Pensieve header: Making transcripts for dbnvp videos. Continues
pensieve://2019-04/SpeechRecognize.nb.

In[ ]:=
```
SetDirectory["C:\\drorbn\\AcademicPensieve\\Projects\\dbnvp"]
```

Out[ ]:= C:\drorbn\AcademicPensieve\Projects\dbnvp

In[ ]:=
```
Options[MakeTranscript] = {SegmentLength → 60, SaveTo → None};
MakeTranscript[v_String] :=
   MakeTranscript[Source → "C:/drorbn/dbnvp/orig/" <> v, SaveTo → v <> ".txt"];
MakeTranscript[opts__Rule] := Module[
   {
    src = Source /. {opts},
    txt = SaveTo /. {opts} /. Options[MakeTranscript],
    d = SegmentLength /. {opts} /. Options[MakeTranscript],
    audio, len, transcript
   },
   audio = Import[src, "Audio"];
   len = QuantityMagnitude[Duration[audio], "Second"];
   Echo[len / 60];
   transcript = Table[
     Echo@{t, SpeechRecognize[audio, Masking → {t - 1, t + d + 1}]}, {t, 0., len - 1, d}];
   transcript
  ]
```

In[ ]:=
```
transcript = MakeTranscript["Toronto-1811.mp4"]
```

" 53.1781

" {0.,
 o actually you cost so first of all my to follow the handout i hope you're all harding a copy i
   am but you know it is to scary that he tell you that the re talking on the first page
   and a turn bit of the second and the rest is just a show it to show up okay at the
   second thank you for inviting me to wrong to and the truth is that i was gone to say
   no you know it's too far to whatever but that was like an hour after the last four to
   but then i just couldn't resuse the temptation you see the previous speaker spoke that}

" {60.,
 spoken to told us that you can do our representation theory with all vector spaces and my talk
   is trying to tell you that you can do without representation theory altogether in so
   of course it depends up to also mytock has a web page and you can go there and double
   the houndout iftuish in the video impeter to about videos by the way you know one in
   every ten talks that ideat is worthy of taking a video but since i don't know which
   money do tal of them but think it's a generally good practice of the organizer should
   be doing it there one in every tinkful of intaic work you leasing into a second time
   in one he two but still is ported to take all of them if only for them a i should say
   that what i'm saying will be following a donskin overbad pictures attached and is joint
   be fallen under been also picture is given and you know one more propaganda thing or}

" {120.,
 you know one more propaganda thing before i really start so this is the abstract of a similar
   talk that i gave in a conference as nothing washington in ero to go so you don't have
   to like it doesn't matter if you like the formula im going to show you the theories im
   going to humble about whether or not you like that they describe the strongest through
   computable noting variet we know where would i say truly computer book i mean computer
   but in putting on the attine okay so as for the other pages that are not going to talk
   about so this is like the third and fourth faces of the undout and basically it is posthat
   in serious everything is implemented so this is a form incrementation of everything
   thereticals that will talk about and a few other things as well and the concrete
   results and give it out withof the program again formated to for our joyment but y}

" {180., for your adjomenot is actually that programming its actual computer concrete for long
   invariance of various specific nuts okay okay so let's really start so a first
   problem inocore not necessarily the fundamental problem at the turt problem within
   no theory has to tell not apart so here are the first thirty six knots and how on
   earth are you going to tell whether or not this one is the same as that one so not
   are the candies of not pure and the first problem is to tell the counties apart
   of orono here are two notes how can you tell if you can you know this one looks a
   little bit more complicated this one looks a little bit simpler how can you tell
   maybe you could form this one somehow in some crazy way until it becomes autono}

" {240.,
 ok so the answer is to find multinvarians what the noting variants is so computable quantity
   something that you can compute from a picture of the not and that does not change
   when you form the picture so that may constant unless you actually change the note
   and that takes values in some space where it is easy to tell things apart of omeas or
   matrices or integers or so more where it's easy to decide equality and an if you want
   to tell that this note is different from that dog you compute there in varions if this
   one comes out seven and this one comes out night you know they're different okay so
   there are lots of techniques how to compute not invarians and here is one which is}

" {300.,
 here is one which is extremely successful but extremely slow in some sense so let me explain so
   this is a young boxter technique so first of all a unique son ishal doctor so given an
   algebra you and typically this is going to be a complete universal and eloping algebraps
   on the algebra or maybe the quantize version of the same thing but we dont even really
   need to know what these things are at the moment and you also need two elements you leave
   an element called the armad tricky are you happy which is an elementing outan or you and
   le an element code well s i'm only one in the world cause the cop so you hit an element
   called the cop which is an element in you what what does everybody else call it up t}

" {360.,
 what does everybody else calling him the tween seliment may be something like that okay so
   you see them in with class so ah and or there are matrix being in utons or you
   can be written as a sum of a items or beaibi and then given this information and
   assuming are nc sucdespie equations or are difficult and are not going to write them
   down right now and it is very difficult to find them but still assuming you have
   this see things a you can form an assuming have a picture of a not you can form
   an expression of photos so first of all you put a copy of the armatrix near each
   crossing so near the top crossing on the after strong you put ai and on the lower
   strone you put pi like wise you put a second copy on the middle crossing one up}

$\{420.,$

on the middle crossing on the upper strong to put a jam on the lower strong you put bj and
on the likewise on the third for crossing and then on all the cops cups or caps
lady on all the crops you bought the copies of sea okay and a there actually sign
so real crossing is positive you would are if it's negative to put himburger our
inverse like wise some convention for the cogs you don't want to know what it is
its not important it not but it is very important utits not out interesting and
after you do that you put you pick at a healing point and you read what you see so
rather long then often you see a c and a apj and sc so you see it c and aij and
akac then in other sea already to c squared and so on you go you get a certain$\}$

$\{480.,$

you get a certain expression which you can interpret as an expression in the algebrau you
sum over all the indeces that could possibly appear and the claim is a forein
appropriate choice of or and s namely they have to sentisfy the young poster
equation and the foother complicated eventions you get a noting variant this
invariant is valued in the order for you and if you lucky it's easy to tell apart
elements of you okay and so you achieve the initial goal so the problem is that
they use you have to work with are typically infinite dimensional and then it is
very hard to actually extract information out of sea that to solution is to use
representation theory namely you represent finally the natural representation of you$\}$

$\{540.,$ l representation of ou and then you replace every element here by a matrix and
everything becomes final dimentional and computer book however you still have the
summations overall jack and a see summation are now bound or bounded by but the
dimension of the representation or reor be teention of the representation squared
in but still you need to compute multiple sons in which the indeces rateso finano
such sums are some over sets on size is growing exponentially in the dimension $\}$

