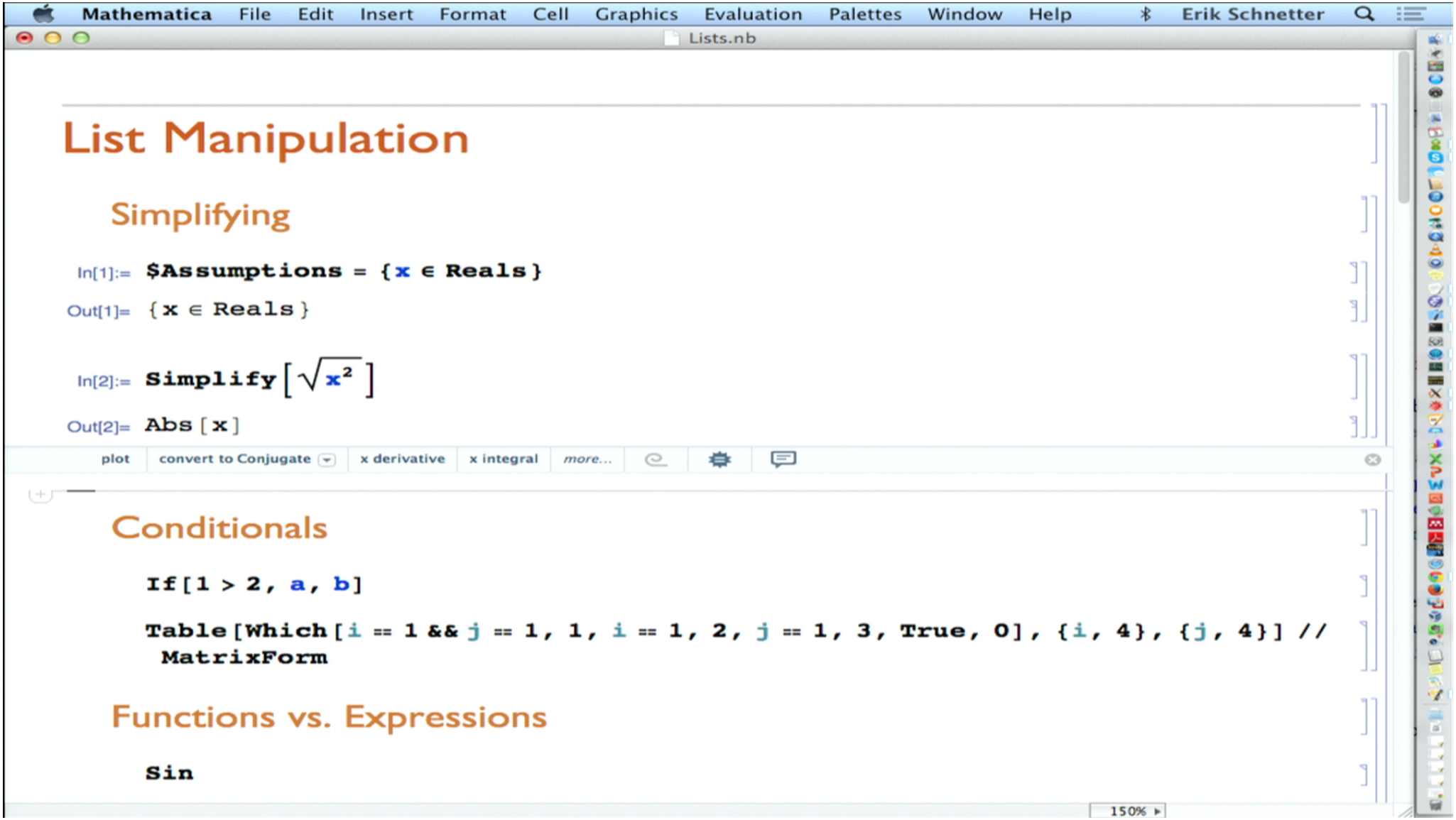
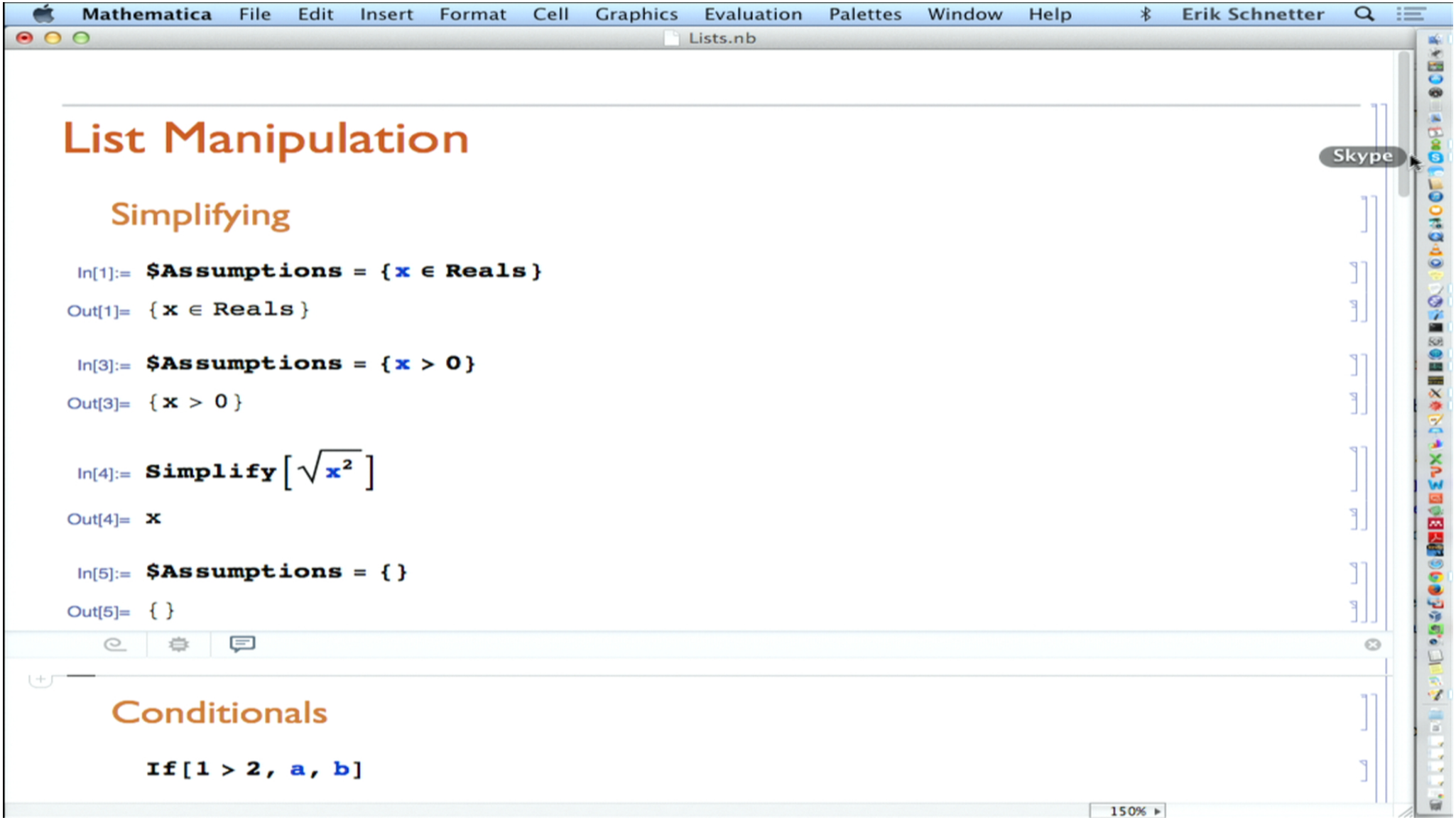
Title: 14/15 PSI - Mathematica

