AskOmics: Integration and Interrogation of Genomic and PostGenomic Regulation Networks

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[4] INRA, UMR IGEPP, BIPAA / [5] INRIA, UMR IRISA, Genouest / [6] INRIA, UMR IRISA, Genscale

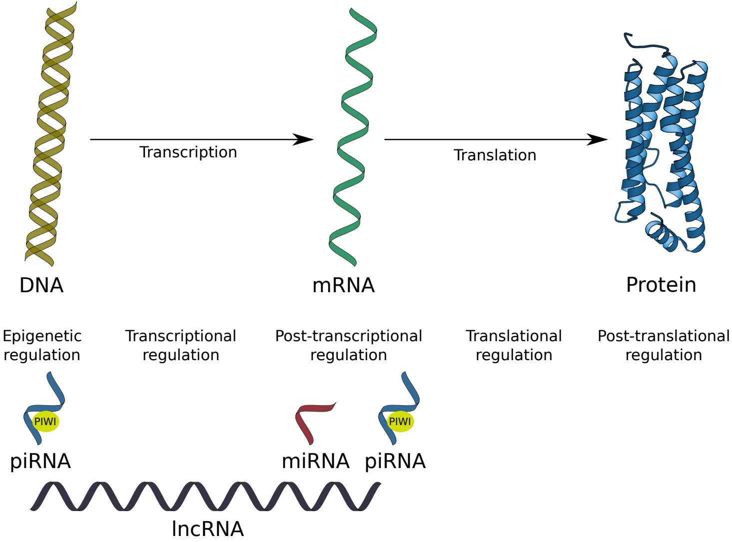
Atelier IN-OVIVE - 29 juin 2015

Pea aphid phenotypic plasticity

MiRNAdapt ANR Project

- Identify gene functions involved in the pea aphid phenotypic plasticity
  - Sexual reproduction
  - Asexual reproduction
- PhD work (Valentin Wucher)
  - Post-transcriptional regulation network between microRNAs and mRNAs
  - Kinetic expressions change depending on the embryogenesis
- Regulation network enrichment
  - piRNAs
  - lncRNAs
  - additional informations

RNA Regulation



DNA → Transcription → mRNA → Translation → Protein

Epigenetic regulation

Transcriptional regulation

Post-transcriptional regulation

Translational regulation

Post-translational regulation

piRNA

miRNA

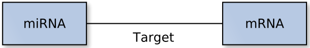
piRNA

lncRNA

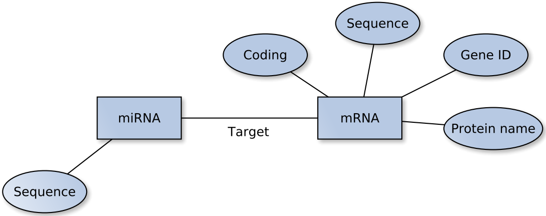
Data inventory

- 36939 coding transcripts (mRNAs)
- 2172 long non coding transcripts (lncRNAs)
- 6059 overlaps between the coding transcripts and the lncRNAs
- 802 micro RNAs (miRNAs)
- 4998271 pairings between the transcripts and the miRNAs
- 77811 piRNAs clusters
- 99382 overlaps between the transcripts and the piRNAs
- 10062 coding transcripts are annoted by 41030 Gene Ontology terms
- Difference of expression between sexual and asexual Aphid pea embryogenesis for:
  - 4996 coding transcripts
  - 370 long non coding transcripts
  - 15 micro RNAs
  - 408 piRNAs clusters

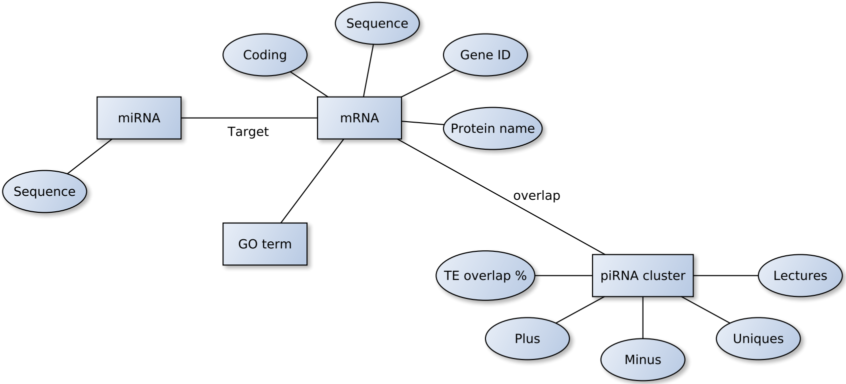
Linked data



Linked data

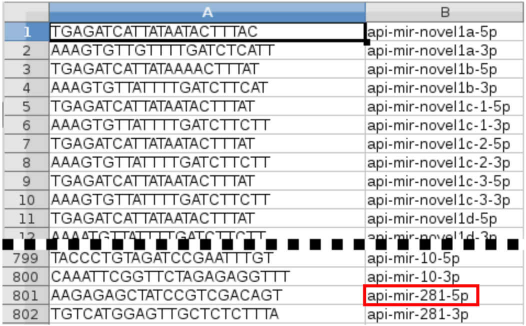

Sequence
Coding
Gene ID
miRNA
mRNA
Target
Protein name
Sequence

Linked data


Coding
Sequence
Gene ID
miRNA
Target
mRNA
Protein name
Sequence
overlap
GO term
TE overlap %
piRNA cluster
Lectures
Plus
Minus
Uniques