$\{600.,$

in the dimension of the sorry in the number of crossings of the not and so if it is is the
trefor not like here is easy to compute but it is if it's a hundred crossing not
it's praticly impossible really the big issue here is that you end up needing to
look at tens or powers of representations and tens of powers growing dimensions
exponentially fast and so the problem is very very difficult actually not theory
so let me move aside a bit not tell you sometimes want to do a little bit more
than just computing not in varia so sometimes so somehow you know that they did
not are candies are the rough products or the end result okay but usually you
want to decompose them and think of them as made in made out of smaller part$\}$

$\{660.,$

made out of smaller parts so a time lay and i would not give you formal definition but it
can low is a piece of a not drown in a part of the play and basically every note
is so how a composition of several can be written as a composition of several
ton loids so for example a single crossing is a very simple conte peace made
out of cease to strangen this longlish strong going that way is another bigger
tung load okay and the point of tobloids are support as opposed to notes is it
they admit operations namely for example this complicate the tonloid shown here$\}$

" {720.,
onloin shown here was made by taking a se a simpler one the piece over here and another simpler
one name is cook over here and stitching them with each other so there is a
certain stitching operation which takes a two components onloyd with one component
cold eye and the other cal j and stitches them together or more precisely it
takes us two strands in thundroys and stitches stitches them together then there
is a strong reverse cooperation as i so this trut you can see you wanted to go
downward but i applied to her how it goes upward so it's the only one of the
consistent with the flow of the rest in this picture likewise series a strong
doubling operation so you could say that this air was created by applying per}

" {780.,
by applying the operation called delta ijk which means takes trot lunger eye delta it double
sorry and cold the doctor trans that are resulting jk okay so there is a certain
portfolio of operations and when i say for for your operations i mean i don't know
it metaoger something like that but don't want to say what it is i just want to
say a collection of operations which so isfy some rules and whats the complication
them to bright name who cares it doesn't matter right now okay a the tents sorry a
there is one more operation in the disjoun union so if you have to conlde you can
put that side by side and i will have one big temploy that has two components early}

" {840.,
clearly with these operations the world of ton loids is finitely generated the factit is even
finitely presented namely one generator is the war another generator is the crossing
and every other tone loid is obtained by taking a hisjoing union of crossings and
maybe crops and then stitching them together as appropriate okay so principle if
you want an invarion which is well behaved under these operations it's enough to
define it on the crossing and on the go now there is an even greater avent advantage
to switching to ton los and is the following so you know if you compare with
number theory these are like the number one two three for me want to three more }

" {900.,
on to three more you know how exciting or just is just counting number theorists don't really
care about five hundred and seventy three number theories care about properties at
numbers may or a no top so he is the number a sum of two squares or not and even if you
just want to ask this question you must have operations or numbers right a number is
some of two squares if it is the result of the sub operation applied to whether what
it is but the point that the moment to have operations or nots say stop being a single
continuum but you can ask you can also ask about properties that they may or may not have
so i'm not going to tell you what this properties are im just going to tell you that
there are lovely properties like the genoo and off and whether or enough is a rebon or}

" {960.,
bone or not and this properties become definable the moment you allow yourself to look at these
operations as well and against these are like the unalogs of being the sum of the
quares and if you want your invarions to say something good about the genus to be
able to tell the genus of an auter to be able to detect whether knock is root it's
clear that it is useful if they will be well behaved relative to these operations
everything and saying can be made concrete but not in fifteenites a so what i really
want is more than merely an algebra and an ar and c i want a wall portfolio of things}

″ {1020.,
    of things parallel for young loids namely i want the vetter stay cool and i wont further moms
      as in the top row of this diagram namely i want a multiplication a multiplication map is
      essentially enough from the tender squared it is enough from the temper square of the
      vector space into a single copy of the vector space and my notation is a bit funny so
      rather than taking the terms of square i am taking tensors to the power and to edaman set
      which really means that im associating with each tens of fuctor a label just like you
      may want to label that compone the strong in a tongo so i need an operation m jigoing}

″ {1080.,
    i going from you to the ten or j to you to tens or eye normally it would call it the product
      likewise i need an operation corresponding to a strong doubling operation let us
      call it delta ij going from you to the tensorie to you to the tenter likewise need
      an i going this way the struggers corresponding to the strong reversal operation
      likewise need two elements see and a but an element is merely the image of right now
      back from p into a vector space that's the same as specifying an element in it so i
      also want the up from you to the tems or the empty set to outano square to the tent
      or j let's call jrj and likewise a macci from you to the tender depty said to the }

″ {1140.,
    y said to thetor eye and of course all of these maps must subdespire some properties which
      are precisely analogous to the properties that the corresponding tonloid
      operations satisfy once you have that portfolio of operations you can do
      not theory mean think in your mind like you can do number theory okay a do
      a with me so far is this all right okay so a my way our way instead of using
      representation theory to decipher what you do with these uths i want to do
      something else so for certain specific algebra so again i will find an ougebra or }

″ {1200., era or i will find a you with these properties a with the operations on their foring the
      problem is a again i would need to be within the process of computing things will need to
      be looking at you need to look at tens of towers of you this growth is plationy in fuse
      a presentation theory instead i will restrict my attention to subspaces of these spaces
      so subspaces of things are described by a certain type of formulas these subspaces will
      be put onaldivention of social dimension will grow polnonially instead of exponentially
      in the number of factors that up here here but nevertheless they will be closed under al}

″ {1260.,
    will be closed under all the operations that care about say we not however be linear suspaces
      so i said so spaces should have said subsets they will not however be in your
      subspaces and they will not even be multiplically in the sense of the subspace
      corresponding to u squared will not be the square of the subspace corresponding
      to do to the tens or one so it really is somehow a different type of algebra
      okay so a the next few slides so this one and that one in that wat and that one
      and make also this one and that one are actually fully general and i could tell
      you about them before specifying the alterbro that i want to actually work with}

" {1320.,
  to actually work with however just to be concrete i want to tell you what is the youth with
    which i actually work today okay so a because this a process of replacing powers
    by formulas a doesn't always work it works on the fore of specific algebra
    so the gras i will work with are a bit funny they are solvable approximations
    of sea simple the algebra so let me tell you in a minute what is what that
    is okay so first of all its chemotic picture so there is a completely fate
    picture of the modulid space of all the algebra so peak a veteral space}

" {1380.,
  so be a ventral space feed and look for the set of all brackets you can find on this venter
    spect so basically the set of only algebra over a fixed vector space bee so a bracket
    a lip rocket is something which is untisymetric and satisfies the jakobia equation
    so it satisfies one linear equation in one quadratic equation the doct equation is a
    quadratic equation an equation on the pocket and so ah the modulary space of neagebras
    on a vector space be is a certain quadratic variety inside the second tens of power
    of the vectors of the due of the vector pastents or the vector space named inside
    the set of all maps from p squared to vand such a map is abrupt would be a rocket so}

