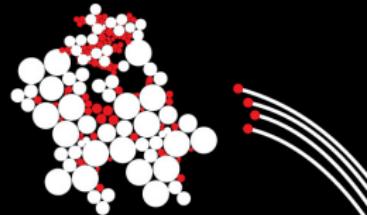


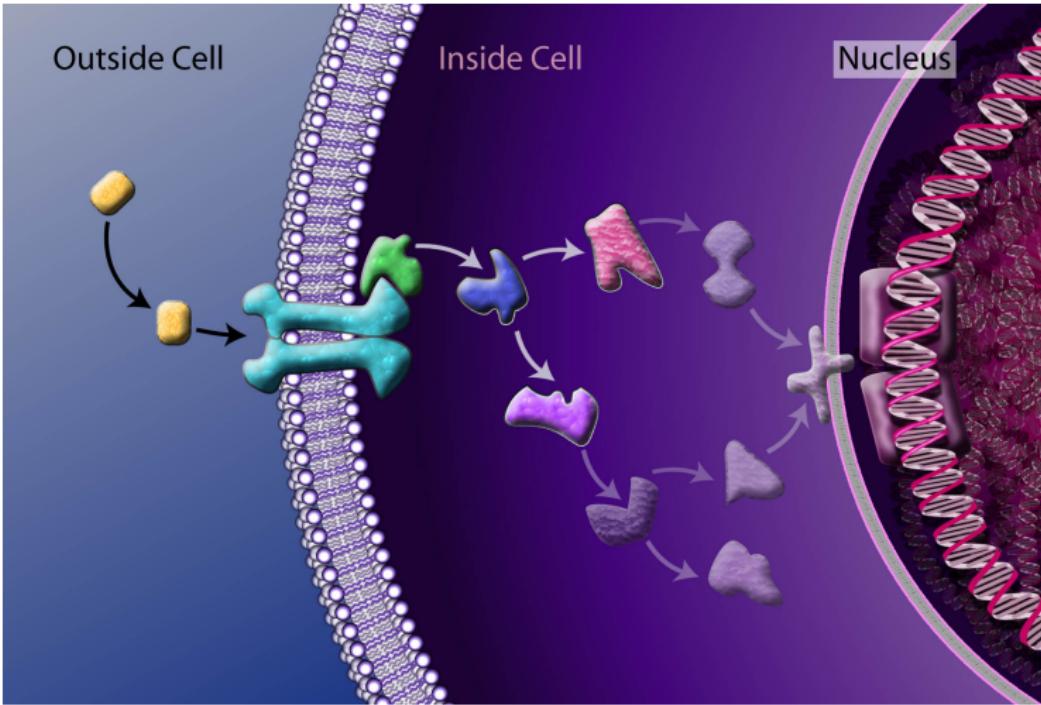
## Setting parameters for biological models with ANIMO

Stefano Schivo, Jetse Scholma,  
Marcel Karperien, Janine N. Post,  
Jaco van de Pol, Rom Langerak

