

Introduction

1st day



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Department of Bioinformatics-BiGCaT, Maastricht University, The Netherlands

BioSB course: Biological Network Analysis

<http://tinyurl.com/pl5yreh>

Amsterdam, 17-18 September 2015

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Who are we?



Friederike Ehrhart, PhD

Postdoctoral researcher at BiGCaT



Susan Steinbusch-Coort, PhD

Assistant Professor at BiGCaT



Martina Summer-Kutmon, PhD

Postdoctoral researcher at BiGCaT / MaCSBio

Outline of the day

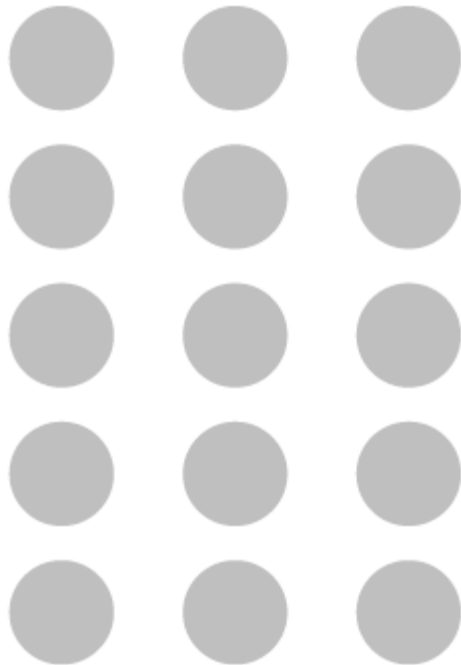
Morning session	(10:00-12:30)	
11:00-11:15	Introduction	Friederike Ehrhart, PhD
11:15-11:45	Lecture: Pathway Analysis	Susan Steinbusch-Coort, PhD
11:45-12:30	Hands on session: Pathway Analysis I	
Lunch	(12:30-13:30)	
Afternoon session	(13:30-16:30)	
13:30-14:00	Hands on session: Pathway Analysis II	
14:00-14:30	Lecture: Network Analysis	Martina Summer-Kutmon, PhD
14:30-15:00	Coffee Break	
15:00-16:30	Hands on session: Network Analysis	
Quiz and Q&A session	(16:30-17:00)	



