assignment_14

May 1, 2020

1 Assignment 14

Find your favorite news source and grab the article text.

1. Show the most common words in the article.
2. Show the most common words under a part of speech. (i.e. NOUN: {'Bob':12, 'Alice':4,})
3. Find a subject/object relationship through the dependency parser in any sentence.
4. Show the most common Entities and their types.
5. Find Entites and their dependency (hint: entity.root.head)
6. Find the most similar words in the article

```
[105]: import spacy
       from collections import Counter
       import unicodedata
```

```
[66]: processor = spacy.load('en')
```

```
[117]: txt = """
```

The Universe, as we see it today, sure is full of "stuff." Everything we see, feel, and interact with is made of subatomic particles at the most fundamental level, and they've assembled into large structures - humans, planets, stars, galaxies, and galaxy clusters - over the Universe's history. They all obey the same laws of physics, and exist in the context of the same spacetime that everything occupies. All of those things that we see and experience in the Universe today have only been around for a finite amount of time. The Universe didn't always have galaxies, stars, or atoms, and so they must have arisen at some point. But what did they come from? While the obvious answer might seem to be "something," that's not necessarily true; they may have arisen from nothing. What does "nothing" mean to a scientist in that context? Depending on who you ask, you might get one of four different answers. Here's what they all mean. 1.) A condition where the raw ingredients to create your "something" didn't exist. You can't have galaxies, stars, planets, or humans without the particles necessary to build them out of. Everything we know of and interact with is made of subatomic matter particles; those are the raw ingredients that our Universe as we know it is built out of. If you start with a matter-filled Universe, we understand how it can expand, cool, and gravitate to lead to the Universe as we know it today. We know how stars live-and-die, leading to the heavy elements that enable the creation of low-mass stars, rocky planets, organic molecules, and eventually, the possibility of life. But how did we wind up with a matter-filled Universe, instead of one with equal amounts of matter and antimatter? That's the first scientific meaning of getting something from nothing. It's also one of the biggest puzzles in physics: if the laws of physics are such that we can only create matter and antimatter in equal amounts, how did we wind up with a Universe where every structure we see is made of matter and not antimatter? Every planet, star, and galaxy we've ever seen is known to be made of matter and not antimatter. So how, then, did we create an excess of these necessary raw ingredients if the Universe wasn't born with one? This is what is meant when you hear that the matter in our Universe arose from nothing. The origin of the matter-antimatter asymmetry - a puzzle known in the physics community as baryogenesis - is one of the greatest unsolved problems in physics today. Many ideas and mechanisms have been proposed and are theoretically plausible, but we do not yet know the answer. We don't know why there's something (more matter than antimatter) instead of nothing (equal amounts) at all. 2.) Nothingness is the void of empty space. Perhaps you prefer a definition of nothing that contains literally "no things" in it at all. If you follow that line of thinking, then the first definition is inadequate: it clearly contains "something." In order to achieve nothingness, you'll have to get rid of every fundamental constituent of matter. Every quantum of radiation has to go. Every particle and antiparticle, from the ghostly neutrino to whatever dark matter is, must be removed. If you could somehow remove them all - each and every one - you could ensure that the only thing that was left behind was empty space itself. With no particles or antiparticles, no matter or radiation, no identifiable

And, perhaps most importantly, the zero-point energy of space is still there,
↪and it's still at its current, positive, non-zero value. Today, this
↪manifests itself as dark energy; before the Big Bang, this manifested in the
↪form of cosmic inflation, whose end gave rise to the entire Universe. This
↪is where the phrase, "a Universe from nothing" comes from. Even without
↪matter or radiation of any type, this form of "nothing" still leads to a
↪fascinating Universe. 3.) Nothingness as the ideal lowest-energy state
↪possible for spacetime. Right now, our Universe has a zero-point energy, or
↪an energy inherent to space itself, that's at a positive, non-zero value. We
↪do not know whether this is the true "ground state" of the Universe, i.e.,
↪the lowest energy state possible, or whether we can still go lower. It's
↪still possible that we're in a false vacuum state, and that the true vacuum,
↪or the true lowest-energy state, will either be closer to zero or may
↪actually go all the way to zero (or below). To transition there from our
↪current state would likely lead to a catastrophe that forever altered the
↪Universe: a nightmare scenario known as vacuum decay. This would result in
↪many unsavory things for our existence. The photon would become a massive
↪particle, the electromagnetic force would only travel short ranges, and
↪practically all the sunlight our star emits would fail to make its way to
↪Earth. But in terms of imagining this as a state of true nothingness, it's
↪perhaps the ideal scenario that still keeps the laws of physics intact.
↪(Although some of the rules would be different.) If you were able to reach
↪the true ground state of the Universe - whatever that state may look like -
↪and expelled from your Universe all the matter, energy, radiation, spacetime
↪curvature and ripples, etc., you'd be left with the ultimate idea of
↪"physical nothingness." You'd at least still have a stage for the Universe
↪to play out on, but there would be no players. There would be no cast, no
↪script, and no scene to your play, but the vast abyss of physical
↪nothingness still provides you with a stage. The cosmic vacuum would be at
↪its absolute minimum, and there would be no way to extract work, energy, or
↪any real particles (or antiparticles) from it. And yet, to some, this still

```
"""
```

```
[118]:  # reomve eol characters from str.
        txt = unicodedata.normalize("NFKD", txt)
        txt = txt.replace('\n', '')
```

```
[119]:  txt = processor(txt)
```

