Abstract

The purpose of the project is to perform two versions of indexing on set of documents both in compressed format and uncompressed format. The project is implemented in java.

Project Structure

The project starts executing from ApplicationRunner.java. Following are the input arguments expected for successful execution

  a. arg 0 – relative file path of document set
  b. arg 1 – relative file path of stop words(txt file)

All the data structures used to record the information resides as static members in ApplicationRunner.java.

Interface iProsessor

This interface enforces to implement execute and write file. Four classes implements this interface

  a. UncompressedLemmaProcessor
  b. UncompressedStemProcessor
  c. CompressedLemmaProcessor
  d. CompressedStemProcessor

Uncompressed Lemma Processor

This class takes care of uncompressed format of version 1 based on lemmatization. Here all the tokenized words are lemmatized and dictionary is constructed based on lemmatized term with posting list as values (PostingNode.java).
PostingNode.java carried document id and term frequency in that document.

Uncompressed Stem Processor

This class takes care of uncompressed format of version 2 based on stemming. Here all the tokenized words are stemmed and dictionary is constructed based on stemming term with posting list as values.

Compressed Lemma Processor

This class takes care of compressed format of version 1 based on lemmatization. Here Collection of Blocks (BlockCollection.java) is created as we process each posting term from version 1 of uncompressed dictionary. Each block will have a term pointer pointing to corresponding position of the term. Here, the size of the block (count of terms in each block) is set as 8. The posting list are encoded to byte array data structure using gamma coding. This helps in compressing the final file.

Compressed Stem Processor

This class takes care of compressed format of version 2 based on stemming. Here Collection of Blocks (BlockCollection.java) is created as we process each posting term from version 2 of uncompressed dictionary. Each block will have a term pointer pointing to corresponding position of the term. Here all the terms are constructed based on front coding. Here, the size of the block (count of terms in each block) is set as 8. The posting list are encoded to byte array data structure using delta coding. This helps in compressing the final file.

Implementation Setup

1. BitInputStream.java and BitOutputStream.java are owned by Marty Stepp. It is mentioned in the actual java class file too. These two files are used to derive byte array from strings of gamma codes and delta codes.
2. Standford Core-NLP 3.5.0 version is used as part of this project for version 1 implementation.
3. Document ID printed as output are zero-indexed document IDs.

Sample Output

Uncompressed Index Version 1 completed...
Time taken to complete Uncompressed Version 1 is 16102 ms
Uncompressed Index Version 2 started...
Uncompressed Index Version 2 completed...
Time taken to complete Uncompressed Version 2 is 2068 ms
Compressed Index Version 1 started...
Compressed Index Version 1 completed...
Time taken to complete Compressed Version 1 is 1413 ms
Compressed Index Version 2 started...
Compressed Index Version 2 completed...
Time taken to complete Compressed Version 2 is 928 ms
*******File Size Information***********
Index size of Version 1 uncompressed (in bytes):   1644264
Index size of Version 1 compressed (in bytes): 459545
Index size of Version 2 uncompressed (in bytes): 1611052
Index size of Version 2 compressed (in bytes): 426126
*******Inverted List Count***********
Number of inverted Lists in index V1(Both Compressed and Uncompressed): 7209
Number of inverted Lists in index V2(Both Compressed and Uncompressed): 6802
*******Analysis of Following Terms***********
Verion 1 Analysis

Type	Lemma	Doc Frequency	Total Term Frequency	Inverted list in bytes
Uncompressed	boundary	467	1185	6637
Compressed	boundary	467	1185	347
Uncompressed	prandtl	63	80	981
Compressed	prandtl	63	80	88
Uncompressed	nasa	145	148	2129
Compressed	nasa	145	148	109
Uncompressed	reynold	200	384	2899
Compressed	reynold	200	384	186
Uncompressed	shock	239	737	3445
Compressed	shock	239	737	229
Uncompressed	pressure	540	1353	7659

Type	Stem	Doc Frequency	Total Term Frequency	Inverted list in bytes
Compressed	pressure	540	1353	378
Uncompressed	flow	730	2079	10319
Compressed	flow	730	2079	475

Verion 2 Analysis

Type	Stem	Doc Frequency	Total Term Frequency	Inverted list in bytes
Uncompressed	boundari	467	1185	6637
Compressed	boundari	467	1185	393
Uncompressed	prandtl	63	80	981
Compressed	prandtl	63	80	89
Uncompressed	nasa	145	148	2129
Compressed	nasa	145	148	113
Uncompressed	reynold	200	384	2899
Compressed	reynold	200	384	206
Uncompressed	pressur	550	1381	7799
Compressed	pressur	550	1381	431
Uncompressed	shock	239	737	3445
Compressed	shock	239	737	252
Uncompressed	flow	730	2078	10319
Compressed	flow	730	2078	540

*******More Information about term NASA***********

Version 1 details

Doc ID	Term Freq	Doc Length	Max Term Frequency
52	1	207	11
57	1	169	6
67	1	115	4

Version 2 details

Doc ID	Term Freq	Doc Length	Max Term Frequency
52	1	207	11
57	1	169	6
67	1	115	4

*******Print Maximum and Minimum Document Frequency Terms***********

Max and Min Doc Frequency of Index 1
****

Max Document frequency

Document Frequency: 1257
List of Terms:
[to]

Min Document frequency

Document Frequency: 1

List of Terms:

