

# Synthetic Biology Workflow Using SBOLDesigner

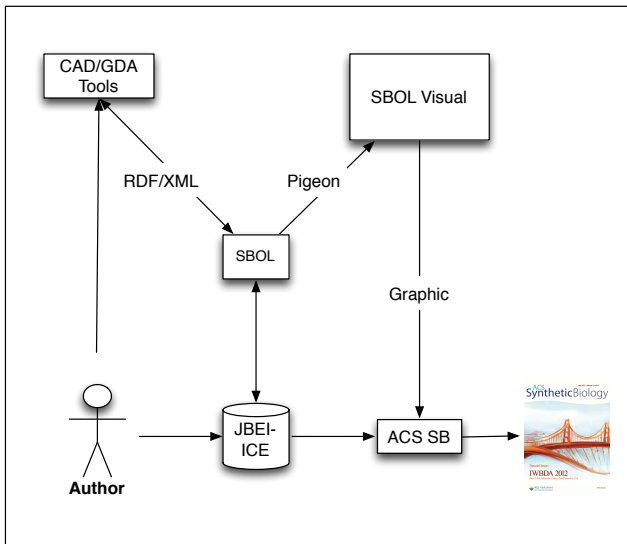
Michael Zhang

University of Utah

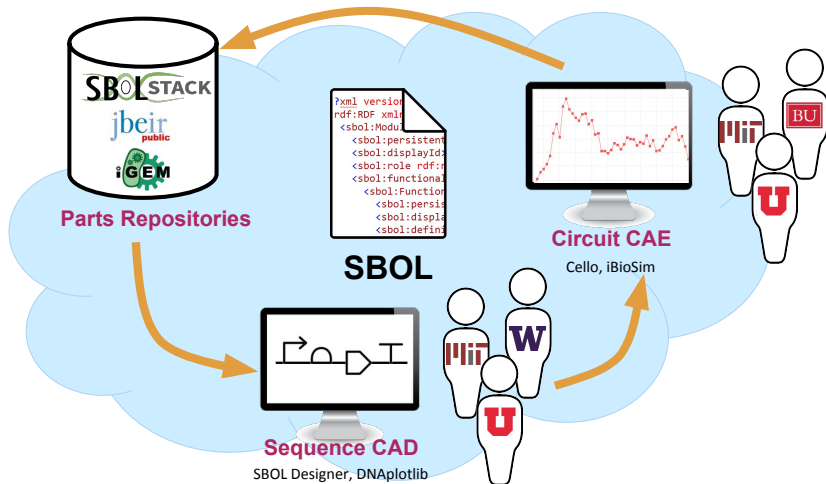
IWBDA

August 18, 2016

# SBOL and ACS Synthetic Biology



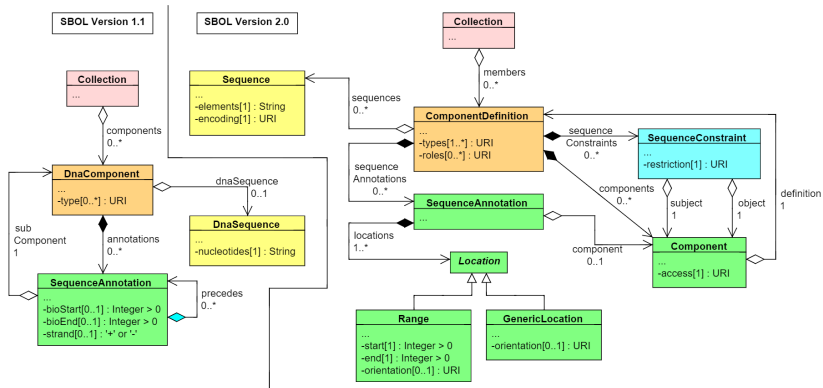
# Synthetic Biology Workflow Using SBML/SBOL



