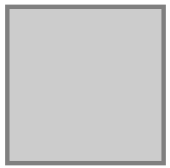
Exploring Biological Databases

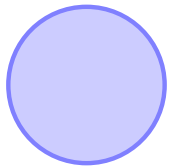
Holger Dinkel

EMBO Practical Course Computational analysis of protein-protein interactions: From sequences to networks

Web Services

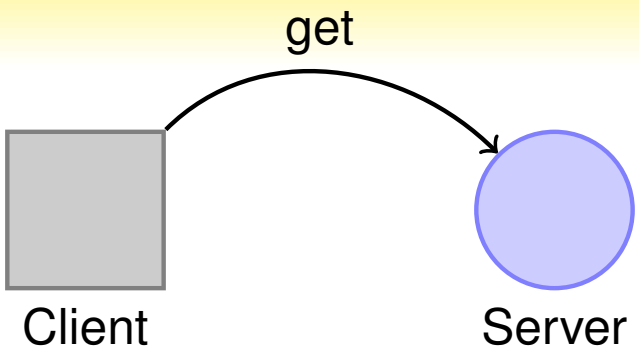


Client



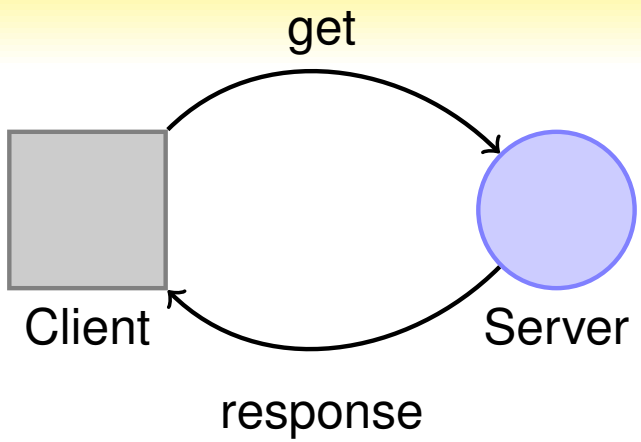
Server

Web Services



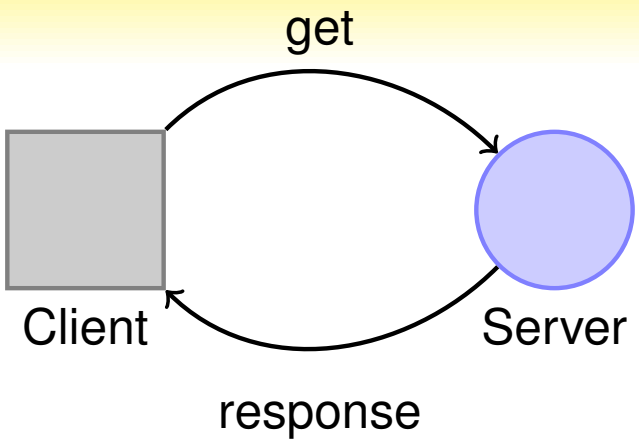
get: `http://www.uniprot.org/uniprot/P12931`

Web Services



get: `http://www.uniprot.org/uniprot/P12931`

response: **HTML**



get: `http://www.uniprot.org/uniprot/P12931.txt`
response: **TEXT/TSV**

```
ID SRC_HUMAN Reviewed; 536 AA.
AC P12931; E1P5V4; Q76P87; Q86VB9; Q9H5A8;
DT 01-OCT-1989, integrated into UniProtKB/Swiss-Prot.
DT 23-JAN-2007, sequence version 3.
DT 03-SEP-2014, entry version 187.
DE RecName:  Full=Proto-oncogene tyrosine-protein kinase Src;
...
```

A RESTful application

is an application that exposes its state and functionality as a set of resources that the clients can manipulate and conforms to a certain set of principles:

- All resources are uniquely addressable, usually through URIs; other addressing can also be used, though.
- All resources can be manipulated through a constrained set of well-known actions, usually CRUD (create, read, update, delete), represented most often through the HTTP's POST, GET, PUT and DELETE; it can be a different set or a subset though - for example, some implementations limit that set to read and modify only (GET and PUT) for example
- The data for all resources is transferred through any of a constrained number of well-known representations, usually HTML, XML or JSON;
- The communication between the client and the application is performed over a *stateless* protocol that allows for multiple layered intermediaries that can reroute and cache the requests and response packets transparently for the client and the application.

A RESTful application

is an application that exposes its state and functionality as a set of resources that the clients can manipulate and conforms to a certain set of principles:

- All resources are uniquely addressable, usually through URIs; other addressing can also be used, though.
- All resources can be manipulated through a constrained set of well-known actions, usually CRUD (create, read, update, delete), represented most often through the HTTP's POST, GET, PUT and DELETE; it can be a different set or a subset though - for example, some implementations limit that set to read and modify only (GET and PUT) for example
- The data for all resources is transferred through any of a constrained number of well-known representations, usually HTML, XML or JSON;
- The communication between the client and the application is performed over a *stateless* protocol that allows for multiple layered intermediaries that can reroute and cache the requests and response packets transparently for the client and the application.

A RESTful application

is an application that exposes its state and functionality as a set of resources that the clients can manipulate and conforms to a certain set of principles:

- All resources are uniquely addressable, usually through URIs; other addressing can also be used, though.
- All resources can be manipulated through a constrained set of well-known actions, usually CRUD (create, read, update, delete), represented most often through the HTTP's POST, GET, PUT and DELETE; it can be a different set or a subset though - for example, some implementations limit that set to read and modify only (GET and PUT) for example
- The data for all resources is transferred through any of a constrained number of well-known representations, usually HTML, XML or JSON;
- The communication between the client and the application is performed over a *stateless* protocol that allows for multiple layered intermediaries that can reroute and cache the requests and response packets transparently for the client and the application.

A RESTful application

is an application that exposes its state and functionality as a set of resources that the clients can manipulate and conforms to a certain set of principles:

- All resources are uniquely addressable, usually through URIs; other addressing can also be used, though.
- All resources can be manipulated through a constrained set of well-known actions, usually CRUD (create, read, update, delete), represented most often through the HTTP's POST, GET, PUT and DELETE; it can be a different set or a subset though - for example, some implementations limit that set to read and modify only (GET and PUT) for example
- The data for all resources is transferred through any of a constrained number of well-known representations, usually HTML, XML or JSON;
- The communication between the client and the application is performed over a *stateless* protocol that allows for multiple layered intermediaries that can reroute and cache the requests and response packets transparently for the client and the application.

REST Methods

Method defines what you want to do (**GET**=retrieve, **POST**=create/update, **DELETE**=remove).
We'll be using just GET requests which can be thought of as read-only access.
POST/DELETE are used to modify data on a server.

URL defines a path to a resource

Parameters additional arguments, filters etc. usually in the form *parameter* = *value*; the first parameter is separated from the url by '?' while subsequent ones use '&'.

Example: searching for the term 'EMBO':

https://startpage.com/do/search?query=EMBO&with_language=lang_de

REST Methods

Method defines what you want to do (**GET**=retrieve, **POST**=create/update, **DELETE**=remove).
We'll be using just GET requests which can be thought of as read-only access.
POST/DELETE are used to modify data on a server.

URL defines a path to a resource

Parameters additional arguments, filters etc. usually in the form *parameter* = *value*; the first parameter is separated from the url by '?' while subsequent ones use '&'.

Example: searching for the term 'EMBO':

https://**startpage.com/do/search**?query=EMBO&with_language=lang_de

REST Methods

Method defines what you want to do (**GET**=retrieve, **POST**=create/update, **DELETE**=remove).
We'll be using just GET requests which can be thought of as read-only access.
POST/DELETE are used to modify data on a server.

URL defines a path to a resource

Parameters additional arguments, filters etc. usually in the form *parameter* = *value*; the first parameter is separated from the url by '?' while subsequent ones use '&'.

Example: searching for the term 'EMBO':

https://startpage.com/do/search**?query=EMBO&with_language=lang_de**

REST METHODS

Method defines what you want to do (**GET**=retrieve, **POST**=create/update, **DELETE**=remove).
We'll be using just GET requests which can be thought of as read-only access.
POST/DELETE are used to modify data on a server.

URL defines a path to a resource

Parameters additional arguments, filters etc. usually in the form *parameter* = *value*; the first parameter is separated from the url by '?' while subsequent ones use '&'.

Example: searching for the term 'EMBO':

https://startpage.com/do/search?query=EMBO&with_language=lang_de

Note:

For all these examples, any common browser can be used, however for proper 'programmatic' access tools such as 'curl' or 'wget' on the Linux/Mac commandline are much more efficient and can easily be incorporated into little scripts...

Benefits

Easy requests The data can be requested with simple HTTP requests and returned in a variety of programatic and bioinformatical relevant formats such as JSON, XML, YAML and FASTA.

Easy debugging Debugging can be done in any browser. While some might not call this real programming, it surely is the first step towards programmatically querying resources.

Reproducable You can write all your queries into a simple script and repeat the same query later. Even just saving the URL as a bookmark in your browser helps!

Powerful Any data can be made available via a REST service.

Bandwidth An API allows programmatic access to some information if one does not want to download the entire dataset.

Standards By using existing protocols and best-methods (HTTP), all the existing knowledge can be reused (Caching, Redirecting, ...).