" {1440.,
  so here is a fake picture of of the modelized space of e brackets on some high dimensional
    vector spacing namely it is made of one big or a the zero bracket somewhere in
    the middle that's a completing legitimate bracket it has so big cells somewhere
    a free algebra searized morphine to s seventeen it has another cell somewhere of
    corresponding to the abras that are morphic to end never mind the fact that there
    isn't an outer treaty in this is a schematic safe picture and here is another cell
    of liaga bars orphin to evise now sees legabra this so called semising the algebra
    are well known to be rigit and the meaning of brigid is if you perturb them in}

" {1500.,
  is if you perturb them a little perturb of a little bit and still get a yanda brok the result
    is the same leagera so see three cells of seventeen inine and an are open
    sets to which really means that if you sit for more in the middle and you look
    around you you see something boring always you see the same way however they
    still have boundaries so if you sit on the boundary of one such cell you may
    be able to the form into that set in the algebra so im looking at a really
    well passers of algebra but the parameterized by for parameter axion and i care
    about this puncess near epion equals to zero so i care about well a small ma}

" {1560.,
  be a small neighborhood of a point in the boundary of the cell corresponding to a semisineagra
    and how it the forms into that semi simple legebra okay that was a schematic picture
    here is a slightly less schematic a version of the same thing so let me look for
    example of chile so for celn it turns out it if you want to understand chilland
    it's enough to understand half of god and the same is true for all semi simply
    atoposit you want to understand gets enough to understand half of ename leads uper
    bore a satada may so genin he's roughly specking the direct some of the upper
    triangular in the lower trial clar matrices and really i lied a little bit because
    they they ago now the so call cure so called curtains about a got doubled but}

" {1620.,

double but modeus money gen is the direct sum of the up of the upper travelers in the lower
tramplers and sees two anebrather are tuned to each other so it's enough to understand
one of them namely if you look at just the upper triangular matrices so this some algebra
it has a bracket called p its a subargas because e brocket but in addition there is a
bracket on his turn space which means that if you tuilize you get the cobrocket or a up
delta going from humper translot to offer drive or tens or upper gig and it turns out to
if you know be in denta you can recover ah all of giny again with an extra divine factor }

" {1680.,

so what we do is instead of recovering giel from the parbdata we take the death apart and
he iplied by exilon and then apply the same recovery process the result is so
basically we take the double of the apertagular house matrices using the original
bracket and exit all times the cobrocket the result is a newly algebra in which
everything depends on exiton epion equals to one you get the oldly agebra you get
in a leg was to zero you get something very funny and in fact it's always so about
and and what we tend to do is to look at at a caution in which epilon to some power}

" {1740.,

which exilon to some power is made to be zero so we look at of neighborhood anything in teim
neighborhood of absolon equals to zero and it turns out that the algorist together
are always solvabout yet they approximate the original jaren better the a better and
better the higher caves and again i'm sorry that i have to be schematic but i only
have wefty one minutes remaining common questions so specifically in our case we just
do it doing or an x is a three dimensional artero half opi is two dimensional so it
is generated by two generators and ext you double it you get the foreensional thing
and here are the specific computation relations that you get and then there is a more
procedure that takes hours to describe and is very computated than he called one type}

" {1800.,

one types using standard tools and as a result you get the tebroad racecare about cute oxidon
fees of absolutely the do of the previous slides and manit doesn't matter how
it came just told you how it came about but ateend it's a very specific other
body four dimensional algebra generated by four generators why add is central
sode competitors with anything is equal to zero and then there are specific
commutation relations for the for the other things and i didnt write it here
though it appears on page three of your handop there is also a cop product and an
antipoden s sorter is a dealt is and all the ingredients one and even an ar and co}

" {1860.,

n clock okay so talk to generalities so they are this specific algebra and in general the
ebras that arise inquatum boots always have a so called pbw basis which amounts the
same that they are describable in terms of semetriculture broth or polynomes aly so
if you have an algebra generated by so if you is generated by generators x and y and
so on you can look at the symmetric algebra with generators exagaic once the same
that we're just looking up to plenoma for maybe power series in the variables x and
y and if you choose an order to the generators you get them up from here to hear}

" {1920.,

from here to hear so you get the map which i called the ordering map which depends on choosing
an order for the generators so for example the ordering map in the order why applied to ex
the seven wie to the thirteen will simply take this commutative poliomial the domain of
the ordering app is commutative polionial and will not be into a known community poliol in
which you wrote the generators in the order specified in the subscript here so you will be
writing you this will be happed to y to the thirteen x to the seven oy and they for the
algaps i hear about including the land ring up here is ordering knop our sector space }

" {1980.,

our sector space is orpis they are not algebra so more risms of course because this one is
communitie and this one is not from you to them but is there are vector spaces of
orfisms so basically for not a for now as give you names for all the elements here
okay a so this means is that the no commutative portfolio of operations that we have
here can be translated to a commutative portfolio of operations so it part for of
operations and elements leaving in symmetric algebras corresponding with generators
corresponding to the generators of this imagriculture bus the moment you choose
ordering specific order in maps the problem is a cease operations the notification an}

" {2040.,

the motifications and the come duplications of all the elements become very complicated right
because well i to what might have been simpler from here and an it imported a twist to
incler spaces but the prices of the operations get complicated a maybe one more thing
so about location so b is supposed to be a set of generators of it so if i want to make
if i want to map into you then i mean to mark from the symmetry age but with generators
corresponding to the generators of you and my convention will be that if i'm looking
at you to the tems or jac so two copies of you one label ja and one they ou i will}

" {2100., i will label the generators a yjxj it aris hot subscripts to degenerators a then the
substricts will be jank the sense of generators will be called bj and b and if we
want to look up you to the ten or cheek ja that commutative analog or the metry contr
corresponding to it will be the symmetric counterbap on generators p sufj coma be
subky which means two copies of the original set of generators one labor jack in
one level k and what i really need to understand now is maps or all kind need to be
able to understand inplemen compute values complicated maps between cemetry thusa
both with generators bey and cemetriculters with generated with bj communitic ca}

" {2160.,

ah so here is a slide of pro showing too much detail so basically what i need to understand is
the more reasons between s of b and so prime were nd primes or two sets titically bi
and but or something like that okso by standard lineariba this is the symmetricalura
of p tube tenson the symmetry argibrap prime and i'm thing lazy to tell you that
certain things need to be completed am not worrying about this about completions this
point is a schematic now the symmetricarder room be you is the symmetric so inthe
tude of the symmetry controvers again a symmetric culture br only tual collection of
variables and my convention will be up if if then if the elements in the are denoted by }