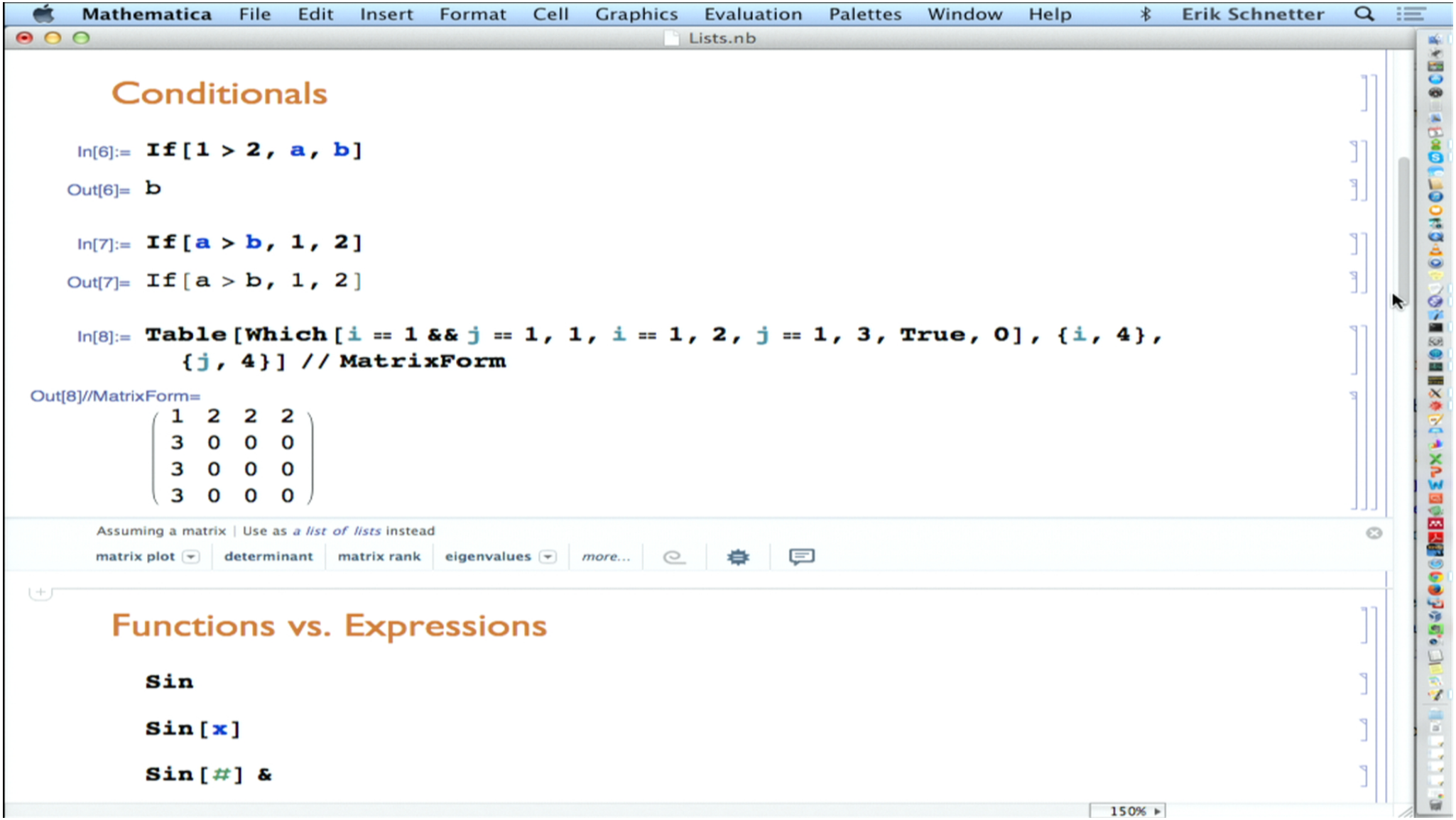
Date: Sep 03, 2014 10:30 AM

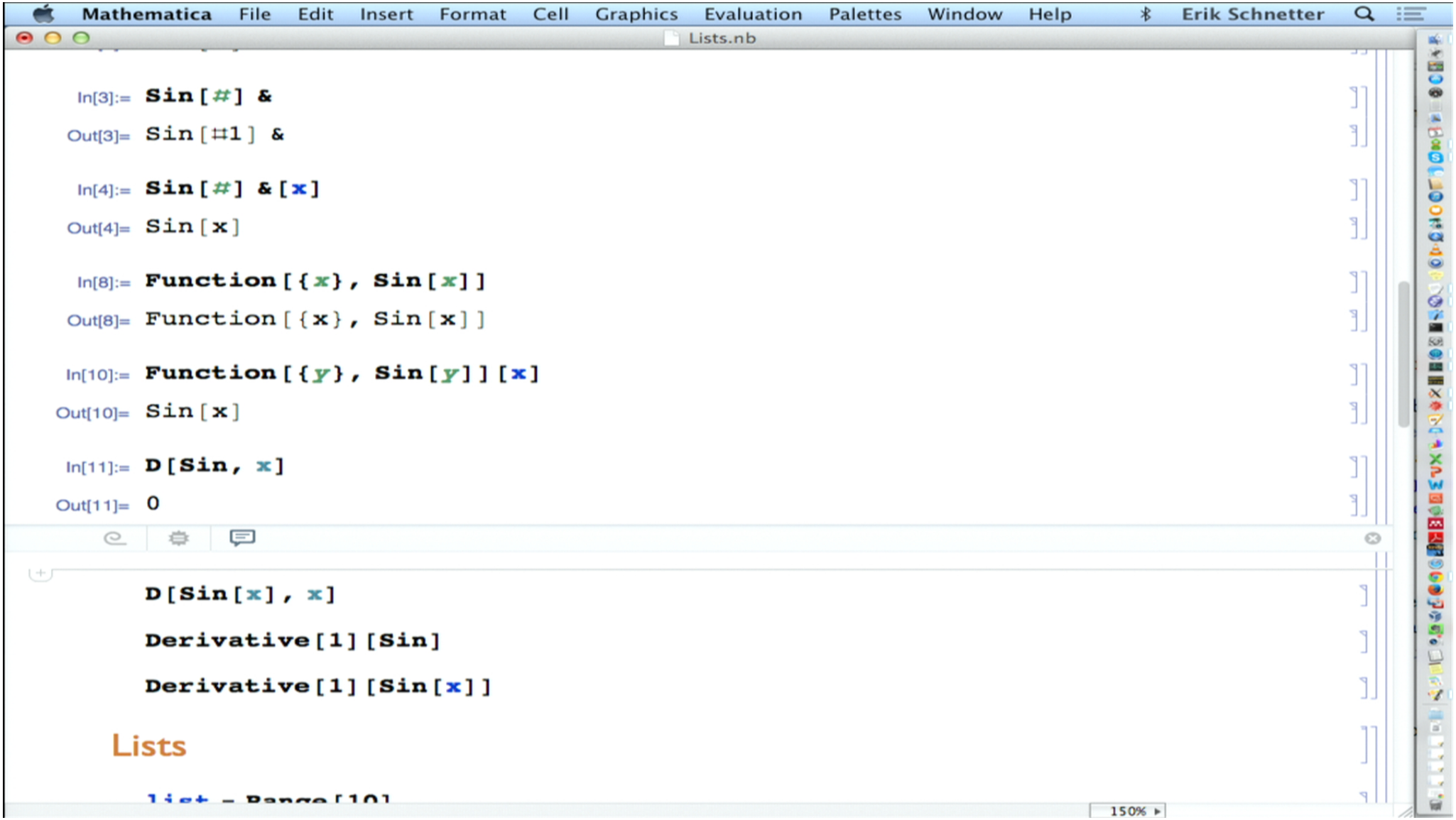
URL: http://pirsa.org/14090038

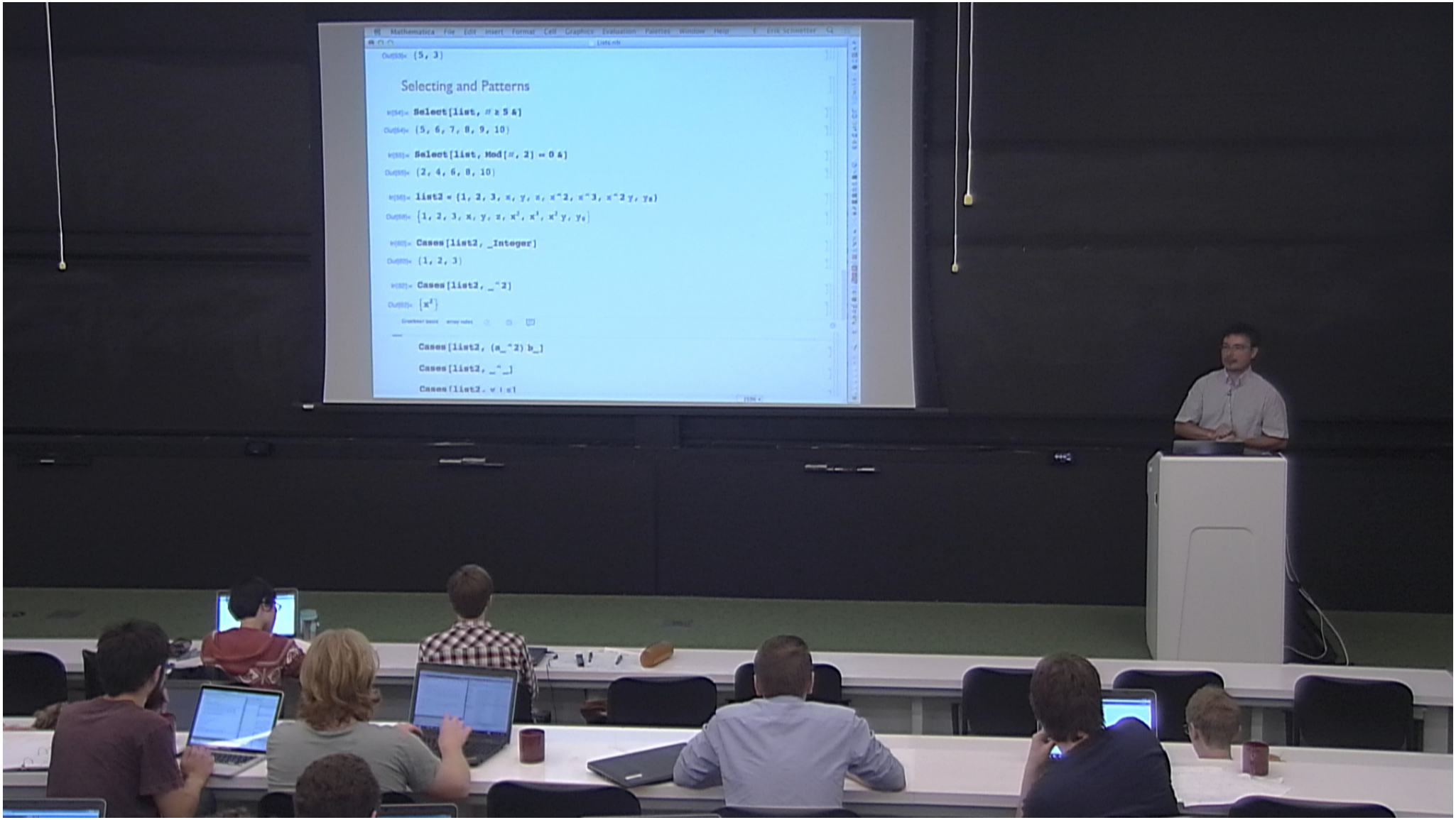
Abstract:

