**Introduction**

Here we seek to improve the performance of GPT-3 extracting context by using 4-shot learning. The prompt breaks up the context from “Get\_Bio\_Strat\_2” into an organism context and environment context.

**Prompt**

Refer to prompt 5 in the “Context\_prompt\_list” file in this directory.

**Test From OpenAI Playground**

Text: Harbor seal vibrissa morphology suppresses vortex-induced vibrations. Harbor seals (Phoca vitulina) often live in dark and turbid waters, where their mystacial vibrissae, or whiskers, play an important role in orientation. Besides detecting and discriminating objects by direct touch, harbor seals use their whiskers to analyze water movements, for example those generated by prey fish or by conspecifics. Even the weak water movements left behind by objects that have passed by earlier can be sensed and followed accurately (hydrodynamic trail following). While scanning the water for these hydrodynamic signals at a swimming speed in the order of meters per second, the seal keeps its long and flexible whiskers in an abducted position, largely perpendicular to the swimming direction. Remarkably, the whiskers of harbor seals possess a specialized undulated surface structure, the function of which was, up to now, unknown. Here, we show that this structure effectively changes the vortex street behind the whiskers and reduces the vibrations that would otherwise be induced by the shedding of vortices from the whiskers (vortex-induced vibrations). Using force measurements, flow measurements and numerical simulations, we find that the dynamic forces on harbor seal whiskers are, by at least an order of magnitude, lower than those on sea lion (Zalophus californianus) whiskers, which do not share the undulated structure. The results are discussed in the light of pinniped sensory biology and potential biomimetic applications.

Function: to reduce vibrations

Mechanism: undulated surface structure

Context: while scanning the water

Environment: in the water

Organism: harbor seal

Part of: mystacial vibrissae

Strategy: Harbor seal mystacial vibrissae reduce vibrations by having an undulated surface structure while scanning the water.