Widespread More and more resource providers change from fat/heavy webservices to this lightweight system, for obvious reasons.

Benefits

Easy requests The data can be requested with simple HTTP requests and returned in a variety of programatic and bioinformatical relevant formats such as JSON, XML, YAML and FASTA.

Easy debugging Debugging can be done in any browser. While some might not call this real programming, it surely is the first step towards programmatically querying resources.

Reproducable You can write all your queries into a simple script and repeat the same query later. Even just saving the URL as a bookmark in your browser helps!

Powerful Any data can be made available via a REST service.

Bandwidth An API allows programmatic access to some information if one does not want to download the entire dataset.

Standards By using existing protocols and best-methods (HTTP), all the existing knowledge can be reused (Caching, Redirecting, ...).

Widespread More and more resource providers change from fat/heavy webservices to this lightweight system, for obvious reasons.

Benefits

Easy requests The data can be requested with simple HTTP requests and returned in a variety of programatic and bioinformatical relevant formats such as JSON, XML, YAML and FASTA.

Easy debugging Debugging can be done in any browser. While some might not call this real programming, it surely is the first step towards programmatically querying resources.

Reproducable You can write all your queries into a simple script and repeat the same query later. Even just saving the URL as a bookmark in your browser helps!

Powerful Any data can be made available via a REST service.

Bandwidth An API allows programmatic access to some information if one does not want to download the entire dataset.

Standards By using existing protocols and best-methods (HTTP), all the existing knowledge can be reused (Caching, Redirecting, ...).

Widespread More and more resource providers change from fat/heavy webservices to this lightweight system, for obvious reasons.

Benefits

Easy requests The data can be requested with simple HTTP requests and returned in a variety of programatic and bioinformatical relevant formats such as JSON, XML, YAML and FASTA.

Easy debugging Debugging can be done in any browser. While some might not call this real programming, it surely is the first step towards programmatically querying resources.

Reproducable You can write all your queries into a simple script and repeat the same query later. Even just saving the URL as a bookmark in your browser helps!

Powerful Any data can be made available via a REST service.

Bandwidth An API allows programmatic access to some information if one does not want to download the entire dataset.

Standards By using existing protocols and best-methods (HTTP), all the existing knowledge can be reused (Caching, Redirecting, ...).

Widespread More and more resource providers change from fat/heavy webservices to this lightweight system, for obvious reasons.

Benefits

Easy requests The data can be requested with simple HTTP requests and returned in a variety of programatic and bioinformatical relevant formats such as JSON, XML, YAML and FASTA.

Easy debugging Debugging can be done in any browser. While some might not call this real programming, it surely is the first step towards programmatically querying resources.

Reproducable You can write all your queries into a simple script and repeat the same query later. Even just saving the URL as a bookmark in your browser helps!

Powerful Any data can be made available via a REST service.

Bandwidth An API allows programmatic access to some information if one does not want to download the entire dataset.

Standards By using existing protocols and best-methods (HTTP), all the existing knowledge can be reused (Caching, Redirecting, ...).

Widespread More and more resource providers change from fat/heavy webservices to this lightweight system, for obvious reasons.

Benefits

Easy requests The data can be requested with simple HTTP requests and returned in a variety of programatic and bioinformatical relevant formats such as JSON, XML, YAML and FASTA.

Easy debugging Debugging can be done in any browser. While some might not call this real programming, it surely is the first step towards programmatically querying resources.

Reproducable You can write all your queries into a simple script and repeat the same query later. Even just saving the URL as a bookmark in your browser helps!

Powerful Any data can be made available via a REST service.

Bandwidth An API allows programmatic access to some information if one does not want to download the entire dataset.

Standards By using existing protocols and best-methods (HTTP), all the existing knowledge can be reused (Caching, Redirecting, ...).

Widespread More and more resource providers change from fat/heavy webservices to this lightweight system, for obvious reasons.

Benefits

Easy requests The data can be requested with simple HTTP requests and returned in a variety of programatic and bioinformatical relevant formats such as JSON, XML, YAML and FASTA.

Easy debugging Debugging can be done in any browser. While some might not call this real programming, it surely is the first step towards programmatically querying resources.

Reproducable You can write all your queries into a simple script and repeat the same query later. Even just saving the URL as a bookmark in your browser helps!

Powerful Any data can be made available via a REST service.

Bandwidth An API allows programmatic access to some information if one does not want to download the entire dataset.

Standards By using existing protocols and best-methods (HTTP), all the existing knowledge can be reused (Caching, Redirecting, ...).

Widespread More and more resource providers change from fat/heavy webservices to this lightweight system, for obvious reasons.

Benefits

Easy requests The data can be requested with simple HTTP requests and returned in a variety of programatic and bioinformatical relevant formats such as JSON, XML, YAML and FASTA.

Easy debugging Debugging can be done in any browser. While some might not call this real programming, it surely is the first step towards programmatically querying resources.

Reproducable You can write all your queries into a simple script and repeat the same query later. Even just saving the URL as a bookmark in your browser helps!

Powerful Any data can be made available via a REST service.

Bandwidth An API allows programmatic access to some information if one does not want to download the entire dataset.

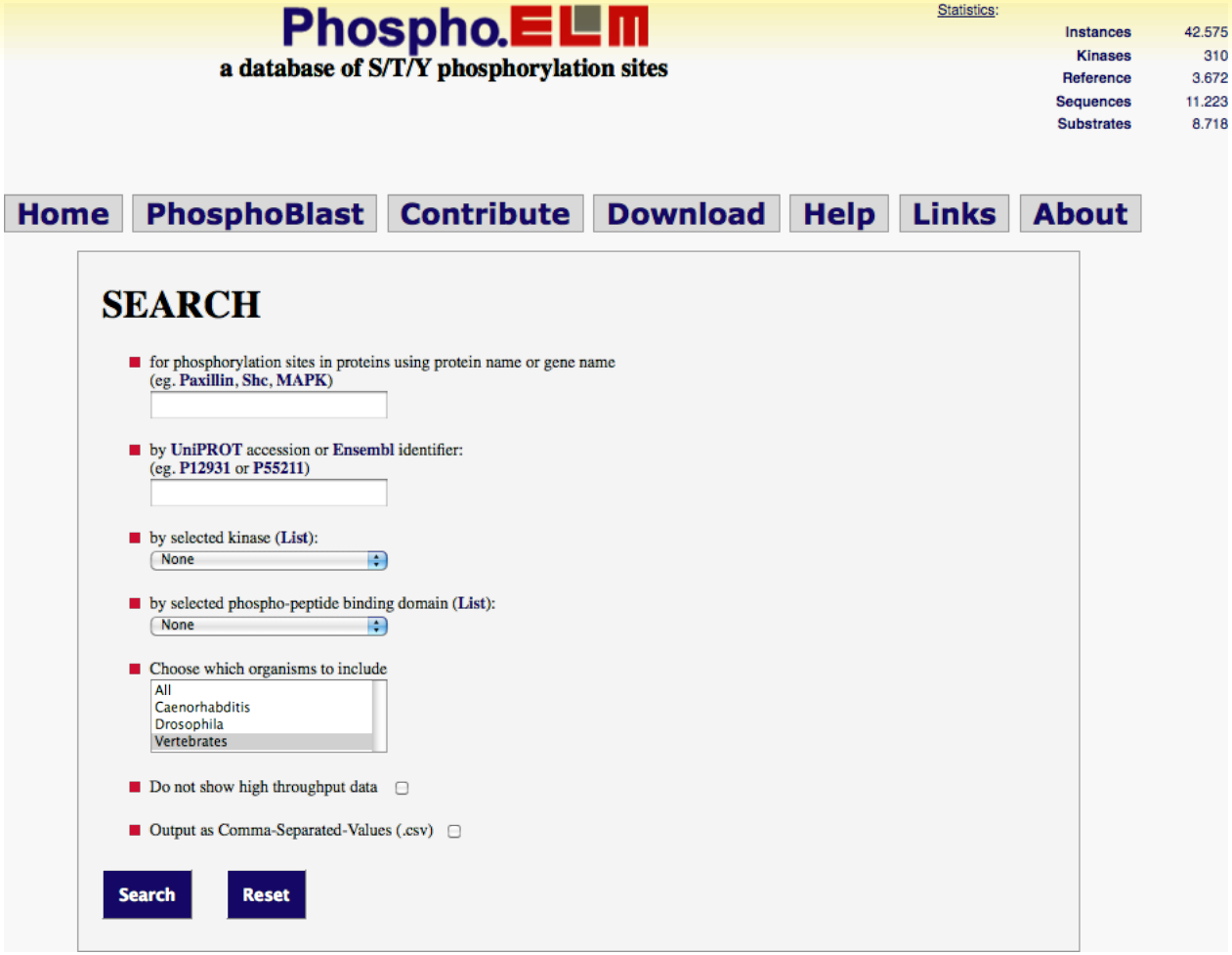
Standards By using existing protocols and best-methods (HTTP), all the existing knowledge can be reused (Caching, Redirecting, ...).

Widespread More and more resource providers change from fat/heavy webservices to this lightweight system, for obvious reasons.

Note:

Not meant to be a substitute for resources such as BioMART etc!