Introduction

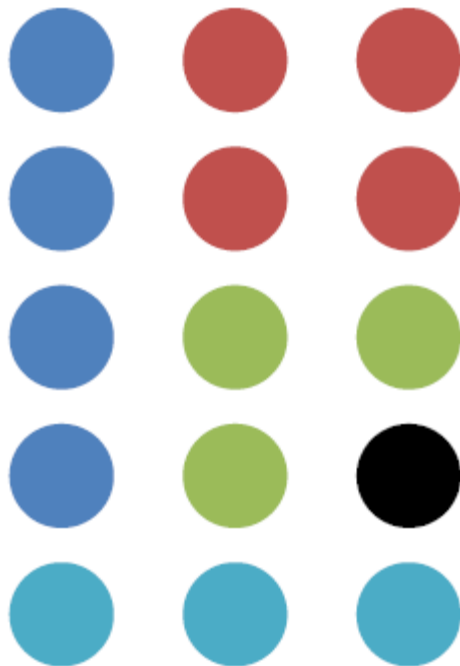
Pathways & Networks

Data analysis



Quantitative measurements
Isolated data points

Data analysis



Comparative statistics

Isolated lists

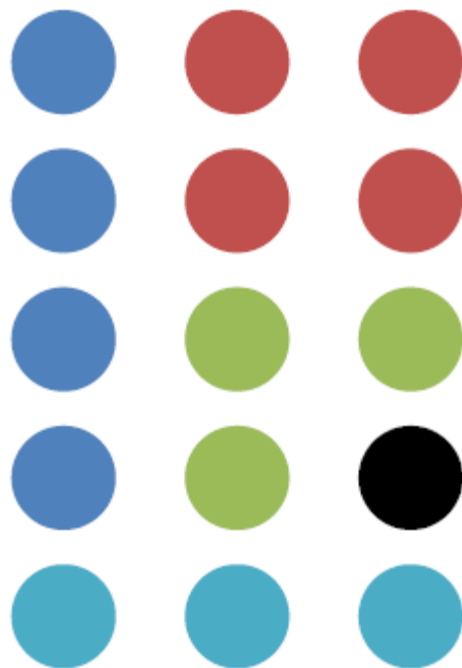
Clustering

Isolated groups

Gene sets