**Content**

1. W2005539166
   * "title": "Polarization sensitivity in two species of cuttlefish - Sepia plangon (Gray 1849) and Sepia mestus (Gray 1849) - demonstrated with polarized optomotor stimuli.", "abstract": "the existence of polarization sensitivity (ps), most likely resulting from the orthogonal arrangement of microvilli in photoreceptors, has been proposed in cephalopods for some time, although it has rarely been examined behaviourally. here, we tested the mourning cuttlefish, sepia plangon, and the reaper cuttlefish, sepia mestus, for polarization sensitivity using a large-field optomotor stimulus containing polarization contrast. polaroid filter drums with stripes producing alternating e-vectors were rotated around free-moving animals. polarized optomotor responses were displayed, and these responses were similar to those performed in response to a black-and-white, vertically-striped drum, whereas no responses were displayed to a plain polarizing control drum producing just a vertical e-vector. this indicates that the animals are able to see the contrast between adjacent stripes in the polarizing drum. to our knowledge, this is the first demonstration of functional polarization sensitivity in cuttlefish."
   * Output:
     + Organism: Polarization sensitive cuttlefish
     + Part of: eyes
     + Function: see contrast between adjacent stripes
     + Mechanisms: polaroid filter drums
     + Environment: large-field optomotor stimulus
     + Context: rotating around free-moving animals
     + Strategy: Cuttlefish see the contrast between adjacent stripes by rotating around free-moving animals in a large-field optomotor stimulus.
   * Notes
     + Correct
       - Organism, Part Of, Function, Environment
       - However, the environment abstracted is the experimental environment of the researchers, not the environment of the cuttlefish.
     + Incorrect
       - Mechanism → orthogonal arrangement of microvilli in photoreceptor
       - Context → orthogonal arrangement of microvilli in photoreceptor
       - Strategy → Cuttlefish see the contrast between adjacent stripes by orthogonal arrangement of microvilli in photoreceptor in a large-field optomotor stimulus.
     + 4/7
2. W2151557512
   * "title": "Identification and characterization of a multidomain hyperthermophilic cellulase from an archaeal enrichment.", "abstract": "archaea are microorganisms that use a wide range of carbon and energy sources. graham et al. describe an archaeal consortium that can grow at temperatures above 90 \u00b0c using crystalline cellulose as a carbon source, with potential applications in enzymatic degradation under extreme conditions."
   * Baseline:
     + Organism: archaeal consortium
     + Part Of: cellulase
     + Function: can grow at high temperatures
     + Mechanism: multidomain hyperthermophilic
     + Context: using crystalline cellulose as a carbon source
     + Strategy: A multidomain hyperthermophilic cellulase from an archaeal enrichment can grow at temperatures above 90 °c using crystalline cellulose as a carbon source.
   * Baseline:
     + Organism: archaea
     + Part Of: cellulase
     + Function: can grow at high temperatures
     + Mechanism: using crystalline cellulose
     + Environment: extreme conditions
     + Context: temperatures above 90 °c
     + Strategy: Archaea grow at high temperatures by using crystalline cellulose as a carbon source under extreme conditions.
   * Notes:
     + Baseline
       - Correct
         * Organism, Part Of, Function
       - Incorrect
         * Mechanism, Context, Strategy
       - 3/6
     + New
       - Perfect
       - Environment and Context are interchangeable
       - 7/7
3. W2160542693
   * "title": “DIFFERENCES IN POLYSACCHARIDE STRUCTURE BETWEEN CALCIFIED AND UNCALCIFIED SEGMENTS IN THE CORALLINE CALLIARTHRON CHEILOSPORIOIDES (CORALLINALES, RHODOPHYTA) 1", "abstract": "the articulated coralline calliarthron cheilosporioides manza produces segmented fronds composed of calcified segments (intergenicula) separated by uncalcified joints (genicula), which allow fronds to bend and reorient under breaking waves in the wave-swept intertidal zone. genicula are formed when calcified cells decalcify and restructure to create flexible tissue. the present study has identified important differences in the main agaran disaccharidic repeating units [\u21923)-\u03b2-d-galp (1\u2192 4)-\u03b1-l-galp(1\u2192] synthesized by genicular and intergenicular segments. based on chemical and spectroscopical analyses, we report that genicular cells from c. cheilosporioides biosynthesize a highly methoxylated galactan at c-6 position with low levels of branching with xylose side stubs on c-6 of the [\u21923)-\u03b2-d-galp (1\u2192] units, whereas intergenicular segments produce xylogalactans with high levels of xylose and low levels of 6-o-methyl \u03b2-d-gal units. these data suggest that, during genicular development, xylosyl branched, 3-linked \u03b2-d-galp units present in the xylogalactan backbones from intergenicular walls are mostly replaced by 6-o-methyl-d-galactose units. we speculate that this structural shift is a consequence of a putative and specific methoxyl transferase that blocks the xylosylation on c-6 of the 3-linked \u03b2-d-galp units. changes in galactan substitutions may contribute to the distinct mechanical properties of genicula and may lend insight into the calcification process in coralline algae."
   * Output:
     + Organism: Coralline Calliarthron
     + Part Of: fronds
     + Function: allow fronds to bend and reorient under breaking waves
     + Mechanism: producing segmented fronds composed of calcified segments separated by uncalcified joints
     + Environment: on water
     + Context: in the wave-swept intertidal zone
     + Strategy: Coralline Calliarthron produces segmented fronds composed of calcified segments separated by uncalcified joints to allow fronds to bend and reorient under breaking waves in the wave-swept intertidal zone.
   * Notes:
     + 7/7
     + In a perfect world, I would want the function and mechanism to be switched
4. W2130285640
   * Sample: "title": "Foam nest components of the t\u00fangara frog: a cocktail of proteins conferring physical and biological resilience", "abstract": "the foam nests of the tungara frog (engystomops pustulosus) form a biocompatible incubation medium for eggs and sperm while resisting considerable environmental and microbiological assault. we have shown that much of this behaviour can be attributed to a cocktail of six proteins, designated ranaspumins (rsn-1 to rsn-6), which predominate in the foam. these fall into two discernable classes based on sequence analysis and biophysical properties. rsn-2, with an amphiphilic amino acid sequence unlike any hitherto reported, exhibits substantial detergent-like surfactant activity necessary for production of foam, yet is harmless to the membranes of eggs and spermatozoa. a further four (rsn-3 to rsn-6) are lectins, three of which are similar to fucolectins found in teleosts but not previously identified in a land vertebrate, though with a carbohydrate binding specificity different from previously described fucolectins. the sixth, rsn-1, is structurally similar to proteinase inhibitors of the cystatin class, but does not itself appear to exhibit any such activity. the nest foam itself, however, does exhibit potent cystatin activity. rsn-encoding genes are transcribed in many tissues of the adult frogs, but the full cocktail is present only in oviduct glands. combinations of lectins and cystatins have known roles in plants and animals for defence against microbial colonization and insect attack. tungara nest foam displays a novel synergy of selected elements of innate defence plus a specialized surfactant protein, comprising a previously unreported strategy for protection of unattended reproductive stages of animals."
   * Baseline:
     + Organism: Túngara frog
     + Part Of: Oviduct glands
     + Function: to form a biocompatible incubation medium for eggs and sperm
     + Mechanism: a cocktail of six proteins
     + Context: while resisting considerable environmental and microbiological assault
     + Strategy: Túngara frogs form a biocompatible incubation medium for eggs and sperm by producing a cocktail of six proteins in their oviduct glands.
   * New:
     + Organism: Túngara frog
     + Part Of: Oviduct glands
     + Function: to form a biocompatible incubation medium (for sperm and eggs)
     + Mechanism: a cocktail of six proteins
     + Environment: the nests of the túngara frog
     + Context: while resisting considerable environmental and microbiological assault
     + Strategy: Túngara frogs form a biocompatible incubation medium (for eggs and sperm) by producing a cocktail of six proteins in their oviduct glands.
   * Notes:
     + Baseline
       - Correct
         * Organism, Part Of, Function, Mechanism, Context
         * Strategy is missing information.

