

VisBOL






















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SBOL & SBOL Visual

- SBOL provides the exchange format for designs, but it's a non-visual language intended for machines
- Need a way to communicate features of genetic circuit designs to humans
- Graphical representations have always been widely used in genomics

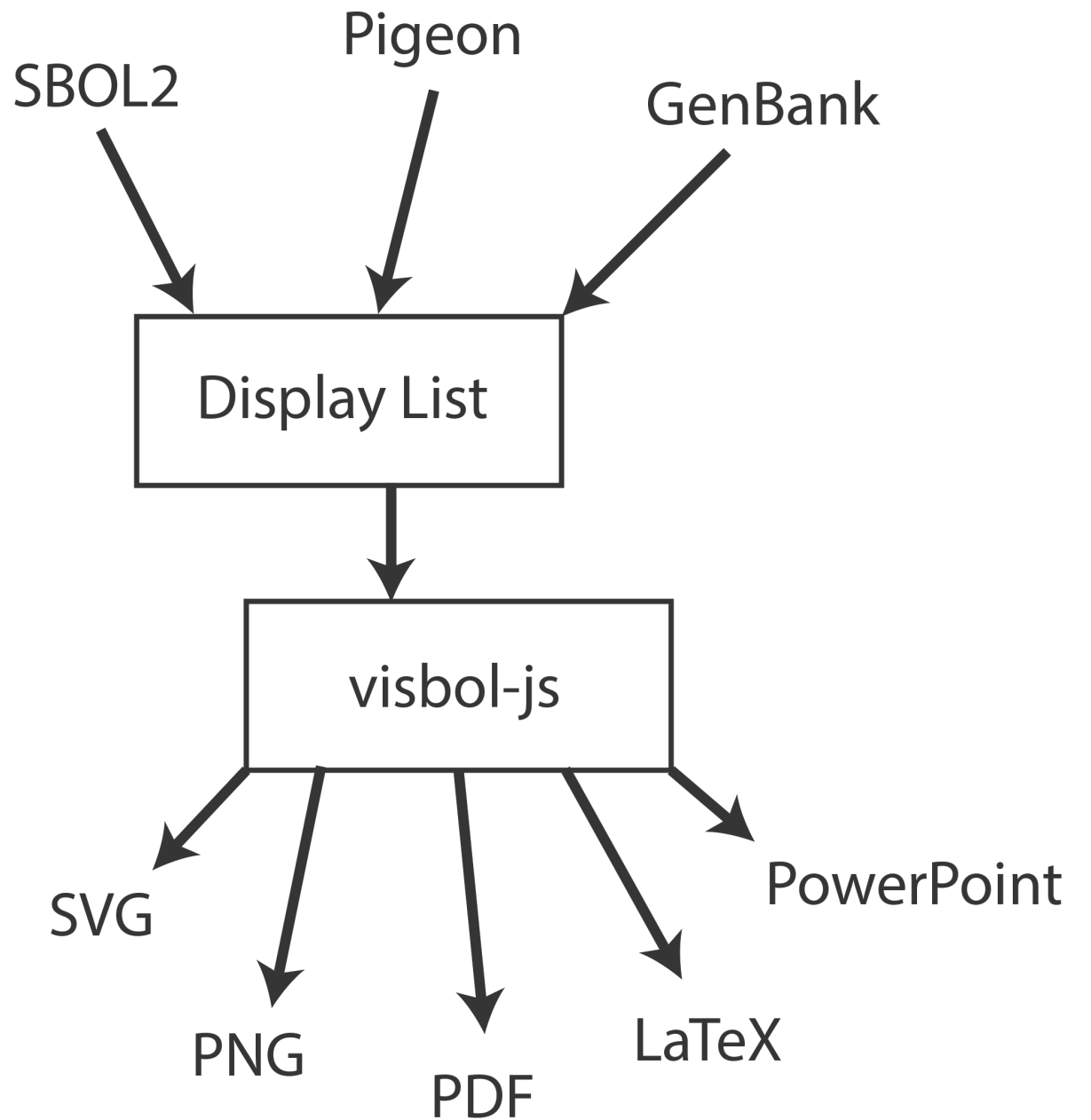
SBOL & SBOL Visual

- SBOL Visual defines an open set of glyphs to convey genetic features
- Software such as PigeonCAD and SBOL Designer enable construction of visual designs using SBOL Visual glyphs
- But we can't yet automatically generate a visualisation from an SBOL2 document

 promoter	 primer binding site
 cds	 restriction site
 ribosome entry site	 blunt restriction site
 terminator	 5' sticky restriction site
 operator	 3' sticky restriction site
 insulator	 5' overhang
 ribonuclease site	 3' overhang
 rna stability element	 assembly scar
 protease site	 signature
 protein stability element	 user defined
 origin of replication	