EXAMPLE: PHOSPHO.ELM



http://phospho.elm.eu.org/index.html

EXAMPLE: PHOSPHO.ELM

Access:

The PhosphoELM database can also be accessed via URL as follows:

- by ***substrate name:***
  http://phospho.elm.eu.org/bySubstrate/Paxillin.html
- by ***Uniprot ID:***
  http://phospho.elm.eu.org/byAccession/P12931.html
- by ***Uniprot ID*** and ***Position***
  http://phospho.elm.eu.org/byAccession/P12931/Pos17.html
- by ***ENSEMBL ID*** and multiple ***Positions***
  http://phospho.elm.eu.org/byAccession/ENSP00000265709/Pos216,231.html
- by ***Uniprot name:***
  http://phospho.elm.eu.org/byAccession/src_human.html
- by ***Kinase:***
  http://phospho.elm.eu.org/byKinase/Abl2.html
- by ***Binding domain:***
  http://phospho.elm.eu.org/byDomain/CBL_SH2.html
- retrieve a ***stored Sequence:***
  http://phospho.elm.eu.org/P12931.fasta
- retrieve data ***as CSV***
  http://phospho.elm.eu.org/byAccession/P12931.csv
- retrieve data for a single position***as CSV***
  http://phospho.elm.eu.org/byAccession/P12931/Pos12.csv
- retrieve data for ***multiple*** IDs ***as CSV***
  http://phospho.elm.eu.org/byAccession/P12931,P55211.csv
- using ***web-services:***
  http://phospho.elm.eu.org/webservice/phosphoELMdb.wsdl

http://phospho.elm.eu.org/byAccession/P55211.html

EXAMPLE: PHOSPHO.ELM

Access:

The PhosphoELM database can also be accessed via URL as follows:

- by ***substrate name:***
  http://phospho.elm.eu.org/bySubstrate/Paxillin.html
- by ***Uniprot ID:***
  http://phospho.elm.eu.org/byAccession/P12931.html
- by ***Uniprot ID*** and ***Position***
  http://phospho.elm.eu.org/byAccession/P12931/Pos17.html
- by ***ENSEMBL ID*** and multiple ***Positions***
  http://phospho.elm.eu.org/byAccession/ENSP00000265709/Pos216,231.html
- by ***Uniprot name:***
  http://phospho.elm.eu.org/byAccession/src_human.html
- by ***Kinase:***
  http://phospho.elm.eu.org/byKinase/Abl2.html
- by ***Binding domain:***
  http://phospho.elm.eu.org/byDomain/CBL_SH2.html
- retrieve a ***stored Sequence:***
  http://phospho.elm.eu.org/P12931.fasta
- retrieve data ***as CSV***
  http://phospho.elm.eu.org/byAccession/P12931.csv
- retrieve data for a single position***as CSV***
  http://phospho.elm.eu.org/byAccession/P12931/Pos12.csv
- retrieve data for ***multiple*** IDs ***as CSV***
  http://phospho.elm.eu.org/byAccession/P12931,P55211.csv
- using ***web-services:***
  http://phospho.elm.eu.org/webservice/phosphoELMdb.wsdl

http://phospho.elm.eu.org/byAccession/P55211.csv

EXAMPLE: PHOSPHO.ELM

Query

http://phospho.elm.eu.org/bySubstrate/cd66.html

Output:

Substrate: CD66 (Immunoglobulin)
Seq-ID: P13688 [*Homo sapiens*]
Interaction Network(s): NetworKIN
External Source(s): PhosphoSitePlus
MINT Interaction(s): -
GO-Terms: [show]
Conservation:

Click on table headers for sorting

Res.	Pos.	Sequence	Kinase	PMID	Src	Cons.	ELM	Binding Domain	SMART/Pfam	IUPRED score	PDB	P3D Acc.
Y	493	DPPNKMNEVTYSTLNFEAQQP	-	9867848	LTP	1.00		-	-	0.65	-	low
S	508	FEAQQPTQPTSASPSLTATEI	-	11850617	LTP	1.00		-	-	0.65	-	low
Y	520	SPSLTATEIIYSEVKKQ	-	9867848	LTP	1.00		-	-	0.38	-	low

Substrate: CD66 (Immunoglobulin)
Seq-ID: P31809 [*Mus musculus*]
Interaction Network(s): -
External Source(s): PHOSIDA PhosphoSitePlus
MINT Interaction(s): -
GO-Terms: [show]
Conservation:

Click on table headers for sorting

EXAMPLE: PHOSPHO.ELM

Query

http://phospho.elm.eu.org/**bySubstrate**/cd66.html

- **Query by Substrate name**
- Substrate name
- Output as HTML

Output:

Substrate: CD66 (Immunoglobulin)
Seq-ID: P13688 [*Homo sapiens*]
Interaction Network(s): NetworKIN
External Source(s): PhosphoSitePlus
MINT Interaction(s): -
GO-Terms: [show]
Conservation:

Click on table headers for sorting

Res.	Pos.	Sequence	Kinase	PMID	Src	Cons.	ELM	Binding Domain	SMART/Pfam	IUPRED score	PDB	P3D Acc.
Y	493	DPPNKMNEVTYSTLNFEAQQP	-	9867848	LTP	1.00		-	-	0.65	-	low
S	508	FEAQQPTQPTSASPSLTATEI	-	11850617	LTP	1.00		-	-	0.65	-	low
Y	520	SPSLTATEIIYSEVKKQ	-	9867848	LTP	1.00		-	-	0.38	-	low

Substrate: CD66 (Immunoglobulin)
Seq-ID: P31809 [*Mus musculus*]
Interaction Network(s): -
External Source(s): PHOSIDA PhosphoSitePlus
MINT Interaction(s): -
GO-Terms: [show]
Conservation:

Click on table headers for sorting

EXAMPLE: PHOSPHO.ELM

Query

http://phospho.elm.eu.org/bySubstrate/**cd66**.html

- Query by Substrate name
- **Substrate name**
- Output as HTML

Output:

Substrate: CD66 (Immunoglobulin)
Seq-ID: P13688 [*Homo sapiens*]
Interaction Network(s): NetworKIN
External Source(s): PhosphoSitePlus
MINT Interaction(s): -
GO-Terms: [show]
Conservation:

Click on table headers for sorting

Res.	Pos.	Sequence	Kinase	PMID	Src	Cons.	ELM	Binding Domain	SMART/Pfam	IUPRED score	PDB	P3D Acc.
Y	493	DPPNKMNEVTYSTLNFEAQQP	-	9867848	LTP	1.00		-	-	0.65	-	low
S	508	FEAQQPTQPTSASPSLTATEI	-	11850617	LTP	1.00		-	-	0.65	-	low
Y	520	SPSLTATEIIYSEVKKQ	-	9867848	LTP	1.00		-	-	0.38	-	low

Substrate: CD66 (Immunoglobulin)
Seq-ID: P31809 [*Mus musculus*]
Interaction Network(s): -
External Source(s): PHOSIDA PhosphoSitePlus
MINT Interaction(s): -
GO-Terms: [show]
Conservation:

Click on table headers for sorting

EXAMPLE: PHOSPHO.ELM

Query

http://phospho.elm.eu.org/bySubstrate/cd66.**html**

- Query by Substrate name
- Substrate name
- **Output as HTML**

Output:

Substrate: CD66 (Immunoglobulin)
Seq-ID: P13688 [*Homo sapiens*]
Interaction Network(s): NetworKIN
External Source(s): PhosphoSitePlus
MINT Interaction(s): -
GO-Terms: [show]
Conservation:

Click on table headers for sorting

Res.	Pos.	Sequence	Kinase	PMID	Src	Cons.	ELM	Binding Domain	SMART/Pfam	IUPRED score	PDB	P3D Acc.
Y	493	DPPNKMNEVTYSTLNFEAQQP	-	9867848	LTP	1.00		-	-	0.65	-	low
S	508	FEAQQPTQPTSASPSLTATEI	-	11850617	LTP	1.00		-	-	0.65	-	low
Y	520	SPSLTATEIIYSEVKKQ	-	9867848	LTP	1.00		-	-	0.38	-	low

Substrate: CD66 (Immunoglobulin)
Seq-ID: P31809 [*Mus musculus*]
Interaction Network(s): -
External Source(s): PHOSIDA PhosphoSitePlus
MINT Interaction(s): -
GO-Terms: [show]
Conservation:

Click on table headers for sorting

Example: Phospho.ELM

Query

http://phospho.elm.eu.org/byAccession/P12931/Pos12,17.csv

Output:

```
Acc.; Res.; Pos.; Context; Kinase; PMID; Source; ConScore; ELM; Domain; SMART; IUPRED; PDB; P3D-
P12931; S; 12; SNKSKPKDASQRRRSLEPAE; none; 2136766; 1; 0.21; ; -; ; 0.9168; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 18088087; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17192257; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17081983; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; PKA_group; 11804588; 1; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
...
```

Example: Phospho.ELM

Query

http://phospho.elm.eu.org/**byAccession**/P12931/Pos12,17.csv

- **query by Uniprot Accession**
- Protein Sequence Accession/ID
- Position / multiple Positions
- Output as CSV (character separated values)

Output:

```
Acc.; Res.; Pos.; Context; Kinase; PMID; Source; ConScore; ELM; Domain; SMART; IUPRED; PDB; P3D-
P12931; S; 12; SNKSKPKDASQRRRSLEPAE; none; 2136766; 1; 0.21; ; -; ; 0.9168; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 18088087; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17192257; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17081983; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; PKA_group; 11804588; 1; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
...
```