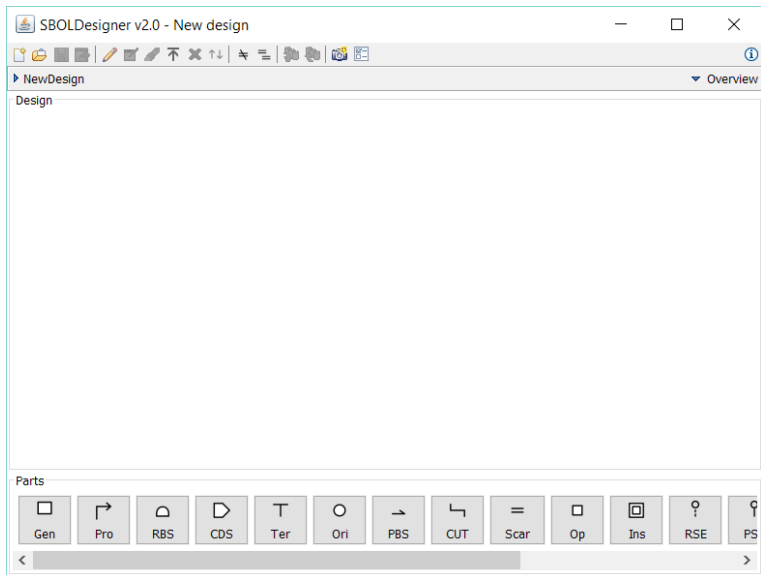


- SBOLDesigner is a tool that leverages libSBOLj 2.0 to create and design the sequence portion of genetic circuits using SBOL Visual glyphs.
- SBOLDesigner 1.0 was initially developed by the University of Washington and Clark & Parsia LLC.
- SBOLDesigner 2.0 is now being developed at the University of Utah.

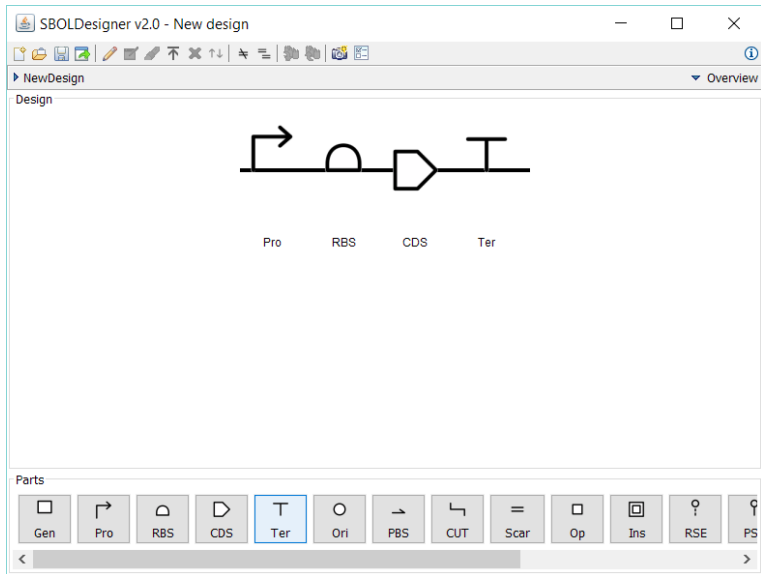
# SBOL 1.1 to SBOL 2.0




# Mapping SBOLDesigner to the Data Model



# Parts



# Parts

 Part: BBa\_R0010 ✕

Part role

Pro (Promoter) ▾

Role refinement

None ▾

Display ID

BBa\_R0010

Name

BBa\_R0010

Version

Description

promoter (lacI regulated)

DNA sequence

```
caatacgcaaacgcctctccccgcggttgccgattcattaatgcagctggcacgacaggtt
tcccgactggaaagcgggcagtgcgcaacgcaattaatgtgagttagctcactcattaggca
ccccaggtttacactttatgcttcggctcgtatgttggtggaattgtgagcggataacaat
ttcacaca
```