context

* + - * 6/6
    - New
      * 7/7
      * But missing key information → (for eggs and sperm)

1. W2168114966
   * 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."
   * Baseline:
     + Organism: Solifugae
     + Part Of: Suctorial organ
     + Function: prey capture
     + Mechanism: suction
     + Context: in the wild
     + Strategy: Solifugae use suction to capture prey in the wild
   * New:
     + Organism: Solifugae
     + Part Of: Suctorial organ
     + Function: prey capture
     + Mechanism: suction
     + Environment: in the wild
     + Context: smooth, vertical surfaces
     + Strategy: Solifugae capture prey by suctioning onto smooth, vertical surfaces in the wild.
   * Notes:
     + Baseline
       - Correct
         * Organism, Part Of, Function, Mechanism, Context
         * Mechanism is abstracted from suctorial organ
         * Strategy is missing information.

Part Of

* + - * 6/6
    - New
      * 7/7
      * But, Strategy missing part Of

1. W1589686983
   * 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."
   * Baseline:
     + Organism: Macrotermes michaelseni
     + Part Of: Mound
     + Function: Homeostasis of the mound atmosphere
     + Mechanism: Wind energy
     + Context: Temporal variation in wind speed and wind direction
     + Strategy: The mound of Macrotermes michaelseni is an organ of respiratory gas exchange that is powered by wind energy and maintains homeostasis of the mound atmosphere.
   * New:
     + Organism: Macrotermes michaelseni
     + Part Of: Mound
     + Function: Homeostasis of the mound atmosphere
     + Mechanism: Wind energy
     + Environment: inside the mound
     + Context: Temporal variation in wind speed and wind direction
     + Strategy: The mound of Macrotermes michaelseni is an organ of respiratory gas exchange that is that uses wind energy to maintain homeostasis of the mound atmosphere.
   * Notes:
     + Baseline
       - Correct
         * Organism, Part Of, Function, Mechanism, Context
         * Strategy is missing information

Context

* + - * + Also it adds information that is not part of the main elements extracted.
      * 6/6
    - New
      * 7/7
      * Not much change