[+18, .0, .1, .2, .3, .4, .5, 0.14, 0.15, 0.195, 0.5772, 0.6, 0.8, 000degree, 000efficient, 1.3, 1.6, 1.8, 100degree, 109placement, 10th, 12degree, 1400degreek, 14in, 180degree, 18in, 1degree, 2.25, 2.3, 200degree, 20degreec, 20in, 2by, 2nd, 3.2, 3.8, 3.9, 3000degreek, 300degreer, 30th, 32pp, 3600degreek, 400degree, 40degree, 49degree, 4ft, 4th, 5.8, 500degree, 55degree, 57d19a, 6, 6000degreek, 63a2xx, 63a4xx, 65degree, 6in, 6th, 700f, 75degree, 79.5, 800degree, 85degree, 99degree, =, a.a.aero, a.a.aero.conf, a.a.s.u., a.f.r.ae.s, a.k., a.m.brit, a.m.brit.i.r.e, a.m.i.e.e., a.n.c., a.r.a., a.r.s.jnl, a.s.c.e., a.v., a131, a159, a269, a50f06, a51j04, a52b06, a55c08, a55c23, a56b15, ab, abbott, abbreviated, ablatedlength, ablative, abovementioned, absent, abundantly, accelerometer, accentuate, acceptability, acceptably, acceptance, accessible, accidental, accountable, accounting, accrue, accumulate, acetate, achievable, acoust, acoustically, acquisition, acr, acrodynamic, acrothermochemistry, acrothermoelasticity, actural, adamson, adaptable, additive, ade, adjacentequilibrium, adjoining, adjoint, admixture, adsorption, advent, aeolotropic, aerelastic, aerfoil, aerial, aero.eng.rev, aero.res, aeroballistic, aerocosmonautic, aerodynamicheate, aerodynamieist, aeroelastician, aeronautique, aerothermal, aerothermochemical, aerothermodynamic, aerothermoelastic, affinely, affinity, affirmative, afftc, afresh, afterburner, afterflow, age, agency, agrawal, ah, ailcron, airborne, aircrafttype, airforce, airliner, airload, airscrew, akin, al1029, alan, algrantus, align, alksne, allcock, allmovable, allround, allude, alternately, alternatively, altogether, amer, amongst, ample, amplifier, amply, analogously, analoguous, analyser, analyticially, analyzable, analyzer, anastasio, andland, angele, anh, anhedral, anisotropy, ann, annex, anniv, announce, annual, annul, anove, anthony, anti, antielastic, antisymmetric, antisymmetrical, anyway, ao, apogee, app.mech, app.sc.res, apparentmass, appraisal, appraise, appraisement, appraoch, apropriate, aquart, ar, arbor, arch, ardc, aren, arithmetic, arithmetical, armstrong, arrest, arrow, arsj, ary, ascribe, ashley, ashwell, aside, asimplify, ask, aspectratio, assembly, assert, assistance, association, assortment, assure, astro, astronautics, astrophy, astrophysics, atabeck, atlarge, atosphere, attaindd, attainment, atten, attract, audio, aural, auspices, authority, availability, avaluate, avove, avro, ax, axialthrust, ayre, b, b.b., b.c., b.e., b.o., b.sc, b.v., backing, backup, backward, bakanov, balanced, balsa, ban, bang, barber, bare, barmby, baron, barrel, barry, bartle, basetype, baughman, bc, bearing, beasley, beat, beckett, bed, beg, being, belief, belleville, bellman, belltype, belt, bendict, bendingtorsion, benser, bent, benton, beograd, ber, berger, bergle, bergmann, berlot, bernard, berndt, berner, bernoullus, berthelot, beskin, beta, bethpage, bevel, beyween, bifurcate, bifurcation, bijlaard, billow, bimetallic, bimolecular, birchall, birnbaum, bisector, bisplinghoff, blackie, blackstock, bland, bleich, blended, blessing, blowout, bloxson, blue, bluish, blunttrail, bo, board, boat, bobbitt, bodt, boiloff, boison, bolshakov, bolz, bomb, bonus, boost, borcher, bornel, bounary, boundwell, boxall, boyd, boyer, bracalente, bracket, branchline, brandmaier, bratt, braunschweig, breguet, brenckman, brevoort, brightness, bristol, brit.j.app.phys, britton, broadbent, broadwell, bromm, brother, brower, browne, bruch, brush, bryce, bryer, bryson, builtup, bulent, bulge, bulkhead, bullen, bullet, bump, buoyancy, burgraf, burke, burton, bury, butler, buzz, by, bypass, c.a.l., c.c.l., c.d., c.j, c.k., c.o., c.u.p., cabin, calcualt, calcualtion, caliber, callaghan, callahan, cam.phil, camac, camb, camera, canard, cancellation, cant, capillary, capsule, caravelle, carbide, carborundum, card, carderock, cardullo, caret, carro, casaccio, cast, castigliano, castile, castolite, catalytic, catalytically,