Import part

Import sequence

Cancel

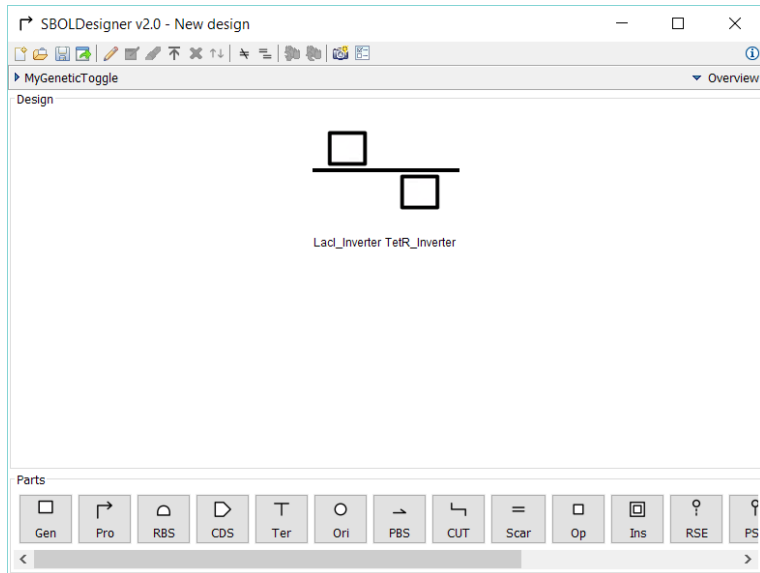
Save



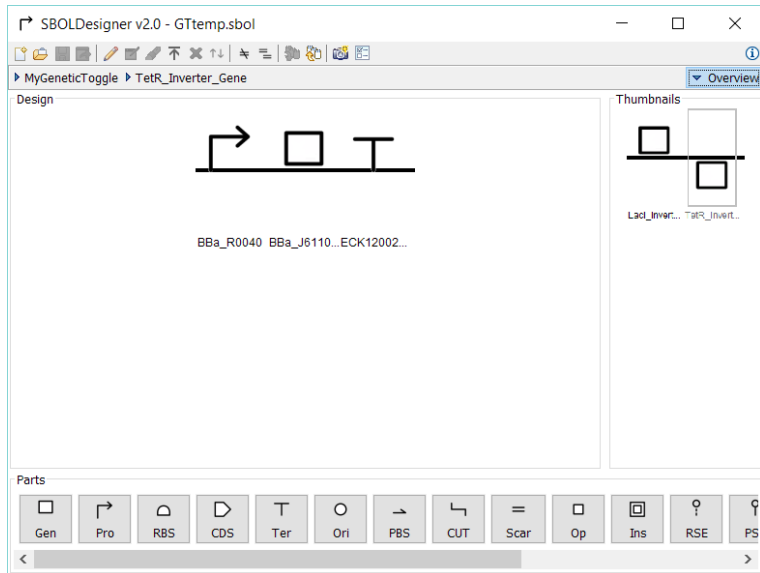
# Order

- Parts are ordered by SequenceConstraints and SequenceAnnotations.
- SequenceConstraints define ordering: "A precedes B".
- SequenceAnnotations define ranges: "A starts at 1 and ends at 42" and "B starts at 43 and ends at 95".
- SBOLDesigner uses both behind the scenes.

# Hierarchy



# Hierarchy

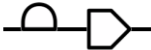


# Hierarchy

SBOLDesigner v2.0 - GTtemp.sbol

MyGeneticToggle ▶ TetR\_Inverter\_Gene ▶ BBa\_J61101\_BBa\_C0012

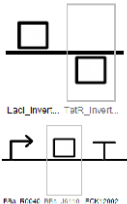
Design



BBa\_J61101 BBa\_C0012

Overview

Thumbnails




LacI\_Invert... TetR\_Invert...

BBa\_R0040 BBa\_J61101 BBa\_C0012

Parts

Gen Pro RBS CDS Ter Ori PBS CUT Scar Op Ins RSE PS

# Multiple Designs

 Select a root design to open ✕

There are multiple designs. Which would you like to load? (You will be editing a new partial design)

Part role All (All parts)

☒ Only show root ComponentDefinitions

Delete selected part. (This will resave the file)


Filter parts

Matching parts (17)

Display Id	Name	Version	Description
MyGeneticToggle	pIKE Genetic Tog...		Gardner/Collins Genetic Toggle Switch
pIKERightCassett...			pIKERightCassette_2
pTAKRightCassett...			pTAKRightCassette_3
pIKELeftCassette_3			pIKELeftCassette_3
pIKERightCassett...			pIKERightCassette_3
pTAKRightCassett...			pTAKRightCassette_1
pTAKRightCassett...			pTAKRightCassette_4
LacI_Inverter_Gene		1	
pTAKLeftCassette_1			pTAKLeftCassette_1
pTAKLeftCassette_4			pTAKLeftCassette_4
pIKELeftCassette_2			pIKELeftCassette_2
pTAKRightCassett...			pTAKRightCassette_2
LacIIInverter		1	
pTAKLeftCassette_3			pTAKLeftCassette_3
pIKELeftCassette_4			pIKELeftCassette_4
pIKERightCassett...			pIKERightCassette_4
pTAKLeftCassette_2			pTAKLeftCassette_2

