



InSyBio

Intelligent Systems Biology

User Manual

Analyze Protein-Protein Interactions with InSyBio Interact

November 2019

Insybio Suite v2.6

www.insybio.com

Introduction

Interact is an intracellular interaction analysis tool for the

- analysis of proteins
- analysis of protein interactions
- prediction of proteins' functionality

Proteins are the functional components of many cellular processes and the identification of their physical Protein-Protein Interactions (PPIs) is an area of mature academic research.

InSyBio Interact enables users to combine a variety of sequential, structural and functional information using a high performance machine learning technique to predict a confidence score for each protein pair. This confidence score indicates the probability of these two proteins to interact and the strength of this interaction. Users are able to tune this confidence score and extract their own datasets as well as obtain only positives or negative interactions. Moreover, InSyBio Suite also provides visualization and meta-analysis of the Protein Interaction Networks. The protein interaction networks are clustered using a novel methodology to extract information about the protein complexes which the proteins form to perform specific tasks. These complexes and the overall PPI networks may be visualized using an interactive visualization module.

With Insybio Interact you can:

- a) Search Positive/Negative PPIs
- b) Retrieve information about a specific protein
- c) View and download the list of clusters created by the EEMC algorithm
- d) Search proteins and Complexes with a GO Term
- e) Create and Save your own PPI dataset
- f) Create a network from your set of biomarkers (genes, transcripts, proteins)
- g) Perform functional enrichment analysis on your set of biomarkers
- h) Annotate functionally a specific protein

Search positive/negative PPIs

You can search for positive and negative Human Protein-Protein Interaction Data by specifying a threshold referring to the PPI confidence score.

Uniprot Id 1	Uniprot Id 2	Interaction Score	GO Function	GO Component	GO Process	Sequence Similarity	Co-localization
P25788	P28870	1.2993	0.275862668965517	0.0769230769230769	0.15625	0.576036866359447	Co-localized on the same cellular compartment
Q9N5T8	P29317	1.2992	0	0.0769230769230769	0	2.30414746543779e-59	Probably localized on the same or neighbor cellular compartment
Q8N4N8	O66674	1.2989	0.0114942528735632	0.0769230769230769	0.0625	0.576036866359447	Co-localized on the same cellular compartment
Q5JTC6	O15169	1.2959	0.0114942528735632	0.153846153846154	0.09375	0.576036866359447	Co-localized on the same cellular compartment
P19447	Q8NBB4	1.2956	0.0114942528735632	0.0769230769230769	0.03125	0.576036866359447	Co-localized on the same cellular compartment
P66241	P69619	1.2921	0	0.230769230769231	0.03125	3.45622119815668e-35	Not localized on the same cellular compartment

You can search by choosing:

- The classification threshold value
- Positive or negative PPIs
- The application of normalization to the features to the interval [0-1]

The results are presented in your screen in a browse-able table or you can download them as a TAB delimited CSV file.

For each PPI the following are presented:

- The Uniprot IDs of the two proteins,
- 22 informative sequential, structural and functional features,
- Presence in the APID database,

- The protein-protein interaction score - a confidence score indicating the probability of a protein pair to be an interacting one and the strength of this interaction.

For every protein pair 22 informative features are calculated and provided including sequential, structural and functional features:

- **Gene Ontology (Co-function, Co-process, Co-localization)** (3 features). Gene Ontology database contains information of three types that include:
 - Molecular function of a gene product,
 - Biological process in which the gene product participates,
 - Cellular component where the gene product actsIn this features the number of common GO terms existing in a protein pair are calculated.
- **Sequence Similarity** (1 feature). This feature was obtained using the NCBI-BLAST+ standalone executable BLASTP to perform the human to human protein alignment. All BLASTP hits obtained with the default parameters and the sequence alignment E-values of each protein-protein pair have been used to fill in the specific feature.
- **Homology Based PPI** (1 feature). For each human protein pair we have found its homology pairs in yeast by using the 0.001 cutoff on the E-value taken by similarity tests that were conducted using BLASTP. If at least one of the resulting homology pairs is referred as interacting in the Yeast organism's DIP dataset, a value equal to "1" is assigned to this feature, otherwise "0".
- **Gene Expression Profile Similarity** (15 features). Fifteen gene expression datasets were used to estimate 15 gene expression profile similarity features. The datasets selected are extracted from NCBI Gene Expression Omnibus (GDS531, GDS534, GDS596, GDS651, GDS806, GDS807, GDS843, GDS987, GDS1085, GDS2855, GDS1402, GDS181, GDS1088, GDS841, GDS3257). For each dataset, the expression profile of each protein of every protein-pair was extracted and the Pearson correlation between the two profiles was estimated.
- **Co-localization** (1 feature). PLST tool (Scott et al, 2004) was used to predict the local cellular compartments in which each protein is likely to function. For

every pair of proteins, a feature is calculated by taking the value of 1 if the two proteins share at least one local compartment and the value of 0 if they do not have any common local cellular compartment.

- **Domain-Domain Interactions** (1 feature). All possible domain pairs (downloaded from InterPro) were evaluated using the training set and the hypergeometric distribution to locate pairs that are interacting with high probability (p-values less than 0.05). Then for every protein pair, their domain combinations are computed and the number of the interacting ones is measured and used as the feature's value.

Retrieve information about a specific protein

You can extract information about a specific Human protein by providing its UNIPROT identifier.

You can:

- Request the PPIs that are related to the specific protein and download the results;

The screenshot shows the InSyBio Suite Beta - Protein Search interface. The search bar contains the Uniprot ID 'Q9P212'. The results are displayed in a table with the following columns: Uniprot Id 1, Uniprot Id 2, Interaction Score, GO Function, GO Component, GO Process, Sequence Similarity, Co-localization, Homology Yeast, Domain Domain Interaction, HPRD, APID_verified, and Co-expressions. The table shows four interaction entries for Q9P212 with various partner proteins (Q15124, Q5NGF3, Q6NSJ0, Q76KD6).