Biologists files

correspondance_mirdeep2_mirbaseNom_seq5p3p.csv



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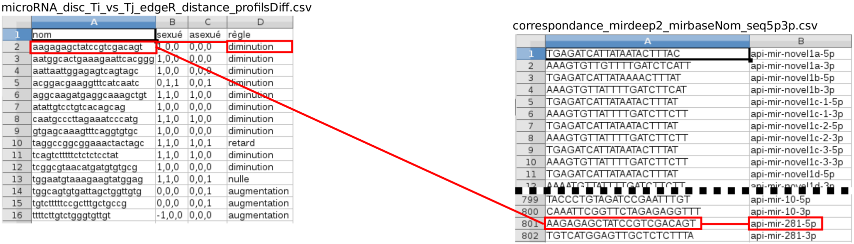
3	TGAGATCATTATAAAACTTTAT	api-mir-novel1b-5p
4	AAAGTGTTATTTTGATCTTCAT	api-mir-novel1b-3p
5	TGAGATCATTATAATACTTTAT	api-mir-novel1c-1-5p
6	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-1-3p
7	TGAGATCATTATAATACTTTAT	api-mir-novel1c-2-5p
8	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-2-3p
9	TGAGATCATTATAATACTTTAT	api-mir-novel1c-3-5p
10	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-3-3p
11	TGAGATCATTATAATACTTTAT	api-mir-novel1d-5p
12	AAAATGTTATTTTGATCTTCTT	api-mir-novel1d-3p
799	TACCCTGTAGATCCGAATTTGT	api-mir-10-5p
800	CAAATTCGGTTCTAGAGAGGTTT	api-mir-10-3p
801	AAGAGAGCTATCCGTCGACAGT	api-mir-281-5p
802	TGTCATGGAGTTGCTCTCTTTA	api-mir-281-3p

Biologists files



microRNA_disc_Ti_vs_Tj_edgeR_distance_profilsDiff.csv

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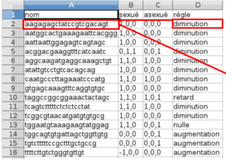
1	nom	sexué	asexué	règle
2	aagagagctatccgtcgacagt	1,0,0	0,0,0	diminution
3	aatggcactgaaagaattcacggg	1,0,0	0,0,0	diminution
4	aattaattggagagtcagtagc	1,0,0	0,0,0	diminution
5	acggacgaaggtttcatcaatc	0,1,1	0,0,1	diminution
6	aggcaagatgaggcaaagctgt	1,1,0	1,0,0	diminution
7	atattgtcctgtcacagcag	1,0,0	0,0,0	diminution
8	caatgcccttagaaatcccatg	1,1,0	1,0,0	diminution
9	gtgagcaaagtttcaggtgtgc	1,0,0	0,0,0	diminution
10	taggccggcggaaactactagc	1,1,0	1,0,1	retard
11	tcagtctttttctctctcctat	1,1,0	1,0,0	diminution
12	tcggcgtaacatgatgtgtgcg	1,0,0	0,0,0	diminution
13	tggaatgtaaagaagtatggag	1,1,0	0,0,1	nulle
14	tggcagtgtgattagctggttgtg	0,0,0	0,0,1	augmentation
15	tgtctttttccgctttgctgccg	0,0,0	0,0,1	augmentation
16	ttttcttgtctgggtgttgt	-1,0,0	0,0,0	augmentation

correspondance_mirdeep2_mirbaseNom_seq5p3p.csv

	A	B
1	TGAGATCATTATAATACTTTAC	api-mir-novel1a-5p
2	AAAGTGTTGTTTTGATCTCATT	api-mir-novel1a-3p
3	TGAGATCATTATAAAACTTTAT	api-mir-novel1b-5p
4	AAAGTGTTATTTTGATCTTCAT	api-mir-novel1b-3p
5	TGAGATCATTATAATACTTTAT	api-mir-novel1c-1-5p
6	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-1-3p
7	TGAGATCATTATAATACTTTAT	api-mir-novel1c-2-5p
8	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-2-3p
9	TGAGATCATTATAATACTTTAT	api-mir-novel1c-3-5p
10	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-3-3p
11	TGAGATCATTATAATACTTTAT	api-mir-novel1d-5p
12	AAAATGTTATTTTGATCTTCTT	api-mir-novel1d-3p
799	TACCCTGTAGATCCGAATTTGT	api-mir-10-5p
800	CAAATTCGGTTCTAGAGAGGTTT	api-mir-10-3p
801	AAGAGAGCTATCCGTCGACAGT	api-mir-281-5p
802	TGTCATGGAGTTGCTCTCTTTA	api-mir-281-3p

