How to Share FAIR — The FAIRDOM Data and Model Management Practice
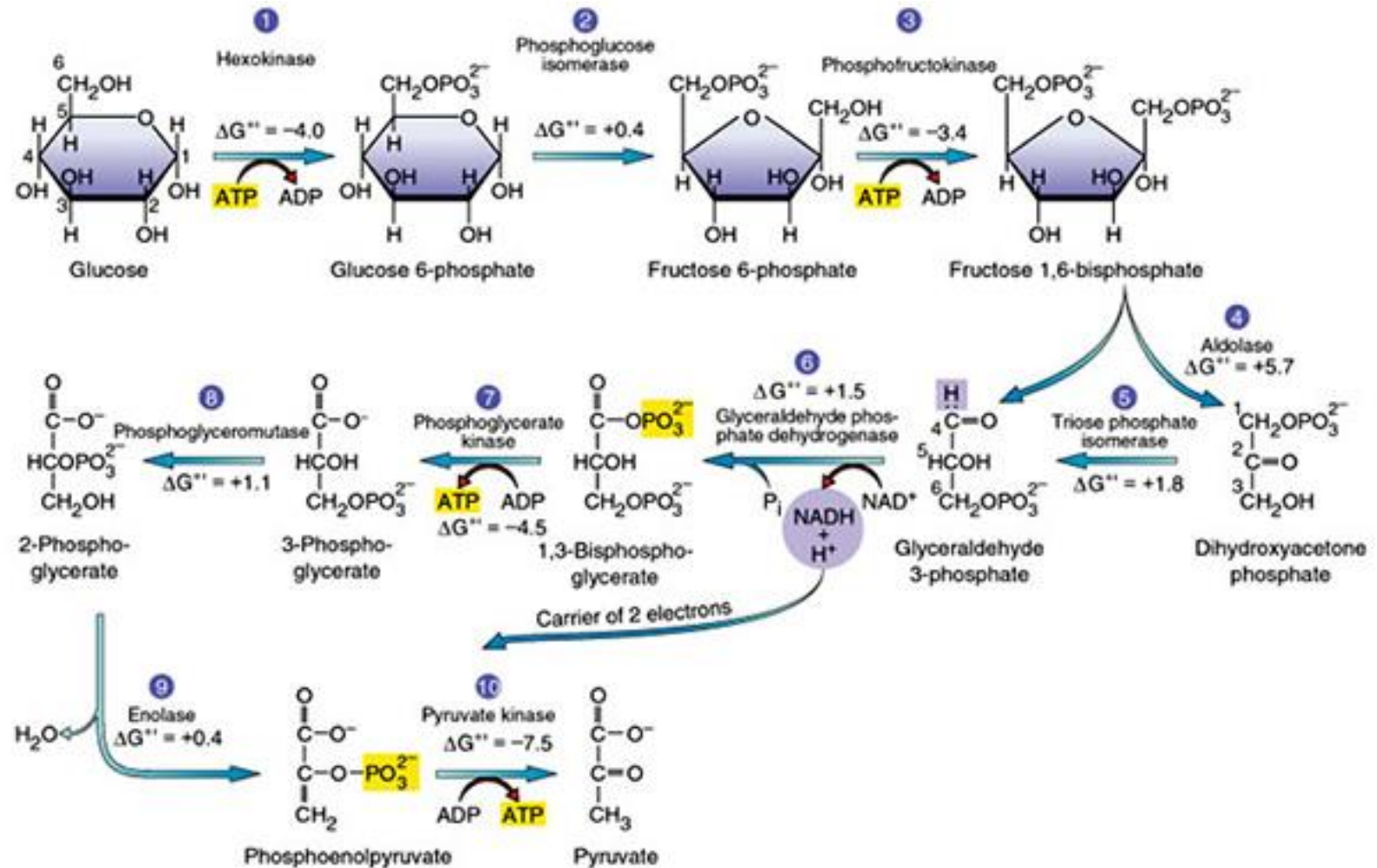