Uniprot Id 1	Uniprot Id 2	Interaction Score	GO Function	GO Component	GO Process	Sequence Similarity	Co-localization	Homology Yeast	Domain Domain Interaction	HPRD	APID_verified	Co-expressions
Q9P212	Q15124	0.2873	0	0	0.03125	0.576036866359447	Not localized on the same cellurall compartment	No	0.000133246913580247	No	0	
Q9P212	Q5NGF3	-0.031725	6.3416091954023e-06	0.00155646153846154	0.0004603125	0.576036866359447	Not localized on the same cellurall compartment	No	3.4566049382716e-05	No	0	
Q9P212	Q6NSJ0	0.017539	0	0	0	0.576036866359447	Not localized on the same cellurall compartment	No	0.000191006172839506	No	0	
Q9P212	Q76KD6	0.15875	0	0	0	0.576036866359447	Not localized on the same cellurall compartment	No	0.000229654320987654	No	0	

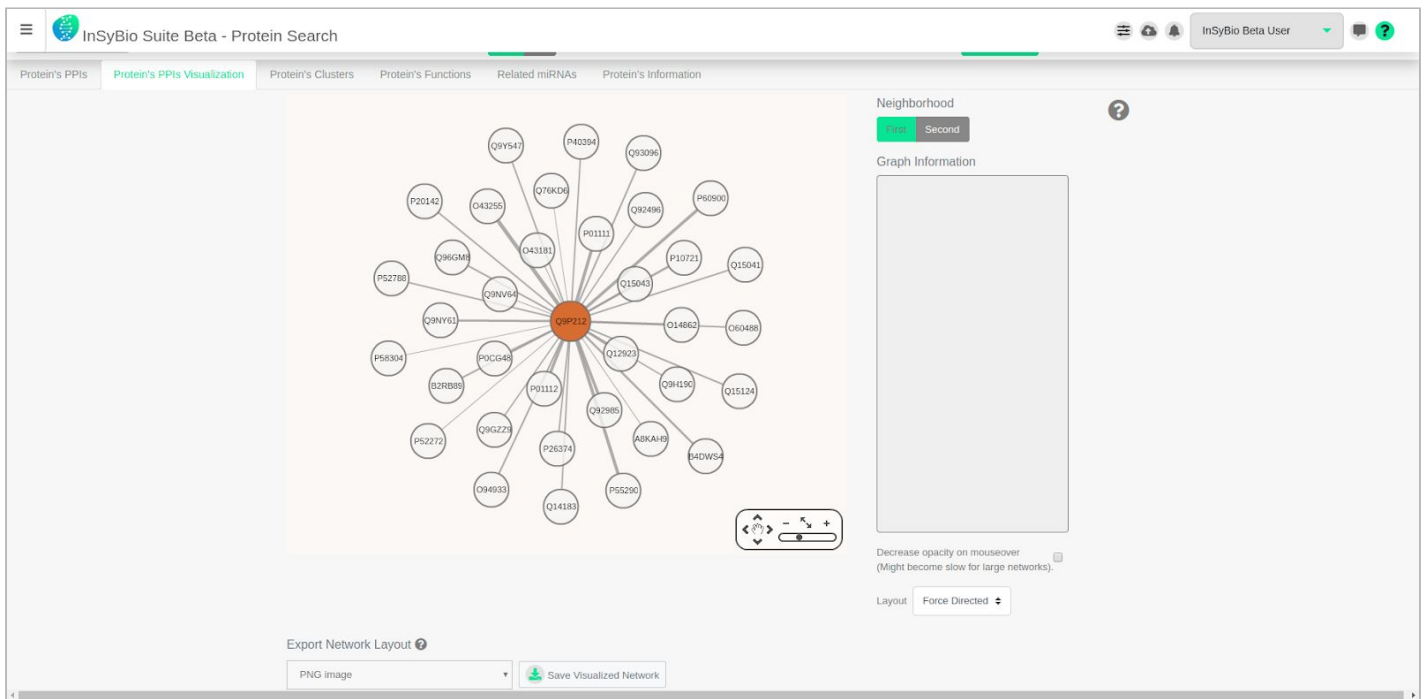
The results are presented in your screen in a browse-able table or you can download them as a TAB delimited CSV file.

For each PPI the following are presented:

- The Uniprot IDs of the two proteins,
- 22 informative sequential, structural and functional features,
- Presence in the APID database,

- The protein-protein interaction score - a confidence score indicating the probability of a protein pair to be an interacting one and the strength of this interaction.

b) Visualize the protein interaction network related to the specific protein and download it in various graph-representation file formats;



The result is an interactive graph displaying the first or the second neighborhood of the protein of interest (after user choice).

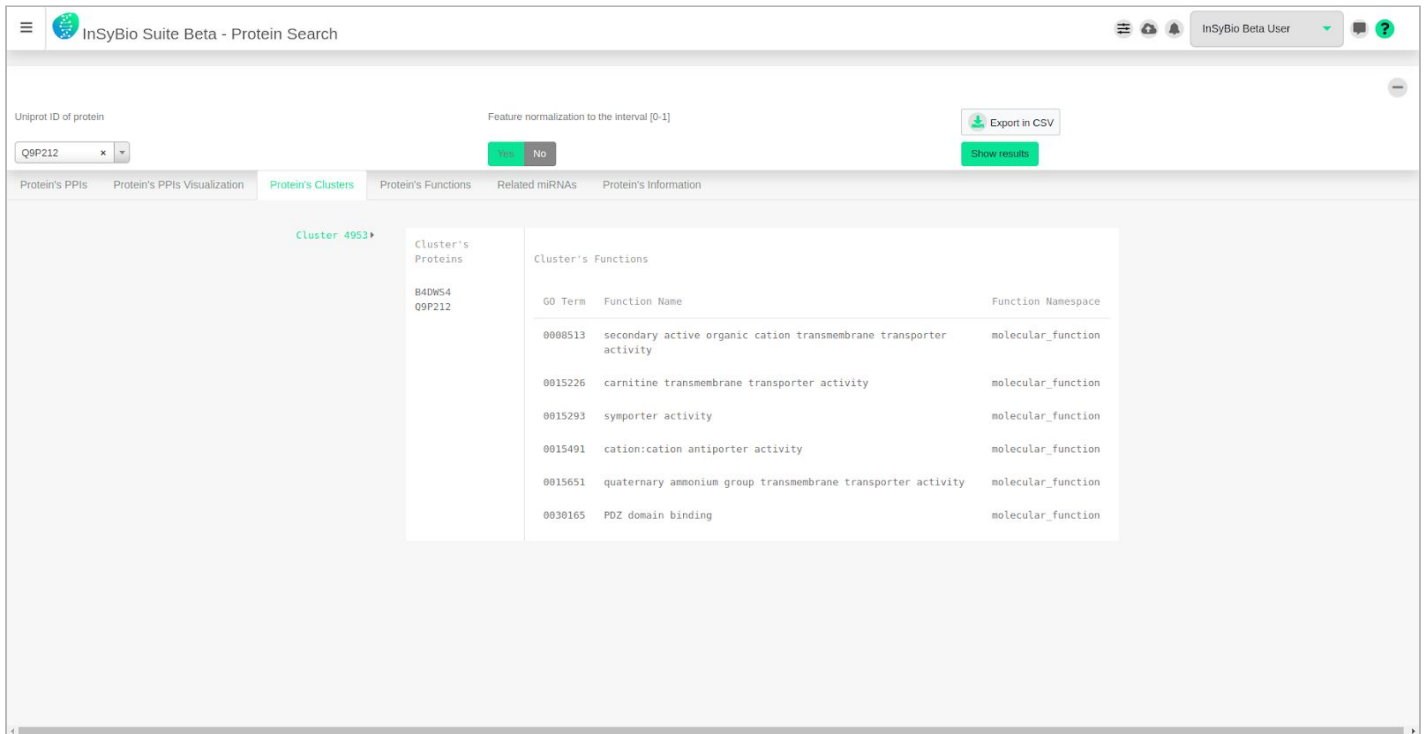
Clicking on a node-protein or on an edge-interaction, the respective information is presented.