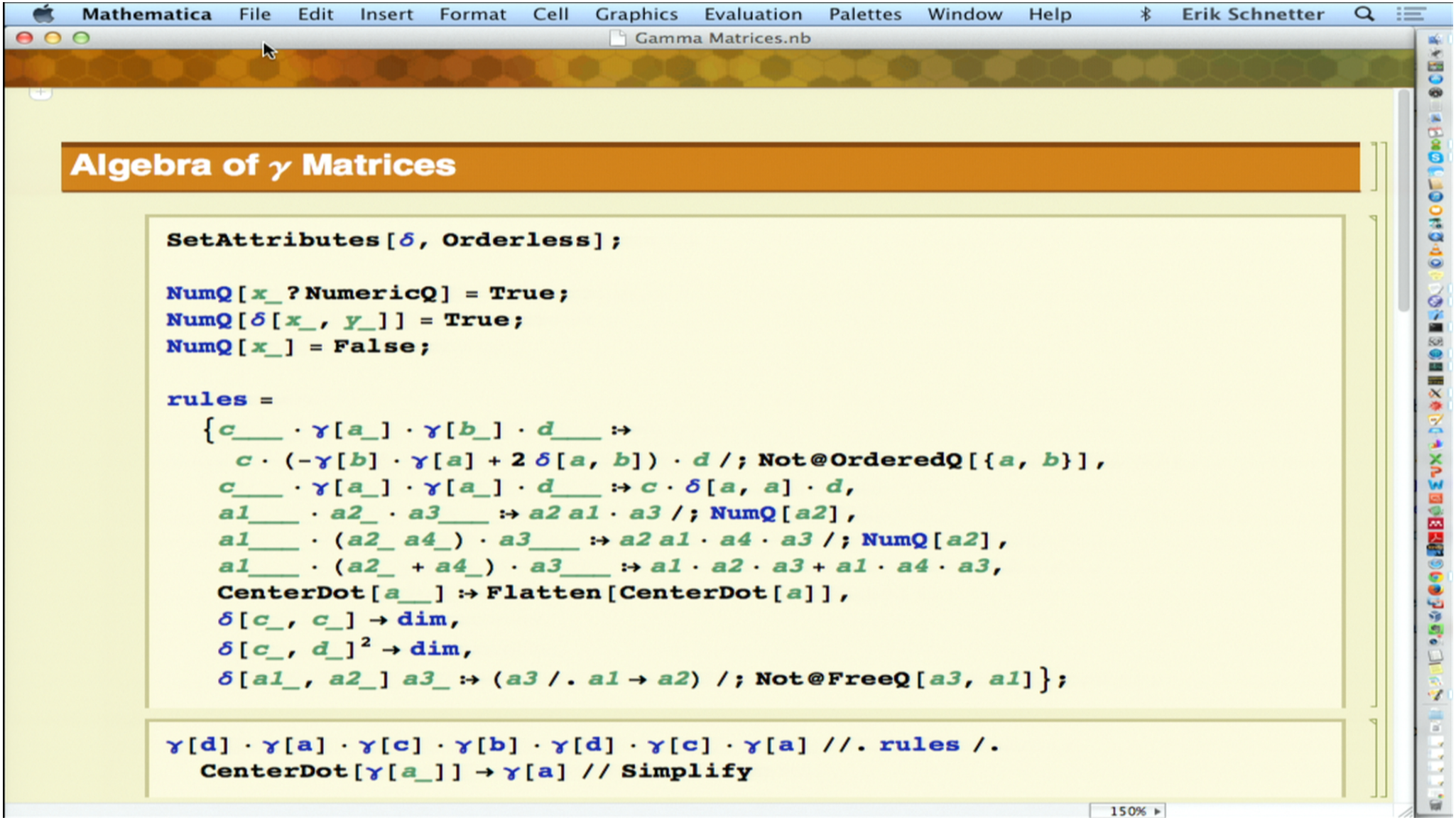

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Lists.nb
List Manipulation
Simplifying
In[1]:= $Assumptions = {x ∈ Reals}
Out[1]= {x ∈ Reals}
In[2]:= Simplify[√x²]
Out[2]= Abs[x]
plot convert to Conjugate x derivative x integral more...
Conditionals
If[1 > 2, a, b]
Table[Which[i == 1 && j == 1, 1, i == 1, 2, j == 1, 3, True, 0], {i, 4}, {j, 4}] // MatrixForm
Functions vs. Expressions
Sin
150%

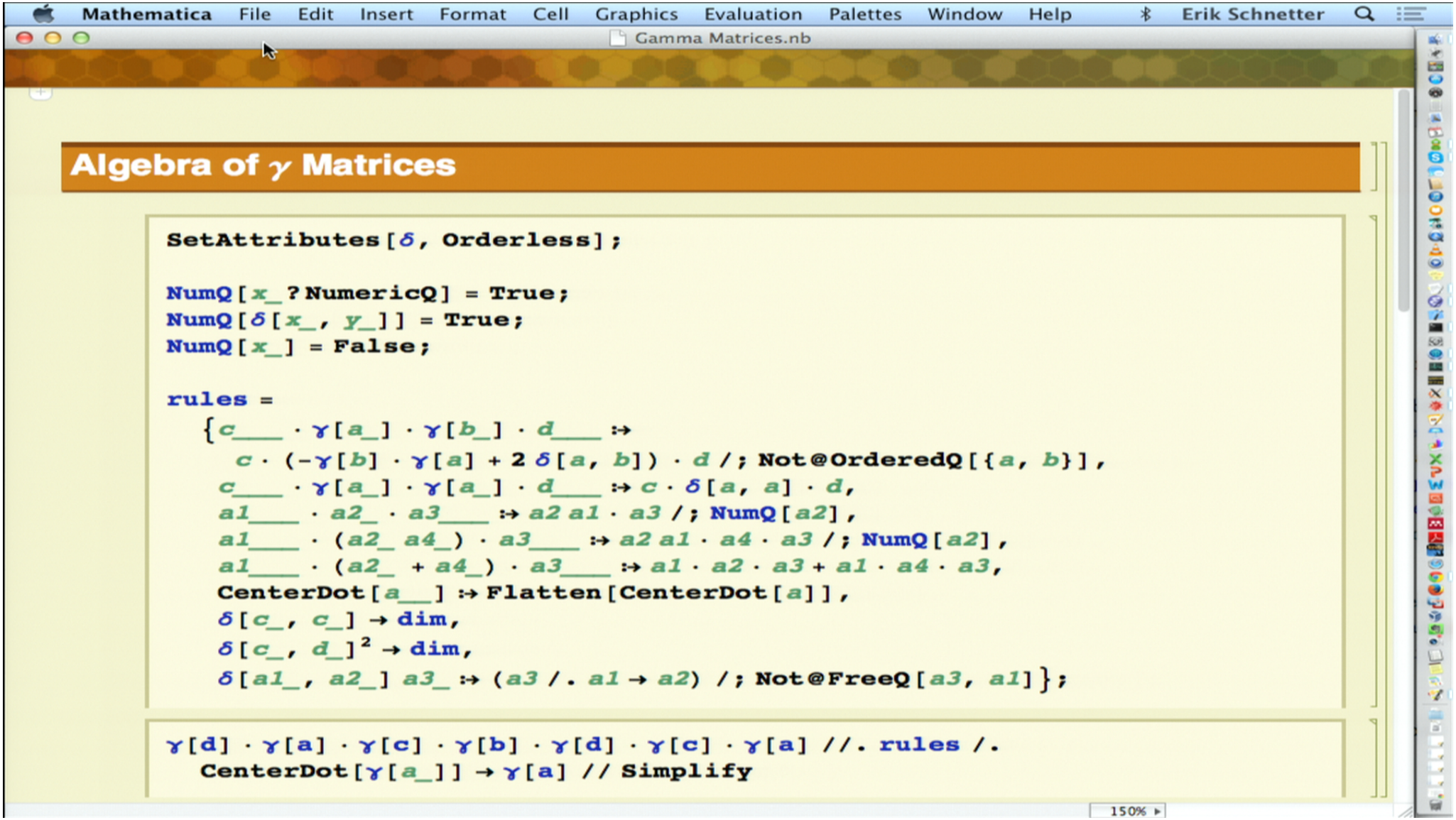

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Lists.nb
List Manipulation
Skype
Simplifying
In[1]:= $Assumptions = {x ∈ Reals}
Out[1]= {x ∈ Reals}
In[3]:= $Assumptions = {x > 0}
Out[3]= {x > 0}
In[4]:= Simplify[√x²]
Out[4]= x
In[5]:= $Assumptions = {}
Out[5]= {}
Conditionals
If[1 > 2, a, b]
150%