Maja Rey

HITS Heidelberg, Germany

LiSyM/de.NBI/ERASysAPP Tutorial, Bremen, July 4, 2018
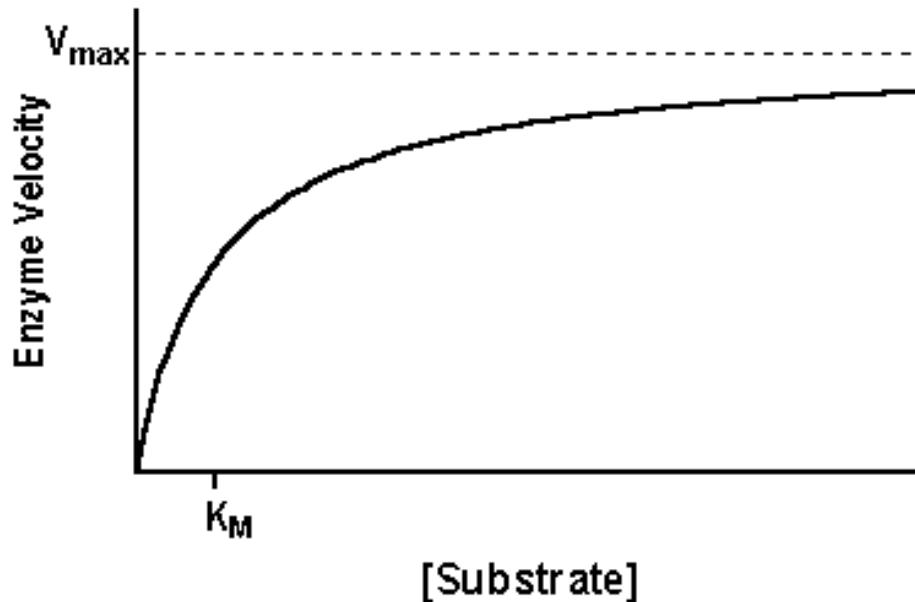
Enzyme kinetics

Example: Glycolysis pathway, conversion of Glucose into Pyruvate

Enzyme kinetics

Kinetic law type: Michaelis–Menten

$$v = \frac{d[P]}{dt} = \frac{V_{\max}[S]}{K_M + [S]}.$$

Equation describing the rate of enzymatic reactions

v rate: formation of product P from substrate S
Km, Vmax: specific constants for this reaction
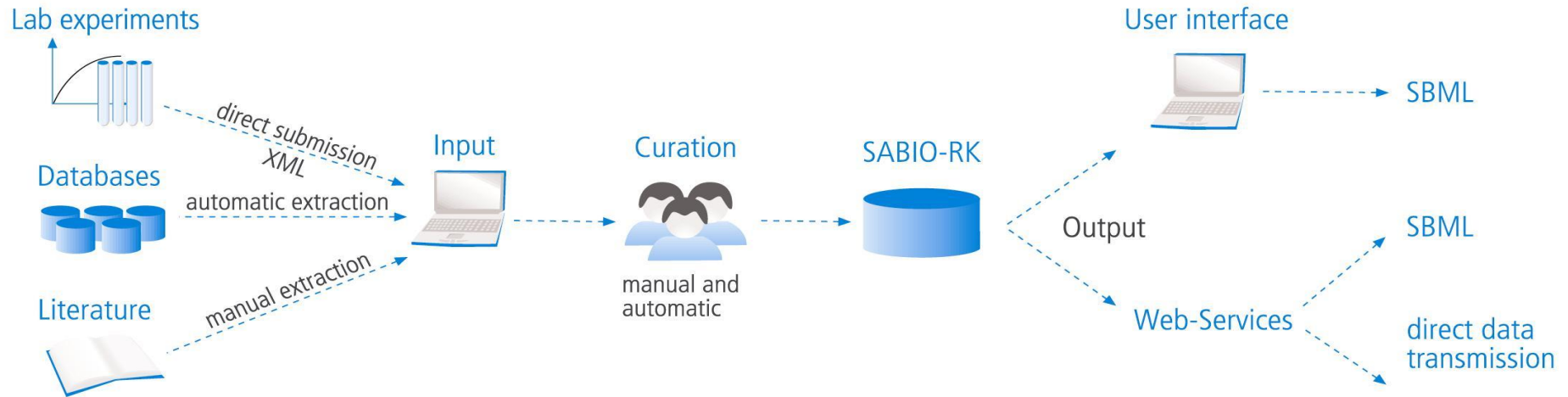
Motivation for an reaction kinetics database