Example: Phospho.ELM

Query

http://phospho.elm.eu.org/byAccession/**P12931**/Pos12,17.csv

- query by Uniprot Accession
- **Protein Sequence Accession/ID**
- Position / multiple Positions
- Output as CSV (character separated values)

Output:

```
Acc.; Res.; Pos.; Context; Kinase; PMID; Source; ConScore; ELM; Domain; SMART; IUPRED; PDB; P3D-
P12931; S; 12; SNKSKPKDASQRRRSLEPAE; none; 2136766; 1; 0.21; ; -; ; 0.9168; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 18088087; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17192257; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17081983; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; PKA_group; 11804588; 1; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
...
```

Example: Phospho.ELM

Query

http://phospho.elm.eu.org/byAccession/P12931/**Pos12,17**.csv

- query by Uniprot Accession
- Protein Sequence Accession/ID
- **Position / multiple Positions**
- Output as CSV (character separated values)

Output:

```
Acc.; Res.; Pos.; Context; Kinase; PMID; Source; ConScore; ELM; Domain; SMART; IUPRED; PDB; P3D-
P12931; S; 12; SNKSKPKDASQRRRSLEPAE; none; 2136766; 1; 0.21; ; -; ; 0.9168; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 18088087; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17192257; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17081983; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; PKA_group; 11804588; 1; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
...
```

Example: Phospho.ELM

Query

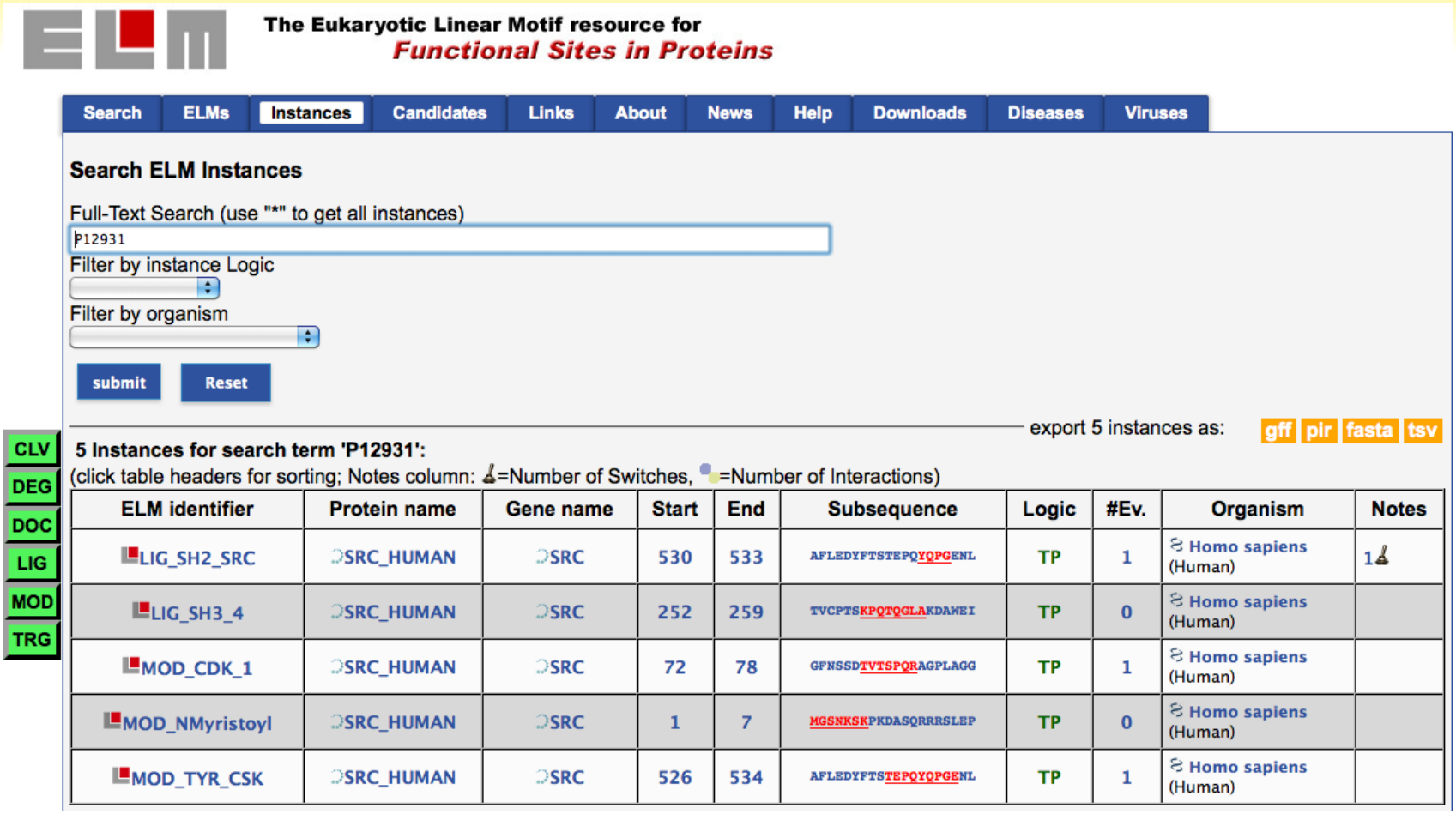
http://phospho.elm.eu.org/byAccession/P12931/Pos12,17.csv

- query by Uniprot Accession
- Protein Sequence Accession/ID
- Position / multiple Positions
- **Output as CSV (character separated values)**

Output:

```
Acc.; Res.; Pos.; Context; Kinase; PMID; Source; ConScore; ELM; Domain; SMART; IUPRED; PDB; P3D-
P12931; S; 12; SNKSKPKDASQRRRSLEPAE; none; 2136766; 1; 0.21; ; -; ; 0.9168; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 18088087; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17192257; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; none; 17081983; 2; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
P12931; S; 17; PKDASQRRRSLEPAENVHGA; PKA_group; 11804588; 1; 0.24; MOD_PKA_1; -; ; 0.8828; -; ;
...
```

EXAMPLE: ELM



The Eukaryotic Linear Motif resource for
Functional Sites in Proteins

Search | ELMs | Instances | Candidates | Links | About | News | Help | Downloads | Diseases | Viruses

Search ELM Instances

Full-Text Search (use "*" to get all instances)

P12931

Filter by instance Logic

Filter by organism

submit Reset

export 5 instances as: gff pir fasta tsv

CLV DEG DOC LIG MOD TRG

5 Instances for search term 'P12931':

(click table headers for sorting; Notes column: =Number of Switches, =Number of Interactions)

ELM identifier	Protein name	Gene name	Start	End	Subsequence	Logic	#Ev.	Organism	Notes
LIG_SH2_SRC	SRC_HUMAN	SRC	530	533	AFLEDYFTSTEPQYQPGENL	TP	1	Homo sapiens (Human)	1
LIG_SH3_4	SRC_HUMAN	SRC	252	259	TVCPTSKPQTQGLAKDAWEI	TP	0	Homo sapiens (Human)	
MOD_CDK_1	SRC_HUMAN	SRC	72	78	GFNSSDTVTSPQRAGPLAGG	TP	1	Homo sapiens (Human)	
MOD_NMyristoyl	SRC_HUMAN	SRC	1	7	MGSNKSKPKDASQRRRSLEP	TP	0	Homo sapiens (Human)	
MOD_TYR_CSK	SRC_HUMAN	SRC	526	534	AFLEDYFTSTEPQYQPGENL	TP	1	Homo sapiens (Human)	

EXAMPLE: ELM

The Eukaryotic Linear Motif resource for
Functional Sites in Proteins

Search | ELMs | Instances | Candidates | Links | About | News | Help | Downloads | Diseases | Viruses

Search ELM Instances

Full-Text Search (use "*" to get all instances)