Biologists files

microRNA_disc_Ti_vs_Tj_edgeR_distance_profilsDiff.csv

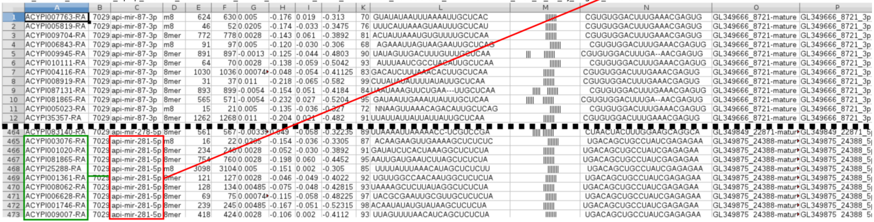


	A	B	C	D
1	nom	sexué	asexué	règle
2	aagagagctatccgtcgacagt	1,0,0	0,0,0	diminution
3	aatggcactgaaagaattcacggg	1,0,0	0,0,0	diminution
4	aattaattggagagtcagtagc	1,0,0	0,0,0	diminution
5	acggacgaaggtttcatcaatc	0,1,1	0,0,1	diminution
6	aggcaagatgaggcaaagctgt	1,1,0	1,0,0	diminution
7	atattgtcctgtcacagcag	1,0,0	0,0,0	diminution
8	caatgcccttagaaatcccatg	1,1,0	1,0,0	diminution
9	gtgagcaaagtttcaggtgtgc	1,0,0	0,0,0	diminution
10	taggccggcggaaactactagc	1,1,0	1,0,1	retard
11	tcagtctttttctctctcctat	1,1,0	1,0,0	diminution
12	tcggcgtaacatgatgtgtgcg	1,0,0	0,0,0	diminution
13	tggaatgtaaagaagtatggag	1,1,0	0,0,1	nulle
14	tggcagtgtgattagctggttgtg	0,0,0	0,0,1	augmentation
15	tgtctttttccgctttgctgccg	0,0,0	0,0,1	augmentation
16	ttttcttgtctgggtgttgt	-1,0,0	0,0,0	augmentation

correspondance_mirdeep2_mirbaseNom_seq5p3p.csv

	A	B
1	TGAGATCATTATAATACTTTAC	api-mir-novel1a-5p
2	AAAGTGTTGTTTTGATCTCATT	api-mir-novel1a-3p
3	TGAGATCATTATAAAACTTTAT	api-mir-novel1b-5p
4	AAAGTGTTATTTTGATCTTCAT	api-mir-novel1b-3p
5	TGAGATCATTATAATACTTTAT	api-mir-novel1c-1-5p
6	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-1-3p
7	TGAGATCATTATAATACTTTAT	api-mir-novel1c-2-5p
8	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-2-3p
9	TGAGATCATTATAATACTTTAT	api-mir-novel1c-3-5p
10	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-3-3p
11	TGAGATCATTATAATACTTTAT	api-mir-novel1d-5p
12	AAAATGTTATTTTGATCTTCTT	api-mir-novel1d-3p
799	TACCCTGTAGATCCGAATTTGT	api-mir-10-5p
800	CAAATTCGGTTCTAGAGAGGTTT	api-mir-10-3p
801	AAGAGAGCTATCCGTCGACAGT	api-mir-281-5p
802	TGTCATGGAGTTGCTCTCTTTA	api-mir-281-3p

reseau_miARN_21102013_5p3p_StSeOk_nomMicroOk_ARNm_05112012_UTRc_nomArnOk_noTooClose_miARNetARNm_disc_Ti_vs_Tj_edgeR_inf-0.3.txt