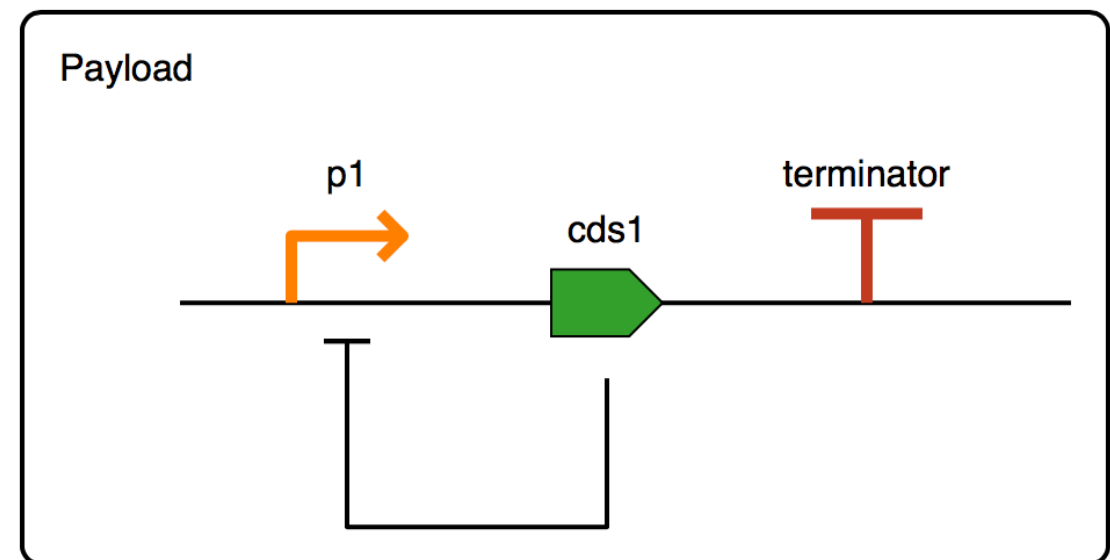
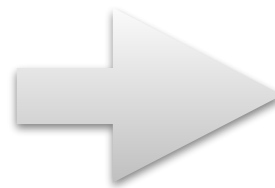
Display Lists

- An intermediate format to describe visual genetic circuit designs
- Specified in JSON
- Display list generators are available for SBOL2, PigeonCAD notation, and GenBank



Display Lists

```
{
  "version": 1,
  "components": [
    {
      "segments": [
        {
          "id": "payload",
          "name": "Payload",
          "sequence": [
            {
              "strand": "positive",
              "type": "promoter",
              "id": "p1",
              "name": "p1",
              "color": "#ff7f00"
            },
            {
              "strand": "positive",
              "type": "cds",
              "id": "cds1",
              "name": "cds1",
              "color": "#33a02c"
            },
            {
              "strand": "positive",
              "type": "terminator",
              "id": "terminator",
              "name": "terminator"
            }
          ]
        }
      ],
      "entities": [],
      "joins": []
    }
  ],
  "interactions": [
    {
      "id": "cds1-p1",
      "type": "repression",
      "origin": "cds1",
      "target": "p1"
    }
  ]
}
```



VisBOL

- VisBOL is an open source design visualization framework written in JavaScript
- Generates designs from display lists
- Renders visualization to SVG directly in the browser; export to SVG or PNG

The screenshot displays the VisBOL web application. On the left, a text editor shows SBOL XML code for a genetic circuit. A handwritten note "generate your design from any format" points to the code. The code includes definitions for a `LacI` inverter, a `TetR` inverter, and a `LacI/TetR Toggle Switch`. On the right, the graphical representation of these circuits is shown. The `LacI Inverter` diagram includes a `pLacI` promoter, a `BBa_J61101` RBS, a `tetR` gene with a `CODING SITE 69-729` label, another `BBa_J61101` RBS, a `gfp` gene, and a `ECK120033736` terminator. The `TetR Inverter` diagram includes a `pTetR` promoter, a `BBa_J61101` RBS, a `lacI` gene, and a `ECK120029600` terminator. The `LacI/TetR Toggle Switch` diagram shows two boxes labeled `TetR Inverter` and `LacI Inverter` connected by lines. The interface also features a `Font` dropdown set to `SBOL Visual`, a `Proportional` checkbox, and a `Scale` slider. A `Test me on CodeLab` button is in the top right corner. Logos for `ICOS` and `Newcastle University` are at the bottom right.