1. W1589686983
   * 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."
   * Baseline:
     + Organism: Hookworm
     + Part Of: brush border membrane
     + Function: digest hemoglobin
     + Mechanism: aspartic proteases, cysteine proteases, and metalloproteases
     + Context: intestinal brush border membrane
     + Strategy: Hookworms digest hemoglobin by using aspartic proteases, cysteine proteases, and metalloproteases in their intestinal brush border membrane.
   * New:
     + Organism: Hookworm
     + Part Of: digestive system
     + Function: digest hemoglobin
     + Mechanism: aspartic proteases, cysteine proteases, and metalloproteases
     + Environment: blood-feeding pathogens
     + Context: intestinal brush border membrane
     + Strategy: Hookworms digest hemoglobin by aspartic proteases, cysteine proteases, and metalloproteases in their intestinal brush border membrane.
   * Notes:
     + Baseline
     + Correct
       - Organism
       - Part Of
       - Function
       - Mechanism
       - Strategy is missing.
     + Incorrect
       - Context → not sure, but could be → blood-feeding pathogens
     + ⅚
     + New
     + 5/7
     + Environment and Context should be switched.
2. W2052657884
   * 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."
   * Baseline:
     + Organism: anemones, wormlike invertebrates, tube feet of echinoderms, mammalian and turtle penises, feet of burrowing bivalves and snails, legs of spiders
     + Part Of: fluid-filled cavities
     + Function: support, movement, muscular antagonism, and the amplification of the force and displacement of muscle contraction
     + Mechanism: internal pressure
     + Context: animals and animal structures
     + Strategy: animals rely on hydrostatic skeletons for support, movement, muscular antagonism, and the amplification of the force and displacement of muscle contraction by using internal pressure to control the various dimensions
   * New:
     + Organism: anemones, wormlike invertebrates, tube feet of echinoderms, mammalian and turtle penises, feet of burrowing bivalves and snails, legs of spiders
     + Part Of:
     + Function: support, movement, muscular antagonism, and the amplification of the force and displacement of muscle contraction
     + Mechanism: internal pressure
     + Environment:
     + Context: contraction of muscle
     + Strategy: animals rely on hydrostatic skeletons for support, movement, muscular antagonism, and the amplification of the force and displacement of muscle contraction by using internal pressure to control the various dimensions
   * Notes:
     + Baseline
     + Correct
       - Organism is technically correct, but it should be more general → animals
       - Function
       - Mechanism
       - Part Of is technically Correct, but it should be more general → fluid-filled cavities of the hydrostatic skeleton → hydrostatic skeleton
       - Context
       - Strategy abstracted is good, but it is not consistent with what is abstracted.
     + 6/6
     + New
     + 4/7
     + Context → animals and animal structures
     + Environmet → earth
     + Part Of → hydrostatic skeleton
3. W2005779387
   * 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."
   * Baseline:
     + Organism: pearly nautilus
     + Part Of: shell
     + Function: support the weight of the shell
     + Mechanism: having more or less liquid inside the chambers of the shell
     + Context: in an adult animal
     + Strategy: pearly nautilus support the weight of the shell by having more or less liquid inside the chambers of the shell.
   * New:
     + Organism: nautilus
     + Part Of: shell
     + Function: support the weight of the shell
     + Mechanism: having more or less liquid inside the chambers of the shell
     + Environment: in sea water
     + Context: when freshly caught
     + Strategy: Nautilus support the weight of the shell by having more or less liquid inside the chambers of the shell when freshly caught in sea water
   * Notes:
     + Baseline
     + Correct
       - Organism, Function, Mechanism, Part Of
       - Strategy is missing information.
         * Context
     + Incorrect
       - Context → was close to neutral buoyancy
     + ⅚
     + New
     + 7/7
     + Context could also be was close to neutral buoyancy
4. 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."
   * Baseline:
     + Organism: temperate deciduous trees
     + Part Of: leaf
     + Function: improve canopy performancel
     + Mechanism: plasticity in tree leaf form
     + Context: arboretum-grown trees
     + Strategy: Temperate deciduous trees improve canopy performance by plasticity in tree leaf form.
   * Baseline:
     + Organism: temperate deciduous trees
     + Part Of: leaf
     + Function: improve canopy performancel
     + Mechanism: intracanopy plasticity
     + Environment: arboretum
     + Context: tree leaf form
     + Strategy: Temperate deciduous trees improve canopy performance by plasticity in tree leaf form.
   * Notes:
     + Baseline
       - Correct
         * Organism, Function, Mechanism, Part Of
         * Strategy is missing information.

Context

* + - * Incorrect
        + Context → whole-plant function and potentially of forest understory ecology
        + Strategy should be if perfect world→ plasticity in tree leaf form improves canopy performance in Temperate deciduous trees.
      * 5/6
    - New
      * 7/7
      * Context could be whole-plant function and potentially of forest understory ecology

1. 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."
   * Baseline:
     + Organism: baobab tree
     + Part Of: wood
     + Function: support
     + Mechanism: large, water-filled stems
     + Context: water storage
     + Strategy: The large, water-filled stems of baobab trees support the tree by serving as a water storage mechanism.
   * New:
     + Organism: baobab tree
     + Part Of: stem
     + Function: support
     + Mechanism: large, water-filled stems
     + Environment: Madagascar
     + Context: water storage
     + Strategy: Baobab trees support themselves with large, water-filled stems that store water.
   * Notes:
     + Baseline
     + Correct
       - Organism, Function, Mechanism, Context
       - Strategy is missing information.
         * Context
     + Incorrect
       - Part Of → stems
     + 5/6
     + But, It probably should be
       - The large, water-filled stems of baobab trees support the tree with mechanical stability rather than serving as a water storage mechanism.
     + New
       - 7/7
2. 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."
   * Baseline:
     + Organism: Bromeliaceae
     + Part Of: leaf epidermis
     + Function: water repellency
     + Mechanism: dense layer of overlapping, stellate or peltate trichomes
     + Context: majority of cases
     + Strategy: the foliar trichome in bromeliaceae provides water repellency by creating a dense layer of overlapping, stellate or peltate trichomes on the leaf epidermis.
   * New:
     + Organism: Bromeliaceae
     + Part Of: leaf epidermis
     + Function: water repellency
     + Mechanism: dense layer of overlapping, stellate or peltate trichomes
     + Environment: on the leaf epidermis
     + Context: majority of cases
     + Strategy: the foliar trichome in bromeliaceae provides water repellency by creating a dense layer of overlapping, stellate or peltate trichomes on the leaf epidermis.
   * Notes:
     + Baseline
       - Correct
         * Organism, Function, Mechanism, Part Of
         * Strategy is missing information → Context, added extra info
       - Incorrect
         * Context → an important ancestral function
       - ⅚
     + New
       - 6/7
       - Context → an important ancestral function
3. W2127657288
   * 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."
   * Baseline:
     + Organism: tropical montane and pre-montane cloud forest plants
     + Part Of: leaves
     + Function: improve plant water status
     + Mechanism: foliar water uptake
     + Context: 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.
   * New:
     + Organism: plants
     + Part Of: leaves
     + Function: improve plant water status
     + Mechanism: foliar water uptake
     + Environment: tropical montane and pre-montane cloud forests
     + Context: 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.
   * Notes:
     + Baseline
       - Correct
         * Organism, Function, Mechanism, Part Of, Context
         * Strategy is missing information