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2	ACYPI005819-RA	7029	api-mir-87-3p	m8	46	52	0.0205	-0.174	-0.033	-0.3475	76	UUUCAUUAAAGUAAUUUGCUCAU	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
3	ACYPI009704-RA	7029	api-mir-87-3p	8mer	772	778	0.0028	-0.143	0.061	-0.3892	81	ACUAUUAAAUGUGUUUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
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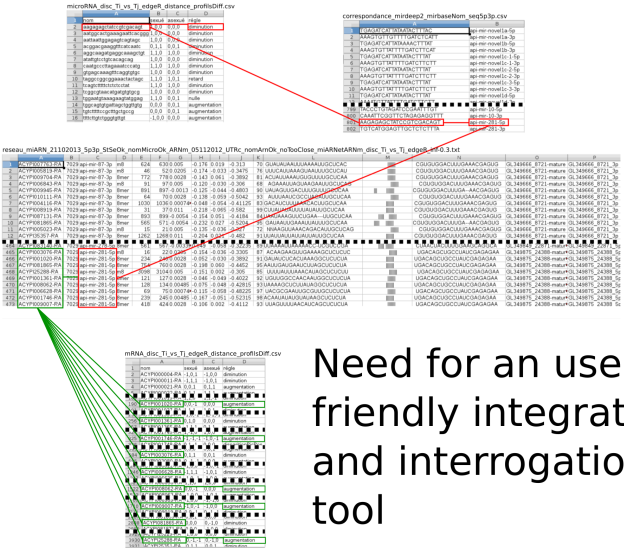
5	ACYPI009945-RA	7029	api-mir-87-3p	8mer	891	897	-0.0013	-0.125	-0.044	-0.4803	90	UAUAGUUGACUUUGUUUGCUCAA	||| |||||||	CGUGUGGACUUUGA--AACGAGUG	GL349666_8721-mature	GL349666_8721_3p
6	ACYPI010111-RA	7029	api-mir-87-3p	8mer	64	70	0.0028	-0.138	-0.059	-0.5042	93	AUUUAAUCGCCUACAUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
7	ACYPI004116-RA	7029	api-mir-87-3p	8mer	1030	1036	0.00074	-0.048	-0.054	-0.41125	83	GACAUCUUUAAACACUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
8	ACYPI008919-RA	7029	api-mir-87-3p	8mer	31	37	0.011	-0.218	-0.065	-0.582	99	CUUAUAUAUUUUAUAUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
9	ACYPI087131-RA	7029	api-mir-87-3p	8mer	893	899	-0.0054	-0.154	0.051	-0.4184	84	UAAUAAAGUUCUGAA---UUGCUCAA	||||| |||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
10	ACYPI081865-RA	7029	api-mir-87-3p	8mer	565	571	-0.0054	-0.232	0.027	-0.5204	95	GAUAAUUGAAAUUAUUUGCUCAA	||||| |||||||	CGUGUGGACUUUGA--AACGAGUG	GL349666_8721-mature	GL349666_8721_3p
11	ACYPI005023-RA	7029	api-mir-87-3p	m8	15	21	0.005	-0.135	-0.036	-0.327	72	NNAAGUUAAACAGACAUUGCUCAG	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
12	ACYPI35357-RA	7029	api-mir-87-3p	8mer	1262	1268	0.011	-0.204	0.021	-0.482	91	UUAUUAUUAUUAUUAUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
464	ACYPI083140-RA	7029	api-mir-278-5p	8mer	561	567	-0.00335	0.049	-0.058	-0.32235	89	UUAAAAUUAAAAACC-UCGUCCGA	||||| |||||||	CUAACUACUUUGGAAGCAGGCA	GL349849_22871-matur	GL349849_22871_5
465	ACYPI003076-RA	7029	api-mir-281-5p	m8	16	22	0.0205	-0.154	-0.036	-0.3305	87	ACAAGAAGUUGAAAAGCUCUCUC	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5
466	ACYPI001020-RA	7029	api-mir-281-5p	8mer	234	240	0.0028	-0.052	-0.030	-0.3892	91	GAUAUCUCACUAAAGGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5
467	ACYPI081865-RA	7029	api-mir-281-5p	8mer	754	760	0.0028	-0.198	0.060	-0.4452	95	AAUUGAUGAAUCUUAGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5
468	ACYPI25288-RA	7029	api-mir-281-5p	m8	3098	3104	0.005	-0.151	0.002	-0.305	85	UUUUAUUUAAACAUAGCUCUCUU	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5
469	ACYPI001361-RA	7029	api-mir-281-5p	8mer	121	127	0.0028	-0.046	-0.049	-0.4022	92	UGUUGGCCAACAAUGGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5
470	ACYPI008062-RA	7029	api-mir-281-5p	8mer	128	134	0.00485	-0.075	-0.048	-0.42815	93	UAAAAGCUCUUAUAGGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5
471	ACYPI006628-RA	7029	api-mir-281-5p	8mer	69	75	0.00074	-0.115	-0.058	-0.48225	97	UACGCGAAUUGCGUUGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5
472	ACYPI001746-RA	7029	api-mir-281-5p	8mer	239	245	0.00485	-0.167	-0.051	-0.52315	98	ACAAUAUAUGUAUAAGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5
473	ACYPI009007-RA	7029	api-mir-281-5p	8mer	418	424	0.0028	-0.106	0.002	-0.4112	93	UUAGUUUUAACAUCAGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5