cater, catherall, cathode, caution, cavitate, cellulose, centaur, centerof, centigrade, centreline, centripetal, centroid, certainty, cf., chain, chalre, chann, chap, characteristy, charczenko, charter, chase, chaudhury, chemisorption, chen, chesky, chester, chien, child, chilver, ching, chinitz, chinneck, choleskus, chou, chow, chrichlow, christiaen, christian, circuit, circuitry, circumlunar, city, clamshell, classic, classically, classificaiton, classify, clause, clauser, clean, clearance, climinate, clinton, clippinger, closeness, closest, closure, clouston, clutter, co., co2, coalescence, coarse, coast, coating, coe, coefstant, coherent, colder, coleman, collaboration, collaborator, collectively, collocation, colour, colston, columnmaterial, combustionheate, combution, command, commence, commercially, communication, comp, companion, compatible, compete, competition, complimentary, compound, compressibleflow, compressional, compressors.dash, comput, conceivable, conceivably, concise, concisely, concoct, concrete, concurrently, condamp, condensed, conductioncontroll, conductionexpansion, conductor, conf, confidence, conformally, conformaltransformation, conformity, congr, conical.dash, conically, conidtion, connexion, connor, conpressibility, conservativeness, consierable, consolidate, const, constancy, constantdensity, constantinescu, constantino, constantly, constitution, consult, consultant, consumption, contemplate, contents, context, continually, contract, contracting, contradiction, controller, contus, convair, conveniently, convergentdivergent, converse, conviction, convolution, cooksey, cooler, cooper, coordinator, cope, copper, corollary, corpuscular, corrective, correctness, correlogram, cortright, cosine, cosmonautic, coulomb, coundary, count, counteract, counterclockwise, coupon, cowling, cp115, cp213, cp271, cp394, craft, crandal, crandall, creager, crease, creepbuckle, crest, crew, crewe, crinoline, criticism, criticize, crooked, crosscorrelation, crushed, csanady, cubbison, culebra, cum, cumbersome, cure, curl, curran, currie, curtain, curti, cuss, cutoff, cx, cylinderhemisphere, cylinderical, d'etude, d.and, d.c.ae, d.c.f., d.f., d.n., d.o., d.s.c., daiber, daley, dalton, damaging, dampometer, dana, danger, dangerous, dashin, dashn, dashthat, dashthe, daughaday, davi, daytime, debatable, dec., decade, decidedly, decision, decisively, declassify, decline, decompose, decomposition, deducted, dee, deeper, deepest, defference, definable, deflagration, deformable, defy, degrade, deich, deionization, deisgn, delft, delimit, delineate, demarcation, demarcus, dence, deni, denmark, denomination, denser, dent, dependency, depict, depletion, depression, dept, deputy, derivable, deryagin, des, describable, descriptively, designate, desk, detectable, determinable, determinant, determinantal, determinate, deutsche, dev, devel, developable, devrease, dewpoint, diaconi, diagonal, diam, diaz, dicamillo, dickinson, dicsover, dictate, diego, dielectric, differentiation, diffuse, diffusely, diffusive, digit, dilation, dill, dilute, dimmock, dipole, dirac, directive, dirichlet, discern, discernible, discoverer, discretefrequency, disequilibrium, dislocation, dismiss, disparity, disperse, dispersion, disposable, dissertation, dissimilar, dissociationrecombination, distant, disturb, div, diverse, diversified, doctor, dodecagonal, doggett, dome, don, donnel, doppler, dore, dorodnitsyn, dorodnitzinhowarth, dorodnitzyn, dorrance, dosanjh, doubly, doubtful, dougla, dover, doyle, dp, dragutin, dramatic, dransfield, drape, draper, drastic, drift, drill, drilling, dropoff, drosophilum, drougge, drum, du, dubose, duce, ducting, dufour, dugan, dugundjus, dugundus, duncan, dunsby, dunwoody, duplicate, duplicated, duralumin, dusinberre, dust, dvl, dx, dyer, e.f., e.f.e., e.g.m., e.o., e.p., e.v., e.w, e05a, e53h25, e56b03b, e56l07, e57e06, e9k25, earl, easier, easiest, echo, economical, economics, economo, economy, ed, eddyviscosity, edelfelt, edelflet, edgedisplacement, edition, edpm, educational, efficacious, efflux, effusion, eggington, eigenvector, einbinder, ejector, elec., electro, electrode, electroformed, electrohydrodynamic, electrostatically, elegant, elemental, elevation, elevator, elimination, ellipselike, elliptically, elongate, embryonic, emerge, emphasise, ence, encircle, endeavour, endorse, endplate, endurance, engesser, eniac, enjoy, enlighten, enormously, enquiry, enskog, ensue, enthalpic, entirety,