″ {2220.,
are denoted by luting letters then we will have the same letters but make greek so see will
become sea become side and so and the symmetry carbon d tens out ero is the same
of the symmetric altibl of the union of plant price which is the same as the set
of pullnoas or maybe power series because it wasn specific about complitions in
variables seta i corresponding to the elements of p so the elements of beaten
greek and zati prime corresponding to the lements of the pride and then a so
basically mobore reasons are pornomials in greek and lot in variable or many
power series in greek and nutty variables and ito tell you how to compose to home}

″ {2280., to compose to home orphisems so suppose you have a moorfice and find orphism g and a
corresponding ponomial power series is in till at which is in variable sins a broad
and cjec so sent and that a from and in other morphis ge whose correspond on from
power series is tild which is a faor comer series in that crime and s car double
from how do you compose them so its attle exercise to check that well chematically
what you do is you par the love teams of s with the greeks of gend and pair in
all possible ways which are consistent with the induces or said differently you}

″ {2340.,
se differently you take gitla and you replace every greek letter by a differentiation with
the corresponding lacking that oue the differential operator you applie to s
has this is lefting variable lucky letters of variables appearing into a so it
makes sense to a large defential operator to that power series and then you make
it a complete part but by setting of sets to zero after apply the differential
operation this is completely equivalent to take in f and replacing all the lucky
letters in it by great but defraciations with respect to the greeks and then
setting all the greeks to zero okay i hope you're still with me and i hope i'm not
installing insofting anybody or lackin is okay i just think with me shape stre}

″ {2400.,
strict subspaces or subset rules to sati all of this is happening well am not quite telling you
in which completion is is opening for each to make so of the level of nonals it totally
makes sense a cities the things i have tile will be power serious and convergence will be
an issue but am not specific enough to tell you at the moment how to resolve this okay
good lets do a few examples so first of all dendic identity map is about from met recoldre
in the variable to the symmetric to symmetry on a variable and you can check that the
corresponding tower series where it should be a power series in this zeter grape so it shou}

″ {2460.,
great so it should be a power series in s and set top and you can change the list exponential
of time set it's basically that story away center will become differentiation
or center gets paired with whatever you apply the identity too and then every
time you can resent up with the s you get another replacing it from the s
time as appears here so then you do nothing ok then there is the retapewold
duplication so the multiplication map is about from as of t terms of an
oce into so and i are talking about the commutative multification of the}

" {2520.,
commutative antification of the esiation but here's a better way of wing it so first of all
at the indusis here i and j and other indexir cases are just renaming the
variable thats nothing and then this is the symmetrical of cincj and you have
a map into the cementry calger brocking de and its really the map which maps
sin the cj to ck he props both variables to zk so you if you have a sea here in
becomes a sea carvers here in becomes a se that's what multification does okay
ain then it's easy to check something corresponding our series is in to the ck
shig plus jopsoryet i plus stageso the inputs become great and output remains a}

" {2580.,
and the output remains rating and we tuat semilar resers the archetypeo core product which
marks the symmetry calebone i to the cymatriculture one janc by mapping cit j glasc or
the most under lotation to if the co product of contents and you can check that the
corresponding power series is this exponential and if you the secretor appears here is that
this is a quadrotic exponential uadratic so hautia this is the exponential of equadratic
so eduction and this is a goussion as well so far the causions on only mix greeks and
datings you the only pair grieks and nothings but in fact if you look at our matrices he
don't need to know what usually look like but they typically have elements of the form }

" {2640.,
elements of the form written here and the corresforming cogulative analogue is a gasia in which
to breath it to lacky letters of here and finally when you know a sin were dealing with
ordering monomials and clear way if we will want to multiply them using the conqueetative
product we will need to reorder and here is the simplest example of a reordering map so
the five form of the economical commutation relations takes so the exponential of center
x times the exponential try is equal to the expression written here in a philologybrop so
in an arguba in which the propet of iden is t times the identity if you think about it a
little bit you realize that the reordering map which comes that ordering the xid ordering}

" {2700.,
ordering the xy ordering to the or to the ordering the yx ordering becomes the power series
in which you get two great letters a look out with each other so in general you
get completely general of gusions and the thing i need to do is to learn how
to compose completely general gasias using the composition law is written here
so the truth is more complete the truth is actually more complicated so in the
algebra we care about the actual rij the actual end the actual delta on the
actual s are an also see with a sort of very quico here a or or not as simple}

" {2760.,
or not as simple as the ones written here but if you look at the athem closely the tools they
look like gausian so the exponential of quadrotics multiply by multipled by perturbations
so how are serious in exilon so in fact when actual equas to zero you get pure
options but more generally he went at face place we care about is near the but not
wite zero you get power series an epilon in which the coefficients are more or less
polnonias in all the variables at care and a yeah the infect the program that on your
undo compute all this from scrap radia so it as a completely effective okay what }

" {2820.,
   w we not only for us is to imprint the basit work for all am i simply alterpain associathe
      other budgets or the lastyears or steer the point of coat of crime boses cure anyway
      a society line to you because our foros conficients here they the craffic as and the
      upper place and note to what they are it works okay how much time do i have about
      three minutes so ill go very quickly somehow what we need to do is to her so and after
      half an allower half so we have to morphism we want to compose them we want to par}

" {2880.,
   we will compare the greeks of this one with the luckies of that one and it turns out that he's
      much easier to do it one by one then all at once the problem is an if you took some of
      the variable first and keep the rest for later what you have is going to see something
      which is not made of to destroy components so as in its in the computation you need to
      seep rather than find and seeing also has a men so basically if you have a polomiale
      both breaks and lucky letters then seeing the variable means carrying internally
      the centers of the senters with the corresponding seas and again this also can ite
      differential operator so basically you substitute into the zetas do you write to}

" {2940.,
   dets you write up to the left so than asit here or maybe a plain here rising to the applien to
      the ones of the right and in the substitute or nothing to e so we eser is this internal
      seeping which is roughly of which is schematically this operation internal sig so i have
      completely concrete formulas for internal sp and again intern it in is stronger than what
      we need is more than at and basically the a running out of time so the formula look like
      so if you want to do cing with respect to some collection of variables to an expression
      which is a cousian porticide by a perturbation so the perturbation has to have finite to}

" {3000.,
   t has to have finites degree in at least one of the collections of art appears in it then a
      there is a completely concrete formula to do it which at the end invo so again im not even
      going through it but it all only involves inverting a matrix and here is the proof but
      of course i'm not going through it and there is a complete implementation and so this is
      put aside from the main bit of code but if you would look at the main beat of code you
      will find that it appears me twice and the reason is that each reality we need to do the
      seting into phases so how there are two sets of forables the cut time variables and the
      fore variables and what you get its much better to do the seting first of the cartons and}