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Lists.nb
Conditionals
In[6]:= If[1 > 2, a, b]
Out[6]= b
In[7]:= If[a > b, 1, 2]
Out[7]= If[a > b, 1, 2]
In[8]:= Table[Which[i == 1 && j == 1, 1, i == 1, 2, j == 1, 3, True, 0], {i, 4}, {j, 4}] // MatrixForm
Out[8]//MatrixForm=
1 2 2 2
3 0 0 0
3 0 0 0
3 0 0 0
Assuming a matrix | Use as a list of lists instead
matrix plot | determinant | matrix rank | eigenvalues | more...
Functions vs. Expressions
Sin
Sin[x]
Sin[#] &
150%


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Lists.nb
In[3]:= Sin[#] &
Out[3]= Sin[#1] &
In[4]:= Sin[#] &[x]
Out[4]= Sin[x]
In[8]:= Function[{x}, Sin[x]]
Out[8]= Function[{x}, Sin[x]]
In[10]:= Function[{y}, Sin[y]][x]
Out[10]= Sin[x]
In[11]:= D[Sin, x]
Out[11]= 0
D[Sin[x], x]
Derivative[1][Sin]
Derivative[1][Sin[x]]
Lists
150%


Selecting and Patterns
Out[53]= {5, 3}
In[54]:= Select[list, # ≥ 5 &]
Out[54]= {5, 6, 7, 8, 9, 10}
In[55]:= Select[list, Mod[#, 2] == 0 &]
Out[55]= {2, 4, 6, 8, 10}
In[58]:= list2 = {1, 2, 3, x, y, z, x^2, x^3, x^2 y, y6}
Out[58]= {1, 2, 3, x, y, z, x², x³, x² y, y6}
In[60]:= Cases[list2, _Integer]
Out[60]= {1, 2, 3}
In[62]:= Cases[list2, _^2]
Out[62]= {x²}
Cases[list2, (a_^2) b_]
Cases[list2, _^_]


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Gamma Matrices.nb
Algebra of γ Matrices
SetAttributes[δ, Orderless];
NumQ[x_?NumericQ] = True;
NumQ[δ[x_, y_]] = True;
NumQ[x_] = False;
rules =
{c___ · γ[a_] · γ[b_] · d___ :→
c · (-γ[b] · γ[a] + 2 δ[a, b]) · d /; Not@OrderedQ[{a, b}],
c___ · γ[a_] · γ[a_] · d___ :→ c · δ[a, a] · d,
a1___ · a2_ · a3___ :→ a2 a1 · a3 /; NumQ[a2],
a1___ · (a2_ a4_) · a3___ :→ a2 a1 · a4 · a3 /; NumQ[a2],
a1___ · (a2_ + a4_) · a3___ :→ a1 · a2 · a3 + a1 · a4 · a3,
CenterDot[a__] :→ Flatten[CenterDot[a]],
δ[c_, c_] → dim,
δ[c_, d_]^2 → dim,
δ[a1_, a2_] a3_ :→ (a3 /. a1 → a2) /; Not@FreeQ[a3, a1]};
γ[d] · γ[a] · γ[c] · γ[b] · γ[d] · γ[c] · γ[a] //. rules /.
CenterDot[γ[a_]] → γ[a] // Simplify
150%