entitle, entrain, entrant, envisage, epoxy, equatorial, equicohesive, equilateral, equilibrate, equivalently, er, erature, erdmann, erfc, erickson, erosive, erratic, et.al, eter, eucken, eulerian, eventual, everett, evvard, exaggeration, examinable, excessively, exchanger, excuse, exhaustive, exotic, exp, expectation, expend, experimenter, exploration, explosive, exponentiallyficient, expound, extendible, extensible, extinction, extra, extremal, eye, f.e.c., f.f.a., f.g., f.h., f.m., f.n., f.p.r.e., f.t., f40umerical, f8u, facet, fage, faget, falangan, fale, fano, farmingdale, fasten, faulder, fd, feb., fetterman, fewer, fibrous, fictitious, fictitiously, fig., financial, fine, finely, finest, finish, finitedifference, fire, firm, firmer, firstorder, fisher, fission, fixedpitch, fl, flagg, flanged, flash, flatness, flatplate, flax, flex, fllayer, flocculent, florida, fluiddynamic, fluidize, fm, foelsch, fog, fohrman, folson, forbe, forcible, forecast, forecasting, forefront, foreknowledge, formulism, forray, forst, fort, forty, forwardacceleration, forwardflight, foughner, foundation, fourcomponent, fourthorder, fourwave, fox, fraiser, france, franci, frank, frankel, fredholm, freedman, freudenthal, frictionless, friedman, frontal, frozenflow, fruit, frustration, ft1, fujihiko, fund, fur, furnace, fuse, fuselagesection, g.j., g.k., g.k.batchelor, g.s., g.t., g.v.r., g.z., gallagher, gardless, garner, gascous, gasdynamical, gather, gaydon, geckeler, gee, gehr, genuine, geoffrey, geophy, geophysical, georgium, germany, gerrard, gersten, gibb, gilbert, gill, ginzel, giraud, glance, glassy, glenny, glick, globule, glycerin, gm, goal, goddard, goebel, goetz, golian, gollnick, goodier, goodwin, gorcum, goree, gothic, gottenberg, gouse, graduate, gram, grand, grant, granular, granville, grape, grashof, grasshof, gravitz, gray, grazing, greensite, gregg, gridwork, grifith, grober, groove, grossman, grunow, guggenheim, guy, gyration, gyroscope, gyroscopic, h, h.e., h.j.a., h.m., h.u., h2o, haag, haberman, hadamard, haggenmacher, hain, hale, haley, halfangle, halfway, halstead, halve, hama, hamel, hamilton, hammerhead, hammerling, hammond, hamper, hanawalt, hancock, handbook, handicap, handley, hangling, hankelman, hantzsche, hara, hardware, harold, hartnett, hartunian, hash, haskell, haslet, hasse, hasten, hasting, hauser, haveg, hay, hayday, hayer, hayman, hazard, heading, heaslet, heaslett, heave, heavier, heimel, heimenz, heisler, heldenfel, helger, helical, heliocentric, hemispheroidal, hemus, hencky, hennessy, herberle, hero, herriot, herrnstein, heuman, heywood, hick, hickman, highenergy, higherorder, highfrequency, highvelocity, hilsenrath, himself, hinder, hingeaxi, hinson, hirschfelder, hirshfelder, hislop, historic, historically, hitherto, hodge, hodographic, hog, hoge, holer, holl, holland, holloway, hollowcylinder, homann, home, homing, homogenous, hopelessly, hopf, hopkin, hopper, hosokawa, hosowaka, hotter, houbolt, housefly, housing, howard, howell, howorth, hpyersonic, huber, hubka, huckell, huff, hufton, huggett, hugh, hughe, humphrey, hundred, hunter, hunton, hunziker, hurd, hurle, huston, hybrid, hydraulic, hydraulically, hydroballistic, hydrocarbon, hyett, hyp, hypass, hyperliptic, hypersoule, hysol, hysteretic, i, i.e.e., i.e.its, i.r, i.r.e., i.t., i.w., idealize, identically, identifiable, identity, iferation, igc, ignorable, igy, illinoi, illustrious, im, imaginary, imaus, immobile, immovable, impair, impart, imperial, implement, impression, imprimerie, improper, inaccessible, inadmissable, inadvertently, inafinite, inapplicable, inappropriate, inasmuch, inboard, incidental, inclusive, incoming, inconclusive, inconel, inconsistency, inconsistent, incrementalnormal, indefinitely, indetermine, indirectly, indium, inducedpressure, inductance, inefficient, inertial, inevitably, inexpensive, infiniteaspect, infite, influential, ing, inhomogeneous, injectioncool, injector, ink, inletmass, inoperative, inouye, inplane, insect, insertion, inspire, instant, instigate, instruct, instruction, instrumented, integrable, integrand, integrity, integrodifferential, intensification, intensify, intention, intentionally, interanl, interchangeable, intercrystalline, interdependence, interferogram, intergranular, interim, internat, interpose, interpretive, interstellar, intimately, intractable, intrierus, intrinsically, introdure, intuition, invariably, invert, investigaion, inviscidflow, invoke, inwards, inyokern, iodine, iowa, irbm, iron, irritant, isaac, isakson, isochronousstress, isofoam, isolation, isotope, item, j.ae.sc, j.aer.scs,