Part Of

* + - * 6/6
    - New
      * 7/7
      * But, organism could be more specific

1. W2024134236
   * Sample: "title": "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."
   * Output:
     + Organism: Thorny devil and Texas horned lizard
     + Part Of: Scale hinge
     + Function: capture, transport, and drink water
     + Mechanism: semi-tubular hinge-joint channels
     + Context: interscalar spaces on their skin's surface
     + Strategy: Thorny devils and Texas horned lizards capture, transport, and drink water by using semi-tubular hinge-joint channels to move water through interscalar spaces on their skin's surface to their mouth.
   * New:
     + Organism: Thorny devil and Texas horned lizard
     + Part Of: Scale hinge
     + Function: capture, transport, and drink water
     + Mechanism: semi-tubular hinge-joint channels
     + Environment: desert
     + Context: interscalar spaces
     + Strategy: Thorny devil and Texas horned lizard use semi-tubular hinge-joint channels to capture, transport, and drink water from sporadic rainfall in the desert.
   * Notes:
     + Baseline
       - Correct
         * Organism, Function, Mechanism, Part Of, Context
         * Context needs to their mouth however
         * Strategy is missing information

Part Of

* + - * 6/6
    - New
      * 7/7

1. W2075613570
   * Sample: "title": "Function of spiral grain in trees", "abstract": "through spiral grain, conduits for sap lead from each root to all branches. this uniform distribution of sap is indicated by the paths of vessels and tracheids, and has been proven experimentally by means of dyed sap injected into the base of stems or taken up by roots. trees receiving water only from roots at one side of the root collar nevertheless stay green and continue growing. spiral grain in bark distributes food from each branch to other flanks of the stem and to most roots. experimental interruptions of the sap and food conduits caused the cambial zone to reorient new conduit cells in new directions, bypassing the interruption. in particular, spiral grooves cut into the stem surface caused spiral grain. the new cells reorient through division and growth. although spiral grain is largely under genetic control, trees appear to have a spiral grain especially where needed for distribution of water when root spheres are dry at one side. compared with straight-grained trees, spiral-grained stems and branches bend and twist more when exposed to strong wind, in this way offering less wind resistance and being less likely to break. through the bending and twisting, snow slides down from branches rather than breaking them, but the main function of spiral grain is the uniform distribution of supplies from each root to all branches, and from each branch to many roots."
   * Baseline:
     + Organism: trees
     + Part Of: stem and bark
     + Function: uniform distribution of supplies
     + Mechanism: spiral grain
     + Context: from each root to all branches and from each branch to many roots
     + Strategy: trees distribute supplies evenly by spiral grain from each root to all branches and from each branch to many roots
   * New:
     + Organism: trees
     + Part Of: stem and bark
     + Function: uniform distribution of supplies
     + Mechanism: spiral grain
     + Environment: in trees
     + Context: from each root to all branches and from each branch to many roots
     + Strategy: trees have a spiral grain in their stem and bark in order to have a uniform distribution of supplies from each root to all branches and from each branch to many roots.
   * Notes:
     + Baseline
       - Correct
         * Organism, Function, Mechanism, Part Of, Context
         * Strategy is missing

