Some Key Dates in the Superconverging Genetics, Biotech, and AI Revolutions

Jamie Metzl

1590

Dutch eyeglass-maker Zacharias Janssen invents the first microscope

1665

Robert Hooke refines the microscope to the point where he can observe structures he calls "cells" in biological samples, a reference to the rooms in cramped monasteries

1675

Antonie van Leeuwenhoek's uses his improved microscope to discover protozoa and bacteria

1796

Edward Jenner introduced first modern vaccine, for smallpox

1821

The first computer, Charles Babbage's Analytical Engine, conceived but never fully built

1848

British mathematician Ada Lovelace writes the world's first computer code

1859

Charles Darwin publishes *On the Origin of Species by Means of Natural Selection*

First commercial oilwell drilled in Titusville, Pennsylvania

1865

Gregor Mendel publishes "Experiments on Plant Hybrids," outlining the transmission of hereditary traits, in peas in the obscure journal, *Verhandlungen des naturforschenden Vereines in Brünn*. Few read it.

1869

Frederick Miescher isolates acid from the nuclei of cells, calling it "nuclein"

1879

Walter Flemming outlines the role of chromosomes in cell division

1900

Work of Gregor Mendel independently rediscovered and popularized by two groups of botanists exploring plant heredity

1907

Leo Baekland produces world's first synthetic plastic

1909

The word "gene," outlining a unit of heredity, coined by Danish botanist Wilhem Johannsen

1911

Columbia University's Thomas Hunt Morgan proves that chromosomes carry genes to pass hereditary information to future generations

1912

The term "synthetic biology" coined by French biologist Stephane Leduc

1919

Hungarian Karoly Ereky invents the term "biotechnology"

1928

Capacity for X-rays and radioactive radium to mutate barley and other plants described

1931

MIT engineer Vannevar Bush invents the first general-purpose analog computer, the Differential Analyzer

1936

Alan Turing proposes and outlines a "universal computing machine"

1940

German Enigma machine decoded by scientists at Bletchley Park, UK

1942

Penicillin mass produced in microbes, providing a significant boost to the Allied war effort

1943

First image captured of X-ray diffraction of DNA provides clues of DNA organizational structure

Warren McCulloch and Walter Pitts conceptualize model of neural network computing in seminal *Bulletin of Mathematical Biophysics* paper

1950

Alan Turing introduces the idea of the "Turing test" for machine intelligence

First synthetic antibiotic created

1952

Alfred Hershey and Martha Chase prove that genes are made of DNA

1953

Watson and Crick (plus Franklin and Wilkins) describe the double helix structure of DNA

1955

Dartmouth professor John McCarthy coins the term "Artificial Intelligence"

Jonas Salk develops first polio vaccine

1956

McCarthy organizes summer "Artificial Intelligence" hackathon

1957

First commercial irradiation of crops

Bell Laboratories scientists invent the transistor

Frank Rosenblatt builds Mark I computer

1958

Washington University biochemist Arthus Kornberg produces DNA in a test tube

First microchip created by US engineer Jack Kilby and others

1961

Sydney Brenner, Francois Jacob, Matthew Meselson, and Jacques Monod show that messenger RNAs take genetic information from the nucleus of cells into the cytoplasm for the generation of proteins

Jacob and Monod publish seminal papers describing cellular circuits in bacterial cells regulating genetic activity and envisioning the engineered manipulation of these mechanisms

1965

MIT's Joseph Weizenbaum creates world's first chatbot, Eliza

1966

Multiple scientists prove that DNA is made of four bases, adenine (A), cytosine (C), guanine (G), and thymine (T), which determine the order of twenty different amino acids making up proteins

1969

US Defense Department introduces DARPANET, the first internet

Marvin Minsky and Seymour Papert publish *Perceptron*, an influential book on AI

1970

Restriction enzymes used to cut DNA identified in bacteria

Norman Borlaug wins Nobel Prize for decades of work with colleagues helping launch the Green Revolution

1971

Paul Berg slices genetic materials from one type of virus to another, launching the field of recombinant DNA

1972

Cohen and Boyer invent a way to clone genetically engineered molecules in non-native cells

1973

First animal gene cloned

1975

Two different scientific groups develop first semi-automated DNA sequencing

Asilomar conference explores implications of recombinant DNA

1976

Biotech company Genentech founded to create recombinant DNA drugs

1977

IBM's Deep Blue computer defeats world grandmaster Garry Kasparov at chess

1978

Louse Brown, the first "test tube baby," born in the UK

Boyer lab creates first synthetic insulin

1980

US Supreme Court upholds first patent on a re-engineered living organisms, in this case a bacteria