1.1 1. Show the most common words in the article.

```
[120]:  counts = Counter()
        for token in txt:
            if token.is_punct != True:
                counts[token.text.lower()] +=1
        counts.most_common(5)
```

```
[120]:  [('the', 85), ('of', 74), ('and', 39), ('to', 38), ('that', 34)]
```

1.2 2. Show the most common words under a part of speech. (i.e. NOUN: {'Bob':12, 'Alice':4,})

```
[121]:  nouns = [token.text.lower() for token in txt if token.is_stop != True and token.
        ↪is_punct != True and token.pos_ == "NOUN"]
        noun_freq = Counter(nouns)
        nouns_count = noun_freq.most_common(5)
        nouns_count
```

```
[121]:  [('universe', 20),
         ('matter', 13),
         ('space', 11),
         ('energy', 11),
         ('state', 11)]
```

1.3 3. Find a subject/object relationship through the dependency parser in any sentence.

```
[122]:  def pr_tree(word, level):
            if word.is_punct:
                return
            for child in word.lefts:
                pr_tree(child, level+1)
            print('\t'* level + word.text + ' - ' + word.dep_)
            for child in word.rights:
                pr_tree(child, level+1)
```

```
for sentence in txt.sents:
    pr_tree(sentence.root, 0)
    print('----------------------------------------')
```

```
                    The - det
            Universe - nsubj
                    as - mark
                    we - nsubj
            see - advcl
                    it - dobj
                    today - npadvmod
            sure - advmod
is - ROOT
        full - acomp
                of - prep
                        stuff - pobj
----------------------------------------
        Everything - nsubj
                        we - nsubj
                see - relcl
feel - ROOT
        and - cc
        interact - conj
                with - prep
                                is - auxpass
                        made - pobj
                                of - prep
                                        subatomic - amod
                                    particles - pobj
                                        at - prep
                                                the - det
                                                    most -
advmod
                                                fundamental -
amod
                                                level - pobj
        and - cc
                they - nsubj
                've - aux
        assembled - conj
                into - prep
                                large - amod
                        structures - pobj
                                humans - conj
                                        planets - conj
                                                stars - conj
                                                    galaxies - conj
```

```
                                                                and - cc
                                                                    galaxy -
amod
                                                                clusters - conj
                over - prep
                                        the - det
                                Universe - poss
                                        's - case
                        history - pobj
------------------------------------------
        They - nsubj
                all - appos
obey - ROOT
                the - det
                same - amod
        laws - dobj
                of - prep
                        physics - pobj
        and - cc
        exist - conj
                in - prep
                                the - det
                        context - pobj
                                of - prep
                                                the - det
                                                same - amod
                                        spacetime - pobj
                                                that - dobj
                                                everything - nsubj
                                        occupies - relcl
------------------------------------------
        All - nsubj
                of - prep
                                those - det
                        things - pobj
                                        that - dobj
                                        we - nsubj
                                see - relcl
                                        and - cc
                                        experience - conj
                                        in - prep
                                                the - det
                                        Universe - pobj
                                        today - npadvmod
        have - aux
        only - advmod
been - ROOT
        around - advmod
```