University of Twente,  
Enschede, The Netherlands  
SynCoP 2014

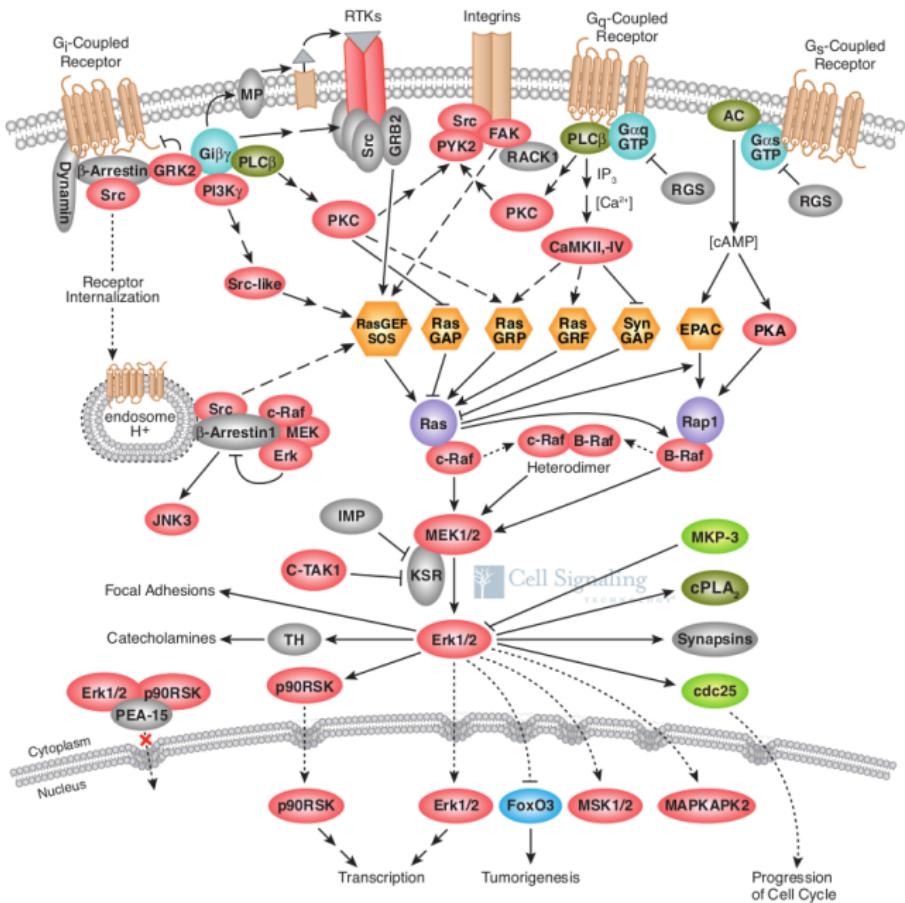


# Signalling Pathways



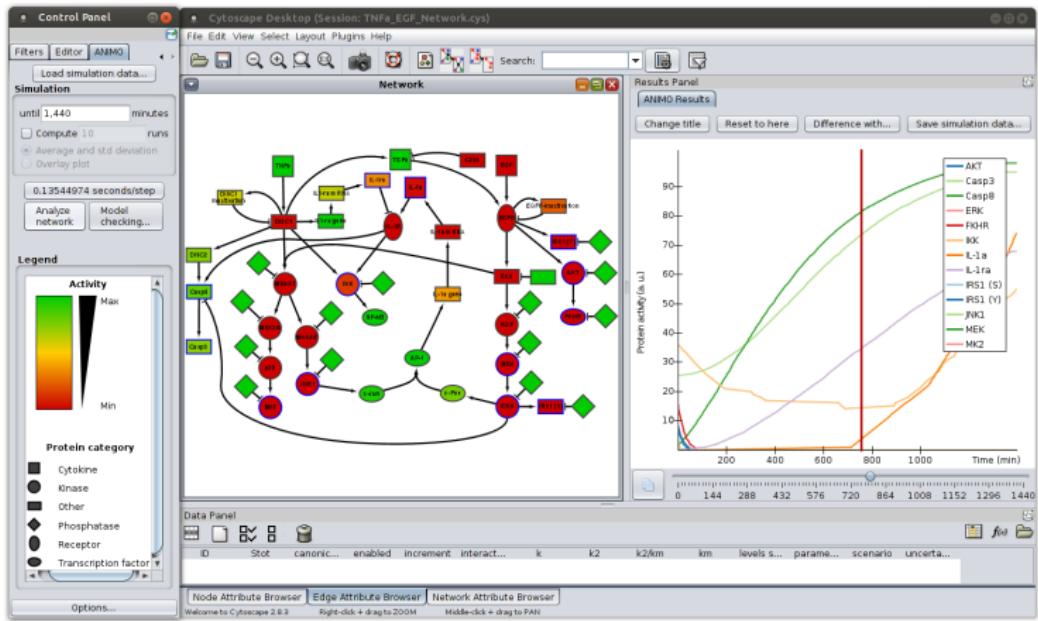
Credit: National Science Foundation

# G-Protein Coupled Receptor Signaling to MAPK/ERK

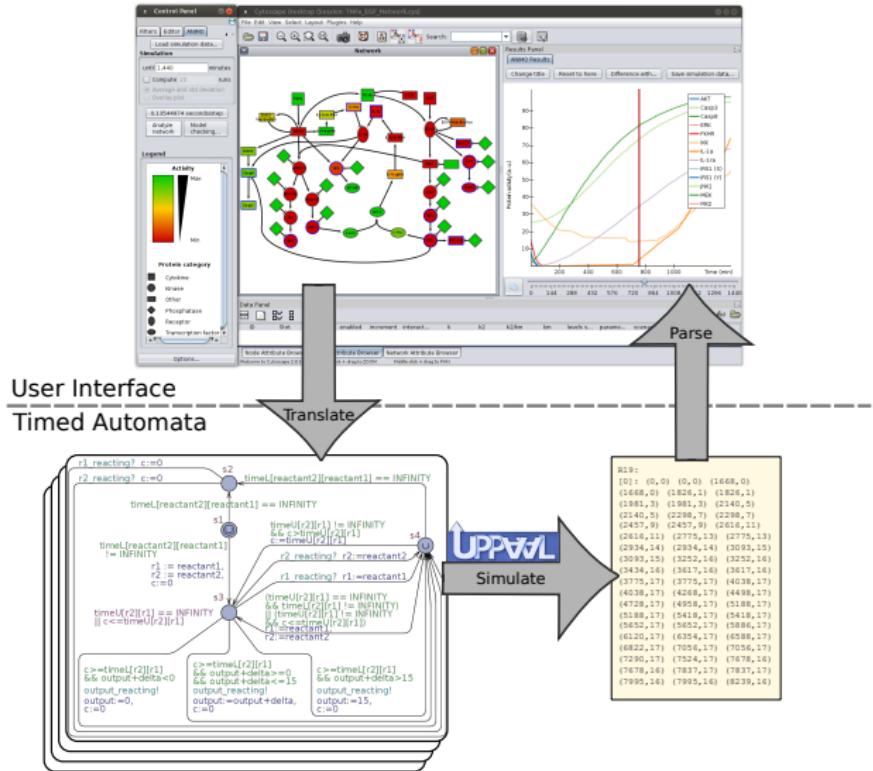


# Analysis of Networks with Interactive MOdelling

## ► Interaction based



# Analysis of Networks with Interactive MOdelling



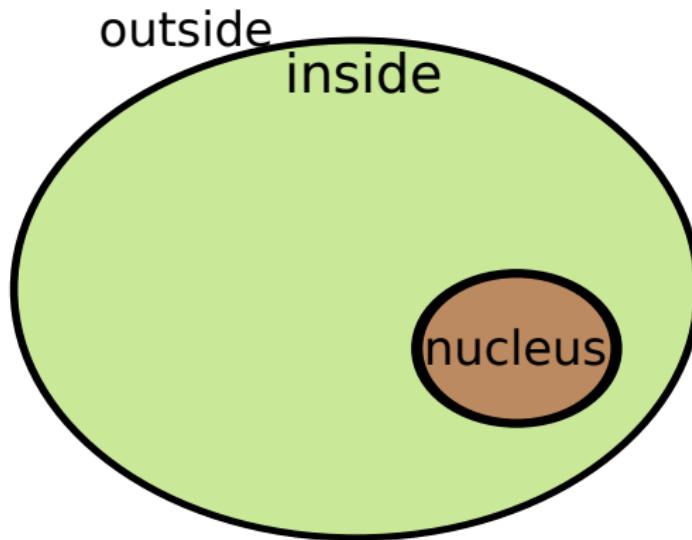