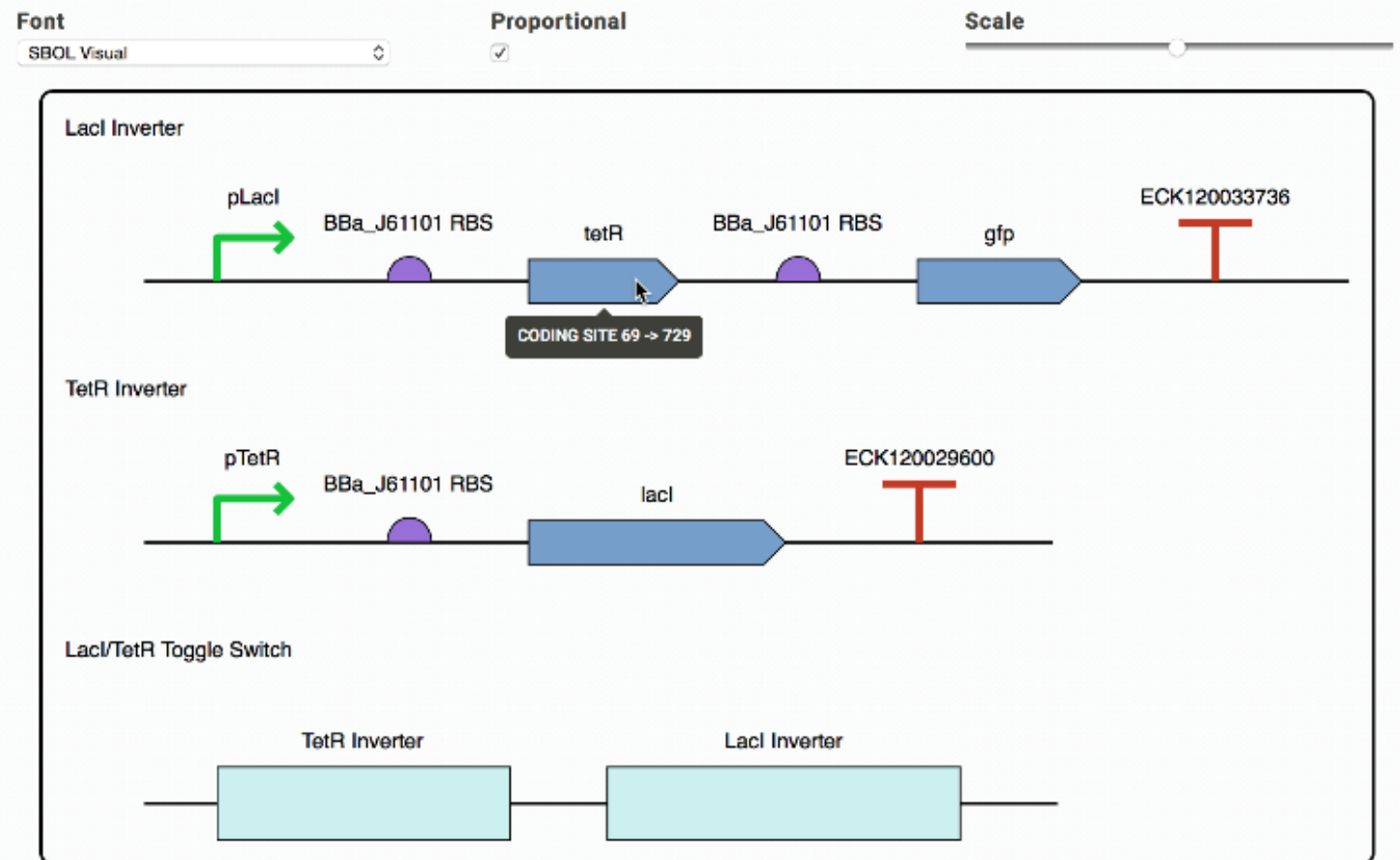
VisBOL

Fork me on GitHub

generate your design from any format

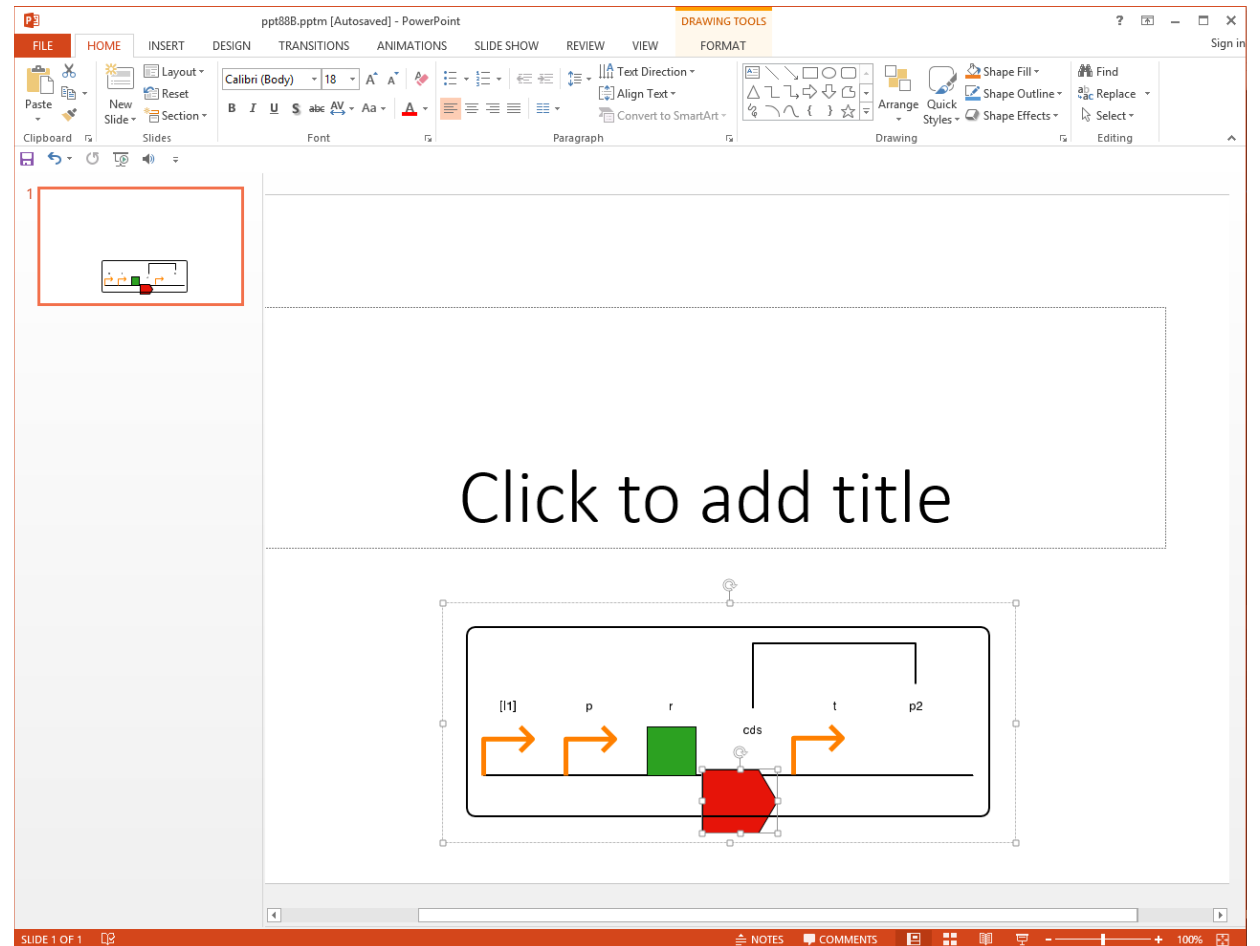
SBOL	PIGEON	GENBANK	DISPLAY LIST
1	<?xml version="1.0" ?>		
2	<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-"		
3	<sbol:ModuleDefinition rdf:about="http://sbolstandard.org/		
4	<sbol:persistentIdentity rdf:resource="http://sbolstanda		
5	<sbol:displayId>tetr_inverter</sbol:displayId>		
6	<sbol:role rdf:resource="http://parts.igem.org/cgi/parts		
7	<sbol:functionalComponent>		
8	<sbol:FunctionalComponent rdf:about="http://sbolstanda		
9	<sbol:persistentIdentity rdf:resource="http://sbolst		
10	<sbol:displayId>promoter</sbol:displayId>		
11	<sbol:definition rdf:resource="http://www.partsregis		
12	<sbol:access rdf:resource="http://sbols.org/v2#publi		
13	<sbol:direction rdf:resource="http://sbols.org/v2#in		
14	</sbol:FunctionalComponent>		
15	</sbol:functionalComponent>		
16	<sbol:functionalComponent>		
17	<sbol:FunctionalComponent rdf:about="http://sbolstanda		
18	<sbol:persistentIdentity rdf:resource="http://sbolst		
19	<sbol:displayId>TF</sbol:displayId>		