Right clicking on a node-protein, its first neighborhood is presented.

There are options for decreasing opacity on mouseover and changing layout (force directed, radial, or circle).

The graph can be saved in various formats (PNG image, SVG image, PDF file, XGML document, GraphML document, or Simple Interaction Format (SIF) document).

c) Find the clusters related to the specific protein;



The screenshot shows the InSyBio Suite Beta - Protein Search interface. The 'Protein's Clusters' tab is active, displaying a list of clusters. The selected cluster is 'Cluster 4953', which contains the proteins B4DWS4 and Q9P212. A table titled 'Cluster's Functions' lists the following GO terms and function names:

GO Term	Function Name	Function Namespace
0008513	secondary active organic cation transmembrane transporter activity	molecular_function
0015226	carnitine transmembrane transporter activity	molecular_function
0015293	symporter activity	molecular_function
0015491	cation:cation antiporter activity	molecular_function
0015651	quaternary ammonium group transmembrane transporter activity	molecular_function
0030165	PDZ domain binding	molecular_function

The result is a list of the clusters the protein of interest takes part in.

Clicking on a cluster, the following information is presented:

- The proteins that form the cluster,
- A table of the cluster's functions.

d) List all the functions related to the specific protein;

Uniprot ID of protein: Q9P212

Feature normalization to the interval [0-1]: Yes (selected) / No

Export in CSV

Show results

GO Term	Function Name	Function Namespace
0008277	regulation of G-protein coupled receptor protein signaling pathway	biological_process
0008283	cell proliferation	biological_process
0016042	lipid catabolic process	biological_process
0019722	calcium-mediated signaling	biological_process
0043547	positive regulation of GTPase activity	biological_process
0048016	inositol phosphate-mediated signaling	biological_process
0046578	regulation of Ras protein signal transduction	biological_process
0045859	regulation of protein kinase activity	biological_process
0032835	glomerulus development	biological_process
0000187	activation of MAPK activity	biological_process
0001550	regulation of cell growth	biological_process
0043647	inositol phosphate metabolic process	biological_process
0006644	phospholipid metabolic process	biological_process

The result is a table with the functions that the protein of interest has.

For each function, the following information is presented:

- The function's GO term,
- The function's name, and
- The function's namespace.

e) List all the miRNAs related to the specific protein;

The screenshot shows the InSyBio Suite Beta - Protein Search interface. At the top, there is a search bar with the text 'Uniprot ID of protein' and a dropdown menu containing 'Q6P212'. To the right of the search bar, there is a 'Feature normalization to the interval [0-1]' section with a 'Yes' button (highlighted in green) and a 'No' button. Further right, there is an 'Export in CSV' button and a 'Show results' button. Below the search bar, there is a navigation menu with tabs: 'Protein's PPIs', 'Protein's PPIs Visualization', 'Protein's Clusters', 'Protein's Functions', 'Related miRNAs' (highlighted in green), and 'Protein's Information'. The main content area displays the message: 'There aren't any miRNAs related to this protein.'

The result is a table with the miRNAs that regulate the expression of the protein of interest.

For each miRNA, the following information is presented:

- The miRNA's accession number, and
- The miRNA's id.

f) Find the protein's information;

The screenshot shows the InSyBio Suite Beta - Protein Search interface. The search bar contains the Uniprot ID 'B2R789'. The 'Feature normalization to the interval [0-1]' section has a 'Yes' button highlighted in green and a 'No' button. There are 'Export in CSV' and 'Show results' buttons. The 'Protein's Information' tab is selected, displaying a table with the following data:

Uniprot ID	Official Gene Symbol	Protein Name	Sequence
B2R789	STARD13	START domain containing 13, isoform CRA_b	MKLDVNFQRKGGDDSEEDLCSNKWTFQRTSRWSRVDDLYTLPRGDRNGSPGGTMRNTTSSSEVLTDLSEPEVCSIHSESSGGSDRSRSPGGQCT DNPVMLDAPLVSSSLQPQPROVLNHPFHKQNEKPTRARAKSLFRKMETLRGKGAHRHKGSGRTGGLVIGPMLQQEPEFKAQCQIQIPNGDLQNSPP PACRGLPCSGKSSGESSPSEHSSGVSTPCLKERKCHEANKRGMYLEDDLVAGTALPDAGQDSRMHEFHSQENLVVHFKDHPKGTFPKALSIEESL SPTDSSNGVMRTGSLGREQVPGAREPRLMASCHRASRVSYDNPVPGSHLYASTGDLLEKDDLFPHLDDILOHVNGLQEVVDDMSKDVPELOTH DTLVGEPGLSTFPSPNQITLDFEGNSVSEGRTPSDVERDVTSLNESEPPGVDRDRDSGVGASLTPNRRLRNNSFQLSHQPRPAPASPHISSQTASQL SLLQRFSLRLTAIMEKHSMSMKHGWTWSPFKMRKVPDYKDKAVFGVPLIVHVORTGQPLPQSIQALRYLRSNCLDQVGLFRKSGVKSRIHALRQ MNEFPFWNYEODSAYVDADNWKQFRDLPEPLFTNMLETFLLHLYQVYVSEKORLDVAVAAIILLADENREVLDTLLCFLNDLVNLLVEENQMTFNNLA VCLAPSLFRLNLLKXESSRVLQKYYATGRQDQKDLNENLAAAGLAIHMTMEQDLRFVPHLVAQSRNSYFAEITWPTLEELGTDLSESGAHTFTYL MHLTGLQKEAKKFKGWVTCSSSTNDTDLAFKXVGDGAPLKLKASVEVEAPPSSVILRVLREHRLMDEDFVQKVYETLDRQTEIYQVYLSNAPHPSP RDFVILRWTDLPKGNCTLVSLVEHEAQLLGGVRAVWMSOYLIEPCGSGKRLTHICRIDLKGHPWYKSGFGHLCAAEVARIRNSFQPLTAEG PETKI

