REJUVE.BIO
Whitepaper
V0.33

Rejuve Biotech stands at the frontline of biotechnological innovation. Leveraging the groundbreaking intelligence of next-gen neural-symbolic AI, the longevity secrets of long-lived animal models, and the power of community-driven human data sets, we are redefining aging. We're on a mission to create breakthrough therapies that not only extend healthspan but also combat aging-related ailments to ultimately reach longevity escape velocity.

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Introduction

The Future of Longevity – Shake Hands with Tomorrow

Haven't we all fantasized about sitting with our great-great-grandkids, still lively though weathered, swapping stories over coffee? From ancient campfire tales to today's science seeking eternal youth, humanity remains obsessed with cheating time to elongate life.

Welcome to Rejuve Biotech…. not just any biotech company. Harnessing cutting-edge artificial intelligence, insights from long-lived animal models, and vast biological datasets, we aim to decipher and master the silent clockwork of aging. Our audacious goal is to develop groundbreaking therapies that could slow, stop, or even reverse aging. Imagine a world where aging no longer defines your trajectory. A life spent constantly growing, evolving, and redefining yourself as your interests and abilities change over time. Instead of education, work, retirement, our lifespans could be fluid canvases where we learn, create, and innovate across a century or more. Picture a world where you can learn to play the violin at 90 or start a new tech startup at 110. Imagine a life where we're constantly growing, evolving, and redefining ourselves. With longer healthy lifespans, the possibilities are boundless. Careers extending beyond 65 could rebalance fiscal weights on younger generations. Lower elderly care costs from expanded healthspans could deliver huge savings. And people living well past 100 may more readily invest in long-term priorities like climate change solutions that they would personally experience. Their elder wisdom can help guide humanity through the turbulent challenges of this century and beyond.
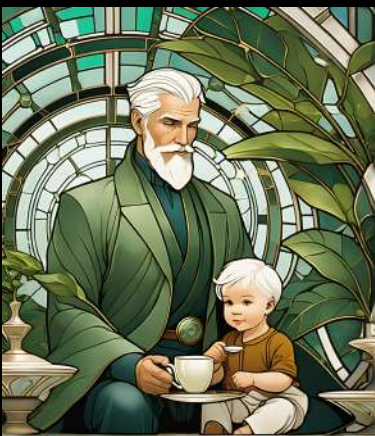
And here's our pledge: Our solemn commitment is to democratize this gift of extended lifespan. Of course, realizing these prospects depends on equitably distributing longevity therapies. That's why we work hard to ensure expanded access across socioeconomic groups, not just the privileged few. After all, unlocking the fullness of human potential should be a shared journey, not an exclusive passage. This voyage of discovery is one we must take together.

Challenging the Inevitability of Aging

At Rejuve.Bio, we challenge the age-old narrative that aging is inevitable. Our mission is clear and urgent – we want to change the story of aging. While there is debate on whether aging itself is a disease, there is no argument that it is the primary risk factor for many of today's most prevalent conditions including heart disease, cancer, diabetes, and dementia. Traditionally, these illnesses were seen as the unavoidable consequence of growing older. But what if they didn't have to be?

We want to confront the very essence of aging, focusing on treatments that can slow, halt, or even reverse the cellular processes that define our advancing years. Imagine a future where individuals remain energetic and productive well into their 90s or even 100s. Picture our cells as intricate gears in a watch, each part working seamlessly, until one misaligns and slows the entire mechanism. Over time, gears wear out and synchronization is lost. We call these small glitches in the system the "**Hallmarks of Aging.**" It's as if a misaligned gear causes the whole watch to lose time. These minute missteps, from genetic mutations to cellular deterioration, are the real culprits behind the toll of years. By targeting these hallmarks, as well as other unknown mechanisms, with the newest and most powerful AI, we believe we can open up an entirely new frontier in medicine.

"For the first time in human history, the prospect of dramatically extending healthy human lifespan is finally within reach. Thanks to the intricate ballet of genetics, regenerative medicine, and AI, we now hold the potential to not merely decelerate but, indeed, halt—and dare I say, rewind—the hands of the biological clock."

Dr. Axel Schumacher, Chief Biotech Officer
Rejuve.Bio, Futurologist, Longevity Expert
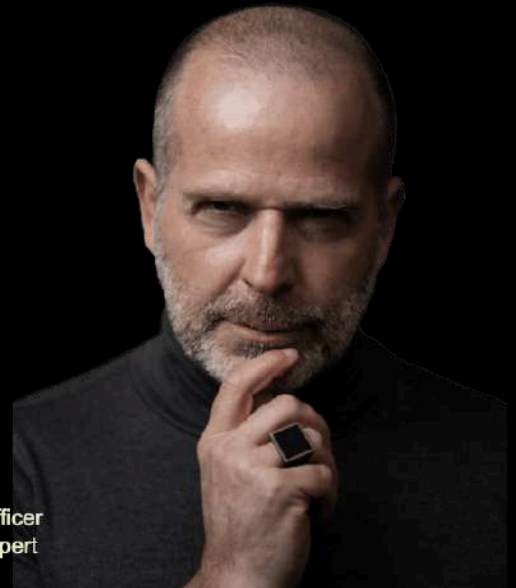
Our quest is fueled by the relentless pursuit of knowledge, turning trillions of stones in the vast field of scientific research. The scientific community has already identified at least 14 distinct hallmarks of aging, akin to how early astronomers identified constellations in the night sky. As technology advances, we anticipate this list to grow and refine, just as telescopes have enabled us to discover more stars and galaxies than previously imagined. Each of these represents a potential point of intervention, a gateway to extending human healthspan. The stakes are monumental, but so is our commitment. By addressing aging at its core biological roots, we aim to usher in a medical revolution – transforming how we understand and experience our later years. Our goal is to grant each person a vibrant, extended lease on life. There are many milestones left to reach, but the journey has begun.

Rejuve Biotech stands at the forefront of this promising and transformative journey into the biology of aging. The traditional hallmarks of aging have played a pivotal role in guiding our research and have been instrumental in setting the direction for the entire field. These hallmarks serve as a foundation upon which we've built our understanding, but as with any pioneering science, our knowledge continues to evolve.

The nine 'classic' hallmarks of aging

- **Genome Instability:** Exogenous factors, as well as by endogenous challenges such as DNA replication errors, cause a wide range of genetic lesions, include point mutations, deletions, translocations, telomere shortening, single- and double-strand breaks, or chromosomal rearrangements.

- **Telomere attrition:** Replicative DNA polymerases are unable to complete the copy of telomere regions (end of the chromosomes) of our DNA. Accordingly, after several cell divisions, telomeres undergo a substantial shortening that induces genomic instability and finally either apoptosis or cell senescence.

- **Epigenetic Alterations:** Epigenetic changes (e.g., DNA methylation, abnormal post-histone modifications, aberrant chromatin remodeling, and deregulated of non-coding RNAs) impact on gene expression and other cellular processes, resulting in the development and progression of several age-related human diseases.

- **Mitochondrial Dysfunction:** Mitochondria are responsible for producing energy. As we age, mitochondria become less efficient, which can lead to an increased risk of age-related diseases. Mitochondria also produce reactive oxygen species (ROS), molecules that can damage cells. Over time, this damage can lead to cell death.

- **Loss of Proteostasis:** Proteostasis is the maintenance of a balanced proteome. As we age, proteostasis declines, leading to the accumulation of misfolded proteins which can damage cells in a number of ways, including by forming aggregates that can clog up cells and by triggering cell death.

- **Deregulated Nutrient-Sensing:** A process by which cells detect the availability of nutrients and adjust their metabolism accordingly. As we age, nutrient-sensing declines, leading to the overactivation of pathways that promote cell growth and proliferation leading to problems such as cancer, obesity, and insulin resistance.

- **Cellular senescence:** A process by which cells stop dividing and enter a state of permanent growth arrest. This can happen in response to DNA damage, telomere shortening, and chronic inflammation. Senescent cells secrete a number of factors that can damage tissues and promote age-related diseases.

- **Stem Cell Exhaustion:** Stem cells are cells that can divide and differentiate into specialized cells. As we age, the number of stem cells in our bodies declines, and those that remain become less functional. This can lead to impaired tissue regeneration and repair, which can contribute to a number of age-related diseases.

- **Altered Intercellular Communication:** A process by which cells send and receive signals to each other. As we age, this ability declines, leading to the disruption of signals between cells. This can contribute to a number of age-related diseases, including cancer, heart disease, and neurodegenerative diseases.

The 'new' hallmarks of aging

- **Autophagy:** A process by which cells recycle their own components to maintain their health and function. When autophagy declines, it leads to the decline of cellular quality control and the accumulation of debris which can contribute to a number of age-related diseases, including Alzheimer's, Parkinson's disease, and cancer.

- **Dysbiosis (Microbiome Disturbance):** The gut microbiota, made of bacteria, viruses, and other microorganisms play an important role in digestion, immune function, and metabolism. Aging can lead to an imbalance in the microbiota, contributing to many diseases, including obesity, type 2 diabetes, and Alzheimer's.

- **Altered Mechanical Properties:** Cells are surrounded by matrix of proteins and other molecules. This matrix gives tissues their strength and flexibility. With age, the matrix becomes less able to withstand stress and strain, e.g. fibroblast senescence, which leads to age-related diseases (like osteoarthritis, osteoporosis, and sarcopenia).

- **Splicing Dysregulation:** Splicing is the process by which genes splice transcribed RNA together to produce mature mRNA. An age-specific dysregulated, leads to abnormal proteins with altered functions that contribute to a number of age-related diseases, including Alzheimer's disease, Parkinson's disease, and cancer.

- **Chronic Inflammation:** A natural process that helps the body to fight infection and heal injuries. Ageing correlates with high, levels of inflammatory mediators in the blood, such as IL-1, IL-6, C-reactive protein, IFNα, and several others. It can damage tissues and organs and contribute to a number of age-related diseases.

- **Cellular Enlargement:** It was also proposed that that cellular enlargement is causally associated with aging. Changes in the cell's volume during various processes are necessary for the cell to function, for example during the cell cycle, development, and differentiation.

It's important to recognize the Hallmarks of Aging, though groundbreaking, do not fully explain the intricacies of aging. They provide a framework to view aging's complexities. And through this lens, we've made an exciting discovery – by targeting these hallmarks precisely, we may not only slow but potentially reverse aspects of aging.

Looking beyond what makes us old, we can also examine what keeps us young – the "Hallmarks of Health." From an organizational perspective, health is a set of dynamic features that maintain balance and prevent aging across microscopic and macroscopic levels. Specific biological hallmarks should correlate with a healthy state. Disrupting these hallmarks may lead to disease, while restoring them could promote longevity. Another area of interest is the 'antagonistic pleiotropy' theory of aging. This proposes genes beneficial early in life can become harmful later. For example, genes promoting growth and development may increase cancer risk in old age. The gene IGF-1 follows this pattern – it builds muscle and bone density in youth but can fuel cancers in later life.

Overall, these perspectives suggest a future where age-related diseases could be prevented or delayed significantly. Though many questions remain, the possibilities emerging from research into the biology of aging are tremendously exciting.

AI: Humanity's Key to Unlocking the Secrets of Longevity

At Rejuve.Bio, we're not just talking about the potential of AI; we're living its transformative power every day. We firmly believe in the unparalleled potential of advanced artificial intelligence in redefining longevity research. AI isn't just the latest tech buzzword; it's a real game-changer in the world of medical discoveries. It is ushering in an age of rapid discoveries and unprecedented innovations, especially in diagnostics, drug development, and new treatments.

Consider the vast complexity of the human genome, a mesmerizing orchestra of over 20,000 genes. Their interactions are not merely intricate; they weave a dance so complex, so vast, that envisioning their innumerable exchanges boggles the mind—literally trillions upon trillions of interplays. Determining which of these pathways influence the aging process is beyond human comprehension. Yet, **AI thrives in such environments.** Our state-of-the-art BioAtomspace AI platform is designed to navigate these vast molecular labyrinths. It scans enormous genomic databases to unveil previously undiscovered genetic pathways tied to lifespan and health. With AI, what was once a monumental task is now expedited, allowing us to spotlight new drug targets and swiftly test thousands of compounds for their anti-aging potential.

But our quest doesn't stop with genes. We believe in holistic research, meaning we are not concentrating on a few specific known genes or pathways. This is what kept longevity research stuck for way too long. Consider science's historical obsession with cholesterol. For years, medical professionals focused almost exclusively on LDL ("bad") cholesterol levels, believing it was the primary factor in heart disease. Yet, we now know heart disease is influenced by a plethora of factors: inflammation, HDL cholesterol levels, triglycerides, and more. By fixating solely on LDL, we missed the larger, intricate picture. Similarly, look at Alzheimer's research as an example—a tale of tunnel vision. For decades, science peered intently at merely two facets of the disease, entranced by the dance of amyloid-beta peptides and the erratic steps of tau proteins. Such narrowed gazes can blind us to the complexities of aging at large. This means we need to assimilate data from myriad sources – from lab tests and wearable health metrics to environmental variables and disease histories. We even take cues from nature. By studying long-lived species like our Methuselah Flies, specially bred for longevity, we gain insights into what grants these organisms extended health and life. These clues potentially unlock secrets to enhancing human longevity.

The immense challenge is deciphering the tangled web of interactions among the myriad factors influencing aging. This is where our advanced AI tool, the BioAtomspace, comes in. It's adept at synthesizing vast, multidimensional datasets - like assembling a jigsaw puzzle with countless pieces, each representing part of our health and environment. Our AI can weave together data on genotype, gut microbiome, blood markers, activity patterns, transcriptome, epigenome, and even external factors like weather. The result is a comprehensive view of an individual's unique aging journey, identifying key environmental, lifestyle, and molecular triggers. This holistic approach provides granular understanding of aging mechanisms at the cellular level, paving the way for innovative treatments. The BioAtomspace helps unravel aging's complexity, giving us an unprecedented vantage point to advance our anti-aging mission.

Precision Medicine – Turning Back the Clock on Aging

At Rejuve.Bio, we don't view aging as inevitable, but as a tapestry of individual experiences. Historically, anti-aging treatments have taken a one-size-fits-all approach. However, we understand aging's intricacies are shaped by a personalized blend of genetics, lifestyle, and environment.

With precision medicine, we're revolutionizing anti-aging. Instead of generic treatments, our mission is to design therapies tailored to people's unique biology. How? By harnessing AI to integrate genetic, microbiome, biomarker, and clinical data. This allows us to devise custom regimens of drugs, diet, and lifestyle changes aimed not just at delaying aging, but preventing disease. We're moving beyond one-size-fits-all to transform the future of personalized anti-aging care.

Unlocking the Synergy of Aging & Disease Research

Aging — Therapeutic Potential — Disease

- **A Dual Approach:** Investigating aging biomarkers may unlock keys to multiple disease biomarkers.
- **Pharmaceutical Impact:** Drugs effective against aging biomarkers may show efficacy across various diseases.
- **Efficiency:** By targeting aging, we are potentially addressing numerous health concerns in tandem.

This commitment to personalized care underlines Rejuve's dedication to making longevity research actionable. We're not just studying aging; we're actively translating our findings into real-world solutions that amplify both healthspan and lifespan. As we stride into the future, our multifaceted approach promises to combat the ailments of old age with more vigor than ever before. By intertwining AI, genomics, and personalized medicine, we're crafting groundbreaking therapies with a vision to redefine aging itself. The ripple effect of such a success would be monumental, transforming societies at a magnitude reminiscent of the antibiotic revolution.

The Problem

Why aren't we curing aging faster?

Aging research, for the longest time, was like trying to read a novel in dim candlelight: challenging, often mystifying, with many pages stuck together. But as the world evolved, so did the curiosity to understand this inevitable journey, paving the way for a multitude of questions and challenges. Overall, there are many reasons why research on longevity & aging was comparably slow in past decades:

1. The Pitfall of After-the-fact Solutions

Picture this: you're at the beach, building a sandcastle. But instead of constructing a strong foundation, you're more focused on patching up the little holes that keep popping up as waves roll in. It's an exhausting, never-ending cycle. Similarly, medicine has reacted to aging instead of preventing it. Resources go toward treating diseases after they arise rather than researching prevention. It's like fixing cracks in a dam instead of engineering a robust one from the start.

Alzheimer's is a prime example. Efforts center on managing late-stage symptoms rather than understanding early precursors. The challenge lies in shifting from late intervention to early prevention. We need to move upstream and address the origins of aging itself. That is the only way to build a formidable dam against the downstream torrent of age-related diseases. Prevention first, reaction later.