# Analysis of Networks with Interactive MOdelling

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- ▶ Interaction based
- ▶ Discrete concentration/activity levels

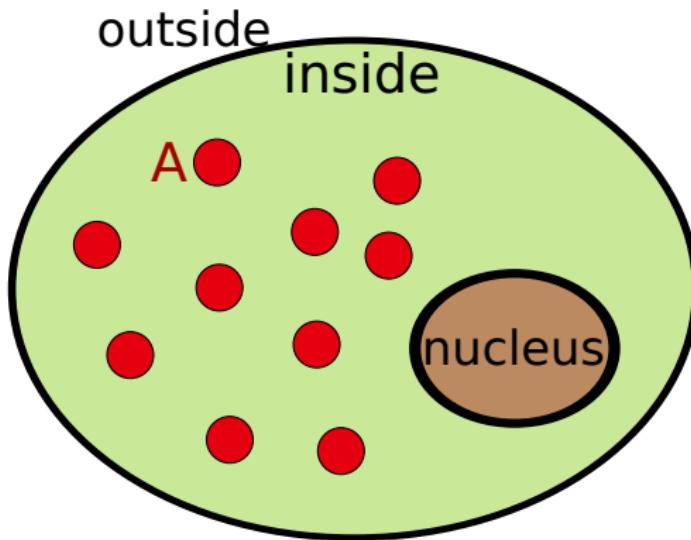
## Discrete activity levels

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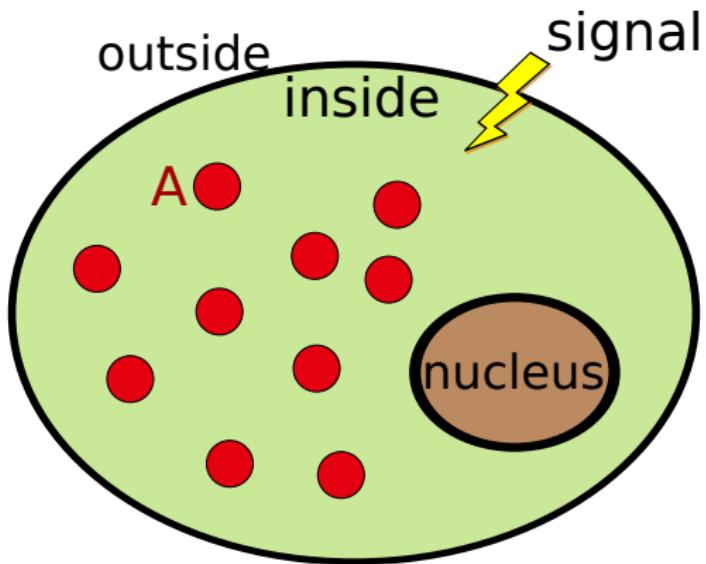
# Discrete activity levels

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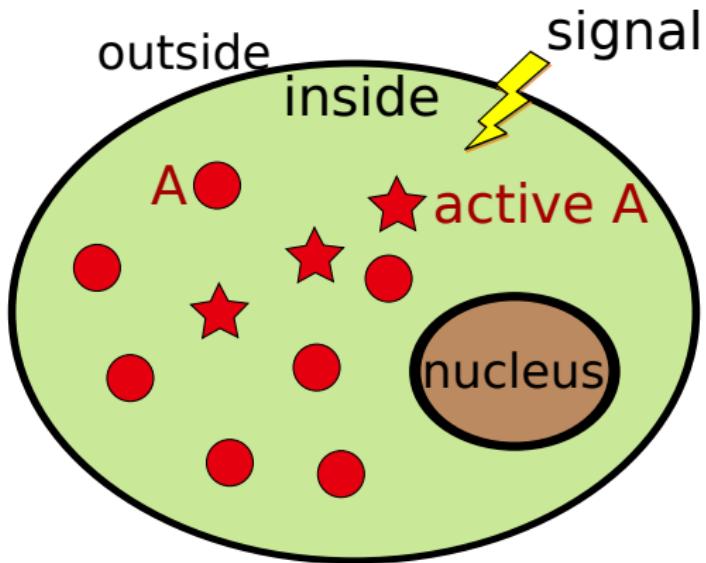
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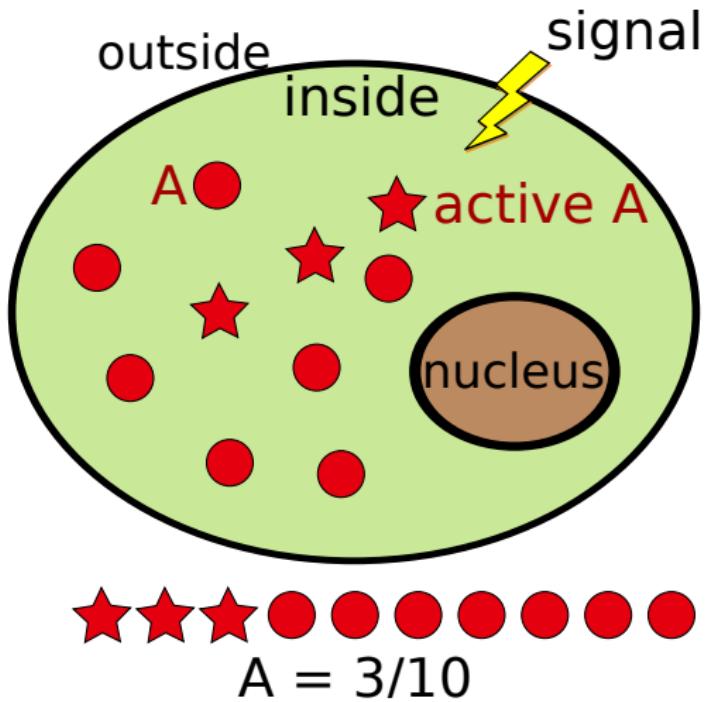