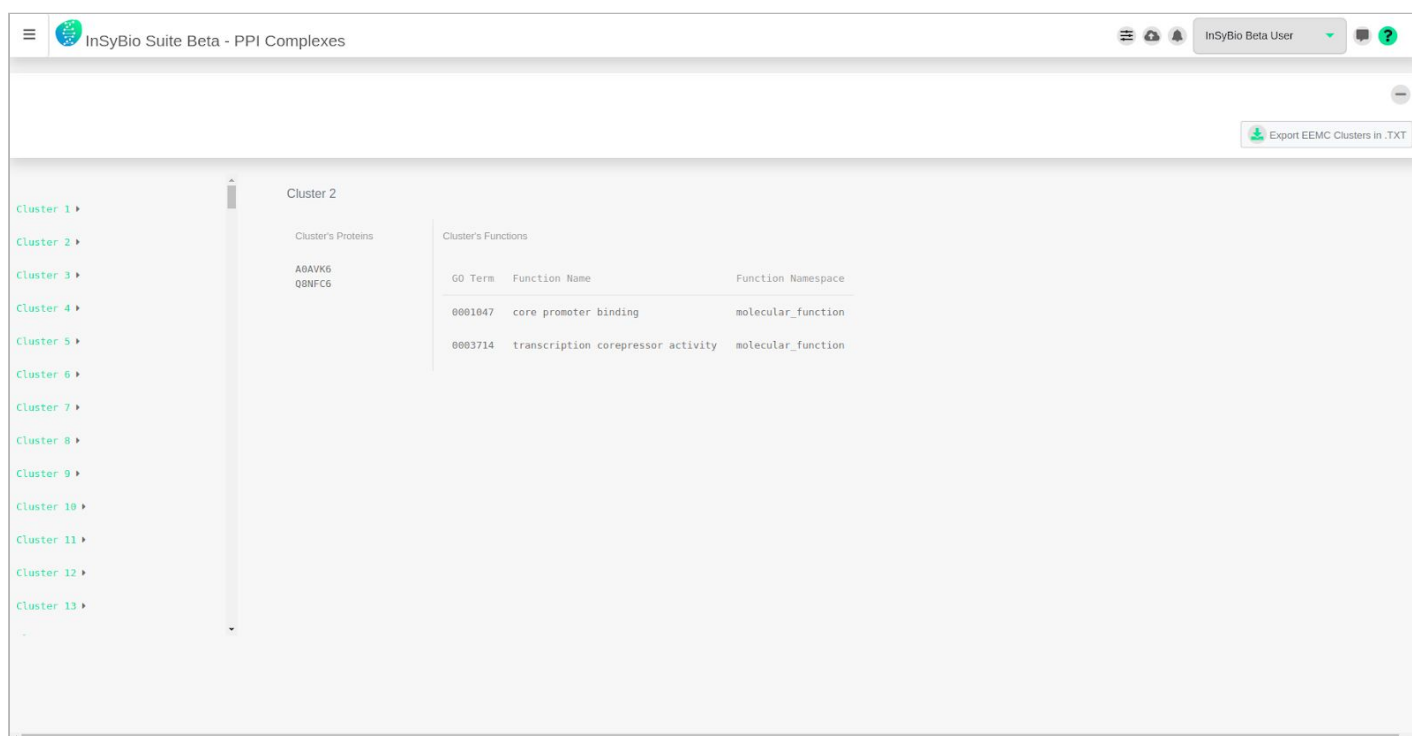
The result is a table containing information about the protein of interest.

For each protein, the following information is presented:

- The uniprot ID,
- The official gene symbol
- The protein name, and
- The protein's sequence.

PPI complexes

You can view a list of all the clusters computed from the algorithm EEMC. EEMC (Evolutionary Enhanced Markov Clustering) is a novel fully unsupervised methodology that InSyBio team has proposed for the prediction of protein complexes from weighted PPI graphs. It is a hybrid combination of an adaptive evolutionary algorithm and a state-of-the-art clustering algorithm named Enhanced Markov Clustering. When applied to new human datasets EEMC's performance was encouraging in the prediction of protein complexes which consist of proteins with high functional similarity. From EEMC's analysis, we suggest new potentially true Human protein complexes which should be further validated using experimental techniques.



The screenshot shows the InSyBio Suite Beta - PPI Complexes interface. On the left, there is a vertical list of clusters from Cluster 1 to Cluster 13. Cluster 2 is selected, and its details are shown in the main area. The details are divided into two sections: 'Cluster's Proteins' and 'Cluster's Functions'.

Cluster's Proteins:

- A0AVK6
- Q8NFC6

Cluster's Functions:

GO Term	Function Name	Function Namespace
0001047	core promoter binding	molecular_function
0003714	transcription corepressor activity	molecular_function

The result is a list of the clusters calculated using the EEMC algorithm. Clicking on a cluster, the user can be informed about the proteins that form the cluster and the cluster's functions.

The entire set of clusters can be downloaded in a txt file with the following format:

```
cluster_id,proteins,go_terms
```

```
1,A0AV96 Q9COH2,0005254
```

```
2,Q8NFC6 A0AVK6,0001047 0003714
```

```
3,A0AVT1 Q7Z6D5,0019780 0016874
```

```
...
```

PPI functions

You can derive the details of your function of interest by providing its GO-term.