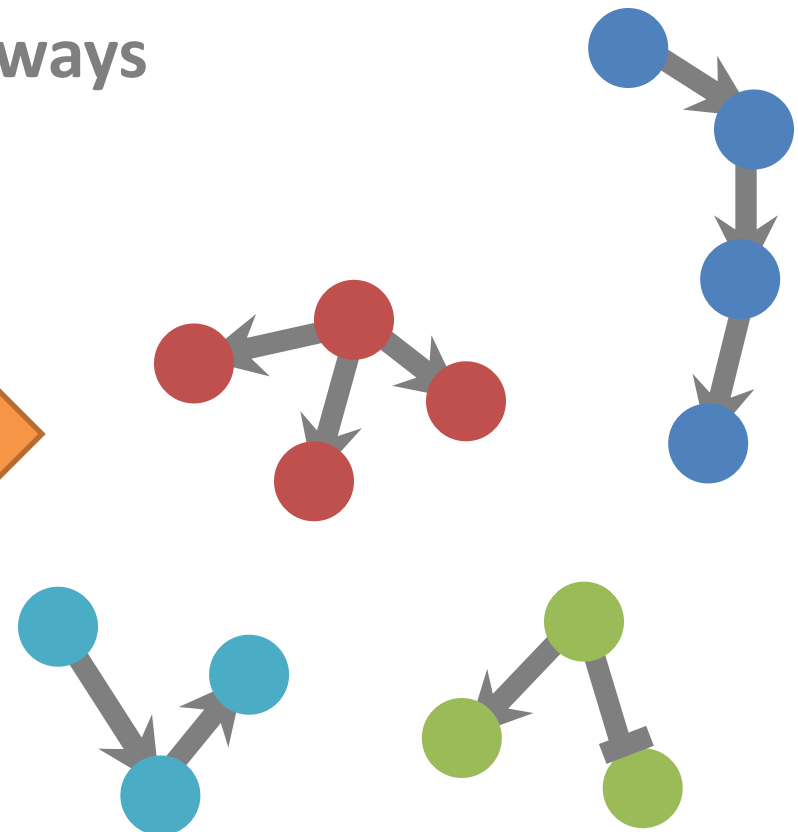
Functional groups

Data analysis

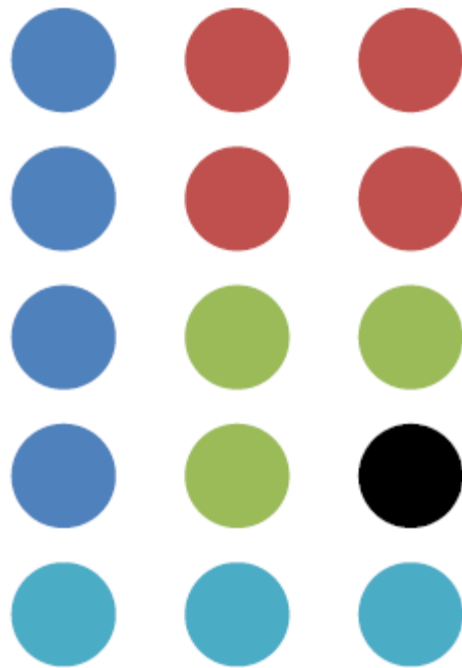


Functional organisation

Pathways

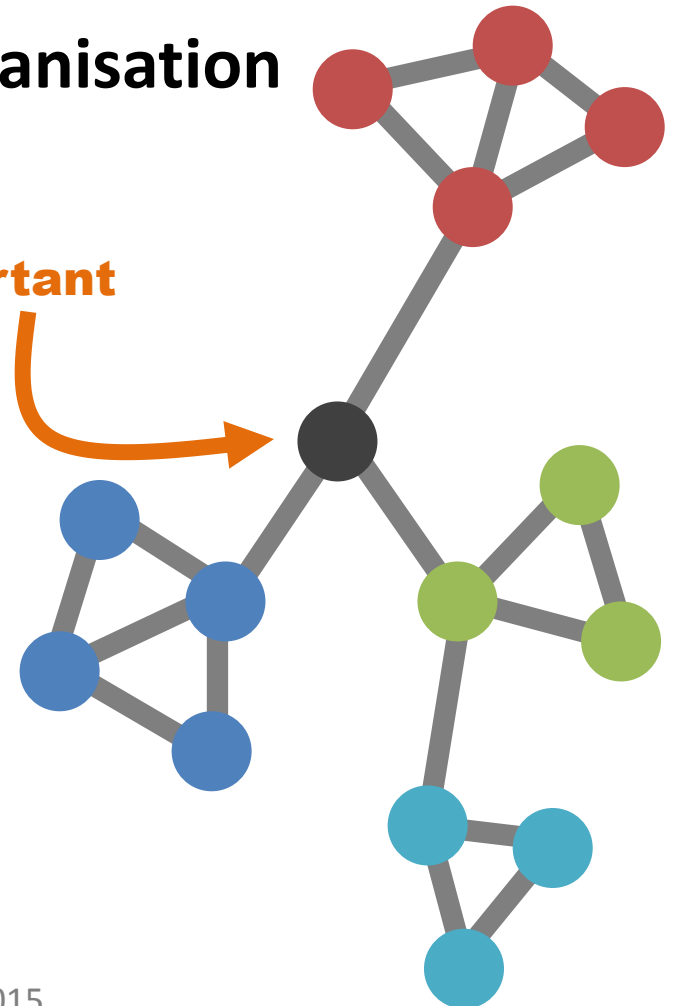


Data analysis

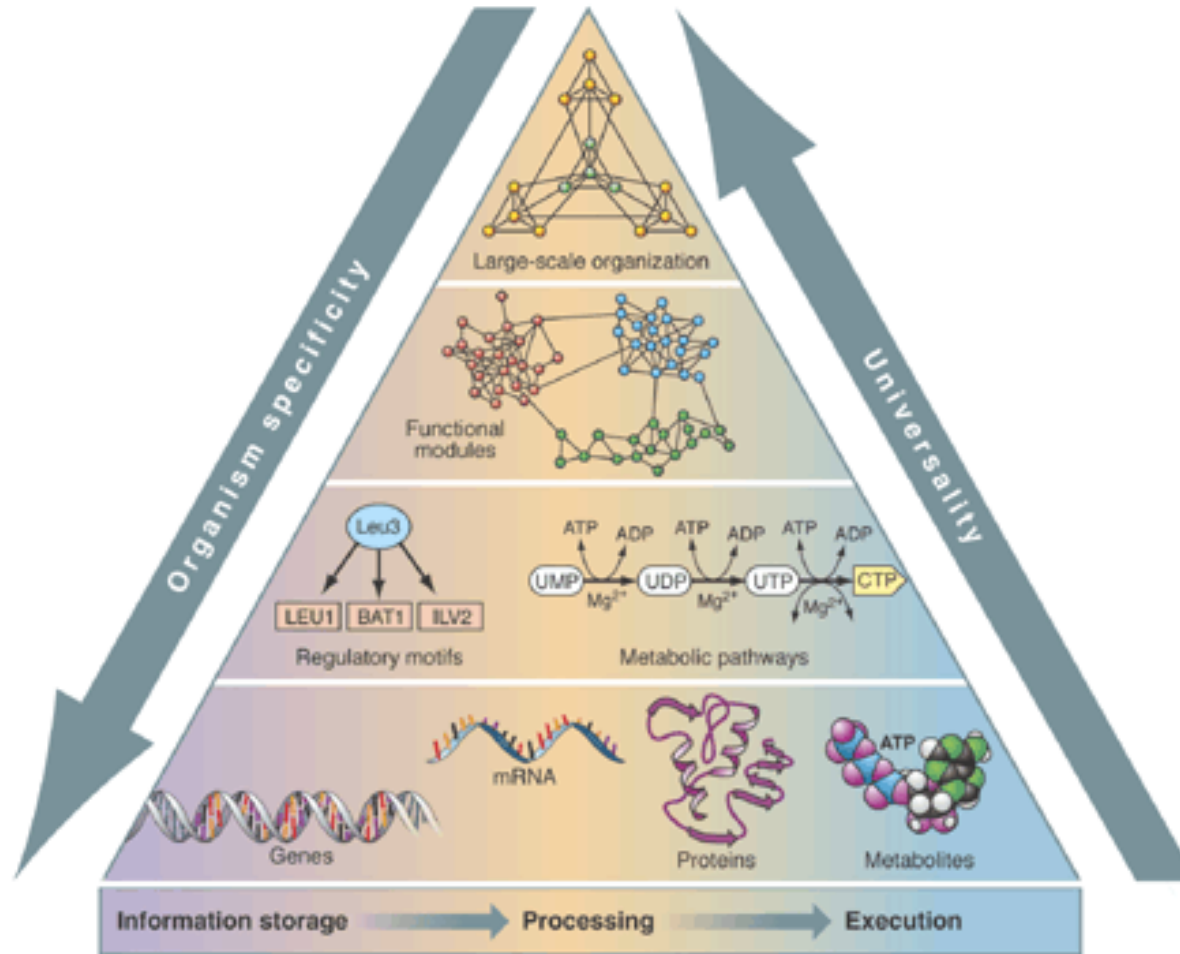


Systems organisation
Networks

Important link!