Biologists files



microRNA_disc_Ti_vs_Tj_edgeR_distance_profilsDiff.csv

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3	aatggcactgaaagaattcacggg	1,0,0	0,0,0	diminution
4	aattaattggagagtcagtagc	1,0,0	0,0,0	diminution
5	acggacgaaggtttcatcaatc	0,1,1	0,0,1	diminution
6	aggcaagatgaggcaaagctgt	1,1,0	1,0,0	diminution
7	atattgtcctgtcacagcag	1,0,0	0,0,0	diminution
8	caatgcccttagaaatcccatg	1,1,0	1,0,0	diminution
9	gtgagcaaagtttcaggtgtgc	1,0,0	0,0,0	diminution
10	taggccggcggaaactactagc	1,1,0	1,0,1	retard
11	tcagtctttttctctctcctat	1,1,0	1,0,0	diminution
12	tcggcgtaacatgatgtgtgcg	1,0,0	0,0,0	diminution
13	tggaatgtaaagaagtatggag	1,1,0	0,0,1	nulle
14	tggcagtgtgattagctggttgtg	0,0,0	0,0,1	augmentation
15	tgtctttttccgctttgctgccg	0,0,0	0,0,1	augmentation
16	ttttcttgtctgggtgttgt	-1,0,0	0,0,0	augmentation

correspondance_mirdeep2_mirbaseNom_seq5p3p.csv

	A	B
1	TGAGATCATTATAATACTTTAC	api-mir-novel1a-5p
2	AAAGTGTTGTTTTGATCTCATT	api-mir-novel1a-3p
3	TGAGATCATTATAAAACTTTAT	api-mir-novel1b-5p
4	AAAGTGTTATTTTGATCTTCAT	api-mir-novel1b-3p
5	TGAGATCATTATAATACTTTAT	api-mir-novel1c-1-5p
6	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-1-3p
7	TGAGATCATTATAATACTTTAT	api-mir-novel1c-2-5p
8	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-2-3p
9	TGAGATCATTATAATACTTTAT	api-mir-novel1c-3-5p
10	AAAGTGTTATTTTGATCTTCTT	api-mir-novel1c-3-3p
11	TGAGATCATTATAATACTTTAT	api-mir-novel1d-5p
799	TACCCTGTAGATCCGAATTTGT	api-mir-10-5p
800	CAAATTCGGTTCTAGAGAGGTTT	api-mir-10-3p
801	AAGAGAGCTATCCGTCGACAGT	api-mir-281-5p
802	TGTCATGGAGTTGCTCTCTTTA	api-mir-281-3p

reseau_miARN_21102013_5p3p_StSeOk_nomMicroOk_ARNm_05112012_UTRc_nomArnOk_noTooClose_miARNetARNm_disc_Ti_vs_Tj_edgeR_inf-0.3.txt