2. The Chronological Challenge of Longevity Research

Humans inherently live for decades, which makes observing the long-term impacts of interventions a slow and challenging process. When we turn to animal studies, hoping for a quicker resolution, we find ourselves still bound by time. A mouse might live for two years, but its lifespan is still a lengthy chapter in the story of anti-aging research. Understanding the intricacies of longevity in such a time-limited frame poses its own set of challenges. In addition, the traditional "old" pharmaceutical research and development (R&D) process is long and arduous, involving numerous steps from the discovery of a potential drug target to the approval of a new drug by regulatory bodies. Taken together, anti-aging research was doomed for a long time.

Lead Discovery	Drug Discovery	Pre-Clinical	Clinical Trials			Regulatory	To Market
			Phase I	Phase II	Phase III		$$
6-8 Years	3-5 Years	1-2 Years	6-7 Years			1-2 Years	

Fig. 1: Classical Drug development takes time. Identifying potential drug molecules or "leads" involves exhaustive lab work and then screening of thousands, sometimes millions, of compounds. Scientists must then refine these leads to have the desired effect on the target without being toxic. Before testing in humans, potential drugs undergo rigorous laboratory and animal testing. These tests assess the drug's safety profile, pharmacodynamics (what the drug does to the body), and pharmacokinetics (how the body processes the drug). Phase 1 Clinical Trials: Typically involving a small number of healthy volunteers, this phase assesses the drug's safety, dosage ranges, side effects, and how it's metabolized and excreted. Phase 2 Clinical Trials: Here, the drug's effectiveness is tested on a larger group of patients, often a few hundred, who have the condition the drug aims to treat. Researchers also monitor side effects and determine optimal dosing. Phase 3 Clinical Trials: This phase involves large-scale testing on hundreds to thousands of patients, further evaluating the drug's effectiveness and monitoring adverse reactions in a diverse population. Once the clinical trials demonstrate that the drug is both safe and effective, the data is submitted to regulatory agencies (like the FDA in the U.S.). Even after a drug is approved, it's monitored in the general population to detect rare side effects or long-term risks that might not have been apparent in clinical trials.

3. The Untapped Potential of Cross-dataset Analysis

With the availability of vast amounts of data from both human and animal studies, one would assume researchers would eagerly delve into cross-dataset analysis. Unfortunately, this remains a neglected area. Integrating findings from, say, fruit fly longevity studies with those of human cellular aging could potentially provide richer insights. The reluctance to tap into this 'treasure trove' could be attributed to factors like data inconsistency or the sheer magnitude of information. Yet, by not diving into this treasure, we're leaving some of the most thrilling chapters of our longevity saga unread.

4. The underutilized Giant : Personalized Medicine

While some people might grapple with osteoporosis in their golden years, others might face cardiovascular challenges. This calls for personalized medicine—an approach tailored to individual genetic, environmental, and lifestyle factors. Sadly, this giant remains largely dormant. Viewing aging as a jigsaw puzzle, it's clear that a one-size-fits-all approach will not suffice. With billions of pieces representing diverse aging paths, we need a comprehensive view to truly address the challenges of aging.

5. The Complex Web of Aging

Aging is complex. The interplay between genetics, environment, metabolism, and more, paints a multi-dimensional picture. Addressing aging, therefore, isn't just about tackling individual threads but understanding and managing the intricate network. The dawn of artificial general intelligence offers a solution. This next generation of computational power might hold the key to mapping and navigating the vast and complex terrain of human aging.

The longevity industry has a seasoned roadmap, though many overlook its history. Most companies target specific diseases, influenced by regulatory challenges in anti-aging treatments. Such strategies saw varying success - funding wins, innovative launches, acquisitions, and winding down. Even highly praised pharma companies, after acquisition, couldn't surmount all challenges.

From an investment and commercial perspective, it's time for a shift. Rather than dancing around it, why not confront aging head-on? Why not brave regulations, target aging at its core, and champion prevention over cure? After all, preventive medications already exist for many conditions. Introducing drugs that slow aging, averting age-linked diseases, seems not just logical but imminent. The longevity industry is poised to learn from the past while boldly reshaping the future.

In conclusion, though combating aging may seem daunting, the journey brims with potential. By confronting challenges directly and harnessing exponential technologies, we stand at the threshold of rewriting the epic human story of longevity. The road ahead remains long, but for the first time we have sight of the destination. The future of aging is now in our hands to shape.

The Solution

At the forefront of biotechnological advances, Rejuve.Bio is pioneering a new era in health enhancement. How? By fusing three groundbreaking approaches:

- **We use next-generation AI that seamlessly blends neural networks with symbolic reasoning.**
- **We dive into the longevity secrets of animals known for their impressive lifespans.**
- **We harness the collective insights from vast human data sets, embracing the collective wisdom of many.**

Our goal isn't just extending life but filling extra years with health and vibrance. We're committed to developing therapies, drugs, supplements and interventions that don't just delay aging, but combat its associated ailments. Imagine aging without slowing down, where wisdom accrues without weariness. This is our vision for the future of human health and longevity. We want to help you live long and well. So, let's dive into the three different areas of our solution.

Rejuve.Bio's AI Revolution

Everyone's chatting about AI. And not just in the corridors of biomedical labs. It's big news everywhere. It's not just because of wonders like ChatGPT; real game-changers are coming to life. Imagine AI as a visionary guide, unlocking realms of the biomedical universe that we once deemed unreachable, kindling aspirations we never knew we harbored. Here's what we're seeing:

· **New Biomarkers Discovery:** With AI's ability to identify intricate patterns in medical data—patterns beyond human perception—we've unveiled new biomarkers for diseases. These markers allow for earlier diagnosis and more timely interventions.

· **Innovative Drug Design:** AI is shaping the pharmaceutical industry by designing drugs that outperform their traditional counterparts. These novel drugs offer heightened effectiveness while minimizing toxic side effects.

· **Virtual Simulations:** The power of AI extends to the creation of virtual replicas of the human body. Such simulations empower researchers to test pioneering treatments and procedures without any direct implications on real patients.

· **Enhanced Research Productivity:** The automation capabilities of AI streamline tasks in biomedical research, such as intricate data analysis and drug discovery processes. This not only amplifies efficiency but also liberates researchers to engage in more innovative pursuits.

In essence, AI is not a future concept in biomedical research—it's the present. Those who are not using the latest AI tools are simply missing the train. It's rejuvenating methods, refining diagnostics, expediting drug discoveries, and charting novel treatment pathways. Leading this charge is Rejuve.Bio. With an AI arsenal among the most advanced on Earth, we are the torchbearers in the audacious expedition into the enigma of aging. Let's dive into it!

Understanding OpenCog Hyperon, the BioAtomspace, and MeTTa

Rejuve.Bio's AI platform evolved from the OpenCog AI ecosystem. OpenCog Hyperon is an advanced software development framework that aims to support the creation of systems with **artificial general intelligence (AGI)** at or beyond human-level capabilities. OpenCog's core design feature is the 'Atomspace', a distributed metagraph consisting of nodes and links labeled with various types of information. What makes it special? It organizes data in a unique way that allows AI to complete vital operations more efficiently, boosting performance speeds and conserving memory.
But the Atomspace isn't a passive data warehouse. It serves as a dynamic playground for a medley of AI algorithms, each springing from different foundational concepts—be it logical reasoning, probabilistic programming, the mysterious workings of attractor neural networks, or the principles of evolutionary learning. These algorithms don't just coexist; they interact, using the Atomspace as their common language and channel of communication.

In essence, OpenCog Hyperon isn't just about creating a smarter AI—it's about weaving together diverse mathematical tools and techniques to craft a more scalable and user-friendly platform for AGI

development. It's about embracing the vastness of human cognition and distilling it into an AI system, bridging different branches of math in the architectural blueprint.

The BioAtomspace- The Pinnacle of Knowledge Graph Technology

The digital revolution, led by the rise of Artificial Intelligence and Machine Learning, has transformed our understanding and engagement with information. Amidst this transformation, representing intricate biological knowledge both accurately and efficiently is pivotal. Here's where Rejuve.Bio's BioAtomspace Knowledge Graph steps in, challenging and expanding the horizons of biological knowledge representation and processing.

> "The BioAtomspace representational framework provides a unique level of abstraction that allows multiple types of biological knowledge to be expressed in ways that are natural in terms of their own intrinsic properties, but also connect cleanly and in an easily manipulable way with other types of knowledge. Relationships from research papers, discrete data like gene sequences, continuous data like gene expression vectors or clinical lab test values, dynamical data regarding the time-course of various parameters within an organ or organism, can all be represented in clear and interdependent ways."
>
> Dr. Ben Goertzel, Chief AI Scientist Rejuve.Bio, AGI Guru & Serial Entrepreneur

So, what exactly makes our BioAtomspace stand out in a world already buzzing with AI innovations?
Let's step back a little and let us try to explain it from the start. At the heart of BioAtomspace is what is called the 'Atomspace'—a distributed metagraph made up of nodes and (hyper)links that are tagged with a diverse range of types and supplementary information. Think of this as the bedrock: a core design feature that underpins the entire system. But it's not just about the architecture. The true magic lies in the myriad of AI algorithms it employs. Originating from an array of AI paradigms—from logical reasoning and probabilistic programming to attractor neural networks and evolutionary learning—these algorithms harness the power of Atomspace. Not just for their own internal representation, but also to communicate across different algorithms.

Our BioAtomspace doesn't just act as a tool. An associated cognitive systems theory suggests that it can potentially encapsulate all key facets of human intelligence. At its core is the idea of "cognitive synergy"—a harmonious interplay between various algorithms and memory organization modes. And the driving force behind this state-of-the-art AI platform? A fervent desire for enhanced scalability and usability. Moreover, it integrates profound mathematical tools and methods, delving deep into dependent type theory, intuitionistic, and paraconsistent logic, embedding them into the very fabric of the system design.

To put it simply, BioAtomspace is the brain behind our AI framework. It's an avant-garde system rooted in the notion of hypergraphs, reshaping the way we store and retrieve information in the AI realm.
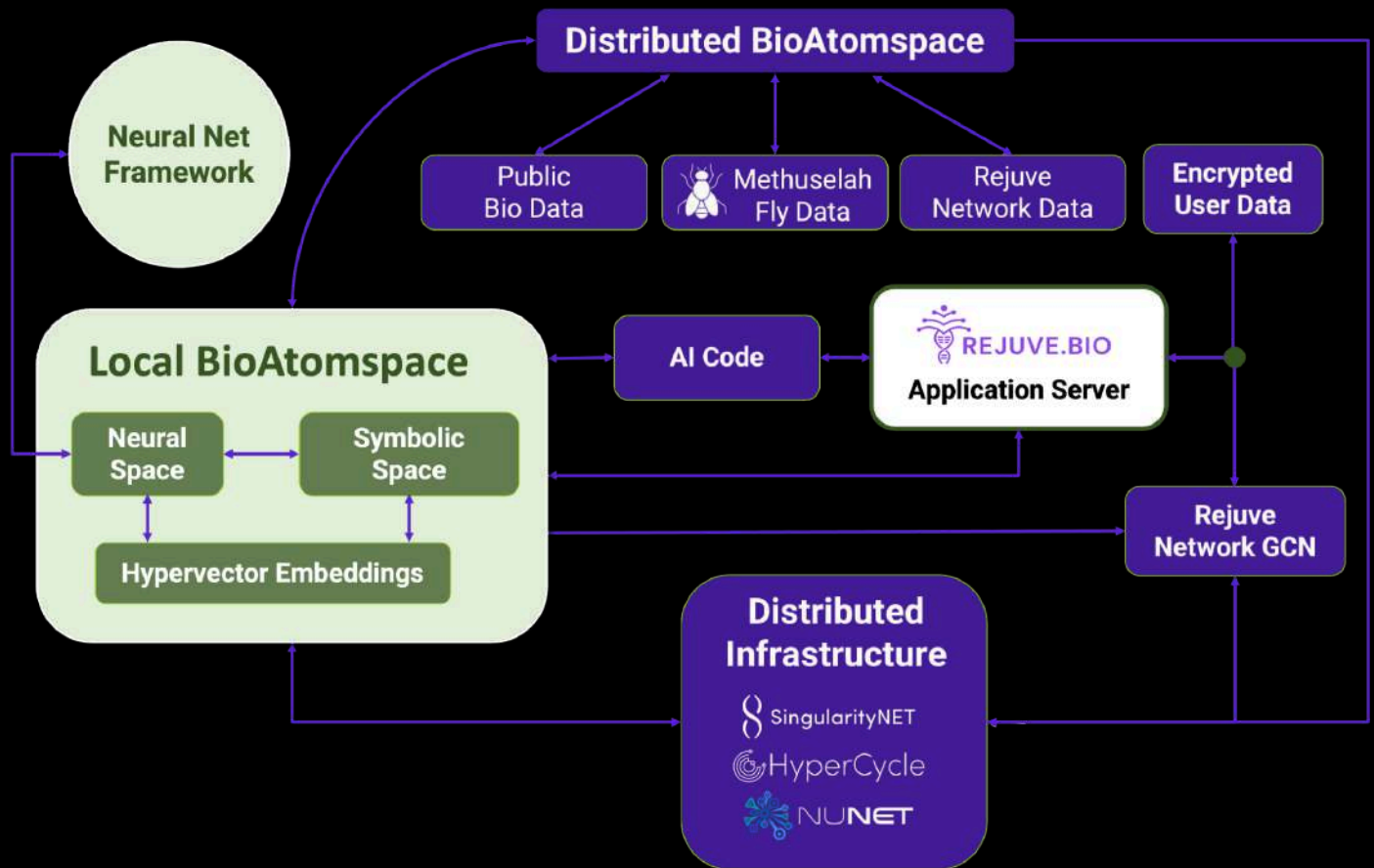
Fig. 3: The Bioatomspace is a metagraph (graph of graphs) knowledge base that combines existing publicly available biological reference data, proprietary experimental data, and semantic representations of scientific publications in a format directly interpretable by symbolic inference engines (like the Opencog PLN system) and by state of the art foundational transformer models (chatGPT et al) via graph embeddings. This multiplicity of algorithms can join forces in a cognitive synergy to tackle problems beyond the reach of any one AI or machine learning technique.

The uniqueness of the BioAtomspace as explained by our AI Guru, Dr. Ben Goertzel, for decades one of the leading minds in AI research: "The Atomspace representational framework provides a level of abstraction that allows multiple types of biological knowledge to be expressed in ways that are natural in terms of their own intrinsic properties, but also connect cleanly and in an easily manipulable way with other types of knowledge. Relationships from research papers, discrete data like gene sequences, continuous data like gene expression vectors or clinical lab test values, dynamical data regarding the time-course of various parameters within an organ or organism, can all be represented in clear and interdependent ways." But this is not where it ends. "A variety of reasoning, learning, pattern mining, and concept/hypothesis formation methods are then implemented on top of this representational fabric, leveraging its generality to make discoveries and conjectures that span datasets, levels of organization, organisms and species."

High-Level Representation and Processing

Let's step back another step to illustrate what we build, starting from Graph Theory. Graph theory is a significant component of many AI-related disciplines, including neural networks, pathfinding algorithms, and more. Graphs provide a flexible and robust framework for modeling and analyzing various kinds of complex structures, from social networks to the structure of the web to various kinds of biological data. For simple queries and basic predicate-argument relationships, various simple graphs could suffice. They are effective infrastructures for triple stores, basic databases that store information as a trio of

entities. However, the power of the BioAtomspace is unveiled when one seeks a more abstract representation of knowledge.

The BioAtomspace excels in representing knowledge in first or higher-order predicate logic; that's a type of logic that is used to represent knowledge about relationships between concepts. It can handle complex relationships involving higher-order functions (functions that can take functions as inputs or outputs), nested universally and existentially quantified variables, and uncertainty – all crucial for real-world applications. In simpler language: The BioAtomspace system is different because it can represent knowledge in a more abstract way. This means that it can represent knowledge about relationships between concepts, as well as knowledge about the properties of concepts. For example, the BioAtomspace system can represent knowledge about the relationship between genes, longevity, and diseases. This knowledge can then be used to develop new drugs or treatments against aging. The ability to represent knowledge about the properties of concepts is also important because it allows the BioAtomspace system to represent more precise knowledge. For example, the system can represent knowledge about the properties of a gene, such as its location on a chromosome or its function. This knowledge can then be used to understand how genes work and how they interact with each other. A hypergraph is a mathematical and computer science concept that extends the idea of a traditional graph, allowing an edge to connect any number of vertices, instead of just two. In the realm of artificial intelligence and graph technology, hypergraphs can serve as a more accurate and versatile representation of complex relationships, particularly when modeling relational data or intricate, higher-dimensional relationships.