" {3060.,
   e first of the cartons of the brand a lot of time so so the detail be here then there is a
      hall discussion about why in our case all the power series are so condosile dotile
      means that power secres in emcilon if you look at the coefficient of exon k the
      corresponding cofficient which is a no lot of vorable half boutin the green and i
      skip the precise definition but only tell you why this is valuable this is valuable
      these the runk of the state of docile series is actually prosecute nomially in the
      number of copies of the leagebus you you care about rather than exponentially and
      in fact you can start seeing it already when you look at the quadratic term so}

" {3120.,
    the quadratic term so the number of quadrotics in envariable growth like in squared where
      which is potionian so the number of quadratics is relatively small where are powers of
      ten two dimentional representation grow requite and that's why everything is attend
      a very very quick and computable and i'll end with my or footing from aganda and
      i'm three minutes over time and put no two and half minutes over time and a cice a}

" {3180., thank you fo}

Out[ ]= {{0.,
   o actually you cost so first of all my to follow the handout i hope you're all harding
     a copy i am but you know it is to scary that he tell you that the re talking
     on the first page and a turn bit of the second and the rest is just a
     show it to show up okay at the second thank you for inviting me to wrong
     to and the truth is that i was gone to say no you know it's too far to
     whatever but that was like an hour after the last four to but then i just
     couldn't resuse the temptation you see the previous speaker spoke that},
  {60., spoken to told us that you can do our representation theory with all vector
     spaces and my talk is trying to tell you that you can do without representation
     theory altogether in so of course it depends up to also mytock has a web page
     and you can go there and double the houndout iftuish in the video impeter to
     about videos by the way you know one in every ten talks that ideat is worthy of
     taking a video but since i don't know which money do tal of them but think it's
     a generally good practice of the organizer should be doing it there one in every
     tinkful of intaic work you leasing into a second time in one he two but still is
     ported to take all of them if only for them a i should say that what i'm saying
     will be following a donskin overbad pictures attached and is joint be fallen
     under been also picture is given and you know one more propaganda thing or},
  {120., you know one more propaganda thing before i really start so this is the abstract
     of a similar talk that i gave in a conference as nothing washington in ero to go
     so you don't have to like it doesn't matter if you like the formula im going to
     show you the theories im going to humble about whether or not you like that they
     describe the strongest through computable noting variet we know where would i
     say truly computer book i mean computer but in putting on the attine okay so as
     for the other pages that are not going to talk about so this is like the third
     and fourth faces of the undout and basically it is posthat in serious everything
     is implemented so this is a form incrementation of everything thereticals
     that will talk about and a few other things as well and the concrete results
     and give it out withof the program again formated to for our joyment but y},
  {180., for your adjomenot is actually that programming its actual computer
     concrete for long invariance of various specific nuts okay okay so let's
     really start so a first problem inocore not necessarily the fundamental
     problem at the turt problem within no theory has to tell not apart so here
     are the first thirty six knots and how on earth are you going to tell whether
     or not this one is the same as that one so not are the candies of not pure
     and the first problem is to tell the counties apart of orono here are two
     notes how can you tell if you can you know this one looks a little bit more
     complicated this one looks a little bit simpler how can you tell maybe you
     could form this one somehow in some crazy way until it becomes autono},
  {240., ok so the answer is to find multinvarians what the noting variants is
     so computable quantity something that you can compute from a picture of the
     not and that does not change when you form the picture so that may constant
     unless you actually change the note and that takes values in some space where
     it is easy to tell things apart of omeas or matrices or integers or so more
     where it's easy to decide equality and an if you want to tell that this note
     is different from that dog you compute there in varions if this one comes out
     seven and this one comes out night you know they're different okay so there
     are lots of techniques how to compute not invarians and here is one which is},
  {300., here is one which is extremely successful but extremely slow in some sense

so let me explain so this is a young boxter technique so first of all a unique
son ishal doctor so given an algebra you and typically this is going to be a
complete universal and eloping algebraps on the algebra or maybe the quantize
version of the same thing but we dont even really need to know what these things
are at the moment and you also need two elements you leave an element called the
armad tricky are you happy which is an elementing outan or you and le an element
code well s i'm only one in the world cause the cop so you hit an element called
the cop which is an element in you what what does everybody else call it up t},

{360., what does everybody else calling him the tween seliment may be something
like that okay so you see them in with class so ah and or there are matrix
being in utons or you can be written as a sum of a items or beaibi and
then given this information and assuming are nc sucdespie equations or are
difficult and are not going to write them down right now and it is very
difficult to find them but still assuming you have this see things a you
can form an assuming have a picture of a not you can form an expression of
photos so first of all you put a copy of the armatrix near each crossing so
near the top crossing on the after strong you put ai and on the lower strone
you put pi like wise you put a second copy on the middle crossing one up},

{420., on the middle crossing on the upper strong to put a jam on the lower
strong you put bj and on the likewise on the third for crossing and then on
all the cops cups or caps lady on all the crops you bought the copies of
sea okay and a there actually sign so real crossing is positive you would
are if it's negative to put himburger our inverse like wise some convention
for the cogs you don't want to know what it is its not important it not but
it is very important utits not out interesting and after you do that you
put you pick at a healing point and you read what you see so rather long
then often you see a c and a apj and sc so you see it c and aij and akac
then in other sea already to c squared and so on you go you get a certain},

{480., you get a certain expression which you can interpret as an expression
in the algebrau you sum over all the indeces that could possibly appear and
the claim is a forein appropriate choice of or and s namely they have to
sentisfy the young poster equation and the foother complicated eventions
you get a noting variant this invariant is valued in the order for you
and if you lucky it's easy to tell apart elements of you okay and so you
achieve the initial goal so the problem is that they use you have to work
with are typically infinite dimensional and then it is very hard to actually
extract information out of sea that to solution is to use representation
theory namely you represent finally the natural representation of you},

{540., l representation of ou and then you replace every element here by a matrix and
everything becomes final dimentional and computer book however you still have the
summations overall jack and a see summation are now bound or bounded by but the
dimension of the representation or reor be teention of the representation squared
in but still you need to compute multiple sons in which the indeces rateso finano
such sums are some over sets on size is growing exponentially in the dimension },

{600., in the dimension of the sorry in the number of crossings of the not and so if
it is is the trefor not like here is easy to compute but it is if it's a hundred
crossing not it's praticly impossible really the big issue here is that you end up
needing to look at tens or powers of representations and tens of powers growing
dimensions exponentially fast and so the problem is very very difficult actually
not theory so let me move aside a bit not tell you sometimes want to do a little
bit more than just computing not in varia so sometimes so somehow you know that

they did not are candies are the rough products or the end result okay but usually you want to decompose them and think of them as made in made out of smaller part},