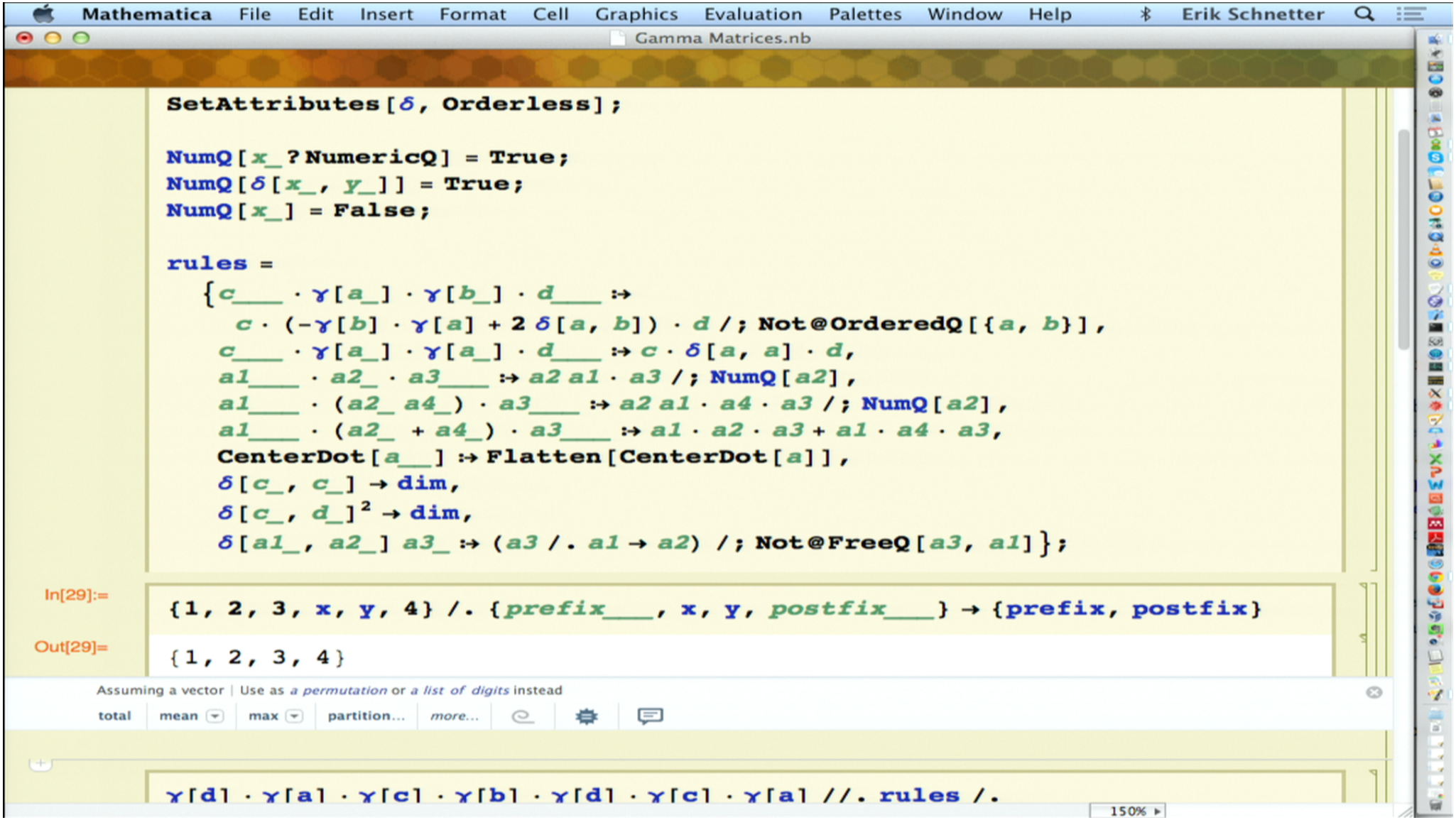

Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Gamma Matrices.nb
Algebra of γ Matrices
SetAttributes[δ, Orderless];
NumQ[x_?NumericQ] = True;
NumQ[δ[x_, y_]] = True;
NumQ[x_] = False;
rules =
{c___ · γ[a_] · γ[b_] · d___ :→
c · (-γ[b] · γ[a] + 2 δ[a, b]) · d /; Not@OrderedQ[{a, b}],
c___ · γ[a_] · γ[a_] · d___ :→ c · δ[a, a] · d,
a1___ · a2_ · a3___ :→ a2 a1 · a3 /; NumQ[a2],
a1___ · (a2_ a4_) · a3___ :→ a2 a1 · a4 · a3 /; NumQ[a2],
a1___ · (a2_ + a4_) · a3___ :→ a1 · a2 · a3 + a1 · a4 · a3,
CenterDot[a__] :→ Flatten[CenterDot[a]],
δ[c_, c_] → dim,
δ[c_, d_]^2 → dim,
δ[a1_, a2_] a3_ :→ (a3 /. a1 → a2) /; Not@FreeQ[a3, a1]};
γ[d] · γ[a] · γ[c] · γ[b] · γ[d] · γ[c] · γ[a] //. rules /.
CenterDot[γ[a_]] → γ[a] // Simplify
150%