Vertices

Vertices are essentially the individual points or 'dots' in a graph or a network. For example, imagine you're drawing a connect-the-dots picture. Each of those dots you're connecting is a vertex. And when you draw a line between two dots, that line is similar to what we call an 'edge' in graph theory. If you're thinking about social networks, a vertex could represent a person. If it's a transportation network, a vertex could represent a city or a bus stop. If it's a molecular network in biology, a vertex could represent a molecule. So, in essence, vertices are the fundamental units or 'building blocks' that we use to create and describe networks or graphs in our research. They represent the entities of interest, and the relationships between them are represented by lines or edges.

Let's explain this concept using a biological example, such as molecular networks. For instance, consider the representation of complex biological interactions like metabolic pathways. A traditional graph might use vertices to represent different molecules (like enzymes and metabolites), and edges to represent binary reactions between them. However, this binary model can fall short of accurately representing multi-component reactions or systems where multiple molecules interact simultaneously.

Here is where hypergraphs shine. In a hypergraph, a single edge – often referred to as a "hyperedge" – can link any number of vertices, enabling the representation of more complex relationships. In our example, this allows for accurate modeling of reactions involving more than two molecular entities or intricate pathways with concurrent reactions. This powerful representation is of great value in AI. For instance, hypergraphs could be used to better understand the complex biochemical interactions in a cell, to identify potential drug targets in aging medicine, or to predict the effects of various compounds in bioinformatics.

Meta-Representational Knowledge Graph

Another key differentiator is BioAtomspace's ability to act as a **meta-representational knowledge graph**. It allows the integration of various subgraphs each with different knowledge representation schemes under a single unified architecture. For instance, one subgraph could be oriented towards natural language, another dealing with formal mathematics, and yet another for functional or imperative

programming languages. Instead of maintaining separate knowledge graphs for each type, the BioAtomspace provides a unified graph for all, enabling shared knowledge and interlinking between the different types of knowledge.

Neural–Symbolic AI Integration

A revolutionary aspect of the BioAtomspace is its capability to facilitate two-way interaction between neural nets and symbolic AI. While other frameworks permit consultation by large language models, the BioAtomspace is designed to encourage a symbiotic relationship between neural and symbolic AI, facilitating a co-learning environment.

Neural- and symbolic artificial intelligence are two different approaches to AI that have different strengths and weaknesses.

- **Neural AI** is inspired by the human brain and uses artificial neural networks to learn from data. Neural networks are made up of interconnected nodes that can learn to recognize patterns in data. This makes neural AI well-suited for tasks such as image recognition and natural language processing.
- **Symbolic AI** is based on knowledge representation and reasoning. Symbolic AI systems represent knowledge in a formal language and use rules to reason about that knowledge. This makes symbolic AI well-suited for tasks such as planning and decision-making.

In other words, it doesn't simply relegate symbolic or neural functions to be resources for the other. Rather, it allows intertwined learning and development between the two, a feature unparalleled in the current AI landscape.

As such, Rejuve.Bio's BioAtomspace Knowledge Graph is not merely a tool; it's an advanced infrastructure for neural-symbolic AI. Its capacity for high-level representation and processing, its meta-representational capability, and its unique neural-symbolic integration make it stand head and shoulders above the competition. This is why many consider it the world's best knowledge graph. There are only a few other, subject-specific neural-symbolic systems in the world, among them DeepMind's AlphaFold is a neuro-symbolic AI system that can predict the structure of proteins, and Google's Pathways is an -in-development- AI system that can plan and execute complex tasks such as driving cars.

Investing in the BioAtomspace means investing in the future of AI, where the seamless integration of varied types of knowledge leads to an era of smarter, more efficient, and more versatile applications to improve human health and longevity.

MeTTa – the "language of thought"

Rejuve.Bio, as part of the wider OpenCog Hyperon AGI ecosystem, is also applying the newest AI language "MeTTa" to its ecosystem. MeTTa's syntax is different from other programming languages to allow computers to navigate through knowledge graphs as a human mind would. The design of the MeTTa language represents a synthesis of ideas from type theory, intuitionistic logic and other theoretical domains with practical experience gained via decades of experimentation with earlier software systems. As a key ingredient of the Hyperon design, MeTTa (Meta Type Talk) serves a language for internal use by Hyperon algorithms, and an end-user language for developers to use in coding algorithms and applications for Hyperon. The goal for MeTTa is not to manipulate knowledge metagraphs, but rather to represent it in the metagraph knowledge metagraphs, enabling knowledge metagraphs to flexibly

self-transform in a cognitively useful and meaningful way. Indeed, MeTTa is considered a viable "language of thought" for AGI because it allows for representation of various types of knowledge and cognitive processes. With MeTTa, knowledge can be transformed in a meaningful way within knowledge metagraphs, which is an important aspect of the overall OpenCog and Hyperon programs.

In other words, this programming language is specifically designed to enable computers to reason and infer knowledge like the human brain. Where regular LLMs like ChatGPT produce responses based on mere probability and pattern finding, MeTTa-powered models can simulate "thinking" processes, learn from experience and apply logic and reasoning like a human would do to produce quality representations of knowledge and accurate responses to the users' queries.

In essence, MeTTa will be capable to serve as a "language of thought" spanning the multiple knowledge and dynamic types characterizing human-level intelligence as well as the leading paradigms in the AI field.

Overall, BioAtomspace's capability to handle abstract knowledge representation is unrivaled, particularly useful when complex knowledge graphs are needed to enhance Machine Learning Models. The BioAtomspace system is under development, but it is already working beyond expectations, and will revolutionize the way that biological knowledge is represented and used in computers. The ability to represent knowledge in a more abstract way will allow computers to understand and process more complex knowledge. This will lead to new advances in fields such as longevity, medicine, biology, and artificial intelligence.

Rejuvenating Genetics: The Tale of the Methuselah Flies

Imagine blowing out another 5 times the candles on your birthday cake while feeling as young and vibrant as you did in your prime. Sounds impossible, doesn't it? But hold on tight because this isn't magic—it's science. Rejuve.Bio has unlocked a groundbreaking discovery: the Methuselah fly. This is no ordinary insect; this unique strain of Drosophila fruit flies, the "Super O's", that can celebrate nearly five birthdays for every one of their wild counterparts.

But how did we achieve this feat? Through painstaking decades of breeding, laser-focused on longevity and thriving health, we've birthed these astonishing animals. These aren't just your average long-lived flies. They remain lively and healthy even in their older age. Intriguingly, many of the genes that grant these flies their enhanced lifespan and health also exist in humans. After all, who said only flies should have all the fun?

How It All Began – The Birth of the Methuselah Flies

Rewind to the 1980s. Dr. Michael Rose, a pioneering biologist, initiated an experiment, selectively breeding Drosophila fruit flies to enhance their lifespan. The offspring of these original Methuselah flies found a home at Genescient Corporation and were further bred and developed by our CEO, Kennedy Schaal. The animals living an impressive 4.5 times longer than their conventional peers. Within this extended lifespan population, distinct subgroups emerged, aptly named B, O, and Super-O, each with its unique longevity traits – some are living even longer.

What's even more fascinating is the genetic similarity between these flies and us. Many genes granting the Methuselah flies their prolonged vitality and robust health are mirrored in the human genome. Unraveling the potential of these shared genes could revolutionize our understanding of aging and longevity.
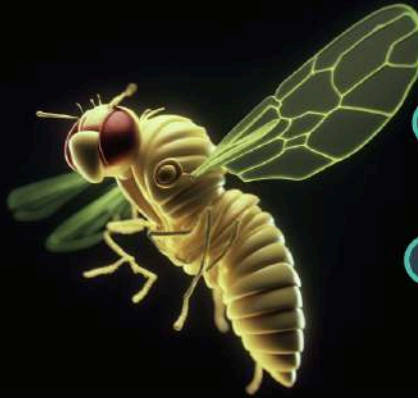
Methuselah Fly Model

Bred for longevity over 43 years and 400+ generations

The animals live more than five times their normal lifespan

A treasure trove for longevity pathways & drug targets

Short life-cycle dramatically speed-up of compound testing and R&D

Selectively bred, equivalent to tens of thousands of years of human evolution

Collaboration and Innovation: Unlocking the Secrets of the Genome

Recognizing this potential goldmine, SingularityNET, under the guidance of our Chief AI Scientist, Dr. Ben Goertzel, formed an alliance with Genescient. Their shared quest? To harness advanced machine learning and reasoning techniques, drawing parallels from the Methuselah fly genome to that of humans. So, from 2006 to 2010, a dedicated team of researchers, spearheaded by the ever-passionate Kennedy Schaal, who is now our CEO at Rejuve.Bio, embarked on a detailed study. They delved into the gene expression of these remarkable flies, contrasting them with regular wild-type flies. The tools at their disposal? Cutting-edge statistical models, machine learning, and intricate network analyses. The results were groundbreaking. We gained unparalleled insights into the genetic factors governing longevity, heart and brain health, and other aging-related conditions. After more than encouraging results, it was decided to obtain the fruit fly model and use it for aging research within Rejuve.Bio to acquire new information regarding gene therapies, drugs, or nutraceutical regimens for prolonging healthy human life. Now, our analysts crunch this data using neural nets and other machine learning tools, along with symbolic AI methods.

From Research to Reality: The Future of Anti-Aging

But we didn't stop at basic research. Merging our discoveries with extensive drug databases, we've assembled an arsenal of substances with potential to combat aging's impact, and already developed our first anti-aging supplement successes. Unlocking longevity secrets in the lab is just the beginning. We're rapidly translating insights into tangible anti-aging products for people to benefit from today. There's more to come as we bridge the gap from research to real-world impact.

Why Fruit flies?

Drosophila melanogaster, commonly known as the fruit fly, has long been a favored model organism in aging research, as well as in various other fields of biology. There are several reasons for this:

- **Short Lifecycle:** Drosophila have a short lifespan that lasts for just several weeks. This allows researchers to study the entire lifespan of an organism in a condensed period, observing changes from birth to death in a manageable timeframe.

- **Rapid Generation Time:** Fruit flies reach maturity quickly and reproduce at a fast rate. Within about 10 days after fertilization, a new generation is ready to begin reproducing. This rapid turnover allows for quick breeding and studying of multiple generations.

- **Compounds Can Be Tested Quickly:** Due to their short lifespan, any impact of a compound or treatment on lifespan or healthspan can be observed quickly. This is advantageous when testing potential anti-aging treatments or interventions.

- **Genetic Tools:** The genetic makeup of Drosophila is well-understood, and they possess many genetic tools, allowing for the easy manipulation of genes. This makes it simpler to investigate the function of specific genes or pathways involved in aging.

- **Conservation of Aging Pathways:** Many molecular pathways implicated in aging in Drosophila are conserved in higher organisms, including humans. This means that insights gained in fruit flies can often be translated, at least conceptually, to more complex organisms.

- **Economical:** Maintaining and breeding Drosophila is cost-effective compared to many other model organisms. This allows for large-scale experiments and replicates without a significant economic burden.

- **Easily Controlled Environment:** The conditions under which fruit flies are raised (temperature, food, light cycle, etc.) can be easily standardized and manipulated, allowing for controlled experiments.

- **Visible Phenotypes:** Aging in Drosophila can be accompanied by easily observable phenotypic changes, such as decreased locomotor activity or increased susceptibility to stress. These can serve as convenient markers for aging and health.

- **Large Sample Sizes:** Due to their small size and ease of breeding, experiments with Drosophila can be conducted with large sample sizes, increasing the statistical power of the results.

- **Ethical Considerations:** Working with invertebrate models like Drosophila often presents fewer ethical concerns than working with vertebrate animals, making the approval process for experiments more straightforward.

Overall, Drosophila offers a unique combination of convenience, relevance, and cost-effectiveness that makes it an attractive model organism for studying aging, among other biological phenomena.

Decoding Life's Clock: The Road Ahead

Now, guided by the expertise of longevity biologist Kennedy Schaal and epigenetics pioneer Dr. Axel Schumacher, our passionate team has ventured into the intricate genome of Methuselah flies. These unique flies have provided us with a blueprint for a groundbreaking therapeutic platform, one that harnesses their incredible extended healthspan to target new facets of human aging.

You might ask, "How?" Simple. What makes our approach distinct is the potent blend of advanced technology and nature's secrets. We employ deep neural networks and the OpenCog probabilistic reasoning platform, augmented by our curated BioAtomspace knowledge graph. This graph gathers insights from a plethora of bio databases, lab data, and research papers. Our mission is straightforward: pinpoint the key biological traits that set Methuselah flies apart from their regular counterparts. By understanding these differences, we can expedite the testing of potential drug targets and innovative compounds, all of which are then re-evaluated using our BioAtomspace platform and our fly models.
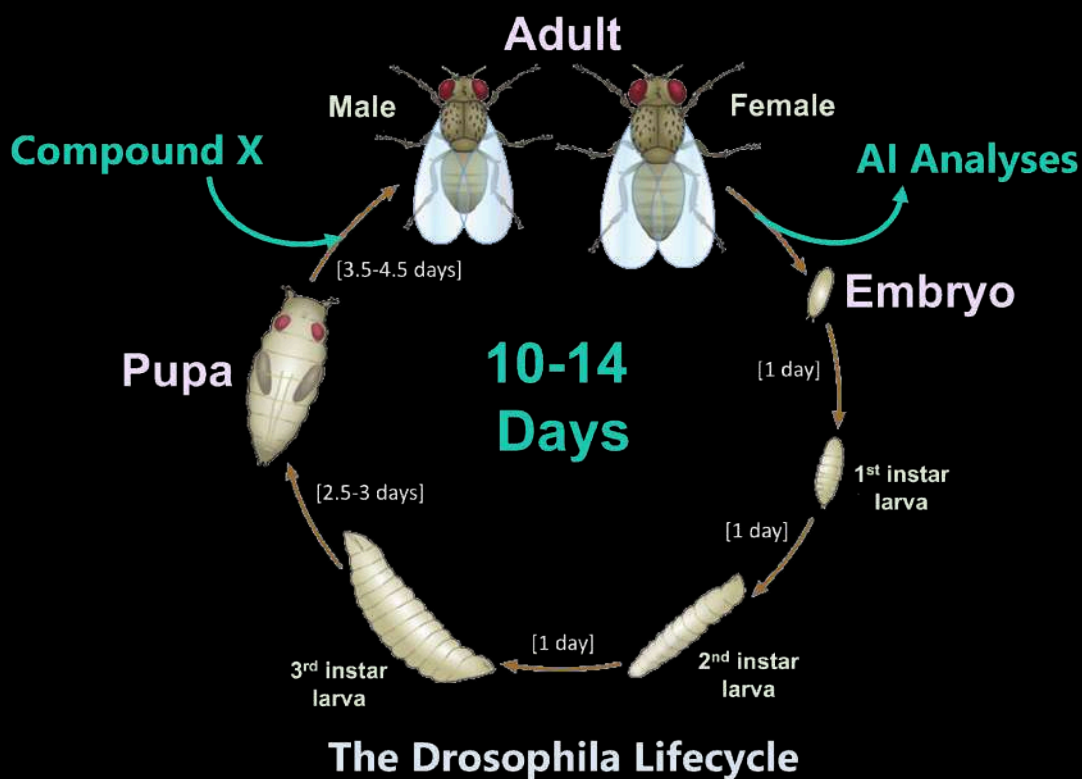
Fig. 2: Our model organism: the long-living Drosophila fly – Super Fast R&D. Embryo: The fertilized egg hatches after about 24 hours at 25°C. The embryo undergoes rapid development, and the adult structures are already present in the embryo. The first instar larva hatches from the egg and is about 1 mm long. The larva has a chewing mouthpart and feeds on decaying fruit. The larva continues to feed and grow. The third instar larva is about 3 mm long. The larva is fully grown and prepares to enter the pupal stage. Pupa: The pupa is the stage of metamorphosis. The larva's body breaks down and the adult structures are formed. Adult: The adult fly emerges from the pupa after about 5 days. The adult fly is about 2 mm long and has wings. The adult fly can mate and lay eggs, starting the cycle again. Figure after Ong et. Al., 2014.

In a demonstration of our platform's potential, our past collaborative efforts shed light on several genes and pathways linked to the exceptional longevity of Methuselah flies. These discoveries spanned a range of functions, from neurological and cardiac to immune, and laid the groundwork for innovative products like Stem Cell 100, a nutraceutical now marketed by our partner firms at Genescient.

Now, in 2023, our Methuselah flies are living even longer and revealing even more profound genetic secrets. With better genomic tools and smarter AI, we can now see the patterns of life with unparalleled clarity. To further refine our understanding, our team has expanded the BioAtomspace, incorporating a vast fruit fly database alongside existing human genomic and clinical data. This comprehensive data set encompasses diverse individuals, spanning various ages and health conditions.