Cancel OK

# Importing Parts/Sequences

 Part: Pro ✕

Part role

Role refinement

Display ID

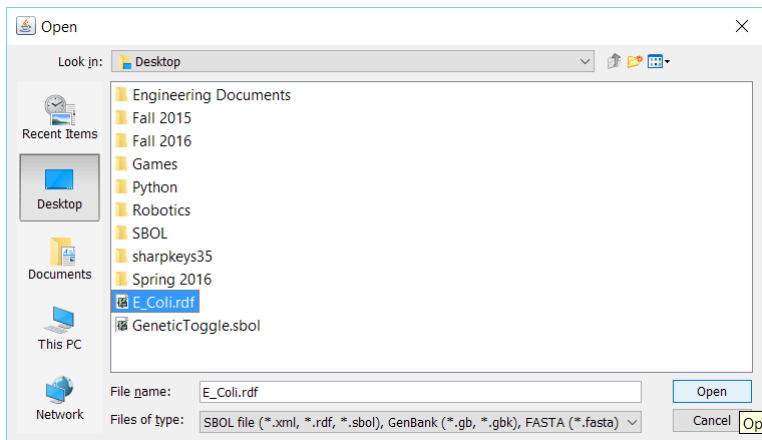
Name

Version


Description

DNA sequence

# Importing Parts/Sequences



# Importing Parts/Sequences

 Select a part to import ✕

Part role Pro (Promoter) ▾

☒ Import with subcomponents

Filter parts


Matching parts (3)

Display Id	Name	Version	Description
BBa_R0010	BBa_R0010		promoter (lacI regulated)
BBa_K121014	BBa_K121014		promoter (lambda cI regulated)
BBa_R0040	BBa_R0040		TetR repressible promoter

Cancel OK



# Importing Parts/Sequences

 Part: BBa\_R0010 ✕

Part role

Pro (Promoter) ▾

Role refinement

None ▾

Display ID

BBa\_R0010

Name

BBa\_R0010

Version

Description

promoter (lacI regulated)

DNA sequence

```
caatacgcaaacgcctctccccgcggttgccgattcattaatgcagctggcacgacaggtt
tcccgactggaaagcgggcagtgagcgcaacgcaattaatgtgagttagctcactcattaggca
ccccaggtttacactttatgcttccggctcgtatgttggtggaattgtgagcggataacaat
ttcacaca
```