6

```
        for - prep
                        a - det
                        finite - compound
                amount - pobj
                        of - prep
                                time - pobj
-------------------------------------------
                The - det
        Universe - nsubj
        did - aux
        n't - neg
        always - advmod
have - ROOT
        galaxies - dobj
                stars - conj
                        or - cc
                        atoms - conj
        and - cc
                so - advmod
                they - nsubj
                must - aux
                have - aux
        arisen - conj
                at - prep
                                some - det
                        point - pobj
-------------------------------------------
        But - cc
        did - aux
        they - nsubj
come - ROOT
                what - pobj
        from - prep
-------------------------------------------
                        While - mark
                                the - det
                                obvious - amod
                        answer - nsubj
                        might - aux
                seem - advcl
                                to - aux
                        be - xcomp
                                something - attr
                that - nsubj
        's - ccomp
                not - neg
                necessarily - advmod
                true - acomp
```

```
        they - nsubj
        may - aux
        have - aux
arisen - ROOT
        from - prep
                nothing - pobj
--------------------------------------------
        What - dobj
        does - aux
        nothing - nsubj
mean - ROOT
        to - prep
                        a - det
                scientist - pobj
                        in - prep
                                        that - det
                        context - pobj
--------------------------------------------
        Depending - prep
                on - prep
                                who - dobj
                                you - nsubj
                        ask - pcomp
        you - nsubj
        might - aux
get - ROOT
        one - dobj
                of - prep
                                four - nummod
                                different - amod
                        answers - pobj
--------------------------------------------
        Here - advmod
's - ROOT
                what - dobj
                they - nsubj
                        all - appos
        mean - ccomp
--------------------------------------------
1 - ROOT
--------------------------------------------
                A - det
        condition - nsubj
                        where - advmod
                                the - det
                                raw - amod
                        ingredients - nsubj
                        to - aux
```

```
                        create - relcl
                                       your - poss
                             something - dobj
            did - aux
            n't - neg
exist - ROOT
--------------------------------------------
            You - nsubj
            ca - aux
            n't - neg
have - ROOT
            galaxies - dobj
                     stars - conj
                             planets - conj
                                      or - cc
                                      humans - conj
                     without - prep
                                      the - det
                             particles - pobj
                                      necessary - amod
                     to - aux
        build - xcomp
                     them - dobj
                     out - prep
                             of - prep
--------------------------------------------
                     Everything - nsubjpass
                                      we - nsubj
                             know - relcl
                                      of - prep
                             and - cc
                             interact - conj
                                      with - prep
                     is - auxpass
        made - ccomp
                     of - prep
                                             subatomic - amod
                                      matter - compound
                             particles - pobj
            those - nsubj
are - ROOT
                     the - det
                     raw - amod
        ingredients - attr
                                      our - poss
                             Universe - nsubjpass
                                             as - mark
                                             we - nsubj

                           9
```

```
                              know - advcl
                    it - nsubjpass
                    is - auxpass
             built - relcl
                              that - pobj
                    out - prep
                              of - prep
------------------------------------------
             If - mark
             you - nsubj
      start - advcl
             with - prep
                              a - det
                                   matter - advmod
                              filled - amod
                    Universe - pobj
      we - nsubj
understand - ROOT
             how - advmod
             it - nsubj
             can - aux
      expand - ccomp
             cool - conj
                    and - cc
                    gravitate - conj
                                   to - aux
                         lead - xcomp
                              to - prep
                                        the - det
                                   Universe - pobj
                                   as - mark
                                   we - nsubj
                              know - advcl
                                   it - dobj
                                   today - npadvmod
------------------------------------------
      We - nsubj
know - ROOT
                    how - advmod
             stars - nsubj
      live - ccomp
             and - cc
             die - conj
             leading - advcl
                    to - prep
                              the - det
                              heavy - amod
                         elements - pobj
```

```
                                                    that - nsubj
                                        enable - relcl
                                                    the - det
                                        creation - dobj
                                                of - prep
low - amod

                                                                        mass -
compound
                                                                stars - pobj

                                                                    planets
- conj
        organic - amod
molecules - conj
        and - cc
                eventually - advmod
                the - det
        possibility - conj
                of - prep
                        life - pobj
------------------------------------------
        But - cc
        how - advmod
        did - aux
        we - nsubj
wind - ROOT
        up - prt
        with - prep
                        a - det
                                matter - advmod
                        filled - amod
                Universe - pobj
                instead - advmod
        of - prep
        one - conj
                with - prep
                                equal - amod
                        amounts - pobj
                                of - prep
                                        matter - pobj
                                        and - cc
                                        antimatter - conj
------------------------------------------
        That - nsubj
's - ROOT
                the - det
                first - amod
                scientific - amod
```

```
        meaning - attr
            of - prep
                    getting - pcomp
                            something - dobj
                            from - prep
                                    nothing - pobj
-------------------------------------------
            It - nsubj
    's - ccomp
            also - advmod
            one - attr
                    of - prep
                                    the - det
                                    biggest - amod
                            puzzles - pobj
                                    in - prep
                                            physics - pobj
            if - mark
                    the - det
            laws - nsubj
                    of - prep
                            physics - pobj
    are - advcl
            such - acomp
                    that - mark
                    we - nsubj
                    can - aux
                    only - advmod
            create - ccomp
                    matter - dobj
                            and - cc
                            antimatter - conj
                    in - prep
                                    equal - amod
                            amounts - pobj
        how - advmod
        did - aux
        we - nsubj
wind - ROOT
        up - prt
        with - prep
                    a - det
            Universe - pobj
                            where - advmod
                                    every - det
                            structure - nsubjpass
                                            we - nsubj
                                    see - relcl
```

```
                                      is - auxpass
                         made - relcl
                                 of - prep
                                       matter - pobj
                                            and - cc
                                                    not - neg
                                       antimatter - conj
------------------------------------------
              Every - det
       planet - nsubjpass
              star - conj
                    and - cc
                    galaxy - conj
                                    we - nsubj
                                    've - aux
                                    ever - advmod
                          seen - ccomp
       is - auxpass
known - ROOT
              to - aux
              be - auxpass
       made - xcomp
              of - prep
                    matter - pobj
                          and - cc
                                   not - neg
                          antimatter - conj
------------------------------------------
       So - advmod
       how - advmod
       then - advmod
       did - aux
       we - nsubj
create - ROOT
              an - det
       excess - dobj
              of - prep
                           these - det
                           necessary - amod
                           raw - amod
                    ingredients - pobj
              if - mark
                    the - det
              Universe - nsubjpass
              was - auxpass
              n't - neg
       born - advcl
              with - prep
```

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```
                               one - pobj
------------------------------------------
        This - nsubj
is - ROOT
                what - nsubjpass
                is - auxpass
        meant - ccomp
                        when - advmod
                        you - nsubj
                hear - advcl
                                that - mark
                                        the - det
                                matter - nsubj
                                        in - prep
                                                our - poss
                                        Universe - pobj
                        arose - ccomp
                                from - prep
                                        nothing - pobj
------------------------------------------
                The - det
        origin - nsubj
                of - prep
                                the - det
                                        matter - compound
                                antimatter - compound
                        asymmetry - pobj
                        a - det
                puzzle - appos
                        known - acl
                                in - prep
                                                the - det
                                                physics - compound
                                        community - pobj
                as - prep
                        baryogenesis - pobj
is - ROOT
        one - attr
                of - prep
                                the - det
                                greatest - amod
                                unsolved - amod
                        problems - pobj
                                in - prep
                                        physics - pobj
                                today - npadvmod
------------------------------------------
                Many - amod
```