- quantitative data on enzyme kinetics are required e.g. for modellers

- problem: data digging is - time consuming
  - hard to find in literature
  - partly hidden in figures and tables

=> 2006 start of collecting reaction kinetics data,
   storage in a public accessible database

http://sabiork.h-its.org
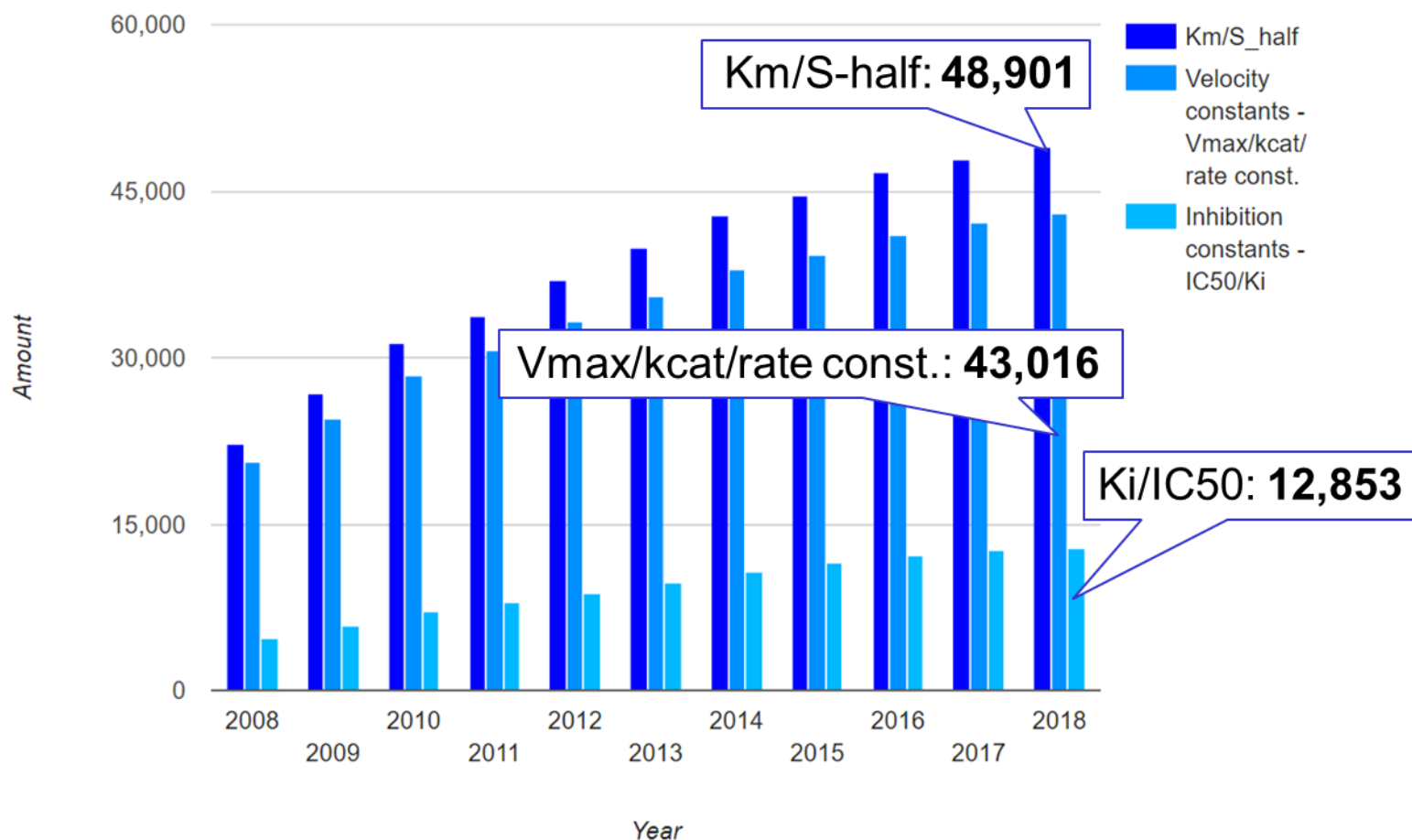
SABIO-RK: data workflow