Complexity



Oltvai, ZN, & Barabasi, AL
Life's complexity pyramid.
Science (2002)

Network Analysis

Broad applications

Nodes can mean anything!

Biology:

Key protein connecting pathways

Organization networks:

Don't fire this guy!

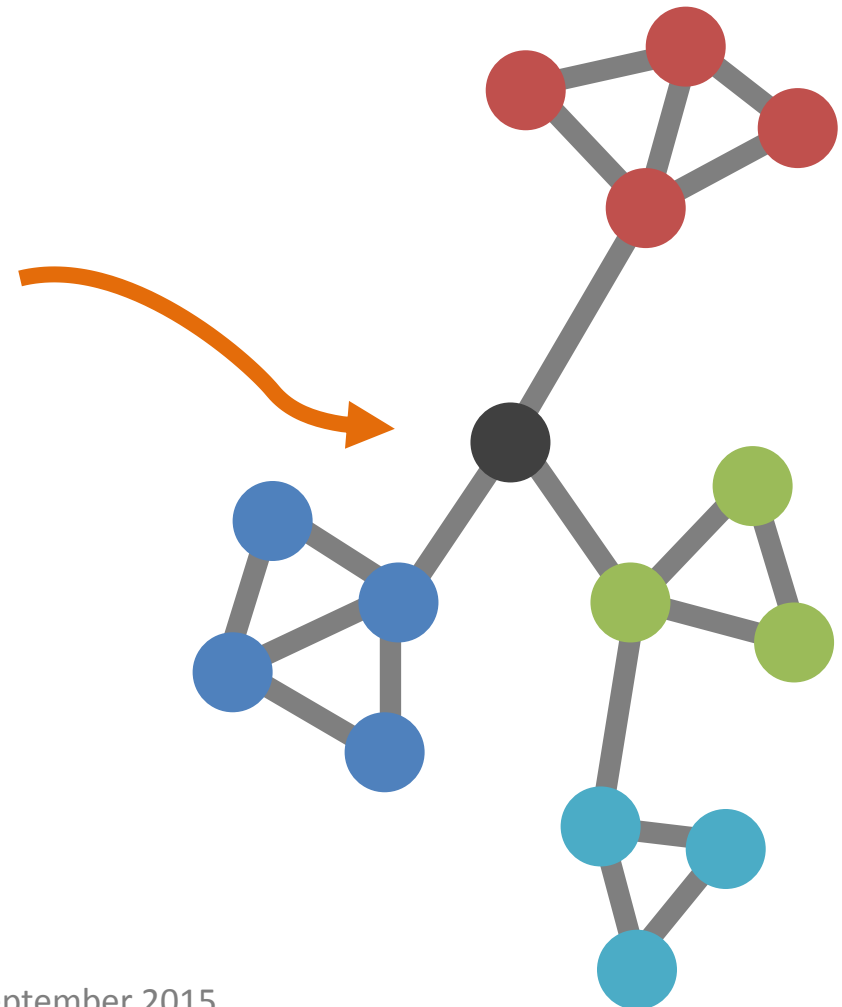
Process engineering:

Bottleneck

Crime networks:

Arrest this man!

...



Slide adapted from Thomas Kelder

BioSB 2015 course: Biological Network Analysis, 17 & 18 September 2015

Publicly available dataset

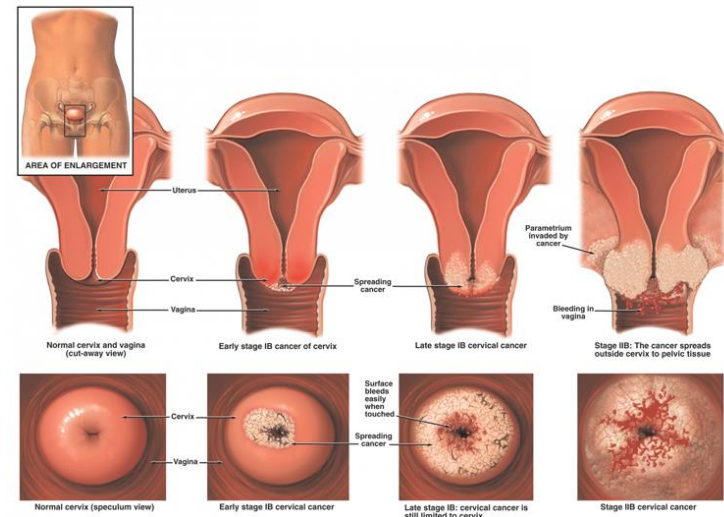
The Journal of Immunology

Gene Expression Patterns Induced by HPV-16 L1 Virus-Like Particles in Leukocytes from Vaccine Recipients¹

Alfonso J. García-Piñeres,^{2*} Allan Hildesheim,[†] Lori Dodd,[‡] Troy J. Kemp,^{*} Jun Yang,[§] Brandie Fullmer,[§] Clayton Harro,[¶] Douglas R. Lowy,^{||} Richard A. Lempicki,[§] and Ligia A. Pinto^{3*}