## Discrete activity levels

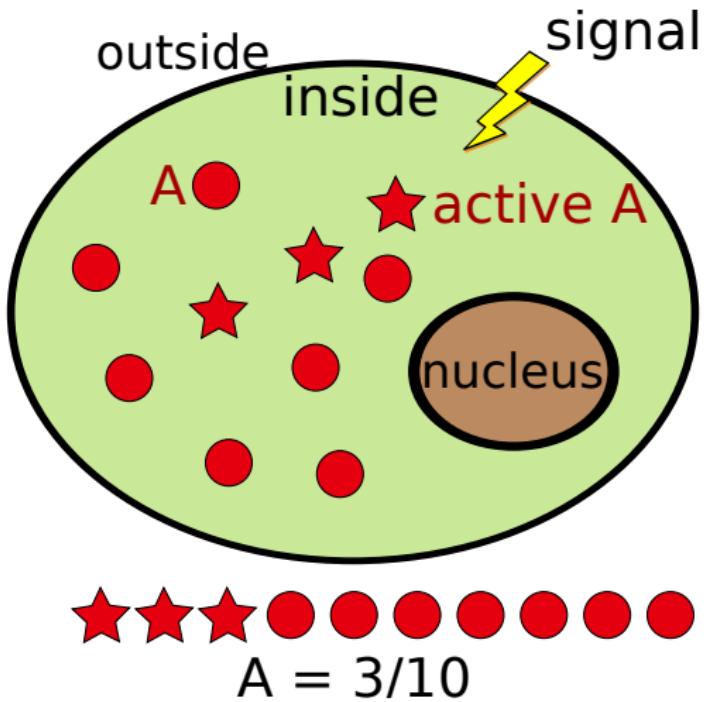
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## Discrete activity levels



## Discrete activity levels



Let the user choose granularity: 2 - 100 discrete levels

# Analysis of Networks with Interactive MOdelling

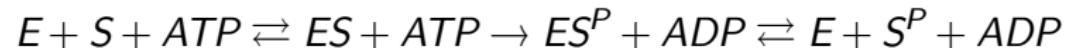
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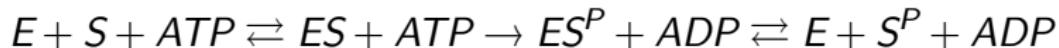


(with  $S + S^P = \text{constant}$  and  $ATP + ADP = \text{constant}$ )

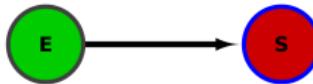
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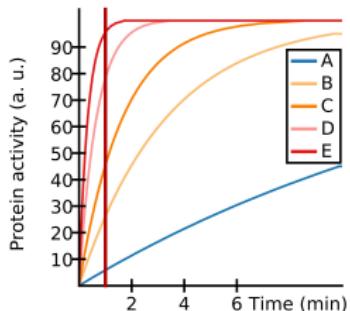
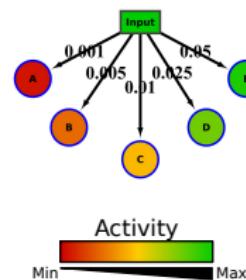
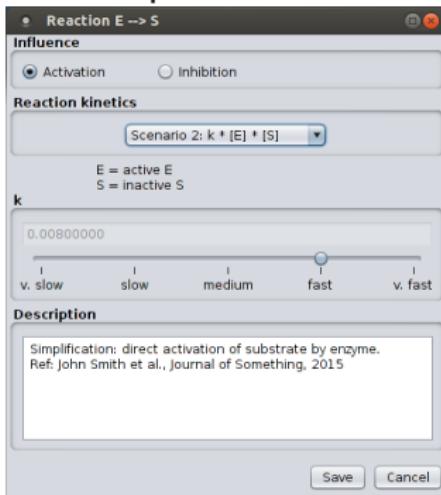


