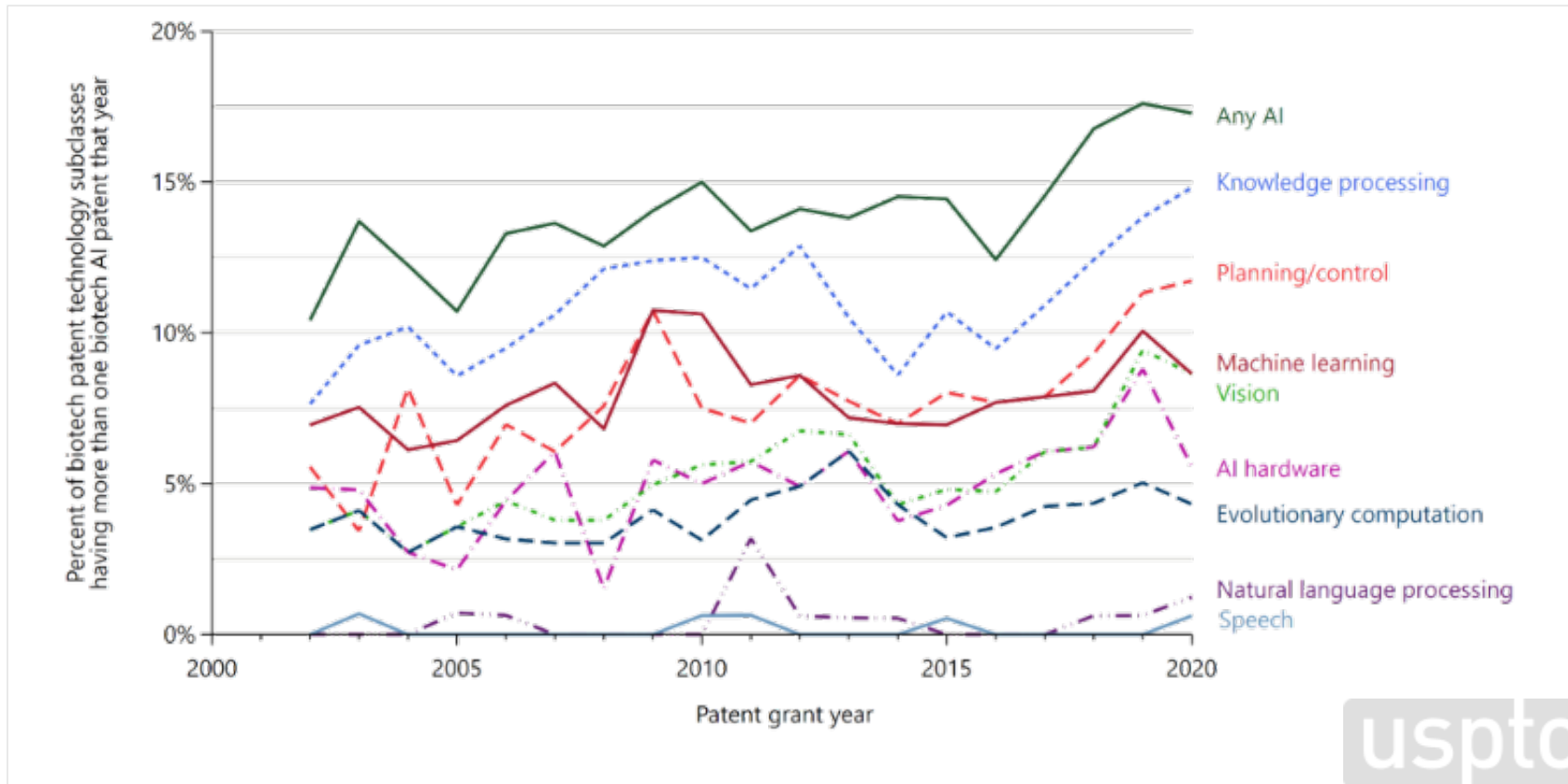

Number of U.S.
AI biotech patents

- 400 – 430
- 300 – 400
- 200 – 300
- 100 – 200
- 10 – 100
- >0 – 10
- None or no data