> Kinetic data manually extracted from literature and data from experiments or models entered in a structured manner

> Data are unified, normalized and annotated

> Data access via a web-based user interface, by web-services or Python Scripts

> Data Export in table (csv) or standard exchange formats (XML)

SABIO-RK statistics

Database entries	58,864
for wildtype enzymes	43,876
for mutant enzymes	15,026
Publications	5,844
Reactions	7,752
Compounds	10,412
EC numbers	1,747
UniprotKB_IDs	4,726
Organisms	979
Tissues	340

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SABIO-RK statistics

Total amount of selected kinetic parameters

SABIO-RK website

http://sabiork.h-its.org

Public search interface

Simple free-text search, e.g. for EC number

Public search interface

Advanced search with many options for detailed search

Search results

1. Entry View of results

Search for Substrate:"ATP" AND Organism:"mammalia (NCBI)" AND Tissue:"liver"

Entry View | Reaction View | Visual Search

Total number of kinetic law entries found: **674**   □ expand all displayed entries
1 2 3 4 5 6 7 8 9 10 .. 45 Next   display [15 ˅] entries per page

| Kinetic data | Reaction | Enzyme | | | Tissue | Organism | Parameter (besides concentration) | Cond. | | Add to export cart? □ |
		ECNumber	Protein	Variant				°C	pH	
▶	ATP + 3-Phospho-D-glycerate = ADP + 3-Phospho-D-glyceroyl phosphate	2.7.2.3	Q3T0P6 ⬈	wildtype	liver ⬈	Bos taurus	Km	22.0	7.2	□
▶	ATP + D-Fructose 6-phosphate = ADP + D-Fructose 1,6-bisphosphate	2.7.1.11	P17858 ⬈	wildtype	liver ⬈	Homo sapiens	S_half	26.0	7.2	□
▶	D-Glucose + ATP = ADP + D-Glucose 6-phosphate	2.7.1.1	P27881 ⬈	wildtype	liver ⬈	Rattus norvegicus	Km	30.0	7.4	□
▶	ATP + 2-Deoxyglucose = ADP + 2-Deoxyglucose 6-phosphate	2.7.1.1	P27881 ⬈	wildtype	liver ⬈	Rattus norvegicus	Km	30.0	7.4	□

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Single entry view

	H2O + L-Arginine = L-Ornithine + Urea	3.5.3.1	P05089 ⬏	wildtype	liver ⬏	Homo sapiens	Ki		25.0	9.5	☐

Entry ID: 10093

General information

Organism	**Homo sapiens**
Tissue	liver ⬏
EC Class	3.5.3.1
SABIO reaction id	574
Variant	wildtype
Recombinant	expressed in Escherichia coli JM109
Experiment Type	in vitro
Pathways	Insulin signaling pathway Urea cycle Arginine and Proline metabolism
Event Description	-

Substrates

name	location	comment
L-Arginine	-	-
H2O	-	-

Products

name	location	comment
L-Ornithine	-	-
Urea	-	-

Modifiers

name	location	effect	comment	protein complex
arginase(Enzyme)	-	Modifier-Catalyst	-	(P05089 ⬏)*3;
L-Lysine	-	Modifier-Inhibitor	-	-

Kinetic Law

type	formula	annotation
Competitive inhibition	-	SBO:0000260 ⬏

Parameter

name	type	species	start val.	end val.	deviat.	unit	comment
S	concentration ⬏	L-Arginine	0.0	0.002	-	M	-
Ki	Ki ⬏	L-Lysine	2.0	-	0.2	mM	-

Experimental conditions

	start value	end value	unit
pH	9.5	-	-
temperature	25.0	-	°C
buffer	50 mM glycine-NaOH, 2 mM MnCl2		
comment	-		