20	<sbol:definition rdf:resource="http://identifiers.or		
21	<sbol:access rdf:resource="http://sbols.org/v2#publi		
22	<sbol:direction rdf:resource="http://sbols.org/v2#in		
23	</sbol:FunctionalComponent>		
24	</sbol:functionalComponent>		
25	<sbol:interaction>		
26	<sbol:Interaction rdf:about="http://sbolstandard.org/e		
27	<sbol:persistentIdentity rdf:resource="http://sbolst		
28	<sbol:displayId>LacI_pLacI</sbol:displayId>		
29	<sbol:type rdf:resource="http://identifiers.org/biom		
30	<sbol:participation>		
31	<sbol:Participation rdf:about="http://sbolstandard		
32	<sbol:persistentIdentity rdf:resource="http://sb		
33	<sbol:displayId>Q6QR72</sbol:displayId>		
34	<sbol:role rdf:resource="http://identifiers.org/		
35	<sbol:participant rdf:resource="http://sbolstand		
36	</sbol:Participation>		
37	</sbol:participation>		
38	<sbol:participation>		
39	<sbol:Participation rdf:about="http://sbolstandard		
40	<sbol:persistentIdentity rdf:resource="http://sb		
41	<sbol:displayId>BBa_R0040</sbol:displayId>		
42	<sbol:role rdf:resource="http://identifiers.org/		
43	<sbol:participant rdf:resource="http://sbolstand		
44	</sbol:Participation>		