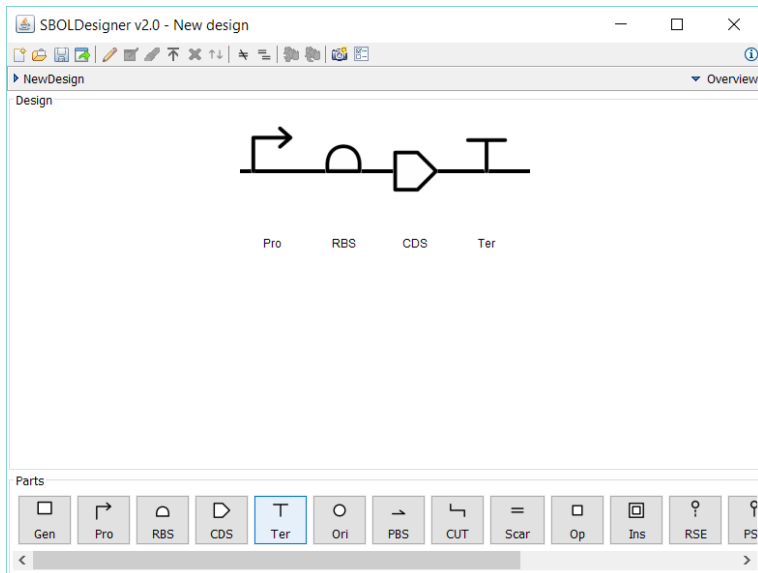
Import part

Import sequence

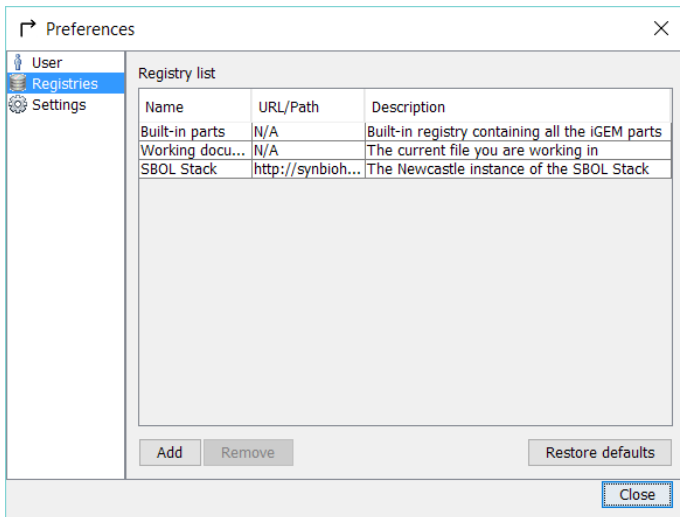
Cancel

Save

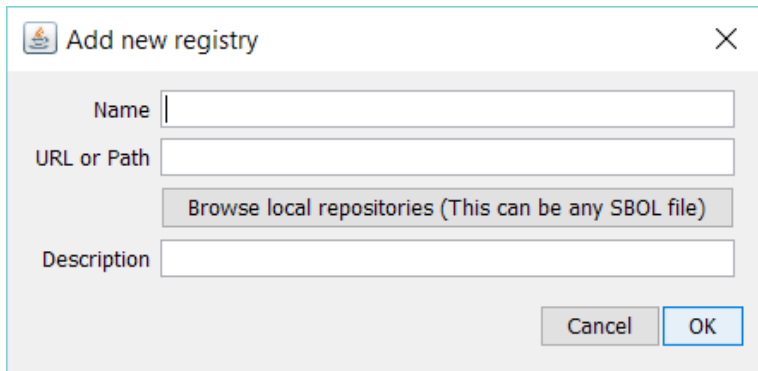
# Registries




# Registries



# Registries



A dialog box titled "Add new registry" with a close button (X) in the top right corner. The dialog contains four input fields: "Name", "URL or Path", "Description", and a button labeled "Browse local repositories (This can be any SBOL file)". The "Name" field is currently empty. The "URL or Path" field is also empty. The "Description" field is empty. The "Browse local repositories" button is located below the "URL or Path" field. At the bottom right of the dialog are "Cancel" and "OK" buttons.

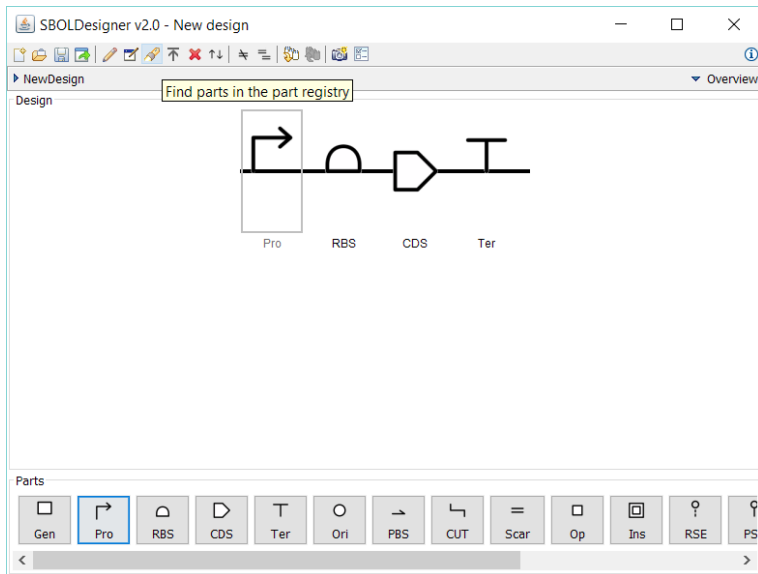
 Add new registry ✕

Name



URL or Path

Description

# Registries



# Registries

 Select a part from registry 

Registry

SBOL Stack (<http://synbiohub.org:9090>)

Part type

DNA

Part role

Pro (Promoter)