Reference

title	author	year	journal	volume	pages	PubMed
Chemical modification and site-directed mutagenesis of human liver arginase: evidence that the imidazole group of histidine-141 is not involved in substrate binding	Carvajal N, Olate J, Salas M, Uribe E, Lopez V, Herrera P, Cerpa J	1999	Arch Biochem Biophys	371	202-6	10545206 ⬏

Organism

Tissue

Compounds

Enzyme details

Kinetic law

Kinetic data

Exp. conditions

Reference

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Search results

2. Reaction View of results

| Entry View | **Reaction View** | Visual Search |

There are **674** entries in **99** reaction(s) matching your query   ☐ expand all displayed reaction entries

1 2 3 4 5 6 7 Next

display [15 ▾] reactions per page

Kinetic data	[Sabio ID]: Reaction	Kegg ID	Visualization (Please allow pop-up windows in your browser)	Number of Entries	Add to export cart? ☐
▶	[7644]: ATP + 3-Phospho-D-glycerate = ADP + 3-Phospho-D-glyceroyl phosphate	R01512 ⬈	*Click here to view visualization*	1	☐
▶	[1113]: ATP + D-Fructose 6-phosphate = ADP + D-Fructose 1,6-bisphosphate	R00756 ⬈	*Click here to view visualization*	38	☐
▶	[793]: D-Glucose + ATP = ADP + D-Glucose 6-phosphate	R00299 ⬈	*Click here to view visualization*	45	☐
▶	[6883]: ATP + 2-Deoxyglucose = ADP + 2-Deoxyglucose 6-phosphate	-	*Click here to view visualization*	11	☐
▶	[3359]: ATP + D-Allose = D-Allose 6-phosphate + ADP	R03576 ⬈	*Click here to view visualization*	1	☐
▶	[9559]: ATP + D-Gulose = ADP + D-Gulose 6-phosphate	-	*Click here to view visualization*	1	☐
▶	[1116]: ATP + D-Fructose = ADP + D-Fructose 6-phosphate	R00760 ⬈	*Click here to view visualization*	6	☐
▶	[576]: ATP + D-Fructose = ADP + D-Fructose 1-phosphate	R00866 ⬈	*Click here to view visualization*	16	☐

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Search results

3. Visualization of search results with option to confine the query
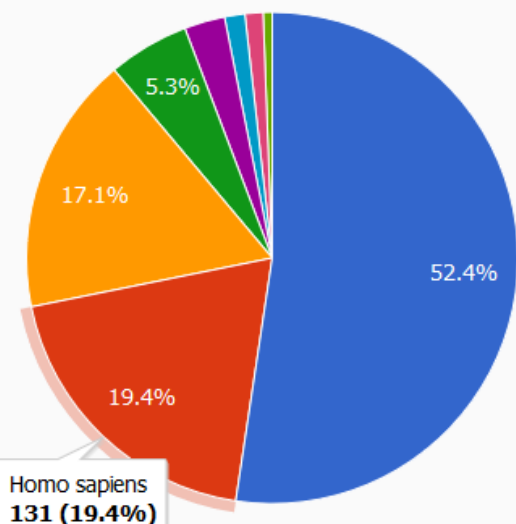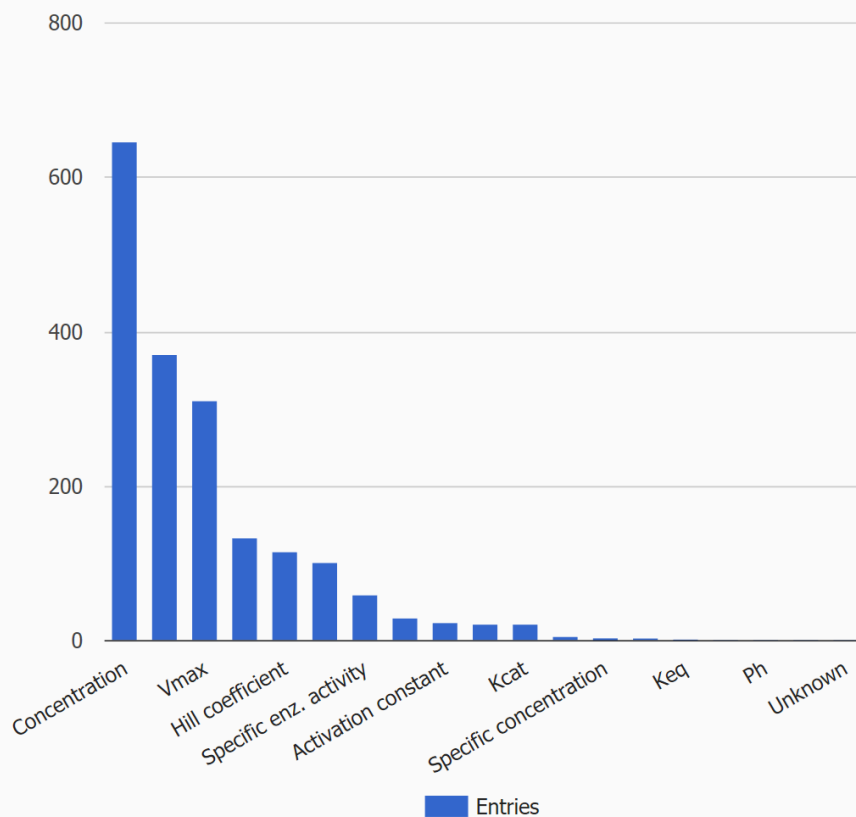
Confine search result