Part Of

* + - * 6/6
    - New
      * 7/7

1. W2071362227
   * Sample: "title": "Bacterial Recognition of Mineral Surfaces: Nanoscale Interactions Between Shewanella and \u03b1-FeOOH", "abstract": "force microscopy has been used to quantitatively measure the infinitesimal forces that characterize interactions between shewanella oneidensis (a dissimilatory metal-reducing bacterium) and goethite (alpha-feooh), both commonly found in earth near-surface environments. force measurements with subnanonewton resolution were made in real time with living cells under aerobic and anaerobic solutions as a function of the distance, in nanometers, between a cell and the mineral surface. energy values [in attojoules (10(-18) joules)] derived from these measurements show that the affinity between s. oneidensis and goethite rapidly increases by two to five times under anaerobic conditions in which electron transfer from bacterium to mineral is expected. specific signatures in the force curves suggest that a 150-kilodalton putative iron reductase is mobilized within the outer membrane of s. oneidensis and specifically interacts with the goethite surface to facilitate the electron transfer process."
   * Baseline:
     + Organism: Shewanella oneidensis
     + Part Of: Outer membrane
     + Function: facilitate electron transfer
     + Mechanism: force measurements
     + Context: real time with living cells under aerobic and anaerobic solutions
     + Strategy: Shewanella oneidensis facilitates electron transfer by force measurements with living cells under aerobic and anaerobic solutions.
   * New:
     + Organism: Shewanella oneidensis
     + Part Of: Outer membrane
     + Function: facilitate electron transfer
     + Mechanism: force measurements
     + Environment: real time, living cells
     + Context: subnanonewton resolution
     + Strategy: Shewanella oneidensis facilitates electron transfer by force measurements with subnanonewton resolution in real time with living cells.
   * Notes:
     + Baseline
       - Correct
         * Organism, Function, Part Of, Context
       - Incorrect
         * Mechanism → putative iron reductase is mobilized
         * Strategy is also missing information

Part Of

* + - * 4/6
    - New
      * 5/7
      * Mechanism → putative iron reductase is mobilized
      * Strategy → putative iron reductase is mobilized within the outer membrane of s. oneidensis and specifically interacts with the goethite surface to facilitate the electron transfer process

1. W1994029841
   * Sample: "title": "Overcoming the brittleness of glass through bio-inspiration and micro-architecture", "abstract": "highly mineralized natural materials such as teeth or mollusk shells boast unusual combinations of stiffness, strength and toughness currently unmatched by engineering materials. while high mineral contents provide stiffness and hardness, these materials also contain weaker interfaces with intricate architectures, which can channel propagating cracks into toughening configurations. here we report the implementation of these features into glass, using a laser engraving technique. three-dimensional arrays of laser-generated microcracks can deflect and guide larger incoming cracks, following the concept of 'stamp holes'. jigsaw-like interfaces, infiltrated with polyurethane, furthermore channel cracks into interlocking configurations and pullout mechanisms, significantly enhancing energy dissipation and toughness. compared with standard glass, which has no microstructure and is brittle, our bio-inspired glass displays built-in mechanisms that make it more deformable and 200 times tougher. this bio-inspired approach, based on carefully architectured interfaces, provides a new pathway to toughening glasses, ceramics or other hard and brittle materials."
   * Baseline:
     + Organism: glass
     + Part Of: microstructure
     + Function: make glass more deformable and tougher
     + Mechanism: three-dimensional arrays of laser-generated microcracks
     + Context: brittle materials
     + Strategy: make glass more deformable and tougher by creating three-dimensional arrays of laser-generated microcracks
   * New:
     + Organism:
     + Part Of:
     + Function: make glass more deformable and tougher
     + Mechanism: three-dimensional arrays of laser-generated microcracks
     + Environment:
     + Context: laser engraving technique
     + Strategy: make glass more deformable and tougher by creating three-dimensional arrays of laser-generated microcracks
   * Notes:
     + Baseline
       - Correct
         * Organism, Function, Mechanism, Part Of, Context
         * Strategy is missing information

Part Of

Context

* + - * 6/6
    - New
      * Not technically wrong
      * Glass is not an organism
      * Microstructure is not part of
      * There is no environment mentioned in the abstract
      * 4/4

