Analysis of Generated Summaries:

* Each entry has
  + Paper Id
  + Title and abstract of the sample
  + Summary generated from GPT-3 Da Vinci
    - Biological Strategy
    - Organism
    - Part of
    - Function
    - Mechanisms
    - Context
  + My notes and analysis
* The prompt that is fed into OpenAI API has 3 training samples
* W2103410568
  + Sample: "title": "The suctorial organ of the Solifugae (Arachnida, Solifugae)", "abstract": "the ability of members of the arachnid order solifugae to climb smooth, vertical surfaces and the organs involved in this behavior are investigated. macroscopic, microscopic, and scanning electron microscopic observations are made of a palpal organ called the suctorial organ. observations of the behavior but not the microstructure have been made in the past. histological examination illustrates the internal gross anatomy of this structure and scanning electron microscopy demonstrates the fine structure in adults of four genera: eremobates (eremobatidae), eremochelis (eremobatidae), eremorhax (eremobatidae), ammotrechula (ammotrechidae), as well as an unidentified late stage immature and third stage instar. the suctorial organ is most likely primarily used for prey capture in the wild. q 2005 elsevier ltd. all rights reserved."
  + Strategy: The suctorial organ of the Solifugae is used for prey capture.
    - Organism: Solifugae
    - Part of: suctorial organ
    - Function: prey capture
    - Mechanisms: suction → suctorial
    - Context: wild
  + Notes:
    - GPT uses extractive text summarization for the most part, mainly getting the strategy from the title and the last sentence of
    - The Organism is correct, but it also could be arachnid
    - Part of is correct
    - Function is correct
    - Mechanism is correct. But, it looks like GPT abstracted this from suctorial, since the word “suction” is nor present in the abstract.
    - The Context is correct, but it is not present in the strategy.
    - Overall, this is a “good” output.
* W2103410568
  + Sample: "title": "On the Mound of Macrotermes michaelseni as an Organ of Respiratory Gas Exchange", "abstract": "patterns and rates of air movements in the mounds and nests of macrotermes michaelseni were studied using tracer methods. wind is a significant source of energy for powering nest ventilation, despite the mound being a completely enclosed structure. nests are ventilated by a tidal movement of air driven by temporal variation in wind speed and wind direction. density gradients sufficiently steep to drive bulk flow by natural convection will be rare. however, metabolism-induced buoyant forces may interact with wind energy in a way that promotes homeostasis of the mound atmosphere."
  + Strategy: The mound of Macrotermes michaelseni is an organ of respiratory gas exchange.
    - Organism: Macrotermes michaelseni
    - Part of: mound
    - Function: respiratory gas exchange
    - Mechanisms: tracer methods, wind, density gradients
    - Context: enclosed structure
  + Notes:
    - The biological strategy is taken completely from the title. The strategy that is extracted has important information, but not right unfortunately. It is a tricky strategy to extract.
    - Correct output:
      * Strategy: metabolism-induced buoyant forces from Macrotermes michaelseni may interact with wind energy in a way that promotes homeostasis of the mound atmosphere.
        + Organism: Macrotermes michaelseni
        + Part of: mound
        + Function: homeostasis
        + Mechanisms: metabolism-induced buoyant forces interacting with wind energy
        + Context: mound atmosphere
* W2103410568
  + Sample: “title”: “A multi-enzyme cascade of hemoglobin proteolysis in the intestine of blood-feeding hookworms.", "abstract": "blood-feeding pathogens digest hemoglobin (hb) as a source of nutrition, but little is known about this process in multicellular parasites. the intestinal brush border membrane of the canine hookworm, ancylostoma caninum, contains aspartic proteases (apr-1), cysteine proteases (cp-2), and metalloproteases (mep-1), the first of which is known to digest hb. we now show that hb is degraded by a multi-enzyme, synergistic cascade of proteolysis. recombinant apr-1 and cp-2, but not mep-1, digested native hb and denatured globin. mep-1, however, did cleave globin fragments that had undergone prior digestion by apr-1 and cp-2. proteolytic cleavage sites within the hb \u03b1 and \u03b2 chains were determined for the three enzymes, identifying a total of 131 cleavage sites. by scanning synthetic combinatorial peptide libraries with each enzyme, we compared the preferred residues cleaved in the libraries with the known cleavage sites within hb. the semi-ordered pathway of hb digestion described here is surprisingly similar to that used by plasmodium to digest hb and provides a potential mechanism by which these hemoglobinases are efficacious vaccines in animal models of hookworm infection.”
