Pensieve header: October 30: Textbook (EIWL) chapters 9-12 (plus Dynamic).

Today. EIWL-9-12, then maybe **Patterns**.

Topics (in no particular order). Whatever you may suggest; whatever comes to my mind; ~~the Fibonacci numbers~~; the Catalan numbers; ~~the Jones polynomial~~; ~~a more efficient Jones algorithm~~; ~~a riddle on spheres~~; Khovanov homology; Γ-calculus; the Hopf fibration; Hilbert's 13th problem; non-commutative Gaussian elimination; free Lie algebras; the Baker-Campbell-Hausdorff formula; wacky numbers; an order 4 torus; the Schwarz Lantern; knot colourings; the Temperley-Lieb pairing; the dodecahedral link; sound experiments; barycentric subdivisions; ~~some Peano curves~~; braid closures and Vogel's algorithm; the insolubility of the quintic; phase portraits; the Mandelbrot set; shadows of the Cantor aerogel; quilt plots; some image transformations; De Bruijn graphs; the Riemann series theorem; finite type invariants and the Willerton fish; ~~the Towers of Hanoi~~; ~~Hochschild homology of (some) coalgebras~~; convolutions and image improvements.

An Image Manipulation Challenge

The image at http://drorbn.net/bbs/show?shot=17-1750-171016-111042.jpg is pathetic. Can you improve it? Whatever you do, should also work well with all other images at http://drorbn.net/bbs/show.php?prefix=17-1750.

A Graphics Challenge

The torus $S^1 \times S^1$ has an order 4 symmetry. Can you draw it in such a manner that it will manifest?

New Rule

Submissions are limited to 20Mb.

9. Interactive Manipulation

```
Manipulate[Table[Orange, n], {n, 1, 5, 1}]
```

```
Table[Table[Orange, n], {n, 1, 5, 1}]
```

```
Manipulate[Column[{n, n^2, n^3}], {n, 1, 10, 1}]
```

```
Table[Column[{n, n^2, n^3}], {n, 1, 10, 1}]
```

```
Manipulate[Column[{n, n^2, n^3}], {n, 1, 10}]
```

```
Manipulate[BarChart[{1, a, 4, 2 * a, 4, 3 * a, 1}], {a, 0, 5}]
```

```
Manipulate[PieChart[{1, a, 4, 2 * a, 4, 3 * a, 1}], {a, 0, 5}]
```

```
Manipulate[Graphics[Style[RegularPolygon[n], Hue[h]]], {n, 5, 20, 1}, {h, 0, 1}]
```

```
Manipulate[Graphics[Style[RegularPolygon[5], color]], {color, {Red, Yellow, Blue}}]
```

```
? Dynamic
```

```
? Slider
```

```
? LocatorPane
```

From "Nobody Solves the Quintic", http://www.math.toronto.edu/~drorbn/Talks/Sydney-1708/:

```
InputBackground = Graphics[{
    Pink, Disk[],
    Red, Point[{0, 0}],
    Table[{Line[{{t, -1}, {t, 1}}], Line[{{-1, t}, {1, t}}]}, {t, -1, 1, 2/3}]
   }];
OutputBackground = {
   LightBlue, Disk[],
   Blue, Point[{0, 0}],
   Table[{Line[{{t, -1}, {t, 1}}], Line[{{-1, t}, {1, t}}]}, {t, -1, 1, 2/3}],
   Black
  };

Module[{a0, b0, c0, a, b, c, Δ, δ, r},
 {a0, b0, c0} = {{1, 0}, {0, 0}, {0, 1/3}};
GraphicsGrid[Partition[#, 2] & @{
    LocatorPane[Dynamic[{a0, b0, c0}], InputBackground, Appearance → {"a", "b", "c"}],
    Dynamic[Graphics[{OutputBackground,
       a = {1, i}.a0; b = {1, i}.b0; c = {1, i}.c0;
       Δ = b^2 - 4 a c; Text["Δ", ReIm@δ]
      }, PlotRange → All, PlotLabel → "Δ=b²-4ac"]],
    Dynamic[Graphics[{OutputBackground,
       δ = √Δ; Text["δ", ReIm@δ]
      }, PlotRange → All, PlotLabel → "δ=√Δ "]],
    Dynamic[Graphics[{OutputBackground,
       r = (-b + δ)/(2 a); Point[ReIm@r]
      }, PlotRange → All, PlotLabel → "r=(-b+δ)/(2a)"]]
   }]
]

Module[{λ1, λ2, x, a, b, c, Δ, δ, r},
 {λ1, λ2} = {{1, 1}/2, {1, -1}/2};
GraphicsGrid[Partition[#, 3] & @ {
    LocatorPane[Dynamic[{λ1, λ2}], InputBackground, Appearance → {"λ₁", "λ₂"}],
    Dynamic[Graphics[{OutputBackground,
       {c, b, a} = CoefficientList[(x - {1, i}.λ1) (x - {1, i}.λ2), x];
       Text["a", ReIm@a], Text["b", ReIm@b], Text["c", ReIm@c]
      }, PlotRange → All, PlotLabel → "(x-λ₁)(x-λ₂)=ax²+bx+c"]],
    Dynamic[Graphics[{OutputBackground,
       Δ = b^2 - 4 a c; Text["Δ", ReIm@Δ]
      }, PlotRange → All, PlotLabel → "Δ=b²-4ac"]],
    Dynamic[Graphics[{OutputBackground,
       δ = √Δ; Text["δ", ReIm@δ]
      }, PlotRange → All, PlotLabel → "δ=√Δ "]],
    Dynamic[Graphics[{OutputBackground,
       r = (-b + δ)/(2 a); Point[ReIm@r]
      }, PlotRange → All, PlotLabel → "r=(-b+δ)/(2a)"]],
    Null
   }]
]
```