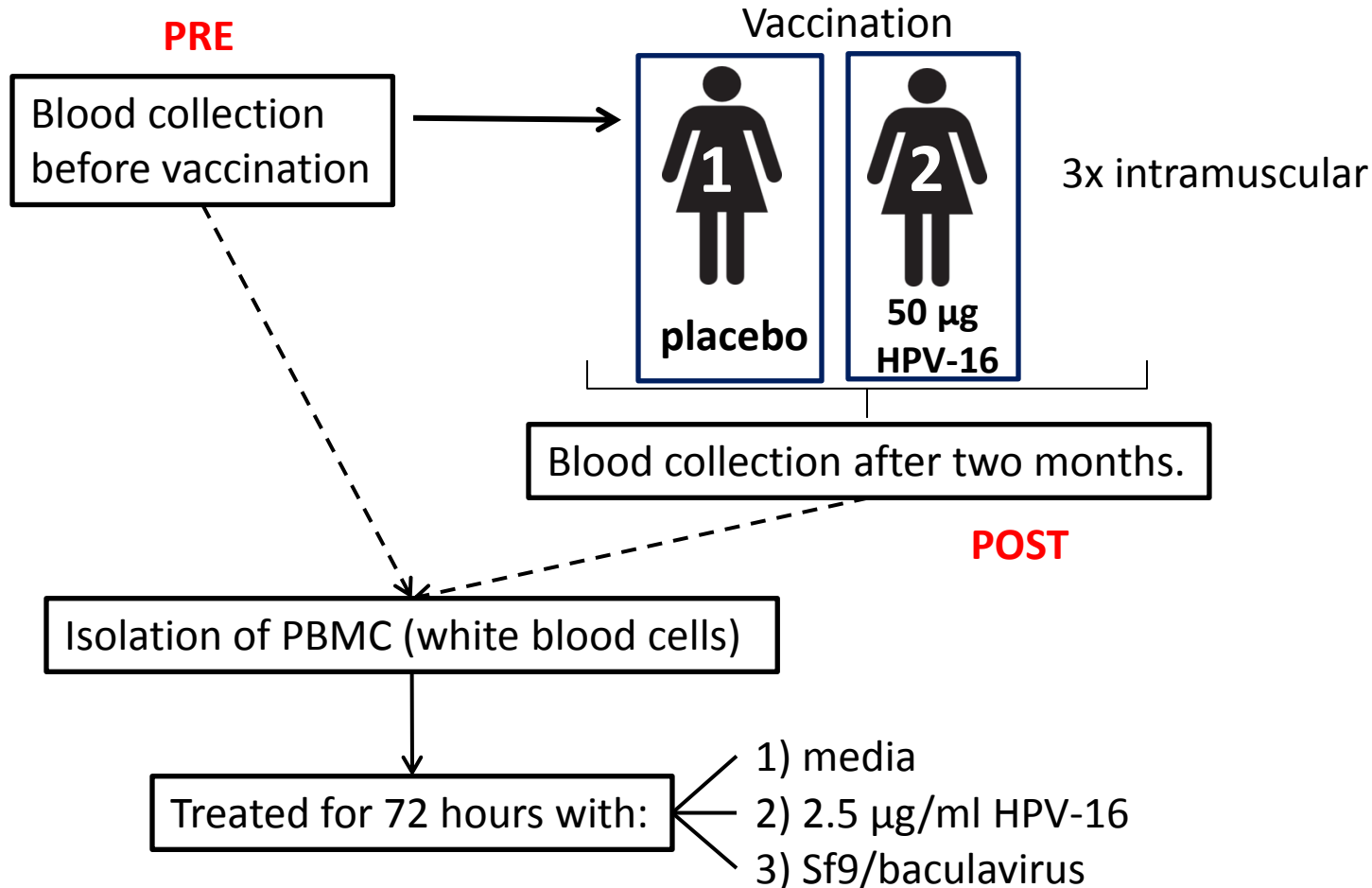
Human papilloma virus (HPV)