your visualization will update automatically



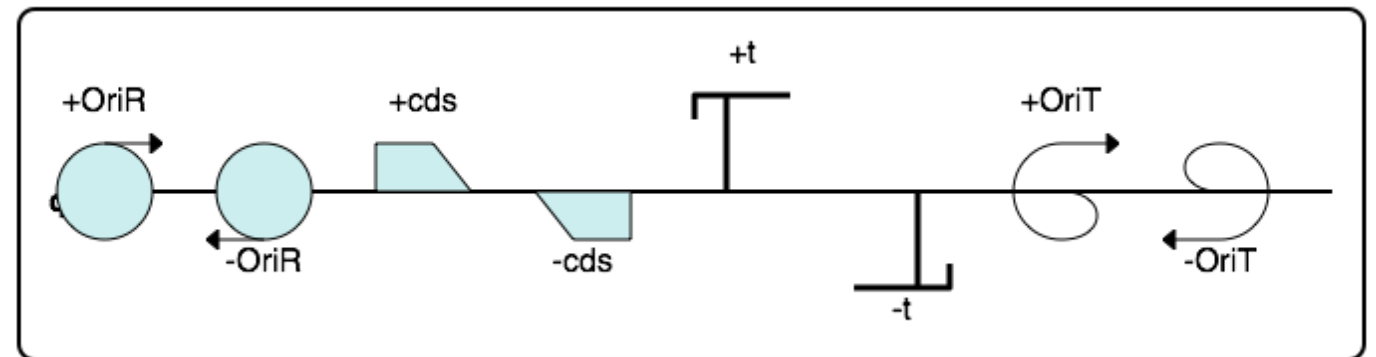
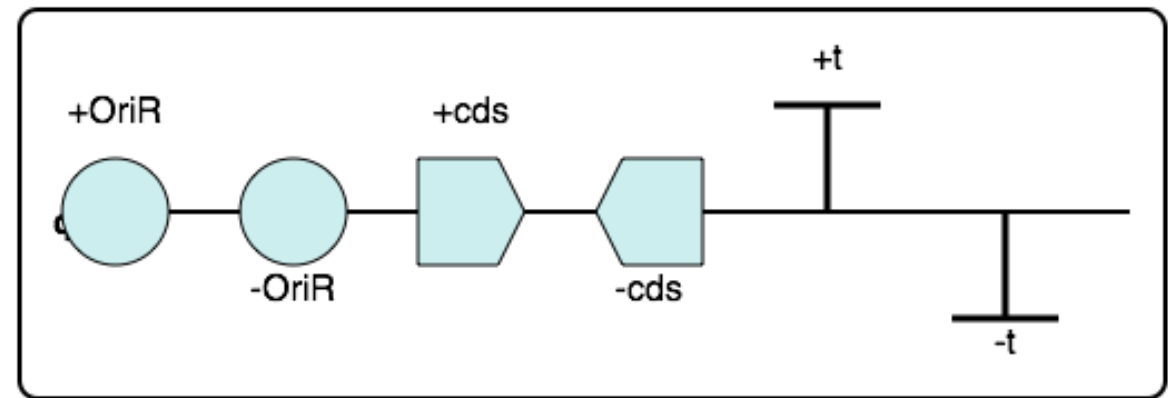
VisBOL