1. W2051302904
   * Sample: "title": "Extreme impact and cavitation forces of a biological hammer: strike forces of the peacock mantis shrimp Odontodactylus scyllarus.", "abstract": "summary - mantis shrimp are renowned for their unusual method of breaking shells with\nbrief, powerful strikes of their raptorial appendages. due to the extreme\nspeeds of these strikes underwater, cavitation occurs between their appendages\nand hard-shelled prey. here we examine the magnitude and relative contribution\nof the impact and cavitation forces generated by the peacock mantis shrimp\n odontodactylus scyllarus . we present the surprising finding that each\nstrike generates two brief, high-amplitude force peaks, typically\n390\u2013480 \u03bcs apart. based on high-speed imaging, force measurements and\nacoustic analyses, it is evident that the first force peak is caused by the\nlimb9s impact and the second force peak is due to the collapse of cavitation\nbubbles. peak limb impact forces range from 400 to 1501 n and peak cavitation\nforces reach 504 n. despite their small size, can\ngenerate impact forces thousands of times their body weight. furthermore, on\naverage, cavitation peak forces are 50% of the limb9s impact force, although\ncavitation forces may exceed the limb impact forces by up to 280%. the rapid\nsuccession of high peak forces used by mantis shrimp suggests that mantis\nshrimp use a potent combination of cavitation forces and extraordinarily high\nimpact forces to fracture shells. the stomatopod9s hammer is fundamentally\ndifferent from typical shell-crushing mechanisms such as fish jaws and lobster\nclaws, and may have played an important and as yet unexamined role in the\nevolution of shell form."
   * Baseline:
     + Organism: peacock mantis shrimp
     + Part Of: raptorial appendages
     + Function: break shells
     + Mechanism: striking with raptorial appendages
     + Context: underwater
     + Strategy: The peacock mantis shrimp breaks shells by striking with raptorial appendages underwater, which generates two brief, high-amplitude force peaks.
   * New:
     + Organism: peacock mantis shrimp
     + Part Of: appendages
     + Function: break shells
     + Mechanism: striking with raptorial appendages
     + Environment: with hard-shelled prey
     + Context: underwater
     + Strategy: The peacock mantis shrimp breaks shells by striking with raptorial appendages underwater with hard-shelled prey
   * Notes:
     + Baseline
       - Correct
         * Organism, Function, Mechanism, Part Of, Context
         * Strategy adds extra information
       - 6/6
     + New
       - 5/7
       - Environment should be switched with context, not necessarily vice versa.
       - Also “with hard-shelled prey” should be changed to “on hard-shelled prey”. This distinction mattersf for the output startegy

Kingfisher Example:

Text: Repeated evolution of drag reduction at the air–water interface in diving kingfishers. Piscivorous birds have a unique suite of adaptations to forage under the water. One method aerial birds use to catch fish is the plunge dive, wherein birds dive from a height to overcome drag and buoyancy in the water. The kingfishers are a well-known clade that contains both terrestrially foraging and plunge-diving species, allowing us to test for morphological and per- formance differences between foraging guilds in an evolutionary context. Diving species have narrower bills in the dorsoventral and sagittal plane and longer bills (size-corrected data, n 1⁄4 71 species, p , 0.01 for all). Although these differences are confounded by phylogeny (phylogenetically corrected ANOVA for dorsoventral p1⁄40.26 and length p1⁄40.14), beak width in the sagittal plane remains statistically different ( p , 0.001). We examined the effects of beak morphology on plunge performance by phys- ically simulating dives with three-dimensional printed models of beaks coupled with an accelerometer, and through computational fluid dynamics (CFD). From physically simulated dives of bill models, diving species have lower peak decelerations, and thus enter the water more quickly, than terres- trial and mixed-foraging species (ANOVA p 1⁄4 0.002), and this result remains unaffected by phylogeny (phylogenetically corrected ANOVA p1⁄40.05). CFD analyses confirm these trends in three representative species and indi- cate that the morphology between the beak and head is a key site for reducing drag in aquatic species.

Baseline:

* Organism: kingfishers
* Part Of: beak
* Function: to catch fish (should be reduce drag)
* Mechanism: diving from a height, narrower bills in the dorsoventral and sagittal plane
* Context: in water
* Strategy: Diving kingfishers catch fish by diving from a height and having narrower bills in the dorsoventral and sagittal plane.

New:

* Organism: kingfishers
* Part Of: beak
* Function: to catch fish (should be reduce drag)
* Mechanism: diving from a height
* Environment: under the water
* Context: aerial birds
* Strategy: kingfishers catch fish by diving from a height, and they have narrower bills in the dorsoventral and sagittal plane and longer bills to help with this.
* Missed a part of the mechanism and “reduce drag”