  + Strategy: The intestinal brush border membrane of the canine hookworm, Ancylostoma caninum, contains aspartic proteases (APR-1), cysteine proteases (CP-2), and metalloproteases (MEP-1), which work together to digest hemoglobin.
    - Organism: Canine hookworm
    - Part of: intestinal brush border membrane
    - Function: digest hemoglobin
    - Mechanisms: aspartic proteases, cysteine proteases, metalloproteases
    - Context: blood-feeding
  + Notes:
    - The strategy seems correct at first glance, but I cannot help but notice the last sentence, which is highlighted in red. It states “ efficacious vaccines in animal models of hookworm infection.” This could very well be the function, and if so, the whole strategy would have to change. We would have to read the paper to verify.
* W2103410568
  + Sample: "title": "The Diversity of Hydrostatic Skeletons", "abstract": "a remarkably diverse group of organisms rely on a hydrostatic skeleton for support, movement, muscular antagonism and the amplification of the force and displacement of muscle contraction. in hydrostatic skeletons, force is transmitted not through rigid skeletal elements but instead by internal pressure. functioning of these systems depends on the fact that they are essentially constant in volume as they consist of relatively incompressible fluids and tissue. contraction of muscle and the resulting decrease in one of the dimensions thus results in an increase in another dimension. by actively (with muscle) or passively (with connective tissue) controlling the various dimensions, a wide array of deformations, movements and changes in stiffness can be created. an amazing range of animals and animal structures rely on this form of skeletal support, including anemones and other polyps, the extremely diverse wormlike invertebrates, the tube feet of echinoderms, mammalian and turtle penises, the feet of burrowing bivalves and snails, and the legs of spiders. in addition, there are structures such as the arms and tentacles of cephalopods, the tongue of mammals and the trunk of the elephant that also rely on hydrostatic skeletal support but lack the fluid-filled cavities that characterize this skeletal type. although we normally consider arthropods to rely on a rigid exoskeleton, a hydrostatic skeleton provides skeletal support immediately following molting and also during the larval stage for many insects. thus, the majority of animals on earth rely on hydrostatic skeletons.”
  + Strategy: A hydrostatic skeleton is a type of skeleton that is supported by internal pressure.
    - Organism: animals
    - Part of: skeleton
    - Function: support, movement, muscular antagonism, and the amplification of the force and displacement of muscle contraction
    - Mechanisms: internal pressure
    - Context: animals
  + Notes:
    - The biological strategy extracted is not correct. It simply does not have enough information within it.
    - Correct Output:
      * Strategy: A hydrostatic skeleton is a type of skeleton that uses internal pressure to transmit force, and is found in a wide variety of animals.
        + Organism: animals
        + Part of: skeleton
        + Function: support, movement, muscular antagonism → transmit force
        + Mechanisms: internal pressure
        + Context: animals
* W2103410568
  + Sample: "title": “On the buoyancy of the pearly nautilus", "abstract": "nautilus macromphalus sowerby when freshly caught was close to neutral buoyancy having a weight in sea water of about 0\u20132% of its weight in air. the animals without their shells varied considerably in density but the volume of the shell was an approximately constant fraction of the total volume of the whole animal and whole animals were brought approximately to the same density by havingmore or less liquid inside the chambers of the shell. about 80 % of the gas space in the shell was used to support the weight of the shell itself in sea water.in an adult animal the centre of buoyancy was found to be about 6 mm above the centre of gravity, which made the animal very stable in its natural swimming position, a couple of about 350 g. cm being required to turn it through 90\u00b0. the pearly partsof the chamber walls were impermeable to sea water but the chalky and horny siphuncular tubes joining the septal necks were very porous. the most newly formed tenor so chambers were the only ones to contain liquids in appreciable volume and theydid this in diminishing amounts from the newest to the oldest. the watery liquids found within the chambers were always hypotonic to sea water and sometimes markedly so; they contained principally sodium and chloride ions. one animal was in the process of forming a new chamber, this incomplete chamber was completely full of liquidwith an osmolarity close to that of sea water but differing in composition from seawater."