- SVG images can be embedded in websites, publications and presentations
- Further edit visualizations using widely available software such as Inkscape, Illustrator, PowerPoint



Fonts

- Glyph sets are defined by fonts
- Easily extendable with new glyphs and alternative renderings
- Base font is SBOL Visual; experimenting at Newcastle with a set of glyphs with improved directionality



Integration

- VisBOL can be embedded directly into Web content to provide visualization capabilities
- Newcastle projects: visbol.org, SynBioModules, SBOLhub, Virtual Parts Repository

The screenshot displays the SBOL Modules web application interface. The top navigation bar includes the SBOL Modules logo, a search bar, and links for 'Submit' and 'Manage Submissions'. The main content area is titled 'LacI/TetR Toggle Switch: Modules View' and shows a hierarchical view of the design. Under the 'MODULES' section, three modules are listed: 'Module: TetR Inverter', 'Module: LacI Inverter', and 'Module: LacI/TetR Toggle Switch'. Each module has a corresponding SBOL diagram and a 'Download SBOL File' button. The 'Module: TetR Inverter' diagram shows a pTetR promoter, a BBa_J61101 RBS, a lacI gene, and an ECK120029600 feature. The 'Module: LacI Inverter' diagram shows a pLacI promoter, a BBa_J61101 RBS, a tetR gene, a BBa_J61101 RBS, a gfp gene, and an ECK120033736 feature. The 'Module: LacI/TetR Toggle Switch' diagram shows a TetR Inverter and a LacI Inverter. Below the modules, there is a section for 'Citations (1)' with a reference to 'Generating Systems Biology Markup Language Models from the Synthetic Biology Open Language' by Roehner, N., Zhang, Z., Nguyen, T., and Myers, C.J. in ACS Synth Biol. To the right of the citations is a 'Design' section with an 'Export image as' button. The design section shows a diagram of the toggle switch mechanism with components labeled p(tetR), TetR 1, -35, and TetR 2. At the bottom of the page, there is a copyright notice: '© 2015 Newcastle University. Design by Antarctic Design.'