{660., made out of smaller parts so a time lay and i would not give you formal definition but it can low is a piece of a not drown in a part of the play and basically every note is so how a composition of several can be written as a composition of several ton loids so for example a single crossing is a very simple conte peace made out of cease to strangen this longlish strong going that way is another bigger tung load okay and the point of tobloids are support as opposed to notes is it they admit operations namely for example this complicate the tonloid shown here},

{720., onloin shown here was made by taking a se a simpler one the piece over here and another simpler one name is cook over here and stitching them with each other so there is a certain stitching operation which takes a two components onloyd with one component cold eye and the other cal j and stitches them together or more precisely it takes us two strands in thundroys and stitches stitches them together then there is a strong reverse cooperation as i so this trut you can see you wanted to go downward but i applied to her how it goes upward so it's the only one of the consistent with the flow of the rest in this picture likewise series a strong doubling operation so you could say that this air was created by applying per},

{780., by applying the operation called delta ijk which means takes trot lunger eye delta it double sorry and cold the doctor trans that are resulting jk okay so there is a certain portfolio of operations and when i say for for your operations i mean i don't know it metaoger something like that but don't want to say what it is i just want to say a collection of operations which so isfy some rules and whats the complication them to bright name who cares it doesn't matter right now okay a the tents sorry a there is one more operation in the disjoun union so if you have to conlde you can put that side by side and i will have one big temploy that has two components early},

{840., clearly with these operations the world of ton loids is finitely generated the factit is even finitely presented namely one generator is the war another generator is the crossing and every other tone loid is obtained by taking a hisjoing union of crossings and maybe crops and then stitching them together as appropriate okay so principle if you want an invarion which is well behaved under these operations it's enough to define it on the crossing and on the go now there is an even greater avent advantage to switching to ton los and is the following so you know if you compare with number theory these are like the number one two three for me want to three more },

{900., on to three more you know how exciting or just is just counting number theorists don't really care about five hundred and seventy three number theories care about properties at numbers may or a no top so he is the number a sum of two squares or not and even if you just want to ask this question you must have operations or numbers right a number is some of two squares if it is the result of the sub operation applied to whether what it is but the point that the moment to have operations or nots say stop being a single continuum but you can ask you can also ask about properties that they may or may not have so i'm not going to tell you what this properties are im just going to tell you that there are lovely properties like the genoo and off and whether or enough is a rebon or},

{960., bone or not and this properties become definable the moment you allow yourself to look at these operations as well and against these are like the unalogs of being the sum of the quares and if you want your invarions to

say something good about the genus to be able to tell the genus of an auter
to be able to detect whether knock is root it's clear that it is useful if
they will be well behaved relative to these operations everything and saying
can be made concrete but not in fifteenites a so what i really want is more
than merely an algebra and an ar and c i want a wall portfolio of things},
{1020., of things parallel for young loids namely i want the vetter stay cool
and i wont further moms as in the top row of this diagram namely i want a
multiplication a multiplication map is essentially enough from the tender squared
it is enough from the temper square of the vector space into a single copy of
the vector space and my notation is a bit funny so rather than taking the terms
of square i am taking tensors to the power and to edaman set which really means
that im associating with each tens of fuctor a label just like you may want
to label that compone the strong in a tongo so i need an operation m jigoing},
{1080., i going from you to the ten or j to you to tens or eye normally it would
call it the product likewise i need an operation corresponding to a strong
doubling operation let us call it delta ij going from you to the tensorie to
you to the tenter likewise need an i going this way the struggers corresponding
to the strong reversal operation likewise need two elements see and a but
an element is merely the image of right now back from p into a vector space
that's the same as specifying an element in it so i also want the up from
you to the tems or the empty set to outano square to the tent or j let's
call jrj and likewise a macci from you to the tender depty said to the },
{1140., y said to thetor eye and of course all of these maps must subdespire
some properties which are precisely analogous to the properties
that the corresponding tonloid operations satisfy once you have that
portfolio of operations you can do not theory mean think in your mind
like you can do number theory okay a do a with me so far is this all
right okay so a my way our way instead of using representation theory
to decipher what you do with these uths i want to do something else
so for certain specific algebra so again i will find an ougebra or },
{1200., era or i will find a you with these properties a with the operations on
their foring the problem is a again i would need to be within the process of
computing things will need to be looking at you need to look at tens of towers
of you this growth is plationy in fuse a presentation theory instead i will
restrict my attention to subspaces of these spaces so subspaces of things are
described by a certain type of formulas these subspaces will be put onaldivention
of social dimension will grow polnonially instead of exponentially in the number
of factors that up here here but nevertheless they will be closed under al},
{1260., will be closed under all the operations that care about say we not
however be linear suspaces so i said so spaces should have said subsets
they will not however be in your subspaces and they will not even be
multiplically in the sense of the subspace corresponding to u squared will
not be the square of the subspace corresponding to do to the tens or one
so it really is somehow a different type of algebra okay so a the next few
slides so this one and that one in that wat and that one and make also this
one and that one are actually fully general and i could tell you about
them before specifying the alterbro that i want to actually work with},
{1320., to actually work with however just to be concrete i want to tell you what
is the youth with which i actually work today okay so a because this a process
of replacing powers by formulas a doesn't always work it works on the fore of
specific algebra so the gras i will work with are a bit funny they are solvable

approximations of sea simple the algebra so let me tell you in a minute what is what that is okay so first of all its chemotic picture so there is a completely fate picture of the modulid space of all the algebra so peak a veteral space},

{1380., so be a ventral space feed and look for the set of all brackets you can find on this venter spect so basically the set of only algebra over a fixed vector space bee so a bracket a lip rocket is something which is untisymetric and satisfies the jakobia equation so it satisfies one linear equation in one quadratic equation the doct equation is a quadratic equation an equation on the pocket and so ah the modulary space of neagebras on a vector space be is a certain quadratic variety inside the second tens of power of the vectors of the due of the vector pastents or the vector space named inside the set of all maps from p squared to vand such a map is abrupt would be a rocket so},

{1440., so here is a fake picture of of the modelized space of e brackets on some high dimensional vector spacing namely it is made of one big or a the zero bracket somewhere in the middle that's a completing legitimate bracket it has so big cells somewhere a free algebra searized morphine to s seventeen it has another cell somewhere of corresponding to the abras that are morphic to end never mind the fact that there isn't an outer treaty in this is a schematic safe picture and here is another cell of liaga bars orphin to evise now sees legabra this so called semising the algebra are well known to be rigit and the meaning of brigid is if you perturb them in},

{1500., is if you perturb them a little perturb of a little bit and still get a yanda brok the result is the same leagera so see three cells of seventeen inine and an are open sets to which really means that if you sit for more in the middle and you look around you you see something boring always you see the same way however they still have boundaries so if you sit on the boundary of one such cell you may be able to the form into that set in the algebra so im looking at a really well passers of algebra but the parameterized by for parameter axion and i care about this puncess near epion equals to zero so i care about well a small ma},