  + Strategy: The pearly nautilus has a shell that is used to support the weight of the animal in sea water. The center of buoyancy for the animal is located above the center of gravity, making the animal stable in its natural swimming position.
    - Organism:
    - Part of:
    - Function:
    - Mechanisms:
    - Context:
  + Notes:
    - The summary generated is correct, but GPT did not fill out the other relevant information in the output.
    - That is odd because it had not happened with the prompt previously.

Conclusion after first 5 samples:

* Looking at only 5 samples, the results are again promising, compared to the last prompt. I believe this prompt also yielded more of the information we wanted.
* One thing is for certain, that GPT-3 can indeed pull biological strategies from the abstract. They may not be correct always, but it looks like it does it well enough.
* I will run 5 more samples below with the same prompt for exploratory analysis.
  + The reason for this is because with the initial results from the playground, I thought the generated strategies would be a bit better.
* W2152749757
  + Sample: title": "How strong is intracanopy leaf plasticity in temperate deciduous trees", "abstract": "intracanopy plasticity in tree leaf form is a major determinant of whole-plant function and potentially of forest understory ecology. however, there exists little systematic information for the full extent of intracanopy plasticity, whether it is linked with height and exposure, or its variation across species. for arboretum-grown trees of six temperate deciduous species averaging 13-18 m in height, we quantified intracanopy plasticity for 11 leaf traits across three canopy locations (basal-interior, basal-exterior, and top). plasticity was pronounced across the canopy, and maximum likelihood analyses indicated that plasticity was primarily linked with irradiance, regardless of height. intracanopy plasticity (the quotient of values for top and basal-interior leaves) was often similar across species and statistically indistinguishable across species for several key traits. at canopy tops, the area of individual leaves was on average 0.5-0.6 times that at basal-interior, stomatal density 1.1-1.5 times higher, sapwood cross-sectional area up to 1.7 times higher, and leaf mass per area 1.5-2.2 times higher; guard cell and stomatal pore lengths were invariant across the canopy. species differed in intracanopy plasticity for the mass of individual leaves, leaf margin dissection, ratio of leaf to sapwood areas, and stomatal pore area per leaf area; plasticity quotients ranged only up to \u22482. across the six species, trait plasticities were uncorrelated and independent of the magnitude of the canopy gradient in irradiance or height and of the species' light requirements for regeneration. this convergence across species indicates general optimization or constraints in development, resulting in a bounded plasticity that improves canopy performance."
  + Strategy: Intracanopy plasticity in tree leaf form is a major determinant of whole-plant function and potentially of forest understory ecology.
    - Organism: tree
    - Part of: leaf
    - Function: major determinant of whole-plant function
    - Mechanisms: Intracanopy plasticity
    - Context: understory ecology
  + Notes:
    - GPT-3 takes the first sentence as a strategy. This mimics one of the “training” samples, specifically W2160542693.
    - The strategy is correct, but there is more to it.
    - I believe what the abstract is trying to explain is that plasticity is formerly correlated with certain traits, but the study finds that they were actually correlated with a different set of traits.
      * My evidence is in the red text.
      * The abstract does not actually explain why the plant needs intracanopy plasticity; it just says “major determinant of whole-plant function”.
      * Therefore, the abstract is flawed in a sense because a scientist building a tool cannot necessarily model intracanopy plasticity without researching it in the first place.