Substrate:"ATP" AND Organism:"mammalia (NCBI)" AND Tissue:"liver"
recommendedOrganismName:"Homo sapiens"

Programmatic data access

Programmatic search of SABIO-RK using RESTful web services

Example URL:
sabiork.h-its.org/sabioRestWebServices/searchKineticLaws/
sbml?q=Tissue:"liver" AND Organism:"Homo sapiens"

Integration of SABIO-RK to other tools

Data export formats

➢ Public search interface, export of result
    set:
    SBML format
    XML
    Tables (xls, tsv)
    BioPax, Matlab, Octave,...
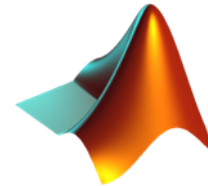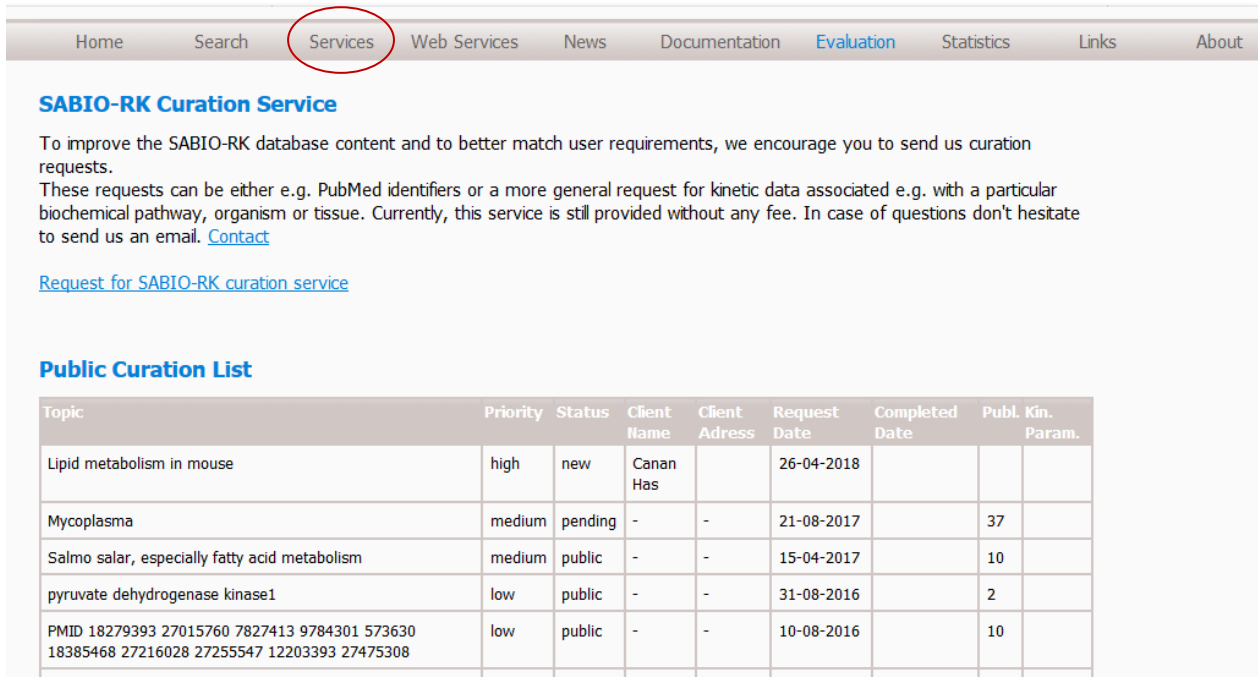
➢ programmatic search using RESTful web
    services:
    SBML format
    TSV (Excel)