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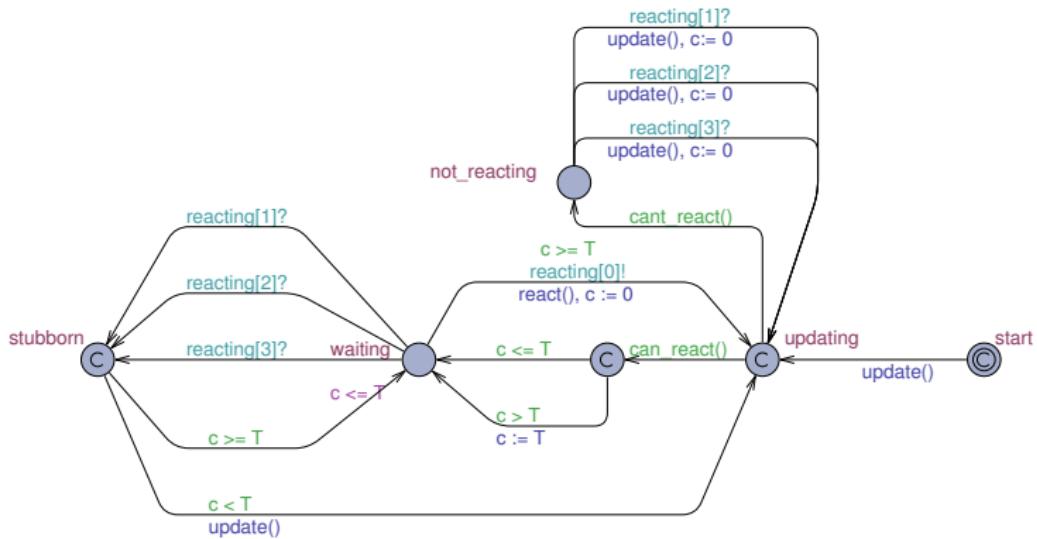


# Analysis of Networks with Interactive MOdelling

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- ▶ Discrete concentration/activity levels
- ▶ Precise reactions ⇒ abstract *interactions*
- ▶ Simplified scenarios for rate computation