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Diffusion of AI technology

Diffusion of Biotechnology AI across biotechnology patent technology subclasses, overall and by AI component, 2002-2020

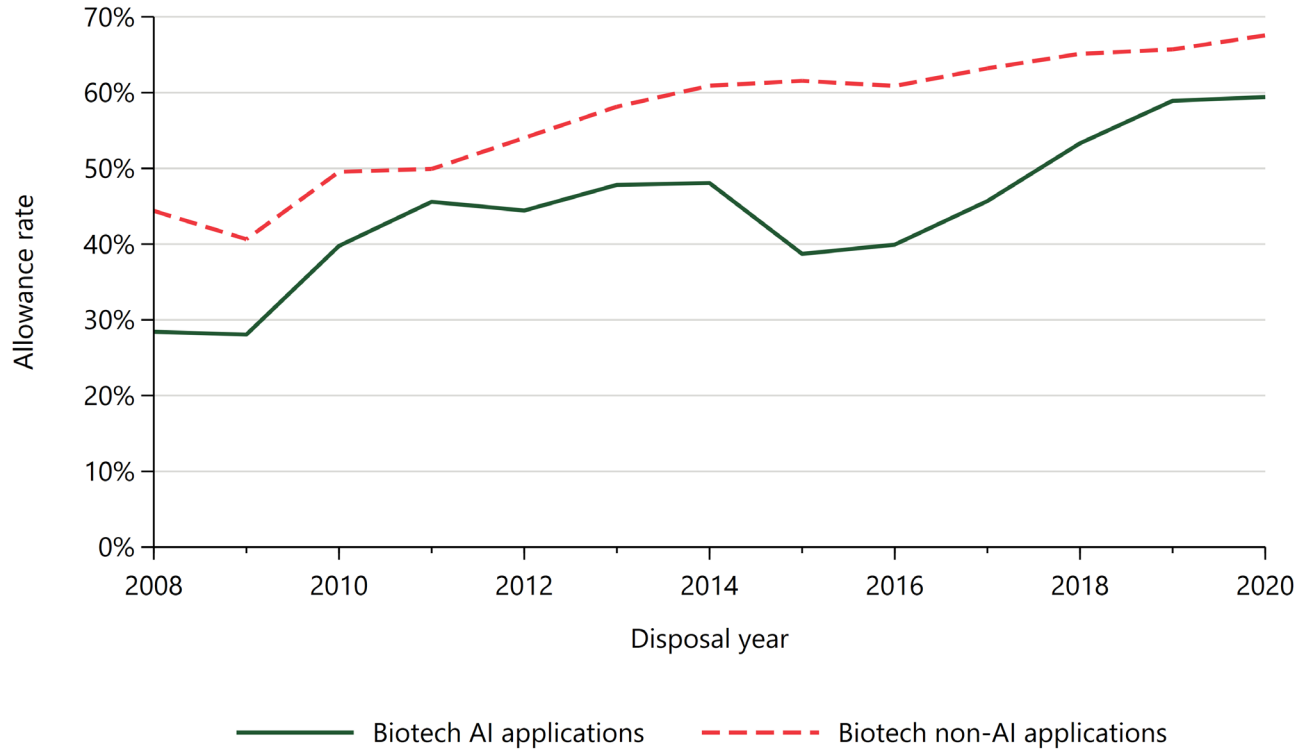Includes only the first technology subclass listed on biotechnology patents.