```
        ideas - nsubjpass
                and - cc
                mechanisms - conj
        have - aux
        been - auxpass
proposed - ROOT
        and - cc
        are - conj
                        theoretically - advmod
                plausible - acomp
        but - cc
                we - nsubj
                do - aux
                not - neg
                yet - advmod
        know - conj
                        the - det
                answer - dobj
------------------------------------------
        We - nsubj
        do - aux
        n't - neg
know - ROOT
                why - advmod
                there - expl
        's - ccomp
                something - attr
                                more - advmod
                        matter - amod
                                than - prep
                                        antimatter - pobj
                                instead - advmod
                        of - prep
                                nothing - pobj
                                                equal - amod
                                        amounts - appos
                                                at - advmod
                                        all - advmod
------------------------------------------
2 - ROOT
------------------------------------------
        Nothingness - nsubj
is - ROOT
                the - det
        void - attr
                of - prep
                                empty - amod
                        space - pobj


                        15
```

```
--------------------------------------------
        Perhaps - advmod
        you - nsubj
prefer - ROOT
                a - det
        definition - dobj
                of - prep
                        nothing - pobj
                                        that - nsubj
                                contains - relcl
                                        literally - advmod
                                                no - det
                                        things - dobj
                                                in - prep
                                                        it - pobj
                                                        at - advmod
                                        all - advmod
--------------------------------------------
                        If - mark
                        you - nsubj
                follow - advcl
                                that - det
                        line - dobj
                                of - prep
                                        thinking - pobj
                then - advmod
                        the - det
                        first - amod
                definition - nsubj
        is - ccomp
                inadequate - acomp
        it - nsubj
        clearly - advmod
contains - ROOT
        something - dobj
--------------------------------------------
        In - prep
                order - pobj
                                to - aux
                        achieve - acl
                                nothingness - dobj
        you - nsubj
        'll - aux
have - ROOT
                to - aux
                get - auxpass
        rid - xcomp
                of - prep
```

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```
                              every - det
                              fundamental - amod
                        constituent - pobj
                              of - prep
                                    matter - pobj
-------------------------------------------
                  Every - det
        quantum - nsubj
              of - prep
                    radiation - pobj
has - ROOT
              to - aux
        go - xcomp
-------------------------------------------
        Every - det
particle - ROOT
        and - cc
        antiparticle - conj
        from - prep
                    the - det
                    ghostly - amod
              neutrino - pobj
              to - prep
                                    whatever - det
                                    dark - amod
                        matter - nsubjpass
                        is - auxpass
                        must - aux
                        be - auxpass
                    removed - pcomp
-------------------------------------------
                  If - mark
                  you - nsubj
                  could - aux
                  somehow - advmod
        remove - advcl
                  them - dobj
                  all - dobj
                  each - npadvmod
                        and - cc
                              every - det
                    one - conj
        you - nsubj
        could - aux
ensure - ROOT
                  that - mark
                        the - det
                        only - amod
```

```
                  thing - nsubj
                              that - nsubjpass
                              was - auxpass
                      left - relcl
                              behind - advmod
        was - ccomp
                      empty - amod
              space - attr
                      itself - appos
------------------------------------------
      With - prep
                    no - det
              particles - pobj
                    or - cc
                    antiparticles - conj
              no - neg
      matter - advmod
              or - cc
              radiation - conj
                    no - det
                    identifiable - amod
              quanta - conj
                    of - prep
                                  any - det
                          type - pobj
                                  in - prep
                                            your - poss
                                  Universe - pobj
      all - nsubj
                    you - nsubj
                    'd - aux
                    have - aux
              left - relcl
is - ROOT
              the - det
      void - attr
              of - prep
                              empty - amod
                      space - pobj
                              itself - appos
------------------------------------------
      To - prep
              some - pobj
      that - nsubj
's - ROOT
              the - det
              true - amod
              scientific - amod
```

```
        definition - attr
                of - prep
                        nothingness - pobj
--------------------------------------------
        But - cc
                certain - amod
                physical - amod
        entities - nsubj
        still - advmod
remain - ROOT
                even - advmod
        under - prep
                        that - det
                                highly - advmod
                        restrictive - amod
                                and - cc
                                imaginative - conj
                scenario - pobj
--------------------------------------------
                The - det
        laws - nsubj
                of - prep
                        physics - pobj
are - ROOT
        still - advmod
        there - advmod
                which - nsubj
        means - advcl
                        that - mark
                                quantum - compound
                        fields - nsubj
                        still - advmod
                permeate - ccomp
                                the - det
                        Universe - dobj
--------------------------------------------
        That - nsubj
includes - ROOT
                the - det
                electromagnetic - amod
        field - dobj
                        the - det
                        gravitational - amod
                field - conj
                                the - det
                                Higgs - compound
                        field - conj
                                and - cc
```

```
                                                    the - det
                                        fields - conj
                                            arising - acl
                                                    from - prep
                                                                    the - det
                                                                    nuclear - amod
                                                        forces - pobj
------------------------------------------
        Spacetime - nsubj
is - ROOT
        still - advmod
        there - advmod
        governed - advcl
                by - agent
                                    General - compound
                        Relativity - pobj
------------------------------------------
                The - det
                fundamental - amod
        constants - nsubj
are - ROOT
        all - dep
        still - advmod
        in - prep
                place - pobj
                all - advmod
        with - prep
                        the - det
                        same - amod
                values - pobj
                                we - nsubj
                        observe - relcl
                                them - dobj
                                        to - aux
                        have - xcomp
------------------------------------------
        And - cc
                perhaps - advmod
                most - advmod
        importantly - advmod
                the - det
                        zero - nummod
                point - compound
        energy - nsubj
                of - prep
                        space - pobj
is - ROOT
        still - advmod
```

```
        there - advmod
        and - cc
                it - nsubj
        's - conj
                still - advmod
                at - prep
                                its - poss
                                current - amod
                                positive - amod
                                        non - amod
                                zero - nummod
                        value - pobj
------------------------------------------
        Today - npadvmod
        this - nsubj
manifests - ROOT
        itself - dobj
        as - prep
                        dark - amod
                energy - pobj
                before - prep
                                the - det
                                Big - compound
                        Bang - pobj
                this - det
        manifested - advcl
                in - prep
                                the - det
                        form - pobj
                                of - prep
                                                cosmic - amod
                                        inflation - pobj
                                                        whose - poss
                                                end - nsubj
                                        gave - relcl
                                                rise - dobj
                                                to - prep
                                                                the -
det
                                                                entire -
amod
                                                        Universe - pobj
-------------------------------------------
        This - nsubj
is - ROOT
                        the - det
                phrase - nsubj
                                a - det
```