P12931

Filter by instance Logic

Filter by organism

submit Reset

export 5 instances as: gff pir fasta tsv

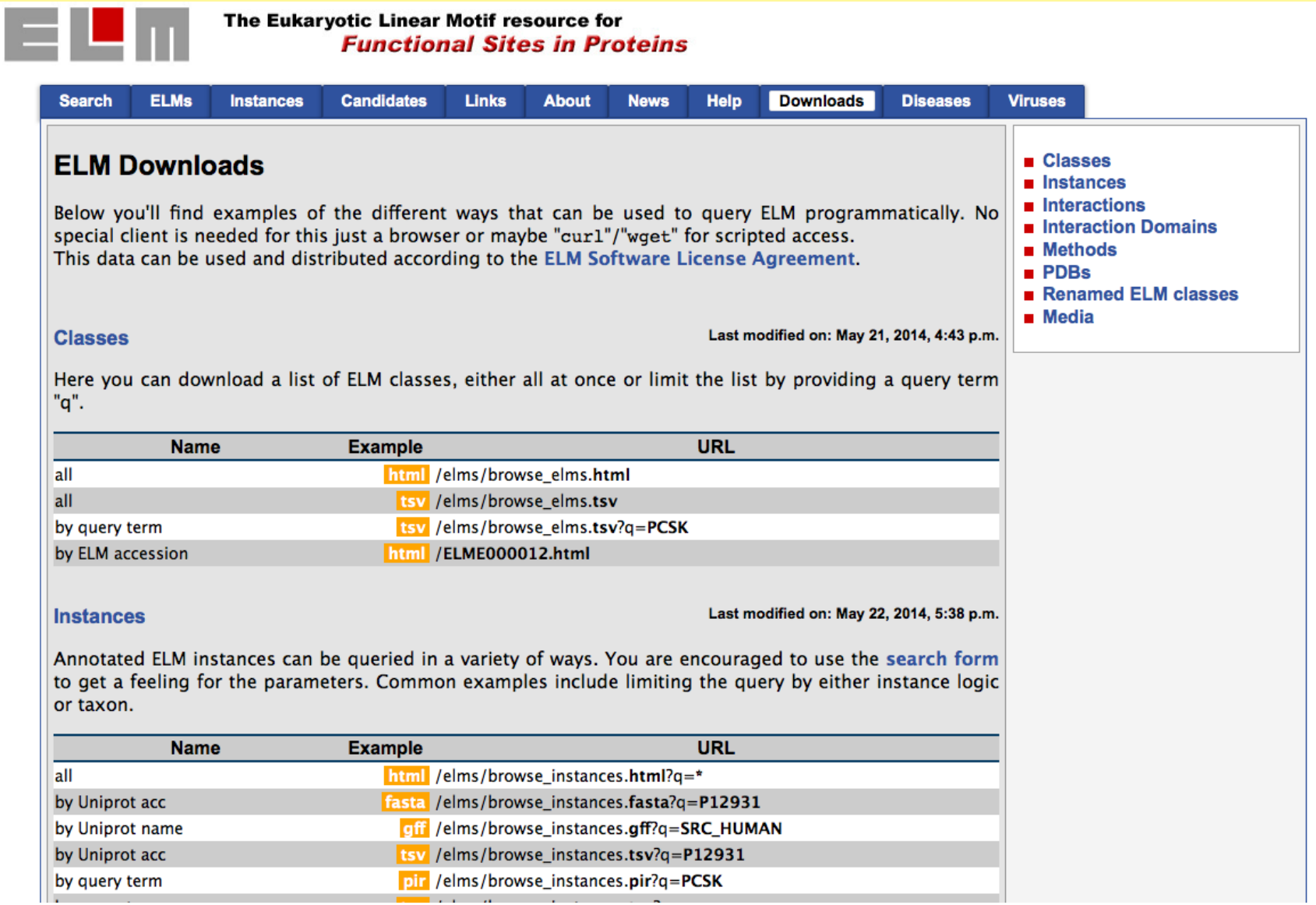
CLV DEG DOC LIG MOD TRG

5 Instances for search term 'P12931':

(click table headers for sorting; Notes column: =Number of Switches, =Number of Interactions)

ELM identifier	Protein name	Gene name	Start	End	Subsequence	Logic	#Ev.	Organism	Notes
LIG_SH2_SRC	SRC_HUMAN	SRC	530	533	AFLEDYFTSTEPQYQPGENL	TP	1	Homo sapiens (Human)	1
LIG_SH3_4	SRC_HUMAN	SRC	252	259	TVCPTSKPQTQGLAKDAWEI	TP	0	Homo sapiens (Human)	
MOD_CDK_1	SRC_HUMAN	SRC	72	78	GFNSSDTVTSPQRAGPLAGG	TP	1	Homo sapiens (Human)	
MOD_NMyristoyl	SRC_HUMAN	SRC	1	7	MGSNKSKPKDASQRRRSLEP	TP	0	Homo sapiens (Human)	
MOD_TYR_CSK	SRC_HUMAN	SRC	526	534	AFLEDYFTSTEPQYQPGENL	TP	1	Homo sapiens (Human)	

EXAMPLE: ELM



The Eukaryotic Linear Motif resource for
Functional Sites in Proteins

Search | ELMs | Instances | Candidates | Links | About | News | Help | Downloads | Diseases | Viruses

ELM Downloads

Below you'll find examples of the different ways that can be used to query ELM programmatically. No special client is needed for this just a browser or maybe "curl"/"wget" for scripted access.
This data can be used and distributed according to the ELM Software License Agreement.

- Classes
- Instances
- Interactions
- Interaction Domains
- Methods
- PDBs
- Renamed ELM classes
- Media

Classes

Last modified on: May 21, 2014, 4:43 p.m.

Here you can download a list of ELM classes, either all at once or limit the list by providing a query term "q".

Name	Example	URL
all	html	/elms/browse_elms.**html**
all	tsv	/elms/browse_elms.**tsv**
by query term	tsv	/elms/browse_elms.**tsv**?q=**PCSK**
by ELM accession	html	/**ELME000012.html**

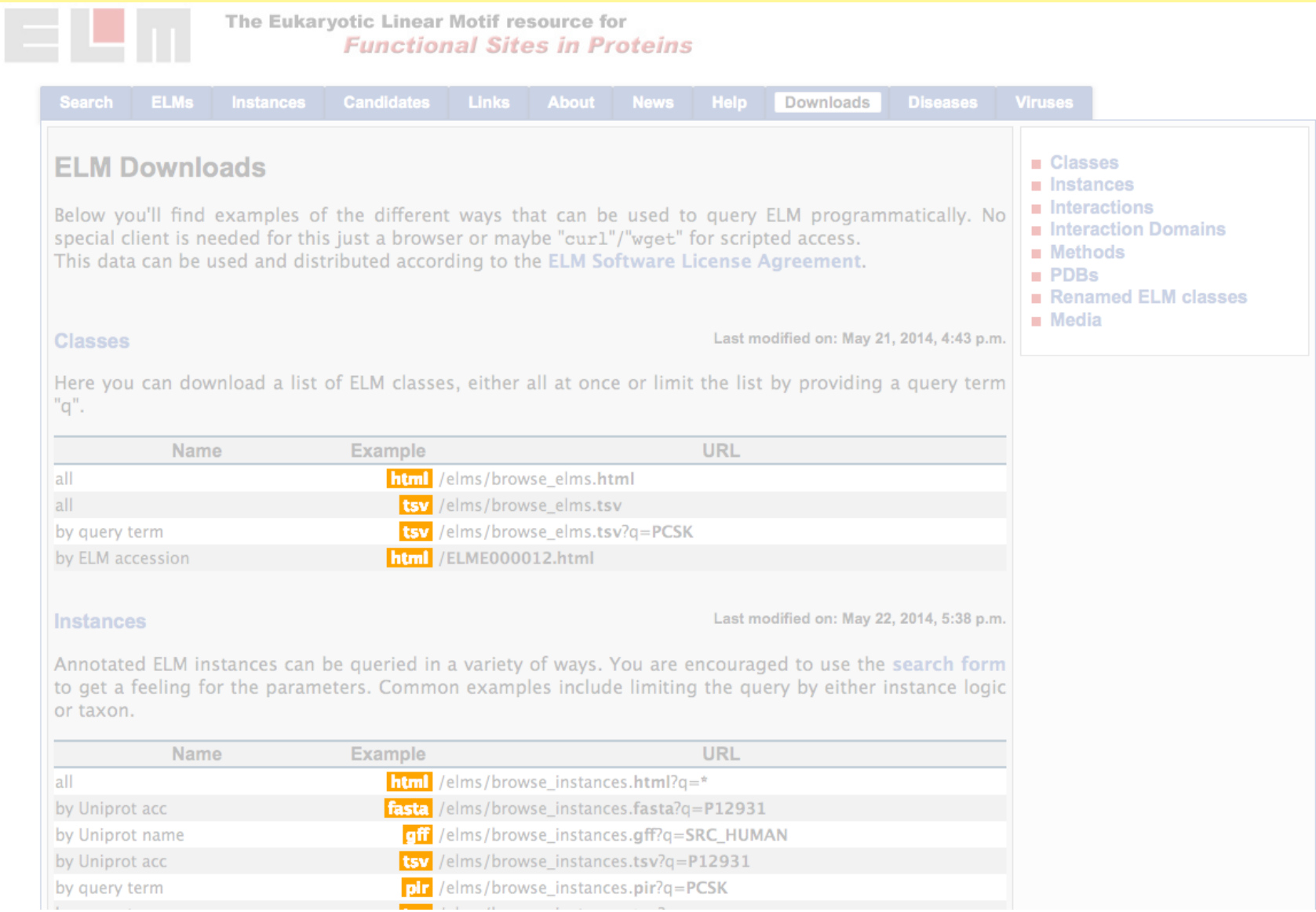
Instances

Last modified on: May 22, 2014, 5:38 p.m.

Annotated ELM instances can be queried in a variety of ways. You are encouraged to use the search form to get a feeling for the parameters. Common examples include limiting the query by either instance logic or taxon.

Name	Example	URL
all	html	/elms/browse_instances.**html**?q=*
by Uniprot acc	fasta	/elms/browse_instances.**fasta**?q=**P12931**
by Uniprot name	gff	/elms/browse_instances.**gff**?q=**SRC_HUMAN**
by Uniprot acc	tsv	/elms/browse_instances.**tsv**?q=**P12931**
by query term	pir	/elms/browse_instances.**pir**?q=**PCSK**

EXAMPLE: ELM



The Eukaryotic Linear Motif resource for
Functional Sites in Proteins

Search | ELMs | Instances | Candidates | Links | About | News | Help | Downloads | Diseases | Viruses

ELM Downloads

Below you'll find examples of the different ways that can be used to query ELM programmatically. No special client is needed for this just a browser or maybe "curl"/"wget" for scripted access.
This data can be used and distributed according to the ELM Software License Agreement.