Role refinement

None

☒ Import with subcomponents

Filter parts

BBa\_R

Matching parts (48)

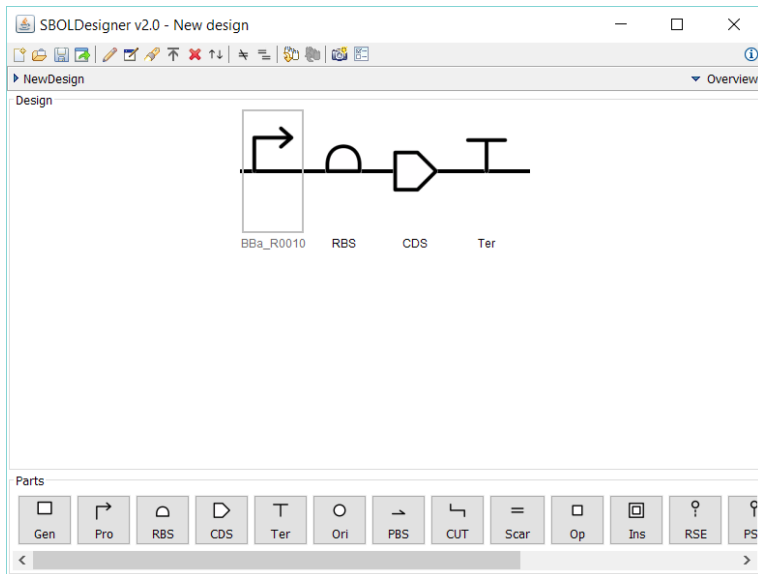
Display Id	Name	Versi...	Description
BBa_R0183_...	BBa_R0183 f...		
BBa_R0062_...	BBa_R0062 (...)		
BBa_R0062	pLuxR		LuxR inducible promoter
BBa_R0051	BBa_R0051		
BBa_R0040	pTetR		TetR repressible promoter
BBa_R0040	BBa_R0040		
BBa_R0040	pTetR		pTet promoter
BBa_R0011_...	BBa_R0011 (...)		
BBa_R0011	BBa_R0011		
BBa_R0011	BBa_R0011		
BBa_R0011	BBa_R0011		

Options

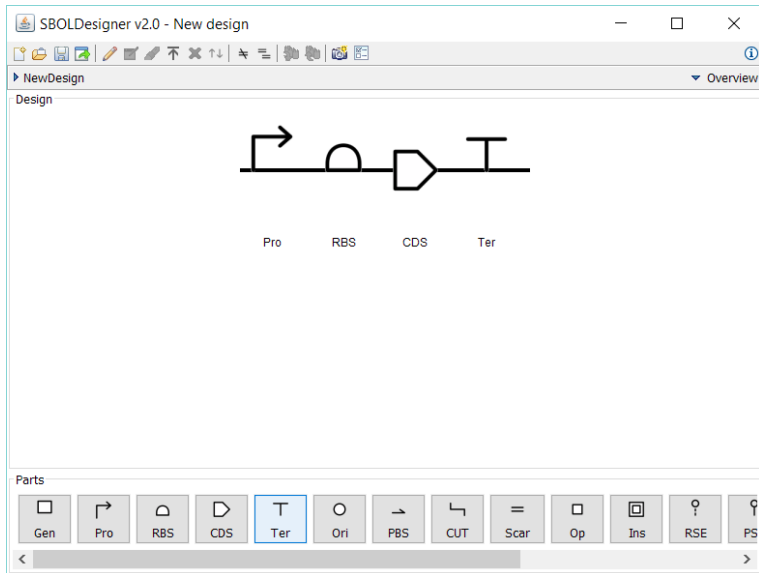
Cancel

OK

# Registries

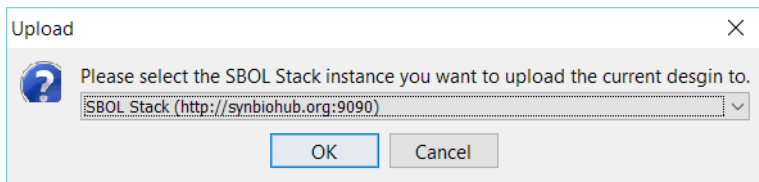


# Upload

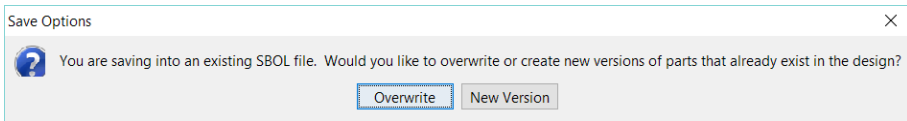





# Upload



# Versioning



# Versioning

 Select a root design to open ✕

There are multiple designs. Which would you like to load? (You will be editing a new partial design)