For each function, the following information is presented:

- The function's GO term,
- The function's name, and
- The function's namespace.

Selecting the respective tab, you can also view the related

a) Complexes;

GO Term (7-digit code) Show Results

Complexes Proteins

GO term
0000987

Function Name
core promoter proximal region sequence-specific DNA binding

Function Namespace
molecular_function

Complexes List

Cluster 468 ▶

Cluster's Proteins

FBMAJ5
Q96CQ1

Cluster's Functions

GO Term	Function Name	Function Namespace
0060977	RNA polymerase II regulatory region sequence-specific DNA binding	molecular_function
0060987	core promoter proximal region sequence-specific DNA binding	molecular_function
0061846	core promoter sequence-specific DNA binding	molecular_function
0061077	transcriptional activator activity, RNA polymerase II core promoter proximal region sequence-specific binding	molecular_function
0063705	transcription factor activity, RNA polymerase II distal enhancer sequence-specific binding	molecular_function
0042826	histone deacetylase binding	molecular_function
0046983	protein dimerization activity	molecular_function
0071837	HMG box domain binding	molecular_function

Cluster 721 ▶

Cluster 1118 ▶

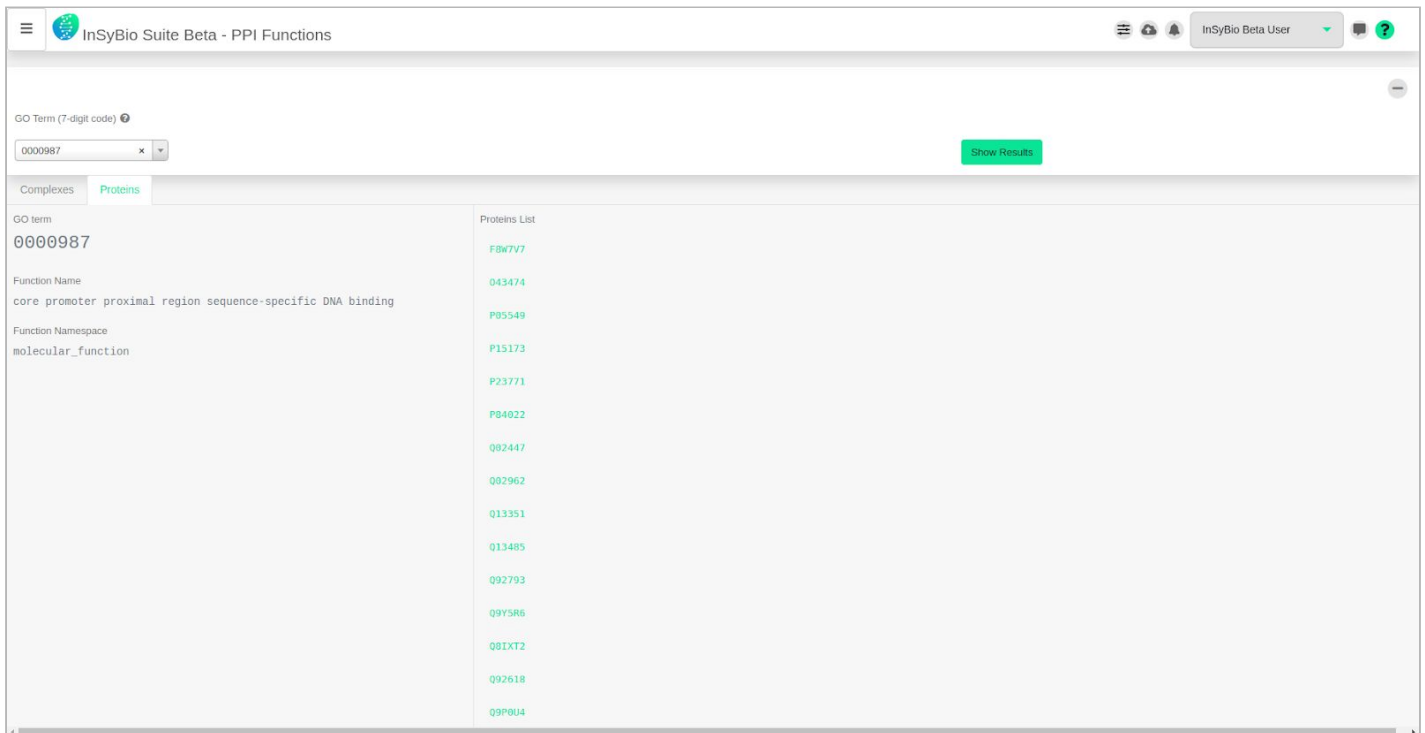
Cluster 3657 ▶

The result is a list of the complexes having the function of interest.

Clicking on a cluster, the following information is presented:

- The proteins that form the cluster, and
- A table of the cluster's functions.

b) Proteins;



The screenshot displays the InSyBio Suite Beta - PPI Functions interface. At the top, there is a search bar for a GO Term (7-digit code) with the value '0000987' entered. A 'Show Results' button is located to the right of the search bar. Below the search bar, there are two tabs: 'Complexes' and 'Proteins', with 'Proteins' selected. The main content area is divided into two columns. The left column shows the GO term '0000987', the Function Name 'core promoter proximal region sequence-specific DNA binding', and the Function Namespace 'molecular_function'. The right column, titled 'Proteins List', contains a vertical list of protein IDs: FBW7V7, 043474, P85549, P15173, P23771, P84022, Q82447, Q82962, Q13351, Q13485, Q92793, Q9Y5R6, Q8IXT2, Q92618, and Q9P8U4.

The result is a list of the proteins having the function of interest. Clicking on a protein the user will be guided to the protein's page.

PPI datasets

You can create your own datasets by using a simple form to choose the number of positive and negative examples.