- Classes
- Instances
- Interactions
- Interaction Domains
- Methods
- PDBs
- Renamed ELM classes
- Media

Classes

Last modified on: May 21, 2014, 4:43 p.m.

Here you can download a list of ELM classes, either all at once or limit the list by providing a query term "q".

Name	Example	URL
all	html	/elms/browse_elms.html
all	tsv	/elms/browse_elms.tsv
by query term	tsv	/elms/browse_elms.tsv?q=PCSK
by ELM accession	html	/ELME000012.html

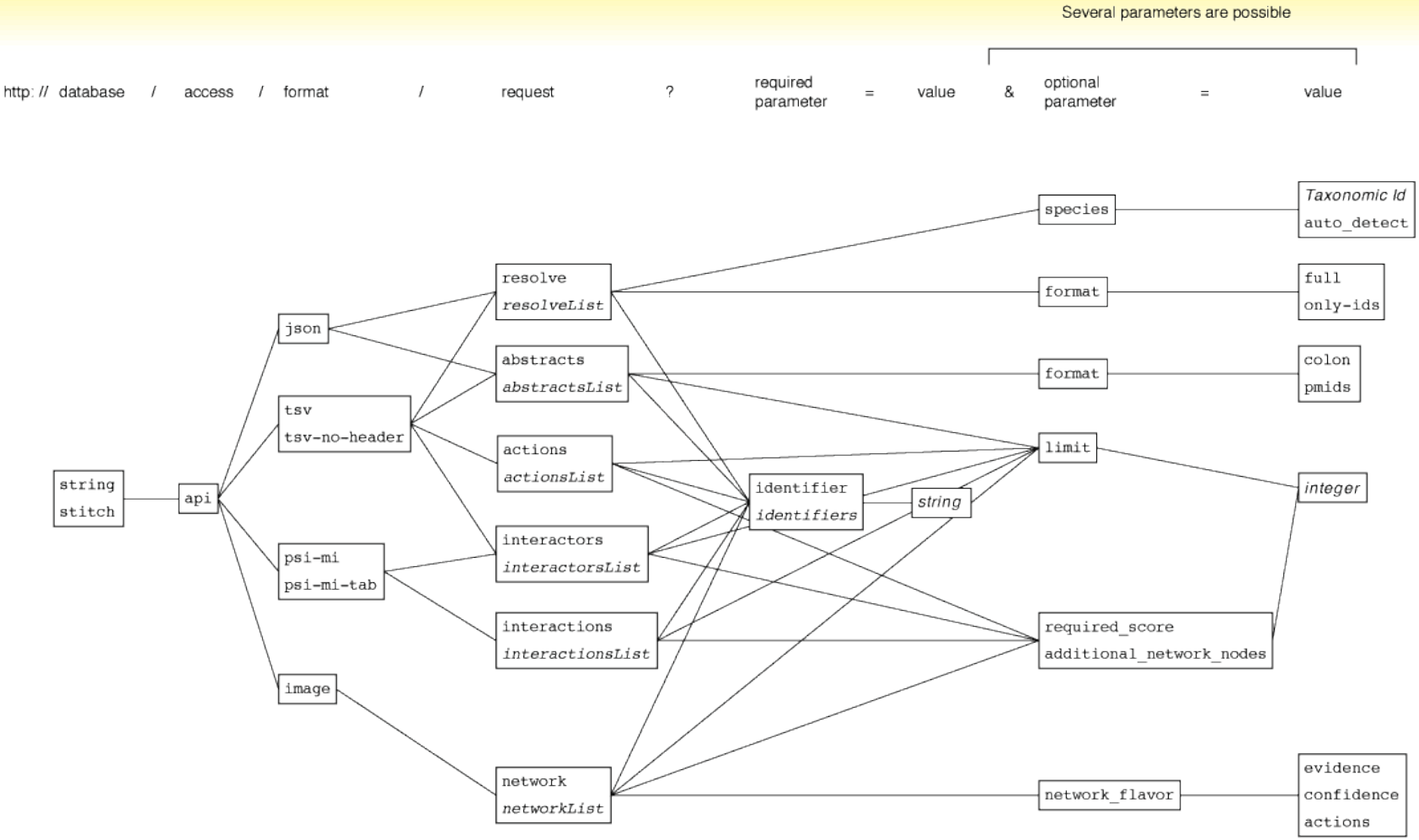
Instances

Last modified on: May 22, 2014, 5:38 p.m.

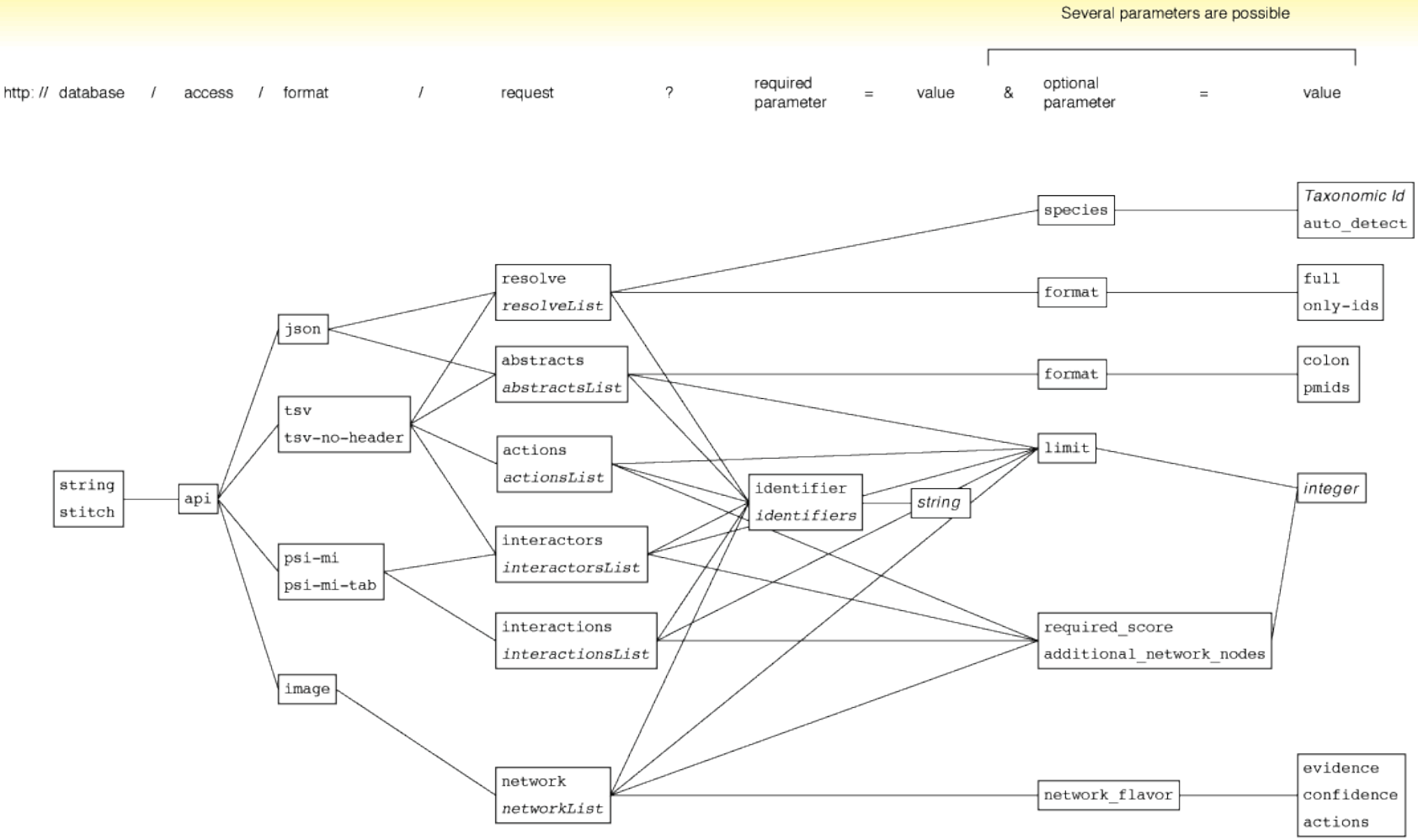
Annotated ELM instances can be queried in a variety of ways. You are encouraged to use the search form to get a feeling for the parameters. Common examples include limiting the query by either instance logic or taxon.