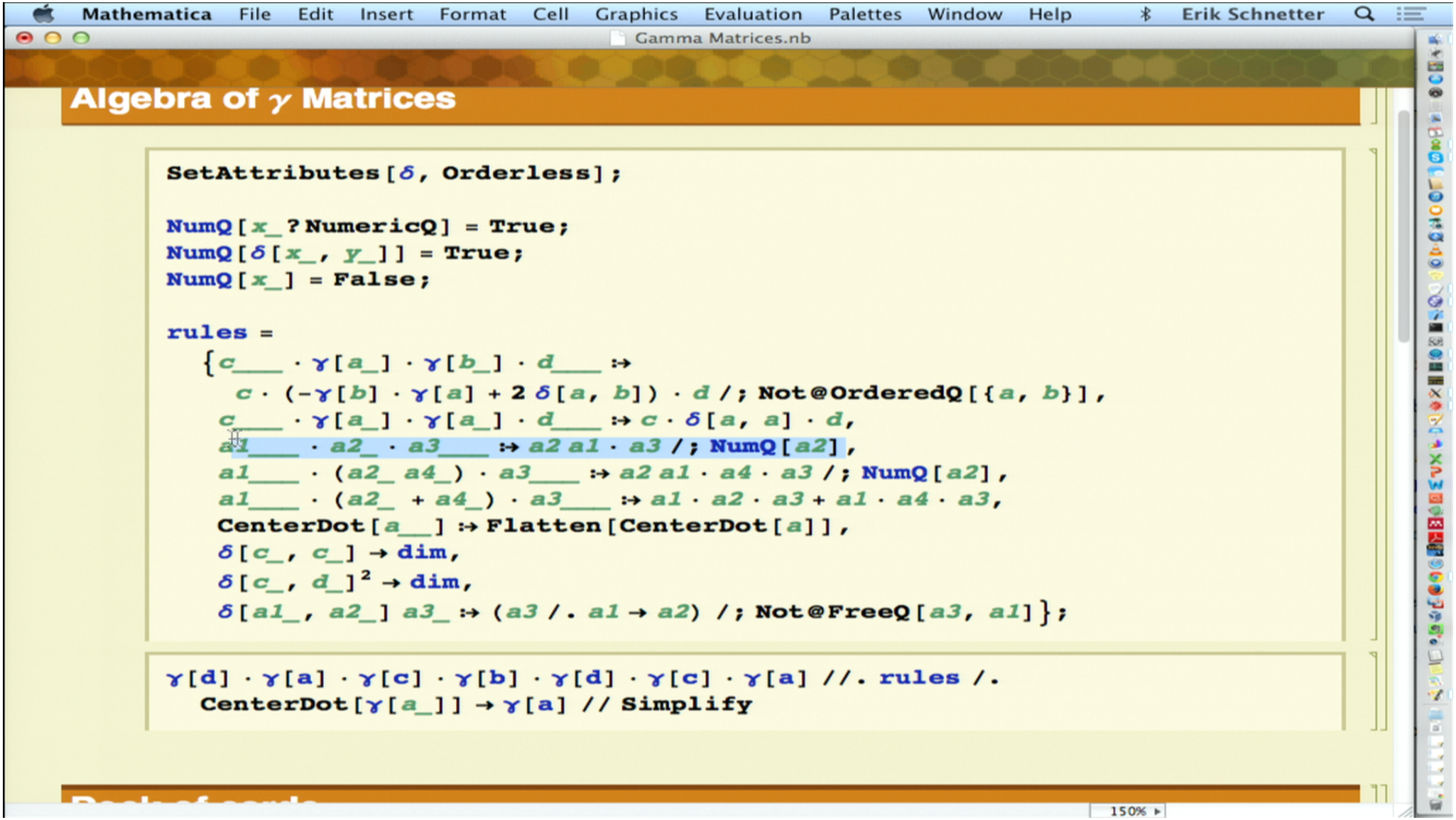
Algebra of γ Matrices

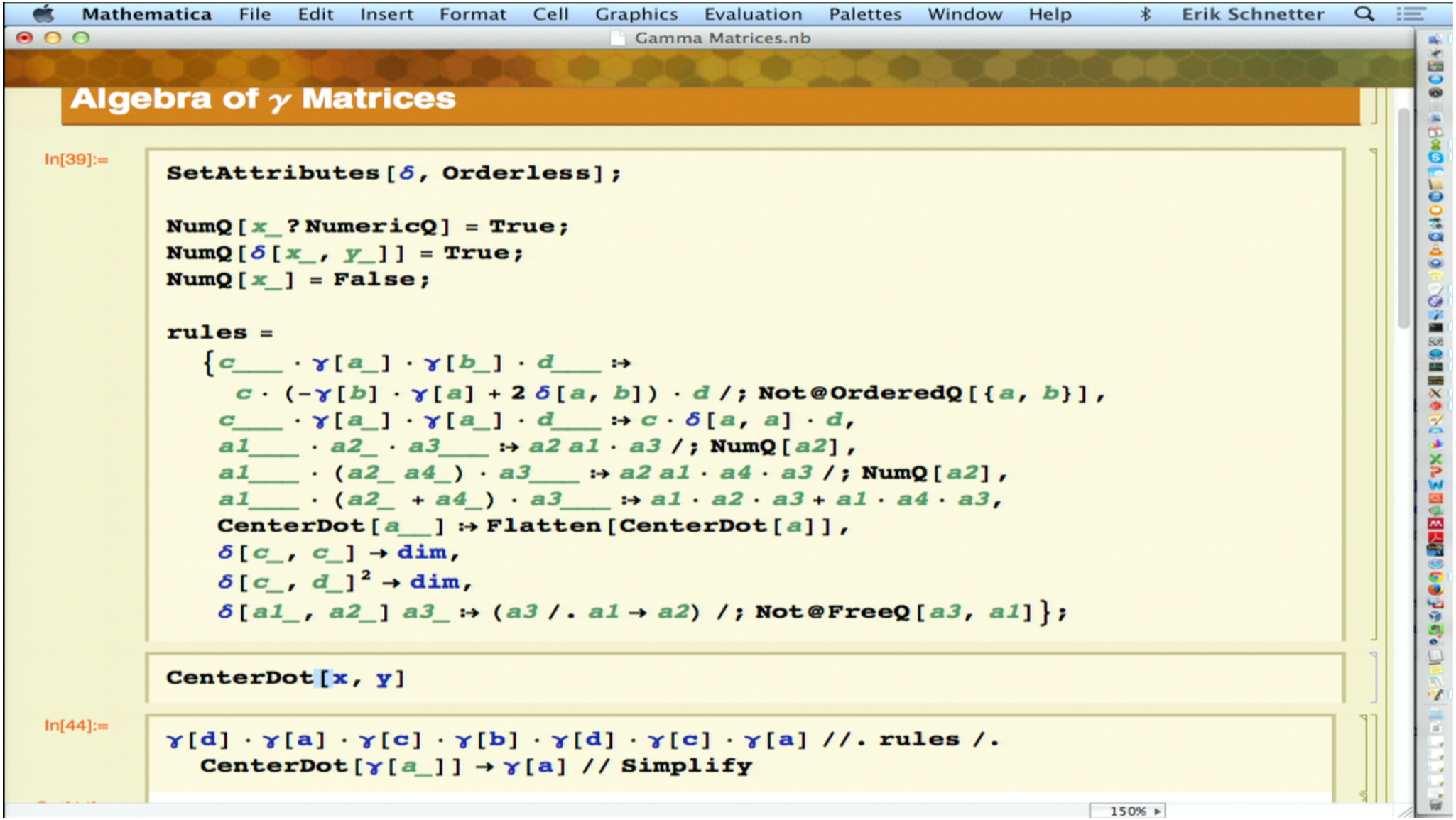
```
SetAttributes[δ, Orderless];

NumQ[x_?NumericQ] = True;
NumQ[δ[x_, y_]] = True;
NumQ[x_] = False;

rules =
  {c___ · γ[a_] · γ[b_] · d___ :>
    c · (-γ[b] · γ[a] + 2 δ[a, b]) · d /; Not@OrderedQ[{a, b}],
   c___ · γ[a_] · γ[a_] · d___ :> c · δ[a, a] · d,
   a1___ · a2_ · a3___ :> a2 a1 · a3 /; NumQ[a2],