j.am.r.s, j.brit.inter.s, j.e.g., j.h.b., j.i., j.inst.metals, j.math.mech, j.n.b., j.o., j.p.l.prog, j.phys.soc.japan, j.r.a., j.roy.ae.soc, j.ze.scs, jackson, jacob, jacobian, jahsman, jame, janzen, jaszlic, jay, jeffery, jeffrey, jenson, jetboundary, jetexit, jetlike, jetstream, jmin, jmjn, jnr, jogarao, johannesen, johansen, jointly, jouguet, joule, joyce, judiciously, jugoslavium, jukoff, justifiable, k.a., k.f.a., k.h., k.j., kallmann, kalman, kana, kanwal, karchmar, kawagutus, keat, keck, keenan, keener, keith, kelley, kempf, kendrick, kenny, kernal, kernelfunction, kerrebrock, kester, keulegan, keune, kg, kidalgo, kilakowskus, kilometre, kinematically, kingdom, kink, kinked, kippenhan, kirby, kivel, klebanoff, kleeman, km.no, knee, knox, ko, kochendorfer, kogan, komoda, korkegus, kosson, kramp, krasilshchikova, krieger, krqus, krumm, krypton, kt, kth, kubota, kuehn, kuethe, l'etude, l'injection, l.d., l.n., l.o., l.r., l.s., l.w., l51e09, l52119a, l53e27, l53h04, l54e05a, l54i16, l55k30, l56e07, l58a16, l58e22, l5d20, l9g06, la, labour, lackman, lacquer, laguerre, laidlaw, lakshmikantham, lambert, laminarboundary, laminarturbulent, laminary, laminate, lance, landau, landrum, langer, langhaar, lap, laplacian, lardner, largeangled, largeaspect, largechord, largescale, late, latent, latitudes, laurence, lavender, lawe, layered, ld, le, leaf, legitimate, lehnert, lengthen, lennard, leonard, letko, letter, lever, levin, levinsky, liable, liapunov, libove, libration, librove, license, lieberstein, liebersten, liepmann, liftingsurface, lightly, liilum, lina, linder, lindholm, lineal, linearisation, linearizedtheory, lingitudinal, liouville, lip, liquidinjection, listing, literal, livesley, livingood, lmethod, localize, localsimilarity, lochtenberg, locus, logically, loitsianskius, longest, longitudinalvortice, longtime, loo, look, loop, lopatoff, lotz, loudspeaker, loui, lowaspect, lowsubsonic, lowturbulence, lr, ltd., lubricant, lucid, ludweig, ludwieg, luftfahrt, luiden, lunar, lynn, lyskov, m.b.t., m.d.c., m.f., m.l., m.o., m.p., m.p.h., m.sc, m359, mabey, macadam, macdonald, machell, machnumber, mackenzie, macneal, magasarian, magnesium, magnetoacoustic, magnetofluidmechanic, magnetoga, magnetoplasma, mahony, maillard, maintainance, maintenance, majorminor, malfunction, malvestuto, manager, mang, manocuvre, manoeuvring, manometer, marin, mario, maritime, marsden, martelluccus, maryland, massachusett, massbalance, massbalanced, master, masus, mather, maurice, mautner, maximuin, maxwell, maye, mayo, mc, mccarthy, mccomb, mcconnell, mcdearmon, mcgraw, mcgregor, mcisaac, mckenzie, mckinnon, mclachlan, mclafferty, mclean, mcmillan, mcnown, mead, meansquare, measurable, mech.app, mech.inst, meh, mehtod, meissner, melamine, mello, melvin, memorial, merely, merger, merle, merriam, mescall, mesh, messiter, meteorite, methanol, mev, mhd, mich., micromanometer, micron, microwave, midchord, middlesex, midspan, midway, miele, migrate, mikula, mil, mild, miller, millimeter, miltonberger, mind, miner, minhinnick, minimization, minneapoli, mirror, misalinement, mismatch, mistake, mitigate, mixedflow, miyaus, mm, modeling, mol, molten, molybdenum, momentary, monograph, monopole, monoxide, morning, mostly, motionless, mound, mountain, mph, ms26, msvo, mth, muffler, mulheim, mullen, muller, multhopp, multiaxial, multibay, multicellular, multicomponent, multipropeller, mum, munk, murduchow, murrow, mushtarus, mw, myself, n.a.c.a., n.b., n.b.s., n.e., n.g.t.e., n.i., n.o., n.r., n.t., n.w., n103, naaa, nacelleexit, nack, nada, nagakura, naleid, nall, nardo, naruse, nation, nationale, nautical, naysmith, nb, nd, nearer, neater, negation, neice, neighbour, ness, neumark, neutrally, newly, news, newsom, neyman, nice, nichol, nick, nicley, nimonic, ninefold, nineteen, ninth, nitric, nitzburg, no.g.w, nocturnal, nomenclature, nominally, nomograph, nonablating, nonaligned, nonaxisymmetrical, noncirculatory, noncommunicating, nonconcurrence, nonconduction, noncorrosive, nondecompose, nondimensionalized, nonexistence, nonflammable, nongyroscopic, nonheat, nonhomogeneous, noninclined, noninjection, noninsulated, nonisentropic, nonisothermal, nonnegative, nonorthogonal, nonpermeable, nonplanar, nonreact, nonreactive, nonrigorous, nonsingular, nonslationary, nonslender, nonsphere, nonspherical, nontoxic, nontrivial, nonunity, nonweiler, normalpressure, norman, notable, noteworthy, noticeably, notion,