Name	Example	URL
all	html	/elms/browse_instances.html?q=*
by Uniprot acc	fasta	/elms/browse_instances.fasta?q=P12931
by Uniprot name	gff	/elms/browse_instances.gff?q=SRC_HUMAN
by Uniprot acc	tsv	/elms/browse_instances.tsv?q=P12931
by query term	pir	/elms/browse_instances.pir?q=PCSK

EXAMPLE: STRING / STITCH

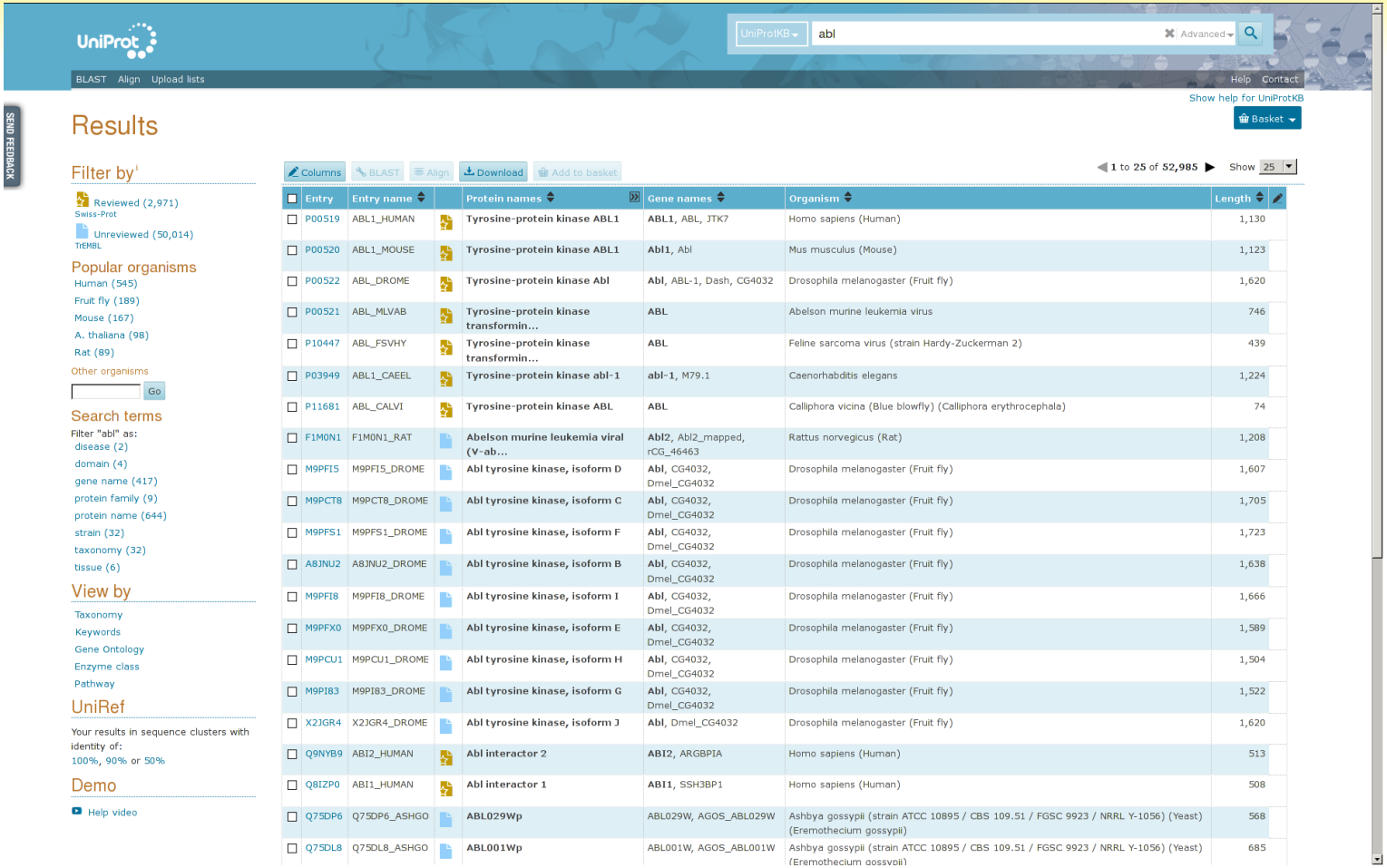


EXAMPLE: STRING / STITCH

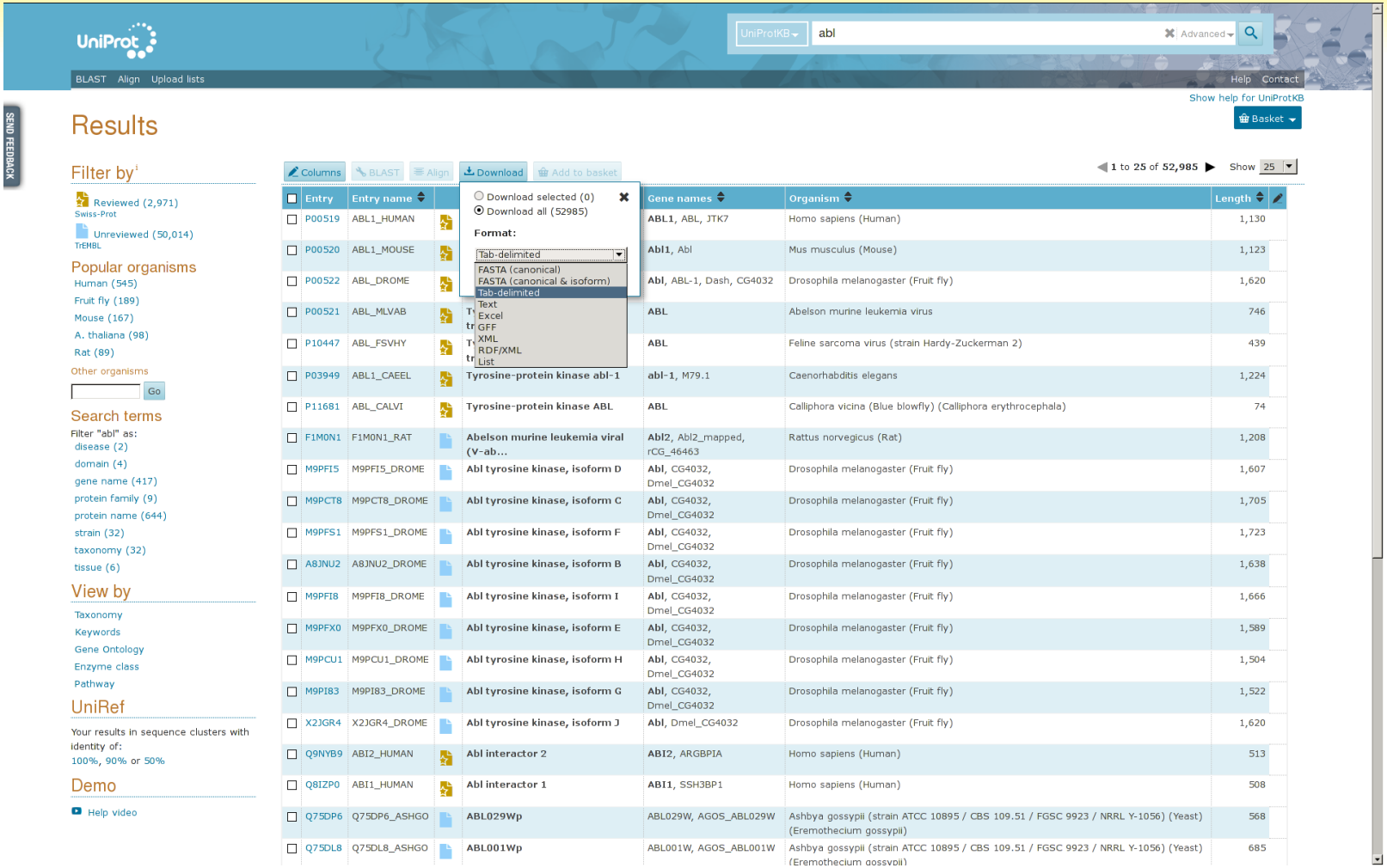


http://string-db.org/api/psi-mi-tab/interactions?identifier=YOL086C&additional_network_nodes=2