   a1___ · (a2_ a4_) · a3___ :> a2 a1 · a4 · a3 /; NumQ[a2],
   a1___ · (a2_ + a4_) · a3___ :> a1 · a2 · a3 + a1 · a4 · a3,
   CenterDot[a__] :> Flatten[CenterDot[a]],
   δ[c_, c_] → dim,
   δ[c_, d_]^2 → dim,
   δ[a1_, a2_] a3_ :> (a3 /. a1 → a2) /; Not@FreeQ[a3, a1]};
```

```
{1, 2, 3, x, y, 4
```

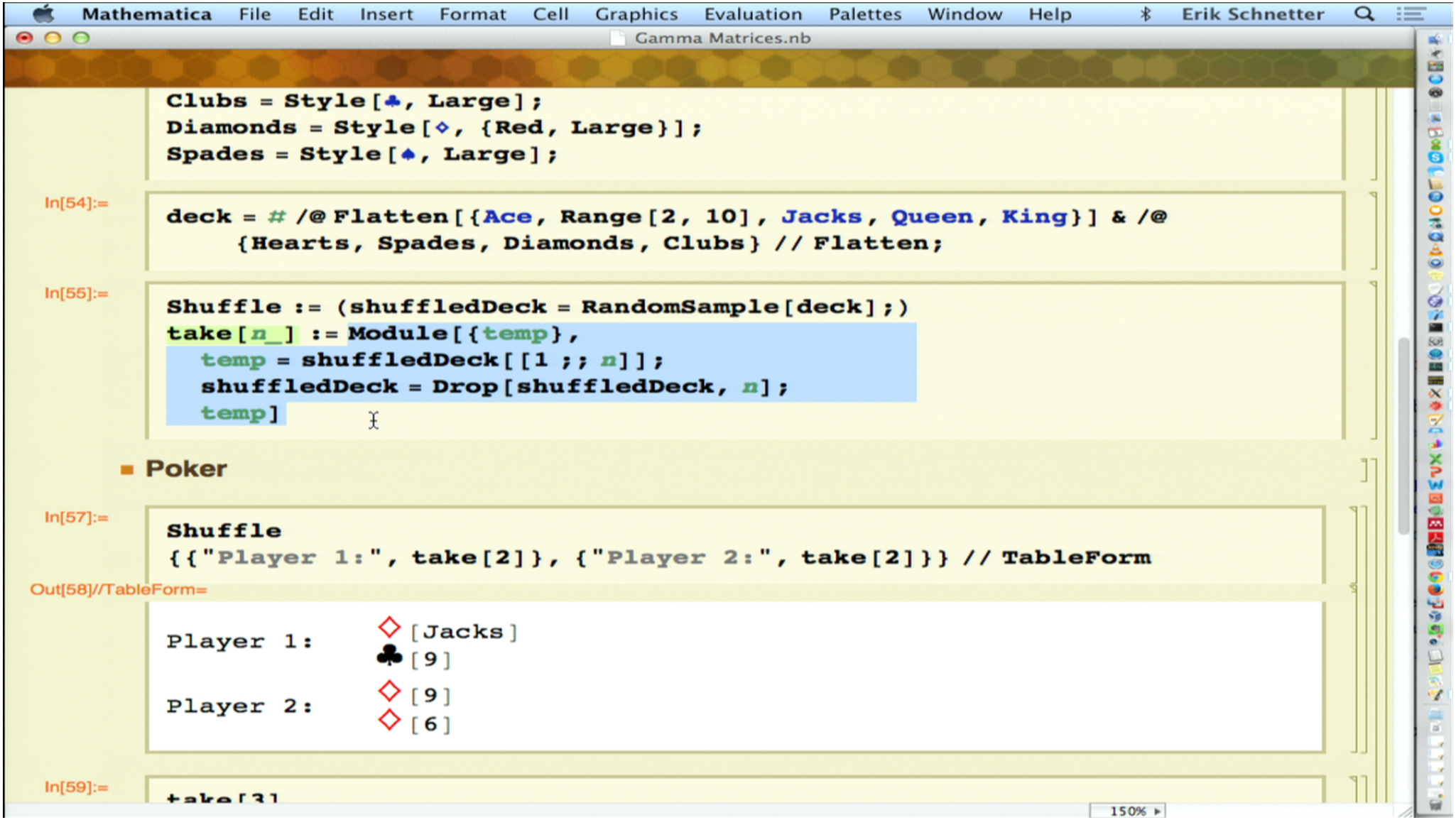
```
γ[d] · γ[a] · γ[c] · γ[b] · γ[d] · γ[c] · γ[a] //. rules /.
  CenterDot[γ[a_]] → γ[a] // Simplify
```