An in-depth dive into the transcriptome-wide sequencing data unveiled a pivotal revelation: distinct genetic profiles demarcate the B, O, and super-O populations. These groupings offer a treasure trove of insights for unraveling the complexities of aging in multifaceted organisms. The Methuselah flies, with their unparalleled data reservoir, illuminate the intricacies of the aging process like never before. A testament to their potential, our prior research enabled us to double the lifespan of middle-aged flies simply through tailored supplement combinations. Today, with cutting-edge AI at our fingertips, we're deciphering which age-related factors in flies can be translated to human aging. Because, let's be real: you're not just here for another scientific breakthrough or a cool story. You're here because you want more out of life. More moments, more memories, more time with loved ones. And we're here to hand you the key.

By harnessing state-of-the-art research methodologies, ranging from Epigenetic clock studies and compound/environment stressor tests to intricate mapping of pivotal genetic variants and biochemical pathways, we're poised to redefine the very concept of aging. What's great about fruit flies is they share about 60 to 70% of their genome with us. And the mechanisms by which they age are particularly similar to ours, so they're a really great model organism, and they're also very economical to study. Furthermore, from our experiences with many different model organisms, those biochemical pathways that affect organismal aging are usually preserved between species.

Join us on this exhilarating journey as we demystify longevity, forging a new, healthier world.

Finding what makes us age

Cutting-edge AI has opened new possibilities in studying aging, a phenomenon touching all living cells. Using deep learning, AI can now forecast biological clocks more accurately, merging dynamic and static data. This gives a more complete, 360-degree view of how we age, revealing underlying causes.

The upshot? More effective anti-aging strategies. AI-generated biomarkers are like a treasure map, highlighting key areas for research and new drug targets. Innovations like knowledge graphs spot new research avenues and even design novel anti-aging molecules.

Imagine connecting these tools into one streamlined pipeline, from biomarkers to drug targets to real-world medicines. With Rejuve.Bio, this is becoming reality. Our system can revolutionize drug development, making it faster and more reliable. AI brings aging research into sharp focus, lighting the path to combat aging more effectively.

Speed – Speed – Speed

Rejuve.Bio presents a revolutionary approach to aging research by amalgamating artificial intelligence methodologies with the established *Drosophila melanogaster* model. This synthesis expedites drug and nutraceutical discovery targeted at aging, presenting a more efficient pathway to market compared to traditional drug R&D:

- **Efficiency:** This integration reduces the duration of research phases, enabling faster transition from conceptualization to testing.
- **Precision:** AI can sift through Drosophila-generated data with unparalleled accuracy, pinpointing potential therapeutic agents with higher likelihoods of success in subsequent human trials.
- **Cost-effectiveness:** The combination reduces the need for repeated, lengthy, and often costly mammalian trials, presenting significant financial advantages.

Conventional drug research and development is a costly and time-consuming endeavor, often spanning a decade or more from initial discovery to market release. Such extended timelines are particularly detrimental when addressing aging-a process that affects global populations with increasing urgency.
By integrating AI with the Drosophila model, Rejuve.Bio has established a streamlined pipeline for anti-aging drug and supplement discovery:
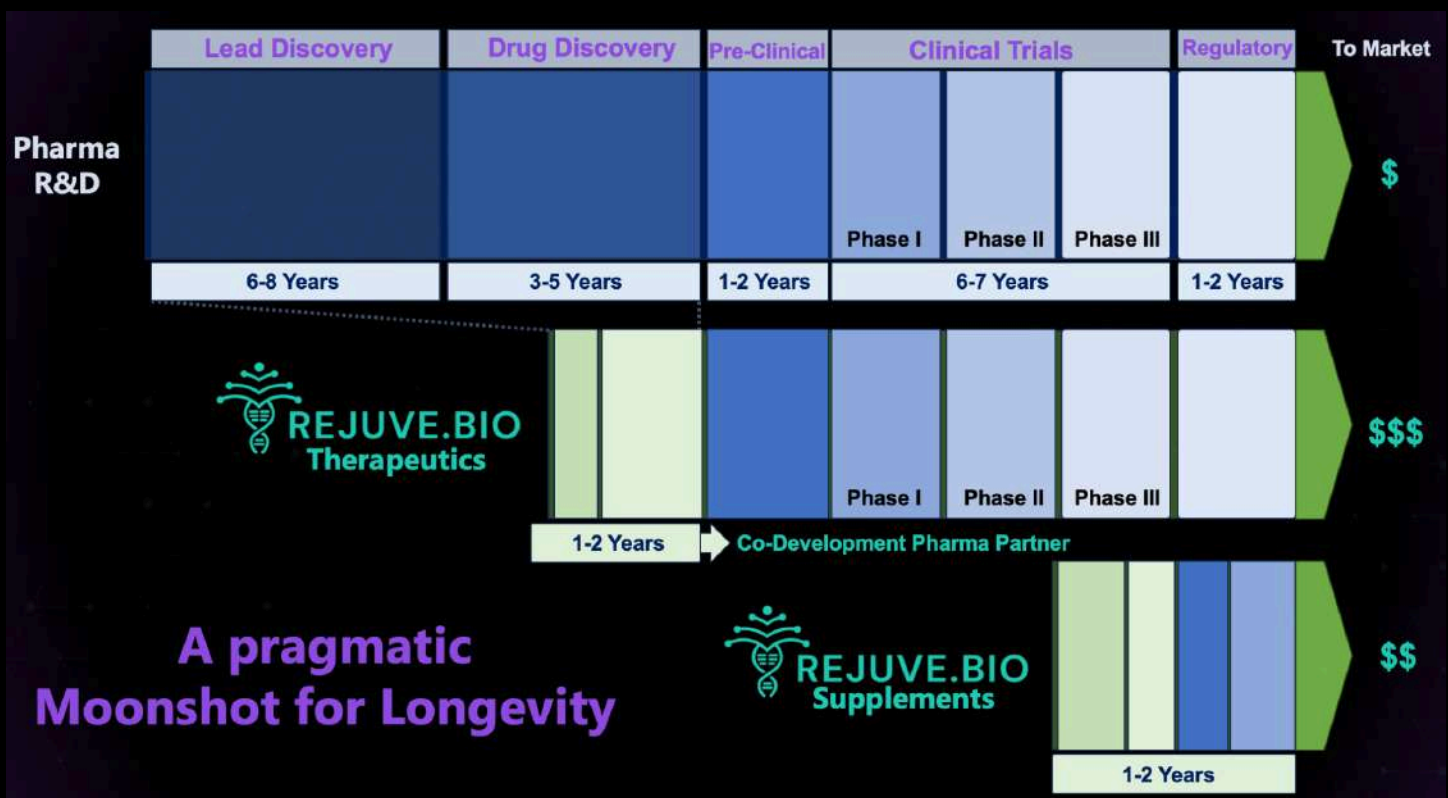
Fig. 4: Rejuve.Bio is developing Supplements and Therapeutics to target the core reasons for human aging. With the power of next-generation AGI, the process of target and drug discovery can be shortened by many years, compared to classical pharma R&D.

Market Impact and the Road Ahead

The market repercussions of Rejuve.Bio's hybrid approach are game-changing:

- **Faster Time-to-Market:** Speeding up R&D means new anti-aging products could hit the shelves sooner than we ever thought possible, giving Rejuve.Bio a competitive edge.

- **Expanded Product Range:** By leveraging AI and Drosophila, Rejuve.Bio can simultaneously investigate drugs, supplements, and nutraceuticals. This broadens their potential lineup and offers consumers more options.

- **Leadership Position:** As a trailblazer in fusing AI with biological research, Rejuve.Bio has the chance to become the go-to authority for solutions in the aging sector.

Long-term we are also looking into the option to add quantum computing to our Bioatomspace platform. We are already working on various options to enable our researchers and developers to create and test new quantum algorithms and applications, and they help to accelerate the development of the quantum computing ecosystem.

In summary, Rejuve.Bio's melding of AI and the Drosophila model isn't just an exciting scientific development; it's a transformative moment in how we combat aging. With its promise of quicker discoveries and faster routes to market, Rejuve.Bio isn't just boosting its own prospects. It's accelerating progress in a field that desperately needs it, positioning itself as a leader in an industry poised for growth.

Combining Human and Animal Data to outpace Aging

At Rejuve.Bio, we're passionate about harnessing heaps of data. In fact, Rejuve.Bio was designed to leverage massive data, for example analyzing the crowd-sourced human longevity data generated by our SingularityNET sister company Rejuve.AI and its tokenomics-incentivized longevity app, a treasure trove of crowd-sourced human longevity data. Together, by building a larger, decentralized health data economy, we put power back into the hands of the people, allowing anyone to monetize their longevity data and yield maximal personal benefit from their contributions.

That data will eventually include everything from height, weight and sleep data to genomic data, microbiome data, EEG data, environmental exposure, blood tests, biomarkers, and so on. We will analyze that data with our neural-symbolic AI platform, crunch it with model organism data from the flies, and other long lived animal models, to make inferences and generate new hypotheses about new targets for aging that haven't been thought of before. In the end, we're aiming to gather so much information that we can offer deeply personalized insights for each and every one of you, finally offering all people the possibility to reach Longevity escape velocity (LEV).

LEV is a hypothetical situation in which the rate of increase in human lifespan exceeds the rate of aging. This means that, for every year that passes, people's remaining lifespans increase by more than one year. The term "escape velocity" is borrowed from physics, where it refers to the minimum speed required for an object to escape the gravitational pull of a planet. In the context of longevity, LEV refers to the point at which the rate of increase in human lifespan is so great that it is no longer possible to die of old age. LEV is a controversial topic, with some people believing that it is possible to achieve within the next few decades, while others believe that it is not possible at all. However, there is a growing body of research that suggests that **LEV may be within reach. We know it's doable! With the help of the newest AI tools, we can achieve LEV within a much shorter time.**

Beyond supplements, there are many biotechnologies that we consider for their potential to extend lifespan. Some of the most promising approaches include:

- **Senolytics:** These are drugs that target and kill senescent cells, which are old, damaged cells that accumulate in the body over time and contribute to age-related diseases.
- **Gene therapy:** This involves using genetic engineering to repair or replace genes that are defective or mutated. Gene therapy could be used to treat or prevent age-related diseases, or to slow down the aging process itself.
- **mRNA vaccines against aging:** a type of vaccine that uses messenger RNA (mRNA) to train the body's immune system to fight what makes us age.

- **Regenerative medicine:** This uses cells, tissues, or organs to repair or replace damaged or diseased tissue. Regenerative medicine could be used to restore youthful function to organs and tissues that decline with age.
- **Small molecules:** A form of drugs, organic compounds with low molecular weight that can interact with biological targets to produce a longevity effect.
- **Metabolic engineering:** This involves manipulating the body's metabolism to slow down the aging process. This could be done by targeting genes or pathways that control metabolism, or by using drugs or other interventions to change the body's metabolism.

These are just a few of the many medical technologies that we may apply for their potential to extend lifespan. It is still too early to say which of these approaches will be most successful, but the field of aging research is rapidly advancing and there is a lot of excitement about the potential to develop new treatments that can help people live longer, healthier lives.

The Team
The Convergence of Excellence

To achieve our ambitious vision, Rejuve.Bio has assembled a cutting-edge team of AI researchers, geneticists, bioinformaticians, biologists, business experts, and longevity scientists. They are committed not just to adding a few years to the human lifespan but extending it dramatically by decades – potentially reaching longevity escape velocity and making these therapies available to people all around the world.

Kennedy Matsagas Schaal
Chief Executive Officer

Drosophila Genetics
Lab Management

Scientist who co-developed Methuselah Model, paving the way for groundbreaking scientific discoveries

Dr. Ben Goertzel
Chief AI Scientist

Artificial General Intelligence
Company Building

World's most famous AGI expert, serial-entrepreneur, founder of SingularityNet, leader of the OpenCog Foundation, the AGI Society, and chair of Humanity+, applying AI to longevity genomics since 2001

Longevity researcher, serial-entrepreneur, inventor of the "Epigenetic Theory of Aging" and large-scale epigenomic profiling
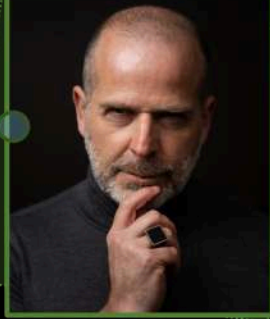
Dr. Axel Schumacher
Chief Biotechnology Officer

Epigenetics & Aging Research
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Entrepreneurship
▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨

Janet Adams
Chief Operating officer

Operations & BD
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Artificial Intelligence
▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨

Senior executive with extensive regulatory knowledge and experience. Published expert in AI Ethics and Regulation.

Decade-long, niche-specific expertise

Resilience, grit, and perseverance

Michael Duncan
Chief Science Officer

Computational Biology
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Mathematics & Epidemiology
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Deep Machine Learning Expertise

Abdulrahman Semrie
Bio-AI Developer

Computational Biology
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Artificial Intelligence
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Passionate about Human Longevity & Commitment to Success

Hedra Yusuf
Chief Technology Officer

Software Engineering
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Computer Science
▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨

Master of Communication, Market Analysis, Customer Segmentation, Strategy, and Business Analytics

Lewis Farrell
Senior Marketing Consultant

Marketing
▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨▨

Crypto/Fintech
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Our world-class team has everything to make the company a success:

- **Leadership & Vision:** Our visionary leaders guide us with integrity and foster a culture of respect, collaboration, and innovation. They are seasoned professionals and industry thought leaders, known for their strategic foresight and ability to inspire.
- **Technological Expertise:** Our team boasts an extraordinary depth of technical expertise, with world-class engineers, data scientists, software developers, and technology strategists; pioneers in their respective fields.
- **Strategic Business Acumen:** Our team comprises seasoned business pros skilled in strategy, finance, and market insight. Their expertise allows us to navigate complex business landscapes with agility and precision.
- **The Power of Diversity:** Our team is diverse, drawing from various backgrounds and cultures. This range of experiences and perspectives ignites creativity and fuels innovative solutions.
- **Key Opinion Leaders:** Our team includes Key Opinion Leaders who amplify our credibility and reach. They enhance brand visibility, earn stakeholder trust, and secure strategic partnerships using their industry authority and network.
- **Resilience & Adaptability:** The startup journey is fraught with unpredictability, demanding a team that's resilient and adaptable. Our team members embody these qualities, proving time and again that they can navigate changes, overcome obstacles, and grow from challenges.
- **Commitment to Continuous Learning:** To stay ahead, we promote continuous learning and skill acquisition among our team, keeping us at the industry's cutting edge and encouraging innovation.

In conclusion, our team is built to win. This blend of attributes isn't just rare - it's what makes us uniquely poised for success.

The Pillars of Guidance: Our Exceptional Board of Advisors

Our success is significantly guided by our diverse Board of Advisors. These industry leaders provide critical insights and connections across domains like technology, finance, and marketing, offering a holistic perspective for our startup's growth.

Prof. Aubrey de Grey
President and CSO, LEV Foundation

Breadth and Depth of Experience

Our Advisory Board offers a diverse range of experience, from leading multinationals to pioneering technologies. Their collective expertise ensures a comprehensive

Liz Parrish, MBA
CEO of BioViva

understanding of diverse business landscapes, crucial for tackling various challenges.

Unmatched Industry Insight

Our Board of Advisors excels in industry insight, staying updated on longevity trends, market dynamics, and tech advances. Their knowledge gives us a competitive edge, allowing strategic market positioning and staying ahead.

Prof. Joao Pedro de Magalhaes
Chair of Molecular Biogerontology,
University of Birmingham

Strategic Network

One of the biggest assets our Board of Advisors brings is their expansive professional network. This network, nurtured over many years, spans numerous industries and geographies.

Dr. José Luis Cordeiro
Transhumanist, Vice
President Humanity Plus

Diversity of Thought

With backgrounds ranging from entrepreneurial ventures to corporate leadership roles across various sectors, each member brings unique insights and perspectives. This richness of perspectives is critical to our startup's ability to innovate and thrive in today's complex business environment.

Prof. Sandra Kraljević Pavelić
Professor for Health
Studies, Univ. Rijeka

Mentors and Guides

Our advisors are also mentors who inspire and guide us with their wisdom and ethos. They understand the struggles and pressures associated with startup life, offering personal experiences and advice to navigate such challenges.

Cristina Rizza-LePort, MD
Cardiologist, Author

Fiduciaries of Ethical Standards

Our Board of Advisors ensures we operate with high ethical standards, transparency, and accountability. Their oversight safeguards our reputation and aligns our business practices with core values and societal expectations.