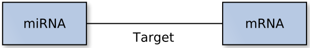
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	ACYPI007763-RA	7029	api-mir-87-3p	m8	624	630	0.005	-0.176	0.019	-0.313	70	GUAUAUAAUUUAAAAUUGCUCAC	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
2	ACYPI005819-RA	7029	api-mir-87-3p	m8	46	52	0.0205	-0.174	-0.033	-0.3475	76	UUUCAUUAAAGUAAUUUGCUCAU	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
3	ACYPI009704-RA	7029	api-mir-87-3p	8mer	772	778	0.0028	-0.143	0.061	-0.3892	81	ACUAUUAAAUGUGUUUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
4	ACYPI006843-RA	7029	api-mir-87-3p	m8	91	97	0.005	-0.120	-0.030	-0.306	68	AGAAAUUAGUAAGAAUUGCUCAG	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
5	ACYPI009945-RA	7029	api-mir-87-3p	8mer	891	897	-0.0013	-0.125	-0.044	-0.4803	90	UAUAGUUGACUUUGUUUGCUCAA	||| |||||||	CGUGUGGACUUUGA--AACGAGUG	GL349666_8721-mature	GL349666_8721_3p
6	ACYPI010111-RA	7029	api-mir-87-3p	8mer	64	70	0.0028	-0.138	-0.059	-0.5042	93	AUUUAAUCGCCUACAUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
7	ACYPI004116-RA	7029	api-mir-87-3p	8mer	1030	1036	0.00074	-0.048	-0.054	-0.41125	83	GACAUCUUUAAACACUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
8	ACYPI008919-RA	7029	api-mir-87-3p	8mer	31	37	0.011	-0.218	-0.065	-0.582	99	CUUAUAUAUUUUAUAUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
9	ACYPI087131-RA	7029	api-mir-87-3p	8mer	893	899	-0.0054	-0.154	0.051	-0.4184	84	UAAUAAAGUUCUGAA---UUGCUCAA	||||| |||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
10	ACYPI081865-RA	7029	api-mir-87-3p	8mer	565	571	-0.0054	-0.232	0.027	-0.5204	95	GAUAAUUGAAAUUAUUUGCUCAA	||||| |||||||	CGUGUGGACUUUGA--AACGAGUG	GL349666_8721-mature	GL349666_8721_3p
11	ACYPI005023-RA	7029	api-mir-87-3p	m8	15	21	0.005	-0.135	-0.036	-0.327	72	NNAAGUUAAACAGACAUUGCUCAG	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
12	ACYPI35357-RA	7029	api-mir-87-3p	8mer	1262	1268	0.011	-0.204	0.021	-0.482	91	UUAUUAUUAUUAUUAUUGCUCAA	|||||||	CGUGUGGACUUUGAAACGAGUG	GL349666_8721-mature	GL349666_8721_3p
464	ACYPI083140-RA	7029	api-mir-278-5p	8mer	561	567	-0.00339	0.049	-0.058	-0.32235	89	UUAAAAUUAAAAACC-UCGUCCGA	||||| |||||||	CUAACUACUUUGGAAGCAGGCA	GL349849_22871-matur	GL349849_22871_5p
465	ACYPI003076-RA	7029	api-mir-281-5p	m8	16	22	0.0205	-0.154	-0.036	-0.3305	87	ACAAGAAGUUGAAAAGCUCUCUC	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p
466	ACYPI001020-RA	7029	api-mir-281-5p	8mer	234	240	0.0028	-0.052	-0.030	-0.3892	91	GAUAUCUCACUAAAGGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p
467	ACYPI081865-RA	7029	api-mir-281-5p	8mer	754	760	0.0028	-0.198	0.060	-0.4452	95	AAUUGAUGAAUCUUAGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p
468	ACYPI25288-RA	7029	api-mir-281-5p	m8	3098	3104	0.005	-0.151	0.002	-0.305	85	UUUUAUUUAAACAUAGCUCUCUU	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p
469	ACYPI001361-RA	7029	api-mir-281-5p	8mer	121	127	0.0028	-0.046	-0.049	-0.4022	92	UGUUGGCCAACAAUGGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p
470	ACYPI008062-RA	7029	api-mir-281-5p	8mer	128	134	0.00485	-0.075	-0.048	-0.42815	93	UAAAAGCUCUUAUAGGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p
471	ACYPI006628-RA	7029	api-mir-281-5p	8mer	69	75	0.00074	-0.115	-0.058	-0.48225	97	UACGCGAAUUGCGUUGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p
472	ACYPI001746-RA	7029	api-mir-281-5p	8mer	239	245	0.00485	-0.167	-0.051	-0.52315	98	ACAAUAUAUGUAUAAGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p
473	ACYPI009007-RA	7029	api-mir-281-5p	8mer	418	424	0.0028	-0.106	0.002	-0.4112	93	UUAGUUUUAACAUCAGCUCUCUA	|||||||	UGACAGCUGCCUAUCGAGAGAA	GL349875_24388-matur	GL349875_24388_5p

mRNA_disc_Ti_vs_Tj_edgeR_distance_profilsDiff.csv

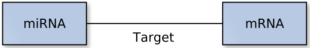
	A	B	C	D
1	nom	sexué	asexué	règle
2	ACYPI000004-RA	-1,0,1	-1,0,0	diminution
3	ACYPI000011-RA	-1,1,1	-1,0,1	diminution
4	ACYPI000021-RA	0,0,1	0,1,1	augmentation
190	ACYPI001020-RA	0,0,-1	0,0,0	augmentation
256	ACYPI001361-RA	0,1,0	0,0,0	diminution
325	ACYPI001746-RA	-1,-1,-1	-1,0,-1	augmentation
584	ACYPI003076-RA	0,1,1	0,0,1	diminution
1246	ACYPI006628-RA	-1,1,1	-1,0,1	diminution
1522	ACYPI008062-RA	0,0,-1	0,0,0	augmentation
1710	ACYPI009007-RA	-1,0,-1	-1,0,0	augmentation
2888	ACYPI081865-RA	0,0,0	0,-1,0	diminution
3930	ACYPI25288-RA	0,-1,-1	0,-1,0	augmentation

Need for an user-friendly integration and interrogation tool

Linking data using triples



Linking data using triples



Subject Predicate Object

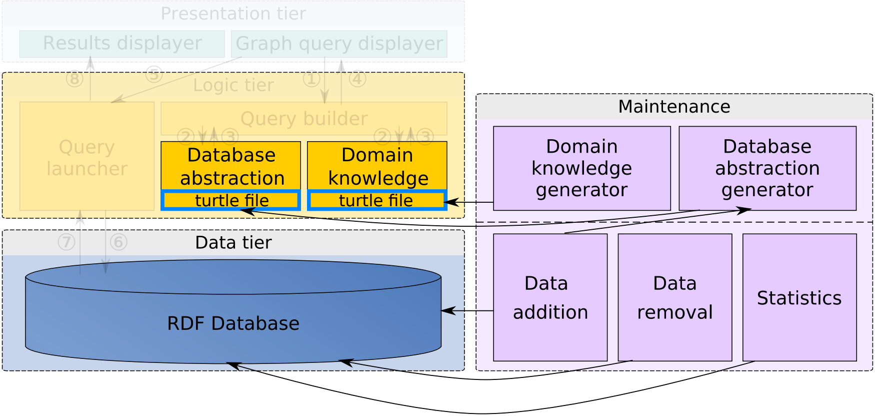
Resource Description Framework

- RDF allow to store the information in the form of triples
- Several syntaxes for this purpose
  - RDF/XML
  - Turtle
  - N-Triples
  - N3
  - ...