10. Images

CurrentImage[]

$ImagingDevices

```
$ImagingDevice = $ImagingDevices[[2]];
img = CurrentImage[]
```

```
ColorNegate[img]
```

```
{Blur[img], Blur[img, 10]}
```

```
Table[Blur[img, n], {n, 0, 15, 5}]
```

```
ImageCollage[Table[Blur[img, n], {n, 0, 15, 5}]]
```

```
DominantColors[img]
```

```
Binarize[img]
```

```
Manipulate[Binarize[img, t], {t, 0, 1}]
```

```
DominantColors[Binarize[img]]
```

```
img1 = EdgeDetect[img]
```

```
ImageAdd[img, img1]
```

```
imgs = WikipediaData["knot theory", "ImageList"]
```

```
ImageCollage[Scaled[1] → imgs, Method → "ClosestPacking", Background → White]
```

```
cf = Import["http://drorbn.net/ap/Classes/17-1750-ShamelessMathematica/20170929_110340.jpg"]
```

```
EdgeDetect[cf]
```

```
faces = FindFaces[cf]
```

```
ImageTrim[cf, #] & /@ faces
```

11. Strings and Text

```
"This is a string."
```

```
StringLength["hello"]
```

```
StringReverse["hello"]
```

```
ToUpperCase["I'm coding in the Wolfram Language!"]
```

```
StringTake["this is about strings", 10]
```

```
StringLength[StringTake["this is about strings", 10]]
```

```
StringJoin["Hello", " ", "there!", " How are you?"]
```

```
{"apple", "banana", "strawberry"}
```

```
StringTake[{"apple", "banana", "strawberry"}, 2]
```

```
StringJoin[{"apple", "banana", "strawberry"}]
```

```
Characters["a string is made of characters"]
```

```
Sort[Characters["a string of characters"]]
```

```
InputForm[Sort[Characters["a string of characters"]]]
```

```
TextWords["This is a sentence. Sentences are made of words."]
```

```
StringLength[TextWords["This is a sentence. Sentences are made of words."]]
```

```
StringTake[WikipediaData["knot theory"], 100]
```

```
WordCloud[DeleteStopwords[WikipediaData["knot theory"]]]
```

```
Take[WordList[], 20]
```

```
WordCloud[StringTake[WordList[], 1]]
```

```
RomanNumeral[1988]
```

```
Table[RomanNumeral[n], {n, 20}]
```

```
ListLinePlot[Table[StringLength[RomanNumeral[n]], {n, 100}]]
```

```
IntegerName[56]
```

```
ListLinePlot[Table[StringLength[IntegerName[n]], {n, 100}]]
```

```
Alphabet[]
```

```
LetterNumber[{"a", "b", "x", "y", "z"}]
```

```
FromLetterNumber[{10, 11, 12, 13, 14, 15}]
```

```
Alphabet["Russian"]
```

```
Rasterize[Style["ABC", 100]]
```

```
EdgeDetect[Rasterize[Style["ABC", 100]]]
```

```
FromCharacterCode /@ Range[1000]
```

12. Sound

```
Sound[SoundNote["C"]]
```

```
Sound[{SoundNote["C"], SoundNote["C"], SoundNote["G"]}]
```

```
Sound[Table[SoundNote[RandomInteger[12], 0.1, "Violin"], 20]]
```

```
Play[Sin[440 × 2 Pi t], {t, 0, 1}]
```

```
Manipulate[{ⅇ^f, Play[Sin[ⅇ^f 2 Pi t], {t, 0, 1}, SampleRate → 100 000]},
 {{f, Log@440}, Log@10, Log@30 000} ]
```