Alex Yang
CEO Mstone Partners, asset
management and financial advisory

Prof. Kresimir Pavelic
Head of Department of
Biotechnology, Univ. Rijeka

In conclusion, our Board of Advisors is a powerhouse of wisdom, experience, and strategic insight. We are immensely proud and grateful to have such an exceptional group

guiding our journey, providing us with the robust strategic guidance necessary to drive success in today's competitive startup landscape.

Business Model

Our BioAtomspace Platform is a game-changer. It uses AI to quickly find new treatments that could completely reshape how we think about getting old and dealing with age-related diseases. We're using all the latest innovations, like specialized gene analysis and computer-driven drug discovery, so our research covers a lot of ground. On the business end, Rejuve.Bio is crafting multiple revenue streams, synchronized in a well-planned timeline. This isn't just about sustainability; we're setting the stage for high returns for both the company and our investors. The main focus lies on the following markets:
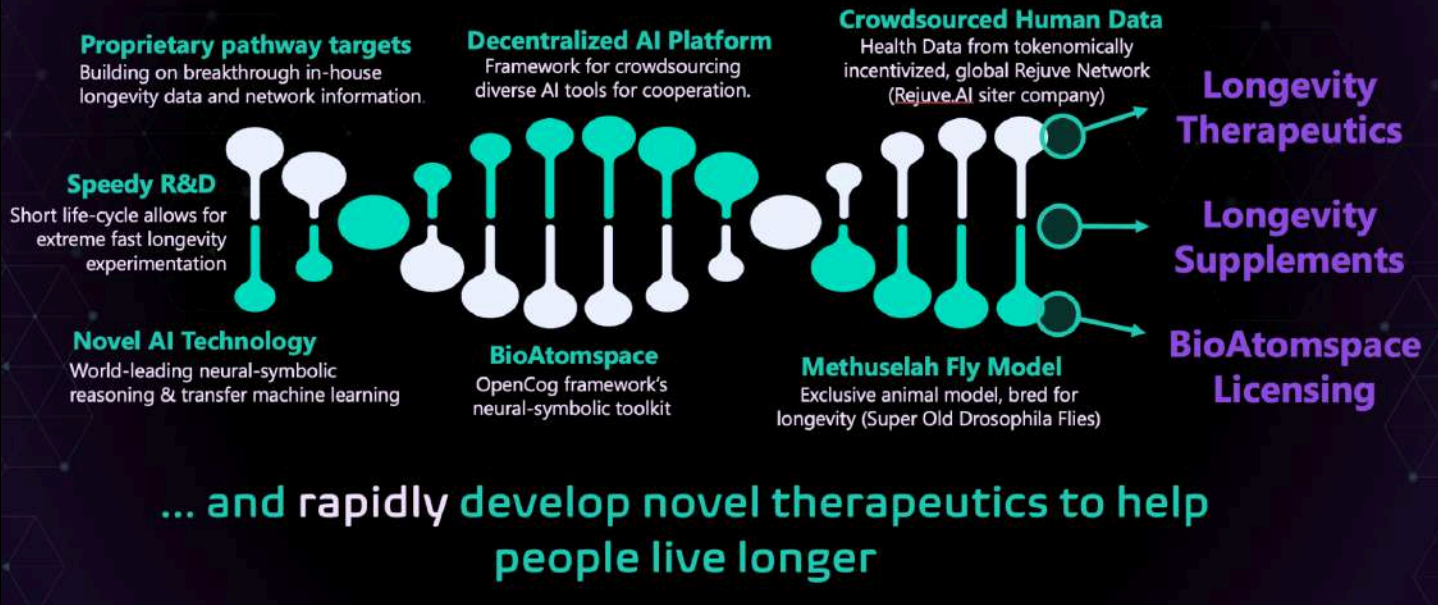
1. Aging Therapeutics
2. BioAtomspace AI Platform
3. Longevity Supplements

1. Aging Therapeutics

At Rejuve.Bio, our core mission is to expedite the development of transformative therapies that enhance longevity and combat age-related diseases. Central to achieving this objective is our cutting-edge BioAtomspace Platform, a game-changing AI-driven technology specifically engineered to rapidly identify novel therapeutics in a variety of disease areas and drug modalities. Our mid-term goal is to determine novel gene-therapy and small-molecule approaches to leveraging longevity pathways, and the transcription factors we have already identified, to prolong human lifespan and combat age-related diseases. This isn't just another piece of tech. It's a pioneering AI engine designed to swiftly zero in on new longevity therapies across various diseases and treatment types.

Our eyes are firmly set on the future—specifically, unraveling the genetic and molecular keys to longevity. Our initial studies on unusually long-lived flies have led us to some promising pathways that could also be game-changers in human aging. Soon, we'll dig deeper into these pathways and human data to pin down exact targets for a new generation of age-defying treatments. Studies show that drug programs grounded in patient or human genetic data have a greater chance of success. Therefore, we will integrate disease traits, genetics, and genomics into our BioAtomspace and use multi-omics data to generate target predictions that maximize our chance of clinical success. Our research isn't confined to just one approach; we're employing a multifaceted lens that spans many technologies.

AI & biology intersect to **radically** shorten the R&D pipeline ...

Proprietary pathway targets
Building on breakthrough in-house longevity data and network information.

Decentralized AI Platform
Framework for crowdsourcing diverse AI tools for cooperation.

Crowdsourced Human Data
Health Data from tokenomically incentivized, global Rejuve Network (Rejuve.AI siter company)

Speedy R&D
Short life-cycle allows for extreme fast longevity experimentation

Novel AI Technology
World-leading neural-symbolic reasoning & transfer machine learning

BioAtomspace
OpenCog framework's neural-symbolic toolkit

Methuselah Fly Model
Exclusive animal model, bred for longevity (Super Old Drosophila Flies)

Longevity Therapeutics

Longevity Supplements

BioAtomspace Licensing

... and **rapidly** develop novel therapeutics to help people live longer

We will leverage a variety of next-generation tools, from tissue-specific transcriptomic analyses, epigenetic clocks, multi-omics based systems biology model of the causal structure of methuselah fly longevity, computational drug repurposing, to population level evolutionary modeling to stratification of subpopulations for insights into basis of different aging and model chronic disease trajectories. It's this type of intricate research that lets us understand how to potentially halt or even reverse the aging process. Our big-picture perspective allows us to understand varying rates of aging and chronic disease progression across different groups.

So, why all this focus on prevention? Because often, by the time age-related diseases like Alzheimer's are diagnosed, it's already too late to halt their advance. That's why we're concentrating on two approaches: preventative treatments for those under 45, and disease-slowing therapies for those 45 and up.

There you have it: a roadmap of our scientific journey. At Rejuve.Bio, we're committed to making the future not just something to look forward to, but something to actively shape—starting with a longer, healthier life for all.

As we are largely technology-agnostic, we aim at using the latest technologies that work for extending human lifespan. One approach we are looking at is gene therapy. In the burgeoning field of gene therapy, the promise of using genes to treat or prevent a wide array of diseases is gaining unprecedented momentum. Initially tested for conditions without alternative treatments, gene therapy has evolved into a clinically viable option, receiving FDA approvals for treating various forms of leukemia, lymphoma, and inherited retinal dystrophies. While these initial forays were accomplished without the aid of AI technologies, the landscape is rapidly shifting. With the explosion of available genomic data, AI has emerged as a transformative force, amplifying the potential of personalized medicine and the precision of gene-editing techniques.

Identify targets with cross-organism multi-omics and AI

AI Helps find herbs, drugs and gene therapies to address targets

Rapid evaluation of therapies on fly model

Human Testing

AI's capabilities resonate particularly well in the arena of anti-aging therapeutics—a focus that aligns seamlessly with our startup's mission. One of the most tantalizing prospects of gene therapy in anti-aging is its ability to target and modify the very genetic sequences associated with aging processes. Current gene-editing technologies offer scientists the unprecedented ability to alter patient DNA. However, the precision of these edits remains a formidable challenge, one that AI technologies are exceptionally equipped to tackle. AI algorithms can sift through complex genomic data to identify optimal gene-editing sites, thereby reducing side effects and improving therapeutic efficacy. Additionally, AI facilitates a more tailored approach by matching the most suitable gene therapy with individual patient profiles. With an AI-driven approach to gene therapy, we offer an investment opportunity that marries cutting-edge science with an unmet medical need—healthy aging. This potent combination provides a compelling rationale for investment, promising not only a lucrative return but also a chance to partake in revolutionizing healthcare for an aging global population.

Global Longevity Market
8 Billion people

65%
Preventative anti-aging solutions
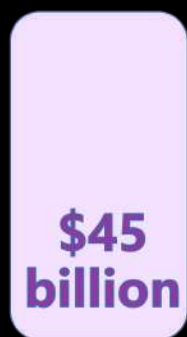<45 years

35%
Disease-mitigating solutions
>45 years

Early Target Market of Health-Conscious People (HCPs):
1.6 Billion people

In light of the burgeoning advancements in AI-driven computational techniques and machine learning models, our startup is uniquely positioned to pioneer the realm of **small molecule-based anti-aging therapeutics.** The approach of using small molecules offers unparalleled advantages such as ease of administration, cost-effectiveness, and potential for high specificity, thereby making them invaluable tools in the quest for longevity.

Traditional pipelines for drug discovery have been characterized by lengthy timelines, significant financial investment, and a high risk of failure. However, advancements in AI have shown promise in generating virtual molecules with specified chemical and biological properties, essentially automating the initial phases of drug discovery. These generative models are capable of handling complex molecular fingerprints, which serve as a numerical representation of the molecular structure. Furthermore, variants of these generative models incorporate explicit memory banks, enhancing their generation capabilities and increasing the diversity and quality of generated molecules.

The computational ability to screen large virtual chemical libraries in silico considerably accelerates the timeline from discovery to preclinical and clinical trials. Prior to entering the expensive phases of drug testing, AI algorithms can predict the likely efficacy and safety profiles of these small molecules, thereby minimizing risk and maximizing potential returns on investment. Special attention is also given to improving the representational systems of the molecular structures, as this can lead to better performance in generative models.

While this field is undoubtedly nascent, and the standards for evaluation are still in development, the success stories already written validate the high growth potential of this approach. The compelling advantage here is the capability of these AI-driven systems to learn from data rather than rely on handcrafted rules, thereby continually evolving and improving. By strategically focusing on small molecules for anti-aging therapies, Rejuve.Bio aims to capitalize on this state-of-the-art technological milieu, serving as a vanguard in a market poised for exponential growth. For investors, this represents not merely an opportunity for substantial financial returns, but also a chance to be a part of a venture with the potential to revolutionize healthcare and extend human longevity.

$45 billion

Global Longevity and Anti-senescence therapy market projected by 2028

In light of the growing focus on **drug repurposing**, our initiative is expanding its scope to explore the reapplication of existing drugs for longevity-enhancing treatments. Leveraging advancements in Deep Learning and AI, our methodology will mirror successful computational strategies within pharmacology to classify drugs into new therapeutic categories for aging. Using datasets from previous studies and incorporating pathway-level data, our approach aims to optimize the accuracy of Deep Neural Network classifiers. As the effects of aging are long-term, and influenced by a myriad of factors, we will also integrate patient feedback and real-world data to adapt and refine our drug discovery engine. This interdisciplinary effort seeks not just to prolong life but to enhance its quality, using computational methods to uncover overlooked opportunities in existing medications.

After all, using Rejuve.AI Network's crowdsourced database in conjunction with Methuselah Fly genomics we will also develop drugs and therapeutics for the prevention and treatment of aging-related diseases such as Alzheimer's, Parkinson's, cardiovascular, and metabolic disease.

Joint Development Partnerships

While our advanced platform provides us with the capabilities to engage in early-stage drug development, such as lead and drug discovery, we recognize the unparalleled advantages of partnering with established biopharma entities. Therefore, we will actively exploring strategic licensing discussions

and late-stage development and commercialization partnerships for specific assets in our pipeline in order to deliver our longevity solutions to patients in need. Here's why this collaborative model is an integral part of our strategy:

- **Bridging Gaps with Industry Titans**

We actively seek collaborations with leading biopharma companies to leverage their existing infrastructure, expertise, and resources. The synergy in these collaborations is obvious: we bring to the table our nimble and innovative early-stage research capabilities, while our partners contribute their robust late-stage development and commercialization experience. This enables us to pool our respective strengths to create a seamless, efficient drug development pipeline, thereby expediting the route from bench to bedside.

- **Licensing and Late-Stage Development: A Strategic Focus**

While early-stage drug discovery is our forte, late-stage development requires a different set of skills and resources, ranging from extensive clinical trial networks to established regulatory pathways and massive-scale manufacturing capacities. By forging partnerships for late-stage R&D, we mitigate the risks and financial burden associated with these stages. It is a mutually beneficial model: we provide our partners with innovative early-stage assets and in return, leverage their proficiency in steering these assets through the labyrinthine process of late-stage development, regulatory approvals, and market entry.

Estimated CAGR through 2028:

| Anti-aging & Longevity Market | 22.2% |

An FDA approved Alzheimer's drug carries an estimated market value of $43.4 billion. Other aging diseases have similar opportunities

- **Customized Co-Development: Licensing for Impact**

We are also actively engaged in strategic licensing discussions aimed at identifying the best pathways to bring our medicines to the patients who need them. By licensing specific assets in our pipeline to partners well-suited for late-stage development and commercialization, we fast-track the drug's journey to market while retaining a stake in its future success.

- **Synergies in Clinical Studies: Two Heads are Better Than One**

Partnering with large biopharma companies allows us to take advantage of their existing clinical study infrastructure. These companies have years, if not decades, of experience in designing and executing rigorous clinical trials, as well as navigating the complex regulatory landscape. Our partnerships enable us to initiate synergistic clinical studies, potentially leading to more robust findings due to a larger and more diverse patient base, better site selection, and a broader scope of research questions addressed.

For investors, this collaborative strategy should underscore our pragmatic approach to business growth and risk mitigation. By concentrating on our strengths in early-stage research and harnessing the capabilities of our partners for late-stage development, we build a resilient and versatile business model based on co-development, licensing, and collaborative research. This not only optimizes our in-house capabilities but also accelerates the delivery of innovative medicines to the people who need them the most, all while maintaining a financially lean and risk-mitigated approach. In essence, our collaboration-first model is engineered to win, by making the drug development process more efficient, effective, and ultimately, more promising for the future of human health.

Commercialization of the BioAtomspace AI Platform

The third pillar of Rejuve.Bio will be to build a platform that can be used by pharma and biotech clients to boost their early research efforts. In the rapidly evolving landscape of pharmaceutical and biotechnology research, the need for accelerated data analysis, target & drug discovery, and market penetration is critical.
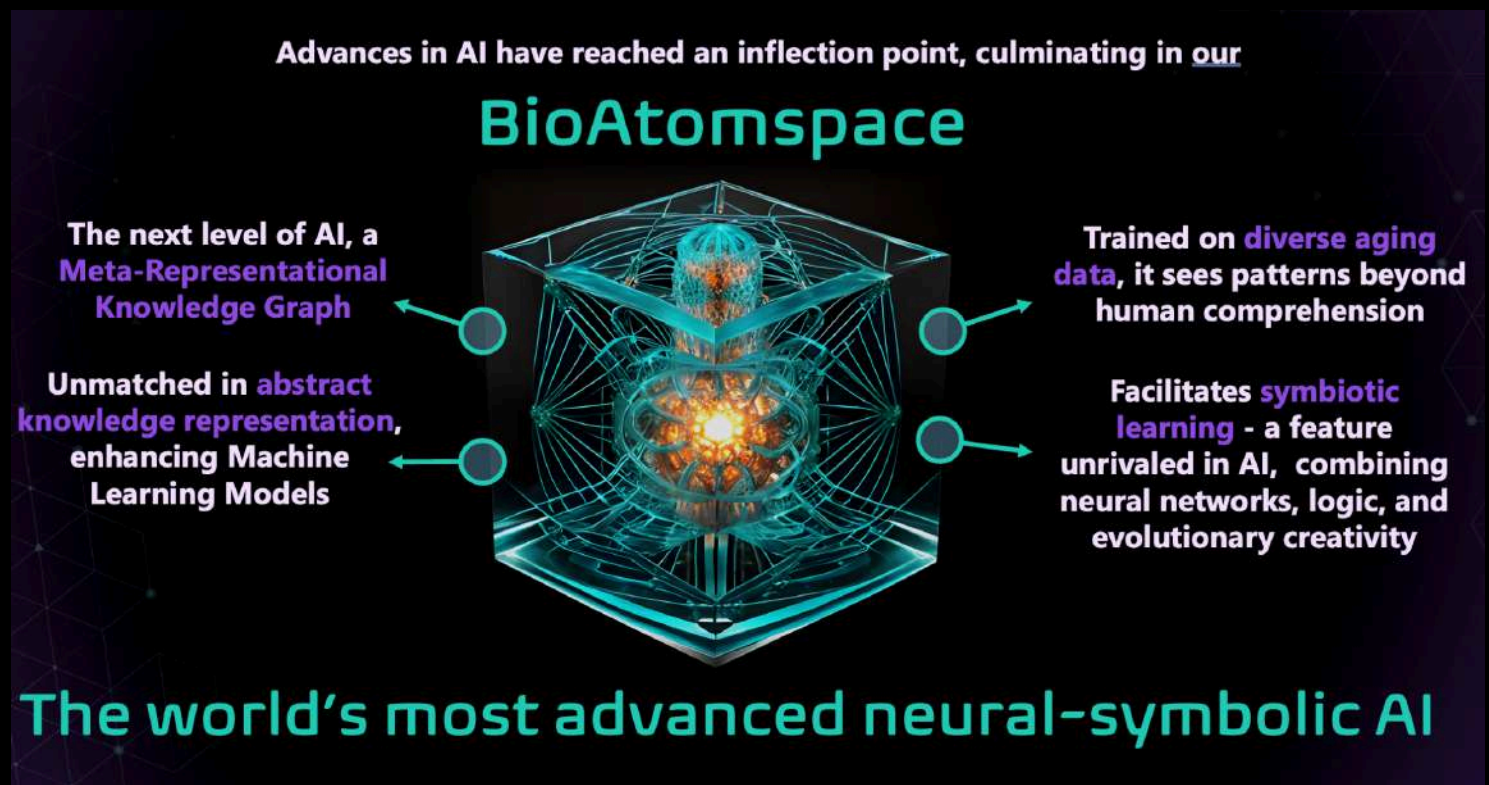
With our BioAtomspace platform, we can address these challenges, offering solutions either as a licensing platform and/or as a full-fledged AI-as-a-Service business.