Integration

```
<svg id="sbol-design"></svg>

<script type="text/javascript">
  require.config({
    packages: [
      {
        name: 'visbol',
        location: 'js/visbol/lib'
      },
      {
        name: 'visbol-font',
        location: 'js/visbol/font'
      }
    ],
    baseUrl: 'http://visbol.org/design'
  });

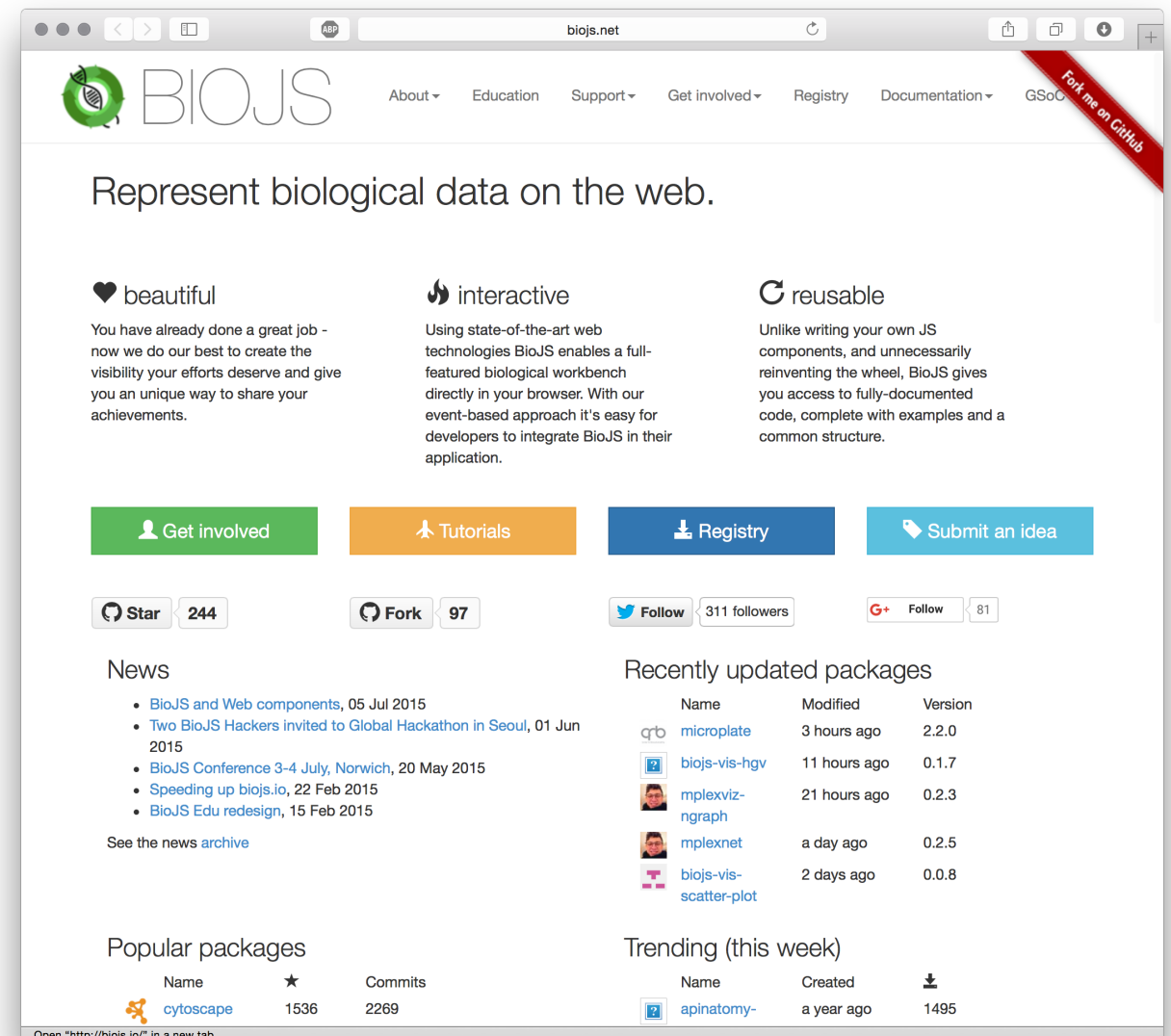
  require([
    'visbol',
    'visbol-font',
    'visbol-font!http://visbol.org/design/js/visbol/font/sbolv',
    'visbol-font!http://visbol.org/design/js/visbol/font/sbolv-improved-directionality'
  ], function (visbol, visbolFont, sbolv, sbolvImprovedDirectionality) {

    var design = new visbol.Design({
      element: document.getElementById('sbol-design'),
      font: visbolFont.get('sbolv')
    });

    design.setDisplayList(displayList);
  });
</script>
```

Integration

- Part of a growing ecosystem of JavaScript bioinformatics tooling
- > 100 packages already available in the registry at biojs.net
- npm has ~200,000 JavaScript packages available: largest module repository of any language



VisBOL

<http://visbol.org/design>

<http://github.com/visbol>

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