Diffusion of AI across U.S. based Biotechnology assignees and inventor-patentees, 2002-2020
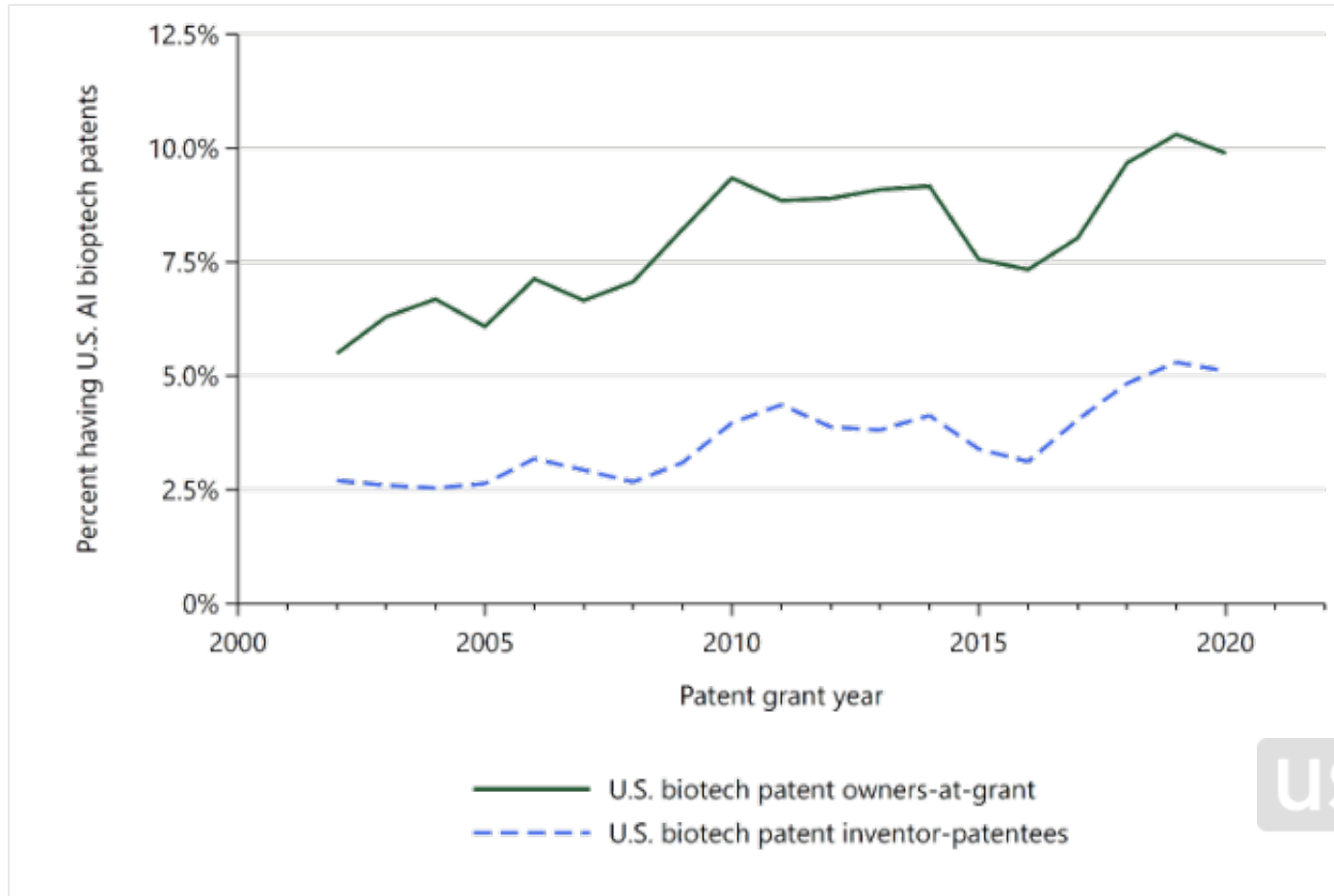
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Allowance rates

Patent application allowance rates, 2008-2020, Biotechnology

The allowance rate is the number of allowances over the number of disposals by disposal year.
An application is classified as AI if the patent is AI, or if not patented, the latest PGPub is AI.
AI patent documents are determined using the methodology in Giczy et al. 2021.
Biotechnology is defined as applications assigned to Technology Center 1600.

Conclusion

- AI is increasingly used in Biotechnology, although to a lesser degree than technology overall.

  - In 2020, about 17.5 percent of all public patent applications included AI, while about 3.5 percent of Biotech applications did.

- Biotechnology AI patenting is diffusing across technologies, owners, and inventor-patentees.

  - In 2020, 17.5 percent of biotech patent technology sub-classes contained AI.

  - About 10 percent of Biotech patent owners-at-grant and about 5 percent of Biotech inventor-patentees patented in AI in 2020.

- Allowance rates for AI in Biotechnology have trended similarly to all AI applications in recent years, and AI Biotech allowance rates are slightly lower than non-AI Biotech allowance rates.

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Thank you!

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