Integration work

Parse all the data describing our RNA regulation network in order to build an RDF database

AskOmics: Integration



Source files RDF conversion

- Numerous solutions for automatic conversion:
  - RDF123[1]
  - XLWrap[1]
  - csv2rdf4lod[1]
  - Tarql[1]
  - Datalift[2]
- Difficult in case of heterogeneous files
- Custom scripts dedicated to each source file
- New generic import script for standardized source files (and guidelines for biologists)

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[1] http://www.w3.org/wiki/ConverterToRdf

[2] http://mondeca.com/index.php/en/

Generating additional RDF while source files conversion

- Database abstraction
    - Description of all classes, data properties and object properties
    - Useful for the interrogation part of AskOmics
    - Generated on the fly during data conversion

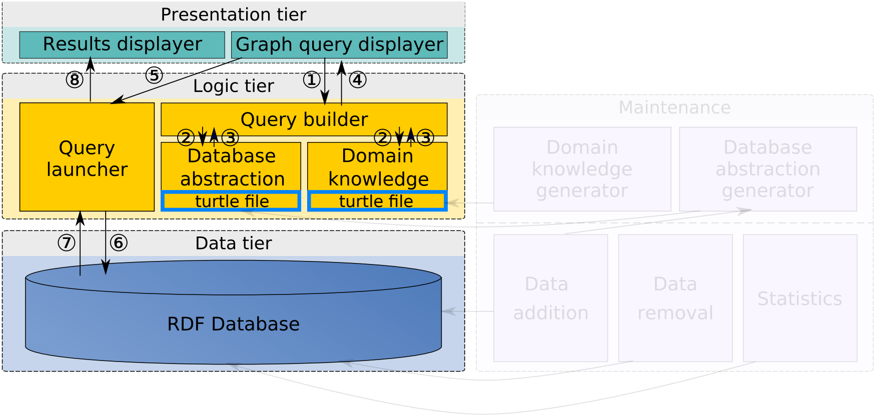
- Domain knowledge
    - Customizable additional information facilitating interrogation process:
        - ★ Startpoints definition
        - ★ Shortcuts definition
        - ★ Define hidden classes to the user

Use case #1

We want to obtain the messengerRNA cis-regulated by a lncRNA and being also the target of a microRNA. We want each of these RNA to have a differential trend of expression comparing sexual and asexual Aphid peas, this trend being “increase” for the microRNA.

```
PREFIX : <http://www.irisa.fr/dyliss/base/>
SELECT DISTINCT ?messengerRNA1 ?lncRNA1 ?microRNA1
WHERE { ?messengerRNA1 a :messengerRNA .
        ?lncRNA1 a :lncRNA .
        ?lncRNA1 :cis_regulates ?messengerRNA1 .
        ?microRNA1 a :microRNA .
        ?microRNA1 :has_target ?messengerRNA1 .
        ?messengerRNA1 :studied_in/:has_results/:trend ?trend1 .
        ?lncRNA1 :studied_in/:has_results/:trend ?trend2 .
        ?microRNA1 :studied_in/:has_results/:trend ?trend3 .
        FILTER (regex(str(?trend3), "increase", "i")) .
}
```

AskOmics: Interrogation

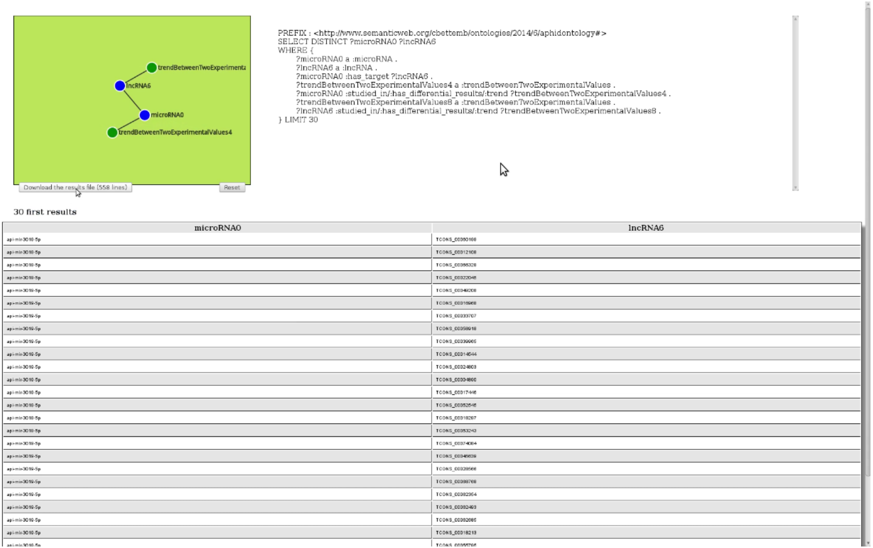


Simple use case with AskOmics

All microRNA targeting a lncRNA, alltogather having a differential trend between sexual and asexual Aphid peas.