InSyBio Suite Beta - PPI Dataset Creation Tool

Number of positive interactions: All positive PPIs in HPRD:
 Number of negative interactions: Feature normalization to the interval [0-1]:

Actions:

Uniprot Id1	Uniprot Id2	Interaction Score	GO Function	GO Component	GO Process	Sequence Similarity	Co-localization	Homology Yeast	Domain Domain Interaction	HPRD	APID_verified	Co-expressions		
P38058	Q960L0	-0.69411	0.0045977	0.092388	0.0375	Not similar	Probable localized on the same or neighbor celllural compartment	No	0.029164	No	0			
G05531	G05534	G05596	G05651	G05806	G05807	G05843	G05987	G051085	G052855	G051402	G05181	G051088	G05841	G053257
0.80245	0.85146	0.56638	0.67806	0.31599	0.27074	0.06652	0.30644	0.26068	0.35597	0.43682	0.88319	-0.7132	0.58059	-0.23966
P62277	P63092	-0.61444	0	0	0	Not similar	Not localized on the same celllural compartment	No	0.028885	No	0			
P0CG48	Q5JWF2	-0.59187	0	0	1	Not similar	Not localized on the same celllural compartment	No	0.044216	No	0			
D1MER9	E7ES66	-0.58602	0.0679141	0.041426	0.0038688	7e-17	Not localized on the same celllural compartment	No	0.012593	No	0			

Showing 1 to 50 of 200 entries

There are options for:

- All positive PPIs being in HPRD or not,
- The application of normalization to the features to the interval [0-1].

The results are presented in your screen in a browse-able table or you can download them as a TAB delimited CSV file through the Actions Button. The dataset created can also be saved in InSyBio Data Store for future use.

For each PPI the following are presented:

- The Uniprot IDs of the two proteins,
- 22 informative sequential, structural and functional features,
- Presence in the APID database,
- The protein-protein interaction score - a confidence score indicating the probability of a protein pair to be an interacting one and the strength of this interaction.

Biological Networks Creation

You can create and view biological networks from your set of biomarkers based on the protein-protein interactions knowledge base of InSyBio Interact.

In the tab New Network Creation you can either Type or Copy-Paste the biomarkers or Upload a file with biomarkers. You can use any known identifier for denoting your biomarkers: Uniprot IDs, gene symbols, RefSeq_id and so on. Mixed identifiers are not supported! Note that each symbol should be in one line or separated by comma.

InSyBio Suite Beta - Network Creation

Create Network

Creation of biological networks from your set of biomarkers based on the protein-protein interactions knowledge base of InSyBio Interact.

Created Networks **New Network Creation** Running and Pending Processes Errors

Create a new network from a list of biomarkers

Input mode

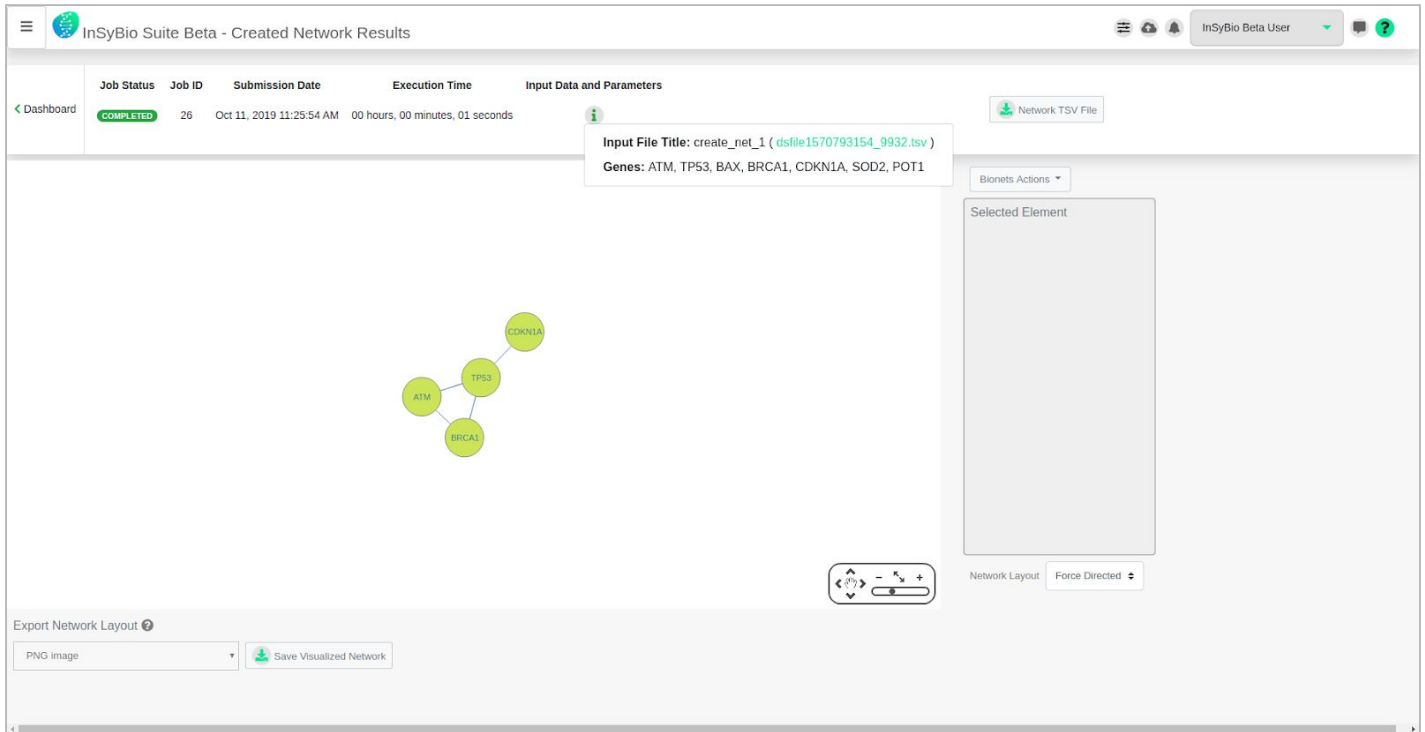
Type or Copy-Paste biomarkers Upload a file with biomarkers

New network's title:

List of symbols :

Start Network Creation

After the network creation, the job will appear in the Created Networks tab. By clicking View Results a new page is opened.



Networks' visualization provides an interactive graphical interface. Users can retrieve information about clicked nodes and edges, export the image in different formats (a PNG, SVG, PDF, XGMML, GraphML or SIF document), decrease opacity on mouseover and view the network using different visualization layouts (force-directed, circle or radial).

You can download the network in a TSV format and perform a list of supported actions in InSyBio BioNets tool.