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```
                              Universe - appos
                                    from - prep
                                           nothing - pobj
            comes - ccomp
                              where - pobj
                    from - prep
-------------------------------------------
                    Even - advmod
            without - prep
                    matter - pobj
                              or - cc
                              radiation - conj
                              of - prep
                                              any - det
                                    type - pobj
                    this - det
            form - nsubj
                    of - prep
                              nothing - pobj
            still - advmod
leads - ROOT
            to - prep
                              a - det
                              fascinating - amod
                    Universe - pobj
-------------------------------------------
3 - ROOT
-------------------------------------------
Nothingness - ROOT
            as - prep
                              the - det
                              ideal - amod
                                    lowest - amod
                              energy - compound
                    state - pobj
                              possible - amod
                              for - prep
                                    spacetime - pobj
-------------------------------------------
                              Right - advmod
                    now - advmod
                              our - poss
                    Universe - nsubj
            has - ccomp
                              a - det
                                    zero - nummod
                              point - compound
                    energy - dobj
```

```
                                or - cc
                                        an - det
                                energy - conj
                                        inherent - amod
                                                        to - aux
                                                space - xcomp
                                                        itself - dobj
                that - nsubj
's - ROOT
        at - prep
                        a - det
                        positive - amod
                                non - amod
                        zero - nummod
                value - pobj
------------------------------------------
        We - nsubj
        do - aux
        not - neg
know - ROOT
                whether - mark
                this - nsubj
        is - ccomp
                        the - det
                        true - amod
                        ground - compound
                state - attr
                        of - prep
                                        the - det
                                Universe - pobj
                        i.e. - advmod
                                the - det
                                lowest - amod
                                energy - compound
                        state - nsubj
                possible - acomp
                or - cc
                        whether - mark
                        we - nsubj
                        can - aux
                        still - advmod
                go - conj
                        lower - advmod
------------------------------------------
        It - nsubj
's - ROOT
        still - advmod
        possible - acomp
```

```
            that - mark
            we - nsubj
    're - ccomp
        in - prep
                    a - det
                    false - amod
                    vacuum - compound
              state - pobj
        and - cc
            that - mark
                the - det
                true - amod
            vacuum - nsubj
                or - cc
                        the - det
                        true - amod
                            lowest - amod
                        energy - compound
                state - conj
            will - aux
            either - preconj
      be - conj
            closer - acomp
                to - prep
                    zero - pobj
            or - cc
                may - aux
                actually - advmod
            go - conj
                            all - predet
                            the - det
                        way - npadvmod
                    to - prep
                        zero - pobj
                            or - cc
                            below - conj
------------------------------------------
            To - aux
      transition - csubj
            there - advmod
            from - prep
                    our - poss
                    current - amod
                state - pobj
      would - aux
      likely - advmod
lead - ROOT
      to - prep
```

```
                              a - det
                    catastrophe - pobj
                                    that - nsubj
                                    forever - advmod
                          altered - relcl
                                            the - det
                          Universe - dobj
                                                a - det
                                                nightmare - compound
                                    scenario - appos
                                        known - acl
                                            as - prep
                                                            vacuum -
compound
                                                        decay - pobj
------------------------------------------
        This - nsubj
        would - aux
result - ROOT
        in - prep
                        many - amod
                        unsavory - amod
                things - pobj
                        for - prep
                                        our - poss
                            existence - pobj
------------------------------------------
                        The - det
                photon - nsubj
                would - aux
        become - ccomp
                        a - det
                        massive - amod
                particle - attr
                the - det
                electromagnetic - amod
        force - nsubj
        would - aux
        only - advmod
travel - ROOT
                    short - amod
        ranges - dobj
        and - cc
                        practically - advmod
                all - predet
                the - det
        sunlight - conj
                                our - poss
```