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helger, helic, heliocentr, hemi, hemispheroid, hencki, hennessi, her, herberl, hero, herriot, herrnstein, heuman, heywood, hick, hickman, highenergi, higherord, highfrequ, highveloc, hilsenrath, himself, hinder, hingeaxi, hinson, hirschfeld, hirshfeld, hislop, hitherto, hodg, hog, hoge, holer, holl, holland, hollowai, hollowcylind, homann, hopelessli, hopf, hopkin, hopper, hosokawa, hosowaka, hotter, houbolt, hous, housefli, howard, howel, howorth, hpyerson, huber, hubka, huckel, huff, hufton, huggett, humphrei, hundr, hunter, hunton, hunzik, hurd, hurl, huston, hwa, hwa., hybrid, hydroballist, hydrocarbon, hyett, hyp., hypass, hyperlipt, hypersoul, hysol, hysteret, i.., i.e.e., i.e.it, i.r, i.r.e., i.t., i.w., i:, ifer, igc, igi, ii:, iii., illinoi, illustri, im, imaginari, imai, immobil, immov, impair, impart, imperi, implement, impress, imprimeri, improp, inaccess, inadmiss, inadvert, inafinit, inapplic, inappropri, inasmuch, inboard, incidence., incident, include.., incom, inconclus, inconel, incrementalnorm, indefinit, indetermin, indirectli, indium, inducedpressur, ineffici, inerti, inexpens, infiniteaspect, infit, influenti, ing, inhomogen, injectioncool, injector, ink, inletmass, inop, inouy, inplan, insect, inspir, inst, instant, instig, integrand, integrodifferenti, intensif, intensifi, intent, intention, inter., interanl, interchang, intercrystallin, interdepend, interferogram, intergranular, interim, internat., interpos, interstellar, intimate', intract, intrieri, introdur, intuit, inversion., investigaion, investigation., inviscidflow, invok, inyokern, iodin, iowa, irbm, iron, irrit, isaac, isakson, isochronousstress, isofoam, isotop, item, j.ae.sc., j.ae.scs.1960, j.ae.scs.26, j.ae.scs.29, j.aer.scs., j.am.r.s., j.app.mech.28, j.brit.inter.s., j.e.g., j.h.b., j.i., j.inst.met, j.math.mech., j.n.b., j.o., j.p.l.prog., j.phys.soc.japan, j.r.a., j.roy.ae.s.58, j.roy.ae.s.63, j.roy.ae.soc., j.ze.scs., jackson, jacob, jacobian, jahsman, jai, jame, janzen, jaszlic, jefferi, jeffrei, jenson, jetboundari, jetexit, jetlik, jets., jetstream, jmin, jmjn, jnr., jogarao, johannesen, johansen, jointli, jones', jouguet, joul, journal., joyc, judici, jugoslavia, jukoff, k+1, k.+., k.a., k.f.a., k.h., k.j., k=0.5, k=2.0, kallmann, kalman, kana, kanwal, karchmar, kawaguti, keat, keck, keenan, keener, keith, kellei, kempf, kendrick, kenni, kernal, kernelfunct, kerrebrock, kester, keulegan, keun, kg, kidalgo, kilakowski, kilometr, kingdom, kippenhan, kirbi, kivel, klebanoff, kleeman, km.no, knee, knox, ko, kochendorf, kogan, komoda, korkegi, kosson, kramp, krasilshchikova, krieger, krqu, krumm, krypton, kt, kth, kubota, kuehn, kueth, l'etud, l'inject, l.d., l.n., l.o., l.r., l.s., l.w., l51e09, l52119a, l53e27, l53h04, l54e05a, l54i16, l55k30, l56e07., l58a16, l58e22, l5d20, l9g06, la, labour, lackman, lacquer, laguerr, laid, laidlaw, lakshmikantham, lambert, lamin, laminarboundari, laminari, laminarturbul, lanc, landau, landrum, langer, langhaar, lap, laplacian, lardner, largeangl, largeaspect, largechord, largescal, late, latent, laurenc, lavend, ld, le, legitim, lehnert, lengthen, lennard, leonard, letko, letter, lever, levin, levinski, liabl, liapunov, libov, librat, librov, licens, lieberstein, liebersten, liepmann, liftingsurfac, lightli, liila, like', lina, linder, lindholm, lineal, linearizedtheori, lingitudin, liouvil, lip, liquidinject, liveslei, livingood, lmethod, localsimilar, lochtenberg, locu, loitsianskii, london., longest, longitudinalvortic, longtim, loo, look, loop, lopatoff, lose, lost, lotz, loudspeak, loui, lowaspect, lowsubson, lowturbul, lr, ltd., lu., lucid, ludweig, ludwieg, luftfahrt, luiden, lunar, lynn, lyskov, m.1991, m.2117, m.2190, m.2234, m.2427, m.2742, m.2971, m.3011., m.3054, m.3115, m.3224, m.3286, m.b.t., m.d.c., m.f., m.l., m.o., m.p., m.p.h., m.sc., m359., m=, m=1, m=2.45, m=6, m=6.8, m=6.85., m=7, m=8.2, m=9, mabei, macadam, macdonald, machel, machnumb, mackenzi, macneal, magasarian, magnesium, magnetoacoust, magnetofluidmechan, magnetoga, magnetoplasma, mahoni, maillard, mainten, majorminor, malfunct, malvestuto, manag, mang, manocuvr, manomet, marin, mario, maritim, marsden, martellucci, maryland, masi, massachusett, massbal, massbalanc, master, mat., mather, maths., mauric, mautner, maximuin, maxwel, may, mayo, mc, mccarthi, mccomb, mcconnel, mcdearmon, mcgraw, mcgregor, mcisaac, mckenzi, mckinnon, mclachlan, mclafferti, mclean, mcmillan, mcnown, mead, meansquar, meant, mech, mech.app., mech.inst., meh., mehtod, meissner, melamin, mello, melvin, memo., memori, merger, merl, merriam,