Part role All (All parts) ▾

☒ Only show root ComponentDefinitions

Delete selected part. (This will resave the file)

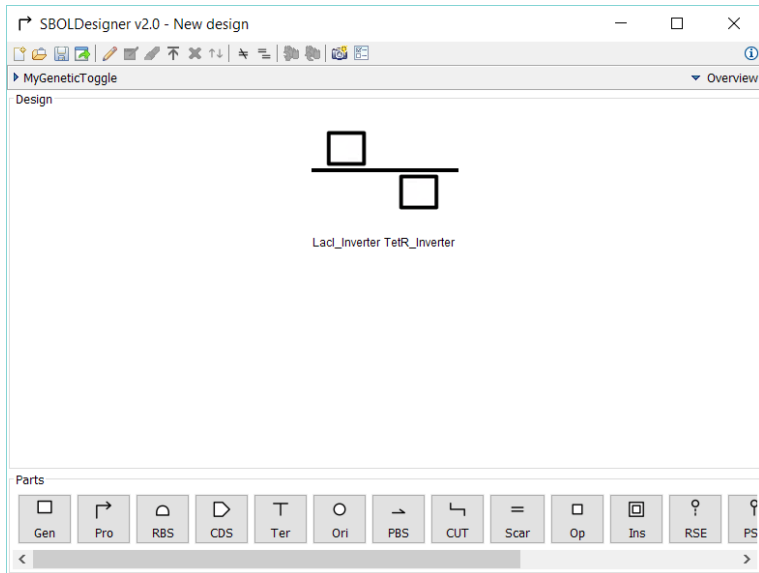
Filter parts

Matching parts (5)

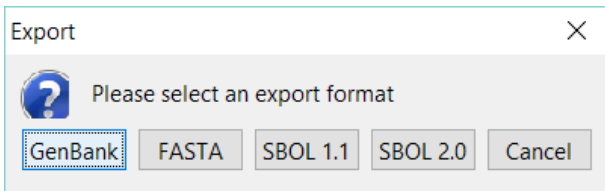
Display Id	Name	Version	Description
E_Coli		5	
E_Coli		3	
E_Coli		1	
E_Coli		4	
E_Coli		2	