**Conclusion**

Baseline

|  |  | Organism | Part Of | Function | Context | Mechanism | Strategy |  | DocLen |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. | W2130285640 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
| 2. | W2168114966 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
| 3. | W1589686983 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
| 4. | W1589686983 | 1 | 1 | 1 | 0 | 1 | 1 | 5/6 |  |
| 5. | W2052657884 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
| 6. | W2005779387 | 1 | 1 | 1 | 0 | 1 | 1 | 5/6 |  |
| 7. | W2152749757 | 1 | 1 | 1 | 0 | 1 | 1 | 5/6 |  |
| 8. | W2025490238 | 1 | 0 | 1 | 1 | 1 | 1 | 5/6 |  |
| 9. | W2112209842 | 1 | 1 | 1 | 0 | 1 | 1 | 5/6 |  |
| 10. | W2127657288 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
| 11. | W2024134236 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
| 12. | W2075613570 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
| 13. | W2071362227 | 1 | 1 | 1 | 1 | 0 | 0 | 4/6 |  |
| 14. | W1994029841 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
| 15. | W2051302904 | 1 | 1 | 1 | 1 | 1 | 1 | 6/6 |  |
|  |  | 15/15 | 14/15 | 15/15 | 11/15 | 14/15 | 14/15 |  |  |

New Samples tried on New prompt

|  |  | Org. | Part. | Func. | Context | Mech. | Env. | Strat. |  | DocLen |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. | W2130285640 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 4/7 |  |
| 2. | W2151557512 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 - prev 4/7 |  |
| 3. | W2160542693 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |

New

|  |  | Org. | Part. | Func. | Context | Mech. | Env. | Strat. |  | DocLen |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. | W2130285640 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 2. | W2168114966 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 3. | W1589686983 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 4. | W1589686983 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 5/7 |  |
| 5. | W2052657884 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 4/7 |  |
| 6. | W2005779387 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 7. | W2152749757 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 8. | W2025490238 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 9. | W2112209842 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 6/7 |  |
| 10. | W2127657288 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 11. | W2024134236 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 12. | W2075613570 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7/7 |  |
| 13. | W2071362227 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 5/7 |  |
| 14. | W1994029841 | - | - | 1 | 1 | 1 | - | 1 | 4/4 |  |
| 15. | W2051302904 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 5/7 |  |
|  |  | 14/14 | 13/14 | 15/15 | 12/15 | 14/15 | 12/15 | 13/15 |  |  |

Note on Sample 14: W1994029841

* This sample is about making glass harder by laser engravings. The reason why only have 4/4 outputs on the new prompt, and 6/6 on the old prompt is because I believe that for our purposes the glass can be treated as an organism or not.
* (Baseline) First Case → Glass is an organism
  + Organism: glass
  + Part Of: microstructure
  + Function: make glass more deformable and tougher
  + Mechanism: three-dimensional arrays of laser-generated microcracks
  + Context: brittle materials
  + Strategy: make glass more deformable and tougher by creating three-dimensional arrays of laser-generated microcracks
* (New) Second Case → Glass is not an organism
  + Organism:
  + Part Of:
  + Function: make glass more deformable and tougher
  + Mechanism: three-dimensional arrays of laser-generated microcracks
  + Environment:
  + Context: laser engraving technique
  + Strategy: make glass more deformable and tougher by creating three-dimensional arrays of laser-generated microcracks
* As you can see, if the glass is treated as an organism, it must have a part of it being used for a function. GPT picks this up.
* If it is not treated as an organism, it cannot have a part Of it being used. Also, there is no specific environment mentioned in the prompt. GPT recognizes this as well.

Analysis on Elements of Biological Strategies Output

* Organism
  + Baseline → 15/15
  + New → 14/14
  + Same performance
* Part Of
  + Baseline → 14/15
  + New → 13/14
  + Same performance
* Function
  + Baseline → 15/15
  + New → 15/15
  + Same performance
* Context
  + Baseline → 11/15
  + New → 12/15
  + Better performance
* Mechanism
  + Baseline → 14/15
  + New → 14/15
  + Same performance
* Environment
  + New → 12/15
* Strategy
  + Baseline → 14/15
  + New → 13/15
  + Worse performance

Conclusion

* It seems that this prompt has not changed the performance much.
* It does get the context slightly more accurate, but it gets the summary slightly worse.
* All in all, we have to try with more samples or a different prompt.

Why is GPT-3 getting things wrong?

Baseline

* W1589686983
  + Context
    - intestinal brush border membrane
    - could be → blood-feeding pathogens

New

* W2005539166
  + Mechanism
    - polaroid filter drums
    - GPT gets the mechanism of the researchers performing the study
    - The correct mechanism is found in the first sentence
  + Context
    - rotating around free-moving animals
    - GPT gets the context of the researchers performing the study
    - The correct context is found in the last
  + Strategy
    - Wrong mechanism → wrong strategy
* W2130285640
  + Function
    - to form a biocompatible incubation medium → to form a biocompatible incubation medium (for sperm and eggs)
    - Not wrong, but cut short
* W1589686983
  + Environment and context should be switched
    - Environment: blood-feeding pathogens
    - Context: intestinal brush border membrane
* W2052657884

Possible new additions

* Status
* Who is it affecting