```
                                        star - compound
                          emits - nsubj
                          would - aux
                  fail - relcl
                                  to - aux
                          make - xcomp
                                          its - poss
                          way - dobj
                          to - prep
                                  Earth - pobj
-------------------------------------------
        But - cc
        in - prep
                terms - pobj
                        of - prep
                                imagining - pcomp
                                        this - dobj
                                        as - prep
                                                        a - det
                                        state - pobj
                                                of - prep
                                                        true -
amod
                                                nothingness -
pobj
        it - nsubj
's - ROOT
        perhaps - advmod
                the - det
                ideal - amod
        scenario - attr
                        that - nsubj
                        still - advmod
                keeps - relcl
                                the - det
                        laws - dobj
                                of - prep
                                        physics - pobj
                        intact - oprd
-------------------------------------------
        Although - mark
        some - nsubj
                of - prep
                                the - det
                        rules - pobj
        would - aux
be - ROOT
        different - acomp
```

```
-------------------------------------------
                If - mark
                you - nsubj
        were - advcl
            able - acomp
                            to - aux
                    reach - xcomp
                                the - det
                                true - amod
                                ground - compound
                        state - dobj
                            of - prep
                                            the - det
                                Universe - pobj
                        that - det
                    state - nsubj
                    may - aux
            look - ccomp
                            whatever - pobj
                    like - prep
                    and - cc
                    expelled - conj
                            from - prep
                                        your - poss
                                Universe - pobj
                                all - predet
                                the - det
                            matter - dobj
                                energy - conj
                                    radiation - conj
                                                spacetime -
compound
                                            curvature - conj
                                                and - cc
                                                ripples - conj
                                                etc - conj
        you - nsubjpass
        'd - aux
        be - auxpass
left - ROOT
        with - prep
                        the - det
                        ultimate - amod
                idea - pobj
                        of - prep
                                        physical - amod
                            nothingness - pobj
-------------------------------------------
```

```
        You - nsubj
        'd - aux
                        at - advmod
                least - advmod
        still - advmod
have - ROOT
                a - det
        stage - dobj
                        for - mark
                                the - det
                        Universe - nsubj
                        to - aux
                play - relcl
                        out - prt
                        on - prt
        but - cc
                there - expl
                would - aux
        be - conj
                        no - det
                players - attr
-------------------------------------------
        There - expl
        would - aux
be - ROOT
                no - det
        cast - attr
                        no - det
                script - conj
                        and - cc
                                no - det
                        scene - conj
                                to - prep
                                                your - poss
                                        play - pobj
        but - cc
                        the - det
                        vast - amod
                abyss - nsubj
                        of - prep
                                        physical - amod
                                nothingness - pobj
                still - advmod
        provides - conj
                you - dobj
                with - prep
                                a - det
                        stage - pobj

                                28
```

```
-------------------------------------------
              The - det
              cosmic - amod
       vacuum - nsubj
       would - aux
be - ROOT
       at - prep
                     its - poss
                     absolute - amod
              minimum - pobj
       and - cc
              there - expl
              would - aux
       be - conj
                     no - det
              way - attr
                            to - aux
                     extract - relcl
                            work - dobj
                                   energy - conj
                                        or - cc
                                             any - det
                                             real - amod
                                   particles - conj
                                        or - cc
                                        antiparticles - conj
                            from - prep
                                   it - pobj
-------------------------------------------
       And - cc
       yet - advmod
       to - prep
              some - pobj
       this - nsubj
       still - advmod
has - ROOT
              the - det
       flavor - dobj
              of - prep
                     something - pobj
              because - mark
              space - nsubj
                     time - conj
                     and - cc
                     rules - conj
       are - advcl
              still - advmod
              in - prep
```

```
                           place - pobj
------------------------------------------
4 - ROOT
------------------------------------------
        Nothingness - nsubj
        only - advmod
occurs - ROOT
                when - advmod
                you - nsubj
        remove - advcl
                        the - det
                        entire - amod
                Universe - dobj
                        and - cc
                                the - det
                        laws - conj
                                        that - nsubj
                                govern - relcl
                                        it - dobj
------------------------------------------
        This - nsubj
is - ROOT
                the - det
                        most - advmod
                extreme - amod
        case - attr
                of - prep
                        all - pobj
                        a - det
                case - appos
                                that - nsubj
                        steps - relcl
                                out - prt
                                        of - prep
                                                reality - pobj
                        out - prep
                                of - prep
                                        space - pobj
                                                time - conj
                                                        and - cc
                                                physics - conj
                                                        itself - appos
                                to - aux
                        imagine - acl
                                        a - det
                                        Platonic - amod
                                ideal - dobj
                                        of - prep

                           30
```

```
                                                    nothingness - pobj
-------------------------------------------
        We - nsubj
        can - aux
conceive - ROOT
        of - prep
                removing - pcomp
                        everything - dobj
                                        we - nsubj
                                        can - aux
                                imagine - relcl
                                space - appos
                                        time - conj
                                                and - cc
                                                        the - det
                                                        governing - amod
                                        rules - conj
                                                of - prep
                                                        reality - pobj
-------------------------------------------
                Physicists - nsubj
        have - ccomp
                        no - det
                definition - dobj
                        for - prep
                                anything - pobj
                                        here - advmod
        this - nsubj
is - ROOT
                pure - amod
                philosophical - amod
        nothingness - attr
-------------------------------------------
                In - prep
                                the - det
                        context - pobj
                                of - prep
                                        physics - pobj
                this - nsubj
        creates - ccomp
                        a - det
                problem - dobj
        we - nsubj
        can - aux
        not - neg
make - ROOT
                any - det
        sense - dobj
```