Our team has many years of experience in building data analytics platforms for the pharmaceutical industry and we understand the need of the end-user. While next-level data analytics is under development in many pharma companies, our experience is that the overall expertise in-house in these companies is still very limited. Especially, there is a massive lack of applying AI to diverse and unstructured datasets. This is a massive problem for pharma and biotech who sit on massive datasets but at the same time they have no idea how to make sense of that data. We can change this status-qo.
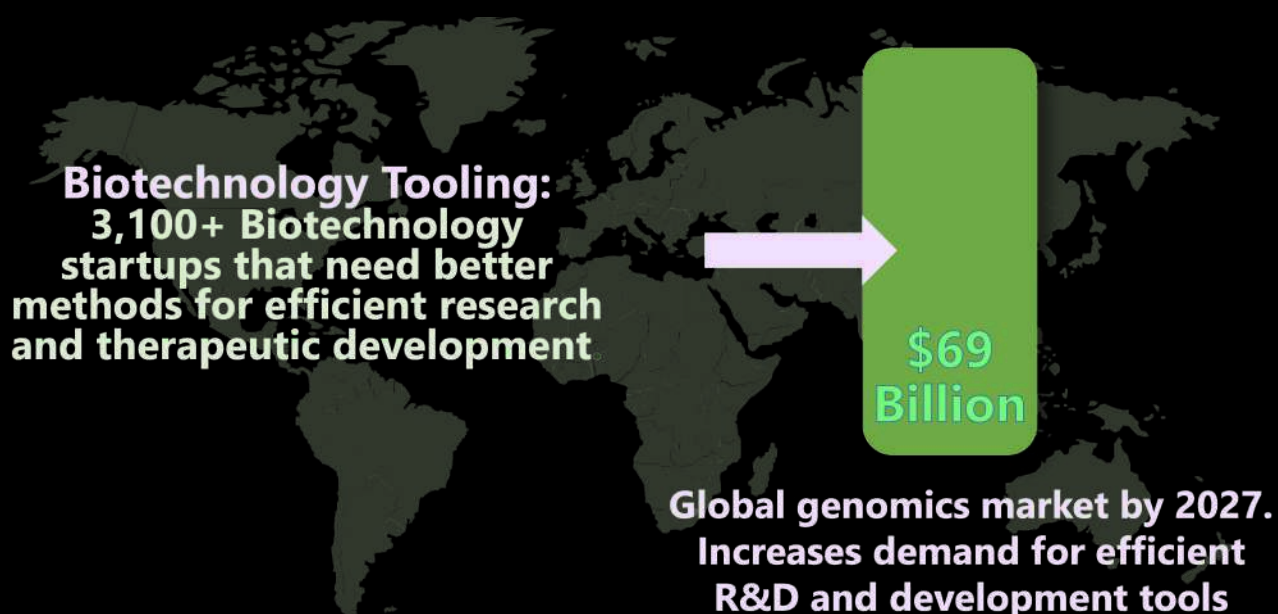
Target Market

Our platform aims to serve pharmaceutical and biotech companies, as well as academic research institutions. These entities demand rapid data analysis, improved drug efficiency, and lower operational costs, making them ideal clients for our service offerings.

Platform Architecture

The platform will be designed as a cloud-based system, easily accessible via web interfaces, and APIs. It will incorporate cutting-edge neural-symbolic AI algorithms for data analysis, cross-datasets, and real-time analytics for complex data sets. In the beginning, our services will center around building an expert service to analyze the data for our clients. In parallel, we will improve our platform to be used by clients without the need for external services. This means we will invest in further:

- **UI/UX Development:** User-friendly interface for seamless integration and operation.
- **Algorithm Optimization:** In-house algorithms with continuous refinement for optimal results.
- **Data Security:** Implementation of state-of-the-art cybersecurity measures.
- **Scalability:** Design with scaling in mind to accommodate growing data sets and increased user demands.

Biotechnology Tooling: 3,100+ Biotechnology startups that need better methods for efficient research and therapeutic development

$69 Billion

Global genomics market by 2027. Increases demand for efficient R&D and development tools

Phase II: Testing and Feedback

Beta Testing: Offering the platform to select clients for real-world trials.
User Feedback: Regularly collect and analyze feedback for iterative improvements.
Data Monitoring: Rigorous data analysis to verify the platform's efficiency and accuracy.

Phase III: Full-Scale Launch

Commercial Rollout: Offer the full suite of features to the public.
Marketing Campaigns: Multi-channel advertising to attract a broad spectrum of clients.

Revenue Streams

Companies can license our AI software to integrate into their existing infrastructures. The licensing fees will be tiered based on the scale of usage.

Standard License: Basic features with regular updates.
Premium License: Includes advanced features and priority support.
**Enterprise License:** Customizable features and dedicated support.

AI-as-a-Service Model

In this model, our in-house researchers will collaborate directly with the client to analyze their specific data sets.

Consultation Fees: Initial fees for project assessment and planning.
Subscription Plans: Monthly/Quarterly plans for ongoing service.
Per-Project Fees: For one-time projects, fees will be based on the project's scope and complexity.

A team of researchers will be dedicated to providing support for our AI-as-a-Service clients. This service will include 24/7 customer support for troubleshooting and general queries as well as training Programs such as conducting regular workshops and webinars to familiarize clients with the platform. Strategic partnerships with industry leaders will help us in mutual value creation. Collaborations with academic institutions will offer research opportunities and skillful talent recruitment.

With a strategic focus on providing a dual service model for the pharma and biotech industries, our next-generation BioAtomspace platform aims to revolutionize how data analysis and drug discovery are conducted. Through meticulous planning, rigorous testing, and targeted service offerings, we anticipate robust growth and a profound impact on healthcare research and development.

The AI platform will be designed as a cloud-based system that will incorporate cutting-edge neural-symbolic AI algorithms for data analysis, cross-datasets, and real-time analytics for complex data sets.
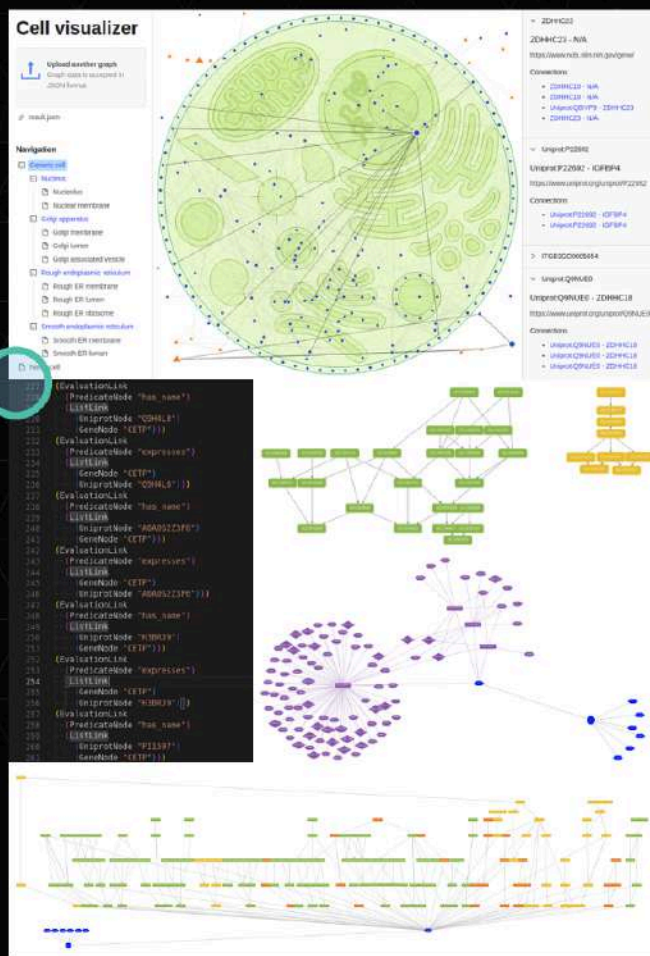
Longevity Supplement Line

In the early stages Rejuve.Bio will develop and market novel, science-based, high-quality supplements that aim to extend human lifespan. Longevity supplements are in high demand. Rooted in our deeply entrenched desire to outsmart mortality, this market promises enhanced lifespans and, at times, a tantalizing taste of immortality. Modern science and commerce, those twin engines of contemporary progress, have converged to produce a plethora of pills, potions, and powders, all claiming to slow the inexorable march of time. From antioxidants to adaptogens, the shelves are brimming with offerings that speak to our cognitive biases. We are, after all, pattern-seeking creatures, eager to connect the dots between what we ingest and how long we live. Yet, it's imperative that we approach this market with a skeptic's lens. As with any emergent field, the chasm between genuine scientific breakthroughs and commercial hyperbole can be vast. There are indeed compounds that show promise, undergirded by rigorous research and peer-reviewed studies. But for every genuine discovery, there are myriad snake oils, playing on hope rather than hard evidence. Rejuve.Bio can add value to the supplement market by providing people with evidence-based supplements that actually work.

Why are we targeting the longevity supplement market?

There are several reasons why we aim at this market. Foremost, we are at an inflection point where people not only look at supplements to boost health levels but start to actively invest in a longer healthy lifespan. This is the opportunity that Rejuve.Bio is well positioned to capture. Overall, the global market for longevity supplements is estimated to be worth $100 billion by 2027, growing at a CAGR of 10%. This growth is being driven by a number of factors, including the increasing awareness of the benefits of healthy aging, the growing demand for preventive healthcare, and the rising disposable income of consumers. Another reason is that it will help us in our overall business development. The development effort for new drugs is significantly higher than for nutritional supplements. While for biotech start-ups in general a long breath and often a budget north of $100 million is necessary to bring a promising molecule to market, consumer longevity topics can be brought to market in a classic company building process in a few months and with low investment. At the same time, the risk of not being granted approval is reduced. Also, the team has in-depth experience, not only in finding new supplement combination for human longevity; we also have experience in supplement formulation, manufacturing processes, ingredient sourcing, innovative product development, and supplement marketing. All of these things dramatically increase the chance that we can build a profitable supplement business quickly, which will then also help to drive the development of more complex therapeutics.

New targets already identified

The long-lived Methuselah flies show a huge number of **significant genetic differences** from wildtype flies

2 genes and related pathways that have emerged as significant in our 2022 Methuselah fly data analysis are:

▶ "Rej-X1" is critical for metabolic and neurological function and is over-expressed in the Methuselah Flies.

▶ "Rej-X2", also over-expressed in the Methuselah flies, required for cellular electron transfer

Gene therapy, small-molecule, and herb-combination approaches are under active exploration

We have also identified **four transcription factors** that appear critical for regulating genomic networks for Methuselah fly longevity

Currently, we work on several different formulations with novel ways to consume the ingredients, blending ingredients which reflect the latest research in longevity and our in-house research, that act in synergy to slow ageing. Compared to other companies in the field, we have the additional in-house research, based on our powerful AI and fruit fly models to make sure we can be evidence-based leaders in the field of longevity, bringing new supplements to the market first, not just selling existing health supplements under a new 'longevity' label. We are convinced we can establish Rejuve.Bio as a brand leader, not only in the US, but also Asia, Europe, and the Middle East.

A Proven Methodology

Our research is a proven method that helped us already to reach some breakthrough discoveries. We can use sequencing technology to identify specific pathways that contribute to the Methuselah Flies' longevity and then use AI and machine learning tools to integrate that information with human health and omics data, allowing us to identify common genetic pathways that can be studied in real-time using the flies' relatively short lifespan, shortening the drug discovery pipeline, and helping to develop supplements that will target aging and aging-related disease.

The Rejuve Biotech team's earlier AI analyses successfully correlated Methuselah fly data with human genomics and medication databases, already demonstrating proof of concept, with the resulting treatment preserving cognitive function in Alzheimer's (AD) patients. To do this, we created models using Drosophila melanogaster engineered with human Amyloid-β and tau mutations, both of which are linked to Alzheimer's. What we found was exciting. When we introduced these mutations into the fruit flies, they started to exhibit early signs of aging, such as slowed mobility.

To measure the effects, we monitored the flies' crawl times as they aged, finding that the mutations led to early mobility difficulties. However, when we treated these transgenic flies with a carefully selected blend of natural products targeting different biological pathways, the results were more than promising. Out of a small pool of natural products, we identified a combination of seven substances that not only

improved mobility but also reversed the life-shortening effects of the mutations. And guess what? These benefits were seen in flies treated from both youth and later adult ages.
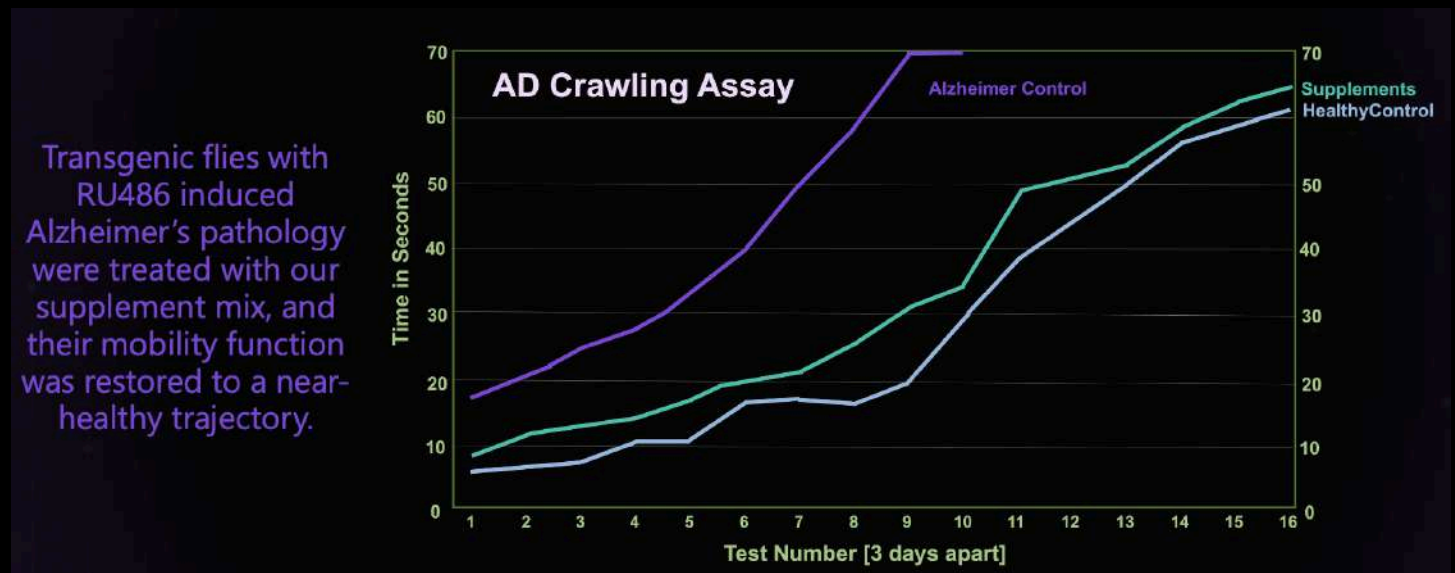
Fig. 5: Multipath Natural Product Supplement Suppresses Dementia Symptoms in Amyloid-β and Tau Transgenic Drosophila. Transgenic AB42 flies with RU486 induced Alzheimer's pathology (RU Control, red line) were treated with a mix of supplements (Green line), and their mobility function was restored to a near-healthy trajectory (Control, Blue line). The Supplements may act on several longevity pathways such as inducers of telomerase, mitochondria efficiency (e.g., AMPK and PPAR), and autophagy (e.g., mTOR). The supplements also help to reduce inflammation (e.g., TNFα) and stress (e.g., NMDA and GABA receptors in brain neurons).