{1560., be a small neighborhood of a point in the boundary of the cell corresponding to a semisineagra and how it the forms into that semi simple legebra okay that was a schematic picture here is a slightly less schematic a version of the same thing so let me look for example of chile so for celn it turns out it if you want to understand chilland it's enough to understand half of god and the same is true for all semi simply atoposit you want to understand gets enough to understand half of ename leads uper bore a satada may so genin he's roughly specking the direct some of the upper triangular in the lower trial clar matrices and really i lied a little bit because they they ago now the so call cure so called curtains about a got doubled but},

{1620., double but modeus money gen is the direct sum of the up of the upper travelers in the lower tramplers and sees two anebrather are tuned to each other so it's enough to understand one of them namely if you look at just the upper triangular matrices so this some algebra it has a bracket called p its a subargas because e brocket but in addition there is a bracket on his turn space which means that if you tuilize you get the cobrocket or a up delta going from humper translot to offer drive or tens or upper gig and it turns out to if you know be in denta you can recover ah all of giny again with an extra divine factor },

{1680., so what we do is instead of recovering giel from the parbdata we take the death apart and he iplied by exilon and then apply the same recovery process the result is so basically we take the double of the apertagular house matrices using the original bracket and exit all times the cobrocket

the result is a newly algebra in which everything depends on exiton epion
equals to one you get the oldly agebra you get in a leg was to zero you
get something very funny and in fact it's always so about and and what
we tend to do is to look at at a caution in which epilon to some power},
{1740., which exilon to some power is made to be zero so we look at of neighborhood
anything in teim neighborhood of absolon equals to zero and it turns out that
the algorist together are always solvabout yet they approximate the original
jaren better the a better and better the higher caves and again i'm sorry that
i have to be schematic but i only have wefty one minutes remaining common
questions so specifically in our case we just do it doing or an x is a three
dimensional artero half opi is two dimensional so it is generated by two
generators and ext you double it you get the foreensional thing and here are the
specific computation relations that you get and then there is a more procedure
that takes hours to describe and is very computated than he called one type},
{1800., one types using standard tools and as a result you get the tebroad
racecare about cute oxidon fees of absolutely the do of the previous slides
and manit doesn't matter how it came just told you how it came about but
ateend it's a very specific other body four dimensional algebra generated
by four generators why add is central sode competitors with anything
is equal to zero and then there are specific commutation relations for
the for the other things and i didnt write it here though it appears on
page three of your handop there is also a cop product and an antipoden s
sorter is a dealt is and all the ingredients one and even an ar and co},
{1860., n clock okay so talk to generalities so they are this specific algebra
and in general the ebras that arise inquatum boots always have a so called
pbw basis which amounts the same that they are describable in terms of
semetriculture broth or polynomes aly so if you have an algebra generated
by so if you is generated by generators x and y and so on you can look at
the symmetric algebra with generators exagaic once the same that we're just
looking up to plenoma for maybe power series in the variables x and y and
if you choose an order to the generators you get them up from here to hear},
{1920., from here to hear so you get the map which i called the ordering map
which depends on choosing an order for the generators so for example the ordering
map in the order why applied to ex the seven wie to the thirteen will simply take
this commutative poliomial the domain of the ordering app is commutative polionial
and will not be into a known community poliol in which you wrote the generators
in the order specified in the subscript here so you will be writing you this
will be happed to y to the thirteen x to the seven oy and they for the algaps i
hear about including the land ring up here is ordering knop our sector space },
{1980., our sector space is orpis they are not algebra so more risms of course
because this one is communitie and this one is not from you to them but is
there are vector spaces of orfisms so basically for not a for now as give
you names for all the elements here okay a so this means is that the no
commutative portfolio of operations that we have here can be translated to a
commutative portfolio of operations so it part for of operations and elements
leaving in symmetric algebras corresponding with generators corresponding
to the generators of this imagriculture bus the moment you choose ordering
specific order in maps the problem is a cease operations the notification an},
{2040., the motifications and the come duplications of all the elements become
very complicated right because well i to what might have been simpler from here
and an it imported a twist to incler spaces but the prices of the operations

get complicated a maybe one more thing so about location so b is supposed to
be a set of generators of it so if i want to make if i want to map into you
then i mean to mark from the symmetry age but with generators corresponding
to the generators of you and my convention will be that if i'm looking at you
to the tems or jac so two copies of you one label ja and one they ou i will},
{2100., i will label the generators a yjxj it aris hot subscripts to degenerators
a then the substricts will be jank the sense of generators will be called bj
and b and if we want to look up you to the ten or cheek ja that commutative
analog or the metry contr corresponding to it will be the symmetric
counterbap on generators p sufj coma be subky which means two copies of the
original set of generators one labor jack in one level k and what i really
need to understand now is maps or all kind need to be able to understand
inplemen compute values complicated maps between cemetry thusa both with
generators bey and cemetriculters with generated with bj communitic ca},
{2160., ah so here is a slide of pro showing too much detail so basically what
i need to understand is the more reasons between s of b and so prime were nd
primes or two sets titically bi and but or something like that okso by standard
lineariba this is the symmetricalura of p tube tenson the symmetry argibrap
prime and i'm thing lazy to tell you that certain things need to be completed
am not worrying about this about completions this point is a schematic now
the symmetricarder room be you is the symmetric so inthe tude of the symmetry
controvers again a symmetric culture br only tual collection of variables and
my convention will be up if if then if the elements in the are denoted by },
{2220., are denoted by luting letters then we will have the same letters but make
greek so see will become sea become side and so and the symmetry carbon d tens out
ero is the same of the symmetric altibl of the union of plant price which is the
same as the set of pullnoas or maybe power series because it wasn specific about
complitions in variables seta i corresponding to the elements of p so the elements
of beaten greek and zati prime corresponding to the lements of the pride and then
a so basically mobore reasons are pornomials in greek and lot in variable or many
power series in greek and nutty variables and ito tell you how to compose to home},
{2280., to compose to home orphisems so suppose you have a moorfice and find
orphism g and a corresponding ponomial power series is in till at which
is in variable sins a broad and cjec so sent and that a from and in other
morphis ge whose correspond on from power series is tild which is a faor
comer series in that crime and s car double from how do you compose them
so its attle exercise to check that well chematically what you do is you
par the love teams of s with the greeks of gend and pair in all possible
ways which are consistent with the induces or said differently you},
{2340., se differently you take gitla and you replace every greek letter by a
differentiation with the corresponding lacking that oue the differential
operator you applie to s has this is lefting variable lucky letters of
variables appearing into a so it makes sense to a large defential operator
to that power series and then you make it a complete part but by setting
of sets to zero after apply the differential operation this is completely
equivalent to take in f and replacing all the lucky letters in it by great
but defraciations with respect to the greeks and then setting all the greeks
to zero okay i hope you're still with me and i hope i'm not installing
insofting anybody or lackin is okay i just think with me shape stre},
{2400., strict subspaces or subset rules to sati all of this is happening well
am not quite telling you in which completion is is opening for each to make so of

the level of nonals it totally makes sense a cities the things i have tile will
be power serious and convergence will be an issue but am not specific enough to
tell you at the moment how to resolve this okay good lets do a few examples so
first of all dendic identity map is about from met recoldre in the variable to
the symmetric to symmetry on a variable and you can check that the corresponding
tower series where it should be a power series in this zeter grape so it shou},