Smallpox officially eradicated after two decade vaccination campaign

1981

First transgenic fruit flies and mice created, making it possible for scientists to more effectively evaluate the impact of induced genetic mutations

1982

Genentech insulin generated from engineered bacteria approved by FDA and hits the market

First transgenic plant introduced, an antibiotic-resistant tobacco plant

1983

The first disease-causing single gene mutation is identified, for Huntington's disease

The polymerase chain reaction, PCR, process is developed, making it possibly to amplify DNA at scale

First artificial chromosome synthesized

1987

M.S. Swaminathan receives inaugural World Food Prize for developing high-yield what and rice varieties and bringing Green Revolution to India

1989

British researcher Tim Berners-Lee proposes model for what would become the World Wide Web

1990

Human Genome Project launched

First successful gene therapy procedure carried out at America's NIH

1994

America's FDA approves its first genetically modified food, FLAVR SAVR tomatoes

1995

Genetically modified corn and soybeans approved for sale in the United States

1996

Dolly the cloned sheep born in Edinburgh, UK

1997

E. coli genome sequenced and soon becomes a workhorse of laboratory and industry research and applications

1998

C. elegans roundworm sequenced, providing an ideal "model organisms" for genetics research

Pest-resistant, genetically modified Bt corn produced

First quantum computer introduced

1999

Nvidia calls its GeForce 256 chip the world's first graphics processing unit (GPU)

2000

First synthetic gene circuits able to carry out targeted functions are designed

First entire plant genome sequenced, for a mustard weed

2003

Human Genome Project completed

Thomes Knight introduces the concept of "biobricks," easily assemble biological Legos

Craig Venter announces creation of the first synthetic virus

First Intercollegiate Genetically Engineered Machine (iGEM) competition held at MIT

2008

Craig Venter and colleagues announce first viable bacterial cell regulated by a chemically synthesized genome

2011

Controversy emerges after scientist in the Netherlands, America, and Japan manipulate H5N1 viruses making them more dangerous to humans

IBM Watson wins the US gameshow, Jeopardy

2012

Multiple authors, including Emmanuel Charpentier, George Church, Jennifer Doudna, and Feng Zhang publish papers outlining CRISPR genome editing

Shinya Yamanaka wins Nobel Prize for development of induced pluripotent stem cells

2013

Mark Post creates first cell-cultured hamburger

Large scale production of malaria drug artemisinin using tools of synthetic biology

2014

Amazon Alexa introduced

Fully functional yeast chromosome synthesized

2015

FDA approves application for commercial development of first genetically modified animal product, genetically modified salmon

Geoff Hinton and colleagues win ImageNet competition, highlighting the potential of neural network computing

2016

Google DeepMind's AlphaGo defeats Go champion Lee Seedol in Seoul, Korea

2017

Google DeepMind AlphaZero defeats AlphaGo after three days of learning Go by playing against itself

Google Brain researchers release seminal paper, "Attention is All You Need," describing transformer model for neural network computing

First blood stem cells grown in Boston laboratory

2018

First human "CRISPR babies" born in China

2019

SARS-CoV-2 virus begins spreading in humans, very possibly stemming from a research-related incident in Wuhan

2020

Google DeepMind AlphaFold becomes able to predict protein shapes from amino acid sequences alone, essentially solving the "protein folding problem"

COVID-19 mRNA vaccines developed in an astounding 11 months

First commercial sale of a cell-cultured animal product, chicken nuggets in Singapore

OpenAI launches GPT-3

2022

Google DeepMind and European Molecular Biology Laboratory release protein shape predictions for 214 million proteins, almost all proteins known to science

ChatGPT released by OpenAI and quickly becomes the fastest growing computer application in history

2023

Global AI arms race begins

First (acknowledged) exascale computer made accessible to researchers at America's Oak Ridge National Laboratory

CRISPR-based gene therapy for sickle cell disease approved by regulators in the UK and US

US congressional hearings on COVID-19 origins begin

2024

Google DeepMind introduced AlphaGeometry, an AI system able to solve problems of the International Mathematical Olympiad at roughly the same level as the average human gold medalists

Google, OpenAI, and others release multimodal AI systems able to analyze and generate text, images, and videos within the same systems

Jamie Metzl publishes *Superconvergence: How the Genetics, Biotech, and AI Revolutions Will Transform our Lives, Work, and World*

(NOTE: This is an incomplete and imperfect list. Please let me know if anything essential is missing.)