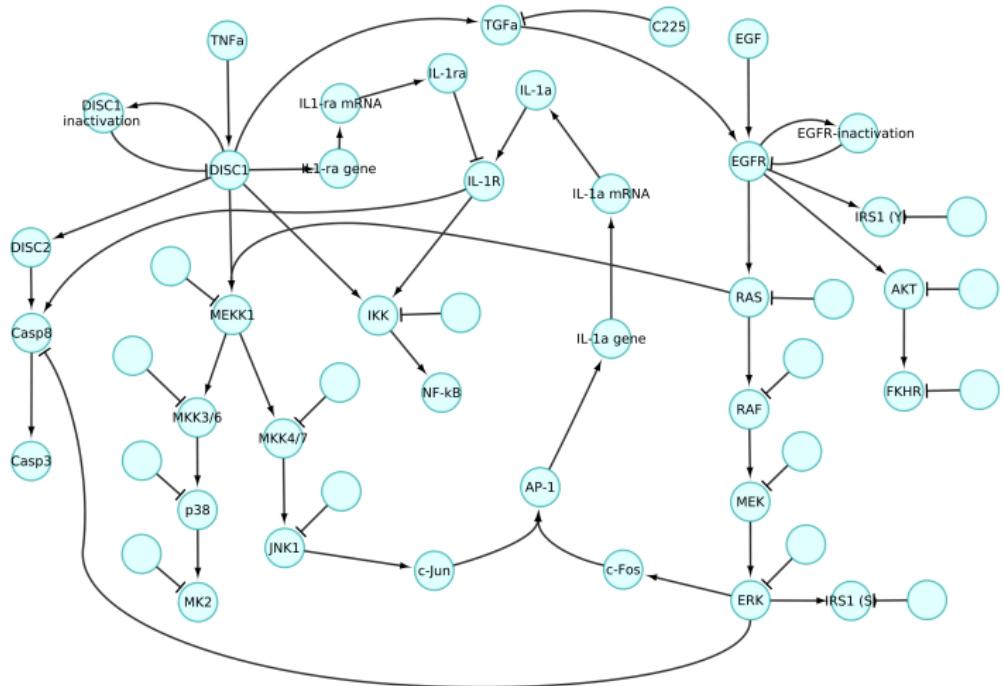


# Timed Automata model



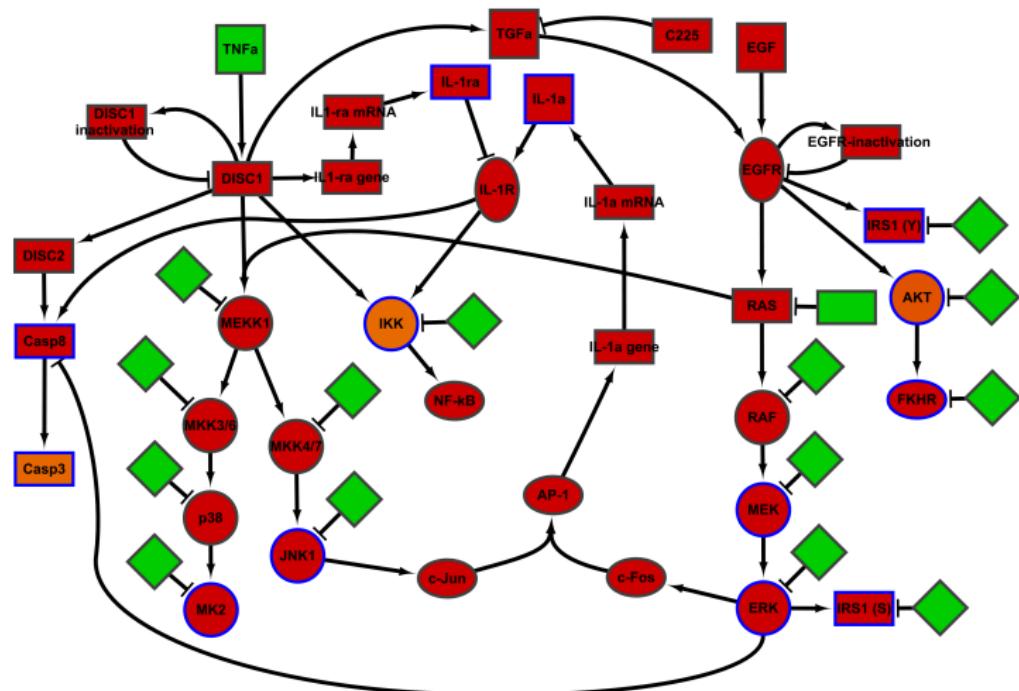
# ANIMO workflow

Start from static network topology



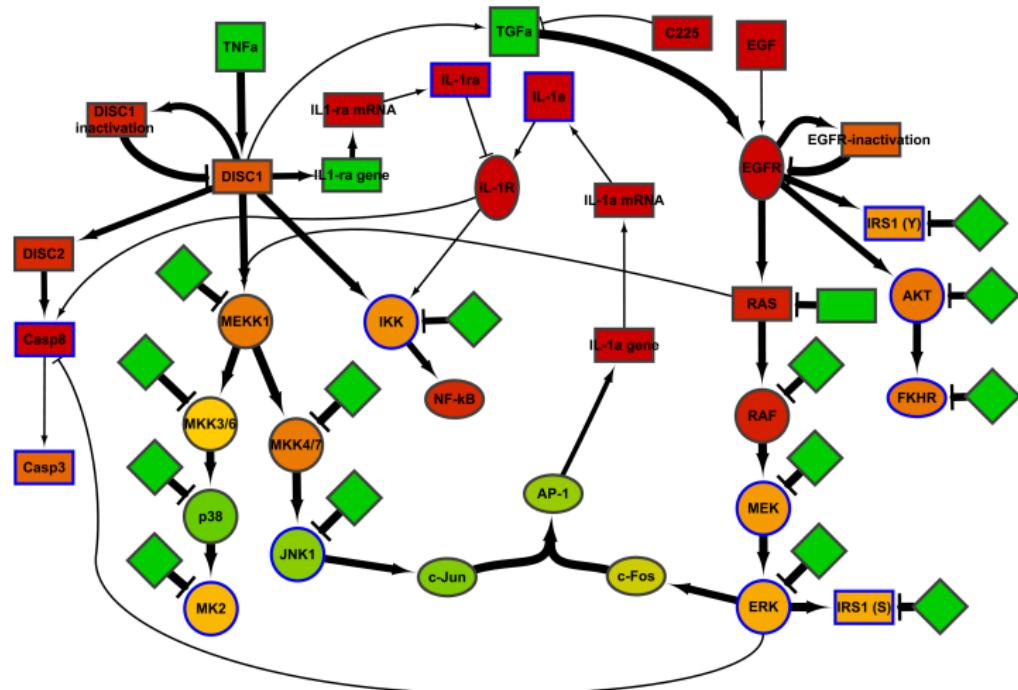
# ANIMO workflow

Add kinetics and choose initial activities



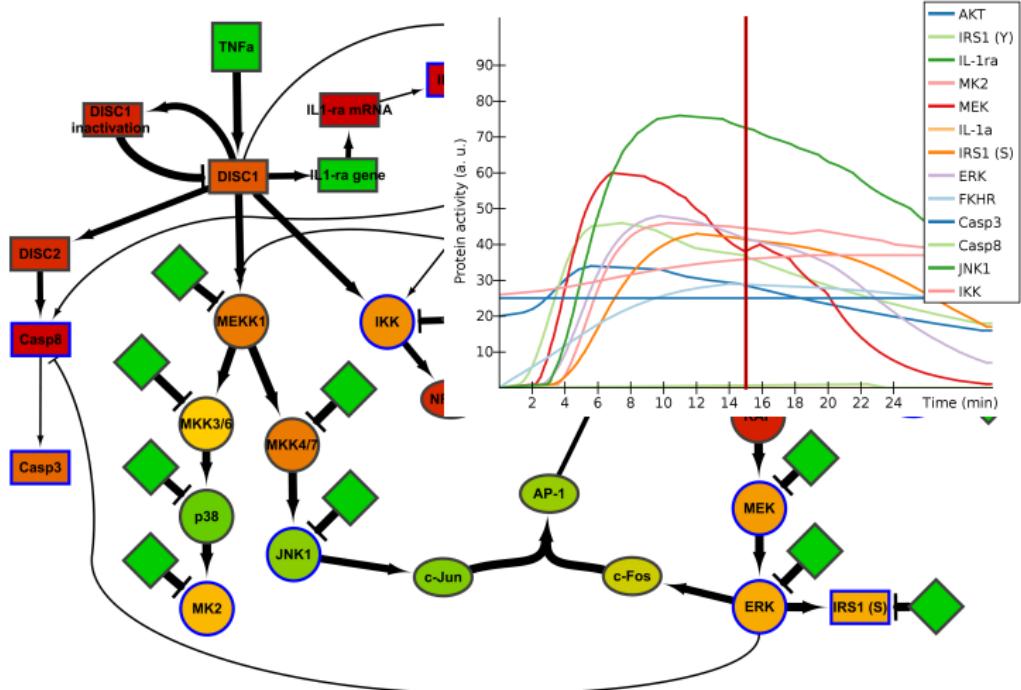
# ANIMO workflow

Inspect system evolution on the fly



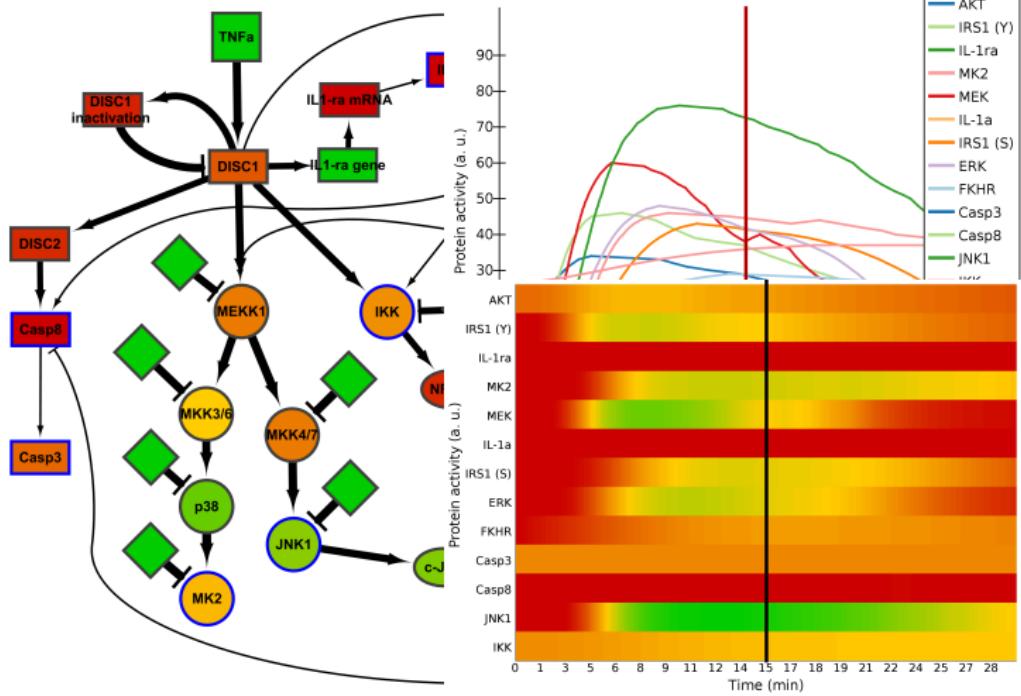