mescal, mesh, messit, meteorit, methanol, mev, mhd, mich., micromanomet, micron, microwav, midchord, middlesex, midspan, midwai, miel, migrat, mikula, mil, mild, miller, millimet, miltonberg, mind, miner, minhinnick, minneapoli, mirror, misalin, mises', mismatch, mistak, mitig, mixedflow, miyai, mm, modified., mol, molten, molybdenum, momentari, monograph, monopol, monoxid, morn, mostli, motionless, motions., mound, mountain, mph, ms, ms26, msvo, mth, muffler, mulheim, mullen, muller, multhopp, multiaxi, multibai, multicellular, multicompon, multipropel, mum, munk, murduchow, murrow, mushtari, mw, myself, n.a.c.a., n.b., n.b.s., n.e., n.g.t.e., n.i., n.o., n.r., n.t., n.w., n103., naaa, nacelleexit, nack, nada, nagakura, naleid, nall, nardo, narus, national, nautic, naysmith, nb, nd, nearer, neater, negation.., neic, neighbour, ness, neumark, newli, newsom, neyman, nice, nichol, nick, niclei, nimon, ninefold, nineteen, ninth, nitric, nitzburg, no.1, no.2, no.320, no.500, no.g.w.533, nocturn, nomenclatur, nomograph, nonabl, nonalign, noncirculatori, noncommun, nonconcurr, noncorros, nondecompos, nonexist, nonflamm, nongyroscop, nonheat, nonhomogen, noninclin, noninject, noninsul, nonisentrop, nonisotherm, nonneg, nonorthogon, nonperm, nonplanar, nonrigor, nonsingular, nonslationari, nonslend, nontox, nontrivi, nonun, nonweil, normalpressur, norman, not., notabl, noteworthi, notion, nozzleexit, np, nullifi, number', numger, nuttal, nyholm, o'bryant, o'donnel, o'sullivan, o.k., o.l., o.m., o.r., o.u.e.l., ob, object., objection, obliter, obscur, obtainec, obvious, oc, occasion, occupi, oct., octagon, octahedr, octav, ofattack, offenhartz, offset, ofr, ogivecylind, ohm, ohman, okuno, old, olsson, olstad, oman, onera, onetenth, onic, ont., onto, op, opaqu, openend, oppenheim, orderof, organ, orgin, origint, orlfic, orlik, orr, oscillograph, osoen, ottawa, our, outermost, outweight, ovalu, oven, overexpans, overhang, overli, overlook, overrid, overshadow, oversimplif, oversimplifi, overst, overstat, oversw, ower, oxygen., p, p.161, p.229, p.578, p.f., p.n., p.p., p.s.i.g., p.w.h., p35., padlog, pain, painlev, paint, palt, pankhurst, pappa, papreg, para.5, parabola, parasol, pari, parietal, particledens, partit, passeng, pau, peckman, peclet, pegg, peng, penland, pennelegion, pennington, penzien, peopl, percentthick, perfectga, periment, perp., perp.509, perplex, persh, person, pessimist, petersohn, ph, phil.mag., phil.s., philadelphia, phillip, philos., phosphoresc, photoelast, phugoid, physcal, physico, physiolog, picard, pierc, pierci, pimpl, pin, pindroh, pitman., planck, planetocentr, plast, plate., plate.., plateau, platinum, plenum, pli, plk, plohr, plung, pneumat, pod, poetic, poincar, poind, pointednos, poiscuil, pole, polyaxi, polycrystallin, polym, polystyren, ponderomot, pool, popular, popularli, portiou, portnoy., pose, postpon, potentialflow, potentiomet, poudr, power., powerpl, pr, pr=0.71, practition, prager, prebuckl, precess, preclud, predigest, preheat, premis, premix, prep., preponder, press., pressureinteract, pressureratio, preval, previouslygiven, prewhirl, prian, price, pride, priester, prikl., prime, prism, prismat, problems.., proc.cam.phil.s., proc.inst.mech.e., proc.roy.s.a., proceed, profound, proj., prolat, promin, propellerresearch, proposel, proposit, propound, prospect, protein, proton, protrus, protuber, proved$., provis, provision, provok, pseudo, psi, psig, psycholog, pt.iii, pugh, pursu, puzzl, pv, pyramid, pyrex, q.app.math., q.j.mech., quadruplet, quantum, quarterchord, quartic, queiijo, quest, quickact, quickli, quiet, quotat, r.1008, r.1013, r.1014, r.1025, r.1050, r.1071, r.1135, r.1228, r.1245, r.128, r.1294, r.1305, r.1312, r.1323, r.1338., r.144, r.147, r.149, r.150, r.20, r.299, r.415, r.479, r.504, r.52, r.527, r.539, r.569, r.59, r.623, r.628., r.69, r.76, r.874, r.898, r.91, r.959, r.9740, r.995, r.a.e.101, r.a.e.104, r.a.s., r.aero.2151, r.aero.2420., r.aero.2429, r.aero.2441, r.aero.2471, r.aero.2564., r.aero.2644, r.aero.2647, r.aero.2660, r.aero.2668, r.b., r.i., r.k., r.m.davies., r.m.s., r.p., r.p.n., r.struct.277, r.von, r1109., r136., r=1.4, r=420, r=502, r=5314, r=5906, rabotnov, radartrack, radialband, radian, radkowski, radom, radon, rae., rae.101, rainbird, rainei, rake, raleigh, ralph, ramet, ramo, ramp, randal, randomli, randon, range., ranni, ratiobeen, reactor, readers', readi, reaffirm, realga, realis, reanalysi, reanalyz, rearrang, recesso,