Cervical cancer

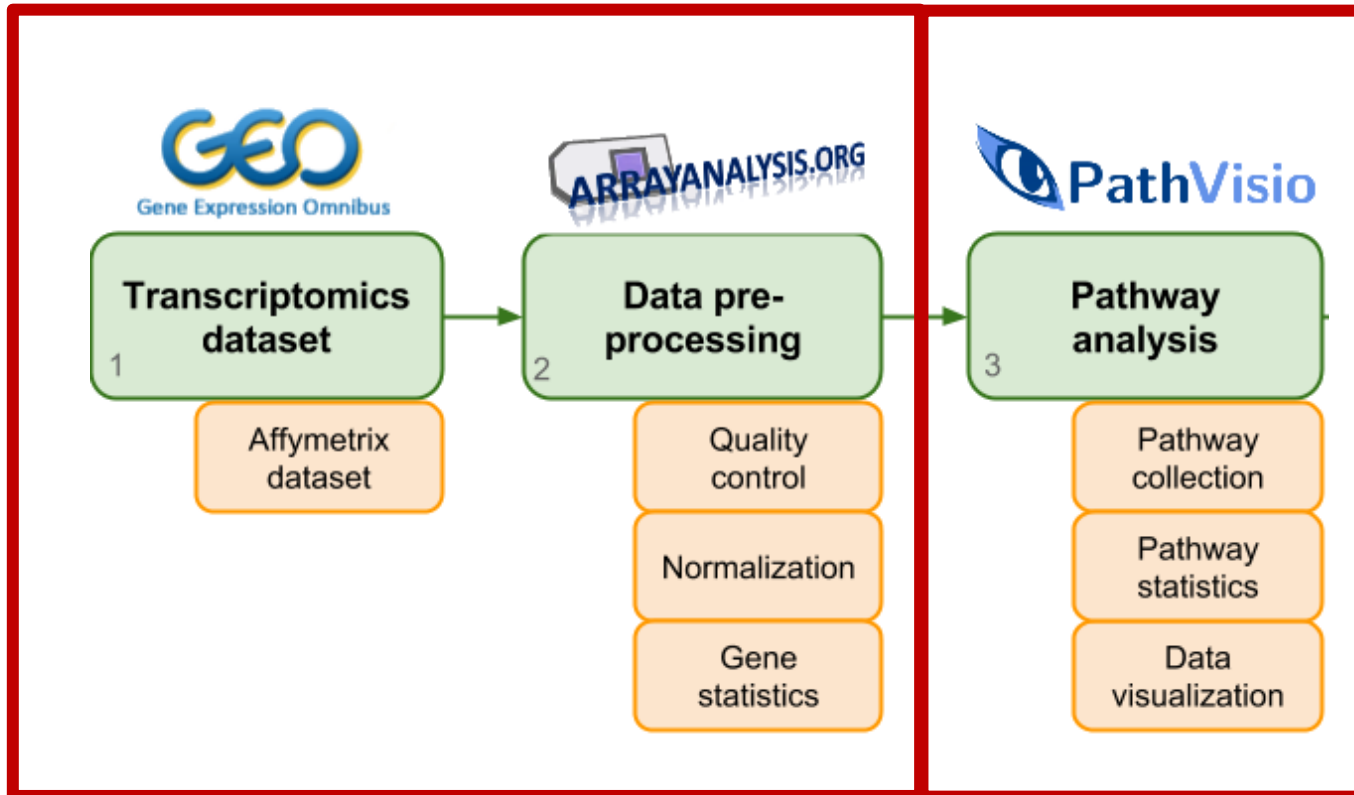
Study design

To characterize the immune response to HPV-16 L1 vaccination



Analysis workflow

YOU!



Done!

Study published in BMC Genomics

Kutmon M, Evelo CT, Coort SL. (2014) A network biology workflow to study transcriptomics data of the diabetic liver. BMC Genomics. 15:971. doi: 10.1186/1471-2164-15-971.