    - TLDR: abstract is vague in terms of explaining function.
* W2025490238
  + Sample: "title": "A biomechanical perspective on the role of large stem volume and high water content in baobab trees (Adansonia spp.; Bombacaceae)", "abstract": "the stems of large trees serve in transport, storage, and support; however, the degree to which these roles are reflected in their morphology is not always apparent. the large, water-filled stems of baobab trees (adansonia spp.) are generally assumed to serve a water storage function, yet recent studies indicate limited use of stored water. through an analysis of wood structure and composition, we examined whether baobab morphology reflects biomechanical constraints rather than water storage capacity in the six madagascar baobab species. baobab wood has a high water content (up to 79%), low wood density (0.09-0.17 g \u00b7 cm(-3)), high parenchyma content (69-88%), and living cells beyond 35 cm into the xylem from the cambium. volumetric construction cost of the wood is several times lower than in more typical trees, and the elastic modulus approaches that of parenchyma tissue. safety factors calculated from estimated elastic buckling heights were low, indicating that baobabs are not more overbuilt than other temperate and tropical trees, yet the energy investment in stem material is comparable to that in temperate deciduous trees. furthermore, the elastic modulus of the wood decreases with water content, such that excessive water withdrawal from the stem could affect mechanical stability."
  + Strategy: The large, water-filled stems of baobab trees serve a biomechanical function rather than a water storage function.
    - Organism: baobab trees
    - Part of: stem
    - Function: biomechanical function
    - Mechanisms: water content, wood structure, composition
    - Context: Madagascar
  + Notes:
    - The biological strategy is correct, but…
      * The water filled stem is not used for the plant as function, rather for elasticity of the stem.
    - Mechanism and Context are not present within the strategy. Also mechanism should have something to do with elasticity of the stem.
* W2112209842
  + Sample: "title": "Hydrophobic trichome layers and epicuticular wax powders in Bromeliaceae", "abstract": "the distinctive foliar trichome of bromeliaceae has promoted the evolution of an epiphytic habit in certain taxa by allowing the shoot to assume a significant role in the uptake of water and mineral nutrients. despite the profound ecophysiological and taxonomic importance of this epidermal structure, the functions of nonabsorbent trichomes in remaining bromeliaceae are not fully understood. the hypothesis that light reflection from these trichome layers provides photoprotection was not supported by spectroradiometry and fluorimetry in the present study; the mean reflectance of visible light from trichome layers did not exceed 6.4% on the adaxial surfaces of species representing a range of ecophysiological types nor was significant photoprotection provided by their presence. several reports suggesting water repellency in some terrestrial bromeliaceae were investigated. scanning electron microscopy (sem) and a new technique-fluorographic dimensional imaging (fdi)-were used to assess the interaction between aqueous droplets and the leaf surfaces of 86 species from 25 genera. in the majority of cases a dense layer of overlapping, stellate or peltate trichomes held water off the leaf epidermis proper. in the case of hydrophobic tank-forming tillandsioideae, a powdery epicuticular wax layer provided water repellency. the irregular architecture of these indumenta resulted in relatively little contact with water droplets. most mesic terrestrial pitcairnioideae examined either possessed glabrous leaf blades or hydrophobic layers of confluent trichomes on the abaxial surface. thus, the present study indicates that an important ancestral function of the foliar trichome in bromeliaceae was water repellency. the ecophysiological consequences of hydrophobia are discussed."
  + Strategy: The foliar trichome in bromeliaceae has evolved to provide water repellency, which has important ecophysiological consequences.
    - Organism: bromeliaceae
    - Part of: foliar trichome
    - Function: water repellency
    - Mechanisms: stellate or peltate trichomes, powdery epicuticular wax layer
    - Context: leaf surfaces
  + Notes:
    - The biological strategy correct, but it does not have the mechanism within it, which is very important.