```
                    of - prep
                              this - det
                 sort - pobj
                          of - prep
                                   nothingness - pobj
-------------------------------------------
        We - nsubjpass
        'd - aux
        be - auxpass
compelled - ROOT
                to - aux
        assume - xcomp
                        that - mark
                        there - expl
                is - ccomp
                                such - predet
                                a - det
                        thing - attr
                                as - prep
                                            a - det
                                state - pobj
                                                that - nsubj
                                                can - aux
                                        exist - relcl
                                                outside - advmod
                                                        of - prep
                                                                space -
pobj
and - cc
time - conj
                        and - cc
                                that - det
                        spacetime - conj
                                itself - appos
                                        as - advmod
                                        well - advmod
                                as - cc
                                        the - det
                                rules - conj
                                                that - nsubj
                                        govern - relcl
                                                all - dobj
                                                        of - prep
                                                                the -
det
                                                                physical
- amod
                                                                entities - pobj


                                32
```

```
we - nsubj
                                                                know -
relcl
of - prep
                                    can - aux
                                    then - advmod
                            emerge - relcl
                                    from - prep
                                                this - det
                                                hypothesized - amod
                                                idealized - amod
                                            state - pobj
------------------------------------------
        Unfortunately - advmod
        we - nsubj
have - ROOT
                no - det
        idea - dobj
                if - mark
                        this - det
                line - nsubj
                        of - prep
                                thought - pobj
        has - advcl
                        any - det
                        physical - amod
                meaning - dobj
------------------------------------------
        It - nsubj
's - ROOT
        possible - acomp
                that - mark
                it - nsubj
        's - ccomp
                merely - advmod
                        an - det
                exercise - attr
                        in - prep
                                        our - poss
                                capacity - pobj
                        to - aux
                imagine - xcomp
                        things - dobj
                        outside - advmod
                                of - prep
                                                our - poss
                                                own - amod
                                        reality - pobj
```

```
                                    with - prep
                                            no - det
                              connection - pobj
                                          to - prep
                                            anything - pobj
                                                        that - nsubj
                                                        can - aux
                                                        actually -
advmod
                                                  exist - relcl

------------------------------------------
                   A - det
          number - nsubj
                   of - prep
                            questions - pobj
arise - ROOT
          immediately - advmod
                   when - advmod
                   we - nsubj
                   start - aux
          thinking - advcl
                   along - prep
                                    these - det
                            lines - pobj
                   with - prep
                                    no - det
                                    definitive - amod
                            answers - pobj
------------------------------------------
          They - nsubj
include - ROOT
                   How - advmod
                   does - aux
                   spacetime - nsubj
          emerge - ccomp
                   at - prep
                                    a - det
                                    particular - amod
                            location - pobj
                                    or - cc
                                    instant - conj
                            when - advmod
                            there - expl
                   's - advcl
                                    no - det
                                    such - amod
                            thing - attr
                                    as - prep
```

```
                                          space - pobj
                        for - prep
                                location - pobj
                        or - cc
                        time - conj
                                    for - prep
                                            instant - pobj
-------------------------------------------
        Can - aux
        we - nsubj
        truly - advmod
imagine - ROOT
                something - nsubj
        being - ccomp
                outside - advmod
                                    the - det
                        Universe - pobj
                        if - mark
                        we - nsubj
                        do - aux
                        n't - neg
                have - advcl
                        space - dobj
                        or - cc
                        having - conj
                                            a - det
                                beginning - dobj
                                        if - mark
                                        we - nsubj
                                        do - aux
                                        n't - neg
                                have - advcl
                                        time - dobj
-------------------------------------------
        From - prep
        where - advmod
        would - aux
                the - det
        rules - nsubj
                governing - acl
                        particles - dobj
                and - cc
                        their - poss
                interactions - conj
arise - ROOT
-------------------------------------------
                This - det
                final - amod
```

```
        definition - nsubj
                of - prep
                        nothing - pobj
                        while - mark
                        it - nsubj
                        certainly - advmod
                feels - advcl
                                the - det
                                        most - advmod
                                philosophically - advmod
                        satisfying - attr
        may - aux
        not - neg
have - ROOT
                a - det
        meaning - dobj
                at - advmod
        all - advmod
------------------------------------------
        It - nsubj
        could - aux
        just - advmod
be - ROOT
                a - det
                logical - amod
        construct - attr
                borne - acl
                        out - prep
                                of - prep
                                        our - poss
                                        inadequate - amod
                                        human - amod
                                intuition - pobj
------------------------------------------
                When - advmod
                scientists - nsubj
        talk - advcl
                about - prep
                        nothing - pobj
        they - nsubj
        often - advmod
talk - ROOT
        past - prep
                one - pobj
                        another - det
        thinking - advcl
                        that - mark
                                their - poss
```

```
                        definition - nsubj
                                of - prep
                                        nothing - pobj
                is - ccomp
                                the - det
                                only - amod
                        one - attr
                                        that - nsubj
                                's - relcl
                                        valid - acomp
------------------------------------------
                But - cc
                there - expl
        is - ccomp
                        no - det
                consensus - attr
                        here - advmod
        language - nsubj
is - ROOT
        ambiguous - acomp
        and - cc
                        the - det
                concept - nsubj
                        of - prep
                                nothingness - pobj
        means - conj
                        different - amod
                things - dobj
                to - prep
                        people - pobj
                                in - prep
                                                different - amod
                                        contexts - pobj
------------------------------------------
        Something - nsubj
                from - prep
                        nothing - pobj
        can - aux
be - ROOT
                a - det
        situation - attr
                        where - advmod
                        something - nsubj
                        fundamentally - advmod
                arises - relcl
                                where - advmod
                                it - nsubj
                        was - ccomp
```