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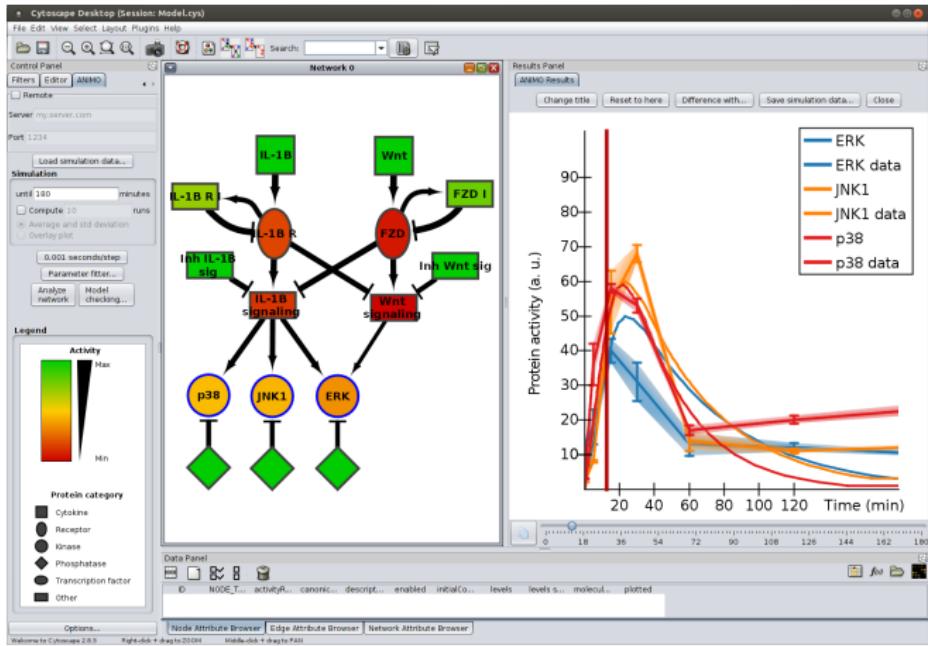


# ANIMO workflow

Inspect system evolution on the fly



# Experimental data as reference



Use data and model to improve knowledge, generate hypotheses.

All good and nice, but...

---

# How to find the parameters?

but we still need to estimate them

All good and nice, but...

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# How to find the parameters?