Simple use case with AskOmics

Simple use case with AskOmics



```
PREFIX : <http://www.semanticweb.org/cbettemb/ontologies/2014/6/aphidontology#>
SELECT DISTINCT ?microRNA0 ?lncRNA6
WHERE {
    ?microRNA0 a :microRNA .
    ?lncRNA6 a :lncRNA .
    ?microRNA0 :has_target ?lncRNA6 .
    ?trendBetweenTwoExperimentalValues4 a :trendBetweenTwoExperimentalValues .
    ?microRNA0 :studied_in/:has_differential_results/:trend ?trendBetweenTwoExperimentalValues4 .
    ?trendBetweenTwoExperimentalValues8 a :trendBetweenTwoExperimentalValues .
    ?lncRNA6 :studied_in/:has_differential_results/:trend ?trendBetweenTwoExperimentalValues8 .
} LIMIT 30
```

30 first results

microRNA0	lncRNA6
api-mir-3016-5p	TCONS_00060169
api-mir-3016-5p	TCONS_00012108
api-mir-3016-5p	TCONS_00066328
api-mir-3018-5p	TCONS_00022046
api-mir-3019-5p	TCONS_00049208
api-mir-3019-5p	TCONS_00016968
api-mir-3019-5p	TCONS_00033707
api-mir-3019-5p	TCONS_00058918
api-mir-3019-5p	TCONS_00039965
api-mir-3019-5p	TCONS_00014544
api-mir-3019-5p	TCONS_00024803
api-mir-3016-5p	TCONS_00004860
api-mir-3016-5p	TCONS_00017446
api-mir-3016-5p	TCONS_00052546
api-mir-3016-5p	TCONS_00018287
api-mir-3016-5p	TCONS_00053243
api-mir-3019-5p	TCONS_00074084
api-mir-3019-5p	TCONS_00045639
api-mir-3019-5p	TCONS_00028566
api-mir-3019-5p	TCONS_00068768
api-mir-3019-5p	TCONS_00062354
api-mir-3019-5p	TCONS_00062469
api-mir-3019-5p	TCONS_00062086
api-mir-3019-5p	TCONS_00018213
api-mir-3019-5p	TCONS_00055796

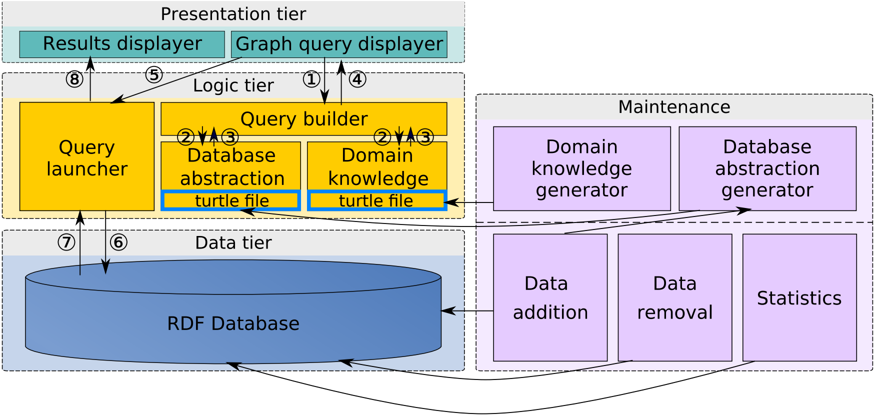
Use case #1 with AskOmics

We want to obtain the messengerRNA cis-regulated by a lncRNA and being also the target of a microRNA. We want each of these RNA to have a differential trend of expression comparing sexual and asexual Aphid peas, this trend being “increase” for the microRNA.

Try it!

- Which piRNA having a trend "increase" overlap with messengerRNA having a trend "decrease"?
- Which microRNA having a trend "increase" target messengerRNA having a trend "decrease"?
- Which piRNA having a trend "increase" overlap with messengerRNA having a trend "decrease" and being the target of a microRNA having a trend "increase"?
- Which target of the microRNA "api-mir-2c-5p" have a trend "decrease" and are also cis-regulated?
- Which messengerRNA targeted by a microRNA are also overlapping a piRNA and are cis-regulated by a lncRNA, these last three RNA having a differential trend?

Conclusion


Presentation tier
Results displayer
Graph query displayer
⑧
⑤
Logic tier
①
④
Query launcher
Query builder
②
③
Database abstraction
turtle file
②
③
Domain knowledge
turtle file
Maintenance
Domain knowledge generator
Database abstraction generator
⑦
⑥
Data tier
RDF Database
Data addition
Data removal
Statistics