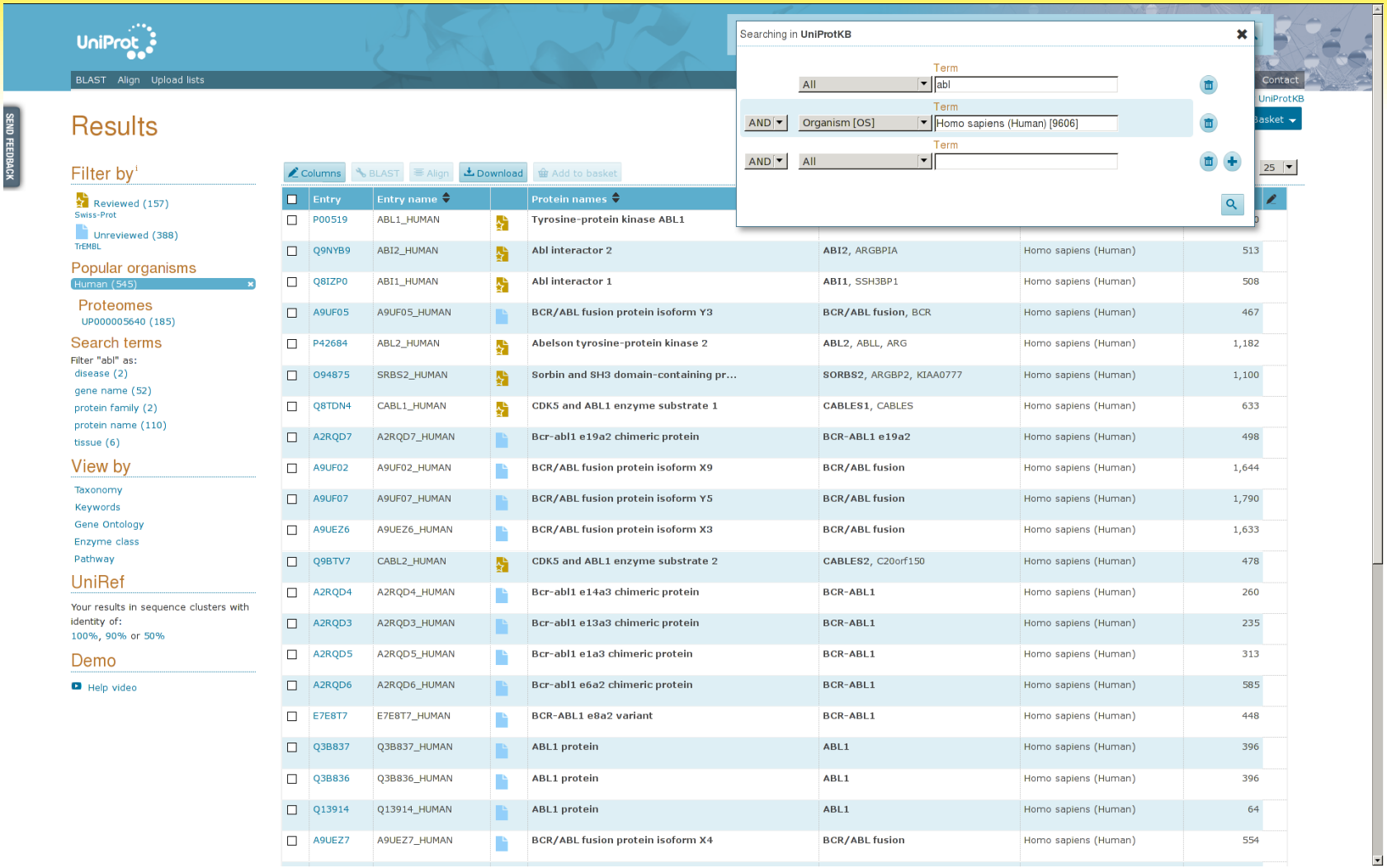
EXAMPLE: UNIPROT



EXAMPLE: UNIPROT

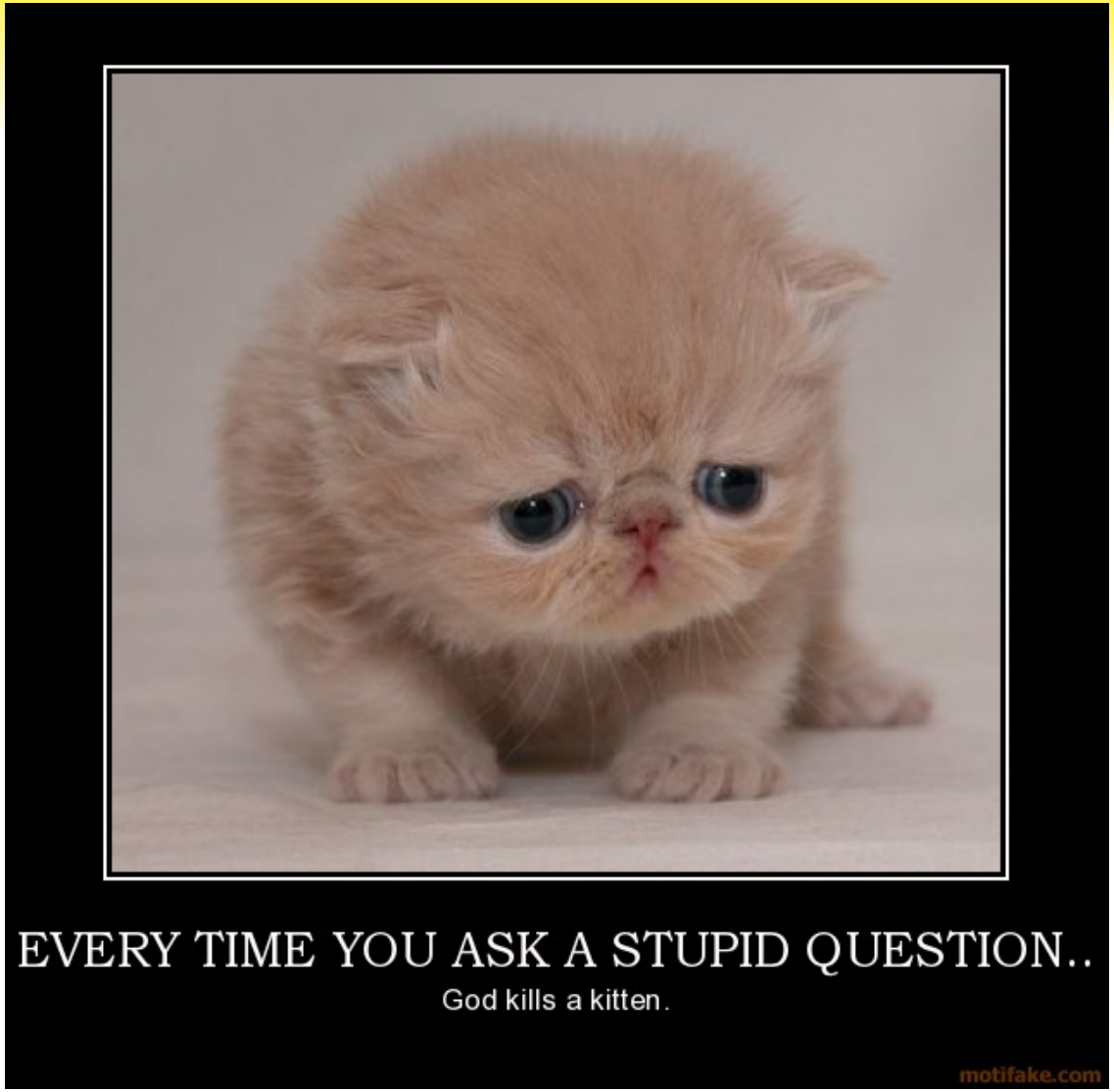


EXAMPLE: UNIPROT



Entry	Entry name	Protein names			
P00519	ABL1_HUMAN	**Tyrosine-protein kinase ABL1**			
Q9NYB9	ABI2_HUMAN	**Abl interactor 2**	**ABI2**, ARGBPIA	Homo sapiens (Human)	513
Q8IZP0	ABI1_HUMAN	**Abl interactor 1**	**ABI1**, SSH3BP1	Homo sapiens (Human)	508
A9UF05	A9UF05_HUMAN	**BCR/ABL fusion protein isoform Y3**	**BCR/ABL fusion**, BCR	Homo sapiens (Human)	467
P42684	ABL2_HUMAN	**Abelson tyrosine-protein kinase 2**	**ABL2**, ABLL, ARG	Homo sapiens (Human)	1,182
O94875	SRBS2_HUMAN	**Sorbin and SH3 domain-containing pr...**	**SORBS2**, ARGBP2, KIAA0777	Homo sapiens (Human)	1,100
Q8TDN4	CABL1_HUMAN	**CDK5 and ABL1 enzyme substrate 1**	**CABLES1**, CABLES	Homo sapiens (Human)	633
A2RQD7	A2RQD7_HUMAN	**Bcr-abl1 e19a2 chimeric protein**	**BCR-ABL1 e19a2**	Homo sapiens (Human)	498
A9UF02	A9UF02_HUMAN	**BCR/ABL fusion protein isoform X9**	**BCR/ABL fusion**	Homo sapiens (Human)	1,644
A9UF07	A9UF07_HUMAN	**BCR/ABL fusion protein isoform Y5**	**BCR/ABL fusion**	Homo sapiens (Human)	1,790
A9UEZ6	A9UEZ6_HUMAN	**BCR/ABL fusion protein isoform X3**	**BCR/ABL fusion**	Homo sapiens (Human)	1,633
Q9BTV7	CABL2_HUMAN	**CDK5 and ABL1 enzyme substrate 2**	**CABLES2**, C20orf150	Homo sapiens (Human)	478
A2RQD4	A2RQD4_HUMAN	**Bcr-abl1 e14a3 chimeric protein**	**BCR-ABL1**	Homo sapiens (Human)	260
A2RQD3	A2RQD3_HUMAN	**Bcr-abl1 e13a3 chimeric protein**	**BCR-ABL1**	Homo sapiens (Human)	235
A2RQD5	A2RQD5_HUMAN	**Bcr-abl1 e1a3 chimeric protein**	**BCR-ABL1**	Homo sapiens (Human)	313
A2RQD6	A2RQD6_HUMAN	**Bcr-abl1 e6a2 chimeric protein**	**BCR-ABL1**	Homo sapiens (Human)	585
E7E8T7	E7E8T7_HUMAN	**BCR-ABL1 e8a2 variant**	**BCR-ABL1**	Homo sapiens (Human)	448
Q3B837	Q3B837_HUMAN	**ABL1 protein**	**ABL1**	Homo sapiens (Human)	396
Q3B836	Q3B836_HUMAN	**ABL1 protein**	**ABL1**	Homo sapiens (Human)	396
Q13914	Q13914_HUMAN	**ABL1 protein**	**ABL1**	Homo sapiens (Human)	64
A9UEZ7	A9UEZ7_HUMAN	**BCR/ABL fusion protein isoform X4**	**BCR/ABL fusion**	Homo sapiens (Human)	554

Questions?


EVERY TIME YOU ASK A STUPID QUESTION..
God kills a kitten.
motifake.com