Statistical analyzed data

ENTREZG_ID	logFC	Fold Change	AveExpr	t	P.Value	adj.P.Val	B
5791	0.91922	1.507253064	9.134413	6.51085	6.64E-07	0.005247	5.916612
1318	0.58061	1.49548195	9.192346	5.75004	4.68E-06	0.008414	4.159066
3290	3.83471	8.476516346	7.005056	5.74157	4.79E-06	0.008414	4.138979
6717	0.715502	1.64205491	9.856558	5.73468	4.87E-06	0.008414	4.122764
29940	0.777776	1.714485322	8.763883	5.59153	7.08E-06	0.008414	3.784871
51762	0.78194	1.714982218	6.303504	5.54298	8.03E-06	0.008414	3.669908
6653	-0.32238	0.50078388	7.852464	-5.4527	1.02E-05	0.008414	3.455171
2526	0.80504	1.39523083	4.13608	5.450	1.02E-05	0.008414	3.450236
64174	-0.33343	0.52001419	4.087996	-5.4188	1.11E-05	0.008414	3.374525
3458	2.035587	4.099895437	4.838017	5.41174	1.13E-05	0.008414	3.357991
8555	-0.25328	0.191914588	1.886148	-5.3826	1.22E-05	0.008414	3.289179
5718	0.722316	1.649828357	7.102273	5.34531	1.35E-05	0.008414	3.199646
51182	0.96766	1.411047008	6.764266	5.33557	1.38E-05	0.008414	3.176252
25797	1.43223	2.698635003	7.09996	5.20499	1.95E-05	0.011015	2.864133
3383	1.87166	2.277049286	8.333091	5.16108	2.19E-05	0.011541	2.758916
10797	0.85378	1.608123033	9.321337	5.13004	2.38E-05	0.011739	2.684728
211	1.34332	2.048165777	9.093823	5.05876	2.87E-05	0.013213	2.513529
11188	-0.9035	0.870593239	8.292531	-5.0245	3.14E-05	0.013213	2.430177
5577	0.909146	1.752173668	3.166374	5.01319	3.24E-05	0.013213	2.404019
23524	-0.31202	0.482883413	7.223792	-4.9779	3.55E-05	0.013213	2.31877
5690	0.901268	1.517049649	8.845243	4.94788	3.84E-05	0.013213	2.247075
716	1.75489	3.194276422	4.618137	4.92304	4.10E-05	0.013213	2.187326
7453	0.81757	1.97486894	10.75333	4.92118	4.12E-05	0.013213	2.182872
1439	0.55567	1.688294479	9.400976	4.91755	4.16E-05	0.013213	2.174205
1033	0.90903	1.405324249	2.810763	4.90253	4.33E-05	0.013213	2.137939
10213	0.55073	1.370852451	9.417582	4.90135	4.35E-05	0.013213	2.13508
56938	1.96181	2.137880041	3.651963	4.86966	4.73E-05	0.013343	2.058936

FC = fold change

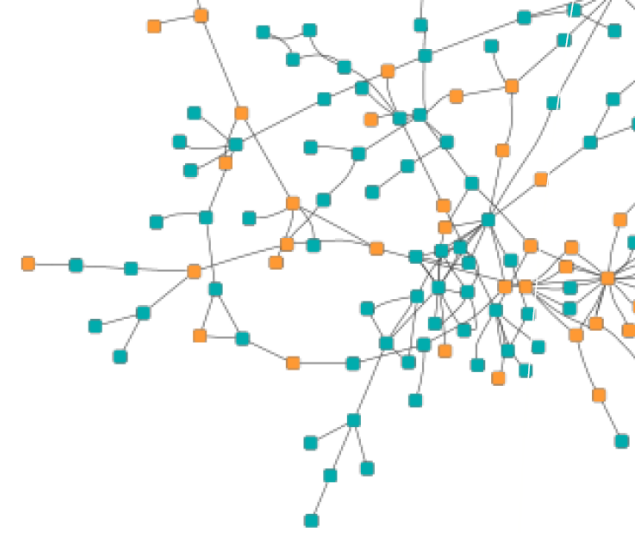
logFC: 2 logged fold change
Comparing treated PBMCs post vaccination with treated PBMCs pre vaccination

P-value: Significance level when comparing post versus pre

Data analysis

Normalization & Statistical analysis

- PBMC's treated with HPV-16 of vaccinated women after (post) and before (pre) vaccination.
- Data quality was checked and the data was normalized.
- Performed a (modified) paired t-test in limma.
- Compare gene expression in treated PBMCs after vaccination with treated PBMCs before vaccination.



Questions?



Information and material:

<http://projects.bigcat.unimaas.nl/biosb2015/>