A supplement targeting AMPK, among other pathways, was developed for Genescient Corp. using the results of our AI analysis of Methuselah Fly data and then tested in patients suffering from mild to moderate Alzheimer's disease over the course of 15 months. Overall, we recruited 50 subjects with mild to moderate AD to participate in a double-blind, placebo-controlled clinical study. During the pilot study, the subjects were evaluated quarterly on the Mini Mental State Exam (MMSE), Alzheimer's Disease Cooperative Study's Activities of Daily Living (ADCS-ADL), and the Clinical Dementia Rating Sum of Boxes (CDR-SB). We found that the addition of our substances to subjects' existing medical regimens stabilized cognitive decline in patients with mild AD and slowed cognitive decline in patients with moderate AD. These results were observed in both sexes and in all ages tested. Importantly, no adverse side effects attributable to our substances were reported.

Target Market

The longevity supplement market is a prime area for our company to move quickly because it is a rapidly growing market with a large addressable population. The market is also fragmented, which means that there is an opportunity for us to gain a significant market share. Some of our key segments include:
- **Baby boomers:** This demographic is increasingly interested in preventive healthcare and is willing to spend money on supplements that can help them live longer and healthier lives.
- **High-income earners:** This group is also more likely to be interested in longevity supplements, as they have the disposable income to afford them.
- **People with chronic diseases:** These individuals may be looking for supplements that can help them manage their conditions and improve their quality of life.

- **The Rejuve-Longevity community:** Together with our sister company, Rejuve.ai, we are building one of the world's largest longevity communities that will help us as a steppingstone into larger markets.
- **People who are active and health-conscious:** This group is interested in supplements that can help them maintain their health and fitness levels.

In order to succeed in this competitive market, it is important to offer products that are differentiated from those of our competition. Therefore, we have a focus on using unique ingredients, synergistic effects of components, offering higher quality products, developing innovative/novel consumer products beyond mere pills, and or providing better customer service.
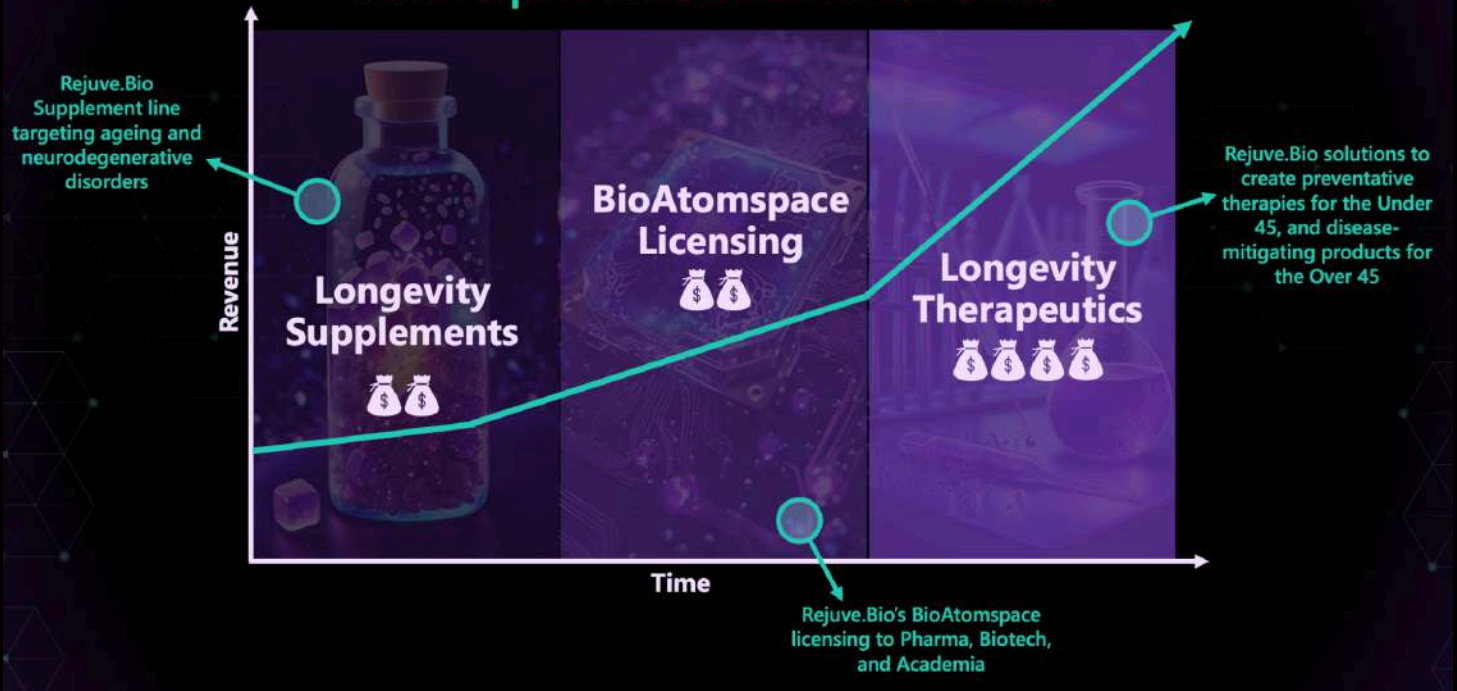
In addition, the longevity supplement market is still in its early stages of development, which means that there is a lot of room for innovation. Our company is well-positioned to capitalize on this innovation by developing new and improved longevity supplements.

Fig. 6: Botanical Mixture Stabilizes Cognitive Function in Patients with Mild and Moderate Alzheimer's Disease. 30 patients suffering from mild to moderate Alzheimer's Disease were placed on a Supplement regimen for 15 months. The decline in cognition was slower than expected, with treated patients gaining 0.28 points on average, as opposed to the expected 1.8 points. The CDR is scored on an 18-point scale, where a lower score indicates less cognitive impairment. The Clinical Dementia Rating (CDR-SB) is used to quantify the severity of symptoms of dementia. This measure assesses a subject's cognitive and functional performance in six areas: memory, orientation, judgment & problem solving, community affairs, home and hobbies, and personal care. Scores in each of these are combined to obtain a composite score, with a higher score indicating greater severity of dementia symptoms.

Overall, there is an enormous market potential for Rejuve.Bio supplements. Who wants to get old and sick when they can maximize their lifespan in the best possible health?

Multiple Revenue Streams

Rejuve.Bio Supplement line targeting ageing and neurodegenerative disorders

Longevity Supplements

BioAtomspace Licensing

Longevity Therapeutics

Rejuve.Bio solutions to create preventative therapies for the Under 45, and disease-mitigating products for the Over 45

Rejuve.Bio's BioAtomspace licensing to Pharma, Biotech, and Academia

Revenue

Time

Investing in artificial intelligence for longevity science isn't just a game-changer for healthcare's future; it's also a gold mine for savvy investors. By 2024, the global market for anti-aging products and services is poised to skyrocket to a whopping $271 billion, as Zion Market Research reports. As artificial intelligence matures, it's increasingly elbowing its way into the longevity science space. Companies wise enough to both develop and adopt these AI technologies are uniquely positioned to benefit from this ballooning market.

In pursuing our business goals we are working with proven business methods such as the D4X framework, popularized by Singularity University, a four-step process for developing and deploying AI solutions to solve real-world problems. The framework was first published in 2017 in the book "Design for Exponentials: A Radically Different Approach to Innovation" by Salim Ismail, Michael S. Malone, and Yuri Van Geest. The framework is based on the idea that exponential technologies, such as artificial intelligence and gene editing, are changing the world at an unprecedented pace. The framework provides a way for organizations to develop and deploy AI solutions that can keep up with this pace of change. The four steps are:

- **Define the problem.** What is the specific longevity problem that we are trying to solve with AI? What are the key metrics for success?
- **Discover the data.** What data do we need to solve the problem? Where can we find this data?
- **Design the solution.** How will we use the BioAtomspace to solve the problem? What algorithms, data sources and models will we use?
- **Deploy the solution.** How will you put the AGI solution into practical production? How will we monitor and maintain it?

Our business framework is a valuable tool for us because it provides a structured approach to developing and deploying AGI solutions in longevity research. The framework helps Rejuve.Bio to avoid common pitfalls, such as choosing the wrong problem to solve or using the wrong data. In addition, our business framework is flexible enough to be adapted to a wide range of AI applications. This makes it a valuable tool for Rejuve.Bio for developing AI solutions for a variety of industries, including healthcare, longevity science, drug development, and biotech.

For our investors, our adoption of such frameworks signals that we are a forward-thinking startup with a solid plan for growth and adaptability. We are not only prepared for the challenges of rapid technological changes but also equipped to harness these changes to drive exponential growth. By demonstrating our ability to scale and adapt, we increase our investment logic by reducing the potential risks and increasing the potential returns.

The Ecosystem

Rejuve.Bio is fortunate to find its place within the Singularity.NET ecosystem, a groundbreaking nexus for benevolent AI and artificial general intelligence. We're aligned with innovative ventures in a space that's like the Silicon Valley of AI. SingularityNET nurtures projects that impact various sectors, from DeFi and Biotech to Arts and Enterprise-level AI. Rejuve.Bio benefits from this flourishing 'digital Eden', standing alongside other groundbreaking projects.
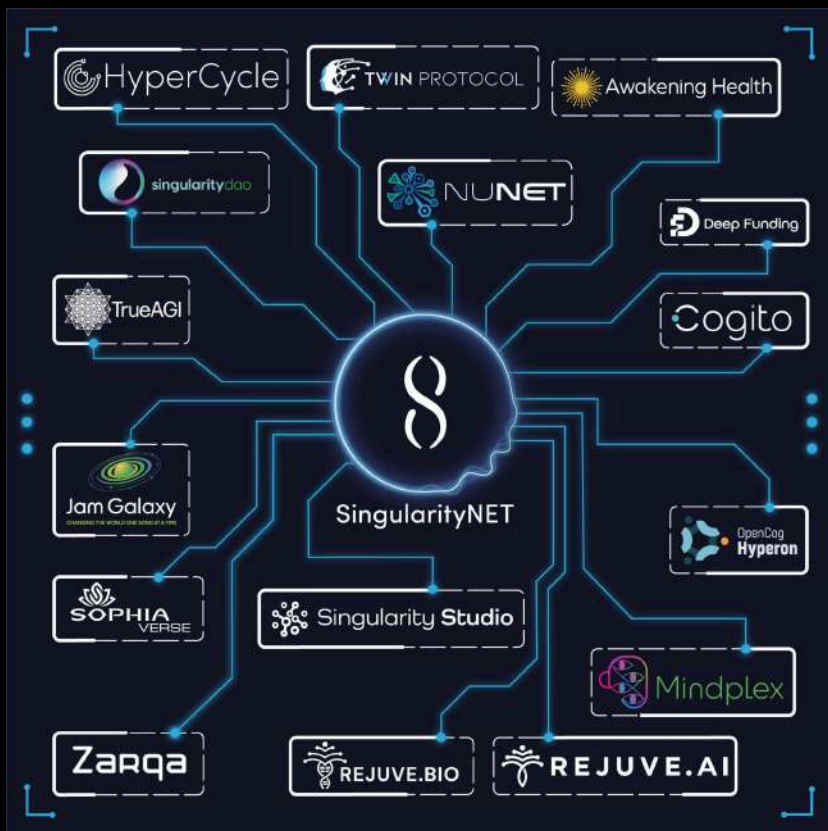
SingularityNET serves as a multifaceted incubator, providing not just funding but also expertise and a supportive environment for young ventures like ours. One of its standout features is the decentralized marketplace, where developers can both offer and find AI services, connecting with customers and collaborators. Integral to the ecosystem is the Research and Development hub, a space fostering a spirit of cooperation and shared innovation among AI developers.

For ventures like ours, the benefits are manifold. We have access to a vast network of seasoned mentors ready to guide us through the complexities of business growth. This mentorship is invaluable, helping us navigate challenges and plot out our future direction. The ecosystem also serves as a bridge to potential investors, a crucial element for any startup looking to scale. The funding avenues that open up through Singularity.NET are instrumental in realizing our business objectives.

Furthermore, being part of Singularity.NET places us in a vibrant entrepreneurial community. This networking hub is abuzz with startups, investors, and potential customers, all sharing a common vision. The collaborative atmosphere has already led to partnerships and unearthed new opportunities, expanding our reach in previously unimaginable ways. On a practical level, the ecosystem equips us with resources that would be costly and time-consuming to acquire independently, from computing power to marketing tools and operational templates.

Overall, Singularity.NET isn't just aiding our growth; it's shaping our journey, powering our progress, and providing a holistic environment that fosters both our innovation and success.

Mission Statement

Our Mission

Transform Lives and Societies by Unleashing the Potential of Human Longevity as soon as possible; being the first company that help humanity reach Longevity Escape Velocity, where the rate of increase in human lifespan exceeds the rate of aging. At the same time Rejuve.Bio was founded with the purpose of creating AI agents, powering us forward towards our goal of beneficial Artificial General Intelligence. while advocating for decentralization as the path for ethical AI and AGI for the benefit of humanity.

How are we doing this? At the heart of our approach lies a crucial shift in perspective – adopting an exponential mindset. This is the key that unlocks our potential for innovation, transcending the constraints of linear thinking that can only take us so far. To truly innovate and create world-changing ideas, we need to step beyond the familiar and challenge the status quo.

Amid a significant uptick in aging research and related R&D investments, we must consider the broader backdrop: the persistent rise in human life expectancy with its attendant societal and economic ramifications. As of 2023, over 750 million individuals were aged 65 or older—a number projected to double by 2050. While this longevity boon has been facilitated by leaps in scientific understanding of aging's complex biology, it also intensifies the prevalence of age-related diseases (ARDs) such as cardiovascular issues, cancer, and neurodegenerative conditions like Parkinson's and Alzheimer's disease. These ARDs not only erode the quality of life for older adults but also strain healthcare systems and economies globally.

Addressing these challenges calls for innovative, large-scale solutions. Enter artificial intelligence in tandem with big data and emerging technologies. These tools can revolutionize the way we track disease trajectories, fine-tune geriatric care, and prioritize drug development efforts. Nations already grappling with an aging citizenry are incorporating these technologies into ambitious healthcare reforms and societal adaptation strategies. By harnessing our BioAtomspace, we can craft data-driven public health policies that promote healthier aging lifestyles across demographic groups, mitigating the strain on healthcare systems and enhancing quality of life. In this multifaceted landscape, Rejuve.Bio stands as a vanguard, poised to collaborate with research entities to expedite the creation and delivery of groundbreaking treatments for these pressing healthcare issues.

What does this involve? First and foremost, a willingness to take risks and push the boundaries of what we perceive as possible. It's about thinking bigger, thinking beyond incremental steps, and visualizing a future of abundant possibilities. It's important to understand that the thinking that led us to our present circumstances will not necessarily lead us to our desired future. Traditional, linear thinking focuses on steady, predictable outcomes, but Rejuve.Bio's approach is about embracing rapid, transformative change. We equip ourselves with breakthrough tools to generate breakthrough ideas, fostering innovations that hold the power to shape the future of our world. It is expansive and daring, inviting us to take bold strides into the uncharted territories of potential – and we invite you to be part of this amazing voyage.

Among other ideas, we apply The Design for Exponentials framework. While relatively new, it has shown promise in enabling startups to adapt to fast-paced technological growth and leverage it to their advantage. Often, technological progress in many domains, also those that we intent to use such as AI, biotech, nanotech, and quantum computing, follows an exponential curve rather than a linear one. Our approach is a response to this reality, fostering a mindset that accommodates and harnesses exponential growth rather than resisting it or being outpaced by it. For AI and quantum computing, these shifts will come and Rejuve.Bio will be a part of it.