```
                                        n't - neg
                                        there - advmod
                                        before - advmod
              but - cc
                                not - neg
                    everyone - nsubj
                    will - aux
          agree - conj
                                that - mark
                                nothing - nsubj
                    is - ccomp
                                        it - nsubj
                                arose - ccomp
                                                    what - pobj
                                from - prep
------------------------------------------
          Each - nsubj
                    of - prep
                                        the - det
                                        four - nummod
                            definitions - pobj
is - ROOT
          correct - acomp
          in - prep
                                its - poss
                                own - amod
                    way - pobj
          but - cc
                                what - nsubj
                    's - csubj
                                        most - advmod
                                important - acomp
          is - conj
                    understanding - acomp
                                        what - dobj
                                                the - det
                                        speaker - nsubj
                                means - ccomp
                                                    when - advmod
                                                    they - nsubj
                                                    're - aux
                                        talking - advcl
                                                    about - prep
                                                                their - poss
                                                                particular - amod
                                                        form - pobj
                                                            of - prep
                                                                    nothingness -
```

```
pobj
-------------------------------------------
                Each - det
        definition - nsubj
has - ROOT
                its - poss
                own - amod
        scope - dobj
                and - cc
                range - conj
                of - prep
                        validity - pobj
        with - prep
                applications - pobj
                        to - prep
                                        a - det
                                        wide - amod
                                range - pobj
                                        of - prep
                                                        particular - amod
                                                        physical - amod
                                                problems - pobj
                                        from - prep
                                                        the - det
                                                origin - pobj
                                                        of - prep
                                                                matter - pobj
                                                to - prep
                                                        dark - amod
                                                energy - pobj
                                                to - prep
                                                        cosmic - amod
                                                inflation - pobj
                                                to - prep
                                                        the - det
                                                                zero -
nummod
                                                        point - compound
                                                energy - pobj
                                                        of - prep
                                                                space -
pobj
itself - appos
-------------------------------------------
                But - cc
                        these - det
                concepts - nsubj
        have - ccomp
```

```
                            a - det
                 drawback - dobj
                            as - advmod
                 well - advmod
         they - nsubj
're - ROOT
         all - advmod
         constructs - attr
                 of - prep
                                    our - poss
                                    own - amod
                            minds - pobj
-------------------------------------------
         Everything - nsubj
                            we - nsubj
                 know - relcl
                            of - prep
         certainly - advmod
came - ROOT
         from - prep
                 nothing - pobj
-------------------------------------------
                 The - det
         key - nsubj
is - ROOT
                 to - aux
         understand - xcomp
                 how - ccomp
-------------------------------------------
```

1.4   4. Show the most common Entities and their types.

```python
[133]:  counts = Counter()
        for entity in txt.ents:
            counts[entity.text.lower(), entity.label_] += 1
        counts.most_common(5)
```

```
[133]:  [(('universe', 'ORG'), 23),
         (('zero', 'CARDINAL'), 6),
         (('one', 'CARDINAL'), 5),
         (('today', 'DATE'), 4),
         (('four', 'CARDINAL'), 2)]
```

1.5 5. Find Entites and their dependency (hint: entity.root.head)

```
[143]: ent_counts = Counter()
       for entity in txt.ents:
           print(entity, entity.root.head)
```

```
Universe is
today see
Universe history
Universe in
Universe have
one get
four answers
1 1
Universe built
Universe with
Universe to
today know
Universe with
one wind
one 's
Universe with
Universe born
Universe in
one is
today problems
2 2
first definition
one each
Universe in
Universe permeate
Higgs field
Spacetime is
General Relativity by
zero point
non-zero value
Today manifests
Universe to
Universe phrase
Universe to
3 3
Universe has
zero point
zero value
Universe of
zero to
zero to
Universe altered
```

```
Earth to
Universe of
Universe from
Universe play
4 4
Universe remove
Platonic ideal
Universe outside
four definitions
zero point
```

1.6   6. Find the most similar words in the article

```python
[164]: sim_words = []
       for i in txt:
           if i.is_punct != True:
               for j in txt:
                   if j.is_punct != True:
                       sim_words.append([i,j, i.similarity(j)])
```

```python
[166]: # sort by sim score.
       sorted_list = sorted(sim_words, key=lambda x: x[2])
```

```python
[180]: # reverse the order in desc order.
       sorted_list.reverse()
```

```python
[181]: # get count of unique comparisons.
       new_list = Counter([str(tuple(i)) for i in sorted_list])
```

```python
[182]: # get a count of the most similar words.
       new_list.most_common(10)
```

```
[182]: [('(the, the, 1.0)', 5929),
        ('(of, of, 1.0)', 5476),
        ('(and, and, 1.0)', 1369),
        ('(to, to, 1.0)', 1296),
        ('(that, that, 1.0)', 1024),
        ('(a, a, 1.0)', 900),
        ('(is, is, 1.0)', 729),
        ('(we, we, 1.0)', 676),
        ('(Universe, Universe, 1.0)', 576),
        ('(in, in, 1.0)', 361)]
```

```
[ ]:
```