    - The context is correct, based on what is stated in the abstract. But, the real context should be something along the lines of the logic → “so plants don’t get over-watered → death”
* W2103410568
  + Sample: "title": "The incidence and implications of clouds for cloud forest plant water relations.", "abstract": "although clouds are the most recognisable and defining feature of tropical montane cloud forests, little research has focussed on how clouds affect plant functioning. we used satellite and ground-based observations to study cloud and leaf wetting patterns in contrasting tropical montane and pre-montane cloud forests. we then studied the consequences of leaf wetting for the direct uptake of water accumulated on leaf surfaces into the leaves themselves. during the dry season, the montane forest experienced higher precipitation, cloud cover and leaf wetting events of longer duration than the pre-montane forest. leaf wetting events resulted in foliar water uptake in all species studied. the capacity for foliar water uptake differed significantly between the montane and pre-montane forest plant communities, as well as among species within a forest. our results indicate that foliar water uptake is common in these forest plants and improves plant water status during the dry season.”
  + Strategy: Foliar water uptake is common in tropical montane and pre-montane cloud forest plants and improves plant water status during the dry season.
    - Organism: tropical montane and pre-montane cloud forest plants
    - Part of: leaves
    - Function: improve plant water status
    - Mechanisms: foliar water uptake
    - Context: dry season
  + Notes:
    - The abstract is basically saying, the forests “are healthier” in terms of plant water status when the trees have foliar uptake, especially in the dry season.
    - The strategy generated is correct.
      * But, the part of is not in the strategy.
* W2103410568
  + Sample: Functional morphology of scale hinges used to transport water: convergent drinking adaptations in desert lizards (Moloch horridus and Phrynosoma cornutum)", "abstract": "the australian thorny devil, moloch horridus gray, 1841, and the texas horned lizard, phrynosoma cornutum harlan, 1825, have the remarkable ability to rapidly move water through interscalar spaces on their skin\u2019s surface to their mouth for drinking. the morphology of these scale hinges has not been studied. we used histological and sem techniques to examine and compare the scale hinges of both species. additional taxa in their respective lineages were examined in order to evaluate the potential that convergent evolution has occurred. in the two species that transport water, each scale hinge has a basally expanded and semi-enclosed channel formed by the hinge joint that is interconnected with all scale hinges on the body. we hypothesize that it is within this semi-tubular channel system of hinge joints, where the \u03b2-layer keratin of the integument is very thin, that water is transported. hinge joint walls are covered by a complex topography of fractured surfaces that greatly expand the channel\u2019s surface area and probably enhance capillary transport of water. in addition, we note differing morphology of scale surfaces at the rear of the jaws of both species. we hypothesize that capillary forces fill the scale-hinge system and additional forces, generated within the mouth by observed motions during drinking, depress local water-pressure to pull water through the channels of the hinge-joint system. we conclude that the combined features in the two species, semi-tubular hinge-joint channels with convoluted walls and a jaw-buccal cavity pumping-mechanism, have convergently evolved for capture, transport, and drinking of water from sporadic rainfall.”
  + Strategy: The articulated coralline Calliarthron cheilosporioides produces segmented fronds composed of calcified segments separated by uncalcified joints which allow fronds to bend and reorient under breaking waves.
    - Organism: Calliarthron cheilosporioides
    - Part of: fronds
    - Function: allow fronds to bend and reorient under breaking waves
    - Mechanisms: segmented fronds, calcified segments, uncalcified joints
    - Context: wave-swept intertidal zone
  + Notes:
    - Absolutely incorrect, this is a strategy from the training sample.
    - Why did it do this?
      * Maybe it did not know how to summarize the sample.

Conclusion after second 5 samples:

* Looking at the next 5 samples, we can see that GPT is able to extract the biological strategy.
* The issue is that the strategy sometimes does not have the function or mechanism, which are arguably the most important parts. The whole point of biomimicry is to design a human system based on a biological system, and if the “function” and “how the function is completed” are not present in the strategy abstracted/extracted from the text, then the tool we are creating is not doing its job.
  + Therefore, it is clear; we need to re-engineer the prompt, such that we tell GPT to “put more importance in finding” the function and mechanism.