Enrichment Analysis Functionality

You can perform enrichment analysis with hypergeometric distribution on a given list of proteins, genes or transcripts and produce a list of GO terms associated with the list, with their term specificity and score in the distribution. You can also provide your custom annotation, term, term type and functional annotation of molecules files, that will be appended to the default files to perform the enrichment.

In the tab New Enrichment Analysis you can:

InSyBio Suite Beta - Enrichment Analysis

Perform Enrichment Analysis

Performed Enrichment Analyses **New Enrichment Analysis** Running and Pending Enrichment Analyses Errors at Enrichment Analyses

Perform Enrichment Analysis

GO term Enrichment Analysis from your set of biomarkers based on the protein-go term correlation knowledge base of InSyBio Interact.

Input mode

Type or Copy-Paste biomarkers Upload a file with biomarkers Upload custom input files

Use any known identifier for denoting your biomarkers: Uniprot IDs, gene symbols, RefSeq_id and so on. **Mixed identifiers are not supported!**

Pvalue threshold ? : 0.05

New enrichment analysis title : Title...

List of symbols ? : ATM,TP53,BRCA1,...

Start Enrichment Analysis

- Either Type or Copy-Paste biomarkers or

InSyBio Suite - Enrichment Analysis

Perform Enrichment Analysis

Performed Enrichment Analyses **New Enrichment Analysis** Running and Pending Enrichment Analyses Errors at Enrichment Analyses

Perform Enrichment Analysis

GO term Enrichment Analysis from your set of biomarkers based on the protein-go term correlation knowledge base of InSyBio Interact.

Input mode

Type or Copy-Paste biomarkers Upload a file with biomarkers Upload custom input files

Use any known identifier for denoting your biomarkers: Uniprot IDs, gene symbols, RefSeq_id and so on. **Mixed identifiers are not supported!**

Pvalue threshold ? :

New enrichment analysis title :

Select File Biomarker Input ? :

Start Enrichment Analysis

- Upload a file with biomarkers or

InSyBio Suite - Enrichment Analysis

Perform Enrichment Analysis

Performed Enrichment Analyses | **New Enrichment Analysis** | Running and Pending Enrichment Analyses | Errors at Enrichment Analyses

Perform Enrichment Analysis

GO term Enrichment Analysis from your set of biomarkers based on the protein-go term correlation knowledge base of InSyBio Interact.

Input mode

Type or Copy-Paste biomarkers | Upload a file with biomarkers | Upload custom input files

Use any known identifier for denoting your biomarkers: Uniprot IDs, gene symbols, RefSeq_id and so on. **Mixed identifiers are not supported!**

Pvalue threshold ? : 0.05

New enrichment analysis title : Title...

Select File Biomarker Input ? : Drop file here to upload or Click to select file

Custom Enrichment Files

Select file (Go Terms) ? : Drop file here to upload or Click to select file

Select file (Annotations) ? : Drop file here to upload or Click to select file

Select file (Go Terms Full) ? : Drop file here to upload or Click to select file

Select file (Go Types) ? : Drop file here to upload or Click to select file

Select file (Goa Pruned) ? : Drop file here to upload or Click to select file

Start Enrichment Analysis

- Upload a file with biomarkers and other custom annotation, term, term type and functional annotation of molecules files

You can use any known identifier for denoting your biomarkers: Uniprot IDs, gene symbols, RefSeq_id and so on. Mixed identifiers are not supported! Note that each symbol should be in one line or separated by comma.

You can also define a pvalue threshold for the biomarker to GO terms association output.

After the enrichment analysis, the job will appear in the Performed Enrichment Analyses tab.

InSyBio Suite - Enrichment Analysis

Perform Enrichment Analysis

Performed Enrichment Analyses | New Enrichment Analysis | Running and Pending Enrichment Analyses | Errors at Enrichment Analyses

List of Performed Enrichment Analyses

ID	Title	Biomarkers	Symbols DB	Submitted	Start Processing	End Processing	Action
28	test_symbols_enrichment	ATM, TP53, BRCA1, ...	GENESYMBOLS	11/13/19 12:09 PM	11/13/19 12:10 PM	11/13/19 12:10 PM	View Results
25	enrichment_test	ATM, TP53, BRCA1...	GENESYMBOLS	10/11/19 1:32 PM	10/11/19 1:32 PM	10/11/19 1:32 PM	View Results
22	1_test	ATM, TP53...	GENESYMBOLS	10/4/19 2:23 PM	10/8/19 6:54 AM	10/8/19 6:54 AM	View Results
21	1_test	ATM, TP53...	GENESYMBOLS	10/4/19 2:23 PM	10/8/19 6:54 AM	10/8/19 6:54 AM	View Results

PREVIOUS 1 Next Show 10 entries

By clicking View Results you will be redirected to the Enrichment Analysis Results window, where you can view the results and download them in a tab delimited file. The results are a list of GO terms, terms type and name, specificity, enrichment score, associated Uniprot ids and input ids.

InSyBio Suite - Enrichment Analysis Results

Job Status: COMPLETED | Job ID: 28 | Submission Date: Nov 13, 2019 12:09:28 PM | Execution Time: 00 hours, 00 minutes, 01 seconds | Input Data and Parameters

Export Results

GO Term	GO Term's Type	GO Term's Name	GO Term's Specificity	Enrichment Score	Associated Uniprot ids	Associated Input ids
GO:0060122	biological:process	negative regulation of transcription from RNA polymerase II promoter		9	0.0352985428365	P04637 TP53
GO:0060729	biological:process	DNA double-strand break processing		8	0.00584764660219	P38398, Q13315 BRCA1, ATM
GO:0060731	biological:process	DNA synthesis involved in DNA repair		7	0.030471091652	P38398, Q13315 BRCA1, ATM
GO:0060732	biological:process	strand displacement		6	0.0188808869879	P38398, Q13315 BRCA1, ATM
GO:0062331	biological:process	pre-B cell allelic exclusion		13	0.0249351691907	Q13315 ATM
GO:0063677	molecular:function	DNA binding		5	0.0291025373332	P04637, P38398, Q13315 TP53, BRCA1, ATM
GO:0063700	molecular:function	transcription factor activity, sequence-specific DNA binding		3	0.0284145684002	P04637 TP53
GO:0064677	molecular:function	DNA-dependent protein kinase activity		8	0.032967327857	Q13315 ATM
GO:0065515	molecular:function	protein binding		3	3.47534911816e-18	P04637, P38398, Q13315 TP53, BRCA1, ATM
GO:0065524	molecular:function	ATP binding		6	0.00218574886077	P04637, Q13315 TP53, ATM

Showing 1 to 10 of 55 entries

Functional Annotation

You can view the confirmed and predicted functional annotation of a given protein, from our database.