Cancel OK

# GenBank/FASTA



# GenBank/FASTA



# Export GenBank

```

LOCUS       pTAKRightCasset                1747 bp    DNA     linear     UNK 08-Jul-2016
DEFINITION   pTAKRightCassette_3
ACCESSION    pTAKRightCassette_3
FEATURES             Location/Qualifiers
     CDS             975..1694
     RBS             963..974
     misc_feature     963..1694
     CDS             213..962
     RBS             201..212
     misc_feature     201..962
     promoter        1..200
     terminator       1695..1747

ORIGIN
1   caatagcga accgcctctc ccgcgcgtt ggccgattca ttaatgcagc tggcacgaca
61  ggtttcccca ctggaaaagc ggcagtgaac gcaacgcaat taatgtgagt tagctcactc
121 attaggcacc ccaggcttta cactttatgc ttccggctcg tatgttgtgt ggaattgtga
181 gcgataacca atttcacaca aaagaacaga caatgagcac aaaaaagaaa cattaatacac
241 aagagcagct tgaggacgca cgtcgcttta aagcaattta tgaaaaaaag aaaaatgaac
301 ttgctttatc ccaggaatct gtcgcagaca agatggggat gggcgactga ggcgttggtg
361 ctttatttaa tggcatcaat gcattaaatg cttataacgc cgcattgctt gcaaaaaattc
421 tcaaaattag cgttgaagaa tttagccctt caatgccagc agaattctac gagatgatg
481 aagcggttag tatgcagcgc tcaactagaa gtgagtatga gtaccctgtt ttttctcatg
541 ttcaaggcagg gatgttctca cctgagctta gaacctttac caaagtgatg gcggagagat
601 gggtaagcac aaccaaaaaa gccagtgatt ctgcattctg gcttgaggtt gaaggtaatt
661 ccgatgaccg accaaccaggc tccaagccaa gcttccctga cggaatgtta attctgtgtg
721 accctgagca ggcctgttgag ccaggtgatt tctgcatagc cagacttggg ggtgatgagt
781 ttaccttcaa gaaactgatac agggatagcg ctgagggtgtt tttacaacca ctaaaaccac
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901 agtggcctga agagacgttt ggcctgcgaa acgacgaaaa ctacgcttta gtacgttaat
961 aaaaagacgc gagaatgcgt aaaggagaag aacttttcac tggagttgtc ccaattcttg
1021 tgaattagaa tgggtgatgtt aatgggcaca aattttctgt cagtggagag ggtgaaggtg
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1141 catggccaac acttgtcact actttcggtt atgggttcca atgctttgag agatgaccaa
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1321 gtgataccct tgttaataga atcaggttaa aaggattatg ttttaagaaa gatggaaaga
1381 ttcttgagca caaattggaa tacaactata actcacacaa tgtatacatc atggcagaca
1441 aacaaaaaaa tggaaatcaa gtttaactta aaattagaca caacattgaa gatggaagcg
1501 ttcaactagc agaccattat caacaaataa ctccaattgg cgatggccct gtctctttac
1561 cagacaacca ttacctgtcc acacaactcg ccctttcgaa agatcccaac gaaaagagag
1621 accacatggt cctcttgtag ttgttaacag ctgctgggat tacacatggc atggatgaac
1681 tatacaataa ataaaacgca tgagaaagcc ccgggaagat cacccttcgg gggccttttt
1741 attgcgc

//
LOCUS       pTAKRightCasset                1746 bp    DNA     linear     UNK 08-Jul-2016
DEFINITION   pTAKRightCassette_2
ACCESSION    pTAKRightCassette_2
FEATURES             Location/Qualifiers
     terminator       1695..1746

```

# Export FASTA

```
> www_async_ece_utah_edu_seq_5_4_2015_20_2_22_118_iBioSim
caatcgcacaaacgcctctccccgcgcttgccgcattcataatgacgtggccacgacaggtttcccgactggaaagc
ggcgagtgagcgcaacgcaatgaatgtagttagctcactcatttagaccgccaggtttacactttatgctctcggtc
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actttaggtttgcatttgaagaatcaagagcatcaagtgcctaaagaagaaggggaaacacactactcgtgatgatgc
cgccattattgcacaaagctatcgaaattttgatcaccaaggtgcagagccagcctttcttattcgcccttgaattgat
catatcgggattagaaaaaacttaaatgtgaagtggtgcgctcgcaaacgacgaaacactgccttagtgagttaa
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cactactggaaaaactactgttccatggccaacactgtcactactttcggttatggtgttcaatgctttcgagatga
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cgtataaacttaactggtttcacattccacatggctcgtcttctgtgctcagtatctctatcactgatggaggtgaat
ctctatcactgatagga
> pTAKLeftCassette_1_sequence
gcatgcacagataaacatctcgggtgataaattatcttggcgggtgttgacataaataccactggcgggtataatgagc
acatcagcaggaagaacagggacattggtgaatgtgaaccagtaacgtttatcagatgtcgcagagatgcggtgtctc
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ggctgcattgggtcaccagcaaatcgcgctgttagcggggccattaaagttctgtctcggcgcgctcgtcgtctggctggc
```

# Demo



# Try It Out

- SBOLDesigner 2.0 is released, and I would love any feedback!
- Download the latest version at:  
<http://www.async.ece.utah.edu/SBOLDesigner>
- Please post feedback/bugs/feature requests to my issue tracker:  
<https://github.com/SynBioDex/SBOLDesigner/issues>

# SBOL Community



- 100+ people from all around the world.
- 40 universities, 22 companies, 6 other types of organizations.

# Organizations Supporting SBOL



**EPSRC**

Engineering and Physical Sciences  
Research Council



Office of  
Science



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Michal Galdzicki

Bryan Bartley

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Evren Sirin

John Gennari

## SBOLDesigner 2.0:

Chris Myers



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