{2460., great so it should be a power series in s and set top and you can change
the list exponential of time set it's basically that story away center will
become differentiation or center gets paired with whatever you apply the identity
too and then every time you can resent up with the s you get another replacing
it from the s time as appears here so then you do nothing ok then there is the
retapewold duplication so the multiplication map is about from as of t terms of
an oce into so and i are talking about the commutative multification of the},

{2520., commutative antification of the esiation but here's a better way of wing
it so first of all at the indusis here i and j and other indexir cases are just
renaming the variable thats nothing and then this is the symmetrical of cincj and
you have a map into the cementry calger brocking de and its really the map which
maps sin the cj to ck he props both variables to zk so you if you have a sea here
in becomes a sea carvers here in becomes a se that's what multification does okay
ain then it's easy to check something corresponding our series is in to the ck
shig plus jopsoryet i plus stageso the inputs become great and output remains a},

{2580., and the output remains rating and we tuat semilar resers the archetypeo
core product which marks the symmetry calebone i to the cymatriculture one janc by
mapping cit j glasc or the most under lotation to if the co product of contents
and you can check that the corresponding power series is this exponential and if
you the secretor appears here is that this is a quadrotic exponential uadratic
so hautia this is the exponential of equadratic so eduction and this is a
goussion as well so far the causions on only mix greeks and datings you the only
pair grieks and nothings but in fact if you look at our matrices he don't need
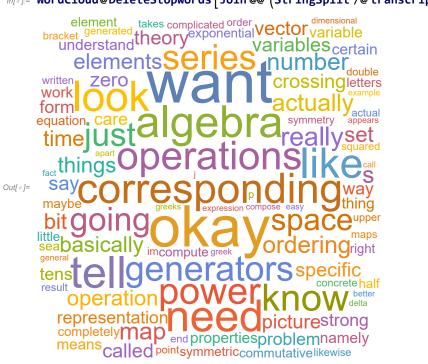to know what usually look like but they typically have elements of the form },

{2640., elements of the form written here and the corresforming cogulative
analogue is a gasia in which to breath it to lacky letters of here and
finally when you know a sin were dealing with ordering monomials and clear
way if we will want to multiply them using the conqueetative product we
will need to reorder and here is the simplest example of a reordering
map so the five form of the economical commutation relations takes so
the exponential of center x times the exponential try is equal to the
expression written here in a philologybrop so in an arguba in which the
propet of iden is t times the identity if you think about it a little bit you
realize that the reordering map which comes that ordering the xid ordering},

{2700., ordering the xy ordering to the or to the ordering the yx ordering becomes
the power series in which you get two great letters a look out with each other so
in general you get completely general of gusions and the thing i need to do is
to learn how to compose completely general gasias using the composition law is
written here so the truth is more complete the truth is actually more complicated
so in the algebra we care about the actual rij the actual end the actual delta on
the actual s are an also see with a sort of very quico here a or or not as simple},

{2760., or not as simple as the ones written here but if you look at the athem
closely the tools they look like gausian so the exponential of quadrotics
multiply by multipled by perturbations so how are serious in exilon so in
fact when actual equas to zero you get pure options but more generally he

went at face place we care about is near the but not wite zero you get power
series an epilon in which the coefficients are more or less polnonias in all
the variables at care and a yeah the infect the program that on your undo
compute all this from scrap radia so it as a completely effective okay what },
{2820., w we not only for us is to imprint the basit work for all am i simply
alterpain associathe other budgets or the lastyears or steer the point of
coat of crime boses cure anyway a society line to you because our foros
conficients here they the craffic as and the upper place and note to what
they are it works okay how much time do i have about three minutes so ill
go very quickly somehow what we need to do is to her so and after half an
allower half so we have to morphism we want to compose them we want to par},
{2880., we will compare the greeks of this one with the luckies of that one and
it turns out that he's much easier to do it one by one then all at once the
problem is an if you took some of the variable first and keep the rest for
later what you have is going to see something which is not made of to destroy
components so as in its in the computation you need to seep rather than find
and seeing also has a men so basically if you have a polomiale both breaks
and lucky letters then seeing the variable means carrying internally the
centers of the senters with the corresponding seas and again this also can ite
differential operator so basically you substitute into the zetas do you write to},
{2940., dets you write up to the left so than asit here or maybe a plain here
rising to the applien to the ones of the right and in the substitute or nothing to
e so we eser is this internal seeping which is roughly of which is schematically
this operation internal sig so i have completely concrete formulas for internal
sp and again intern it in is stronger than what we need is more than at and
basically the a running out of time so the formula look like so if you want to
do cing with respect to some collection of variables to an expression which is a
cousian porticide by a perturbation so the perturbation has to have finite to},
{3000., t has to have finites degree in at least one of the collections of art
appears in it then a there is a completely concrete formula to do it which at the
end invo so again im not even going through it but it all only involves inverting
a matrix and here is the proof but of course i'm not going through it and there
is a complete implementation and so this is put aside from the main bit of code
but if you would look at the main beat of code you will find that it appears me
twice and the reason is that each reality we need to do the seting into phases so
how there are two sets of forables the cut time variables and the fore variables
and what you get its much better to do the seting first of the cartons and},
{3060., e first of the cartons of the brand a lot of time so so the detail be
here then there is a hall discussion about why in our case all the power
series are so condosile dotile means that power secres in emcilon if you
look at the coefficient of exon k the corresponding cofficient which is a
no lot of vorable half boutin the green and i skip the precise definition
but only tell you why this is valuable this is valuable these the runk of
the state of docile series is actually prosecute nomially in the number of
copies of the leagebus you you care about rather than exponentially and in
fact you can start seeing it already when you look at the quadratic term so},
{3120., the quadratic term so the number of quadrotics in envariable growth
like in squared where which is potionian so the number of quadratics is
relatively small where are powers of ten two dimentional representation grow
requite and that's why everything is attend a very very quick and computable
and i'll end with my or footing from aganda and i'm three minutes over time
and put no two and half minutes over time and a cice a}, {3180., thank you fo}}

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Out[⊘]=