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Curation requests as service

> ➢ Users may request for retrieval and storage of kinetic data in SABIO-RK (from literature and exp. data)
> ➢ Service as part of the de.NBI initiative (German Network for Bioinformatics Infrastructure)
> ➢ Service is currently free of charge

Curation requests as service

Curation requests as service

SABIO-RK hands on

➢ Task: Search for 'author: Pritchard'

Task: Search for 'author: Pritchard'

➢ select 'add to export cart'
➢ select 'entries to export'

Task: Search for 'author: Pritchard'

> ➤ select 'write spreadsheet'

Task: Search for 'author: Pritchard'

> - select columns to export:
>   - > include 'rate equation' and 'parameter'
> - export xls and save file

HITS SDBV group @ Heidelberg, Germany
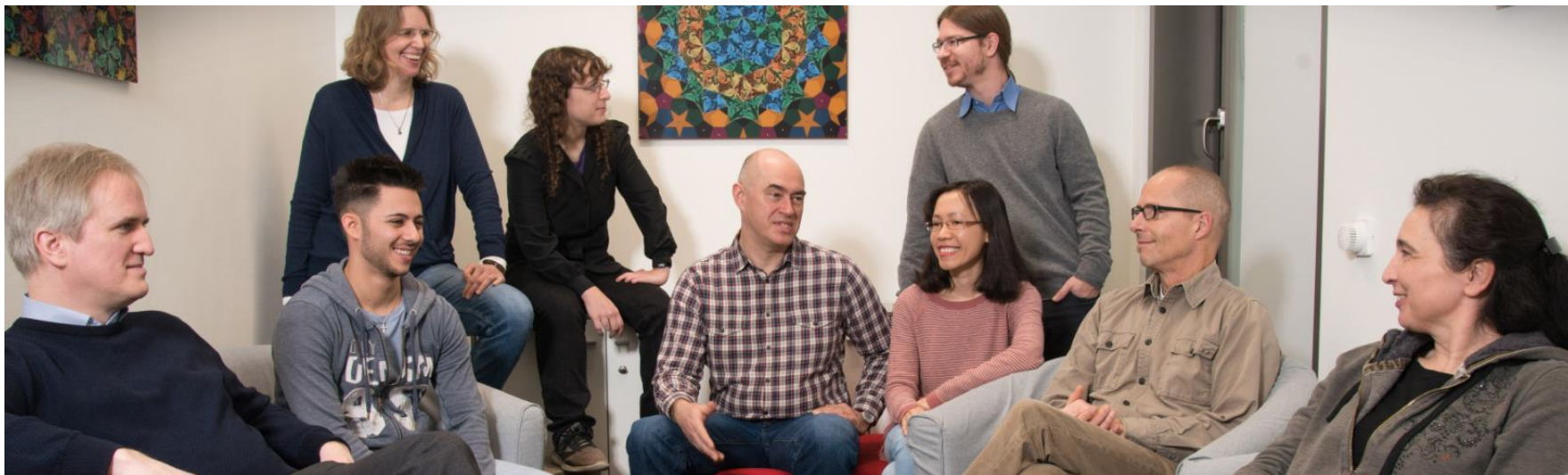
Thanks for your attention!