recherch, recognis, recov, recover, rectangl, rectilinear, recur, recurr, recurs, redefinit, redesign, redirect, reducedfrequ, reducedmodulu, reduction', reed, reeder, reenter, reentrytyp, ref.6, referenceenthalpi, reflex, reformul, refs., regimes.., region', regir, regist, reichardt, reimping, reinvestig, relai, relativist, reli, reliev, rememb, remmler, repair, repercuss, repetit, repli, requenc, request, researchtyp, researchvehicl, reserv, resili, resourc, resultantforc, retrocket, retrorocket, retroveloc, reuss, rev, rf, rhode, rib, ribbon, riccati, richmond, ridyard, rieding, rigidli, riolat, riva, rivet, rl, rm., rm.2078, rm.a55h31, rm.l58e15a, rml53g10a, roa, road, roar, robertson, rock, rocketon, rod, roe, rogh, roi, rom, romano, rosecran, rosenbrock, rosenzweig, ross, rotation., rothstein, roughen, rous, routhhurwitz, roy.s., rozycki, rpm, rsult, rt, rubin, ruckeman, rudimentari, rudin, ruhr, rung, runyal, runyam, russel, russian, russo, rutkowski, ryna, s.., s.d., s.e., s.l.r., s.m.f., s.p., s=1, s=2, saab, sachenkov, saibei, sail, sakao, sakuri, salmi, salmon, salter, samuel, sandpap, sanger, sarason, sashkin, satelit, satellite., sato, satyanarayana, sauer, saunder, savin, scan, scanlan, scarshaack, sce., schaaf, schaffer, schemat, schermerhorn, schetz, scheu, schjeldrup, schlesing, schneider, schoenherr, schuh, schwarz, scs.16, scs.1960., scs.1962., scs.23, scs.27, seattl, secant, sechler, sections., sediment, sednei, sedov, seed, seiff, selfpreserv, sell, semiballist, semicircl, semicircular, semidiamet, sensibl, sept., sequel, seren, serpico, servic, servo, sesir, session, seventhpow, severli, sewal, sextic, sgn, shadow, shandor, shank, sharpedg, sharpnos, shea, shearstress, sheath, shee, sheerlan, shells', shelter, sheng., sherman, shesterikov, shirtliff, shockboundari, shockdetach, shockexpans, shockinduc, shockless, shockstandoff, shorter, shortest, shortli, shortlifetim, shuffl, shukhovitskii, shyperson, sideforc, sight, sign, sigular, silenc, silica, silver, similar., simpson, sinchtel, sinclair, singleand, singlepass, singlestag, singletyp, singli, sinott, sir, situation', sizeabl, skene, sketchi, skewedparabol, skill, skramstad, slatteri, slew, slide, slider, slighlti, slosh, slower, slug, slye, sm22627, smell, smf, snow, soak, sobson, soc, soc.ae.sc., socal, societi, sol, solidconstruct, solidif, som, sommer, sommerfeld, sonder, sophist, soret, soundsourc, sources', southwest, spacewis, spahr, spaid, spark, sparkschlieren, spauld, specialis, spectacular, spectrograph, speed., speedsthre, spera, speric, sphere., sphericalatmospher, spiegler, spillag, spillman, spindl, spinner, spirit, spite, splitter, spoken, spontan, spot, sprai, spreemann, spuriou, sputnik, sq, sq., sq.ft., sr, staff, staff., stagger, stalder, stalker, stalmach, stanford., staniforth, stanitz, stanworth, stark, steadyst, steamlin, steepest, stefan, stepdown, stephen, stergi, stimulu, stipul, stochast, stockman, stoddard, stojanov, stoker, stolleri, stonei, stoni, strang, stratagem, streak, streamlines., streams', strengthen, stress', stripanalysi, stronger, strouhal, struck, struct, struct.237, struct.269, struct.279, struct.308, struct.311, structs., studied.dash, studies.dash, sturm, subarc, subaudio, subroutin, subsidiari, subtend, suck, suer, suffix, sugar, summat, sunderland, sunnyval, supercircular, superfast, superfici, superpos, superscript, supersed, supplort, supposit, surfacetemperatur, surpass, surpris, swallow, swanson, sweet, swigart, swihart, switch, sychev, syng, synthes, synthesi, szewczyk, t', t.b., t.h., t.j., t.k., t.n.40, t.p., t.r.f., tacitli, tailless, tailwind, talbot, tang, tanner, targoff, task, taxi, tear, tech, tech.memo, technique', technot, teddington, teeth, temp, temperatures.., templeton, tempratur, tendeland, tennesse, terminolog, termperatur, termwis, terrestri, testing., tetrachlorid, th, the'dens, the'equilibrium'paramet, the'newtonian'theori, the'solar, thein, their'worst'valu, themselv, therefrom, thermalfatigu, thermoaeroelast, thermomechan, thermopropuls, thesi, theta, thickness', thielemann, thing, think, thinwal, thirdli, thn, thommen, thornton, thorough, threaten, threshold, throttl, through', throw, thwaites', thyson, tical, til.2950., til.3959., til.5576., till, tional, tirumalesa, titan, tm.1147, tm.1215., tm.1302, tm.1393, tm.1418., tm.1433, tm.x, tm.x127, tm.x503, tn.1024, tn.1115, tn.1257, tn.1341, tn.1557, tn.1559, tn.1813, tn.1825, tn.1832, tn.1851, tn.1961., tn.2000, tn.2137, tn.2171, tn.2223, tn.2250, tn.2289, tn.2356., tn.2399, tn.2479, tn.2533, tn.2558, tn.2597, tn.2601, tn.2744., tn.2764.,

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Conclusion

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