Purpose

At Rejuve.Bio, we are committed to the concept of Massive Transformative Purpose, an approach that goes beyond mere profitability. Our purpose is not just a mission statement, it's our North Star guiding every strategic decision, every innovation, and every product we develop. The benefits of this approach are manifold. First, it provides a clear, aspirational goal that motivates our team to push the boundaries of what is possible. Second, it serves as a magnet, attracting the best talent who align with our purpose, as well as loyal customers who share our vision. Third, it differentiates us in the market, setting us apart from competitors. We are here to empower people, to foster decentralization of research efforts, to build a longevity community and bring the world of innovators much closer together. Our purpose propels us to make a significant, positive impact on the world, fostering a culture of innovation, resilience, and commitment to our purpose.

Vision

Rejuve.Bio is committed to unlocking the infinite possibilities that come from the convergence of exponential technologies and grand societal challenges. At the core of our existence is an audacious goal: to extend human longevity, impacting a billion lives or more. We're not just looking to add years to life; we're transforming how we experience aging. Harnessing the unparalleled power of AI and our revolutionary BioAtomspace, we aim to expedite the discovery, development, and delivery of regenerative treatments that extend lifespans and make age-related diseases a thing of the past.

Imagine a future where advanced computing can map intricate biological processes, enabling us to slow down and even reverse the aging process. Envision a world where a lifespan of 120 years is not the exception but the norm, where each of those years is lived with vibrancy, wisdom, and ever-growing

contributions to society. Our innovations are designed to make this future a reality, driving a longevity dividend that enriches our world socially, economically, and spiritually.

Values

We believe that longevity is not only for a few selected biohackers or multi-billionaires. The fruits of our longevity research are for everyone. All people should benefit from living longer, healthier, and more enjoyable life's. We believe that we can achieve more together than we can alone. We are committed to working together to build a successful organization. We recognize the power of diverse perspectives. Our collaborative ecosystem includes partnerships with leading institutions and a workforce comprising individuals from myriad backgrounds. Together, we aim to achieve the otherwise impossible. In doing so, we are committed to innovation and creativity. We believe that AGI has the potential to solve some of the world's most pressing problems, and we are dedicated to using our technology to make a positive impact on the world. As we grow, so does our responsibility toward society and the environment. We are committed to contributing positively, whether through medical breakthroughs or sustainable practices. While we chase innovation, we maintain a firm grip on financial prudence. This allows us to sustainably innovate while providing optimum returns for our stakeholders. We believe that integrity is essential for success. That means, we are committed to conducting our business in an honest and ethical manner. We make sure our values are specific and measurable. We ensure open channels of communication and rigorous auditing to maintain unquestionable integrity. This will help us track our progress and ensure that we are living up to our values. We are here for the long haul. Our robust scalability plans are designed to take us, and our stakeholders, into a future where AGI and longevity are inseparable from daily life.

For the first time in human history, decoding the secrets of aging is within reach.

Leveraging our pioneering AI with Methuselah's evolutionary insights, we'll unravel the path to

life-extending therapeutics

Financials

Funding Requirements

Team/Operations

One of the cornerstone elements of our business model at Rejuve.Bio is assembling a top-notch team that will drive both innovation and profitability. The immediate focus is on three critical departments: Technical AI Expertise, Lab Technicians, and Marketing & Sales. Below is a strategic overview of our staffing plans for each area:

- **Technical AI Experts**

Our products and services are deeply rooted in artificial intelligence technologies; hence, investing in a team of highly skilled AI professionals is non-negotiable. We aim to bring on board experts in machine learning and data analytics to continually innovate and improve our product offerings. By doing so, we can stay ahead of the curve in providing solutions that are both advanced and user-friendly.

- **Lab Technicians**

Equally pivotal to our business's success are lab technicians who will oversee the rigorous testing phases of our products. Their expertise ensures that all products meet the strictest quality and safety standards before hitting the market. By investing in top-tier lab staff, we can ensure a faster turnaround from the conceptual stage to market release, significantly reducing operational costs over the long term.
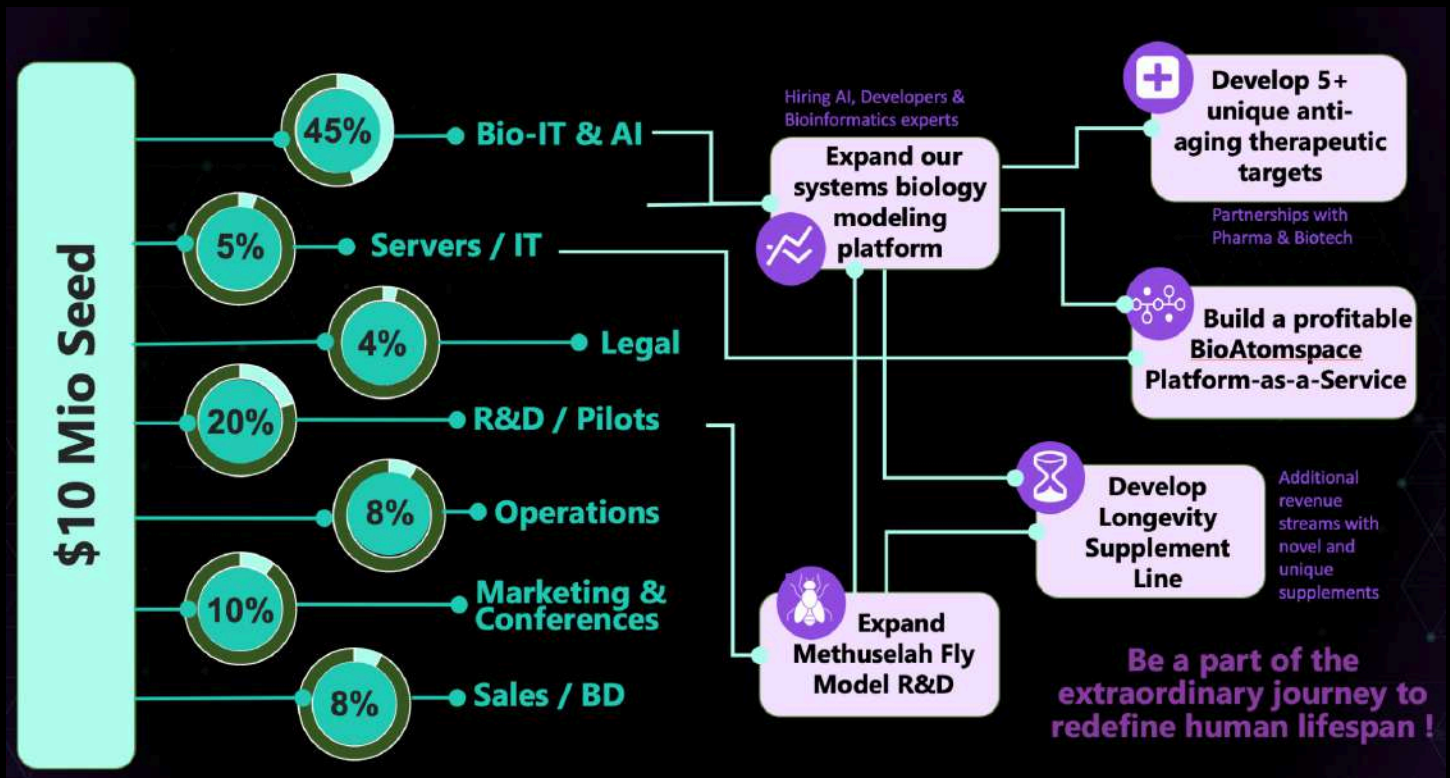
- **Marketing & Sales Team**

No product, regardless of its brilliance, can succeed without a strong marketing and sales force behind it. We intend to build a robust team skilled in digital marketing, brand building, and direct sales to maximize our reach and revenue streams. This team will be responsible for not just promoting the products and services but also engaging in market research to ensure that we are always aligned with consumer needs and trends.

Hiring the right people is an investment, but it's also a crucial element for business profitability. Having technical experts ensures that we can produce innovative products, which in turn increases our market competitiveness. Other areas where investment is needed, i.e. development of the AI platform, R&D activities, and IP

Building advanced lab capabilities to move target validation faster

Targets need to pass through rigorous experimental validation at wet lab. It is planned to move to a new location, where we can apply cutting-edge technologies such as our fly model, CRISPR, epigenomics, RNA-seq and human iPSCs to evaluate target hypotheses in cell-based models.

Bio-IT & AI — 45%
Servers / IT — 5%
Legal — 4%
R&D / Pilots — 20%
Operations — 8%
Marketing & Conferences — 10%
Sales / BD — 8%

$10 Mio Seed

Hiring AI, Developers & Bioinformatics experts

Expand our systems biology modeling platform

Develop 5+ unique anti-aging therapeutic targets

Partnerships with Pharma & Biotech

Build a profitable BioAtomspace Platform-as-a-Service

Develop Longevity Supplement Line

Additional revenue streams with novel and unique supplements

Expand Methuselah Fly Model R&D

Be a part of the extraordinary journey to redefine human lifespan !

Research & IT

● Development of the AI Platform

Central to our vision is a state-of-the-art AGI platform that will power our range of services. Investment in this area involves not just one-time costs for development but also ongoing expenses for updates and improvements. The aim is to build a scalable, robust platform that can support increasing workloads and data sizes, all while delivering optimal performance.

● Research & Development (R&D) Efforts

Innovation is the lifeblood of our company. R&D will be a consistent line item in our budget to ensure we remain at the forefront of technological advancements. Investment will cover everything from initial product concept development to prototype testing. We will also earmark funds for collaborative projects and partnerships with academic institutions or tech incubators that align with our objectives. The focus is on developing proprietary algorithms, methods, and tools that can give us a competitive edge in the marketplace.

● Intellectual Property (IP)

Protecting our innovations is just as important as creating them. A significant allocation will be made towards securing patents, copyrights, and trademarks. These legal safeguards are critical to prevent imitation and ensure that we capitalize on our unique technologies. This creates an invaluable asset for the company and can also become a revenue stream through licensing opportunities.

● Operations: Servers & IT

To manage the back-end of our services, we need a strong operational framework in place. Investment in high-speed servers, robust security measures, and an efficient IT management system is essential. Budget allocation will cover both initial setup costs and ongoing maintenance to ensure our operations

are uninterrupted and secure. By investing in state-of-the-art hardware and software, we aim to achieve operational efficiencies that can reduce long-term costs and increase profit margins.

We are the first generation that has a real chance to cure aging. We need your investment to help us accelerate our research and bring these treatments to market. Together, we can cure aging.

Each of these investment areas is like a cog in a well-oiled machine; they are individually essential but function best when working in concert. A superior AI platform enables exceptional product offerings, bolstered by constant innovation through R&D. Intellectual property protection ensures that our innovations remain exclusively ours, adding to the company's valuation. Finally, a solid operational backbone supports all these elements, ensuring that the business runs smoothly.

Exponential Tech Roadmap

To illustrate, we apply our roadmap within a framework that outlines the various stages of digital technology development and how it can be harnessed for innovation. By understanding these stages, Rejuve.Bio can better anticipate the potential impact of emerging technologies and strategically position us for success.

The investment will be used to achieve the following short-term milestones:

- Build a profitable Platform-as-a-Service based on the BioAtomspace
- Develop 5+ unique therapeutic targets
- Expand our AI-based systems biology modeling platform
- Develop Supplement Line

In plain terms, let's break down our ambitious roadmap aiming to redefine aging and healthcare through cutting-edge technology.

Roadmap

Transfer learning map to human biology

Systems biology model of Methuselah Fly longevity

In silico target identification and hypothesis testing platform

Funding

First Supplement on Market

Build a profitable Platform-as-a-Service based on the BioAtomspace platform

Year 1

Year 2

Generative Cooperative network integrated into Rejuve analytics

Candidate therapeutics tested on flies

Develop 5+ unique therapeutic targets

Therapeutic candidate #1 tested in mice

Supplement-Line on Market

Pharma partner secured for human trials

Year 3

Phase 1 human trial for therapeutic candidate #1 in a small number of people (20-80).

Therapeutic candidates #2-5 tested in mice (optional)

Year 4

Year 1: The Groundwork

   Systems Biology Model of Methuselah Fly Longevity: Rejuve.Bio will further create a comprehensive biological longevity model using our long-living Methuselah flies. This serves as the testing ground for our initial anti-aging research.

   First Supplement Line on Market: They plan to roll out our first line of anti-aging supplements, a tangible product that probably incorporates some insights from the fly model.

   In Silico Target Identification and Hypothesis Testing: Using computer simulations we will identify potential biological targets and run tests to check for anti-aging effects.

   Transfer Learning Map to Human Biology: Information from the Methuselah fly will be adapted to human biology, connecting the dots between fly longevity and human longevity.

   Build a Profitable Platform-as-a-Service (PaaS) based on the BioAtomspace Platform: We are planning to create a cloud-based service, where other organizations can run their own bio-analytic tests, generating an additional revenue stream.

Year 2: Scaling and Refinement

Rejuve.Ai Network Data Integrated with Methuselah Fly Data: We will combine human data from the already-running Rejuve.AI network with the Methuselah Fly research, increasing the richness of our dataset.

OpenCog Hyperon fully Integrated into Rejuve Analytics: We will incorporate all of the new OpenCog Hyperon developments, an AI framework, to make the data analysis more robust and lift it to the next level of AGI.

Develop 5+ Unique Therapeutic Targets: Leveraging the combined data, we aim to identify more than five different biological factors that can be targeted for anti-aging interventions.

Generative Cooperative Network Integrated into Rejuve Analytics: The AI analytics will be further enhanced by adding a Generative Cooperative Network, where AIs collaborate to generate solutions.

Candidate Therapeutics Tested on Flies: We will put the identified therapeutic targets to the test by experimenting on flies.

Therapeutic Candidate #1 Tested in Mice: The most promising anti-aging solution will move from flies to mice, a closer biological match to humans.

Year 3: Moving to Mammals and Humans and Partnering Up

More Therapeutic Candidates Tested in Mice and stem-cell derived organoids: While the first candidate is being tested in humans, a second promising candidate will start its animal and human organoids trial phase, ensuring that the pipeline of potential solutions keeps flowing.

Pharma Partner Secured for Human Trials: With enough promising data from animal trials, they plan to secure a partnership with a pharmaceutical company for human trials.

Phase 1-2 Human Trial for Therapeutic Candidate #1: The first phase is designed to assess the safety of a new drug or treatment in a small number of people (20-80). The second phase is designed to assess the effectiveness of the new drug or treatment in a larger number of people (100-300).

Year 4: Full-scale Human Trials

Phase 1-2 Human Trial for Therapeutic Candidate #2-5

Phase 3 Human Trial for Therapeutic Candidate #1: This phase is designed to confirm the effectiveness of the new drug or treatment in a large number of people (1000-3000).

Unpacking the Startup's Roadmap Philosophy

Digitization: At Rejuve.Bio, our AI-driven approach is revolutionizing the way we understand biological aging. We're converting these complex biological processes into digital data that can be extensively analyzed, leading us closer to groundbreaking anti-aging solutions.

Deception: In our first year, it may appear that we're only laying the groundwork. However, don't be deceived; these are the essential building blocks for the disruptive innovations that are soon to come.

Disruption: By the time we reach Year 4, our phase 1 human trials will not just be newsworthy; they'll be game-changers. We aim to fundamentally shift the way society views and approaches both aging and disease treatment.

Dematerialization and Demonetization: Our utilization of AI technology is designed to streamline traditional healthcare methods, making them more efficient and less costly. Think of it as healthcare, but leaner and smarter, enabling us to deliver more for less.

Democratization: Our ultimate goal is to make our cutting-edge anti-aging technology accessible to all. As we continue to make strides in dematerialization and demonetization, we're opening up new possibilities for a broader audience to benefit from advanced healthcare solutions.

Summary

We are creating a team of scientists, technologists, and researchers who dare to dream of a world where aging and related diseases are no longer inevitable. We are the disruptors who challenge conventional methods and introduce new paradigms in tackling aging. We design the user experience around the people's needs, creating accessible and intuitive ways for them to understand and participate in their longevity journey. Our experts develop the technology and solutions that translate these dreams into reality. We will establish partnerships with healthcare providers, biotech companies, and academic institutions to ensure the distribution and adoption of the technology and longevity solutions. We stay determined to keep innovating and improving the technology despite any challenges that may come along the way.

Exponential technologies like AI – and soon AGI – will revolutionize longevity research by speeding up data analysis, uncovering new insights, and enabling personalized interventions. They can provide scalable, accessible, and cost-effective solutions to tackle aging and related diseases.

We welcome all interested parties to join us on this journey as we design for exponentials, pushing the boundaries of what's possible and creating a prosperous future together.

Partnerships

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Disclaimer

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