InSyBio Suite - Functional Annotation InSyBio Beta User

Uniprot ID of protein: Show Results

	Specificity				
Molecular Function	enzyme activator activity? SH3 domain binding? SH3/SH2 adaptor activity? spectrin binding? MHC class II protein complex binding? phosphoprotein binding? enzyme binding? potassium channel regulator activity? histone deacetylase binding? catalytic activity? signaling adaptor activity? ion channel binding? SH2 domain binding? DNA binding? transcription corepressor activity? GKAP/Homer scaffold activity? actin binding? protein homodimerization activity? protein heterodimerization activity? protein domain specific binding? peptide hormone binding? neuropeptide binding? metal ion binding? protein binding?	tryptophan 5-monoxygenase activity? amino acid binding? protein O-GlcNAc transferase activity? acetylglucosaminyltransferase activity? cysteine-type peptidase activity? ubiquitin protein ligase binding? phosphoserine binding? actin filament binding? ATP binding? ATP binding? protein kinase binding? histone deacetylase activity? G-protein coupled glutamate receptor binding? galanin receptor activity? 3-beta-hydroxy-delta5-steroid dehydrogenase activity? cholest-5-ene-3-beta,7-alpha-diol 3-beta-dehydrogenase activity?	iron ion binding? protein N-acetylglucosaminyltransferase activity? phosphatidylinositol-3,4,5-trisphosphate binding? aminopeptidase activity? carboxypeptidase activity? cysteine-type endopeptidase activity? myosin tail binding? phosphatidylinositol-5-phosphate binding? phosphatidylinositol-3-phosphate binding? phosphatidylinositol-4-phosphate binding? sphingomyelin phosphodiesterase activity?	No Data	histone acetyltransferase activity (H4-K16 specific)? histone acetyltransferase activity (H4-K8 specific)? histone acetyltransferase activity (H4-K5 specific)?
Biological Process	response to activity? response to nutrient levels? oxidation-reduction process? circadian rhythm? positive regulation of catalytic activity? signal transduction? response to nutrient? response to drug? response to toxic substance? proteolysis? protein complex assembly? regulation of membrane repolarization? membrane organization? viral process? intracellular signal transduction? immune response? adaptive immune response? behavioral response to cocaine? chemical synaptic transmission? cell surface receptor signaling pathway? feeding behavior?	response to calcium ion? response to estrogen? regulation of insulin receptor signaling pathway? cellular response to retinoic acid? circadian regulation of gene expression? response to insulin? apoptotic process? inner ear morphogenesis? regulation of microvillus length? cellular protein complex assembly? hippocampus development? hippo signaling? regulation of heart rate by cardiac conduction? regulation of cellular response to heat? skeletal muscle contraction? positive regulation of signal transduction? B cell activation? immunoglobulin secretion? transcription, DNA-templated? regulation of G-protein coupled receptor protein signaling pathway? chemical homeostasis within a tissue? learning or memory? muscle contraction? glycosphingolipid metabolic process?	response to glucocorticoid? cellular response to lithium ion? indolalkylamine biosynthetic process? aromatic amino acid family metabolic process? serotonin biosynthetic process? regulation of gluconeogenesis involved in cellular glucose homeostasis? phosphatidylinositol-mediated signaling? regulation of glycolytic process? sensory perception of light stimulus? equilibriumception? photoreceptor cell maintenance? regulation of potassium ion transmembrane transporter activity? G2/M transition of mitotic cell cycle? regulation of heart rate by hormone? protein targeting? positive regulation of abscisic acid-activated signaling pathway? regulation of cation channel activity? regulation of calcium ion import? positive regulation of calcium ion transport? regulation of transcription, DNA-templated? G-protein coupled glutamate receptor signaling pathway? phosphatidylinositol metabolic process? neuropeptide signaling pathway? phospholipase C-activating G-protein coupled	positive regulation of proteolysis? regulation of Rac protein signal transduction? negative regulation of protein ubiquitination? positive regulation of granulocyte differentiation? protein O-linked glycosylation? homocysteine catabolic process? membrane repolarization during cardiac muscle cell action potential? positive regulation of protein insertion into mitochondrial membrane involved in apoptotic signaling pathway? negative regulation of cysteine-type endopeptidase activity involved in apoptotic process? neuron migration? negative regulation of transcription, DNA-templated? regulation of store-operated calcium entry? phospholipase C-activating G-protein coupled glutamate receptor signaling pathway? skeletal muscle fiber development? negative regulation of T cell activation? antigen receptor-mediated signaling pathway? negative regulation of transcription from RNA polymerase II promoter? histone deacetylation? skeletal muscle cell differentiation? sensory perception of sound? calcium-mediated signaling using intracellular calcium source? negative regulation of adenylate cyclase activity? adenylate cyclase-activating G-protein coupled receptor signaling pathway? adenylate cyclase-modulating G-protein coupled receptor signaling pathway?	histone H4-K16 acetylation? histone H4-K8 acetylation? histone H4-K5 acetylation? histone H3-K4 trimethylation? positive regulation of histone H3-K27 methylation? positive regulation of histone H3-K4 methylation? protein polyubiquitination? inner ear receptor stereocilium organization? cerebral cortex development? substantia nigra development? inactivation of MAPK activity? neuron projection development? positive regulation of cytosolic calcium ion concentration?

Confidence Score

You can provide the Uniprot ID of your protein of interest, and the results of our Functional Annotation Patented method will appear. The associated GO terms with the protein are separated into 3 rows, one for each major term group (molecular function, biological process and cellular component terms). Going from left to right, the specificity of the term increases. Each term's position in a cell represents its

predicted confidence score in descending order, dark green are confirmed associations (score 1), light green high confidence and gray medium confidence predicted associations (with score near 0.5).

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InSyBio Ltd is a bioinformatics pioneer company (www.insybio.com) in personalized healthcare, that focuses on developing computational frameworks and tools for the analysis of complex life-science and biological data in order to develop predictive integrated biomarkers (biomarkers of various categories) with increased prognostic and diagnostic aspects for the personalized Healthcare Industry.

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