- ▶ ANIMO models are centered around the topology more than the parameters

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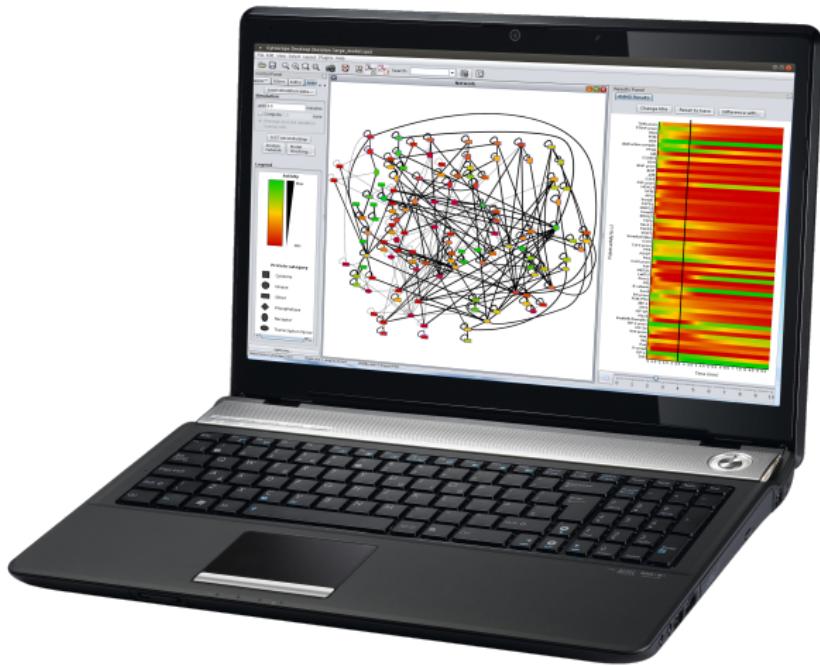
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# ANIMO live demo

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# Conclusions

---

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Timed Automata → dynamic behaviour

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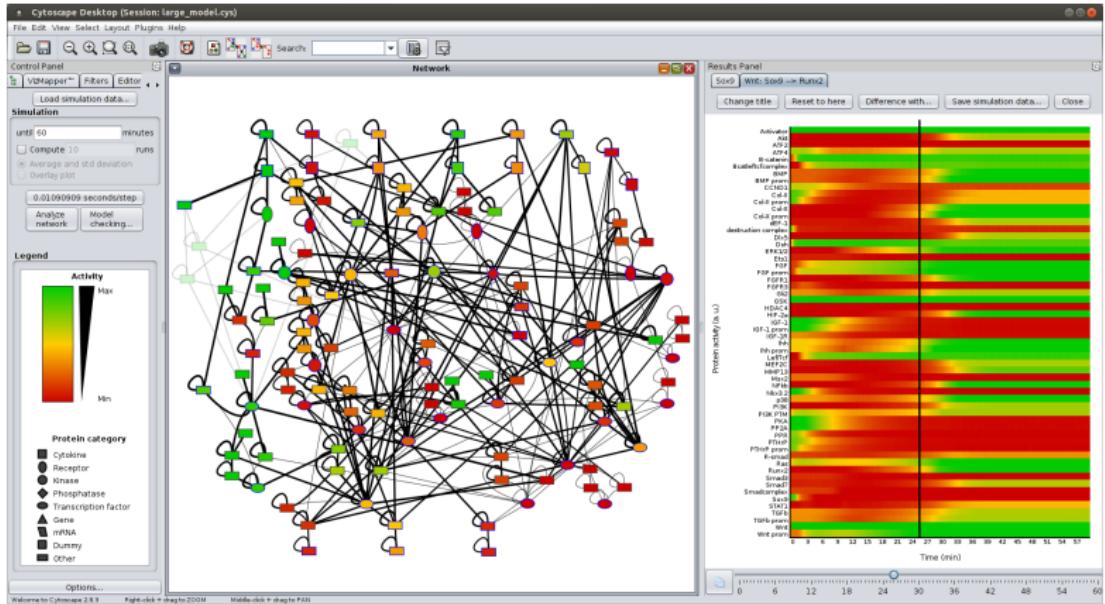
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  - ▶ repeat until satisfied
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- ▶ Complex models:
  - ▶ perform *in silico* experiments
  - ▶ use model checking

# Future work

- ▶ Use *in-silico experiments* to infer biological hypotheses which can be verified through in-vitro experiments



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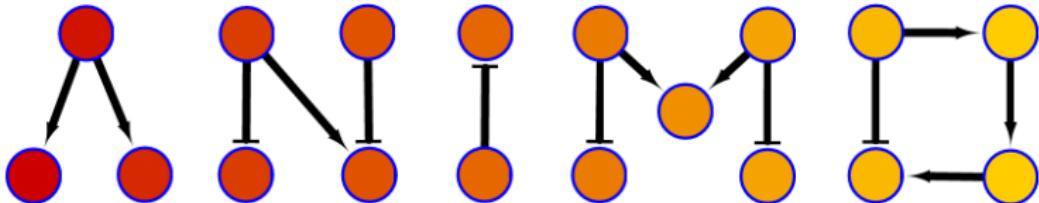
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- ▶ Abstraction techniques to deal with large models

Thank you

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Analysis of Networks with Interactive MOdelling

<http://fmt.cs.utwente.nl/tools/animo>