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Gamma Matrices.nb
SetAttributes[δ, Orderless];
NumQ[x_?NumericQ] = True;
NumQ[δ[x_, y_]] = True;
NumQ[x_] = False;
rules =
{c___ · γ[a_] · γ[b_] · d___ :>
c · (-γ[b] · γ[a] + 2 δ[a, b]) · d /; Not@OrderedQ[{a, b}],
c___ · γ[a_] · γ[a_] · d___ :> c · δ[a, a] · d,
a1___ · a2_ · a3___ :> a2 a1 · a3 /; NumQ[a2],
a1___ · (a2_ a4_) · a3___ :> a2 a1 · a4 · a3 /; NumQ[a2],
a1___ · (a2_ + a4_) · a3___ :> a1 · a2 · a3 + a1 · a4 · a3,
CenterDot[a__] :> Flatten[CenterDot[a]],
δ[c_, c_] → dim,
δ[c_, d_]^2 → dim,
δ[a1_, a2_] a3_ :> (a3 /. a1 → a2) /; Not@FreeQ[a3, a1]};
In[29]:=
{1, 2, 3, x, y, 4} /. {prefix___, x, y, postfix___} → {prefix, postfix}
Out[29]=
{1, 2, 3, 4}
Assuming a vector | Use as a permutation or a list of digits instead
total mean max partition... more...
γ[d] · γ[a] · γ[c] · γ[b] · γ[d] · γ[c] · γ[a] //. rules /.
150%


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Gamma Matrices.nb
Algebra of γ Matrices
SetAttributes[δ, Orderless];
NumQ[x_?NumericQ] = True;
NumQ[δ[x_, y_]] = True;
NumQ[x_] = False;
rules =
{c___ · γ[a_] · γ[b_] · d___ :→
c · (-γ[b] · γ[a] + 2 δ[a, b]) · d /; Not@OrderedQ[{a, b}],
c___ · γ[a_] · γ[a_] · d___ :→ c · δ[a, a] · d,
a1___ · a2_ · a3___ :→ a2 a1 · a3 /; NumQ[a2],
a1___ · (a2_ a4_) · a3___ :→ a2 a1 · a4 · a3 /; NumQ[a2],
a1___ · (a2_ + a4_) · a3___ :→ a1 · a2 · a3 + a1 · a4 · a3,
CenterDot[a__] :→ Flatten[CenterDot[a]],
δ[c_, c_] → dim,
δ[c_, d_]^2 → dim,
δ[a1_, a2_] a3_ :→ (a3 /. a1 → a2) /; Not@FreeQ[a3, a1]};
γ[d] · γ[a] · γ[c] · γ[b] · γ[d] · γ[c] · γ[a] //. rules /.
CenterDot[γ[a_]] → γ[a] // Simplify
150%


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Gamma Matrices.nb
Algebra of γ Matrices
In[39]:=
SetAttributes[δ, Orderless];
NumQ[x_?NumericQ] = True;
NumQ[δ[x_, y_]] = True;
NumQ[x_] = False;
rules =
{c___ · γ[a_] · γ[b_] · d___ :>
c · (-γ[b] · γ[a] + 2 δ[a, b]) · d /; Not@OrderedQ[{a, b}],
c___ · γ[a_] · γ[a_] · d___ :> c · δ[a, a] · d,
a1___ · a2_ · a3___ :> a2 a1 · a3 /; NumQ[a2],
a1___ · (a2_ a4_) · a3___ :> a2 a1 · a4 · a3 /; NumQ[a2],
a1___ · (a2_ + a4_) · a3___ :> a1 · a2 · a3 + a1 · a4 · a3,
CenterDot[a__] :> Flatten[CenterDot[a]],
δ[c_, c_] → dim,
δ[c_, d_]^2 → dim,
δ[a1_, a2_] a3_ :> (a3 /. a1 → a2) /; Not@FreeQ[a3, a1]};
CenterDot[x, y]
In[44]:=
γ[d] · γ[a] · γ[c] · γ[b] · γ[d] · γ[c] · γ[a] //. rules /.
CenterDot[γ[a_]] → γ[a] // Simplify
150%


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Gamma Matrices.nb
Deck of cards
In[50]:=
Hearts = Style[♡, {Red, Large}];
Clubs = Style[♣, Large];
Diamonds = Style[♢, {Red, Large}];
Spades = Style[♠, Large];
deck = # /@ Flatten[{Ace, Range[2, 10], Jacks, Queen, King}] & /@
{Hearts, Spades, Diamonds, Clubs} // Flatten;
Shuffle := (shuffledDeck = RandomSample[deck];)
take[n_] := Module[{temp},
temp = shuffledDeck[[1 ;; n]];
shuffledDeck = Drop[shuffledDeck, n];
temp]
Poker
Shuffle
{{"Player 1:", take[2]}, {"Player 2:", take[2]}} // TableForm
take[3]
150%


Mathematica File Edit Insert Format Cell Graphics Evaluation Palettes Window Help Erik Schnetter
Gamma Matrices.nb
Clubs = Style[♣, Large];
Diamonds = Style[♢, {Red, Large}];
Spades = Style[♠, Large];
In[54]:=
deck = # /@ Flatten[{Ace, Range[2, 10], Jacks, Queen, King}] & /@
{Hearts, Spades, Diamonds, Clubs} // Flatten;
In[55]:=
Shuffle := (shuffledDeck = RandomSample[deck];)
take[n_] := Module[{temp},
temp = shuffledDeck[[1 ;; n]];
shuffledDeck = Drop[shuffledDeck, n];
temp]
Poker
In[57]:=
Shuffle
{{"Player 1:", take[2]}, {"Player 2:", take[2]}} // TableForm
Out[58]//TableForm=
Player 1: ♢ [Jacks]
♣ [9]
Player 2: ♢ [9]
♢ [6]
In[59]:=
take[3]
150%